



**Learn STEM**  
Innovative Model of learning STEM  
in secondary schools



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ERASMUS+ KA220  
Cooperation Partnerships in school education

**LearnSTEM Pedagogical Model**  
**STEM Practices Implementation Teachers'**  
**Handbook**

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## 1 Learning Resources

### 1.1 Learning Unit - Collect and sort garbage

#### 1.1.1 Background

Collecting and sorting garbage responsibly helps to protect the environment. These practices reduce the risk of air, water and soil pollution, as well as the negative impact on natural ecosystems and biodiversity.

Through collecting and sorting garbage, it is possible to identify materials that can be recycled or reused. This means that a large amount of waste can be diverted to recycling or composting processes, avoiding landfill.

Sorting garbage helps conserve natural resources such as wood, metals, paper and plastics. Recyclable materials identified during the sorting process can be recovered and returned to the economy, reducing the need to extract and process new resources.

This lesson not only encourages students to become responsible citizens, but also to explore the connections and practical applications of science disciplines such as chemistry, biology and IT.

In order to start the lesson, students will be divided in two teams and their task will be explained to them. The teacher will prepare a table with several printed recycling codes, and the same codes will also be present on a roulette wheel generated by the Wheel of Names app. Each team will have to spin the roulette wheel and, depending on the recycling symbol selected, they will have to find and match the corresponding materials with the identical symbol on the table. The time allowed for identifying and matching materials will be a maximum of 30 seconds.

Before starting the practical activity, students will watch a video which will present theoretical notions about garbage collection and sorting as well as a practical example of how this activity should be organised. This material will facilitate the understanding of basic concepts and prepare students for the practical tasks.

The activity of identifying and sorting materials for recycling will be followed by a class discussion about the importance and impact of recycling and sorting garbage correctly. Students will be able to share their experiences and reflect on how these practices can help protect the environment.

To consolidate the knowledge acquired, the teacher will also present students additional videos from the YouTube platform, which will increase their understanding and awareness of the topic.

The lesson will conclude with a H5P quiz, which will test the knowledge gained and give students the opportunity to assess their progress and identify possible gaps in their knowledge.

This interdisciplinary and interactive lesson is designed to inspire and educate students about the importance of recycling and proper garbage sorting, thus helping to develop responsible and environmentally conscious citizens.



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### 1.1.2 Content

| LearnSTEM Pedagogical Model                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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| Module 1: Collect and sort garbage                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Aim of the module/ learning unit</b>                                                                                                  | The aim of this module is to highlight the importance of collecting and sorting garbage correctly in order to protect the environment, conserve natural resources and reduce pollution, as well as to promote a more sustainable economy and a more environmentally responsible society.                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Duration</b>                                                                                                                          | 50 minutes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Learning Objectives</b>                                                                                                               | At the end of the lesson, students will be able to:<br>1 Name the seven SPI codes specific to plastic materials;<br>2 Identify the different types of recyclable materials and associate them with the corresponding recycling symbols.<br>3 Develop practical and critical thinking skills through active participation in activities to identify and sort recyclable materials;<br>4 Identify and propose creative solutions for managing waste and promoting recycling in their community.                                                                                                                                                                         |
| <b>Resources&amp;Materials Required</b><br><br>(worksheet,charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.) | <ul style="list-style-type: none"> <li>- - Printed codes;</li> <li>- - Laptop/Videoprojector;</li> <li>- - Recyclable materials collected (Cardboard boxes, plastic, aluminium, bags, plastic bottles, glass, PVC pipes, metal boxes, etc.)</li> <li>- - White or coloured paper;</li> <li>- - Writing objects;</li> <li>- - SHP Quiz</li> <li>- - Didactic video material;</li> <li>- - Additional motivational video materials;</li> <li>- - Power Point presentation;</li> <li>- - Wheel of Names application;</li> </ul>                                                                                                                                          |
| <b>Procedure</b>                                                                                                                         | <p>The instructional steps that students should follow:</p> <p>The teacher divides the class into two groups and proposes a competition to the students.</p> <p>The team with the most correct matches will win.</p> <p>Steps:</p> <ol style="list-style-type: none"> <li>1. View the didactic material;</li> <li>2. Divide the students into groups;</li> <li>3. Collection of recyclable garbage;</li> <li>4. Establishing the rules of the game and starting the game.</li> <li>5. Identify the type of recyclable garbage according to the specific code and position it appropriately.</li> <li>6. Announcing the winning team.</li> <li>7. Feedback.</li> </ol> |
| <b>Content Delivery Methods</b><br>(lecture, discussions, research,                                                                      | <p>Group work</p> <p>Explanation</p> <p>Practice demonstration</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |



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| group work, etc.) | Discussion<br>Problematisation<br>Brainstorming                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Assessment Method | 5HP Quiz<br>Assessment based on achievements and practical results;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| References        | <a href="https://dictionary.cambridge.org/dictionary/english/garbage">https://dictionary.cambridge.org/dictionary/english/garbage</a><br><a href="https://www.ldoceonline.com/dictionary/garbage">https://www.ldoceonline.com/dictionary/garbage</a><br><a href="https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage">https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage</a><br><a href="https://www.roadrunnerwm.com/blog/history-of-garbage">https://www.roadrunnerwm.com/blog/history-of-garbage</a><br><a href="https://ecoresources.net.au/why-is-waste-sorting-important/">https://ecoresources.net.au/why-is-waste-sorting-important/</a><br><a href="https://wheelofnames.com">https://wheelofnames.com</a><br><a href="https://www.youtube.com/watch?v=b-0eajX7Xlo">https://www.youtube.com/watch?v=b-0eajX7Xlo</a><br><a href="https://www.youtube.com/watch?v=3Lzsu8SxaWY">https://www.youtube.com/watch?v=3Lzsu8SxaWY</a> |



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## 1.2 Learning Unit - Build a Balance Scale

### 1.2.1 Background

The manufacturing of new materials contributes to air, water and soil pollution through emissions of greenhouse gases, toxic chemicals and hazardous waste. Reusing recyclable products helps reduce this pollution by avoiding additional material production and recycling the amount of waste.

This lesson not only demonstrates the importance of recycling and sustainable thinking, but also stimulates students' creativity, giving them the freedom to design and build their own scale according to their imagination and preferences.

This lesson is designed to provide students with an engaging and interactive educational experience, combining creativity and STEM (Science, Technology, Engineering and Math) knowledge to promote learning and discovery. Through an inspirational video, students are invited to explore the process of creating a balance scale using recycled materials such as plastic bottles, cardboard boxes or other items that would otherwise be thrown away.

In addition to the practical aspect, the lesson aims to stimulate critical thinking and problem-solving skills, giving students the opportunity to explore the intersections between engineering, mathematics, physics and ecology.

Through their challenge to design and build their own balances, students will learn to identify and apply mathematical and scientific concepts in a real-world context relevant to their everyday lives.

The lesson also aims to give students the opportunity to understand the difference between mass and weight and to discover the units of measurement associated with these concepts.

For students, knowing and promoting the importance of reusing recyclable products is essential for their environmental education, developing responsible behaviour and contributing to environmental protection.

In order to increase the importance and the relevance of the topic addressed, starting from the curriculum - Recycling, we proposed to build a balance scale, for teaching purposes, using recyclable materials.

In this way, the lesson aims to inspire students to become responsible citizens and actively engage in building a greener and more sustainable future for all.



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#### 1.2.2 Content

| LearnSTEM Pedagogical Model                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| Module 2: Build a Balance Scale                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Aim of the module/ learning unit</b>                                                                                                  | <b>The aim of this module is to highlight the importance of reusing recyclable materials in order to create a balance scale.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Duration</b>                                                                                                                          | <b>50 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Learning Objectives</b>                                                                                                               | At the end of this module, students will be able to:<br>1 define the concept of balance scale;<br>2 identify the recyclable materials needed to build the balance scale;<br>3 select the tools needed to build the balance scale;<br>4 identify the units of measurement used in weighing;<br>5. measure the mass of an object using the balance scale;<br>6. identify the difference between mass and weight;                                                                                                                                                                                                                                                                    |
| <b>Resources&amp;Materials Required</b><br><br>(worksheet,charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.) | <ul style="list-style-type: none"> <li>- - Cardboard boxes;</li> <li>- - String;</li> <li>- - Plastic bottles;</li> <li>- - Scissors;</li> <li>- - Cutter;</li> <li>- - Measuring tape;</li> <li>- - Adhesive tape;</li> <li>- - White and coloured paper;</li> <li>- - Plastic and cardboard cups;</li> <li>- - Pens and pencils;</li> <li>- - Silicone glue gun;</li> <li>- - Video projector/laptop;</li> <li>- - Instructional video material;</li> <li>- - Additional video materials;</li> <li>- - PPT presentation;</li> <li>- - H5P quiz</li> <li>- - Kitchen scale;</li> <li>- - Various recyclable materials (plastic, buttons, stoppers, bags etc.)</li> </ul>         |
| <b>Procedure</b>                                                                                                                         | <p>The class is divided into groups of 4 pupils chosen randomly and the task is set out: make a balance scale using the recyclable materials provided.</p> <p>Working time: 40 minutes.</p> <p>Steps to follow:</p> <ol style="list-style-type: none"> <li>1. View the practical example;</li> <li>2. Identify the recyclable materials to be used in making the balance scale;</li> <li>3. Divide the students into groups;</li> <li>4. Building the balance scale using the video material provided by the teacher as a model;</li> <li>5. Balancing the balance scale using recyclable materials, after the teacher has added the standard object to one of the two</li> </ol> |



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|                                                                                       | <p>trays.</p> <p>6. Weighing the recycled objects added by the students in the second free tray in order to restore the balance of the balance scale.</p> <p>7. Ranking of the groups based on the value obtained by weighing the recycled items. The winning group is the one whose value is closest to the mass of the standard object.</p> <p>8. Feedback.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Content Delivery Methods</b><br>(lecture, discussions, research, group work, etc.) | Teamwork<br>Research<br>Practical demonstration<br>Discussions<br>Explanation<br>Brainstorming<br>Problematisation<br>Practical experiment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Assessment Method                                                                     | H5P Quiz<br>Assessment based on achievements and practical outcomes;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| References                                                                            | <p><a href="http://www.amathsdictionaryforkids.com/qr/b/balanceScales.html">http://www.amathsdictionaryforkids.com/qr/b/balanceScales.html</a></p> <p><a href="https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales">https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales</a></p> <p><a href="https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/">https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/</a></p> <p><a href="https://www.youtube.com/watch?v=Z0X0yE8loc">https://www.youtube.com/watch?v=Z0X0yE8loc</a></p> <p><a href="https://www.youtube.com/watch?v=J-DF5nYw7E&amp;t=72s">https://www.youtube.com/watch?v=J-DF5nYw7E&amp;t=72s</a></p> |



## 1.3 Learning Unit 3 - Composting in a bottle and creation of a composter - reuse of biodegradable waste

### 1.3.1. Background

This lesson is designed in order to educate students on the importance of responsible waste management and recycling through the creation of composters from plastic bottles. By making these composters, students will not only learn how to recycle and reuse plastic materials, but will also learn how to recycle organic household waste such as fruit and vegetable peels, kitchen scraps, dried leaves, paper and other biodegradable materials. Through the interactive and practical activities proposed, students will also learn how they can contribute to protect the environment and conserve natural resources.

The first part of the lesson presents an informative video that shows the problems of improper waste management, including the negative impact of burning plastics or improper disposal, which leads to environmental pollution.

In this way, students will understand the consequences of these practices and will be motivated to find alternative and sustainable solutions.

Also in this video, practical examples of how to make a composter out of plastic bottles will be presented and its advantages will be highlighted, as well as how to make compost and its benefits in gardening and agriculture.

Afterwards, students will be divided into groups and will be presented an assignment to create composters out of plastic bottles. Each team will receive the necessary materials and will be guided by the teacher through the construction process. Students will be encouraged to use their creativity and practical skills to make the composters according to the requirements.

During the practical activity, students will learn about the composting process and they will understand its benefits in producing natural fertilizer for plants.

Composting is an effective way to reduce organic waste. As around 30-40% of household waste is compostable organic material, by composting this waste, we can reduce the amount of waste sent to landfill and thus reduce the negative impact on the environment. Compost is an organic fertiliser rich in essential soil nutrients such as nitrogen, phosphorus and potassium. Therefore, the use of compost in gardening and agriculture can reduce dependence on synthetic chemical fertilisers. Compost provides a natural and balanced source of plant nutrients, helping to maintain long-term soil health.

For students, learning about the composting process is important because it educates them about protecting the environment, conserving natural resources and adopting responsible and sustainable waste management behaviour.

Composting can be a practical and creative activity for them. They can learn to combine different organic materials, monitor the decomposition process and observe the positive effects of compost on plants and soil.

By learning to compost, students develop practical skills and responsibility in waste management.





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#### 1.3.2. Content

| LearnSTEM Pedagogical Model                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| Module 3: Composting in a bottle and creation of a composter - reuse of biodegradable waste                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Aim of the module/ learning unit</b>                                                                                                   | The aim of this module is to develop students' responsible and practical waste management skills, to learn how to recycle and reuse organic materials instead of throwing them away, and to promote environmentally responsible behaviour.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Duration</b>                                                                                                                           | 50 min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Learning Objectives</b>                                                                                                                | At the end of the class, students will be able to:<br>1. Define compost;<br>2. Identify the types of household waste that can be used to make compost;<br>3. Make their own composter at home.<br>4. Know the importance of using compost and give examples of where it can be used.<br>5. Develop practical and creative thinking skills by actively participating in the construction of composters using recycled materials.                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Resources&amp;Materials Required</b><br><br>(worksheet, charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.) | <ul style="list-style-type: none"> <li>- - Plastic bottles;</li> <li>- - Organic household waste (leaves, plant resources)</li> <li>- - Soil;</li> <li>- - Water;</li> <li>- - Pieces of paper;</li> <li>- - Scissors</li> <li>- - Adhesive tape;</li> <li>- - Instructional video material;</li> <li>- - Laptop/Videoprojector;</li> <li>- - H5P Quiz;</li> <li>- - Additional video materials;</li> <li>- - Power Point Presentation;</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Procedure</b>                                                                                                                          | <p>The training steps students must follow:<br/>Divide the class into groups of 4 students chosen at random and outline the work task: make the composter using the materials provided by the teacher and add the raw material to make the compost. Actual working time: 40 minutes.</p> <p>Steps to follow:</p> <ol style="list-style-type: none"> <li>1. View the practical example;</li> <li>2. Identify the materials needed to make the composter;</li> <li>3. Divide the students into groups;</li> <li>4. Making the composter;</li> <li>5. Adding the raw material to obtain the compost;</li> </ol> <p>Once the above steps have been completed, the composters will be placed so that they can benefit from the sunlight. The development of the compost will be visible within 3 to 6 weeks. Thus we have the following steps:</p> |



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|                                                                                       | <ol style="list-style-type: none"> <li>1. Watering the compost - daily;</li> <li>2. Checking the condition of the compost and changes in structure.</li> <li>3. Proper use of compost.</li> <li>4. Giving feedback.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Content Delivery Methods</b><br>(lecture, discussions, research, group work, etc.) | Group work<br>Research<br>Explanation<br>Discussion<br>Problematizing<br>Practical demonstration<br>Practical experiment<br>Group project<br>Brainstorming                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Assessment Method                                                                     | 5HP Quiz<br>Assessment based on achievements and practical results<br>Continuous evaluation by observation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| References                                                                            | <a href="https://dictionary.cambridge.org/dictionary/english/compost">https://dictionary.cambridge.org/dictionary/english/compost</a><br><a href="https://www.collinsdictionary.com/dictionary/english/compost">https://www.collinsdictionary.com/dictionary/english/compost</a><br><a href="https://www.oxfordlearnersdictionaries.com/definition/english/compost_1">https://www.oxfordlearnersdictionaries.com/definition/english/compost_1</a><br><a href="https://www.carryoncomposting.com/142941469.html">https://www.carryoncomposting.com/142941469.html</a><br><a href="https://www.nrdc.org/stories/composting-101#types">https://www.nrdc.org/stories/composting-101#types</a><br><a href="https://www.youtube.com/watch?v=O4dI4YljMZk">https://www.youtube.com/watch?v=O4dI4YljMZk</a><br><a href="https://www.youtube.com/watch?v=pi-vsJOaduk">https://www.youtube.com/watch?v=pi-vsJOaduk</a> |



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#### **1.4. Learning Unit 4 - Upcycling – Reuse of plastic**

##### **1.4.1. Background**

This engaging and interactive lesson is designed to educate students about upcycling - reusing plastic and the importance of this practice for the environment and for protecting biodiversity.

Through an informative video, students will understand how crucial it is to give new life to materials that are no longer useful, instead of throwing them away and contributing to environmental pollution.

The lesson aims to combine several disciplines, such as biology and engineering, to give students a holistic perspective on the issue of plastic and its impact on the environment and human health. Students will learn that plastic is extremely dangerous and harmful to all of humanity, affecting negatively both the environment and wildlife, taking seabirds as an example.

With millions of birds dying each year from plastic ingestion, including microplastics, it is clear that urgent action is needed. Upcycling is the life-saving solution that can turn plastic from an enemy of birds into an ally.

Students will be guided to build bird feeders using recyclable materials and place them in accessible places to provide food and shelter for these incredible creatures.

Students will use the materials provided by the teacher and follow the directions and requirements for the construction of the feeders. Once the feeders are in place, students will fill them with seeds and carefully observe if the birds are coming to feed, photographing them to highlight the positive impact of their actions.

This lesson is important for students as it educates them about environmental responsibility and encourages them to act proactively to protect biodiversity. Through upcycling, students learn that every gesture counts in the fight against pollution and that they can have a positive impact on the environment through simple and sustainable actions.

Reusing plastic waste can also be a way to save money. Instead of buying new containers every time we need them, we can reuse existing ones, saving the costs associated with buying new ones.

Reusing plastic can stimulate creativity and innovation. People can find inventive ways to reuse plastic containers for purposes other than their original purpose, such as creating art, toys or household items.

Encouraging the reuse of plastic waste can stimulate creativity and innovation among students. They can find inventive ways to transform containers into other useful or decorative objects, developing practical and creative skills.



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#### 1.4.2. Content

| LearnSTEM Pedagogical Model                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| Module 4: Upcycling – Reuse of plastic                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Aim of the module/ learning unit</b>                                                                                                  | The aim of this module is to encourage the reuse and upcycling of materials, giving students not only the opportunity to contribute to the protection of the environment, but also to develop empathy and awareness towards the dangers to which living creatures are exposed.                                                                                                                                                                                                                                                                                                                               |
| <b>Duration</b>                                                                                                                          | 50 min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Learning Objectives</b>                                                                                                               | At the end of the lesson, students will be able to:<br>1 Define upcycling;<br>2 Identify the dangers related to plastic particle pollution;<br>3 Enumerate the dangers to which seabirds are exposed.<br>4 Know the benefits of upcycling.<br>5 Give examples of seabirds that may ingest plastic.<br>6 Develop practical and creative thinking skills by actively participating in the construction of bird feeders.                                                                                                                                                                                        |
| <b>Resources&amp;Materials Required</b><br><br>(worksheet,charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.) | <ul style="list-style-type: none"> <li>- - Plastic bottles;</li> <li>- - Scissors;</li> <li>- - Cutter;</li> <li>- - Adhesive tape;</li> <li>- - String;</li> <li>- - Wire;</li> <li>- - Plastic plates;</li> <li>- - White and coloured paper;</li> <li>- - Writing instruments;</li> <li>- - Silicone glue gun;</li> <li>- - Wooden sticks;</li> <li>- - Screws and nuts;</li> <li>- - PowerPoint presentation;</li> <li>- - Instructional video material;</li> <li>- - Additional video material;</li> <li>- - 5HP Quiz;</li> <li>- - Laptop/Videoprojector;</li> </ul>                                   |
| <b>Procedure</b>                                                                                                                         | <p>Steps to follow:</p> <p>Divide the class into groups of 4 students chosen at random and set the working task: Build a bird feeder using the materials provided by the teacher.</p> <p>Working time: 40 minutes</p> <ol style="list-style-type: none"> <li>1. Watch the video material;</li> <li>2. Divide students into groups;</li> <li>3. Identify the materials needed to build the feeders;</li> <li>4. Building bird feeders</li> <li>5. Presentation of the product made by each group and testing its conformity;</li> </ol> <p>After following the previous steps, the bird feeders should be</p> |



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|                                                                                       | <p>placed in a visible place so that they are accessible to the birds and easy to see. The supervision of the activity in the feeder area is one hour per day for one week.</p> <p>Next we have the following steps:</p> <ol style="list-style-type: none"> <li>1. Counting and identifying birds visiting the feeders;</li> <li>2. Photographing the birds visiting the feeders;</li> <li>3. Presentation of the results;</li> <li>4. Giving feedback.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Content Delivery Methods</b><br>(lecture, discussions, research, group work, etc.) | <p>Working in groups</p> <p>Research</p> <p>Explanation</p> <p>Discussion</p> <p>Problematizing</p> <p>Practical experiment</p> <p>Group project</p> <p>Brainstorming</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Assessment Method</b>                                                              | <p>5HP Quiz;</p> <p>Assessment based on practical achievements and results;</p> <p>Continuous assessment through observation;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>References</b>                                                                     | <p><a href="https://www.oxfordlearnersdictionaries.com/definition/english/upcycle">https://www.oxfordlearnersdictionaries.com/definition/english/upcycle</a></p> <p><a href="https://dictionary.cambridge.org/dictionary/english/upcycling">https://dictionary.cambridge.org/dictionary/english/upcycling</a></p> <p><a href="https://www.treehugger.com/what-is-upcycling-5116081">https://www.treehugger.com/what-is-upcycling-5116081</a></p> <p><a href="https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/">https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/</a></p> <p><a href="https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684">https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684</a></p> <p><a href="https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/">https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/</a></p> <p><a href="https://www.youtube.com/watch?v=rd7qP9FdTal">https://www.youtube.com/watch?v=rd7qP9FdTal</a></p> <p><a href="https://www.youtube.com/watch?v=P5OBWbZDZlc">https://www.youtube.com/watch?v=P5OBWbZDZlc</a></p> |



# Ortaokullarda STEM öğrenmenin Yenilikçi Modeli STEM Öğrenin



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## *Ortaokullarda* **STEM** *Öğrenmenin Yenilikçi Modeli*

ERASMUS+ KA220 Okul eğitiminde İşbirliği Ortaklıkları

## **LearnSTEM Pedagojik Modeli** **STEM Uygulamaları Öğretmen El Kitabı**

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"Erasmus+ / Avrupa Dayanışma Programı kapsamında Avrupa Komisyonu tarafından desteklenmektedir. Burada yer alan içerik yazarın görüşlerini yansıtmaktadır ve bu görüşlerden Avrupa Komisyonu ve Türkiye Ulusal Ajansı sorumlu tutulamaz."



## 1 Öğrenme Kaynakları

### 1.1 Öğrenim Birimi - Çöp toplayın ve ayırın

#### 1.1.1 Arka plan

Çöplerin bir şekilde toplanması ve ayrıştırılması çevrenin korunmasına yardımcı olur. Bu uygulamalar hava, su ve toprak kirliliği riskinin yanı sıra doğal ekosistemler ve biyolojik çeşitlilik üzerindeki olumsuz etkiyi de azaltır.

Çöplerin toplanması ve ayrıştırılması yoluyla geri dönüştürülebilecek veya yeniden kullanılabilir malzemeleri belirlemek mümkündür. Bu, büyük miktarda atığın çöp depolamadan kaçınarak geri dönüşüm veya kompostlama işlemlerine yönlendirilebileceği anlamına gelir.

Çöplerin ayrıştırılması ahşap, metal, kağıt ve plastik gibi doğal kaynakların korunmasına yardımcı olur. Ayırma işlemi sırasında belirlenen geri dönüştürülebilir malzemeler geri kazanılıp ekonomiye geri döndürülebilir, böylece yeni kaynakların çıkarılması ve işlenmesi ihtiyacı azalır.

Bu ders öğrencileri yalnızca sorumlu vatandaşlar olmaya teşvik etmekle kalmaz, aynı zamanda kimya, biyoloji ve bilişim gibi bilim disiplinlerinin bağlantılarını ve pratik uygulamalarını keşfetmeye de teşvik eder.

Derse başlamak için öğrenciler iki takıma ayrılacak ve onlara görevleri anlatılacaktır. Öğretmen, çeşitli basılı geri dönüşüm kodlarının bulunduğu bir tablo hazırlayacak ve aynı kodlar, Çarkıfelek uygulaması tarafından oluşturulan bir rulet çarkında da bulunacaktır. Her takımın rulet çarkını döndürmesi gerekecek ve seçilen geri dönüşüm sembolüne bağlı olarak, masadaki aynı sembolle ilgili malzemeleri bulup eşleştirmeleri gerekecek. Malzemelerin tanımlanması ve eşleştirilmesi için tanınan süre en fazla 30 saniye olacaktır.

Uygulamalı etkinliğe başlamadan önce öğrenciler, çöp toplama ve ayırmaya ilişkin teorik kavramların yanı sıra bu etkinliğin nasıl organize edilmesi gerektiğine dair pratik bir örnek sunan bir video izleyeceklerdir. Bu materyal temel kavramların anlaşılmasını kolaylaştıracak ve öğrencileri pratik görevlere hazırlayacaktır.

Geri dönüşüm için malzemeleri belirleme ve ayırma faaliyetini, geri dönüşümün ve çöpleri doğru şekilde ayırmanın önemi ve etkisi hakkında bir sınıf tartışması izleyecektir. Öğrenciler deneyimlerini paylaşabilecek ve bu uygulamaların çevrenin korunmasına nasıl yardımcı olabileceği üzerinde düşünebileceklerdir.

Edinilen bilgilerin pekiştirilmesi için öğretmen ayrıca öğrencilere YouTube platformundan ek videolar sunacak ve bu onların konuyla ilgili anlayışlarını ve farkındalıklarını artıracaktır.

Ders, kazanılan bilgiyi test edecek ve öğrencilere ilerlemelerini değerlendirme ve bilgilerindeki olası boşlukları tespit etme fırsatı verecek bir H5P sınavıyla sona erecek.

Bu disiplinlerarası ve etkileşimli ders, öğrencilere geri dönüşümün ve çöplerin doğru şekilde ayrıştırılmasının önemi konusunda ilham vermek ve onları eğitmek, böylece sorumlu ve çevreye duyarlı vatandaşlar yetiştirmeye yardımcı olmak için tasarlanmıştır.



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### 1.1.2 İçerik

| LearnSTEM Pedagojik Modeli                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modül 1: Çöpleri toplayın ve ayırın                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Modülün/öğrenme ünitesinin amacı</b>                                                                                                                              | Bu modülün amacı, çevreyi korumak, doğal kaynakları muhafaza etmek ve kirliliği azaltmak, ayrıca daha sürdürülebilir bir ekonomiyi ve çevresel açıdan daha sorumlu bir toplumu teşvik etmek için çöpleri doğru şekilde toplamanın ve ayırmanın önemini vurgulamaktır.                                                                                                                                                                                                                                                                 |
| <b>Süre</b>                                                                                                                                                          | 50 dakika                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Öğrenme hedefleri</b>                                                                                                                                             | Dersin sonunda öğrenciler şunları yapabilecektir:<br>1 Plastik malzemelere özel yedi SPI kodunu adlandırın;<br>2 Farklı geri dönüştürülebilir malzeme türlerini tanımlayın ve bunları ilgili geri dönüşüm sembolleriyle ilişkilendirin.<br>3 Geri dönüştürülebilir malzemeleri belirleme ve ayırma faaliyetlerine aktif katılım yoluyla pratik ve eleştirel düşünme becerilerini geliştirin;<br>4 Atıkları yönetmek ve topluluklarında geri dönüşümü teşvik etmek için yaratıcı çözümler belirleyin ve önerin.                        |
| <b>Gerekli Kaynaklar ve Malzemeler</b><br>( çalışma sayfası, çizelgeler , bildiriler, öğretici videolar, kitaplardan/kılavuzlardan alıntılar, zihin haritaları, vb.) | <ul style="list-style-type: none"><li>- Basılı kodlar;</li><li>- Dizüstü Bilgisayar/ Video projektörü ;</li><li>- Toplanan geri dönüştürülebilir malzemeler (Karton kutular, plastik, alüminyum, çantalar, plastik şişeler, cam, PVC borular, metal kutular vb.)</li><li>- Beyaz veya renkli kağıt;</li><li>- Nesnelerin yazılması;</li><li>- 5HP Sınavı</li><li>- Didaktik video materyali;</li><li>- Ek motive edici video materyalleri;</li><li>- Powerpoint sunum;</li><li>- İsim Çarkı uygulaması;</li></ul>                     |
| <b>Prosedür</b>                                                                                                                                                      | Öğrencilerin izlemesi gereken öğretim adımları:<br>Öğretmen sınıfı iki gruba ayırır ve öğrencilere bir yarışma teklif eder.<br>En doğru eşleşmeyi yapan takım kazanacak.<br>Adımlar:<br>1. Didaktik materyali görüntüleyin;<br>2. Öğrencileri gruplara ayırın;<br>3. Geri dönüştürülebilir çöplerin toplanması;<br>4. Oyunun kurallarının belirlenmesi ve oyuna başlanması.<br>5. Geri dönüştürülebilir çöpün türünü özel koda göre belirleyin ve uygun şekilde konumlandırın.<br>6. Kazanan takımın duyurulması.<br>7. Geribildirim. |
| <b>İçerik Yayınlama Yöntemleri</b>                                                                                                                                   | Grup çalışması<br>Açıklama                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |





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|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ( konuşma, tartışma ,<br>araştırma, grup çalışması vb.) | Uygulama gösterimi<br>Tartışma<br>Sorunsallaştırma<br>Beyin fırtınası                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Değerlendirme yöntemi                                   | 5HP Sınavı<br>Başarılarla ve pratik sonuçlara dayalı değerlendirme;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Referanslar                                             | <a href="https://dictionary.cambridge.org/dictionary/english/garbage">https://dictionary.cambridge.org/dictionary/english/garbage</a><br><a href="https://www.ldoceonline.com/dictionary/garbage">https://www.ldoceonline.com/dictionary/garbage</a><br><a href="https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage">https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage</a><br><a href="https://www.roadrunnerwm.com/blog/history-of-garbage">https://www.roadrunnerwm.com/blog/history-of-garbage</a><br><a href="https://ecoresources.net.au/why-is-waste-sorting-important/">https://ecoresources.net.au/why-is-waste-sorting-important/</a><br><a href="https://wheelofnames.com">https://wheelofnames.com</a><br><a href="https://www.youtube.com/watch?v=b-0eajX7Xlo">https://www.youtube.com/watch?v=b-0eajX7Xlo</a><br><a href="https://www.youtube.com/watch?v=3Lzsu8SxaWY">https://www.youtube.com/watch?v=3Lzsu8SxaWY</a> |



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### 1.2 Öğrenim Ünitesi - Denge Ölçeği Oluşturma

#### 1.2.1 Arka plan

Yeni malzemelerin üretimi, sera gazı emisyonları, toksik kimyasallar ve tehlikeli atıklar yoluyla hava, su ve toprak kirliliğine katkıda bulunuyor. Geri dönüştürülebilir ürünlerin yeniden kullanılması, ek malzeme üretimini önleyerek ve atık miktarını geri dönüştürerek bu kirliliğin azaltılmasına yardımcı olur.

Bu ders yalnızca geri dönüşümün ve sürdürülebilir düşüncenin önemini göstermekle kalmıyor, aynı zamanda öğrencilerin yaratıcılığını teşvik ederek onlara hayal güçlerine ve tercihlerine göre kendi ölçeklerini tasarlama ve inşa etme özgürlüğü veriyor.

Bu ders, öğrenmeyi ve keşfetmeyi teşvik etmek için yaratıcılık ile STEM (Bilim, Teknoloji, Mühendislik ve Matematik) bilgisini birleştirerek öğrencilere ilgi çekici ve etkileşimli bir eğitim deneyimi sağlamak üzere tasarlanmıştır. İlham verici bir video aracılığıyla öğrenciler, plastik şişeler, karton kutular veya aksi takdirde atılacak diğer eşyalar gibi geri dönüştürülmüş malzemeleri kullanarak bir terazi oluşturma sürecini keşfetmeye davet ediliyor.

Pratik yönüne ek olarak ders, öğrencilere mühendislik, matematik, fizik ve ekoloji arasındaki kesişim noktalarını keşfetme fırsatı vererek eleştirel düşünme ve problem çözme becerilerini teşvik etmeyi amaçlamaktadır.

Kendi dengelerini tasarlama ve oluşturma mücadelesi sayesinde öğrenciler, günlük yaşamlarıyla ilgili gerçek dünya bağlamında matematiksel ve bilimsel kavramları tanımlamayı ve uygulamayı öğreneceklerdir.

Ders ayrıca öğrencilere kütle ve ağırlık arasındaki farkı anlama ve bu kavramlarla ilişkili ölçü birimlerini keşfetme fırsatı vermeyi de amaçlamaktadır.

Öğrencilerin geri dönüştürülebilir ürünleri yeniden kullanmanın önemini bilmeleri ve tanıtımları, çevre eğitimleri, sorumlu davranışlar geliştirmeleri ve çevrenin korunmasına katkıda bulunmaları açısından önemlidir.

Ele alınan konunun önemini ve alaka düzeyini artırmak için, geri dönüşüm müfredatından başlayarak, geri dönüştürülebilir malzemeler kullanılarak öğretim amaçlı bir denge ölçeği oluşturulmasını önerdik.

Bu şekilde ders, öğrencilere sorumlu vatandaşlar olma ve herkes için daha yeşil ve daha sürdürülebilir bir gelecek inşa etmeye aktif olarak katılma konusunda ilham vermeyi amaçlamaktadır.



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### 1.2.2 İçerik

| LearnSTEM Pedagojik Modeli                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modül 2: Denge Ölçeği Oluşturun                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Modülün/öğrenme ünitesinin amacı</b>                                                                                                                                       | Bu modülün amacı, denge ölçeği oluşturmak için geri dönüştürülebilir malzemelerin yeniden kullanılmasının önemini vurgulamaktır.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Süre</b>                                                                                                                                                                   | 50 dakika                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Öğrenme hedefleri</b>                                                                                                                                                      | Bu modülün sonunda öğrenciler şunları yapabilecektir:<br>1 Terazinin kavramını tanımlayabilir;<br>2 teraziyi oluşturmak için gereken geri dönüştürülebilir malzemeleri belirleyin;<br>3 denge terazisini oluşturmak için gereken araçları seçin;<br>4 Tartımda kullanılan ölçü birimlerini tanımlayabilecek;<br>5. Teraziyi kullanarak bir nesnenin kütlesini ölçün;<br>6. Kütle ve ağırlık arasındaki farkı tanımlayabilecek;                                                                                                                                                                                                  |
| <b>Gerekli Kaynaklar ve Malzemeler</b><br>( çalışma sayfası, çizelgeler ,<br>bildiriler, öğretici videolar,<br>kitaplardan/kılavuzlardan<br>alıntılar, zihin haritaları, vb.) | <ul style="list-style-type: none"><li>- Karton kutular;</li><li>- Sicim;</li><li>- Plastik şişeler;</li><li>- Makas;</li><li>- Kesici;</li><li>- Mezura;</li><li>- Yapışkan bant;</li><li>- Beyaz ve renkli kağıt;</li><li>- Plastik ve karton bardaklar;</li><li>- Tükenmez kalem ve kurşun kalem;</li><li>- Silikon tutkal tabancası;</li><li>- Video projektörü/dizüstü bilgisayar;</li><li>- Eğitici video materyali;</li><li>- Ek video materyalleri;</li><li>- PPT sunumu;</li><li>- H5P sınavı</li><li>- Mutfak terazisi;</li><li>- Çeşitli geri dönüştürülebilir malzemeler (plastik, düğme, tıpa, çanta vb.)</li></ul> |
| <b>Prosedür</b>                                                                                                                                                               | Sınıf rastgele seçilen 4 öğrenciden oluşan gruplara ayrılır ve görev belirlenir: Sağlanan geri dönüştürülebilir malzemeleri kullanarak bir denge ölçeği yapın.<br>Çalışma süresi: 40 dakika.<br>Takip edilecek adımlar:<br>1. Pratik örneği inceleyin;<br>2. Terazinin yapımında kullanılacak geri dönüştürülebilir malzemeleri belirleyin;<br>3. Öğrencileri gruplara ayırın;<br>4. Öğretmenin sunduğu video materyalini model olarak kullanarak                                                                                                                                                                               |



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|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                        | <p>denge ölçeğini oluşturmak;</p> <p>5. Öğretmen standart nesneyi iki tepsiden birine ekledikten sonra geri dönüştürülebilir malzemeler kullanarak teraziyi dengelemek.</p> <p>6. Terazinin dengesini sağlamak için öğrencilerin ikinci boş tepsiye ekledikleri geri dönüştürülmüş nesnelerin tartılması.</p> <p>7. Geri dönüştürülmüş eşyaların tartılmasıyla elde edilen değere göre grupların sıralanması. Kazanan grup, değeri standart nesnenin kütesine en yakın olan gruptur.</p> <p>8. Geribildirim.</p>                                                                                                                                                                                                                                                                                                                         |
| <b>İçerik Yayınlama Yöntemleri</b> (konuşma, tartışma , araştırma, grup çalışması vb.) | <p>Takım çalışması</p> <p>Araştırma</p> <p>Pratik gösteri</p> <p>Tartışmalar</p> <p>Açıklama</p> <p>Beyin fırtınası</p> <p>Sorunsallaştırma</p> <p>Pratik deney</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Değerlendirme yöntemi</b>                                                           | <p>H5P Sınavı</p> <p>Başarılarla ve pratik sonuçlara dayalı değerlendirme;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Referanslar</b>                                                                     | <p><a href="http://www.amathsdictionaryforkids.com/gr/b/balanceScales.html">http://www.amathsdictionaryforkids.com/gr/b/balanceScales.html</a></p> <p><a href="https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales">https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales</a></p> <p><a href="https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/">https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/</a></p> <p><a href="https://www.youtube.com/watch?v= Z0X0yE8loc">https://www.youtube.com/watch?v= Z0X0yE8loc</a></p> <p><a href="https://www.youtube.com/watch?v=J -DF5nYw7E&amp;t=72s">https://www.youtube.com/watch?v=J -DF5nYw7E&amp;t=72s</a></p> |



### 1.3 3 - Şişede kompostlama Ve bir kompost oluşturma - biyolojik olarak

#### parçalanabilenlerin yeniden kullanılması atık

##### 1.3.1. Arka plan

Bu ders, plastik şişelerden kompost üretimi yoluyla öğrencileri sorumlu atık yönetimi ve geri dönüşümün önemi konusunda eğitmek amacıyla tasarlanmıştır. Öğrenciler bu kompostlama makinelerini yaparak yalnızca plastik malzemelerin nasıl geri dönüştürüleceğini ve yeniden kullanılacağını öğrenmekle kalmayacak, aynı zamanda meyve ve sebze kabukları, mutfak artıkları, kurutulmuş yapraklar, kağıt ve diğer biyolojik olarak parçalanabilen malzemeler gibi organik ev atıklarının nasıl geri dönüştürüleceğini de öğrenecekler. Önerilen interaktif ve pratik aktiviteler aracılığıyla öğrenciler aynı zamanda çevrenin ve doğal kaynakların korunmasına nasıl katkıda bulunabileceklerini de öğrenecekler.

Dersin ilk bölümünde, çevre kirliliğine yol açan plastiklerin yakılması veya uygunsuz şekilde imha edilmesinin olumsuz etkileri de dahil olmak üzere, uygunsuz atık yönetiminin sorunlarını gösteren bilgilendirici bir video sunulmaktadır.

Böylece öğrenciler bu uygulamaların sonuçlarını anlayacak, alternatif ve sürdürülebilir çözümler bulmaya motive olacaklardır.

Ayrıca bu videoda plastik şişelerden kompost yapımına dair pratik örnekler sunulacak ve bunun avantajlarının yanı sıra kompostun nasıl yapılacağı, bahçecilik ve tarımdaki faydaları da vurgulanacak.

Daha sonra öğrencilere gruplara ayrılacak ve plastik şişelerden kompost yapma ödevi verilecek. Her takım gerekli malzemeleri alacak ve inşaat süreci boyunca öğretmen tarafından yönlendirilecektir. Öğrenciler, kompostlama makinelerini gereksinimlere göre yapmak için yaratıcılıklarını ve pratik becerilerini kullanmaya teşvik edilecektir.

Uygulamalı etkinlik sırasında öğrenciler kompostlama sürecini öğrenecek ve bitkiler için doğal gübre üretimindeki faydalarını anlayacaklar.

Kompostlama organik atığı azaltmanın etkili bir yoludur. Evsel atıkların yaklaşık %30-40'ı kompostlaştırılabilir organik madde olduğundan, bu atığı kompostlaştırarak çöp sahalarına gönderilen atık miktarını azaltabilir ve dolayısıyla çevre üzerindeki olumsuz etkiyi azaltabiliriz. Kompost, azot, fosfor ve potasyum gibi temel toprak besin maddeleri açısından zengin organik bir gübredir. Bu nedenle bahçecilik ve tarımda kompost kullanımı sentetik kimyasal gübrelere olan bağımlılığı azaltabilir. Kompost, doğal ve dengeli bir bitki besin kaynağı sağlayarak uzun vadeli toprak sağlığının korunmasına yardımcı olur.

Öğrenciler için kompostlama sürecini öğrenmek önemlidir çünkü bu süreç onları çevreyi koruma, doğal kaynakları koruma ve sorumlu ve sürdürülebilir atık yönetimi davranışını benimseme konusunda eğitir.

Kompostlama onlar için pratik ve yaratıcı bir aktivite olabilir. Farklı organik malzemeleri birleştirmeyi öğrenebilir, ayrışma sürecini izleyebilir ve kompostun bitkiler ve toprak üzerindeki olumlu etkilerini gözlemleyebilirler.

Öğrenciler kompost yapmayı öğrenerek atık yönetiminde pratik beceriler ve sorumluluk geliştirirler.



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### 1.3.2. İçerik

| LearnSTEM Pedagojik Modeli                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| Modül 3 : Şişede kompostlama Ve bir kompost oluşturma - biyolojik olarak parçalanabilenlerin yeniden kullanılması atık                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Modülün/öğrenme ünitesinin amacı</b>                                                                                                                              | Bu modülün amacı öğrencilerin sorumlu ve pratik atık yönetimi becerilerini geliştirmek, organik malzemeleri atmak yerine nasıl geri dönüştürüleceğini ve yeniden kullanılacağını öğrenmek ve çevreye karşı sorumlu davranışı teşvik etmektir.                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Süre</b>                                                                                                                                                          | <b>50 dakika</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Öğrenme hedefleri</b>                                                                                                                                             | Dersin sonunda öğrenciler şunları yapabilecektir:<br>1. Kompostu tanımlayın;<br>2. Kompost yapımında kullanılabilecek evsel atık türlerini tanımlayın;<br>3. Evde kendi kompost makinesini yapın.<br>4. Kompost kullanımının önemini bilir ve nerelerde kullanılabileceğine dair örnekler verir.<br>5. Geri dönüştürülmüş malzemeler kullanarak kompost yapımına aktif olarak katılarak pratik ve yaratıcı düşünme becerilerini geliştirin.                                                                                                                                                                                                                                            |
| <b>Gerekli Kaynaklar ve Malzemeler</b><br>( çalışma sayfası, çizelgeler , bildiriler, öğretici videolar, kitaplardan/kılavuzlardan alıntılar, zihin haritaları, vb.) | <ul style="list-style-type: none"><li>- Plastik şişeler;</li><li>- Organik evsel atıklar (yapraklar, bitki kaynakları)</li><li>- Toprak;</li><li>- Su;</li><li>- Kağıt parçaları;</li><li>- Makas</li><li>- Yapışkan bant;</li><li>- Eğitici video materyali;</li><li>- Dizüstü Bilgisayar/ Video projektörü ;</li><li>- H5P Sınavı;</li><li>- Ek video materyalleri;</li><li>- Powerpoint sunum;</li></ul>                                                                                                                                                                                                                                                                            |
| <b>Prosedür</b>                                                                                                                                                      | Öğrencilerin takip etmesi gereken eğitim adımları:<br>Sınıfı rastgele seçilen 4 kişilik gruplara ayırın ve çalışma görevinin ana hatlarını çizin: öğretmen tarafından sağlanan malzemeleri kullanarak kompost yapın ve kompost yapmak için ham maddeyi ekleyin. Gerçek çalışma süresi: 40 dakika.<br>Takip edilecek adımlar:<br>1. Pratik örneği inceleyin;<br>2. Kompostlayıcıyı yapmak için gereken malzemeleri belirleyin;<br>3. Öğrencileri gruplara ayırın;<br>4. Kompostlayıcının yapımı;<br>5. Kompostu elde etmek için hammaddenin eklenmesi;<br><br>Yukarıdaki adımlar tamamlandıktan sonra kompostlar güneş ışığından faydalanabilecek şekilde yerleştirilecektir. Kompostun |



## Ortaokullarda STEM öğrenmenin Yenilikçi Modeli STEM Öğrenin



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|                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                         | <p>gelişimi 3 ila 6 hafta içinde görülecektir.<br/>Böylece aşağıdaki adımlara sahibiz:</p> <ol style="list-style-type: none"><li>1. Kompostun sulanması - günlük;</li><li>2. Kompostun durumunun ve yapıdaki değişikliklerin kontrol edilmesi.</li><li>3. Kompostun doğru kullanımı.</li><li>4. Geribildirim vermek.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>İçerik Yayınlama Yöntemleri ( konuşma, tartışma , araştırma, grup çalışması vb.)</b> | <p>Grup çalışması<br/>Araştırma<br/>Açıklama<br/>Tartışma<br/>Sorunsallaştırma<br/>Pratik gösteri<br/>Pratik deney<br/>Grup projesi<br/>Beyin fırtınası</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Değerlendirme yöntemi</b>                                                            | <p>5HP Sınavı<br/>Başarılar ve pratik sonuçlara dayalı değerlendirme<br/>Gözlem yoluyla sürekli değerlendirme</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Referanslar</b>                                                                      | <p><a href="https://dictionary.cambridge.org/dictionary/english/compost">https://dictionary.cambridge.org/dictionary/english/compost</a><br/><a href="https://www.collinsdictionary.com/dictionary/english/compost">https://www.collinsdictionary.com/dictionary/english/compost</a><br/><a href="https://www.oxfordlearnersdictionaries.com/definition/english/compost_1">https://www.oxfordlearnersdictionaries.com/definition/english/compost_1</a><br/><a href="https://www.carryoncomposting.com/142941469.html">https://www.carryoncomposting.com/142941469.html</a><br/><a href="https://www.nrdc.org/stories/composting-101#types">https://www.nrdc.org/stories/composting-101#types</a><br/><a href="https://www.youtube.com/watch?v=O4dl4YljMZk">https://www.youtube.com/watch?v=O4dl4YljMZk</a><br/><a href="https://www.youtube.com/watch?v=pi-vsJOaduk">https://www.youtube.com/watch?v=pi-vsJOaduk</a></p> |



## 1.4. Öğrenim Ünitesi 4 - İleri Dönüşüm – Plastiğin Yeniden Kullanımı

### 1.4.1. Arka plan

Bu ilgi çekici ve etkileşimli ders, öğrencileri ileri dönüşüm - plastiğin yeniden kullanımı ve bu uygulamanın çevre ve biyolojik çeşitliliğin korunması açısından önemi konusunda eğitmek için tasarlanmıştır.

Öğrenciler, bilgilendirici bir video aracılığıyla, artık kullanışlı olmayan malzemeleri çöpe atıp çevre kirliliğine katkıda bulunmak yerine, onlara yeniden hayat vermenin ne kadar önemli olduğunu anlayacaklar.

Ders, öğrencilere plastik konusu ve bunun çevre ve insan sağlığı üzerindeki etkisi hakkında bütünsel bir bakış açısı kazandırmak için biyoloji ve mühendislik gibi çeşitli disiplinleri birleştirmeyi amaçlamaktadır. Öğrenciler, deniz kuşlarını örnek alarak plastiğin tüm insanlık için son derece tehlikeli ve zararlı olduğunu, hem çevreyi hem de yaban hayatını olumsuz yönde etkilediğini öğrenecekler.

Her yıl milyonlarca kuşun mikroplastikler de dahil olmak üzere plastik tüketimi nedeniyle öldüğü göz önüne alındığında, acil önlem alınması gerektiği açıktır. İleri dönüşüm, plastiği kuşların düşmanı olmaktan çıkarıp müttefike dönüştürebilecek hayat kurtaran bir çözümdür.

Öğrencilere geri dönüştürülebilir malzemeler kullanarak kuş besleyicileri yapmaları ve bu inanılmaz yaratıklara yiyecek ve barınak sağlamak için bunları erişilebilir yerlere yerleştirmeleri konusunda rehberlik edilecek.

Öğrenciler öğretmenin sağladığı malzemeleri kullanacak ve besleyicilerin yapımına ilişkin yönergeleri ve gereksinimleri takip edeceklerdir. Besleyiciler yerleştirildikten sonra öğrenciler bunları tohumlarla dolduracak ve kuşların beslenmeye gelip gelmediğini dikkatlice gözlemleyecek ve eylemlerinin olumlu etkisini vurgulamak için fotoğraflarını çekecekler.

Bu ders, öğrencileri çevresel sorumluluk konusunda eğittiği ve biyoçeşitliliği korumak için proaktif davranmaya teşvik ettiği için önemlidir. Öğrenciler ileri dönüşüm sayesinde kirliliğe karşı mücadelede her hareketin önemli olduğunu ve basit ve sürdürülebilir eylemlerle çevre üzerinde olumlu bir etki yaratabileceklerini öğreniyorlar.

Plastik atıkların yeniden kullanılması da paradan tasarruf etmenin bir yolu olabilir. Her ihtiyaç duyduğumuzda yeni konteynerler almak yerine, mevcut olanları yeniden kullanabilir, yenilerini satın alma maliyetlerinden tasarruf edebiliriz.

Plastiğin yeniden kullanılması yaratıcılığı ve yeniliği teşvik edebilir. İnsanlar plastik kapları sanat eserleri, oyuncaklar veya ev eşyaları yaratmak gibi orijinal amaçları dışında yeniden kullanmanın yaratıcı yollarını bulabilirler.

Plastik atıkların yeniden kullanımının teşvik edilmesi, öğrenciler arasında yaratıcılığı ve yenilikçiliği teşvik edebilir. Pratik ve yaratıcı beceriler geliştirerek kapları diğer kullanışlı veya dekoratif nesnelere dönüştürmenin yaratıcı yollarını bulabilirler.





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### 1.4.2. İçerik

| LearnSTEM Pedagojik Modeli                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| Modül 4: İleri Dönüşüm – Plastiğin Yeniden Kullanımı                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Modülün/öğrenme ünitesinin amacı</b>                                                                                                                              | Bu modülün amacı, malzemelerin yeniden kullanımını ve ileri dönüşümünü teşvik ederek öğrencilere sadece çevrenin korunmasına katkıda bulunma fırsatını vermek değil, aynı zamanda canlıların maruz kaldığı tehlikelere karşı empati ve farkındalık geliştirmelerini sağlamaktır.                                                                                                                                                                                                                                       |
| <b>Süre</b>                                                                                                                                                          | 50 dakika                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Öğrenme hedefleri</b>                                                                                                                                             | Dersin sonunda öğrenciler şunları yapabilecektir:<br>1 İleri dönüşümü tanımlayın;<br>2 Plastik parçacık kirliliğine bağlı tehlikeleri tanımlayın;<br>3 Deniz kuşlarının maruz kaldığı tehlikeleri sıralayın.<br>4 İleri dönüşümün faydalarını bilin.<br>5 Plastik yutabilen deniz kuşlarına örnekler verin.<br>6 Kuş besleyicilerinin yapımına aktif olarak katılarak pratik ve yaratıcı düşünme becerilerini geliştirmek.                                                                                             |
| <b>Gerekli Kaynaklar ve Malzemeler</b><br>( çalışma sayfası, çizelgeler , bildiriler, öğretici videolar, kitaplardan/kılavuzlardan alıntılar, zihin haritaları, vb.) | <ul style="list-style-type: none"><li>- Plastik şişeler;</li><li>- Makas;</li><li>- Kesici;</li><li>- Yapışkan bant;</li><li>- Sicim;</li><li>- Tel;</li><li>- Plastik tabaklar;</li><li>- Beyaz ve renkli kağıt;</li><li>- Yazı gereçleri;</li><li>- Silikon tutkal tabancası;</li><li>- Tahta çubuklar;</li><li>- Vidalar ve somunlar;</li><li>- Powerpoint sunum;</li><li>- Eğitici video materyali;</li><li>- Ek video materyali;</li><li>- SHP Sınavı;</li><li>- Dizüstü Bilgisayar/ Video projektörü ;</li></ul> |
| <b>Prosedür</b>                                                                                                                                                      | Takip edilecek adımlar:<br>Sınıfı rastgele seçilen 4 kişilik gruplara ayırın ve çalışma görevini belirleyin: Öğretmenin sağladığı malzemeleri kullanarak bir kuş besleyici yapın.<br>Çalışma süresi: 40 dakika<br>1. Video materyalini izleyin;<br>2. Öğrencileri gruplara ayırın;<br>3. Besleyicileri oluşturmak için gereken malzemeleri belirleyin;<br>4. Kuş besleyicileri inşa etmek<br>5. Her grubun yaptığı ürünün tanıtımı ve uygunluğunun test                                                                |



## Ortaokullarda STEM öğrenmenin Yenilikçi Modeli STEM Öğrenin



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|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                       | <p>edilmesi;<br/>Önceki adımları izledikten sonra kuş yemlikleri kuşların erişebileceği ve kolayca görülebileceği şekilde görünür bir yere yerleştirilmelidir. Besleyici alandaki aktivitenin denetimi bir hafta boyunca günde bir saattir.<br/>Daha sonra aşağıdaki adımlarımız var:<br/>1. Besleyicileri ziyaret eden kuşların sayılması ve tanımlanması;<br/>2. Besleyicileri ziyaret eden kuşların fotoğraflanması;<br/>3. Sonuçların sunumu;<br/>4. Geribildirim vermek.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>İçerik Yayınlama Yöntemleri</b> (konuşma, tartışma, araştırma, grup çalışması vb.) | <p>Grup halinde çalışma<br/>Araştırma<br/>Açıklama<br/>Tartışma<br/>Sorunsallaştırma<br/>Pratik deney<br/>Grup projesi<br/>Beyin fırtınası</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Değerlendirme yöntemi</b>                                                          | <p>5HP Sınavı;<br/>Pratik başarılarla ve sonuçlara dayalı değerlendirme;<br/>Gözlem yoluyla sürekli değerlendirme;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Referanslar</b>                                                                    | <p><a href="https://www.oxfordlearnersdictionaries.com/definition/english/upcycle">https://www.oxfordlearnersdictionaries.com/definition/english/upcycle</a><br/><a href="https://dictionary.cambridge.org/dictionary/english/upcycling">https://dictionary.cambridge.org/dictionary/english/upcycling</a><br/><a href="https://www.treehugger.com/what-is-upcycling-5116081">https://www.treehugger.com/what-is-upcycling-5116081</a><br/><a href="https://oceanblueproject.org/the-facts-of-plastic-p-on-seabirds/">https://oceanblueproject.org/the-facts-of-plastic-p-on-seabirds/</a><br/><a href="https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684">https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684</a><br/><a href="https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/">https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/</a><br/><a href="https://www.youtube.com/watch?v=rd7qP9FdTal">https://www.youtube.com/watch?v=rd7qP9FdTal</a><br/><a href="https://www.youtube.com/watch?v=P5OBWbZDZlc">https://www.youtube.com/watch?v=P5OBWbZDZlc</a></p> |



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## **Μάθετε STEM**

Καινοτόμο μοντέλο μάθησης STEM σε σχολεία δευτεροβάθμιας εκπαίδευσης

## **Μάθετε STEM**

*Καινοτόμο μοντέλο μάθησης STEM σε σχολεία  
δευτεροβάθμιας εκπαίδευσης*

ERASMUS+ KA220 Συνεργασίες Συνεργασίας στη σχολική εκπαίδευση

# **LearnSTEM Pedagogical Model**

## **Εγχειρίδιο Υλοποίησης Πρακτικών STEM**

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**Ημερομηνία:**

28.03.2024

**Αριθμός αναφοράς:**

2022-1-TR01-KA220-SCH-000087583



Η υποστήριξη της Ευρωπαϊκής Επιτροπής για την παραγωγή αυτής της δημοσίευσης δεν συνιστά έγκριση του περιεχομένου που αντικατοπτρίζει μόνο τις απόψεις των συγγραφέων και η Επιτροπή δεν μπορεί να θεωρηθεί υπεύθυνη για οποιαδήποτε χρήση των πληροφοριών που περιέχονται σε αυτήν.



## Μάθετε STEM

Καινοτόμο μοντέλο μάθησης STEM σε σχολεία δευτεροβάθμιας εκπαίδευσης

### 1 Πόροι μάθησης

#### 1.1 Εκπαιδευτική Ενότητα - Συλλέξτε και ταξινομήστε τα σκουπίδια

##### 1.1.1 Ιστορικό

Η υπεύθυνη συλλογή και διαλογή των σκουπιδιών συμβάλλει στην προστασία του περιβάλλοντος. Αυτές οι πρακτικές μειώνουν τον κίνδυνο ρύπανσης του αέρα, των υδάτων και του εδάφους, καθώς και τις αρνητικές επιπτώσεις στα φυσικά οικοσυστήματα και τη βιοποικιλότητα.

Μέσω της συλλογής και διαλογής των σκουπιδιών, είναι δυνατό να εντοπιστούν υλικά που μπορούν να ανακυκλωθούν ή να επαναχρησιμοποιηθούν. Αυτό σημαίνει ότι μια μεγάλη ποσότητα απορριμμάτων μπορεί να εκτραπεί σε διαδικασίες ανακύκλωσης ή κομποστοποίησης, αποφεύγοντας την υγειονομική ταφή.

Η διαλογή των σκουπιδιών βοηθά στη διατήρηση των φυσικών πόρων όπως το ξύλο, τα μέταλλα, το χαρτί και τα πλαστικά. Τα ανακυκλώσιμα υλικά που εντοπίζονται κατά τη διαδικασία διαλογής μπορούν να ανακτηθούν και να επιστραφούν στην οικονομία, μειώνοντας την ανάγκη εξόρυξης και επεξεργασίας νέων πόρων.

Αυτό το μάθημα όχι μόνο ενθαρρύνει τους μαθητές να γίνουν υπεύθυνοι πολίτες, αλλά και να εξερευνήσουν τις συνδέσεις και τις πρακτικές εφαρμογές επιστημονικών κλάδων όπως η χημεία, η βιολογία και η πληροφορική.

Για να ξεκινήσουν το μάθημα, οι μαθητές θα χωριστούν σε δύο ομάδες και θα τους εξηγηθεί η αποστολή τους. Ο δάσκαλος θα ετοιμάσει έναν πίνακα με αρκετούς τυπωμένους κωδικούς ανακύκλωσης και οι ίδιοι κωδικοί θα υπάρχουν επίσης σε μια ρόδα ρουλέτας που δημιουργείται από την εφαρμογή Wheel of Names. Κάθε ομάδα θα πρέπει να γυρίσει τον τροχό της ρουλέτας και, ανάλογα με το σύμβολο ανακύκλωσης που έχει επιλεγεί, θα πρέπει να βρει και να ταιριάζει τα αντίστοιχα υλικά με το ίδιο σύμβολο στο τραπέζι. Ο χρόνος που επιτρέπεται για την αναγνώριση και την αντιστοίχιση υλικών θα είναι το πολύ 30 δευτερόλεπτα.

Πριν ξεκινήσουν την πρακτική δραστηριότητα, οι μαθητές θα παρακολουθήσουν ένα βίντεο το οποίο θα παρουσιάζει θεωρητικές έννοιες σχετικά με τη συλλογή και τη διαλογή των σκουπιδιών καθώς και ένα πρακτικό παράδειγμα για το πώς θα πρέπει να οργανωθεί αυτή η δραστηριότητα. Αυτό το υλικό θα διευκολύνει την κατανόηση βασικών εννοιών και θα προετοιμάσει τους μαθητές για τις πρακτικές εργασίες.

Η δραστηριότητα της αναγνώρισης και διαλογής υλικών για ανακύκλωση θα ακολουθηθεί από συζήτηση στην τάξη σχετικά με τη σημασία και τον αντίκτυπο της σωστής ανακύκλωσης και διαλογής των σκουπιδιών. Οι μαθητές θα μπορούν να μοιραστούν τις εμπειρίες τους και να προβληματιστούν σχετικά με το πώς αυτές οι πρακτικές μπορούν να βοηθήσουν στην προστασία του περιβάλλοντος.

Για να εμπεδώσει τις γνώσεις που αποκτήθηκαν, ο δάσκαλος θα παρουσιάσει επίσης στους μαθητές πρόσθετα βίντεο από την πλατφόρμα YouTube, τα οποία θα αυξήσουν την κατανόηση και την ευαισθητοποίησή τους για το θέμα.

Το μάθημα θα ολοκληρωθεί με ένα κουίζ H5P, το οποίο θα ελέγξει τις γνώσεις που αποκτήθηκαν και θα δώσει στους μαθητές την ευκαιρία να αξιολογήσουν την πρόοδό τους και να εντοπίσουν πιθανά κενά στις γνώσεις τους.

## Μάθετε STEM

### Καινοτόμο μοντέλο μάθησης STEM σε σχολεία δευτεροβάθμιας εκπαίδευσης

Αυτό το διεπιστημονικό και διαδραστικό μάθημα έχει σχεδιαστεί για να εμπνεύσει και να εκπαιδεύσει τους μαθητές σχετικά με τη σημασία της ανακύκλωσης και της σωστής διαλογής των απορριμμάτων, βοηθώντας έτσι στην ανάπτυξη υπεύθυνων και περιβαλλοντικά συνειδητοποιημένων πολιτών.

#### 1.1.2 Περιεχόμενο

| Παιδαγωγικό μοντέλο LearnSTEM                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ενότητα 1: Συλλέξτε και ταξινομήστε τα σκουπίδια                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Στόχος της ενότητας/της μαθησιακής ενότητας</b>                                                                                                  | Στόχος αυτής της ενότητας είναι να τονίσει τη σημασία της σωστής συλλογής και διαλογής των απορριμμάτων για την προστασία του περιβάλλοντος, τη διατήρηση των φυσικών πόρων και τη μείωση της ρύπανσης, καθώς και την προώθηση μιας πιο βιώσιμης οικονομίας και μιας πιο περιβαλλοντικά υπεύθυνης κοινωνίας.                                                                                                                                                                                                                                                  |
| <b>Διάρκεια</b>                                                                                                                                     | 50 λεπτά                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Στόχοι μάθησης</b>                                                                                                                               | Στο τέλος του μαθήματος οι μαθητές θα είναι σε θέση να:<br>1 Ονομάσουν τους επτά κωδικούς SPI που αφορούν ειδικά τα πλαστικά υλικά.<br>2 Προσδιορίσουν τα διάφορα είδη ανακυκλώσιμων υλικών και συσχετίστε τα με τα αντίστοιχα σύμβολα ανακύκλωσης.<br>3 Αναπτύξουν δεξιότητες πρακτικής και κριτικής σκέψης μέσω ενεργού συμμετοχής σε δραστηριότητες για τον εντοπισμό και την ταξινόμηση ανακυκλώσιμων υλικών.<br>4 Εντοπίζουν και προτείνουν δημιουργικές λύσεις για τη διαχείριση των απορριμμάτων και την προώθηση της ανακύκλωσης στην κοινότητά τους. |
| <b>Απαιτούνται πόροι και υλικά</b><br>(φύλλο εργασίας, γραφήματα, φυλλάδια, διδακτικό βίντεο, απόσπασμα από βιβλία/εγχειρίδια, χάρτες μυαλού κ.λπ.) | <ul style="list-style-type: none"> <li>- Έντυποι κωδικοί.</li> <li>- Φορητός υπολογιστής/Βιντεοπροβολέας</li> <li>- Συλλέχθηκαν ανακυκλώσιμα υλικά (Χαρτένια κουτιά, πλαστικά, αλουμίνιο, σακούλες, πλαστικά μπουκάλια, γυαλί, σωλήνες PVC, μεταλλικά κουτιά κ.λπ.)</li> <li>- Λευκό ή έγχρωμο χαρτί.</li> <li>- Γράψιμο αντικειμένων.</li> <li>- Κουίζ 5 HP</li> <li>- Διδακτικό υλικό βίντεο.</li> <li>- Πρόσθετο παρακινητικό υλικό βίντεο.</li> <li>- Παρουσίαση powerpoint;</li> <li>- Εφαρμογή Wheel of Names.</li> </ul>                               |
| <b>Διαδικασία</b>                                                                                                                                   | Τα διδακτικά βήματα που πρέπει να ακολουθήσουν οι μαθητές:<br>Ο δάσκαλος χωρίζει την τάξη σε δύο ομάδες και προτείνει έναν διαγωνισμό στους μαθητές.<br>Η ομάδα με τα πιο σωστά ματς θα κερδίσει.<br>Βήματα:<br>1. Δείτε το διδακτικό υλικό.<br>2. Χωρίστε τους μαθητές σε ομάδες.<br>3. Συλλογή ανακυκλώσιμων απορριμμάτων.                                                                                                                                                                                                                                  |



## Μάθετε STEM

Καινοτόμο μοντέλο μάθησης STEM σε σχολεία δευτεροβάθμιας εκπαίδευσης

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|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                            | <ol style="list-style-type: none"><li>4. Καθιέρωση των κανόνων του παιχνιδιού και έναρξη του παιχνιδιού.</li><li>5. Προσδιορίστε το είδος των ανακυκλώσιμων σκουπιδιών σύμφωνα με τον συγκεκριμένο κωδικό και τοποθετήστε το κατάλληλα.</li><li>6. Ανακοίνωση της νικήτριας ομάδας.</li><li>7. Ανατροφοδότηση.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Μέθοδοι Παράδοσης Περιεχομένου (διάλεξη, συζητήσεις, έρευνα, ομαδική εργασία κ.λπ.)</b> | Ομαδική δουλειά<br>Εξήγηση<br>Εξάσκηση επίδειξης<br>Συζήτηση<br>Προβληματοποίηση<br>καταιγισμός ιδεών                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Μέθοδος Αξιολόγησης</b>                                                                 | Κουίζ 5HP<br>Αξιολόγηση με βάση τα επιτεύγματα και τα πρακτικά αποτελέσματα.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>βιβλιογραφικές αναφορές</b>                                                             | <a href="https://dictionary.cambridge.org/dictionary/english/garbage">https://dictionary.cambridge.org/dictionary/english/garbage</a><br><a href="https://www.ldoceonline.com/dictionary/garbage">https://www.ldoceonline.com/dictionary/garbage</a><br><a href="https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage">https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage</a><br><a href="https://www.roadrunnerwm.com/blog/history-of-garbage">https://www.roadrunnerwm.com/blog/history-of-garbage</a><br><a href="https://ecoresources.net.au/why-is-waste-sorting-important/">https://ecoresources.net.au/why-is-waste-sorting-important/</a><br><a href="https://wheelofnames.com">https://wheelofnames.com</a><br><a href="https://www.youtube.com/watch?v=b-0eajX7Xlo">https://www.youtube.com/watch?v=b-0eajX7Xlo</a><br><a href="https://www.youtube.com/watch?v=3Lzsu8SXaWY">https://www.youtube.com/watch?v=3Lzsu8SXaWY</a> |



## Μάθετε STEM

### Καινοτόμο μοντέλο μάθησης STEM σε σχολεία δευτεροβάθμιας εκπαίδευσης

#### 1.2 Μαθησιακή Ενότητα - Κατασκευάστε μια Κλίμακα Ισορροπίας

##### 1.2.1 Ιστορικό

Η κατασκευή νέων υλικών συμβάλλει στη ρύπανση του αέρα, των υδάτων και του εδάφους μέσω των εκπομπών αερίων του θερμοκηπίου, τοξικών χημικών ουσιών και επικίνδυνων αποβλήτων. Η επαναχρησιμοποίηση ανακυκλώσιμων προϊόντων συμβάλλει στη μείωση αυτής της ρύπανσης, αποφεύγοντας την παραγωγή πρόσθετων υλικών και ανακυκλώνοντας την ποσότητα των απορριμμάτων.

Αυτό το μάθημα όχι μόνο καταδεικνύει τη σημασία της ανακύκλωσης και της βιώσιμης σκέψης, αλλά διεγείρει επίσης τη δημιουργικότητα των μαθητών, δίνοντάς τους την ελευθερία να σχεδιάσουν και να δημιουργήσουν τη δική τους κλίμακα σύμφωνα με τη φαντασία και τις προτιμήσεις τους.

Αυτό το μάθημα έχει σχεδιαστεί για να παρέχει στους μαθητές μια ελκυστική και διαδραστική εκπαιδευτική εμπειρία, συνδυάζοντας τη δημιουργικότητα και τη γνώση STEM (Science, Technology, Engineering and Math) για την προώθηση της μάθησης και της ανακάλυψης. Μέσα από ένα εμπνευσμένο βίντεο, οι μαθητές καλούνται να εξερευνήσουν τη διαδικασία δημιουργίας μιας ζυγαριάς με χρήση ανακυκλωμένων υλικών όπως πλαστικά μπουκάλια, χαρτόκουτα ή άλλα αντικείμενα που διαφορετικά θα πεταχούνταν.

Εκτός από την πρακτική πτυχή, το μάθημα στοχεύει να τονώσει την κριτική σκέψη και τις δεξιότητες επίλυσης προβλημάτων, δίνοντας στους μαθητές την ευκαιρία να εξερευνήσουν τις τομές μεταξύ μηχανικής, μαθηματικών, φυσικής και οικολογίας.

Μέσα από την πρόκληση να σχεδιάσουν και να δημιουργήσουν τις δικές τους ισορροπίες, οι μαθητές θα μάθουν να εντοπίζουν και να εφαρμόζουν μαθηματικές και επιστημονικές έννοιες σε ένα πραγματικό πλαίσιο σχετικό με την καθημερινή τους ζωή.

Το μάθημα στοχεύει επίσης να δώσει στους μαθητές την ευκαιρία να κατανοήσουν τη διαφορά μεταξύ μάζας και βάρους και να ανακαλύψουν τις μονάδες μέτρησης που σχετίζονται με αυτές τις έννοιες.

Για τους μαθητές, η γνώση και η προώθηση της σημασίας της επαναχρησιμοποίησης ανακυκλώσιμων προϊόντων είναι απαραίτητη για την περιβαλλοντική τους εκπαίδευση, την ανάπτυξη υπεύθυνης συμπεριφοράς και τη συμβολή στην προστασία του περιβάλλοντος.

Προκειμένου να αυξηθεί η σημασία και η συνάφεια του θέματος που εξετάζεται, ξεκινώντας από το πρόγραμμα σπουδών - Ανακύκλωση, προτείνουμε να φτιάξουμε μια κλίμακα ισορροπίας, για διδακτικούς σκοπούς, χρησιμοποιώντας ανακυκλώσιμα υλικά.

Με αυτόν τον τρόπο, το μάθημα στοχεύει να εμπνεύσει τους μαθητές να γίνουν υπεύθυνοι πολίτες και να συμμετάσχουν ενεργά στην οικοδόμηση ενός πιο πράσινου και πιο βιώσιμου μέλλοντος για όλους.



## Μάθετε STEM

Καινοτόμο μοντέλο μάθησης STEM σε σχολεία δευτεροβάθμιας εκπαίδευσης

### 1.2.2 Περιεχόμενο

| Παιδαγωγικό μοντέλο LearnSTEM                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ενότητα 2: Δημιουργήστε μια κλίμακα ισορροπίας                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Στόχος της ενότητας/της μαθησιακής ενότητας</b>                                                                                                  | Στόχος αυτής της ενότητας είναι να τονίσει τη σημασία της επαναχρησιμοποίησης ανακυκλώσιμων υλικών προκειμένου να δημιουργηθεί μια κλίμακα ισορροπίας.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Διάρκεια</b>                                                                                                                                     | 50 λεπτά                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Στόχοι μάθησης</b>                                                                                                                               | <p>Στο τέλος αυτής της ενότητας, οι μαθητές θα είναι σε θέση να:</p> <ol style="list-style-type: none"> <li>1 ορίσουν την έννοια της κλίμακας ισορροπίας.</li> <li>2 Προσδιορίσουν τα ανακυκλώσιμα υλικά που απαιτούνται για τη δημιουργία της ζυγαριάς.</li> <li>3 επιλέξουν τα εργαλεία που απαιτούνται για τη δημιουργία της κλίμακας ισορροπίας.</li> <li>4 προσδιορίζουν τις μονάδες μέτρησης που χρησιμοποιούνται στη ζύγιση.</li> <li>5 Μετρήσουν τη μάζα ενός αντικειμένου χρησιμοποιώντας την κλίμακα ισορροπίας.</li> <li>6 Προσδιορίσουν τη διαφορά μεταξύ μάζας και βάρους.</li> </ol>                                              |
| <b>Απαιτούνται πόροι και υλικά</b><br>(φύλλο εργασίας, γραφήματα, φυλλάδια, διδακτικό βίντεο, απόσπασμα από βιβλία/εγχειρίδια, χάρτες μυαλού κ.λπ.) | <ul style="list-style-type: none"> <li>- Χάρτινα κουτιά;</li> <li>- Χορδή</li> <li>- Πλαστικά μπουκάλια;</li> <li>- Ψαλίδι;</li> <li>- Κόφτης;</li> <li>- Μεζούρα;</li> <li>- Κολλητική ταινία;</li> <li>- Λευκό και έγχρωμο χαρτί.</li> <li>- Πλαστικά και χάρτινα κύπελλα.</li> <li>- Στυλό και μολύβια</li> <li>- Πιστόλι κόλλας σιλικόνης.</li> <li>- Βιντεοπροβολέας/φορητός υπολογιστής</li> <li>- Εκπαιδευτικό υλικό βίντεο.</li> <li>- Πρόσθετο υλικό βίντεο.</li> <li>- Παρουσίαση PPT.</li> <li>- Κουίζ H5P</li> <li>- ΖΥΓΑΡΙΑ ΚΟΥΖΙΝΑΣ;</li> <li>- Διάφορα ανακυκλώσιμα υλικά (πλαστικό, κουμπιά, πώματα, σακούλες κ.λπ.)</li> </ul> |
| <b>Διαδικασία</b>                                                                                                                                   | <p>Η τάξη χωρίζεται σε ομάδες των 4 μαθητών που επιλέγονται τυχαία και ορίζεται η εργασία: Φτιάξτε μια κλίμακα ισορροπίας χρησιμοποιώντας τα ανακυκλώσιμα υλικά που παρέχονται. Χρόνος εργασίας: 40 λεπτά.</p> <p>Βήματα που πρέπει να ακολουθήσετε:</p> <ol style="list-style-type: none"> <li>1. Δείτε το πρακτικό παράδειγμα.</li> <li>2. Προσδιορίστε τα ανακυκλώσιμα υλικά που θα χρησιμοποιηθούν για τη δημιουργία της ζυγαριάς.</li> <li>3. Χωρίστε τους μαθητές σε ομάδες.</li> </ol>                                                                                                                                                   |



## Μάθετε STEM

Καινοτόμο μοντέλο μάθησης STEM σε σχολεία δευτεροβάθμιας εκπαίδευσης

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|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                            | <p>4. Δημιουργία της κλίμακας ισορροπίας χρησιμοποιώντας το υλικό βίντεο που παρέχεται από τον δάσκαλο ως μοντέλο.</p> <p>5. Εξισορρόπηση της ζυγαριάς με χρήση ανακυκλώσιμων υλικών, αφού ο δάσκαλος έχει προσθέσει το τυπικό αντικείμενο σε έναν από τους δύο δίσκους.</p> <p>6. Ζύγισμα των ανακυκλωμένων αντικειμένων που προστέθηκαν από τους μαθητές στον δεύτερο ελεύθερο δίσκο για να αποκατασταθεί η ισορροπία της ζυγαριάς.</p> <p>7. Κατάταξη των ομάδων με βάση την αξία που προκύπτει από τη ζύγιση των ανακυκλωμένων αντικειμένων. Η νικήτρια ομάδα είναι αυτή της οποίας η τιμή είναι πιο κοντά στη μάζα του τυπικού αντικειμένου.</p> <p>8. Ανατροφοδότηση.</p>                                                                                                                                                        |
| <b>Μέθοδοι Παράδοσης Περιεχομένου (διάλεξη, συζητήσεις, έρευνα, ομαδική εργασία κ.λπ.)</b> | <p>ΟΜΑΔΙΚΗ ΔΟΥΛΕΙΑ</p> <p>Έρευνα</p> <p>Πρακτική επίδειξη</p> <p>Συζητήσεις</p> <p>Εξήγηση</p> <p>καταιγισμός ιδεών</p> <p>Προβληματοποίηση</p> <p>Πρακτικό πείραμα</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Μέθοδος Αξιολόγησης</b>                                                                 | <p>Κουίζ H5P</p> <p>Αξιολόγηση με βάση τα επιτεύγματα και τα πρακτικά αποτελέσματα.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>βιβλιογραφικές αναφορές</b>                                                             | <p><a href="http://www.amathsdictionaryforkids.com/gr/b/balanceScales.html">http://www.amathsdictionaryforkids.com/gr/b/balanceScales.html</a></p> <p><a href="https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales">https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales</a></p> <p><a href="https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/">https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/</a></p> <p><a href="https://www.youtube.com/watch?v=Z0X0yE8loc">https://www.youtube.com/watch?v=Z0X0yE8loc</a></p> <p><a href="https://www.youtube.com/watch?v=J_-DF5nYw7E&amp;t=72s">https://www.youtube.com/watch?v=J_-DF5nYw7E&amp;t=72s</a></p> |

## Μάθετε STEM

### Καινοτόμο μοντέλο μάθησης STEM σε σχολεία δευτεροβάθμιας εκπαίδευσης

#### 1.3 Μαθησιακή Ενότητα 3 - Κομποστοποίηση σε μπουκάλι και δημιουργία

##### κομποστοποιητή - επαναχρησιμοποίηση βιοαποδομήσιμων απορριμμάτων

##### 1.3.1. Ιστορικό

Αυτό το μάθημα έχει σχεδιαστεί για να εκπαιδεύσει τους μαθητές σχετικά με τη σημασία της υπεύθυνης διαχείρισης και ανακύκλωσης απορριμμάτων μέσω της δημιουργίας κομποστοποιητών από πλαστικά μπουκάλια. Κατασκευάζοντας αυτούς τους κομποστοποιητές, οι μαθητές όχι μόνο θα μάθουν πώς να ανακυκλώνουν και να επαναχρησιμοποιούν πλαστικά υλικά, αλλά θα μάθουν επίσης πώς να ανακυκλώνουν οργανικά οικιακά απορρίμματα, όπως φλούδες φρούτων και λαχανικών, υπολείμματα κουζίνας, αποξηραμένα φύλλα, χαρτί και άλλα βιοαποδομήσιμα υλικά. Μέσω των διαδραστικών και πρακτικών δραστηριοτήτων που προτείνονται, οι μαθητές θα μάθουν επίσης πώς μπορούν να συμβάλουν στην προστασία του περιβάλλοντος και στη διατήρηση των φυσικών πόρων.

Το πρώτο μέρος του μαθήματος παρουσιάζει ένα ενημερωτικό βίντεο που δείχνει τα προβλήματα της ακατάλληλης διαχείρισης απορριμμάτων, συμπεριλαμβανομένων των αρνητικών επιπτώσεων της καύσης πλαστικών ή της ακατάλληλης απόρριψης, που οδηγεί σε ρύπανση του περιβάλλοντος.

Με αυτόν τον τρόπο, οι μαθητές θα κατανοήσουν τις συνέπειες αυτών των πρακτικών και θα παρακινηθούν να βρουν εναλλακτικές και βιώσιμες λύσεις.

Επίσης σε αυτό το βίντεο, θα παρουσιαστούν πρακτικά παραδείγματα για το πώς να φτιάξετε έναν κομποστοποιητή από πλαστικά μπουκάλια και θα τονιστούν τα πλεονεκτήματά του, καθώς και πώς να φτιάξετε κομπόστ και τα οφέλη του στην κηπουρική και τη γεωργία.

Στη συνέχεια, οι μαθητές θα χωριστούν σε ομάδες και θα τους παρουσιαστεί μια εργασία για τη δημιουργία κομποστοποιητών από πλαστικά μπουκάλια. Κάθε ομάδα θα λάβει τα απαραίτητα υλικά και θα καθοδηγηθεί από τον δάσκαλο στη διαδικασία κατασκευής. Οι μαθητές θα ενθαρρυνθούν να χρησιμοποιήσουν τη δημιουργικότητα και τις πρακτικές τους δεξιότητες για να φτιάξουν τους κομποστοποιητές σύμφωνα με τις απαιτήσεις.

Κατά τη διάρκεια της πρακτικής δραστηριότητας, οι μαθητές θα μάθουν για τη διαδικασία κομποστοποίησης και θα κατανοήσουν τα οφέλη της στην παραγωγή φυσικού λιπάσματος για φυτά.

Η κομποστοποίηση είναι ένας αποτελεσματικός τρόπος μείωσης των οργανικών αποβλήτων. Καθώς περίπου το 30-40% των οικιακών απορριμμάτων είναι κομποστοποιήσιμο οργανικό υλικό, κομποστοποιώντας αυτά τα απόβλητα, μπορούμε να μειώσουμε την ποσότητα των απορριμμάτων που αποστέλλονται στους χώρους υγειονομικής ταφής και έτσι να μειώσουμε τις αρνητικές επιπτώσεις στο περιβάλλον. Το κομπόστ είναι ένα οργανικό λίπασμα πλούσιο σε βασικά θρεπτικά συστατικά του εδάφους όπως άζωτο, φώσφορος και κάλιο. Επομένως, η χρήση κομπόστ στην κηπουρική και τη γεωργία μπορεί να μειώσει την εξάρτηση από συνθετικά χημικά λιπάσματα. Το κομπόστ παρέχει μια φυσική και

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ισορροπημένη πηγή φυτικών θρεπτικών συστατικών, συμβάλλοντας στη μακροπρόθεσμη διατήρηση της υγείας του εδάφους.

Για τους μαθητές, η μάθηση για τη διαδικασία κομποστοποίησης είναι σημαντική γιατί τους εκπαιδεύει σχετικά με την προστασία του περιβάλλοντος, τη διατήρηση των φυσικών πόρων και την υιοθέτηση υπεύθυνης και βιώσιμης συμπεριφοράς διαχείρισης απορριμμάτων.

Η κομποστοποίηση μπορεί να είναι μια πρακτική και δημιουργική δραστηριότητα για αυτούς. Μπορούν να μάθουν να συνδυάζουν διαφορετικά οργανικά υλικά, να παρακολουθούν τη διαδικασία αποσύνθεσης και να παρατηρούν τις θετικές επιδράσεις του κομπόστ στα φυτά και το έδαφος.

Μαθαίνοντας να κομποστοποιούν, οι μαθητές αναπτύσσουν πρακτικές δεξιότητες και υπευθυνότητα στη διαχείριση απορριμμάτων.

#### 1.3.2. Περιεχόμενο

| Παιδαγωγικό μοντέλο LearnSTEM                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| Ενότητα 3: Κομποστοποίηση σε φιάλη και δημιουργία κομποστοποιητή - επαναχρησιμοποίηση βιοαποδομήσιμων απορριμμάτων                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Στόχος της ενότητας/της μαθησιακής ενότητας</b>                                                                                                  | Ο στόχος αυτής της ενότητας είναι να αναπτύξει τις υπεύθυνες και πρακτικές δεξιότητες διαχείρισης απορριμμάτων των μαθητών, να μάθουν πώς να ανακυκλώνουν και να επαναχρησιμοποιούν οργανικά υλικά αντί να τα πετούν και να προωθούν περιβαλλοντικά υπεύθυνη συμπεριφορά.                                                                                                                                                                                                                                                                                                                |
| <b>Διάρκεια</b>                                                                                                                                     | <b>50 λεπτά</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Στόχοι μάθησης</b>                                                                                                                               | Στο τέλος του μαθήματος οι μαθητές θα είναι σε θέση να: <ol style="list-style-type: none"> <li>1. Ορίσουν το κομπόστ.</li> <li>2. Προσδιορίσουν τους τύπους οικιακών απορριμμάτων που μπορούν να χρησιμοποιηθούν για την παραγωγή κομπόστ.</li> <li>3. Φτιάξουν τον δικό τους κομποστοποιητή στο σπίτι.</li> <li>4. Γνωρίστε τη σημασία της χρήσης κομπόστ και δώστε παραδείγματα για το πού μπορεί να χρησιμοποιηθεί.</li> <li>5. Αναπτύξουν πρακτικές και δημιουργικές δεξιότητες σκέψης συμμετέχοντας ενεργά στην κατασκευή κομποστοποιητών με χρήση ανακυκλωμένων υλικών.</li> </ol> |
| <b>Απαιτούνται πόροι και υλικά</b><br>(φύλλο εργασίας, γραφήματα, φυλλάδια, διδακτικό βίντεο, απόσπασμα από βιβλία/εγχειρίδια, χάρτες μυαλού κ.λπ.) | <ul style="list-style-type: none"> <li>- Πλαστικά μπουκάλια;</li> <li>- Οργανικά οικιακά απορρίμματα (φύλλα, φυτικοί πόροι)</li> <li>- Έδαφος</li> <li>- Νερό</li> <li>- Κομμάτια χαρτί;</li> <li>- Ψαλίδι</li> <li>- Κολλητική ταινία;</li> <li>- Εκπαιδευτικό υλικό βίντεο.</li> <li>- Φορητός υπολογιστής/Βιντεοπροβολέας</li> <li>- Κουίζ H5P</li> <li>- Πρόσθετο υλικό βίντεο.</li> </ul>                                                                                                                                                                                           |

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|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                            | - - Παρουσίαση powerpoint;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Διαδικασία</b>                                                                          | <p>Τα βήματα εκπαίδευσης που πρέπει να ακολουθήσουν οι μαθητές:</p> <p>Χωρίστε την τάξη σε ομάδες των 4 μαθητών που επιλέχθηκαν τυχαία και περιγράψτε την εργασία εργασίας: φτιάξτε τον κομποστοποιητή χρησιμοποιώντας τα υλικά που παρέχει ο δάσκαλος και προσθέστε την πρώτη ύλη για να φτιάξετε το κομπόστ. Πραγματικός χρόνος εργασίας: 40 λεπτά.</p> <p>Βήματα που πρέπει να ακολουθήσετε:</p> <ol style="list-style-type: none"> <li>1. Δείτε το πρακτικό παράδειγμα.</li> <li>2. Προσδιορίστε τα υλικά που απαιτούνται για την κατασκευή του κομποστοποιητή.</li> <li>3. Χωρίστε τους μαθητές σε ομάδες.</li> <li>4. Κατασκευή του κομποστοποιητή.</li> <li>5. Προσθήκη της πρώτης ύλης για τη λήψη του κομπόστ.</li> </ol> <p>Μόλις ολοκληρωθούν τα παραπάνω βήματα, οι κομποστοποιητές θα τοποθετηθούν έτσι ώστε να μπορούν να επωφεληθούν από το φως του ήλιου. Η ανάπτυξη του κομπόστ θα είναι ορατή μέσα σε 3 έως 6 εβδομάδες.</p> <p>Έτσι έχουμε τα εξής βήματα:</p> <ol style="list-style-type: none"> <li>1. Πότισμα του κομπόστ - καθημερινά.</li> <li>2. Έλεγχος της κατάστασης του κομπόστ και των αλλαγών στη δομή.</li> <li>3. Σωστή χρήση κομπόστ.</li> <li>4. Δίνοντας σχόλια.</li> </ol> |
| <b>Μέθοδοι Παράδοσης Περιεχομένου (διάλεξη, συζητήσεις, έρευνα, ομαδική εργασία κ.λπ.)</b> | <p>Ομαδική δουλειά<br/>Ερευνα<br/>Εξήγηση<br/>Συζήτηση<br/>Προβληματισμός<br/>Πρακτική επίδειξη<br/>Πρακτικό πείραμα<br/>Ομαδικό έργο<br/>καταιγισμός ιδεών</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Μέθοδος Αξιολόγησης</b>                                                                 | <p>Κουίζ 5 HP<br/>Αξιολόγηση με βάση τα επιτεύγματα και τα πρακτικά αποτελέσματα<br/>Συνεχής αξιολόγηση με παρατήρηση</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>βιβλιογραφικές αναφορές</b>                                                             | <p><a href="https://dictionary.cambridge.org/dictionary/english/compost">https://dictionary.cambridge.org/dictionary/english/compost</a><br/> <a href="https://www.collinsdictionary.com/dictionary/english/compost">https://www.collinsdictionary.com/dictionary/english/compost</a><br/> <a href="https://www.oxfordlearnersdictionaries.com/definition/english/compost_1">https://www.oxfordlearnersdictionaries.com/definition/english/compost_1</a><br/> <a href="https://www.carryoncomposting.com/142941469.html">https://www.carryoncomposting.com/142941469.html</a><br/> <a href="https://www.nrdc.org/stories/composting-101#types">https://www.nrdc.org/stories/composting-101#types</a><br/> <a href="https://www.youtube.com/watch?v=O4dl4YljMZk">https://www.youtube.com/watch?v=O4dl4YljMZk</a><br/> <a href="https://www.youtube.com/watch?v=pi-vsJOaduk">https://www.youtube.com/watch?v=pi-vsJOaduk</a></p>                                                                                                                                                                                                                                                                                  |

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#### 1.4. Μαθησιακή Ενότητα 4 - Ανακύκλωση – Επαναχρησιμοποίηση πλαστικού

##### 1.4.1. Ιστορικό

Αυτό το συναρπαστικό και διαδραστικό μάθημα έχει σχεδιαστεί για να εκπαιδεύσει τους μαθητές σχετικά με την ανακύκλωση - επαναχρησιμοποίηση πλαστικού και τη σημασία αυτής της πρακτικής για το περιβάλλον και για την προστασία της βιοποικιλότητας.

Μέσα από ένα ενημερωτικό βίντεο, οι μαθητές θα κατανοήσουν πόσο σημαντικό είναι να δίνουμε νέα ζωή σε υλικά που δεν είναι πλέον χρήσιμα, αντί να τα πετάμε και να συμβάλλουμε στη μόλυνση του περιβάλλοντος.

Το μάθημα στοχεύει να συνδυάσει διάφορους κλάδους, όπως η βιολογία και η μηχανική, για να δώσει στους μαθητές μια ολιστική προοπτική για το ζήτημα του πλαστικού και τις επιπτώσεις του στο περιβάλλον και την ανθρώπινη υγεία. Οι μαθητές θα μάθουν ότι το πλαστικό είναι εξαιρετικά επικίνδυνο και επιβλαβές για όλη την ανθρωπότητα, επηρεάζοντας αρνητικά τόσο το περιβάλλον όσο και την άγρια ζωή, παίρνοντας ως παράδειγμα τα θαλασσοπούλια.

Καθώς εκατομμύρια πουλιά πεθαίνουν κάθε χρόνο από κατάποση πλαστικών, συμπεριλαμβανομένων των μικροπλαστικών, είναι σαφές ότι απαιτείται επείγουσα δράση. Η ανακύκλωση είναι η σωτήρια λύση που μπορεί να μετατρέψει το πλαστικό από εχθρό των πτηνών σε σύμμαχο.

Οι μαθητές θα καθοδηγηθούν να κατασκευάσουν τροφοδότες πουλιών χρησιμοποιώντας ανακυκλώσιμα υλικά και να τις τοποθετήσουν σε προσβάσιμα μέρη για να παρέχουν τροφή και καταφύγιο σε αυτά τα απίστευτα πλάσματα.

Οι μαθητές θα χρησιμοποιήσουν τα υλικά που παρέχει ο δάσκαλος και θα ακολουθήσουν τις οδηγίες και τις απαιτήσεις για την κατασκευή των ταΐστρων. Μόλις τοποθετηθούν οι ταΐστρες, οι μαθητές θα τις γεμίσουν με σπόρους και θα παρατηρήσουν προσεκτικά εάν τα πουλιά έρχονται να ταΐσουν, φωτογραφίζοντάς τα για να τονίσουν τη θετική επίδραση των πράξεών τους.

Αυτό το μάθημα είναι σημαντικό για τους μαθητές, καθώς τους εκπαιδεύει σχετικά με την περιβαλλοντική ευθύνη και τους ενθαρρύνει να ενεργούν προληπτικά για την προστασία της βιοποικιλότητας. Μέσω της ανακύκλωσης, οι μαθητές μαθαίνουν ότι κάθε χειρονομία μετράει για την καταπολέμηση της ρύπανσης και ότι μπορούν να έχουν θετικό αντίκτυπο στο περιβάλλον μέσω απλών και βιώσιμων ενεργειών.

Η επαναχρησιμοποίηση πλαστικών απορριμμάτων μπορεί επίσης να είναι ένας τρόπος εξοικονόμησης χρημάτων. Αντί να αγοράζουμε νέα δοχεία κάθε φορά που τα χρειαζόμαστε, μπορούμε να επαναχρησιμοποιήσουμε τα υπάρχοντα, εξοικονομώντας το κόστος που σχετίζεται με την αγορά νέων.

Η επαναχρησιμοποίηση πλαστικού μπορεί να τονώσει τη δημιουργικότητα και την καινοτομία. Οι άνθρωποι μπορούν να βρουν εφευρετικούς τρόπους για να επαναχρησιμοποιήσουν τα πλαστικά δοχεία για σκοπούς διαφορετικούς από τον αρχικό τους σκοπό, όπως η δημιουργία έργων τέχνης, παιχνιδιών ή ειδών οικιακής χρήσης.

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Η ενθάρρυνση της επαναχρησιμοποίησης πλαστικών απορριμμάτων μπορεί να τονώσει τη δημιουργικότητα και την καινοτομία μεταξύ των μαθητών. Μπορούν να βρουν εφευρετικούς τρόπους για να μετατρέψουν τα δοχεία σε άλλα χρήσιμα ή διακοσμητικά αντικείμενα, αναπτύσσοντας πρακτικές και δημιουργικές δεξιότητες.

#### 1.4.2. Περιεχόμενο

| Παιδαγωγικό μοντέλο LearnSTEM                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| Ενότητα 4: Ανακύκλωση – Επαναχρησιμοποίηση πλαστικού                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Στόχος της ενότητας/της μαθησιακής ενότητας                                                                                                  | Στόχος αυτής της ενότητας είναι να ενθαρρύνει την επαναχρησιμοποίηση και την ανακύκλωση των υλικών, δίνοντας στους μαθητές την ευκαιρία όχι μόνο να συμβάλουν στην προστασία του περιβάλλοντος, αλλά και να αναπτύξουν ενσυναίσθηση και επίγνωση απέναντι στους κινδύνους στους οποίους εκτίθενται τα ζωντανά πλάσματα.                                                                                                                                                                                                                                |
| Διάρκεια                                                                                                                                     | 50 λεπτά                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Στόχοι μάθησης                                                                                                                               | Στο τέλος του μαθήματος οι μαθητές θα είναι σε θέση να :<br>1 Ορίσουν την ανακύκλωση.<br>2 Προσδιορίσουν τους κινδύνους που σχετίζονται με τη ρύπανση από πλαστικά σωματίδια.<br>3 Απαριθμήσουν τους κινδύνους στους οποίους εκτίθενται τα θαλασσοπούλια.<br>4 Γνωρίσουν τα οφέλη της ανακύκλωσης.<br>5 Δώσουν παραδείγματα θαλάσσιων πτηνών που μπορεί να καταπιούν πλαστικό.<br>6 Αναπτύξουν πρακτικές και δημιουργικές δεξιότητες σκέψης συμμετέχοντας ενεργά στην κατασκευή τροφοδοτικών πουλιών.                                                  |
| Απαιτούνται πόροι και υλικά<br>(φύλλο εργασίας, γραφήματα, φυλλάδια, διδακτικό βίντεο, απόσπασμα από βιβλία/εγχειρίδια, χάρτες μυαλού κ.λπ.) | <ul style="list-style-type: none"> <li>- Πλαστικά μπουκάλια;</li> <li>- Ψαλίδι;</li> <li>- Κόφτης;</li> <li>- Κολλητική ταινία;</li> <li>- Χορδή</li> <li>- Σύρμα</li> <li>- Πλαστικές πλάκες</li> <li>- Λευκό και έγχρωμο χαρτί.</li> <li>- Όργανα γραφής.</li> <li>- Πιστόλι κόλλας σιλικόνης.</li> <li>- Ξύλινα μαστούνια</li> <li>- Βίδες και παξιμάδια.</li> <li>- Παρουσίαση powerpoint;</li> <li>- Εκπαιδευτικό υλικό βίντεο.</li> <li>- Πρόσθετο υλικό βίντεο.</li> <li>- Κουίζ 5 HP</li> <li>- Φορητός υπολογιστής/Βιντεοπροβολέας</li> </ul> |



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| <p><b>Διαδικασία</b></p>                                                                          | <p>Βήματα που πρέπει να ακολουθήσετε:</p> <p>Χωρίστε την τάξη σε ομάδες των 4 μαθητών που επιλέχθηκαν τυχαία και ορίστε την εργασία: Φτιάξτε μια τροφοδοσία πουλιών χρησιμοποιώντας τα υλικά που παρέχονται από τον δάσκαλο.</p> <p>Χρόνος εργασίας: 40 λεπτά</p> <ol style="list-style-type: none"> <li>1. Δείτε το υλικό βίντεο.</li> <li>2. Χωρίστε τους μαθητές σε ομάδες.</li> <li>3. Προσδιορίστε τα υλικά που χρειάζονται για την κατασκευή των τροφοδοτικών.</li> <li>4. Κατασκευή ταΐστρων πουλιών</li> <li>5. Παρουσίαση του προϊόντος από κάθε ομάδα και έλεγχος της συμμόρφωσής του.</li> </ol> <p>Αφού ακολουθήσετε τα προηγούμενα βήματα, οι ταΐστρες πουλιών θα πρέπει να τοποθετηθούν σε εμφανές σημείο, ώστε να είναι προσβάσιμες στα πουλιά και να τις βλέπουν εύκολα. Η επίβλεψη της δραστηριότητας στον χώρο του τροφοδότη είναι μία ώρα την ημέρα για μία εβδομάδα.</p> <p>Στη συνέχεια έχουμε τα εξής βήματα:</p> <ol style="list-style-type: none"> <li>1. Καταμέτρηση και αναγνώριση των πτηνών που επισκέπτονται τις ταΐστρες.</li> <li>2. Φωτογράφιση των πουλιών που επισκέπτονται τις ταΐστρες.</li> <li>3. Παρουσίαση των αποτελεσμάτων.</li> <li>4. Δίνοντας σχόλια.</li> </ol>                                                   |
| <p><b>Μέθοδοι Παράδοσης Περιεχομένου (διάλεξη, συζητήσεις, έρευνα, ομαδική εργασία κ.λπ.)</b></p> | <p>Εργασία σε ομάδες<br/>Ερευνα<br/>Εξήγηση<br/>Συζήτηση<br/>Προβληματισμός<br/>Πρακτικό πείραμα<br/>Ομαδικό έργο<br/>καταιγισμός ιδεών</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p><b>Μέθοδος Αξιολόγησης</b></p>                                                                 | <p>Κουίζ 5HP;<br/>Αξιολόγηση με βάση πρακτικά επιτεύγματα και αποτελέσματα.<br/>Συνεχής αξιολόγηση μέσω παρατήρησης.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p><b>βιβλιογραφικές αναφορές</b></p>                                                             | <p><a href="https://www.oxfordlearnersdictionaries.com/definition/english/upcycle">https://www.oxfordlearnersdictionaries.com/definition/english/upcycle</a><br/> <a href="https://dictionary.cambridge.org/dictionary/english/upcycling">https://dictionary.cambridge.org/dictionary/english/upcycling</a><br/> <a href="https://www.treehugger.com/what-is-upcycling-5116081">https://www.treehugger.com/what-is-upcycling-5116081</a><br/> <a href="https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/">https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/</a><br/> <a href="https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684">https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684</a><br/> <a href="https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/">https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/</a><br/> <a href="https://www.youtube.com/watch?v=rd7qP9FdTal">https://www.youtube.com/watch?v=rd7qP9FdTal</a><br/> <a href="https://www.youtube.com/watch?v=P5OBWbZDZlc">https://www.youtube.com/watch?v=P5OBWbZDZlc</a></p> |



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Parteneriate de cooperare în educația școlară

**Modelul pedagogic LearnSTEM**  
**Manualul de implementare a practicilor STEM**

Prof. Carp Monica Mihaela

Prof. Saiz Ana

Prof. Signeanu Gabriel

**COLEGIUL TEHNIC „HARALAMB VASILIU”**

**PODU ILOAIEI, IAȘI,**

**ROMÂNIA**

***Data:***  
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***Număr de referință:***  
**2022-1-TR01-KA220-SCH-000087583**



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## 1. Resursele de învățare

### 1.1. Unitatea de învățare 1- Colectarea și sortarea gunoiului

#### 1.1.1 Context

Colectarea și sortarea gunoaielor, în mod responsabil, contribuie la protejarea mediului înconjurător. Aceste practici reduc riscul de poluare a aerului, apei și a solului, precum și impactul negativ asupra ecosistemelor naturale și a biodiversității.

Prin colectarea și sortarea gunoaielor, este posibil să se identifice materialele care pot fi reciclate sau reutilizate. Aceasta înseamnă că o mare parte din deșeuri poate fi redirecționată către procese de reciclare sau compostare, evitând astfel să fie trimise la depozitele de gunoi.

Sortarea gunoaielor ajută la conservarea resurselor naturale precum lemnul, metalele, hârtia și plasticul. Materialele reciclabile identificate în timpul procesului de sortare pot fi recuperate și reintroduse în circuitul economic, reducând astfel necesitatea de a extrage și de a procesa noi resurse.

Această lecție nu numai că încurajează elevii să devină cetățeni responsabili, dar și să exploreze conexiunile și aplicațiile practice ale disciplinelor științifice, cum ar fi chimia, biologia și IT-ul.

Pentru a începe lecția, elevii vor fi împărțiți în două echipe și li se va explica sarcina lor. Profesorul va pregăti o masă cu mai multe coduri de reciclare printate, iar aceleași coduri vor fi prezente și pe o ruletă generată prin aplicația Wheel of Names. Fiecare echipă va trebui să rotească ruleta și, în funcție de simbolul de reciclare selectat, să găsească și să asocieze materialele corespunzătoare cu simbolul identic de pe masă. Timpul alocat pentru identificarea și poziționarea materialelor va fi de maxim 30 de secunde.

Înainte de începerea activității practice, elevii vor urmări un material video care va prezenta noțiuni teoretice despre colectarea și sortarea gunoiului, precum și un exemplu practic despre modul în care ar trebui să se desfășoare această activitate. Această material va facilita înțelegerea conceptelor de bază și va pregăti elevii pentru sarcinile practice.

Activitatea de identificare și sortare a materialelor reciclabile va fi urmată de o discuție în clasă despre importanța și impactul reciclării și sortării corecte a gunoiului. Elevii vor putea împărtăși experiențele lor și vor putea reflecta asupra modului în care aceste practici pot contribui la protejarea mediului înconjurător.

Pentru a întări cunoștințele dobândite, profesorul va prezenta elevilor și materiale video suplimentare de pe platforma YouTube, care vor îmbogăți înțelegerea și conștientizarea lor în legătură cu acest subiect.

Lecția se va încheia cu un chestionar pe platforma H5P, care va testa cunoștințele acumulate și va oferi elevilor oportunitatea de a-și evalua progresul și de a identifica eventualele lacune în înțelegerea lor.

Această lecție interdisciplinară și interactivă este concepută pentru a inspira și a educa elevii în legătură cu importanța reciclării și a sortării corecte a gunoiului, contribuind astfel la formarea unor cetățeni responsabili și conștienți de mediul înconjurător.



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### 1.1.2 Proiectarea activității didactice

| LearnSTEM Model pedagogic                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulul 1 Colectarea și sortarea gunoiului                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Scopul modului/unității de învățare</b>                                                                                                       | <b>Scopul acestui modul este de a evidenția importanța colectării și sortării gunoaielor, în mod corect, pentru protejarea mediului înconjurător, conservarea resurselor naturale și reducerea poluării, precum și pentru promovarea unei economii mai durabile și a unei societăți mai responsabile din punct de vedere ecologic.</b>                                                                                                                                                                                                                                                                                                                                       |
| <b>Durata</b>                                                                                                                                    | <b>50 minute</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Obiective</b>                                                                                                                                 | La sfârșitul orei, elevii vor fi capabili:<br>1 Să enumere cele 7 coduri SPI specifice materialelor din plastic;<br>2 Să identifice diferitele tipuri de materiale reciclabile și să le asocieze cu simbolurile de reciclare corespunzătoare.<br>3 Să dezvolte abilități practice și de gândire critică prin participarea activă la activități de identificare și sortare a materialelor reciclabile;<br>4 Să identifice și să propună soluții creative pentru gestionarea deșeurilor și pentru promovarea reciclării în comunitatea lor.                                                                                                                                    |
| <b>Resurse și materiale utilizate</b><br><br>(fișă de lucru, diagrame, fișe, videoclip didactic, fragment din cărți/manuale, hărți mentale etc.) | <ul style="list-style-type: none"><li>- Coduri printate;</li><li>- Laptop/Videoproiector;</li><li>- Materiale reciclabile colectate (Cutii din carton, plastic, aluminiu, pungi, sticle de plastic, sticlă, țevi PVC, cutii din metal etc.)</li><li>- Hârtie albă sau colorată;</li><li>- Obiecte de scris;</li><li>- Chestionar 5HP</li><li>- Material video didactic;</li><li>- Materiale video motivaționale adiționale;</li><li>- Prezentare Power Point;</li><li>- Aplicația Wheel of Names;</li></ul>                                                                                                                                                                  |
| <b>Desfășurarea activităților</b>                                                                                                                | Etapele de instruire pe care trebuie să le urmeze elevii:<br>Profesorul împarte clasa în două grupe și propune elevilor un concurs.<br>Va câștiga echipa care are cele mai multe asocieri corecte.<br>Etape:<br><ol style="list-style-type: none"><li>1. Vizionarea materialului didactic;</li><li>2. Împărțirea pe grupe a elevilor;</li><li>3. Colectarea gunoiului reciclabil;</li><li>4. Stabilirea regulilor jocului și demararea acestuia.</li><li>5. Identificarea tipului de gunoi reciclabil, în funcție de codul specific și poziționarea corespunzătoare a acestuia.</li><li>6. Stabilirea echipei câștigătoare.</li><li>7. Transmiterea feedback-ului.</li></ol> |



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|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Metode de învățare                   | <p>Lucrul în echipă</p> <p>Explicația</p> <p>Demonstrarea practică</p> <p>Discuții</p> <p>Problematizarea</p> <p>Brainstorming</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Metode de evaluare                   | <p>Chestionar 5HP</p> <p>Evaluare bazată pe realizări și rezultate practice;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Resurse<br>bibliografice/sitografice | <p><a href="https://dictionary.cambridge.org/dictionary/english/garbage">https://dictionary.cambridge.org/dictionary/english/garbage</a></p> <p><a href="https://www.ldoceonline.com/dictionary/garbage">https://www.ldoceonline.com/dictionary/garbage</a></p> <p><a href="https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage">https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage</a></p> <p><a href="https://www.roadrunnerwm.com/blog/history-of-garbage">https://www.roadrunnerwm.com/blog/history-of-garbage</a></p> <p><a href="https://ecoresources.net.au/why-is-waste-sorting-important/">https://ecoresources.net.au/why-is-waste-sorting-important/</a></p> <p><a href="https://wheelofnames.com">https://wheelofnames.com</a></p> <p><a href="https://www.youtube.com/watch?v=b-0eajX7Xlo">https://www.youtube.com/watch?v=b-0eajX7Xlo</a></p> <p><a href="https://www.youtube.com/watch?v=3Lzsu8SXaWY">https://www.youtube.com/watch?v=3Lzsu8SXaWY</a></p> |



## 1.2. Modulul 1 - Construirea unei balanțe

### 1.2.1. Context

Producția de materiale noi contribuie la poluarea aerului, apei și a solului prin emisiile de gaze cu efect de seră, substanțe chimice toxice și deșeuri periculoase. Reutilizarea produselor reciclabile ajută la reducerea acestei poluări prin evitarea producerii suplimentare de materiale și reciclarea cantităților de deșeuri.

Prin intermediul acestei lecții, nu numai că se demonstrează importanța reciclării și a gândirii sustenabile, ci se și stimulează creativitatea elevilor, oferindu-le libertatea de a-și proiecta și construi propria balanță în funcție de imaginația și preferințele lor.

Această lecție este concepută pentru a oferi elevilor o experiență educațională captivantă și interactivă, îmbinând creativitatea și cunoștințele STEM (Știință, Tehnologie, Inginerie și Matematică) pentru a promova învățarea și descoperirea. Prin intermediul unui material video inspirațional, elevii sunt invitați să exploreze procesul de creare a unei balanțe de măsurare folosind materiale reciclate, cum ar fi sticle de plastic, cutii de carton sau alte obiecte care altfel ar fi aruncate.

Pe lângă aspectul practic, lecția își propune să stimuleze gândirea critică și abilitățile de rezolvare a problemelor, oferind elevilor oportunitatea de a explora intersecțiile dintre inginerie, matematică, fizică și ecologie.

Prin provocarea lor de a proiecta și construi propriile balanțe, elevii vor învăța să identifice și să aplice conceptele matematice și științifice într-un context real și relevant pentru viața lor de zi cu zi.

De asemenea, lecția își propune să le ofere elevilor oportunitatea de a înțelege diferența dintre masa și greutate și de a descoperi unitățile de măsură asociate cu aceste concepte.

Pentru elevi, cunoașterea și promovarea importanței reutilizării produselor reciclabile sunt esențiale pentru educarea lor ecologică, dezvoltarea comportamentelor responsabile și contribuția la protejarea mediului înconjurător.

Pentru a întări importanța și relevanța subiectului abordat având ca punct de plecare în cadrul curriculumului - *Reciclarea*, ne-am propus să construim o balanță, în scop didactic, folosind materiale reciclabile.

În acest fel, lecția își propune să îi inspire pe elevi să devină cetățeni responsabili și să se implice activ în construirea unui viitor mai verde și mai durabil pentru toți.



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### 1.2.2. Proiectarea activității didactice

| LearnSTEM Model Pedagogic                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulul 2: Construirea unei balanțe                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Scopul modulului/unității de învățare                                                                                                 | Scopul acestui modul este de a evidenția importanța reutilizării materialelor reciclabile în vederea realizării unei balanțe didactice                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Timp                                                                                                                                  | 50 min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Obiective                                                                                                                             | La sfârșitul acestui modul, elevii vor fi capabili:<br>1 să definească conceptul de balanță;<br>2 să identifice materialele reciclabile necesare pentru construirea balanței;<br>3 să selecteze instrumentele necesare elaborării balanței;<br>4 să identifice unitățile de măsurare utilizate la cântărire;<br>5. să măsoare masa unui obiect utilizând balanța;<br>6. să identifice diferența dintre masă și greutate;                                                                                                                                                                                                         |
| Resurse și materiale utilizate<br>(fișă de lucru, diagrame, fișe, videoclip didactic, fragment din cărți/manuale, hărți mentale etc.) | <ul style="list-style-type: none"><li>- Cutii din carton;</li><li>- Sfoară;</li><li>- Sticle din plastic;</li><li>- Foarfece;</li><li>- Cutter;</li><li>- Ruletă;</li><li>- Bandă de lipit;</li><li>- Hârtie albă și colorată;</li><li>- Pahare din plastic și carton;</li><li>- Pixuri și creioane;</li><li>- Pistol de lipit cu silicon;</li><li>- Videoproiector/laptop;</li><li>- Material video didactic;</li><li>- Materiale video adiționale;</li><li>- Prezentare PPT;</li><li>- Chestionar H5P</li><li>- Cântar de bucătărie;</li><li>- Diferite materiale reciclabile (plastic, nasturi, dopuri, pungi ș.a.)</li></ul> |
| Desfășurarea activităților                                                                                                            | Se împarte clasa în grupe de câte 4 elevi aleși aleatoriu și se trasează sarcina de lucru: realizarea unei balanțe utilizând materialele reciclabile puse la dispoziție.<br>Timp de lucru: 40 minute.<br>Etapă de urmat:<br><ol style="list-style-type: none"><li>1. Vizionarea exemplului practic;</li><li>2. Identificarea materialelor reciclabile ce urmează a fi folosite în realizarea balanței;</li><li>3. Împărțirea pe grupe a elevilor;</li><li>4. Construirea balanței având ca model materialul video pus la dispoziție de profesor;</li></ol>                                                                       |



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|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                          | <ol style="list-style-type: none"> <li>5. Echilibrarea balanței folosind materiale reciclabile, după adăugarea obiectului etalon de către profesor în unul din cele două talere.</li> <li>6. Cântărirea obiectelor reciclate adăugate de elevi în cel de-al doilea teler rămas liber, cu scopul de a restabili echilibrul balanței.</li> <li>7. Realizarea clasamentului grupelor pe baza valorii obținute prin cântărirea obiectelor reciclate. Grupa câștigătoare este cea a cărei valoare obținută este cea mai apropiată de masa obiectului etalon.</li> <li>8. Transmiterea feedback-ului.</li> </ol>                                                                                                                                                                                                                         |
| <b>Metode de învățare</b>                | <p>Lucrul în echipă<br/>Cercetarea<br/>Demonstrarea practică<br/>Discuții<br/>Explicația<br/>Brainstorming<br/>Problematizarea<br/>Experimentul practic</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Metode de evaluare</b>                | <p>Chestionar H5P<br/>Evaluare bazată pe realizări și rezultate practice;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Resurse bibliografice/sitografice</b> | <p> <a href="http://www.amathsdictionaryforkids.com/qr/b/balanceScales.html">http://www.amathsdictionaryforkids.com/qr/b/balanceScales.html</a><br/> <a href="https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales">https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales</a><br/> <a href="https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/">https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/</a><br/> <a href="https://www.youtube.com/watch?v=_Z0X0yE8loc">https://www.youtube.com/watch?v=_Z0X0yE8loc</a><br/> <a href="https://www.youtube.com/watch?v=_J-DF5nYw7E&amp;t=72s">https://www.youtube.com/watch?v=_J-DF5nYw7E&amp;t=72s</a> </p> |



### 1.3. Unitatea de învățare 3 - Compostarea într-o sticlă și crearea unui compostor - refolosirea deșeurilor biodegradabile

#### 1.3.1. Context

Această lecție este concepută cu scopul de a educa elevii cu privire la importanța gestionării responsabile a deșeurilor și a reciclării, prin intermediul creării de compostoare din sticle de plastic. Prin realizarea acestor compostoare, elevii vor învăța nu doar să recicleze și să reutilizeze materialele din plastic, ci și să valorifice resturile menajere organice, cum ar fi coji de fructe și legume, resturi din bucătărie, frunze uscate, hârtie și alte materiale biodegradabile. În egală măsură, prin activitățile interactive și practice propuse, elevii vor învăța cum pot contribui la protejarea mediului înconjurător și la conservarea resurselor naturale.

Prima parte a lecției constă în prezentarea unui material video informativ care prezintă problemele legate de gestionarea incorectă a deșeurilor, inclusiv impactul negativ al arderii materialelor plastice sau depozitarea incorectă a acestora, lucruri care duc la poluarea mediului înconjurător.

Astfel, elevii vor înțelege consecințele acestor practici și vor fi motivați să găsească soluții alternative și sustenabile.

Tot în cadrul acestui material video, vor fi prezentate și exemple practice despre cum se poate realiza un compostor din sticle de plastic și vor fi evidențiate avantajele acestuia, precum și modul de realizare al compostului și beneficiile acestuia în grădinărit și agricultură.

În continuare, elevii vor fi împărțiți în echipe și li se va prezenta sarcina de a crea compostoare din sticle de plastic. Fiecare echipă va primi materialele necesare și va fi îndrumată de către profesor în procesul de construcție. Elevii vor fi încurajați să își folosească creativitatea și abilitățile practice pentru a realiza compostoare conform cerințelor.

Pe parcursul activității practice, elevii vor învăța despre procesul de compostare și vor înțelege beneficiile acestuia în producerea de îngrășământ natural pentru plante.

Compostul este o modalitate eficientă de a reduce deșeurile organice. Deoarece aproximativ 30-40% din deșeurile menajere sunt materiale organice care pot fi compostate, prin transformarea acestor deșeuri în compost, putem reduce volumul deșeurilor trimise la gropile de gunoi și, implicit, impactul negativ asupra mediului. Compostul este un îngrășământ organic bogat în substanțe nutritive esențiale pentru sol, cum ar fi azotul, fosforul și potasiul. De aceea, utilizarea compostului în grădinărit și agricultură poate reduce dependența de îngrășăminte chimice sintetice. Compostul oferă o sursă naturală și echilibrată de nutrienți pentru plante, contribuind la menținerea sănătății solului pe termen lung.

Pentru elevi, cunoașterea procesului de realizare a compostului este importantă deoarece îi educă în privința protejării mediului, a conservării resurselor naturale și a adoptării unui comportament responsabil și durabil în gestionarea deșeurilor.

Realizarea compostului poate fi o activitate practică și creativă pentru aceștia. Ei pot învăța să combine diferite materiale organice, să monitorizeze procesul de descompunere și să observe efectele pozitive ale compostului asupra plantelor și a solului.



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Învățând să realizeze compostul, elevii dezvoltă abilități practice și responsabilitate în gestionarea deșeurilor.

1.3.2. Proiectarea activității didactice

| <b>LearnSTEM Model Pedagogic</b>                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Modulul 3: Compostul în sticlă de plastic</b>                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Scopul modulului/unității de învățare</b>                                                                                                | <b>Scopul acestui modul este de a dezvolta elevilor abilități practice și responsabile în gestionarea deșeurilor, de a învăța să recicleze și să reutilizeze materialele organice în loc să le arunce la gunoi, promovând un comportament responsabil față de mediul înconjurător.</b>                                                                                                                                                                                                                                                                                                             |
| <b>Timp</b>                                                                                                                                 | <b>50 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Obiective</b>                                                                                                                            | La sfârșitul orei, elevii vor fi capabili:<br><br>1.Să definească compostul;<br>2.Să identifice tipurile de resturi menajere care pot fi utilizate pentru obținerea compostului;<br>3.Să-și confecționeze acasă propriul compostor.<br>4.Să cunoască importanța utilizării compostului și să exemplifice unde poate fi acesta folosit.<br>5.Să-și dezvolte abilități practice și de gândire creativă prin participarea activă la construirea compostoarelor folosind materiale reciclate.                                                                                                          |
| <b>Resurse și materiale utilizate</b><br>(fișă de lucru, diagrame, fișe, videoclip didactic, fragment din cărți/manuale, hărți mentale etc) | <ul style="list-style-type: none"><li>- Sticle de plastic;</li><li>- Resturi menajere organice (Frunze, resurse vegetale)</li><li>- Pământ;</li><li>- Apă;</li><li>- Bucăți din hârtie;</li><li>- Foarfece</li><li>- Bandă Adezivă;</li><li>- Material video didactic;</li><li>- Laptop/Videoproiector;</li><li>- Chestionar H5P;</li><li>- Materiale video adiționale;</li><li>- Prezentare Power Point;</li></ul>                                                                                                                                                                                |
| <b>Desfășurarea activităților</b>                                                                                                           | Etapele de instruire pe care trebuie să le urmeze elevii:<br>Se împarte clasa în grupe de câte 4 elevi aleși aleatoriu și se trasează sarcina de lucru: realizarea compostorului utilizând materialele puse la dispoziție de profesor și adăugarea materiei prime pentru obținerea compostului. Timp efectiv de lucru: 40 minute.<br>Etapă de urmat:<br><ol style="list-style-type: none"><li>1. Vizionarea exemplului practic;</li><li>2. Identificarea materialelor necesare realizării compostorului;</li><li>3. Împărțirea pe grupe a elevilor;</li><li>4. Realizarea compostorului;</li></ol> |





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|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                          | <p>5. Adăugarea materiei prime pentru obținerea compostului;</p> <p>După parcurgerea etapelor de mai sus, compostoarele vor fi plasate încât să poată beneficia de lumina primită de la razele soarelui. Evoluția compostului va fi vizibilă într-un interval cuprins între 3 până la 6 săptămâni.</p> <p>Astfel în continuare avem următoarele etape:</p> <p>6. Udarea compostului - zilnic ;</p> <p>7. Verificarea stării compostului și a modificărilor structurii.</p> <p>8. Folosirea corespunzătoare a compostului.</p> <p>9. Transmiterea feedback-ului.</p>                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Metode de învățare</b>                | <p>Lucrul pe grupe</p> <p>Cercetarea</p> <p>Explicația</p> <p>Discuții</p> <p>Problematizarea</p> <p>Demonstrarea practică</p> <p>Experimentul practic</p> <p>Proiectul de grup</p> <p>Brainstorming</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Metode de evaluare</b>                | <p>Chestionar 5HP</p> <p>Evaluare bazată pe realizări și rezultate practice</p> <p>Evaluare continuă prin observare</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Resurse bibliografice/sitografice</b> | <p><a href="https://dictionary.cambridge.org/dictionary/english/compost">https://dictionary.cambridge.org/dictionary/english/compost</a></p> <p><a href="https://www.collinsdictionary.com/dictionary/english/compost">https://www.collinsdictionary.com/dictionary/english/compost</a></p> <p><a href="https://www.oxfordlearnersdictionaries.com/definition/english/compost_1">https://www.oxfordlearnersdictionaries.com/definition/english/compost_1</a></p> <p><a href="https://www.carryoncomposting.com/142941469.html">https://www.carryoncomposting.com/142941469.html</a></p> <p><a href="https://www.nrdc.org/stories/composting-101#types">https://www.nrdc.org/stories/composting-101#types</a></p> <p><a href="https://www.youtube.com/watch?v=O4dl4YljMZk">https://www.youtube.com/watch?v=O4dl4YljMZk</a></p> <p><a href="https://www.youtube.com/watch?v=pi-vsJOaduk">https://www.youtube.com/watch?v=pi-vsJOaduk</a></p> |



## 1.4. Unitatea de învățare 4 - Upcycling - Refolosirea plasticului

### 1.4.1. Context

Această lecție captivantă și interactivă este concepută pentru a educa elevii despre upcycling - refolosirea plasticului și importanța acestei practici pentru mediu și pentru protejarea biodiversității.

Prin intermediul unui material video informativ, elevii vor înțelege cât de important este să dăm o nouă viață materialelor care nu ne mai sunt de folos, în loc să le aruncăm și să contribuim la poluarea mediului.

Lecția își propune să îmbine mai multe discipline, cum ar fi biologia și ingineria, pentru a oferi elevilor o perspectivă holistică asupra problemei plasticului și a impactului său asupra mediului și a sănătății umane. Elevii vor afla faptul că plasticul este extrem de periculos și nociv pentru întreaga umanitate, afectând negativ atât mediul înconjurător, cât și viața sălbatică, luând drept exemplu păsările maritime.

Cu milioane de păsări care mor anual din cauza ingerării plasticului, inclusiv microplasticului, este evident că este nevoie de acțiune urgentă. Upcyclingul este soluția salvatoare prin care putem transforma plasticul dintr-un dușman al păsărilor într-un aliat.

Astfel, elevii vor fi îndrumați să construiască hrănitore pentru păsări folosind materiale reciclabile și să le plaseze în locuri accesibile pentru a oferi hrană și adăpost acestor vietăți incredibile.

Elevii vor folosi materialele puse la dispoziție de către profesor și vor respecta indicațiile și cerințele impuse pentru construcția hrănitorelor. După ce hrănitorele vor fi poziționate, elevii le vor umple cu semințe și vor observa cu atenție dacă păsările vin să se hrănească, fotografiindu-le pentru a evidenția impactul pozitiv al acțiunilor lor.

Această lecție este importantă pentru elevi, deoarece îi educă în privința responsabilității față de mediu și îi încurajează să acționeze în mod proactiv pentru protejarea biodiversității. Prin intermediul upcyclingului, elevii învață că fiecare gest contează în lupta împotriva poluării și că pot avea un impact pozitiv asupra mediului prin acțiuni simple și sustenabile.

Reutilizarea ambalajelor din plastic poate fi și o modalitate de economisire a banilor. În loc să cumpărăm ambalaje noi de fiecare dată când avem nevoie de ele, putem reutiliza ambalajele existente, economisind astfel costurile asociate cu achiziționarea de noi ambalaje.

Reutilizarea ambalajelor din plastic poate stimula creativitatea și inovația. Oamenii pot găsi modalități inventive de a reutiliza ambalajele în alte scopuri decât cel inițial, cum ar fi creația de obiecte de artă, jucării sau articole de uz casnic.

Încurajarea reutilizării ambalajelor din plastic poate stimula creativitatea și inovația în rândul elevilor. Ei pot găsi modalități inventive de a transforma ambalajele în alte obiecte utile sau decorative, dezvoltând astfel abilități practice și creative.



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### 1.4.2. Proiectarea activităților didactice

| LearnSTEM Model pedagogic                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulul 4: Reutilizarea plasticului                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Scopul modulului/unității de învățare</b>                                                                                                | Scopul acestui modul este să încurajeze reutilizarea și upcyclingul materialelor, oferind elevilor nu doar oportunitatea de a contribui la protejarea mediului înconjurător, ci și de a dezvolta empatia și conștiința față de pericolele la care sunt expuse vietățile.                                                                                                                                                                                                                                                                             |
| <b>Timp</b>                                                                                                                                 | 50 min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Obiective</b>                                                                                                                            | <p>La sfârșitul orei, elevii vor fi capabili:</p> <ol style="list-style-type: none"> <li>1 Să definească upcycling-ul;</li> <li>2 Să identifice pericolele poluării cu particule din plastic;</li> <li>3 Să enumere pericolele la care sunt expuse păsările maritime.</li> <li>4 Să cunoască beneficiile upcycling-ului.</li> <li>5 Să dea exemple de păsări maritime care pot ingera plastic.</li> <li>6 Să-și dezvolte abilități practice și de gândire creativă prin participarea activă la construirea hrănilor pentru păsări</li> </ol>         |
| <b>Resurse și materiale utilizate</b><br>(fișă de lucru, diagrame, fișe, videoclip didactic, fragment din cărți/manuale, hărți mentale etc) | <ul style="list-style-type: none"> <li>- Sticle de plastic;</li> <li>- Foarfece;</li> <li>- Cutter;</li> <li>- Bandă adezivă;</li> <li>- Sfoară;</li> <li>- Sârmă;</li> <li>- Farfurii din plastic;</li> <li>- Hârtie albă și colorată;</li> <li>- Instrumente de scris;</li> <li>- Pistol de lipt cu silicon;</li> <li>- Bețe din lemn;</li> <li>- Șuruburi și piulițe;</li> <li>- Prezentare PowerPoint;</li> <li>- Material video;</li> <li>- Materiale video adiționale;</li> <li>- Chestionar 5HP;</li> <li>- Laptop/Videoproiector;</li> </ul> |
| <b>Desfășurarea activităților</b>                                                                                                           | <p>Etape de urmat:</p> <p>Se împarte clasa în grupe de câte 4 elevi aleși aleatoriu și se trasează sarcina de lucru: Construirea unor hrănilor pentru păsări utilizând materialele puse la dispoziție de către profesor.</p> <p>Timp de lucru: 40 minute</p> <ol style="list-style-type: none"> <li>1. Vizionarea materialului video;</li> <li>2. Împărțirea pe grupe a elevilor;</li> <li>3. Identificarea materialelor necesare pentru construirea hrănilor;</li> <li>4. Construirea hrănilor pentru păsări</li> </ol>                             |



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|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                          | <p>5. Prezentarea produsului realizat de către fiecare grupă și testarea conformității acestuia;</p> <p>După parcurgerea etapelor de mai sus, hrănitorele pentru păsări vor fi plasate în locuri vizibile astfel încât să poată fi accesibile păsărilor dar și ușor de observat. Supravegherea activității desfășurate în zona hrănitorei este de o oră pe zi timp de o săptămână.</p> <p>Astfel în continuare avem următoarele etape:</p> <p>6. Numărarea și identificarea păsărilor care vizitează hrănitorele;</p> <p>7. Fotografierea păsărilor care vizitează hrănitorele;</p> <p>8. Prezentarea rezultatelor obținute;</p> <p>9. Transmiterea feedback-ului.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Metode de învățare</b>                | <p>Lucrul pe grupe</p> <p>Cercetarea</p> <p>Explicația</p> <p>Discuții</p> <p>Problematizarea</p> <p>Experimentul practic</p> <p>Proiectul de grup</p> <p>Brainstorming</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Metode de evaluare</b>                | <p>Chestionar 5HP;</p> <p>Evaluare bazată pe realizări și rezultate practice;</p> <p>Evaluare continuă prin observare;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Resurse bibliografice/sitografice</b> | <p><a href="https://www.oxfordlearnersdictionaries.com/definition/english/upcycle">https://www.oxfordlearnersdictionaries.com/definition/english/upcycle</a></p> <p><a href="https://dictionary.cambridge.org/dictionary/english/upcycling">https://dictionary.cambridge.org/dictionary/english/upcycling</a></p> <p><a href="https://www.treehugger.com/what-is-upcycling-5116081">https://www.treehugger.com/what-is-upcycling-5116081</a></p> <p><a href="https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/">https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/</a></p> <p><a href="https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684">https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684</a></p> <p><a href="https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/">https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/</a></p> <p><a href="https://www.youtube.com/watch?v=rd7qP9FdTal">https://www.youtube.com/watch?v=rd7qP9FdTal</a></p> <p><a href="https://www.youtube.com/watch?v=P5OBWbZDZlc">https://www.youtube.com/watch?v=P5OBWbZDZlc</a></p> |



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ERASMUS+ KA220  
Kooperationspartnerschaften in der Schulbildung

**LearnSTEM**  
**Handbuch zur Umsetzung von MINT-Praktiken**

Monica Mihaela

Saiz Ana

Signeanu Gabriel

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**PODU ILOAIEI, IAȘI,**  
**ROMÂNIA**

***Datum:***  
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## 1 Lernressourcen

### 1.1 Lerneinheit - Müll sammeln und sortieren

#### 1.1.1 Hintergrund

Das verantwortungsvolle Sammeln und Sortieren von Müll trägt zum Schutz der Umwelt bei. Diese Praktiken verringern das Risiko der Luft-, Wasser- und Bodenverschmutzung sowie die negativen Auswirkungen auf natürliche Ökosysteme und die Artenvielfalt.

Durch das Sammeln und Sortieren von Müll ist es möglich, Materialien zu identifizieren, die recycelt oder wiederverwendet werden können. Dies bedeutet, dass eine große Menge an Abfall dem Recycling oder der Kompostierung zugeführt werden kann, wodurch Deponien vermieden werden können.

Die Mülltrennung trägt dazu bei, natürliche Ressourcen wie Holz, Metalle, Papier und Kunststoffe zu schonen. Wiederverwertbare Materialien, die bei der Sortierung identifiziert werden, können zurückgewonnen und der Wirtschaft zugeführt werden, wodurch die Notwendigkeit der Gewinnung und Verarbeitung neuer Ressourcen verringert wird.

Dieser Unterricht ermutigt die Schüler\*innen nicht nur, verantwortungsbewusste Bürger\*innen zu werden, sondern auch die Zusammenhänge und praktischen Anwendungen wissenschaftlicher Disziplinen wie Chemie, Biologie und Informatik zu erkunden.

Zu Beginn der Unterrichtsstunde werden die Schüler\*innen in zwei Teams aufgeteilt und ihre Aufgabe wird ihnen erklärt. Die Lehrkraft bereitet eine Tabelle mit verschiedenen gedruckten Recycling-Codes vor. Die gleichen Codes befinden sich auch auf einem Rouletterad, das von der Wheel of Names-App generiert wird. Jedes Team muss das Rouletterad drehen und je nach ausgewähltem Recyclingsymbol die entsprechenden Materialien mit dem identischen Symbol auf dem Tisch finden und zuordnen. Die Zeit, die für die Identifizierung und Zuordnung von Materialien zur Verfügung steht, beträgt maximal 30 Sekunden.

Bevor die Schüler\*innen mit der praktischen Tätigkeit beginnen, sehen sie sich ein Video an, in dem die theoretischen Konzepte der Müllsammlung und -sortierung sowie ein praktisches Beispiel für die Organisation dieser Tätigkeit vorgestellt werden. Dieses Material wird das Verständnis der grundlegenden Konzepte erleichtern und die Schüler\*innen auf die praktischen Aufgaben vorbereiten.

Nach der Identifizierung und Sortierung von Materialien für das Recycling folgt eine Diskussion in der Klasse über die Bedeutung und die Auswirkungen des Recyclings und der richtigen Mülltrennung. Die Schüler\*innen können ihre Erfahrungen austauschen und darüber nachdenken, wie diese Praktiken zum Schutz der Umwelt beitragen können.

Um das erworbene Wissen zu festigen, wird die Lehrkraft den Schüler\*innen zusätzliche Videos von der YouTube-Plattform zeigen, die ihr Verständnis und ihr Bewusstsein für das Thema erweitern.

Die Lektion wird mit einem H5P-Quiz abgeschlossen, in dem das erworbene Wissen getestet wird und das den Schüler\*innen die Möglichkeit gibt, ihre Fortschritte zu bewerten und mögliche Wissenslücken zu erkennen.



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Diese interdisziplinäre und interaktive Unterrichtseinheit soll die Schüler\*innen inspirieren und über die Bedeutung des Recyclings und der richtigen Mülltrennung aufklären und so dazu beitragen, verantwortungsvolle und umweltbewusste Bürger\*innen zu entwickeln.

### 1.1.2 Inhalt

| LearnSTEM                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modul 1: Müll sammeln und sortieren                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Ziel des Moduls/der Lerneinheit</b>                                                                                                                  | <b>Ziel dieses Moduls ist es, die Bedeutung des richtigen Sammelns und Trennens von Müll hervorzuheben, um die Umwelt zu schützen, die natürlichen Ressourcen zu erhalten und die Verschmutzung zu verringern sowie eine nachhaltigere Wirtschaft und eine umweltbewusstere Gesellschaft zu fördern.</b>                                                                                                                                                                                                                                                                                          |
| <b>Dauer</b>                                                                                                                                            | <b>50 Minuten</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Lernziele</b>                                                                                                                                        | Am Ende der Lektion werden die Schüler*innen in der Lage sein:<br>1 Die sieben SPI-Codes, die sich auf Kunststoffmaterialien beziehen zu benennen;<br>2 Die verschiedenen Arten von recycelbaren Materialien zu identifizieren und den entsprechenden Recyclingsymbolen zuzuordnen;<br>3 Praktische und kritische Denkfähigkeiten durch aktive Teilnahme an Aktivitäten zur Identifizierung und Sortierung von wiederverwertbaren Materialien zu entwickeln;<br>4 Kreative Lösungen für die Abfallbewirtschaftung und die Förderung des Recyclings in ihrer Gemeinde zu finden und vorzuschlagen. |
| <b>Erforderliche Ressourcen/Materialien</b><br>(Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.) | <ul style="list-style-type: none"> <li>- Gedruckte Codes;</li> <li>- Laptop/Videoprojektor;</li> <li>- Gesammelte wiederverwertbare Materialien (Kartons, Plastik, Aluminium, Säcke, Plastikflaschen, Glas, PVC-Rohre, Metallkisten, usw.)</li> <li>- Weißes oder farbiges Papier;</li> <li>- Objekte schreiben;</li> <li>- H5P-Quiz</li> <li>- Didaktisches Videomaterial;</li> <li>- Zusätzliches motivierendes Videomaterial;</li> <li>- Power Point Präsentation;</li> <li>- Wheel of Names-Anwendung;</li> </ul>                                                                             |
| <b>Verfahren</b>                                                                                                                                        | Die Unterrichtsschritte, die die Schüler*innen befolgen sollten:<br>Die Lehrkraft teilt die Klasse in zwei Gruppen auf und schlägt den Schüler*innen einen Wettbewerb vor.<br>Die Mannschaft mit den meisten richtigen Treffern gewinnt.<br>Schritte:<br>1. Das didaktische Material ansehen;<br>2. Teilen Sie die Schüler*innen in Gruppen ein;                                                                                                                                                                                                                                                  |



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|                                                                                                       | <p>3. Die Sammlung von wiederverwertbaren Abfällen;<br/> 4. Die Festlegung der Spielregeln und der Beginn des Spiels.<br/> 5. Die Art des wiederverwertbaren Mülls anhand des spezifischen Codes zu identifizieren und ihn entsprechend zu platzieren.<br/> 6. Die Bekanntgabe des Siegerteams.<br/> 7. Rückmeldung.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Methoden zur Vermittlung von Inhalten</b> (Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.) | <p>Gruppenarbeit<br/> Erläuterung<br/> Praktische Demonstration<br/> Diskussion<br/> Problematisierung<br/> Brainstorming</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Bewertungsmethode</b>                                                                              | <p>H5P-Quiz<br/> Bewertung auf der Grundlage von Leistungen und praktischen Ergebnissen</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Referenzen</b>                                                                                     | <p><a href="https://dictionary.cambridge.org/dictionary/english/garbage">https://dictionary.cambridge.org/dictionary/english/garbage</a><br/> <a href="https://www.ldoceonline.com/dictionary/garbage">https://www.ldoceonline.com/dictionary/garbage</a><br/> <a href="https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage">https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage</a><br/> <a href="https://www.roadrunnerwm.com/blog/history-of-garbage">https://www.roadrunnerwm.com/blog/history-of-garbage</a><br/> <a href="https://ecoresources.net.au/why-is-waste-sorting-important/">https://ecoresources.net.au/why-is-waste-sorting-important/</a><br/> <a href="https://wheelofnames.com">https://wheelofnames.com</a><br/> <a href="https://www.youtube.com/watch?v=b-0eajX7Xlo">https://www.youtube.com/watch?v=b-0eajX7Xlo</a><br/> <a href="https://www.youtube.com/watch?v=3Lzsu8SxaWY">https://www.youtube.com/watch?v=3Lzsu8SxaWY</a></p> |





## 1.2 Lerneinheit - Bau einer Waage

### 1.2.1 Hintergrund

Die Herstellung neuer Materialien trägt durch Emissionen von Treibhausgasen, giftigen Chemikalien und gefährlichen Abfällen zur Verschmutzung von Luft, Wasser und Boden bei. Die Wiederverwendung wiederverwertbarer Produkte trägt zur Verringerung dieser Verschmutzung bei, indem die Produktion zusätzlicher Materialien vermieden und die Abfallmenge recycelt wird.

Diese Lektion zeigt nicht nur, wie wichtig Recycling und nachhaltiges Denken sind, sondern regt auch die Kreativität der Schüler\*innen an, indem sie ihnen die Freiheit gibt, ihre eigene Waage nach ihren Vorstellungen und Vorlieben zu entwerfen und zu bauen.

Diese Lektion soll den Schüler\*innen eine fesselnde und interaktive Lernerfahrung bieten, die Kreativität und MINT-Wissen (Mathematik, Ingenieurwesen, Naturwissenschaften und Technologie) kombiniert, um das Lernen und Entdecken zu fördern. Anhand eines inspirierenden Videos werden die Schüler\*innen eingeladen, den Prozess der Herstellung einer Waage aus recycelten Materialien wie Plastikflaschen, Pappkartons oder anderen Gegenständen, die sonst weggeworfen würden, zu erkunden.

Neben dem praktischen Aspekt zielt der Unterricht darauf ab, das kritische Denken und die Problemlösungskompetenz zu fördern und den Schüler\*innen die Möglichkeit zu geben, die Schnittstellen zwischen Technik, Mathematik, Physik und Ökologie zu erkunden.

Durch die Herausforderung, ihre eigenen Waagen zu entwerfen und zu bauen, lernen die Schüler\*innen, mathematische und wissenschaftliche Konzepte in einem realen Kontext zu erkennen und anzuwenden, der für ihr tägliches Leben relevant ist.

Die Lektion soll den Schüler\*innen auch die Möglichkeit geben, den Unterschied zwischen Masse und Gewicht zu verstehen und die mit diesen Begriffen verbundenen Maßeinheiten zu entdecken.

Für die Schüler\*innen ist die Kenntnis und Förderung der Bedeutung der Wiederverwendung von wiederverwertbaren Produkten von wesentlicher Bedeutung für ihre Umwelterziehung, die Entwicklung eines verantwortungsvollen Verhaltens und den Beitrag zum Umweltschutz.

Um die Bedeutung und die Relevanz des behandelten Themas, ausgehend vom Lehrplan - Recycling - zu erhöhen, wird vorgeschlagen, zu Unterrichtszwecken eine Waage aus wiederverwertbaren Materialien zu bauen.

Auf diese Weise soll der Unterricht die Schüler\*innen dazu anregen, verantwortungsbewusste Bürger\*innen zu werden und sich aktiv für eine grünere und nachhaltigere Zukunft für alle einzusetzen.



## 1.2.2 Inhalt

| LearnSTEM                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modul 2: Bau einer Waage                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Ziel des Moduls/der Lerneinheit</b>                                                                                                                  | <b>Ziel dieses Moduls ist es, die Bedeutung der Wiederverwendung wiederverwertbarer Materialien hervorzuheben, um eine ausgewogene Waage zu schaffen.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Dauer</b>                                                                                                                                            | <b>50 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Lernziele</b>                                                                                                                                        | <p>Am Ende dieses Moduls werden die Schüler*innen in der Lage sein:</p> <ol style="list-style-type: none"> <li>1 Den Begriff der Waage zu definieren;</li> <li>2 Die wiederverwertbaren Materialien zu bestimmen, die zum Bau der Waage benötigt werden;</li> <li>3 Die für den Bau der Waage benötigten Werkzeuge auszuwählen;</li> <li>4 Die beim Wiegen verwendeten Maßeinheiten zu identifizieren;</li> <li>5. Die Masse eines Gegenstandes mit Hilfe der Waage zu messen;</li> <li>6. Den Unterschied zwischen Masse und Gewicht zu erkennen;</li> </ol>                                                                                        |
| <b>Erforderliche Ressourcen/Materialien</b><br>(Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.) | <ul style="list-style-type: none"> <li>- Pappkartons;</li> <li>- Zeichenfolge;</li> <li>- Plastikflaschen;</li> <li>- Schere;</li> <li>- Schneidegerät;</li> <li>- Maßband;</li> <li>- Klebeband;</li> <li>- Weißes und farbiges Papier;</li> <li>- Plastik- und Pappbecher;</li> <li>- Stifte und Bleistifte;</li> <li>- Silikon-Klebepistole;</li> <li>- Videoprojektor/Laptop;</li> <li>- Videomaterial zur Unterweisung;</li> <li>- Zusätzliches Videomaterial;</li> <li>- PPT-Präsentation;</li> <li>- H5P-Quiz</li> <li>- Küchenwaage;</li> <li>- Verschiedene wiederverwertbare Materialien (Plastik, Knöpfe, Stopfen, Tüten usw.)</li> </ul> |
| <b>Verfahren</b>                                                                                                                                        | <p>Die Klasse wird in Gruppen von 4 Schüler*innen aufgeteilt, die nach dem Zufallsprinzip ausgewählt werden, und erhält die Aufgabe, eine Waage aus den bereitgestellten wiederverwertbaren Materialien herzustellen.</p> <p>Bearbeitungszeit: 40 Minuten.</p> <p>Folgende Schritte sind zu beachten:</p> <ol style="list-style-type: none"> <li>1. Sehen Sie sich das praktische Beispiel an;</li> <li>2. Die wiederverwertbaren Materialien bestimmen, die für die Herstellung der Waage verwendet werden sollen;</li> <li>3. Teilen Sie die Schüler*innen in Gruppen ein;</li> </ol>                                                              |



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|                                                                                                       | <p>4. Den Bau der Waage anhand des von der Lehrkraft zur Verfügung gestellten Videomaterials als Modell;</p> <p>5. Die Waage mit wiederverwertbaren Materialien ausbalancieren, nachdem die Lehrkraft das Standardobjekt in eine der beiden Schalen gelegt hat.</p> <p>6. Wiegen der recycelten Gegenstände, die von den Schüler*innen in die zweite freie Schale gelegt wurden, um das Gleichgewicht der Waage wiederherzustellen.</p> <p>7. Die Rangfolge der Gruppen auf der Grundlage des durch das Wiegen der recycelten Gegenstände erhaltenen Wertes. Gewonnen hat die Gruppe, deren Wert der Masse des Standardobjekts am nächsten kommt.</p> <p>8. Rückmeldung.</p>                                                                                                                                                         |
| <b>Methoden zur Vermittlung von Inhalten</b> (Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.) | <p>Teamarbeit</p> <p>Forschung</p> <p>Praktische Demonstration</p> <p>Diskussionen</p> <p>Erläuterung</p> <p>Brainstorming</p> <p>Problematisierung</p> <p>Praktisches Experiment</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Bewertungsmethode</b>                                                                              | <p>H5P-Quiz</p> <p>Bewertung auf der Grundlage von Leistungen und praktischen Ergebnissen</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Referenzen</b>                                                                                     | <p><a href="http://www.amathsdictionaryforkids.com/gr/b/balanceScales.html">http://www.amathsdictionaryforkids.com/gr/b/balanceScales.html</a></p> <p><a href="https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales">https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales</a></p> <p><a href="https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/">https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/</a></p> <p><a href="https://www.youtube.com/watch?v=Z0X0yE8loc">https://www.youtube.com/watch?v=Z0X0yE8loc</a></p> <p><a href="https://www.youtube.com/watch?v=J-DF5nYw7E&amp;t=72s">https://www.youtube.com/watch?v=J-DF5nYw7E&amp;t=72s</a></p> |



### 1.3 Lerneinheit 3 - Kompostierung in einer Flasche und Bau eines Komposters -

#### Wiederverwendung von biologisch abbaubaren Abfällen

##### 1.3.1. Hintergrund

Diese Unterrichtseinheit soll den Schüler\*innen die Bedeutung einer verantwortungsvollen Abfallwirtschaft und des Recyclings durch die Herstellung von Kompostern aus Plastikflaschen näher bringen. Durch den Bau dieser Komposter lernen die Schüler\*innen nicht nur, wie man Plastik recycelt und wiederverwendet, sondern auch, wie man organische Haushaltsabfälle wie Obst- und Gemüseschalen, Küchenabfälle, getrocknete Blätter, Papier und andere biologisch abbaubare Materialien recycelt. Durch die vorgeschlagenen interaktiven und praktischen Aktivitäten werden die Schüler\*innen auch lernen, wie sie zum Schutz der Umwelt und zur Erhaltung der natürlichen Ressourcen beitragen können.

Im ersten Teil der Lektion wird ein informatives Video gezeigt, das die Probleme der unsachgemäßen Abfallentsorgung aufzeigt, einschließlich der negativen Auswirkungen der Verbrennung von Kunststoffen oder der unsachgemäßen Entsorgung, die zu Umweltverschmutzung führt.

Auf diese Weise werden die Schüler\*innen die Folgen dieser Praktiken verstehen und motiviert werden, alternative und nachhaltige Lösungen zu finden.

Außerdem werden in diesem Video praktische Beispiele für den Bau eines Komposters aus Plastikflaschen vorgestellt und seine Vorteile hervorgehoben sowie die Herstellung von Kompost und seine Vorteile für den Gartenbau und die Landwirtschaft erläutert.

Anschließend werden die Schüler\*innen in Gruppen eingeteilt und erhalten die Aufgabe, Komposter aus Plastikflaschen zu bauen. Jedes Team erhält die notwendigen Materialien und wird von der Lehrkraft durch den Bauprozess geführt. Die Schüler\*innen werden ermutigt, ihre Kreativität und ihr praktisches Geschick einzusetzen, um die Komposter entsprechend den Anforderungen zu bauen.

Während der praktischen Tätigkeit lernen die Schüler\*innen den Kompostierungsprozess kennen und verstehen dessen Vorteile bei der Herstellung von natürlichem Dünger für Pflanzen.

Die Kompostierung ist eine wirksame Methode zur Verringerung organischer Abfälle. Da etwa 30-40 % der Haushaltsabfälle aus kompostierbarem organischem Material bestehen, können wir durch die Kompostierung dieser Abfälle die Menge der auf Deponien entsorgten Abfälle und damit die negativen Auswirkungen auf die Umwelt verringern. Kompost ist ein organischer Dünger, der reich an wichtigen Bodennährstoffen wie Stickstoff, Phosphor und Kalium ist. Daher kann die Verwendung von Kompost in Garten und Landwirtschaft die Abhängigkeit von chemisch-synthetischen Düngemitteln verringern. Kompost ist eine natürliche und ausgewogene Quelle für Pflanzennährstoffe und trägt dazu bei, die Gesundheit des Bodens langfristig zu erhalten.



Für die Schüler\*innen ist es wichtig, etwas über den Kompostierungsprozess zu lernen, weil sie dadurch lernen, die Umwelt zu schützen, die natürlichen Ressourcen zu erhalten und ein verantwortungsvolles und nachhaltiges Abfallmanagement zu betreiben.

Das Kompostieren kann für sie eine praktische und kreative Tätigkeit sein. Sie können lernen, verschiedene organische Materialien zu kombinieren, den Zersetzungsprozess zu überwachen und die positiven Auswirkungen von Kompost auf Pflanzen und Boden zu beobachten.

Durch das Erlernen des Kompostierens entwickeln die Schüler\*innen praktische Fähigkeiten und Verantwortung in der Abfallwirtschaft.

### 1.3.2. Inhalt

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modul 3: Kompostierung in einer Flasche und Bau eines Komposters - Wiederverwendung von biologisch abbaubaren Abfällen                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Ziel des Moduls/der Lerneinheit</b>                                                                                                                      | <b>Ziel dieses Moduls ist es, die Fähigkeiten der Schüler*innen im verantwortungsvollen und praktischen Umgang mit Abfällen zu entwickeln, zu lernen, wie organische Materialien recycelt und wiederverwendet werden können, anstatt sie wegzuerwerfen, und umweltbewusstes Verhalten zu fördern.</b>                                                                                                                                                                                                                      |
| <b>Dauer</b>                                                                                                                                                | <b>50 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Lernziele</b>                                                                                                                                            | Am Ende des Kurses werden die Schüler*innen in der Lage sein:<br>1. Kompost zu definieren;<br>2. Die Arten von Haushaltsabfällen zu identifizieren, die für die Kompostierung verwendet werden können;<br>3. Einen eigenen Komposter zu Hause zu bauen;<br>4. Wissen, wie wichtig die Verwendung von Kompost ist, und können Beispiele dafür nennen, wo er verwendet werden kann;<br>5) Praktische und kreative Denkfähigkeiten durch die aktive Teilnahme am Bau von Kompostern aus recycelten Materialien zu entwickeln. |
| <b>Erforderliche Ressourcen/Materialien</b><br><br>(Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.) | <ul style="list-style-type: none"> <li>- Plastikflaschen;</li> <li>- Organische Haushaltsabfälle (Laub, Pflanzenreste);</li> <li>- Boden;</li> <li>- Wasser;</li> <li>- Ein Stück Papier;</li> <li>- Schere;</li> <li>- Klebeband;</li> <li>- Videomaterial zur Unterweisung;</li> <li>- Laptop/Videoprojektor;</li> <li>- H5P-Quiz;</li> <li>- Zusätzliches Videomaterial;</li> <li>- Power Point Präsentation.</li> </ul>                                                                                                |



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| <b>Verfahren</b>                                                                                      | <p>Die Schritte, die die Schüler*innen befolgen müssen:<br/>Teilen Sie die Klasse in 4 zufällig ausgewählte Gruppen auf und geben Sie die Arbeitsaufgabe vor: Bauen Sie den Komposter mit den von der Lehrkraft bereitgestellten Materialien und fügen Sie das Rohmaterial hinzu, um den Kompost herzustellen. Tatsächliche Arbeitszeit: 40 Minuten.<br/>Folgende Schritte sind zu beachten:</p> <ol style="list-style-type: none"> <li>1. Sehen Sie sich das praktische Beispiel an;</li> <li>2. Die für den Bau des Komposters benötigten Materialien zu bestimmen;</li> <li>3. Teilen Sie die Schüler*innen in Gruppen ein;</li> <li>4. Herstellung des Komposters;</li> <li>5. Die Zugabe des Rohmaterials, um den Kompost zu erhalten.</li> </ol> <p>Sobald die oben genannten Schritte abgeschlossen sind, werden die Komposter so aufgestellt, dass sie von der Sonneneinstrahlung profitieren können. Die Entwicklung des Komposts wird innerhalb von 3 bis 6 Wochen sichtbar sein. Daraus ergeben sich die folgenden Schritte:</p> <ol style="list-style-type: none"> <li>1. die Bewässerung des Komposts - täglich;</li> <li>2. die Überprüfung des Zustands des Komposts und der Veränderungen in der Struktur.</li> <li>3. ordnungsgemäße Verwendung von Kompost.</li> <li>4. ein Feedback zu geben.</li> </ol> |
| <b>Methoden zur Vermittlung von Inhalten</b> (Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.) | <p>Gruppenarbeit<br/>Forschung<br/>Erläuterung<br/>Diskussion<br/>Problemmatisierung<br/>Praktische Demonstration<br/>Praktisches Experiment<br/>Gruppenprojekt<br/>Brainstorming</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Bewertungsmethode</b>                                                                              | <p>5HP-Quiz<br/>Bewertung auf der Grundlage von Leistungen und praktischen Ergebnissen<br/>Kontinuierliche Bewertung durch Beobachtung</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Referenzen</b>                                                                                     | <p><a href="https://dictionary.cambridge.org/dictionary/english/compost">https://dictionary.cambridge.org/dictionary/english/compost</a><br/> <a href="https://www.collinsdictionary.com/dictionary/english/compost">https://www.collinsdictionary.com/dictionary/english/compost</a><br/> <a href="https://www.oxfordlearnersdictionaries.com/definition/english/compost_1">https://www.oxfordlearnersdictionaries.com/definition/english/compost_1</a><br/> <a href="https://www.carryoncomposting.com/142941469.html">https://www.carryoncomposting.com/142941469.html</a><br/> <a href="https://www.nrdc.org/stories/composting-101#types">https://www.nrdc.org/stories/composting-101#types</a><br/> <a href="https://www.youtube.com/watch?v=O4dl4YlJMZk">https://www.youtube.com/watch?v=O4dl4YlJMZk</a><br/> <a href="https://www.youtube.com/watch?v=pi-vsJOaduk">https://www.youtube.com/watch?v=pi-vsJOaduk</a></p>                                                                                                                                                                                                                                                                                                                                                                                              |



## 1.4. Lerneinheit 4 - Upcycling - Wiederverwendung von Plastik

### 1.4.1. Hintergrund

Diese fesselnde und interaktive Lektion soll die Schüler\*innen über Upcycling - die Wiederverwendung von Plastik - und die Bedeutung dieser Praxis für die Umwelt und den Schutz der Artenvielfalt aufklären.

Anhand eines informativen Videos werden die Schüler\*innen verstehen, wie wichtig es ist, Materialien, die nicht mehr brauchbar sind, ein neues Leben zu geben, anstatt sie wegzuworfen und zur Umweltverschmutzung beizutragen.

Die Lektion zielt darauf ab, verschiedene Disziplinen wie Biologie und Technik zu kombinieren, um den Schüler\*innen eine ganzheitliche Perspektive auf das Thema Plastik und seine Auswirkungen auf die Umwelt und die menschliche Gesundheit zu vermitteln. Die Schüler\*innen lernen, dass Plastik extrem gefährlich und schädlich für die gesamte Menschheit ist und sich negativ auf die Umwelt und die Tierwelt auswirkt, zum Beispiel auf Seevögel.

Angesichts der Tatsache, dass jedes Jahr Millionen von Vögeln durch das Verschlucken von Plastik, einschließlich Mikroplastik, sterben, ist klar, dass dringend gehandelt werden muss. Upcycling ist die lebensrettende Lösung, die Plastik von einem Feind der Vögel zu einem Verbündeten machen kann.

Die Schüler\*innen werden angeleitet, aus wiederverwertbaren Materialien Vogelfutterhäuschen zu bauen und sie an zugänglichen Orten aufzustellen, um diesen unglaublichen Lebewesen Nahrung und Schutz zu bieten.

Die Schüler\*innen verwenden die von der Lehrkraft bereitgestellten Materialien und befolgen die Anweisungen und Anforderungen für den Bau der Futterhäuschen. Sobald die Futterhäuschen aufgestellt sind, füllen die SchülerInnen sie mit Samen und beobachten sorgfältig, ob die Vögel zum Füttern kommen und fotografieren sie, um die positiven Auswirkungen ihres Handelns hervorzuheben.

Diese Lektion ist für die Schüler\*innen wichtig, da sie sie über die Verantwortung für die Umwelt aufklärt und sie ermutigt, proaktiv zu handeln, um die Artenvielfalt zu schützen. Durch Upcycling lernen die Schüler\*innen, dass jede Geste im Kampf gegen die Umweltverschmutzung zählt und dass sie durch einfache und nachhaltige Maßnahmen einen positiven Einfluss auf die Umwelt haben können.

Die Wiederverwendung von Kunststoffabfällen kann auch eine Möglichkeit sein, Geld zu sparen. Anstatt jedes Mal neue Behälter zu kaufen, wenn wir sie brauchen, können wir vorhandene Behälter wiederverwenden und so die Kosten für den Kauf neuer Behälter sparen.

Die Wiederverwendung von Kunststoff kann Kreativität und Innovation anregen. Menschen können erfinderische Wege finden, um Kunststoffbehälter für andere Zwecke als ihren ursprünglichen Zweck wiederzuverwenden, z. B. für die Herstellung von Kunst, Spielzeug oder Haushaltsgegenständen.





Die Förderung der Wiederverwendung von Kunststoffabfällen kann die Kreativität und Innovation der Schüler\*innen anregen. Sie können erfinderische Wege finden, um Behälter in andere nützliche oder dekorative Gegenstände umzuwandeln und so praktische und kreative Fähigkeiten entwickeln.

#### 1.4.2. Inhalt

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modul 4: Upcycling - Wiederverwendung von Kunststoffen                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Ziel des Moduls/der Lerneinheit</b>                                                                                                                      | Ziel dieses Moduls ist es, die Wiederverwendung und das Upcycling von Materialien zu fördern und den Schüler*innen nicht nur die Möglichkeit zu geben, einen Beitrag zum Umweltschutz zu leisten, sondern auch Empathie und Bewusstsein für die Gefahren zu entwickeln, denen Lebewesen ausgesetzt sind.                                                                                                                                                                                                                                                      |
| <b>Dauer</b>                                                                                                                                                | 50 min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Lernziele</b>                                                                                                                                            | Am Ende der Lektion werden die Schüler*innen in der Lage sein<br>1 Upcycling zu definieren;<br>2 Die Gefahren, die mit der Verschmutzung durch Plastikpartikel verbunden sind zu nennen;<br>3 Die Gefahren aufzuzählen, denen Seevögel ausgesetzt sind;<br>4 Die Vorteile von Upcycling zu kennen;<br>5 Beispiele für Seevögel, die Plastik verschlucken können, zu nennen;<br>6 Praktische und kreative Denkfähigkeiten, indem Sie sich aktiv am Bau von Vogelfutterhäuschen beteiligen, zu entwickeln.                                                      |
| <b>Erforderliche Ressourcen/Materialien</b><br><br>(Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.) | <ul style="list-style-type: none"> <li>- Plastikflaschen;</li> <li>- Schere;</li> <li>- Schneidegerät;</li> <li>- Klebeband;</li> <li>- Zeichenfolge;</li> <li>- Draht;</li> <li>- Kunststoffplatten;</li> <li>- Weißes und farbiges Papier;</li> <li>- Schreibgeräte;</li> <li>- Silikon-Klebepistole;</li> <li>- Hölzerne Stöcke;</li> <li>- Schrauben und Muttern;</li> <li>- PowerPoint-Präsentation;</li> <li>- Videomaterial zur Unterweisung;</li> <li>- Zusätzliches Videomaterial;</li> <li>- H5P-Quiz;</li> <li>- Laptop/Videoprojektor;</li> </ul> |
| <b>Verfahren</b>                                                                                                                                            | Folgende Schritte sind zu beachten:<br>Teilen Sie die Klasse in 4 zufällig ausgewählte Gruppen auf und stellen Sie die Arbeitsaufgabe: Bauen Sie mit den von der                                                                                                                                                                                                                                                                                                                                                                                              |





## LearnSTEM

### Innovatives Modell für MINT-Unterricht in Sekundarschulen



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|                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                       | <p>Lehrkraft bereitgestellten Materialien ein Vogelfutterhaus.<br/>Bearbeitungszeit: 40 Minuten</p> <ol style="list-style-type: none"> <li>1. Das Videomaterial ansehen;</li> <li>2. Teilen Sie die Schüler*innen in Gruppen ein;</li> <li>3. Die für den Bau der Futterautomaten benötigten Materialien bestimmen;</li> <li>4. Den Bau von Vogelfutterhäuschen</li> <li>5. Die Präsentation des von jeder Gruppe hergestellten Produkts und die Prüfung seiner Konformität.</li> </ol> <p>Nachdem Sie die vorangegangenen Schritte befolgt haben, sollten die Futterhäuschen an einem gut sichtbaren Ort aufgestellt werden, so dass sie für die Vögel zugänglich und leicht zu sehen sind. Die Überwachung der Aktivitäten im Bereich der Futterstelle beträgt eine Stunde pro Tag für eine Woche.</p> <p>Als nächstes folgen die folgenden Schritte:</p> <ol style="list-style-type: none"> <li>1. Das Zählen und Bestimmen der Vögel, die die Futterstellen besuchen;</li> <li>2. Das Fotografieren der Vögel, die die Futterstellen besuchen;</li> <li>3. Die Präsentation der Ergebnisse;</li> <li>4. Ein Feedback geben.</li> </ol>                                                                                                                      |
| <b>Methoden zur Vermittlung von Inhalten</b> (Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.) | <p>Arbeit in Gruppen<br/>Forschung<br/>Erläuterung<br/>Diskussion<br/>Problematisierung<br/>Praktisches Experiment<br/>Gruppenprojekt<br/>Brainstorming</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Bewertungsmethode</b>                                                                              | <p>H5P-Quiz;<br/>Bewertung auf der Grundlage von praktischen Leistungen und Ergebnissen;<br/>Kontinuierliche Bewertung durch Beobachtung</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Referenzen</b>                                                                                     | <p><a href="https://www.oxfordlearnersdictionaries.com/definition/english/upcycle">https://www.oxfordlearnersdictionaries.com/definition/english/upcycle</a><br/> <a href="https://dictionary.cambridge.org/dictionary/english/upcycling">https://dictionary.cambridge.org/dictionary/english/upcycling</a><br/> <a href="https://www.treehugger.com/what-is-upcycling-5116081">https://www.treehugger.com/what-is-upcycling-5116081</a><br/> <a href="https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/">https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/</a><br/> <a href="https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684">https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684</a><br/> <a href="https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/">https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/</a><br/> <a href="https://www.youtube.com/watch?v=rd7qP9FdTal">https://www.youtube.com/watch?v=rd7qP9FdTal</a><br/> <a href="https://www.youtube.com/watch?v=P5OBWbZDZlc">https://www.youtube.com/watch?v=P5OBWbZDZlc</a></p> |



**Imparare le STEM**  
Modello innovativo di apprendimento delle materie STEM  
nelle scuole secondarie



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**Imparare le STEM**  
*Modello innovativo di apprendimento delle materie  
STEM  
nelle scuole secondarie*

ERASMUS+ KA220  
Cooperazione Partenariati nell'istruzione scolastica

**Modello pedagogico LearnSTEM**  
**Manuale di implementazione delle pratiche  
STEM**

Carpa Monica Mihaela

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Signeanu Gabriel

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**ROMANIA**

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28.03.2024

***Numero di riferimento:***  
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# Imparare le STEM

## Modello innovativo di apprendimento delle materie STEM nelle scuole secondarie



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## 1 Risorse didattiche

### 1.1 Unità didattica - Raccogliere e differenziare i rifiuti

#### 1.1.1 Sfondo

Raccogliere e differenziare i rifiuti in modo responsabile contribuisce a proteggere l'ambiente. Queste pratiche riducono il rischio di inquinamento dell'aria, dell'acqua e del suolo, nonché l'impatto negativo sugli ecosistemi naturali e sulla biodiversità.

Attraverso la raccolta e la differenziazione dei rifiuti, è possibile identificare i materiali che possono essere riciclati o riutilizzati. Ciò significa che una grande quantità di rifiuti può essere dirottata verso processi di riciclaggio o compostaggio, evitando le discariche.

La raccolta differenziata aiuta a preservare le risorse naturali come legno, metalli, carta e plastica. I materiali riciclabili identificati durante il processo di differenziazione possono essere recuperati e restituiti all'economia, riducendo la necessità di estrarre e lavorare nuove risorse.

Questa lezione non solo incoraggia gli studenti a diventare cittadini responsabili, ma anche a esplorare le connessioni e le applicazioni pratiche di discipline scientifiche come la chimica, la biologia e l'informatica.

Per iniziare la lezione, gli studenti verranno divisi in due squadre e verrà spiegato loro il compito. L'insegnante preparerà una tabella con diversi codici di riciclaggio stampati e gli stessi codici saranno presenti anche su una roulette generata dall'applicazione Wheel of Names. Ogni squadra dovrà girare la roulette e, a seconda del simbolo di riciclaggio selezionato, dovrà trovare e abbinare i materiali corrispondenti con l'identico simbolo sulla tabella. Il tempo concesso per individuare e abbinare i materiali sarà di massimo 30 secondi.

Prima di iniziare l'attività pratica, gli studenti guarderanno un video che presenterà le nozioni teoriche sulla raccolta e l'ordinamento dei rifiuti e un esempio pratico di come dovrebbe essere organizzata questa attività. Questo materiale faciliterà la comprensione dei concetti di base e preparerà gli studenti alle attività pratiche.

L'attività di identificazione e selezione dei materiali da riciclare sarà seguita da una discussione in classe sull'importanza e l'impatto del riciclaggio e della corretta selezione dei rifiuti. Gli studenti potranno condividere le loro esperienze e riflettere su come queste pratiche possano aiutare a proteggere l'ambiente.

Per consolidare le conoscenze acquisite, l'insegnante presenterà agli studenti ulteriori video dalla piattaforma YouTube, che aumenteranno la loro comprensione e consapevolezza dell'argomento.

La lezione si concluderà con un quiz H5P, che verificherà le conoscenze acquisite e darà agli studenti l'opportunità di valutare i loro progressi e di identificare eventuali lacune nelle loro conoscenze.



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Questa lezione interdisciplinare e interattiva è stata progettata per ispirare ed educare gli studenti sull'importanza del riciclaggio e della corretta differenziazione dei rifiuti, contribuendo così a sviluppare cittadini responsabili e attenti all'ambiente.

#### 1.1.2 Contenuto

| Modello pedagogico LearnSTEM                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulo 1: Raccogliere e smistare i rifiuti                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Obiettivo del modulo/unità di apprendimento</b>                                                                                            | L'obiettivo di questo modulo è quello di evidenziare l'importanza di raccogliere e differenziare correttamente i rifiuti per proteggere l'ambiente, conservare le risorse naturali e ridurre l'inquinamento, oltre che per promuovere un'economia più sostenibile e una società più responsabile dal punto di vista ambientale.                                                                                                                                                                                                                         |
| <b>Durata</b>                                                                                                                                 | 50 minuti                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Obiettivi di apprendimento</b>                                                                                                             | Al termine della lezione, gli studenti saranno in grado di:<br>1 Indicare i sette codici SPI specifici per i materiali plastici;<br>2 Identificare i diversi tipi di materiali riciclabili e associarli ai corrispondenti simboli di riciclaggio.<br>3 Sviluppare capacità pratiche e di pensiero critico attraverso la partecipazione attiva ad attività di identificazione e selezione di materiali riciclabili;<br>4 Identificare e proporre soluzioni creative per la gestione dei rifiuti e la promozione del riciclaggio nella propria comunità.  |
| <b>Risorse e materiali necessari</b><br>(fogli di lavoro, grafici, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"><li>- Codici stampati;</li><li>- Computer portatile/videoproiettore;</li><li>- Materiali riciclabili raccolti (scatole di cartone, plastica, alluminio, sacchetti, bottiglie di plastica, vetro, tubi in PVC, scatole di metallo, ecc.)</li><li>- Carta bianca o colorata;</li><li>- Oggetti di scrittura;</li><li>- Quiz 5HP</li><li>- Materiale video didattico;</li><li>- Materiale video motivazionale aggiuntivo;</li><li>- Presentazione in Power Point;</li><li>- Applicazione della Ruota dei nomi;</li></ul> |
| <b>Procedura</b>                                                                                                                              | Le fasi didattiche che gli studenti devono seguire:<br>L'insegnante divide la classe in due gruppi e propone agli studenti una gara.<br>Vincerà la squadra con il maggior numero di corrispondenze corrette.<br>Passi:<br>1. Visualizzare il materiale didattico;<br>2. Dividere gli studenti in gruppi;<br>3. Raccolta di rifiuti riciclabili;<br>4. Stabilire le regole del gioco e iniziare la partita.                                                                                                                                              |



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|                                                                                                    | <p>5. Identificare il tipo di rifiuti riciclabili in base al codice specifico e posizzarli in modo appropriato.</p> <p>6. Annuncio della squadra vincitrice.</p> <p>7. Feedback.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Metodi di erogazione dei contenuti</b> (lezioni, discussioni, ricerche, lavori di gruppo, ecc.) | <p>Lavoro di gruppo</p> <p>Spiegazione</p> <p>Dimostrazione pratica</p> <p>Discussione</p> <p>Problematizzazione</p> <p>Brainstorming</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Metodo di valutazione</b>                                                                       | <p>Quiz 5HP</p> <p>Valutazione basata sui risultati ottenuti e sui risultati pratici;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Riferimenti</b>                                                                                 | <p><a href="https://dictionary.cambridge.org/dictionary/english/garbage">https://dictionary.cambridge.org/dictionary/english/garbage</a></p> <p><a href="https://www.ldoceonline.com/dictionary/garbage">https://www.ldoceonline.com/dictionary/garbage</a></p> <p><a href="https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage">https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage</a></p> <p><a href="https://www.roadrunnerwm.com/blog/history-of-garbage">https://www.roadrunnerwm.com/blog/history-of-garbage</a></p> <p><a href="https://ecoresources.net.au/why-is-waste-sorting-important/">https://ecoresources.net.au/why-is-waste-sorting-important/</a></p> <p><a href="https://wheelofnames.com">https://wheelofnames.com</a></p> <p><a href="https://www.youtube.com/watch?v=b-0eajX7Xlo">https://www.youtube.com/watch?v=b-0eajX7Xlo</a></p> <p><a href="https://www.youtube.com/watch?v=3Lzsu8SXaWY">https://www.youtube.com/watch?v=3Lzsu8SXaWY</a></p> |



## **Imparare le STEM**

### **Modello innovativo di apprendimento delle materie STEM nelle scuole secondarie**



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## **1.2 Unità didattica - Costruire una bilancia**

### **1.2.1 Sfondo**

La produzione di nuovi materiali contribuisce all'inquinamento dell'aria, dell'acqua e del suolo attraverso l'emissione di gas serra, sostanze chimiche tossiche e rifiuti pericolosi. Il riutilizzo di prodotti riciclabili contribuisce a ridurre questo inquinamento, evitando la produzione di ulteriori materiali e riciclando la quantità di rifiuti.

Questa lezione non solo dimostra l'importanza del riciclo e del pensiero sostenibile, ma stimola anche la creatività degli studenti, dando loro la libertà di progettare e costruire la propria scala secondo la loro immaginazione e le loro preferenze.

Questa lezione è stata progettata per offrire agli studenti un'esperienza educativa coinvolgente e interattiva, combinando creatività e conoscenze STEM (Science, Technology, Engineering and Math) per promuovere l'apprendimento e la scoperta. Attraverso un video ispiratore, gli studenti sono invitati a esplorare il processo di creazione di una bilancia utilizzando materiali riciclati come bottiglie di plastica, scatole di cartone o altri oggetti che altrimenti verrebbero gettati via.

Oltre all'aspetto pratico, la lezione mira a stimolare il pensiero critico e la capacità di risolvere i problemi, dando agli studenti l'opportunità di esplorare le intersezioni tra ingegneria, matematica, fisica ed ecologia.

Attraverso la sfida di progettare e costruire le proprie bilance, gli studenti impareranno a identificare e applicare i concetti matematici e scientifici in un contesto reale e rilevante per la loro vita quotidiana.

La lezione mira anche a dare agli studenti l'opportunità di capire la differenza tra massa e peso e di scoprire le unità di misura associate a questi concetti.

Per gli studenti, conoscere e promuovere l'importanza del riutilizzo dei prodotti riciclabili è essenziale per la loro educazione ambientale, per sviluppare un comportamento responsabile e per contribuire alla tutela dell'ambiente.

Per aumentare l'importanza e la rilevanza del tema affrontato, a partire dal curriculum - Riciclaggio, abbiamo proposto di costruire una bilancia, a scopo didattico, utilizzando materiali riciclabili.

In questo modo, la lezione mira a ispirare gli studenti a diventare cittadini responsabili e a impegnarsi attivamente nella costruzione di un futuro più verde e sostenibile per tutti.



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## 1.2.2 Contenuto

| Modello pedagogico LearnSTEM                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulo 2: Costruire una bilancia                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Obiettivo del modulo/unità di apprendimento</b>                                                                                            | L'obiettivo di questo modulo è quello di evidenziare l'importanza del riutilizzo dei materiali riciclabili per creare una bilancia di equilibrio.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Durata</b>                                                                                                                                 | 50 min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Obiettivi di apprendimento</b>                                                                                                             | Al termine di questo modulo, gli studenti saranno in grado di:<br>1 definire il concetto di bilancia;<br>2 identificare i materiali riciclabili necessari per costruire la bilancia;<br>3 selezionare gli strumenti necessari per costruire la bilancia;<br>4 identificare le unità di misura utilizzate nella pesatura;<br>5. misurare la massa di un oggetto utilizzando la bilancia;<br>6. individuare la differenza tra massa e peso;                                                                                                                                                                                                                                     |
| <b>Risorse e materiali necessari</b><br>(fogli di lavoro, grafici, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"> <li>- Scatole di cartone;</li> <li>- Stringa;</li> <li>- Bottiglie di plastica;</li> <li>- Forbici;</li> <li>- Taglierina;</li> <li>- Nastro di misurazione;</li> <li>- Nastro adesivo;</li> <li>- Carta bianca e colorata;</li> <li>- Bicchieri di plastica e cartone;</li> <li>- Penne e matite;</li> <li>- Pistola per colla al silicone;</li> <li>- Videoproiettore/laptop;</li> <li>- Materiale video didattico;</li> <li>- Materiale video aggiuntivo;</li> <li>- Presentazione PPT;</li> <li>- Quiz H5P</li> <li>- Bilancia da cucina;</li> <li>- Vari materiali riciclabili (plastica, bottoni, tappi, sacchetti, ecc.)</li> </ul> |
| <b>Procedura</b>                                                                                                                              | <p>La classe viene divisa in gruppi di 4 alunni scelti a caso e viene assegnato un compito: realizzare una bilancia utilizzando i materiali riciclabili forniti.</p> <p>Tempo di lavoro: 40 minuti.</p> <p>Passi da seguire:</p> <ol style="list-style-type: none"> <li>1. Visualizzare l'esempio pratico;</li> <li>2. Identificare i materiali riciclabili da utilizzare per la realizzazione della bilancia;</li> <li>3. Dividere gli studenti in gruppi;</li> <li>4. Costruire la bilancia utilizzando come modello il materiale video fornito dall'insegnante;</li> <li>5. Bilanciamento della bilancia con materiali riciclabili, dopo</li> </ol>                        |



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|                                                                                                    | <p>che l'insegnante ha aggiunto l'oggetto standard a uno dei due vassoi.</p> <p>6. Pesare gli oggetti riciclati aggiunti dagli studenti nel secondo vassoio libero per ripristinare l'equilibrio della bilancia.</p> <p>7. Classifica dei gruppi in base al valore ottenuto pesando gli oggetti riciclati. Il gruppo vincitore è quello il cui valore si avvicina di più alla massa dell'oggetto standard.</p> <p>8. Feedback.</p>                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Metodi di erogazione dei contenuti</b> (lezioni, discussioni, ricerche, lavori di gruppo, ecc.) | <p>Lavoro di squadra</p> <p>Ricerca</p> <p>Dimostrazione pratica</p> <p>Discussioni</p> <p>Spiegazione</p> <p>Brainstorming</p> <p>Problematizzazione</p> <p>Esperimento pratico</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Metodo di valutazione</b>                                                                       | <p>Quiz H5P</p> <p>Valutazione basata sui risultati ottenuti e sui risultati pratici;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Riferimenti</b>                                                                                 | <p><a href="http://www.amathsdictionaryforkids.com/qr/b/balanceScales.html">http://www.amathsdictionaryforkids.com/qr/b/balanceScales.html</a></p> <p><a href="https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales">https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales</a></p> <p><a href="https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/">https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/</a></p> <p><a href="https://www.youtube.com/watch?v=Z0X0yE8loc">https://www.youtube.com/watch?v=Z0X0yE8loc</a></p> <p><a href="https://www.youtube.com/watch?v=J-DF5nYw7E&amp;t=72s">https://www.youtube.com/watch?v=J-DF5nYw7E&amp;t=72s</a></p> |





### 1.3 Unità didattica 3 - **Compostaggio in bottiglia e creazione di una compostiera - riutilizzo dei rifiuti biodegradabili**

#### 1.3.1. Sfondo

Questa lezione è stata progettata per educare gli studenti all'importanza della gestione responsabile dei rifiuti e del riciclaggio attraverso la creazione di compostiere da bottiglie di plastica. Realizzando queste compostiere, gli studenti non solo impareranno a riciclare e riutilizzare i materiali plastici, ma impareranno anche a riciclare i rifiuti organici domestici come bucce di frutta e verdura, scarti di cucina, foglie secche, carta e altri materiali biodegradabili. Attraverso le attività interattive e pratiche proposte, gli studenti impareranno anche come contribuire alla tutela dell'ambiente e alla conservazione delle risorse naturali.

La prima parte della lezione presenta un video informativo che illustra i problemi della gestione impropria dei rifiuti, compreso l'impatto negativo della combustione della plastica o dello smaltimento improprio, che porta all'inquinamento ambientale.

In questo modo, gli studenti capiranno le conseguenze di queste pratiche e saranno motivati a trovare soluzioni alternative e sostenibili.

Anche in questo video verranno presentati esempi pratici di come realizzare una compostiera con bottiglie di plastica e ne verranno evidenziati i vantaggi, oltre a come realizzare il compost e i suoi benefici nel giardinaggio e nell'agricoltura.

Successivamente, gli studenti saranno divisi in gruppi e verrà loro affidato il compito di creare compostiere con bottiglie di plastica. Ogni squadra riceverà i materiali necessari e sarà guidata dall'insegnante nel processo di costruzione. Gli studenti saranno incoraggiati a usare la loro creatività e le loro abilità pratiche per realizzare le compostiere secondo i requisiti richiesti.

Durante l'attività pratica, gli studenti impareranno a conoscere il processo di compostaggio e ne comprenderanno i vantaggi nella produzione di fertilizzante naturale per le piante.

Il compostaggio è un modo efficace per ridurre i rifiuti organici. Poiché circa il 30-40% dei rifiuti domestici è costituito da materiale organico compostabile, il compostaggio di questi rifiuti consente di ridurre la quantità di rifiuti inviati in discarica e quindi di ridurre l'impatto negativo sull'ambiente. Il compost è un fertilizzante organico ricco di sostanze nutritive essenziali per il suolo come azoto, fosforo e potassio. Pertanto, l'uso del compost nel giardinaggio e nell'agricoltura può ridurre la dipendenza dai fertilizzanti chimici di sintesi. Il compost fornisce una fonte naturale ed equilibrata di nutrienti per le piante, contribuendo a mantenere la salute del suolo a lungo termine.

Per gli studenti, conoscere il processo di compostaggio è importante perché li educa alla tutela dell'ambiente, alla conservazione delle risorse naturali e all'adozione di comportamenti responsabili e sostenibili nella gestione dei rifiuti.

Il compostaggio può essere un'attività pratica e creativa per loro. Possono imparare a combinare diversi materiali organici, monitorare il processo di decomposizione e osservare gli effetti positivi del compost sulle piante e sul terreno.



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Imparando a fare il compostaggio, gli studenti sviluppano competenze pratiche e responsabilità nella gestione dei rifiuti.

#### 1.3.2. Contenuto

| Modello pedagogico LearnSTEM                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulo 3: Compostaggio in bottiglia e creazione di una compostiera - Riutilizzo dei rifiuti biodegradabili                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Obiettivo del modulo/unità di apprendimento</b>                                                                                            | L'obiettivo di questo modulo è quello di sviluppare le competenze pratiche e responsabili degli studenti in materia di gestione dei rifiuti, di imparare a riciclare e riutilizzare i materiali organici invece di gettarli via e di promuovere un comportamento responsabile nei confronti dell'ambiente.                                                                                                                                                                                                                                   |
| <b>Durata</b>                                                                                                                                 | <b>50 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Obiettivi di apprendimento</b>                                                                                                             | Al termine del corso, gli studenti saranno in grado di:<br>1. Definire il compost;<br>2. Identificare i tipi di rifiuti domestici che possono essere utilizzati per produrre compost;<br>3. Realizzare la propria compostiera a casa.<br>4. Conoscere l'importanza dell'uso del compost e fornire esempi di dove può essere utilizzato.<br>5. Sviluppare capacità di pensiero pratico e creativo partecipando attivamente alla costruzione di compostiere con materiali riciclati.                                                           |
| <b>Risorse e materiali necessari</b><br>(fogli di lavoro, grafici, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"><li>- Bottiglie di plastica;</li><li>- Rifiuti organici domestici (foglie, risorse vegetali)</li><li>- Suolo;</li><li>- Acqua;</li><li>- Pezzi di carta;</li><li>- Forbici</li><li>- Nastro adesivo;</li><li>- Materiale video didattico;</li><li>- Computer portatile/videoproiettore;</li><li>- Quiz H5P;</li><li>- Materiale video aggiuntivo;</li><li>- Presentazione in Power Point;</li></ul>                                                                                                        |
| <b>Procedura</b>                                                                                                                              | Le fasi di formazione che gli studenti devono seguire:<br>Dividere la classe in gruppi di 4 studenti scelti a caso e delineare il compito di lavoro: costruire la compostiera con i materiali forniti dall'insegnante e aggiungere le materie prime per ottenere il compost. Tempo di lavoro effettivo: 40 minuti.<br>Passi da seguire:<br>1. Visualizzare l'esempio pratico;<br>2. Identificare i materiali necessari per la realizzazione della compostiera;<br>3. Dividere gli studenti in gruppi;<br>4. Realizzazione della compostiera; |



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|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                    | <p>5. Aggiungere la materia prima per ottenere il compost;</p> <p>Una volta completate le fasi sopra descritte, le compostiere saranno posizionate in modo da poter beneficiare della luce del sole. Lo sviluppo del compost sarà visibile entro 3-6 settimane. Abbiamo quindi i seguenti passaggi:</p> <ol style="list-style-type: none"> <li>1. Innaffiare il compost - quotidianamente;</li> <li>2. Controllare le condizioni del compost e i cambiamenti nella struttura.</li> <li>3. Uso corretto del compost.</li> <li>4. Dare un feedback.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Metodi di erogazione dei contenuti</b> (lezioni, discussioni, ricerche, lavori di gruppo, ecc.) | <p>Lavoro di gruppo<br/>Ricerca<br/>Spiegazione<br/>Discussione<br/>Problematizzare<br/>Dimostrazione pratica<br/>Esperimento pratico<br/>Progetto di gruppo<br/>Brainstorming</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Metodo di valutazione</b>                                                                       | <p>Quiz 5HP<br/>Valutazione basata sui risultati ottenuti e sui risultati pratici<br/>Valutazione continua tramite osservazione</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Riferimenti</b>                                                                                 | <p><a href="https://dictionary.cambridge.org/dictionary/english/compost">https://dictionary.cambridge.org/dictionary/english/compost</a><br/> <a href="https://www.collinsdictionary.com/dictionary/english/compost">https://www.collinsdictionary.com/dictionary/english/compost</a><br/> <a href="https://www.oxfordlearnersdictionaries.com/definition/english/compost_1">https://www.oxfordlearnersdictionaries.com/definition/english/compost_1</a><br/> <a href="https://www.carryoncomposting.com/142941469.html">https://www.carryoncomposting.com/142941469.html</a><br/> <a href="https://www.nrdc.org/stories/composting-101#types">https://www.nrdc.org/stories/composting-101#types</a><br/> <a href="https://www.youtube.com/watch?v=O4dl4YljMZk">https://www.youtube.com/watch?v=O4dl4YljMZk</a><br/> <a href="https://www.youtube.com/watch?v=pi-vsJOaduk">https://www.youtube.com/watch?v=pi-vsJOaduk</a></p> |



## 1.4. Unità didattica 4 - Upcycling - Riutilizzo della plastica

### 1.4.1. Sfondo

Questa lezione coinvolgente e interattiva è stata pensata per educare gli studenti all'upcycling - il riutilizzo della plastica - e all'importanza di questa pratica per l'ambiente e per la protezione della biodiversità.

Attraverso un video informativo, gli studenti capiranno quanto sia fondamentale dare nuova vita ai materiali non più utili, invece di buttarli via e contribuire all'inquinamento ambientale.

La lezione mira a combinare diverse discipline, come la biologia e l'ingegneria, per dare agli studenti una prospettiva olistica sul problema della plastica e del suo impatto sull'ambiente e sulla salute umana. Gli studenti impareranno che la plastica è estremamente pericolosa e dannosa per tutta l'umanità, influenzando negativamente sia sull'ambiente che sulla fauna selvatica, prendendo come esempio gli uccelli marini.

Con milioni di uccelli che muoiono ogni anno a causa dell'ingestione di plastica, comprese le microplastiche, è chiaro che è necessario un intervento urgente. L'upcycling è la soluzione salvavita che può trasformare la plastica da nemico degli uccelli ad alleato.

Gli studenti saranno guidati a costruire mangiatoie per uccelli con materiali riciclabili e a posizionarle in luoghi accessibili per fornire cibo e riparo a queste incredibili creature.

Gli studenti utilizzeranno i materiali forniti dall'insegnante e seguiranno le indicazioni e i requisiti per la costruzione delle mangiatoie. Una volta posizionate le mangiatoie, gli studenti le riempiranno di semi e osserveranno attentamente se gli uccelli vengono a nutrirsi, fotografandoli per evidenziare l'impatto positivo delle loro azioni.

Questa lezione è importante per gli studenti perché li educa alla responsabilità ambientale e li incoraggia ad agire in modo proattivo per proteggere la biodiversità. Attraverso l'upcycling, gli studenti imparano che ogni gesto conta nella lotta all'inquinamento e che possono avere un impatto positivo sull'ambiente attraverso azioni semplici e sostenibili.

Il riutilizzo dei rifiuti in plastica può essere anche un modo per risparmiare denaro. Invece di acquistare nuovi contenitori ogni volta che ne abbiamo bisogno, possiamo riutilizzare quelli esistenti, risparmiando i costi associati all'acquisto di nuovi.

Il riutilizzo della plastica può stimolare la creatività e l'innovazione. Le persone possono trovare modi ingegnosi per riutilizzare i contenitori di plastica per scopi diversi da quelli originali, come la creazione di oggetti artistici, giocattoli o articoli per la casa.

Incoraggiare il riutilizzo dei rifiuti di plastica può stimolare la creatività e l'innovazione degli studenti. Possono trovare modi ingegnosi per trasformare i contenitori in altri oggetti utili o decorativi, sviluppando abilità pratiche e creative.



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#### 1.4.2. Contenuto

| Modello pedagogico LearnSTEM                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulo 4: Upcycling - Riutilizzo della plastica                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Obiettivo del modulo/unità di apprendimento</b>                                                                                            | L'obiettivo di questo modulo è incoraggiare il riutilizzo e l'upcycling dei materiali, dando agli studenti non solo l'opportunità di contribuire alla protezione dell'ambiente, ma anche di sviluppare empatia e consapevolezza nei confronti dei pericoli a cui sono esposti gli esseri viventi.                                                                                                                                                                                                                                                                    |
| <b>Durata</b>                                                                                                                                 | 50 min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Obiettivi di apprendimento</b>                                                                                                             | Al termine della lezione, gli studenti saranno in grado di:<br>1 Definire l'upcycling;<br>2 Identificare i pericoli legati all'inquinamento da particelle di plastica;<br>3 Elencare i pericoli a cui sono esposti gli uccelli marini.<br>4 Conoscere i vantaggi dell'upcycling.<br>5 Fornire esempi di uccelli marini che possono ingerire plastica.<br>6 Sviluppare le capacità pratiche e creative partecipando attivamente alla costruzione di mangiatoie per uccelli.                                                                                           |
| <b>Risorse e materiali necessari</b><br>(fogli di lavoro, grafici, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"><li>- Bottiglie di plastica;</li><li>- Forbici;</li><li>- Taglierina;</li><li>- Nastro adesivo;</li><li>- Stringa;</li><li>- Filo;</li><li>- Piatti di plastica;</li><li>- Carta bianca e colorata;</li><li>- Strumenti di scrittura;</li><li>- Pistola per colla al silicone;</li><li>- Bastoncini di legno;</li><li>- Viti e dadi;</li><li>- Presentazione di PowerPoint;</li><li>- Materiale video didattico;</li><li>- Materiale video aggiuntivo;</li><li>- 5HP Quiz;</li><li>- Computer portatile/videoproiettore;</li></ul> |
| <b>Procedura</b>                                                                                                                              | Passi da seguire:<br>Dividete la classe in gruppi di 4 studenti scelti a caso e stabilite il compito di lavoro: costruire una mangiatoia per uccelli utilizzando i materiali forniti dall'insegnante.<br>Tempo di lavoro: 40 minuti<br>1. Guardare il materiale video;<br>2. Dividete gli studenti in gruppi;<br>3. Identificare i materiali necessari per costruire le mangiatoie;<br>4. Costruire mangiatoie per uccelli                                                                                                                                           |



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|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                    | <p>5. Presentazione del prodotto realizzato da ciascun gruppo e verifica della sua conformità;</p> <p>Dopo aver seguito le fasi precedenti, le mangiatoie per uccelli devono essere collocate in un luogo visibile, in modo che siano accessibili agli uccelli e facili da vedere. La supervisione dell'attività nell'area della mangiatoia è di un'ora al giorno per una settimana.</p> <p>Quindi si procede con i seguenti passaggi:</p> <ol style="list-style-type: none"> <li>1. Contare e identificare gli uccelli che visitano le mangiatoie;</li> <li>2. Fotografare gli uccelli che visitano le mangiatoie;</li> <li>3. Presentazione dei risultati;</li> <li>4. Dare un feedback.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Metodi di erogazione dei contenuti</b> (lezioni, discussioni, ricerche, lavori di gruppo, ecc.) | <p>Lavorare in gruppo</p> <p>Ricerca</p> <p>Spiegazione</p> <p>Discussione</p> <p>Problematizzare</p> <p>Esperimento pratico</p> <p>Progetto di gruppo</p> <p>Brainstorming</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Metodo di valutazione</b>                                                                       | <p>5HP Quiz;</p> <p>Valutazione basata sulle realizzazioni e sui risultati pratici;</p> <p>Valutazione continua attraverso l'osservazione;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Riferimenti</b>                                                                                 | <p><a href="https://www.oxfordlearnersdictionaries.com/definition/english/upcycle">https://www.oxfordlearnersdictionaries.com/definition/english/upcycle</a></p> <p><a href="https://dictionary.cambridge.org/dictionary/english/upcycling">https://dictionary.cambridge.org/dictionary/english/upcycling</a></p> <p><a href="https://www.treehugger.com/what-is-upcycling-5116081">https://www.treehugger.com/what-is-upcycling-5116081</a></p> <p><a href="https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/">https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/</a></p> <p><a href="https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684">https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684</a></p> <p><a href="https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/">https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/</a></p> <p><a href="https://www.youtube.com/watch?v=rd7qP9FdTal">https://www.youtube.com/watch?v=rd7qP9FdTal</a></p> <p><a href="https://www.youtube.com/watch?v=P5OBWbZDZlc">https://www.youtube.com/watch?v=P5OBWbZDZlc</a></p> |



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Innovative Model of learning STEM  
in secondary schools



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in secondary schools*

ERASMUS+ KA220  
Cooperation Partnerships in school education

**LearnSTEM Pedagogical Model**  
**STEM Practices Implementation Handbook**

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**Date:**  
30.03.2024

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# 1 Learning Resources

## 1.1 Module 1- Pollution: The Tanker spills oil

### 1.1.1 Background

An oil spill is the release of a liquid petroleum hydrocarbon into the environment, especially marine areas, due to human activity. The term is usually applied to marine oil spills, where oil is released into the ocean or coastal waters, but spills may also occur on land.

Although not as destructive as human-made global climate change, the environmental damage due to an oil spill can be devastating to ecosystems. This lesson will introduce some basics of aquatic ecosystems and how they can be changed by the introduction of petroleum.

During this lesson, students will learn about oil spills that occur in various bodies of water and the environmental and social implications they have on surrounding areas, including Indigenous communities. Students will use hands-on activities to explore the different technology that is used for cleanup and remediation efforts.

### 1.1.2 Content

| LearnSTEM Pedagogical Model                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Module 1: Pollution: The Tanker spills oil |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Aim of the module/ learning unit</b>    | The aim of this module is to study the environmental effects of oil spills and create awareness about cleaning up oil spills and its paramount importance.                                                                                                                                                                                                                                                                                                                           |
| <b>Duration</b>                            | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Learning Objectives</b>                 | On successful completion of this module/learning unit (LU), trainees will be able to: <ol style="list-style-type: none"> <li>1. Understand the environmental effects of oil spills.</li> <li>2. Understand the different methods of cleaning oil spills.</li> <li>3. Work as a team to identify the best method(s) for cleaning up a model oil spill.</li> <li>4. Enhance their communication skills by participating in class discussions and presenting their findings.</li> </ol> |
| <b>Resources&amp;Materials Required</b>    | <ul style="list-style-type: none"> <li>- Didactic video (WP2-P2-LearnSTEM-Learning resource-Pollution_The Tanker spills oil_EN.mp4),</li> <li>- PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_The Tanker spills oil_EN.pptx),</li> <li>- Additional resources (WP2-P2-LearnSTEM_text_The Tanker spills oil-ADDITIONAL RESOURCHES_EN.docx),</li> <li>Assessment (H5P) (WP2-P2-LearnSTEM_text_The Tanker spills oil-H5P_EN.docx),</li> </ul>                                       |





|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|                  | - Experiment (similar to the video presented above)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Procedure</b> | <p>Instructional steps that trainees need to follow:</p> <ol style="list-style-type: none"> <li>1. Presentation and discussion of oil spills. Have students recall the damage an oil spill can do to a natural environment (15-20 min).</li> <li>2. Introduce the challenges of cleaning up an oil spill and what methods are used (10 min).</li> <li>3. Display the video (10 min)</li> <li>4. Create a model oil spill and discuss the concept of a model.</li> </ol> <p>Assemble the team and systematically test the many different methods for cleaning up the model oil spill. Students should record their findings. (30-40 min).</p> <p><b>Experiment – Cleaning up oil spills</b></p> <p><b>Materials:</b></p> <ul style="list-style-type: none"> <li>Cotton balls</li> <li>Container</li> <li>Sponge, string</li> <li>Vegetable oil: amount depends on the container</li> <li>Plastic spoons</li> <li>Dawn dish soap</li> <li>Plastic cups: to put soap and cotton balls in</li> <li>Cocoa powder: to mix with oil and make it look like crude oil</li> <li>Bird feathers</li> </ul> <p><b>Procedure:</b></p> <p>Each group will need to clean up “oil” from a simulated oil spill disaster that includes feathers to represent marine life. The activity may resume in a few different ways, depending on the constraints of the class. It might set a time limit to allow the trainees to clean up the oil spill and feathers as much as possible. Then discuss the challenges faced with the different methods and materials used to try to eliminate the oil.</p> <p>Because the oil is separated from the water, qualitative comparisons may be observed and measured then used to complete maths problems related to this activity. Discuss findings and decide what methods worked the best. Explain how the different methods in the experiment related to the methods used in real life.</p> <ol style="list-style-type: none"> <li>5. Assessment (H5P) (10 min)</li> <li>6. Discard the model oil spills and clean up any messes (5-10 min).</li> </ol> |



|                                 |                                                                      |
|---------------------------------|----------------------------------------------------------------------|
| <b>Content Delivery Methods</b> | Lecture,<br>Discussion,<br>Brainstorming,<br>Research,<br>Group work |
| <b>Assessment Method</b>        | H5P                                                                  |
| <b>References</b>               |                                                                      |

## 1.2 Learning Unit 2- Pollution: Sulphur Dioxide Destroys Plants and Buildings

### 1.2.1 Background

Air pollution is caused by the accumulation of one or more chemicals or substances in the air in high enough concentrations to harm humans, other animals, vegetation, or materials. Air pollution consists of chemicals or particles in the air that can harm the health of humans, animals, and plants. It also damages buildings. Pollutants in the air take many forms. They can be gases, solid particles, or liquid droplets.

Air pollution can result from both human and natural actions. Natural events that pollute the air include forest fires, volcanic eruptions, wind erosion, pollen dispersal, evaporation of organic compounds and natural radioactivity. Pollution from natural occurrences are not very often. Human activities that result in air pollution include emissions from industries and manufacturing activities, burning fossil fuels, and household and farming chemicals. For instance, common causes of air pollution are emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, chemical solvents, roadway dust, and smoke.

Air pollution can cause many health problems such as burning eyes, cancer, birth defects, brain damage, or even death. Air pollution can also damage the environment and property such as food crops, trees, lakes and buildings.

Pollutants are unwanted chemicals or other materials found in the air, at high enough concentrations to endanger the environment and people's health. Emissions are discharges of a pollutant from a particular source (e.g., a factory) or group of sources (e.g., vehicles) into the air. Processes such as fossil fuel burning in industry, motor vehicles and buildings emit pollutants that cause local and regional pollution.

Acid rain looks, feels, and tastes just like clean rain. Walking in acid rain, or even swimming in an acid lake, is no more dangerous for humans than walking or swimming in clean water. However, breathing air that contains the pollutants that cause acid rain can damage human health. Sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), particulate matter, and ozone all irritate or even damage our lungs. These effects are mostly seen in people whose lungs have already been weakened by respiratory illness, but even healthy people can sometimes have pain or difficulty breathing because of air pollution.



SO<sub>2</sub> and NO<sub>x</sub>, the pollutants that cause acid rain, can also reduce visibility, limiting how far into the distance we can see. These pollutants form small particles in the atmosphere. These particles reduce visibility by scattering light. Reduced visibility is most noticeable in places like National Parks, where people go to see some of the nation's most beautiful landscapes.

Acid rain eats away at stone, metal, paint—almost any material exposed to the weather for a long period of time. Human-made materials gradually deteriorate even when exposed to unpolluted rain, but acid rain speeds up the process. Acid rain can rust metals and cause marble statues carved long ago to lose their features. This happens because marble is made of a compound called calcium carbonate, which can be dissolved by acids. Calcium carbonate is also found in limestone. Many buildings and monuments are made of marble and limestone and are damaged by acid rain. Repairing acid rain damage to buildings and monuments can cost billions of euros.

### 1.2.2 Content

| <b>LearnSTEM Pedagogical Model</b>                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Module 2 Pollution: Sulphur Dioxide Destroys Plants and Buildings</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Aim of the module/ learning unit</b>                                  | The aim of this module is by using a variety of activities to help students understand the environmental problems that Sulphur Dioxide creates as one form of pollution that results mainly from burning fossil fuels.                                                                                                                                                                                                                                                                                                                                         |
| <b>Duration</b>                                                          | <b>90 – 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Learning Objectives</b>                                               | On successful completion of this module/learning unit (LU), trainees will be able to: <ol style="list-style-type: none"> <li>1. Identify some of the main causes, effects and sources of air pollution.</li> <li>2. Explain the effects of Sulphur Dioxide on vegetation</li> <li>3. Explain the effects of Sulphur Dioxide on water</li> <li>4. Explain the effects of Sulphur Dioxide on man-made objects</li> <li>5. Explain the effects of Sulphur Dioxide on humans</li> <li>6. Describe what can be done to solve the Sulphur Dioxide problem</li> </ol> |
| <b>Resources&amp;Materials Required</b>                                  | <ul style="list-style-type: none"> <li>-Didactic video (WP2-P2-LearnSTEM-Learning resource-Pollution_Sulfur Dioxide Destroys Plants and Buildings_EN.mp4),</li> <li>- PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Sulfur Dioxide Destroys Plants and Buildings_EN.pptx),</li> <li>- Additional resources (WP2-P2-LearnSTEM_text_Sulfur Dioxide Destroys Plants and Buildings-ADDITIONAL RESOURCES_EN.docx),</li> <li>- Assessment (H5P) (WP2-P2-LearnSTEM_text_Sulfur Dioxide Destroys Plants and Buildings-H5P_EN.docx),</li> </ul>                     |



|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|                  | - Experiment (similar to the video presented above)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Procedure</b> | <p>Instructional steps which trainees need to follow:</p> <ol style="list-style-type: none"> <li>1. Presentation and discussion: What Are Air Pollutants? Air Pollution Sources. How Do Air Pollutants Affect Us? Sulphuric Acid is formed when water vapour interacts with Sulphur Oxides, as a by-product of coal burning, from volcano gases, etc. Acid Rain changes the pH of aquatic systems. (20 min)</li> <li>2. Display the video (10 min)</li> <li>3. <b>Experiment 1 Acid rain on buildings. (20-25 min)</b></li> </ol> <p><b>Purpose</b><br/>To demonstrate the effect of acid rain on statues and buildings.</p> <p><b>Objective</b><br/>Students will learn how acid rain is an air pollution problem.</p> <p><b>Materials</b><br/>Chalk<br/>Clear cups, glasses, or jars<br/>Vinegar<br/>Optional: Long nails</p> <p><b>Procedure</b><br/>Explain that acids react chemically with limestone.<br/>Explain that vinegar is an acid and that chalk is limestone, or give your students pH paper and get them to assess whether vinegar is an acid or base.<br/>Give each group a piece of chalk and you can choose to give them a long nail to scratch a design on the side of the chalk. I usually go with squiggly lines or the students' initials. This will make their chalk unique, and will represent their statue.<br/>Add vinegar to the groups' glass/cup/jar and ask them to drop in their statue, observing closely.<br/>Ask students about their observations.<br/>Ask students what would happen if they had used acid rain instead of vinegar. You may want to remind them at this point that vinegar is more acidic than acid rain.</p> <p><b>Experiment 2 Acid Rain &amp; Plants (20-25 min)</b></p> <p><b>Purpose</b><br/>To demonstrate the effect of acid rain on plants</p> <p><b>Objective</b><br/>Students will learn how acid rain is an air pollution problem.</p> <p><b>Materials</b><br/>Labels<br/>Plants<br/>Water bottles or spray bottles<br/>Measuring cup/cylinder<br/>Pens</p> |



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|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | <p>PH paper<br/>Vinegar<br/>Water</p> <p><b>Procedure</b></p> <p>Explain to the students that they are going to do an experiment about acids, bases, and plants. What do they think will happen if we water plants with liquids of different pHs? What changes do they expect to see? How long do they think it will take plants to change?</p> <p>Split students into groups.<br/>Give each group a plant and a water bottle/spray bottle.<br/>Give each group their recipe for their liquid (see below).</p> <p>Recipe for liquids<br/>Group 1: water<br/>Group 2: 5 parts water, 1 part vinegar<br/>Group 3: 2 parts water, 1 part vinegar</p> <p>Ask the groups to label their water bottle and plant with their group number or allow them to create a group name.</p> <p>Ask the groups to take responsibility to water their plant each day and take notes on whether they notice any change in colour, foliage, and health over the next two weeks.</p> <p>At the end of the two weeks, lead a discussion about the differences observed in the plants that they took care of.</p> <p>Ask the students if they should be concerned about acid rain? Why? How can we try to prevent it? (Remember the sources, factories, automobiles, and utilities). Answers should relate to driving less (carpool, bus, bike, and walk), saving energy (turning off lights, lowering a.c.), and buying less stuff (the 3 R's: reduce, reuse, recycle).</p> <p>Who Cares? Why Do We Need Pollution Solutions?</p> <ol style="list-style-type: none"> <li>4. Assessment (H5P) (10 min)</li> <li>5. Clean up any messes (5-10 min).</li> </ol> |
| <b>Content Delivery Methods</b> | <p>Lecture,<br/>Discussion,<br/>Brainstorming,<br/>Research,<br/>Group work</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Assessment Method</b>        | H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>References</b>               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |



## 1.3 Learning Unit 3- Pollution: Acid Rain pH

### 1.3.1 Background

A substance that is neither acidic nor basic is neutral. The pH scale measures the acidic or basic level of a substance. The pH scale ranges from 0 to 14. A pH of 7 is neutral, while a pH less than 7 is acidic and a pH greater than 7 is basic. Pure water is neutral. However, when chemicals are mixed with water, the mixture can become either acidic or basic.

Acid rain is rain that is more acidic than it should be. Acid rain is a complicated problem affecting soil and water chemistry, as well as the life cycles of plants and animals on land and in the water.

Water moves through the air, streams, lakes, oceans, and every living plant and animal in the hydrologic cycle. When water droplets form and fall to the Earth they pick up particles like the dust and chemicals that float in the air. Even clean, unpolluted air contains particles such as dust or pollen. Clean air also contains naturally occurring gases such as carbon dioxide (CO<sub>2</sub>). The interaction between the water droplets and the CO<sub>2</sub> in the atmosphere gives rain a pH of 5.6, making even clean rain slightly acidic. However, when rain contains pollutants, especially SO<sub>2</sub> and NO<sub>x</sub>, the rainwater can become very acidic.

Acid rain and the air pollution that causes it can severely damage ecosystems.

Every ecosystem is very interconnected, and the organisms that live there rely heavily on each other. For example, ecosystems have food webs, where species depend on one another for food. If any animal is affected, so are several others. This is how acid rain can affect entire ecosystems. Acid rain may only damage a few organisms in an ecosystem, but everything else is indirectly affected. The damage acid rain causes can also take years, or even decades to reverse.

### 1.3.2 Content

| <b>LearnSTEM Pedagogical Model</b>       |                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Module 3: Pollution: Acid Rain pH</b> |                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Aim of the module/ learning unit</b>  | The aim of this module is to know why it matters to combat acid rain                                                                                                                                                                                                                                                                                                                                   |
| <b>Duration</b>                          | <b>90 – 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Learning Objectives</b>               | On successful completion of this module/learning unit (LU), trainees will be able to: <ol style="list-style-type: none"><li>1. describe what acid rain and pH are.</li><li>2. understand the concept of chemical balance (pH) as a way to clarify what “acid” is and means in the context of “acid rain.”</li><li>3. determine the natural and manmade contributions to acid rain formation.</li></ol> |



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|                                             | <ol style="list-style-type: none"> <li>4. demonstrate understanding of the pH scale.</li> <li>5. determine the effects of acid rain on the environment and human health.</li> <li>6. explore options for reducing man-made contributions to acid rain formation.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Resources&amp;Materials<br/>Required</b> | <ul style="list-style-type: none"> <li>- Didactic video (WP2-P2-LearnSTEM-Learning resource-Pollution_Acid Rain pH_EN.mp4),</li> <li>- PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Acid Rain pH_EN.pptx),</li> <li>- Additional resources (WP2-P2-LearnSTEM_text_Acid Rain pH-ADDITIONAL RESOURCHES_EN.docx),</li> <li>- Assessment (H5P) (WP2-P2-LearnSTEM_text_Acid Rain pH-H5P_EN.docx),</li> <li>- Experiment (similar to the video presented above)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Procedure</b>                            | <p>Instructional steps which trainees need to follow:</p> <ol style="list-style-type: none"> <li>1. Presentation and discussion of what is Acid rain? What gases cause acid rain? What type of pollution causes acid rain? What is pH? What form can acid rain occur in?(wet, dry). (15-20 min).</li> <li>2. Mention some human activities that cause damage (10 min).</li> <li>3. Display the video (10 min)</li> <li>4. Create an experiment (similar to video displayed) to demonstrate acid rain impacts on marine, animal life, forests, soil, vegetation, buildings, monuments and humans. (20-30 min)</li> </ol> <p><b>EXPERIMENT</b></p> <p><b>Materials</b></p> <p>vinegar<br/>water<br/>2 medium sized egg shell pieces<br/>2 small green leaves<br/>two paper clips<br/>two containers with lids</p> <p><b>Procedure</b></p> <p>Before activity, make predictions. If vinegar contains acid, then how will some items placed in vinegar change? If these items were placed in water, would they change in the same ways as in vinegar?</p> <ol style="list-style-type: none"> <li>1. Pour vinegar in one container. Place an eggshell piece, a leaf, and a paperclip in the container. Put the lid on the container.</li> <li>2. Pour water in the other container. Place an eggshell, a leaf, and a paperclip in this container. Put the lid on the container.</li> </ol> |



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|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | <p>3. Let the two sealed containers sit overnight.</p> <p>4. Remove the container lids. Observe any changes that took place in the two containers. Write down observations.</p> <p><b>Results</b></p> <p>In the container of water, the items will not show noticeable changes. In the container of vinegar, the eggshell will be soft, the leaf will have brown spots on it, and the paperclip will not show a noticeable change. This activity indicates that acidic solutions can be harmful.</p> <p><b>Extensions</b></p> <p>Measure the acid in several solutions using inexpensive pH papers.</p> <p>Suggestions for solutions to be tested are:</p> <p>lemon juice (pH of 2.0)</p> <p>vinegar (2.2)</p> <p>apple juice (3.0)</p> <p>tomato juice (4.2)</p> <p>milk (6.2)</p> <p>pure water (7.0)</p> <p>Compare the solution pH values with acid rain (below 5.6) and normal rain (above 5.6). Explain that some foods we eat have healthy acids like citric acid, which is not harmful. However, there are stronger acids, which are the products of factories and industries, which are harmful.</p> <p>5. Discuss findings and relate to issues we have to deal with in real life about soil erosion, marine life degradation, wall degradation, forests and species extinction, and humans life degradation. (15-20 min).</p> <p>6. Assessment (H5P) (10 min)</p> <p>7. Clean up any messes (5 min).</p> |
| <b>Content Delivery Methods</b> | <p>Lecture,</p> <p>Discussion,</p> <p>Brainstorming,</p> <p>Research,</p> <p>Group work</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Assessment Method</b>        | <b>H5P</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>References</b>               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |





## 1.4 Learning Unit 4- Pollution: Fertilizer, Acid rain and algae growth

### 1.4.1 Background

The effects of acid rain are most clearly seen in aquatic environments such as streams, lakes, and marshes. Acid rain flows to streams, lakes, and marshes after falling on forests, fields, buildings, and roads. Acid rain also falls directly on aquatic habitats.

Most lakes and streams have a pH between 6 and 8, because the buffering capacity of soil usually neutralizes slightly acidic, clean rain. Lakes and streams become acidic (pH value goes down) when the rainwater itself is so acidic that the surrounding soil cannot buffer the rain enough to neutralize it. For this reason, some lakes in areas where soil does not have a lot of buffering capacity are naturally acidic even without acid rain.

As lakes and streams become more acidic, the numbers and types of fish and other aquatic plants and animals that live in these waters decrease. Some types of plants and animals can tolerate acidic waters. Others, however, are acid-sensitive and will leave or die as the pH declines.

Most commercial fertilizers contain high levels of nitrogen, phosphorus, and potassium since plant growth is typically limited by these nutrients. When the fertilizer washes into a natural body of water, it causes rapid growth of microalgae (phytoplankton) and macroalgae. This excess algae causes many problems.

### 1.4.2 Content

| LearnSTEM Pedagogical Model                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Module 4: Pollution: Fertilizer, Acid rain and algae growth |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Aim of the module/ learning unit</b>                     | The aim of this module is to create awareness of acid rain and its effects on the natural world. Trainees also will be able to learn about eutrophication and harmful algal growth and the consequences on the environment.                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Duration</b>                                             | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Learning Objectives</b>                                  | On successful completion of this module/learning unit (LU), trainees will be able to: <ol style="list-style-type: none"> <li>1. be aware of the adverse effects of acid rain and the ways humans affect the environment.</li> <li>2. develop critical thinking skills by analysing the causes and effects of acid rain.</li> <li>3. gain an understanding of the global impact of acid rain and the importance of environmental conservation.</li> <li>4. understand the problem with harmful algal blooms</li> <li>5. explain the process of eutrophication and what factors can magnify or mitigate it.</li> <li>6. become more environmentally aware to act.</li> </ol> |
| <b>Resources&amp;Materials Required</b>                     | <ul style="list-style-type: none"> <li>- Didactic video (WP2-P2-LearnSTEM-Learning resource_Fertilizer, Acid rain and algae growth_EN.mp4),</li> <li>- PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |



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|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | <p>Fertilizer, Acid rain and algae growth_EN.pptx),</p> <ul style="list-style-type: none"> <li>- Additional resources (WP2-P2-LearnSTEM_text_ Fertilizer, Acid rain and algae growth_ADDITIONAL RESOURCHES_EN.docx),</li> <li>- Assessment (H5P) (WP2-P2-LearnSTEM_text_Fertilizer, Acid rain and algae growth-H5P_EN.docx),</li> <li>- Experiment (similar to the video presented above)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Procedure</b> | <p>Instructional steps which trainees need to follow:</p> <ol style="list-style-type: none"> <li>1. Presentation and discussion of (15-20 min).</li> <li>2. Introduce the issue of eutrophication and harmful algal growth and the consequences on the environment. (10 min)</li> <li>3. Display the video (10 min)</li> <li>4. <b>EXPERIMENT (30-40 min)</b></li> </ol> <p><b>Materials:</b><br/>two-litre plastic bottles with the tops cut off or glass jars, phosphate-based dishwasher detergent, vinegar, fertiliser, distilled water, tap water, lake water.</p> <p><b>Procedure:</b><br/>Prepare the bottles: Fill one bottle with distilled water, one bottle with tap water, and some bottles with lake water.</p> <p>Add phosphates to some bottles filled with lake water by adding the high-phosphate dishwasher detergent. Add vinegar and fertiliser to other bottles. Add different quantities. Label the bottles clearly, and mix well. Leave one bottle of lake water as the control.</p> <p>Place the bottles together in a warm place that receives plenty of sunlight.</p> <p><b>Observations:</b> Appoint one-two students to record observations for each day on the Observation Chart. Students should record any subjective observations they have about the flasks. Things to look for include: overall appearance, turbidity, colour, sediments, and odour.</p> <p>Keep the water levels constant from day to day by adding enough water to replace the loss from evaporation. Unless your water is heavily chlorinated, tap water will do.</p> <p><b>Class discussion:</b> At the end of two weeks, gather the class and discuss the results. What was the relationship between nutrients and algae growth? What did the algae do to the quality of the water? What would be the best way to keep algae from growing in Lakes and Seas? Be sure to bring up the subject of nonpoint source pollution. How can it be prevented?</p> <p><b>Options:</b><br/>Teachers might elect to have trainees measure algae concentrations by preparing microscopic slides then counting the number of algae found in a microscopic</p> |



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|                                 | <p>field. This data could then be recorded and charted on a graph.</p> <p>A bottle can be prepared identically to one of the others, but then placed in a dark area to produce the effect of no sunlight on algae growth.</p> <p>5. Discuss findings and relate to issues we have to deal with in real life about soil erosion, marine life degradation, wall degradation, forests and species extinction, humans life degradation. (15-20 min).</p> <p>6. Assessment (H5P) (10 min)</p> <p>7. Clean up any messes (5 min).</p> |
| <b>Content Delivery Methods</b> | <p>Lecture,</p> <p>Discussion,</p> <p>Brainstorming,</p> <p>Research,</p> <p>Group work</p>                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Assessment Method</b>        | H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>References</b>               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



# Ortaokullarda STEM öğrenmenin Yenilikçi Modeli STEM Öğrenin



Avrupa Birliği tarafından  
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## *Ortaokullarda* **STEM** *Öğrenmenin Yenilikçi Modeli*

ERASMUS+ KA220 Okul eğitiminde İşbirliği Ortaklıkları

## **LearnSTEM Pedagojik Modeli** **STEM Uygulamaları Öğretmen El Kitabı**

Kalliopi Ntolou  
IEK Kavalas, Kavala, Yunanistan

**Tarih:**  
30.03.2024

**Referans Numarası:**  
2022-1-TR01-KA220-SCH-000087583



"Erasmus+ / Avrupa Dayanışma Programı kapsamında Avrupa Komisyonu tarafından desteklenmektedir. Burada yer alan içerik yazarın görüşlerini yansıtmaktadır ve bu görüşlerden Avrupa Komisyonu ve Türkiye Ulusal Ajansı sorumlu tutulamaz."



## 1 Öğrenme Kaynakları

### 1.1 Modül 1- Kirlilik: Tankerden petrol dökülüyor

#### 1.1.1 Arka plan

Derste işlenecek konu veya kavramın kısa bir özetini verin. Müfredatla olan önemini ve ilgisini ve öğrencilerin öğrenmesinin neden önemli olduğunu ekleyin.

Petrol sızıntısı, insan faaliyetleri nedeniyle sıvı petrol hidrokarbonunun çevreye, özellikle deniz alanlarına salınmasıdır. Bu terim genellikle petrolün okyanusa veya kıyı sularına salındığı denizdeki petrol sızıntılarına uygulanır, ancak dökülmeler karada da meydana gelebilir.

İnsan yapımı küresel iklim değişikliği kadar yıkıcı olmasa da, petrol sızıntısının neden olduğu çevresel hasar, ekosistemler için yıkıcı olabilir. Bu derste su ekosistemlerinin bazı temelleri ve bunların petrolün kullanılmaya başlanmasıyla nasıl değiştirilebileceği anlatılacaktır.

Bu ders sırasında öğrenciler, çeşitli su kütlelerinde meydana gelen petrol sızıntılarını ve bunların Yerli topluluklar da dahil olmak üzere çevredeki alanlar üzerindeki çevresel ve sosyal etkilerini öğreneceklerdir. Öğrenciler, temizleme ve iyileştirme çalışmaları için kullanılan farklı teknolojileri keşfetmek için uygulamalı etkinliklerden yararlanacak.

#### 1.1.2 İçerik

| LearnSTEM Pedagojik Modeli                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modül 1: Kirlilik: Tankerden petrol dökülüyor |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Modülün/öğrenme ünitesinin amacı</b>       | Bu modülün amacı, petrol sızıntılarının çevresel etkilerini incelemek ve petrol sızıntılarının temizlenmesi ve bunun büyük önemi hakkında bir farkındalık yaratmaktır.                                                                                                                                                                                                                                                                            |
| <b>Süre</b>                                   | <b>90 - 120 dakika</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Öğrenme hedefleri</b>                      | Bu modülün/öğrenme biriminin (LU) başarıyla tamamlanmasının ardından kursiyerler şunları yapabilecektir:<br>1 Petrol sızıntılarının çevresel etkilerini anlayın.<br>2 Petrol sızıntılarını temizlemenin farklı yöntemlerini anlayın.<br>3 Bir model petrol sızıntısını temizlemek için en iyi yöntemi/yöntemleri belirlemek için ekip olarak çalışın.<br>4 Sınıf tartışmalarına katılarak ve bulgularını sunarak iletişim becerilerini geliştirin |
| <b>Gerekli Kaynaklar ve Malzemeler</b>        | <ul style="list-style-type: none"><li>- Öğretici video (WP2-P2-LearnSTEM-Öğrenim kaynağı-Kirlilik_Tanker petrol döküyor_EN.mp4),</li><li>- PPT (WP2-P2-LearnSTEM-Öğrenim kaynağı-Kirlilik_Tanker petrol döküyor_EN.pptx),</li></ul>                                                                                                                                                                                                               |



## Ortaokullarda STEM öğrenmenin Yenilikçi Modeli STEM Öğrenin



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|                 | <ul style="list-style-type: none"><li>- Ek kaynaklar (WP2-P2-LearnSTEM_text_Tanker petrol döküyor-EK KAYNAKLAR_EN.docx),</li><li>- Değerlendirme (H5P) (WP2-P2-LearnSTEM_text_Tanker petrol döküyor-H5P_EN.docx),</li><li>- Deney (yukarıda sunulan videoya benzer)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Prosedür</b> | <p>Kursiyerlerin izlemesi gereken öğretim adımları:</p> <ol style="list-style-type: none"><li>1. Petrol sızıntılarının sunumu ve tartışılması. Öğrencilere, bir petrol sızıntısının doğal çevreye verebileceği zararı hatırlatın (15-20 dakika).</li><li>2. Petrol sızıntısını temizlemenin zorluklarını ve hangi yöntemlerin kullanıldığını anlatın (10 dakika).</li><li>3. Videoyu görüntüle (10 dk)</li><li>4. Bir petrol sızıntısı modeli oluşturun ve model kavramını tartışın.</li></ol> <p>Ekibinizi toplayın ve model petrol sızıntısını temizlemek için birçok farklı yöntemi sistematik olarak test edin. Öğrenciler bulgularını kaydetmelidir. (30-40 dk).</p> <p><b>Deney – Petrol sızıntılarını temizleme</b></p> <p><b>Malzemeler:</b></p> <p>Pamuk topları<br/>Konteyner<br/>Sünger, ip<br/>Bitkisel yağ: miktar kaba bağlıdır<br/>Plastik kaşık<br/>Şafak bulaşık sabunu<br/>Plastik bardaklar: Sabun ve pamuk toplarını koymak için<br/>Kakao tozu: yağla karıştırıp şöyle görünmesini sağlamak için<br/>ham petrol<br/>Kuş tüyleri</p> <p>Her grubun deniz yaşamını temsil eden tüyleri içeren simüle edilmiş bir petrol sızıntısı felaketinden "petrol"ü temizlemesi gerekecek. Etkinlik, sınıfın kısıtlamalarına bağlı olarak birkaç farklı şekilde devam edebilir. Kursiyerlerin petrol sızıntısını ve tüyleri mümkün olduğu kadar temizlemesine izin verecek bir zaman sınırı koyabilir. Daha sonra petrolü ortadan kaldırmak için kullanılan farklı yöntem ve materyallerle karşılaşılan zorlukları tartışın.</p> <p>Yağ sudan ayrıldığı için niteliksel karşılaştırmalar gözlemlenebilir ve ölçülebilir, daha sonra bu aktiviteyle ilgili matematik problemlerini tamamlamak için kullanılabilir. Bulguları tartışın ve hangi yöntemlerin en iyi sonuç verdiğine karar verin. Deneydeki farklı yöntemlerin gerçek hayatta kullanılan yöntemlerle nasıl ilişkili</p> |



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|                                    | <p>olduğunu açıklayın.</p> <p>5. Değerlendirme (H5P) (10 dk)</p> <p>6. Model yağ sızıntılarını atın ve pislikleri temizleyin (5-10 dakika).</p> |
| <b>İçerik Yayınlama Yöntemleri</b> | <p>Sunma,<br/>Tartışma,<br/>Beyin fırtınası,<br/>Araştırma,<br/>Grup çalışması</p>                                                              |
| <b>Değerlendirme yöntemi</b>       | <p>H5P</p>                                                                                                                                      |
| <b>Referanslar</b>                 |                                                                                                                                                 |



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### 1.2 Öğrenim Ünitesi 2- Kirlilik: Kükürt Dioksit Bitkileri ve Binaları Yok Eder

#### 1.2.1 Arka plan

Derste işlenecek konu veya kavramın kısa bir özetini verin. Müfredatla olan önemini ve ilgisini ve öğrencilerin öğrenmesinin neden önemli olduğunu ekleyin.

Hava kirliliği, bir veya daha fazla kimyasalın veya maddenin insanlara, diğer hayvanlara, bitkilere veya malzemelere zarar verecek kadar yüksek konsantrasyonlarda havada birikmesinden kaynaklanır. Hava kirliliği, havadaki insan, hayvan ve bitki sağlığına zarar verebilecek kimyasal maddeler veya parçacıklardan oluşur. Ayrıca binalara da zarar veriyor. Havadaki kirlleticiler birçok biçimde olabilir. Gazlar, katı parçacıklar veya sıvı damlacıklar olabilirler.

Hava kirliliği hem insan hem de doğal faaliyetlerden kaynaklanabilir. Havayı kirlüten doğal olaylar arasında orman yangınları, volkanik patlamalar, rüzgar erozyonu, polen yayılması, organik bileşiklerin buharlaşması ve doğal radyoaktivite yer alır. Doğal olaylardan kaynaklanan kirlilik çok sık değildir. Hava kirliliğine neden olan insan faaliyetleri arasında endüstrilerden ve üretim faaliyetlerinden kaynaklanan emisyonlar, yanan fosil yakıtlar ile ev ve tarım kimyasalları yer alır. Örneğin, hava kirliliğinin yaygın nedenleri endüstriyel tesislerden ve elektrik tesislerinden kaynaklanan emisyonlar, motorlu taşıt egzozu, benzin buharları, kimyasal solventler, yol tozu ve dumandır.

Hava kirliliği göz yanması, kanser, doğum kusurları, beyin hasarı ve hatta ölüm gibi birçok sağlık sorununa neden olabilir. Hava kirliliği ayrıca çevreye ve gıda ürünleri, ağaçlar, göller ve binalar gibi mülklere de zarar verebilir.

Kirleticiler, çevreyi ve insan sağlığını tehlikeye atacak kadar yüksek konsantrasyonlarda havada bulunan istenmeyen kimyasallar veya diğer maddelerdir. Emisyonlar, kirleticinin belirli bir kaynaktan (örneğin bir fabrika) veya kaynak grubundan (örneğin araçlar) havaya boşaltılmasıdır.

Sanayide, motorlu taşıtlarda ve binalarda fosil yakıtların yakılması gibi süreçler, yerel ve bölgesel kirliliğe neden olan kirleticiler yayar.

Asit yağmuru tıpkı temiz yağmur gibi görünür, hissedilir ve tadı vardır. Asit yağmurunda yürümek, hatta asit gölünde yüzmek, insanlar için temiz suda yürümekten veya yüzmekten daha tehlikeli değildir. Ancak asit yağmurlarına neden olan kirleticileri içeren havanın solunması insan sağlığına zarar verebilmektedir. Kükürt dioksit (SO<sub>2</sub>), nitrojen oksitler (NO<sub>x</sub>), partikül maddeler ve ozon akciğerlerimizi tahriş eder, hatta zarar verir. Bu etkiler çoğunlukla akciğerleri solunum yolu hastalığı nedeniyle zayıflamış kişilerde görülür, ancak sağlıklı insanlar bile bazen hava kirliliği nedeniyle ağrı veya nefes almada zorluk yaşayabilir.

Asit yağmuruna neden olan kirleticiler olan SO<sub>2</sub> ve NO<sub>x</sub> de görüş mesafesini azaltarak, görebildiğimiz mesafeyi sınırlandırabilir. Bu kirleticiler atmosferde küçük parçacıklar oluşturur. Bu parçacıklar ışığı dağıtarak görünürlüğü azaltır. Görüş mesafesinin azalması, insanların ülkenin en güzel manzaralarından bazılarını görmek için gittikleri Milli Parklar gibi yerlerde en çok fark edilir.





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Asit yağmuru, uzun süre havaya maruz kalan hemen hemen her türlü malzemeyi, taşı, metali, boyayı aşındırır. İnsan yapımı malzemeler, kirlenmemiş yağmura maruz kaldıklarında bile giderek bozulur, ancak asit yağmuru bu süreci hızlandırır. Asit yağmuru metalleri paslandırabilir ve uzun zaman önce oyulmuş mermer heykellerin özelliklerini kaybetmesine neden olabilir. Bunun nedeni mermerin kalsiyum karbonat adı verilen ve asitlerle çözülebilen bir bileşikten yapılmış olmasıdır. Kalsiyum karbonat ayrıca kireçtaşında da bulunur. Birçok bina ve anıt mermer ve kireçtaşından yapılmış olup asit yağmurlarından zarar görmektedir. Asit yağmurunun binalara ve anıtlara verdiği hasarı onarmak milyarlarca avroya mal olabilir.

### 1.2.2 İçerik

| LearnSTEM Pedagojik Modeli                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| Modül 2 Kirlilik: Kükürt Dioksit Bitkileri ve Binaları Yok Eder                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Modülün/öğrenme ünitesinin amacı</b>                                                                                                                            | Bu modülün amacı çeşitli aktiviteler kullanarak öğrencilerin Kükürt Dioksitin esas olarak fosil yakıtların yakılmasından kaynaklanan bir kirlilik türü olarak yarattığı çevre sorunlarını anlamalarına yardımcı olmaktır.                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Süre</b>                                                                                                                                                        | <b>90 – 120 dakika</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Öğrenme hedefleri</b>                                                                                                                                           | Bu modülün/öğrenme biriminin (LU) başarıyla tamamlanmasının ardından kursiyerler şunları yapabilecektir: <ol style="list-style-type: none"><li>1. Hava kirliliğinin bazı temel nedenlerini, etkilerini ve kaynaklarını tanımlayın.</li><li>2. Etkilerini açıklayın Bitki örtüsündeki Kükürt Dioksit</li><li>3. Kükürt dioksitin su üzerindeki etkilerini açıklayınız</li><li>4. Sülfür dioksitin insan yapımı nesneler üzerindeki etkilerini açıklayın</li><li>5. Kükürt dioksitin insanlar üzerindeki etkilerini açıklayınız</li><li>6. Kükürt Dioksit sorununu çözmek için neler yapılabileceğini açıklayın</li></ol> |
| <b>Gerekli Kaynaklar ve Malzemeler</b><br>(çalışma sayfası, çizelgeler, bildiriler, öğretici videolar, kitaplardan/kılavuzlardan alıntılar, zihin haritaları, vb.) | <ul style="list-style-type: none"><li>- Öğretici video (WP2-P2-LearnSTEM-Öğrenim kaynağı-Kirlilik_Kükürt Dioksit Bitkileri ve Binaları Yok Eder_EN.mp4),</li><li>- PPT (WP2-P2-LearnSTEM-Öğrenim kaynağı-Kirlilik_Kükürt Dioksit Bitkileri ve Binaları Yok Eder_EN.pptx),</li><li>- Ek kaynaklar (WP2-P2-LearnSTEM_text_Kükürt Dioksit Bitkileri ve Binaları Yok Eder-EK KAYNAKLAR_EN.docx),</li><li>- Değerlendirme (H5P) (WP2-P2-LearnSTEM_text_Kükürt Dioksit Bitkileri ve Binaları Yok Eder-H5P_EN.docx),</li><li>- Deney (yukarıda sunulan videoya benzer)</li></ul>                                               |
| <b>Prosedür</b>                                                                                                                                                    | Kursiyerlerin izlemesi gereken öğretim adımları: <ol style="list-style-type: none"><li>1. Sunum ve tartışma: Hava Kirleticileri Nelerdir? Hava Kirliliği Kaynakları. Hava Kirleticileri Bizi Nasıl Etkiler? Sülfürik Asit, su buharı, kömür yakılmasının bir yan ürünü olarak volkan gazlarından vb. kaynaklanan Sülfür Oksitlerle etkileşime girdiğinde oluşur. Asit Yağmuru, su</li></ol>                                                                                                                                                                                                                             |



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|  | <p>sistemlerinin pH'ını değiştirir. (20 Dakika)</p> <p>2. Videoyu görüntüle (10 dk)</p> <p>3. <b>Deney 1 Binalara asit yağmuru. (20-25 dk)</b></p> <p><b>Amaç</b><br/>Asit yağmurunun heykeller ve binalar üzerindeki etkisini göstermek.</p> <p><b>Amaç</b><br/>Öğrenciler asit yağmurunun nasıl bir hava kirliliği sorunu olduğunu öğrenecekler.</p> <p><b>Malzemeler</b><br/>Tebeşir<br/>Bardakları, bardakları veya kavanozları temizleyin<br/>Sirke<br/>İsteğe bağlı: Uzun tırnaklar</p> <p><b>Prosedür</b><br/>Asitlerin kireç taşıyla kimyasal reaksiyona girdiğini açıklayın.<br/>Sirkenin bir asit, tebeşirin ise kireç taşı olduğunu açıklayın veya öğrencilerinize pH kağıdı verin ve sirkenin asit mi yoksa baz mı olduğunu değerlendirmelerini sağlayın.<br/>Her gruba bir parça tebeşir verin ve tebeşirin yan tarafına bir desen çizmeleri için onlara uzun bir çivi vermeyi seçebilirsiniz. Genellikle dalgalı çizgiler veya öğrencilerin baş harfleriyle giderim. Bu, tebeşirlerini benzersiz kılacak ve heykellerini temsil edecektir.<br/>Grupların bardaklarına/bardaklarına/kavanozlarına sirke ekleyin ve yakından gözlemleyerek heykellerini yere bırakmalarını isteyin.<br/>Öğrencilere gözlemlerini sorun.<br/>Öğrencilere sirke yerine asit yağmuru kullansalardı ne olacağını sorun. Bu noktada onlara sirkenin asit yağmurundan daha asidik olduğunu hatırlatmak isteyebilirsiniz.</p> <p><b>Deney 2 Asit Yağmuru ve Bitkiler (20-25 dk)</b></p> <p><b>Amaç</b><br/>Asit yağmurlarının bitkiler üzerindeki etkisini göstermek</p> <p><b>Amaç</b><br/>Öğrenciler asit yağmurunun nasıl bir hava kirliliği sorunu olduğunu öğrenecekler.</p> <p><b>Malzemeler</b><br/>Etiketler<br/>Bitkiler<br/>Su şişeleri veya sprey şişeleri<br/>Ölçme kabı/silindiri<br/>Kalemler</p> |
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|                                    | <p>PH kağıdı<br/>Sirke<br/>su<br/><b>Prosedür</b><br/>Öğrencilere asitler, bazlar ve bitkilerle ilgili bir deney yapacaklarını açıklayın. Bitkileri farklı pH'lara sahip sıvılarla sularsak ne olacağını düşünüyorlar? Hangi değişiklikleri görmeyi bekliyorlar? Bitkilerin değişmesinin ne kadar süreceğini düşünüyorlar?<br/>Öğrencileri gruplara ayırın.<br/>Her gruba bir bitki ve bir su şişesi/sprey şişesi verin.<br/>Her gruba kendi sıvılarının tarifini verin (aşağıya bakın).<br/>Sıvılar için tarif<br/>Grup 1: su<br/>Grup 2: 5 ölçü su, 1 ölçü sirke<br/>Grup 3: 2 ölçü su, 1 ölçü sirke<br/>Gruplardan su şişelerini ve bitkilerini grup numaralarıyla etiketlemelerini isteyin veya grup adı oluşturmalarına izin verin.<br/>Gruplardan bitkilerini her gün sulama sorumluluğunu üstlenmelerini ve önümüzdeki iki hafta boyunca renk, yaprak ve sağlıkta herhangi bir değişiklik fark edip etmediklerini not etmelerini isteyin.<br/>İki haftanın sonunda bakımını üstlendikleri bitkilerde gözlemlenen farklılıklar hakkında bir tartışma başlatın.<br/>Öğrencilere asit yağmuru konusunda endişelenmeleri gerekip gerekmediğini sorun. Neden? Bunu nasıl engellemeye çalışabiliriz? (Kaynakları, fabrikaları, otomobilleri ve kamu hizmetlerini hatırlayın). Cevaplar daha az araç kullanmak (araba paylaşımı, otobüs, bisiklet ve yürüyüş), enerji tasarrufu (ışıkları kapatmak, klimayı düşürmek) ve daha az eşya satın almak (3 R: azalt, yeniden kullan, geri dönüştür) ile ilgili olmalıdır.<br/>Kimin umurunda? Neden Kirlilik Çözümlerine İhtiyaç Duyuyoruz?</p> <p>4. Değerlendirme (H5P) (10 dk)<br/>5. Ortallığı temizleyin (5-10 dk).</p> |
| <b>İçerik Yayınlama Yöntemleri</b> | Sunma,<br>Tartışma,<br>Beyin fırtınası,<br>Araştırma,<br>Grup çalışması                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Değerlendirme yöntemi</b>       | H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Referanslar</b>                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |



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### 1.3 Öğrenim Ünitesi 3- Kirlilik: Asit Yağmuru pH

#### 1.3.1 Arka plan

Derste işlenecek konu veya kavramın kısa bir özetini verin. Müfredatla olan önemini ve ilgisini ve öğrencilerin öğrenmesinin neden önemli olduğunu ekleyin.

Ne asidik ne de bazik olan bir madde nötrdür. PH ölçeği bir maddenin asidik veya bazik seviyesini ölçer. PH ölçeği 0 ile 14 arasında değişir. 7'lik bir pH nötrdür, 7'den düşük bir pH asidiktir ve 7'den büyük bir pH baziktir. Saf su nötrdür. Ancak kimyasallar suyla karıştırıldığında karışım asidik veya bazik hale gelebilir.

Asit yağmuru olması gerekenden daha asitli olan yağmurdur. Asit yağmuru, toprak ve su kimyasının yanı sıra bitki ve hayvanların karada ve sudaki yaşam döngülerini etkileyen karmaşık bir sorundur.

Su, hidrolojik döngü içerisinde havada, akarsularda, göllerde, okyanuslarda ve yaşayan her bitki ve hayvanda hareket eder. Su damlacıkları oluşup Dünya'ya düştüğünde, havada yüzen toz ve kimyasallar gibi parçacıkları toplar. Temiz, kirlenmemiş havada bile toz veya polen gibi parçacıklar bulunur. Temiz hava aynı zamanda karbondioksit (CO<sub>2</sub>) gibi doğal olarak oluşan gazları da içerir. Su damlacıkları ile atmosferdeki CO<sub>2</sub> arasındaki etkileşim, yağmurun pH'ını 5,6 verir ve temiz yağmuru bile hafif asidik hale getirir. Ancak yağmur, özellikle SO<sub>2</sub> ve NOX gibi kirlenici maddeler içerdiğinde yağmur suyu çok asitli hale gelebilir.

Asit yağmurları ve buna sebep olan hava kirliliği ekosistemlere ciddi zararlar verebilmektedir.

Her ekosistem birbirine çok bağlıdır ve orada yaşayan organizmalar büyük ölçüde birbirlerine bağımlıdır. Örneğin ekosistemlerde türlerin yiyecek için birbirine bağımlı olduğu besin ağları vardır. Herhangi bir hayvan etkilenirse diğer birkaç hayvan da etkilenir. Asit yağmuru tüm ekosistemleri bu şekilde etkileyebilir. Asit yağmuru ekosistemdeki yalnızca birkaç organizmaya zarar verebilir, ancak geri kalan her şey dolaylı olarak etkilenir. Asit yağmurunun neden olduğu hasarın tersine çevrilmesi yıllar, hatta on yıllar alabilir.



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### 1.3.2 İçerik

| <b>LearnSTEM Pedagojik Modeli</b>         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| <b>Modül 3: Kirlilik: Asit Yağmuru pH</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Modülün/öğrenme ünitesinin amacı</b>   | Bu modülün amacı asit yağmurlarıyla mücadelenin neden önemli olduğunu bilmektir.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Süre</b>                               | <b>90 – 120 dakika</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Öğrenme hedefleri</b>                  | <p>Bu modülün/öğrenme biriminin (LU) başarıyla tamamlanmasının ardından kursiyerler şunları yapabilecektir:</p> <ol style="list-style-type: none"><li>1. Asit yağmuru ve pH'ın ne olduğunu açıklamak.</li><li>2. "Asit yağmuru" bağlamında "asit"in ne olduğunu ve ne anlama geldiğini açıklamanın bir yolu olarak kimyasal denge (pH) kavramını anlamak.</li><li>3. Asit yağmuru oluşumuna doğal ve insan yapımı katkıları belirler.</li><li>4. pH ölçeğini anladığınızı gösterin.</li><li>5. Asit yağmurlarının çevre ve insan sağlığına etkilerini belirler.</li><li>6. Asit yağmuru oluşumuna insan yapımı katkıların azaltılmasına yönelik seçeneklerin araştırılması .</li></ol> |
| <b>Gerekli Kaynaklar ve Malzemeler</b>    | <ul style="list-style-type: none"><li>- Öğretici video (WP2-P2-LearnSTEM-Öğrenim kaynağı-Kirlilik_Asit Yağmuru pH_EN . mp4),</li><li>- PPT (WP2-P2-LearnSTEM-Öğrenim kaynağı-Kirlilik_Asit Yağmuru pH_EN.pptx),</li><li>- Ek kaynaklar (WP2-P2-LearnSTEM_text_Acid Rain pH-ADDITIONAL RESOURCES_EN.docx),</li><li>- Değerlendirme (H5P) (WP2-P2-LearnSTEM_text_Acid Rain pH-H5P_EN.docx),</li><li>- Deney (yukarıda sunulan videoya benzer)</li></ul>                                                                                                                                                                                                                                  |
| <b>Prosedür</b>                           | <p>Kursiyerlerin izlemesi gereken öğretim adımları:</p> <ol style="list-style-type: none"><li>1. Asit yağmuru nedir konulu sunum ve tartışma? Asit yağmurlarına hangi gazlar neden olur? Asit yağmurlarına ne tür kirlilik neden olur? PH nedir? Asit yağmuru hangi biçimde oluşabilir?(ıslak, kuru). (15-20 dk).</li><li>2. Hasara neden olan bazı insan aktivitelerinden bahsedin (10 dk).</li><li>3. Videoyu görüntüle (10 dk)</li><li>4. Asit yağmurunun deniz, hayvan yaşamı, ormanlar, toprak, bitki örtüsü, binalar, anıtlar ve insanlar üzerindeki etkilerini göstermek için bir deney (görüntülenen videoya benzer) oluşturun. (20-30 dk)</li></ol>                           |



## Ortaokullarda STEM öğrenmenin Yenilikçi Modeli STEM Öğrenin



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### DENEY

#### Malzemeler

sirke

su

2 adet orta boy yumurta kabuğu parçası

2 küçük yeşil yaprak

iki ataş

kapaklı iki kap

#### Prosedür

Etkinlikten önce tahminlerde bulunun. Sirke asit içeriyorsa sirkenin içine konulan bazı eşyalar nasıl değişecek? Bu maddeler suya konulsaydı sirkedekiyle aynı şekilde değişir miydi?

1. Sirkeyi bir kaba dökün. Kabin içine bir yumurta kabuğu parçası, bir yaprak ve bir ataş yerleştirin. Kapağı kabin üzerine koyun.

2. Diğer kaba su dökün. Bu kaba bir yumurta kabuğu, bir yaprak ve bir ataş yerleştirin. Kapağı kabin üzerine koyun.

3. İki mühürlü kabı gece boyunca bekletin.

4. Kabin kapaklarını çıkarın. İki kaptaki meydana gelen değişiklikleri gözlemleyin. Gözlemlerinizi yazın.

#### Sonuçlar

Su kabındaki eşyalar gözle görülür değişiklikler göstermez. Sirke kabında yumurta kabuğu yumuşak olacak, yaprağın üzerinde kahverengi lekeler oluşacak ve ataşta gözle görülür bir değişiklik görülmemektedir. Bu aktivite asidik çözeltilerin zararlı olabileceğini göstermektedir.

#### Uzantılar

Ucuz pH kağıtları kullanarak çeşitli solüsyonlardaki asidi ölçün.

Test edilecek çözüm önerileri şunlardır:

limon suyu (pH 2,0)

sirke (2.2)

elma suyu (3.0)

domates suyu (4.2)

süt (6.2)

saf su (7,0)

Çözeltinin pH değerlerini asit yağmuru (5,6'nın altında) ve normal yağmur (5,6'nın üzerinde) ile karşılaştırın. Yediğimiz bazı gıdaların sitrik asit gibi zararlı olmayan sağlıklı asitler içerdiğini açıklayın. Ancak fabrika ve sanayi ürünü olan, zararlı olan daha güçlü asitler de vardır.

5. toprak erozyonu, deniz yaşamının bozulması, duvar bozulması, ormanların ve türlerin yok olması, insan yaşamının bozulması ile ilgili gerçek hayatta uğraşmamız



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|                                    |                                                                                                                          |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
|                                    | gereken sorunlarla bağlantı kurun . (15-20 dk).<br>6. Değerlendirme (H5P) (10 dk)<br>7. Ortallığı temizleyin (5 dakika). |
| <b>İçerik Yayınlama Yöntemleri</b> | Sunma,<br>Tartışma,<br>Beyin fırtınası,<br>Araştırma,<br>Grup çalışması                                                  |
| <b>Değerlendirme yöntemi</b>       | <b>H5P</b>                                                                                                               |
| <b>Referanslar</b>                 |                                                                                                                          |



## Ortaokullarda STEM öğrenmenin Yenilikçi Modeli STEM Öğrenin



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### 1.4 Öğrenim Ünitesi 4- Kirlilik: Gübre, Asit yağmuru ve alg büyümesi

#### 1.4.1 Arka plan

Derste işlenecek konu veya kavramın kısa bir özetini verin. Müfredatla olan önemini ve ilgisini ve öğrencilerin öğrenmesinin neden önemli olduğunu ekleyin.

Asit yağmurlarının etkileri en açık şekilde akarsu, göl, bataklık gibi su ortamlarında görülür. Asit yağmurları ormanlara, tarlalara, binalara ve yollara düştükten sonra derelere, göllere ve bataklıklara akar. Asit yağmuru aynı zamanda doğrudan su habitatlarına da düşer.

Çoğu göl ve akarsuyun pH'ı 6 ila 8 arasındadır çünkü toprağın tamponlama kapasitesi genellikle hafif asidik, temiz yağmuru nötralize eder. Yağmur suyunun kendisi çok asitli olduğunda, çevredeki toprak yağmuru nötralize edecek kadar tamponlayamadığı zaman göller ve akarsular asidik hale gelir (pH değeri düşer). Bu nedenle toprağın tamponlama kapasitesinin çok fazla olmadığı bölgelerdeki bazı göller, asit yağmuru olmasa bile doğal olarak asidiktir.

Göller ve akarsular asidik hale geldikçe bu sularda yaşayan balıkların ve diğer su bitkilerinin ve hayvanlarının sayısı ve türü azalır. Bazı bitki ve hayvan türleri asitli suları tolere edebilir. Ancak diğerleri aside duyarlıdır ve pH düştükçe gidecek veya öleceklerdir.

Çoğu ticari gübre yüksek düzeyde nitrojen, fosfor ve potasyum içerir, çünkü bitki büyümesi tipik olarak bu besinlerle sınırlanır. Gübre doğal su kütlesine karıştığında mikroalglerin (fitoplankton) ve makroalglerin hızlı büyümesine neden olur. Bu fazla algler birçok soruna neden olur.

#### 1.4.2 İçerik

| LearnSTEM Pedagojik Modeli                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modül 4: Kirlilik: Gübre, Asit yağmuru ve alg büyümesi |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Modülün/öğrenme ünitesinin amacı</b>                | Bu modülün amacı asit yağmurları ve doğal dünya üzerindeki etkileri konusunda farkındalık yaratmaktır. Kursiyerler ayrıca ötrofikasyon, zararlı alg büyümesi ve bunların çevre üzerindeki sonuçları hakkında da bilgi edinebilecek.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Süre</b>                                            | <b>90 - 120 dakika</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Öğrenme hedefleri</b>                               | <p>Bu modülün/öğrenme biriminin (LU) başarıyla tamamlanmasının ardından kursiyerler şunları yapabilecektir:</p> <ol style="list-style-type: none"><li>1. Asit yağmurunun olumsuz etkilerinin ve insanların çevreyi nasıl etkilediğinin farkında olun.</li><li>2. Asit yağmurunun nedenlerini ve etkilerini analiz ederek eleştirel düşünme becerilerini geliştirin.</li><li>3. Asit yağmurunun küresel etkisi ve çevreyi korumanın önemi hakkında bilgi sahibi olmak.</li><li>4. Zararlı alg çoğalmalarıyla ilgili sorunu anlayın</li><li>5. Ötrofikasyon sürecini ve hangi faktörlerin onu büyütebileceğini veya azaltabileceğini açıklayın.</li><li>6. harekete geçmek için çevre konusunda daha bilinçli hale</li></ol> |





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|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                        | gelmek.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Gerekli Kaynaklar ve Malzemeler</b> | <ul style="list-style-type: none"><li>- Öğretici video (WP2-P2-LearnSTEM-Öğrenim kaynağı_Gübre, Asit yağmuru ve yosun büyümesi_EN.mp4),</li><li>- PPT (WP2-P2-LearnSTEM-Öğrenim kaynağı-Kirlilik_ Gübre, Asit yağmuru ve yosun büyümesi_EN.pptx),</li><li>- Ek kaynaklar (WP2-P2-LearnSTEM_text_ Gübre, Asit yağmuru ve alg büyümesi_EK KAYNAKLAR_EN.docx),</li><li>- Değerlendirme (H5P) (WP2-P2-LearnSTEM_text_Fertilizer, Asit yağmuru ve yosun büyümesi-H5P_EN.docx),</li><li>- Deney (yukarıda sunulan videoya benzer)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Prosedür</b>                        | <p>Kursiyerlerin izlemesi gereken öğretim adımları:</p> <ol style="list-style-type: none"><li>1. Sunum ve tartışma (15-20 dk).</li><li>2. Ötöfikasyon ve zararlı alg büyümesi ve bunların çevre üzerindeki sonuçları konularını tanıtmak. (10 dk)</li><li>3. Videoyu görüntüleyin (10 dk)</li><li>4. <b>DENEY (30-40 dk)</b></li></ol> <p><b>Malzemeler:</b><br/>üstleri kesilmiş iki litrelik plastik şişeler veya cam kavanozlar, fosfat bazlı bulaşık makinesi deterjanı, sirke, gübre, damıtılmış su, musluk suyu, göl suyu.</p> <p><b>Prosedür:</b><br/>Şişeleri hazırlayın: Bir şişeyi damıtılmış suyla, bir şişeyi musluk suyuyla ve birkaç şişeyi de göl suyuyla doldurun. Göl suyuyla doldurulmuş bazı şişelere yüksek fosfatlı bulaşık makinesi deterjanı ekleyerek fosfat ekleyin. Diğer şişelere sirke ve gübre ekleyin. Farklı miktarlarda ekleyin. Şişeleri açıkça etiketleyin ve iyice karıştırın. Kontrol olarak bir şişe göl suyu bırakın.</p> <p>Şişeleri bol güneş ışığı alan sıcak bir yere bir araya getirin.</p> <p><b>Gözlemler:</b> Bir veya iki öğrenciyi her gün için gözlemlerini Gözlem Tablosuna kaydetmeleri için görevlendirin. Öğrenciler şişelerle ilgili her türlü öznel gözlemini kaydetmelidir. Aranacak şeyler şunlardır: genel görünüm, bulanıklık, renk, çökeltiler ve koku.</p> <p>Buharlaştırmadan kaynaklanan kaybı telafi etmek için yeterli miktarda su ekleyerek su seviyelerini günden güne sabit tutun. Suyunuz aşırı derecede klorlu olmadığı sürece musluk suyu işinizi görecektir.</p> <p><b>Sınıf tartışması:</b> İki haftanın sonunda sınıfı toplayın ve sonuçları tartışın. Besin maddeleri ile alg büyümesi arasındaki ilişki neydi? Algler suyun kalitesine ne yaptı? Göllerde ve Denizlerde alglerin büyümesini engellemenin en iyi yolu ne olabilir? Noktasal olmayan kaynak kirliliği konusunu gündeme getirdiğinizden emin olun. Nasıl</p> |



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|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                    | <p>önlenebilir?</p> <p><b>Seçenekler:</b></p> <p>Öğretmenler, kursiyerlerin mikroskobik slaytlar hazırlayarak ve ardından mikroskobik alanda bulunan alg sayısını sayarak alg konsantrasyonlarını ölçmelerini seçebilirler. Bu veriler daha sonra kaydedilebilir ve bir grafik üzerinde gösterilebilir.</p> <p>Bir şişe diğerleriyle aynı şekilde hazırlanabilir, ancak daha sonra alg büyümesi üzerinde güneş ışığının olmamasının etkisini yaratmak için karanlık bir alana yerleştirilebilir.</p> <p>5. Bulguları tartışın ve toprak erozyonu, deniz yaşamının bozulması, duvar bozulması, ormanların ve türlerin yok olması, insan yaşamının bozulması ile ilgili gerçek hayatta uğraşmamız gereken sorunlarla bağlantı kurun. (15-20 dk).</p> <p>6. Değerlendirme (H5P) (10 dk)</p> <p>7. Ortılığı temizleyin (5 dk).</p> |
| <b>İçerik Yayınlama Yöntemleri</b> | Sunma,<br>Tartışma,<br>Beyin fırtınası,<br>Araştırma,<br>Grup çalışması                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Değerlendirme yöntemi</b>       | H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Referanslar</b>                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |



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Καινοτόμο μοντέλο μάθησης STEM  
σε σχολεία δευτεροβάθμιας εκπαίδευσης



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## **Μάθετε STEM**

### *Καινοτόμο μοντέλο μάθησης STEM σε σχολεία δευτεροβάθμιας εκπαίδευσης*

ERASMUS+ KA220 Συνεργασίες Συνεργασίας στη σχολική εκπαίδευση

## **LearnSTEM Pedagogical Model**

### **Εγχειρίδιο Υλοποίησης Πρακτικών STEM**

Καλλιόπη Ντόλου ΙΕΚ Καβάλας, Καβάλα, Ελλάδα

**Ημερομηνία:**  
30.03.2024

**Αριθμός αναφοράς:**  
2022-1-TR01-KA220-SCH-000087583



Η υποστήριξη της Ευρωπαϊκής Επιτροπής για την παραγωγή αυτής της δημοσίευσης δεν συνιστά έγκριση του περιεχομένου που αντικατοπτρίζει μόνο τις απόψεις των συγγραφέων και η Επιτροπή δεν μπορεί να θεωρηθεί υπεύθυνη για οποιαδήποτε χρήση των πληροφοριών που περιέχονται σε αυτήν.



## 1 Πόροι μάθησης

### 1.1 Ενότητα 1- Ρύπανση: Το Tanker χύνει λάδι

#### 1.1.1 Ιστορικό

Δώστε μια σύντομη περίληψη του θέματος ή της έννοιας που θα καλυφθεί στο μάθημα. Συμπεριλάβετε τη σημασία και τη συνάφειά του με το πρόγραμμα σπουδών και γιατί είναι σημαντικό να μαθαίνουν οι μαθητές.

Πετρελαιοκηλίδα είναι η απελευθέρωση υγρού υδρογονάνθρακα πετρελαίου στο περιβάλλον, ιδιαίτερα στις θαλάσσιες περιοχές, λόγω ανθρώπινης δραστηριότητας. Ο όρος χρησιμοποιείται συνήθως για θαλάσσιες πετρελαιοκηλίδες, όπου το πετρέλαιο απελευθερώνεται στον ωκεανό ή στα παράκτια ύδατα, αλλά μπορεί επίσης να εμφανιστούν διαρροές στην ξηρά.

Αν και δεν είναι τόσο καταστροφική όσο η ανθρωπογενής παγκόσμια κλιματική αλλαγή, η περιβαλλοντική ζημιά λόγω πετρελαιοκηλίδας μπορεί να είναι καταστροφική για τα οικοσυστήματα. Αυτό το μάθημα θα εισαγάγει ορισμένες βασικές αρχές των υδάτινων οικοσυστημάτων και πώς μπορούν να αλλάξουν με την εισαγωγή του πετρελαίου.

Κατά τη διάρκεια αυτού του μαθήματος, οι μαθητές θα μάθουν για τις πετρελαιοκηλίδες που συμβαίνουν σε διάφορα υδάτινα σώματα περιβαλλοντικές και κοινωνικές επιπτώσεις που έχουν στις γύρω περιοχές, συμπεριλαμβανομένων των αυτόχθονων κοινοτήτων. Οι μαθητές θα χρησιμοποιήσουν πρακτικές δραστηριότητες για να εξερευνήσουν τη διαφορετική τεχνολογία που χρησιμοποιείται για τις προσπάθειες καθαρισμού και αποκατάστασης.

#### 1.1.2 Περιεχόμενο

| Παιδαγωγικό μοντέλο LearnSTEM               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ενότητα 1: Ρύπανση: Το Tanker χύνει λάδι    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Στόχος της ενότητας/της μαθησιακής ενότητας | Ο στόχος αυτής της ενότητας είναι να μελετήσει τις περιβαλλοντικές επιπτώσεις των πετρελαιοκηλίδων και να δημιουργήσει μια ευαισθητοποίηση σχετικά με τον καθαρισμό των πετρελαιοκηλίδων και την ύψιστη σημασία τους.                                                                                                                                                                                                                                                    |
| Διάρκεια                                    | 90 - 120 λεπτά                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Στόχοι μάθησης                              | Με την επιτυχή ολοκλήρωση αυτής της ενότητας/μαθησιακής ενότητας (LU), οι εκπαιδευόμενοι θα είναι σε θέση να:<br>1 Κατανοήσουν τις περιβαλλοντικές επιπτώσεις των πετρελαιοκηλίδων.<br>2 Κατανοήσουν τις διάφορες μεθόδους καθαρισμού πετρελαιοκηλίδων.<br>3 Εργαστούν ως ομάδα για να εντοπίσετε την καλύτερη μέθοδο(ες) για τον καθαρισμό μιας πετρελαιοκηλίδας μοντέλου.<br>4 Ενισχύσουν τις επικοινωνιακές τους δεξιότητες συμμετέχοντας σε συζητήσεις στην τάξη και |



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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                    | παρουσιάζοντας τα ευρήματά τους.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Απαιτούνται πόροι και υλικά</b><br>(φύλλο εργασίας,<br>διαγράμματα, φυλλάδια,<br>διδασκτικό βίντεο, απόσπασμα<br>από βιβλία/εγχειρίδια,<br>χάρτες μυαλού κ.λπ.) | -διδασκτικό βίντεο (WP2-P2-LearnSTEM-Learning resource-Pollution_The Tanker spills oil_EN.mp4),<br>-PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_The Tanker spills oil_EN.pptx),<br>πρόσθετοι πόροι (WP2-P2-LearnSTEM_text_The Tanker spills oil-ADDITIONAL RESOURCES_EL.docx),<br>-αξιολόγηση (H5P) (WP2-P2-LearnSTEM_text_The Tanker spills oil-H5P_EN.docx),<br>-πείραμα (παρόμοιο με το βίντεο που παρουσιάστηκε παραπάνω)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Διαδικασία</b>                                                                                                                                                  | <p>Εκπαιδευτικά βήματα που πρέπει να ακολουθήσουν οι εκπαιδευόμενοι:</p> <ol style="list-style-type: none"><li>1. Παρουσίαση και συζήτηση για τις πετρελαιοκηλίδες. Ζητήστε από τους μαθητές να θυμηθούν τη ζημιά που μπορεί να προκαλέσει μια πετρελαιοκηλίδα σε ένα φυσικό περιβάλλον (15-20 λεπτά).</li><li>2. Παρουσιάστε τις προκλήσεις του καθαρισμού μιας πετρελαιοκηλίδας και ποιες μεθόδους χρησιμοποιούνται (10 λεπτά).</li><li>3. Εμφάνιση του βίντεο (10 λεπτά)</li><li>4. Δημιουργήστε ένα μοντέλο πετρελαιοκηλίδας και συζητήστε την έννοια του μοντέλου.<br/>Συγκεντρώστε την ομάδα και δοκιμάστε συστηματικά τις πολλές διαφορετικές μεθόδους για τον καθαρισμό της πετρελαιοκηλίδας μοντέλου. Οι μαθητές θα πρέπει να καταγράφουν τα ευρήματά τους. (30-40 λεπτά).</li></ol> <p><b>Πείραμα – Καθαρισμός πετρελαιοκηλίδων</b></p> <p><b>Υλικά:</b></p> <p>Μπάλες βαμβακιού<br/>Δοχείο<br/>Σφουγγάρι, κορδόνι<br/>Φυτικό λάδι: η ποσότητα εξαρτάται από το δοχείο<br/>Πλαστικά κουτάλια<br/>Σαπούνι πιάτων Dawn<br/>Πλαστικά ποτήρια: για να βάλετε μέσα σαπούνι και βαμβάκι<br/>Κακάο σε σκόνη: να ανακατευτεί με λάδι και να μοιάζει μαζούτ<br/>Φτερά πουλιών</p> |



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|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                         | <p>Διαδικασία:</p> <p>Κάθε ομάδα θα χρειαστεί να καθαρίσει το «πετρέλαιο» από μια προσομοίωση καταστροφής πετρελαιοκηλίδας που περιλαμβάνει φτερά που αντιπροσωπεύουν τη θαλάσσια ζωή. Η δραστηριότητα μπορεί να συνεχιστεί με μερικούς διαφορετικούς τρόπους, ανάλογα με τους περιορισμούς της τάξης. Μπορεί να ορίσει ένα χρονικό όριο για να επιτρέψει στους εκπαιδευόμενους να καθαρίσουν όσο το δυνατόν περισσότερο την πετρελαιοκηλίδα και τα φτερά. Στη συνέχεια, συζητήστε τις προκλήσεις που αντιμετωπίζετε με τις διαφορετικές μεθόδους και υλικά που χρησιμοποιούνται για την προσπάθεια εξάλειψης του λαδιού.</p> <p>Επειδή το λάδι διαχωρίζεται από το νερό, μπορούν να παρατηρηθούν ποιοτικές συγκρίσεις και να μετρηθούν και στη συνέχεια να χρησιμοποιηθούν για την ολοκλήρωση μαθηματικών προβλημάτων που σχετίζονται με αυτή τη δραστηριότητα. Συζητήστε τα ευρήματα και αποφασίστε ποιες μέθοδοι λειτούργησαν καλύτερα. Εξηγήστε πώς οι διάφορες μέθοδοι στο πείραμα σχετίζονται με τις μεθόδους που χρησιμοποιούνται στην πραγματική ζωή.</p> <p>5. Αξιολόγηση (H5P) (10 λεπτά)</p> <p>6. Απορρίψτε τις πετρελαιοκηλίδες του μοντέλου και καθαρίστε τυχόν βρωμιές (5-10 λεπτά).</p> |
| <b>Μέθοδοι Παράδοσης Περιεχομένου -</b> | διάλεξη, συζήτηση, καταιγισμός ιδεών, έρευνα, ομαδική εργασία                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Μέθοδος Αξιολόγησης                     | H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Παραπομπές -                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## 1.2 Μαθησιακή Ενότητα 2- Ρύπανση: Το διοξείδιο του θείου καταστρέφει φυτά και κτίρια

### 1.2.1 Ιστορικό

Δώστε μια σύντομη περίληψη του θέματος ή της έννοιας που θα καλυφθεί στο μάθημα. Συμπεριλάβετε τη σημασία και τη συνάφειά του με το πρόγραμμα σπουδών και γιατί είναι σημαντικό να μαθαίνουν οι μαθητές.

Η ατμοσφαιρική ρύπανση προκαλείται από τη συσσώρευση μιας ή περισσότερων χημικών ή ουσιών στον αέρα σε αρκετά υψηλές συγκεντρώσεις ώστε να βλάψουν τον άνθρωπο, άλλα ζώα, τη βλάστηση ή τα υλικά. Η ατμοσφαιρική ρύπανση αποτελείται από χημικές ουσίες ή σωματίδια στον αέρα που μπορούν να βλάψουν την υγεία των ανθρώπων, των ζώων και των φυτών. Επίσης βλάπτει



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τα κτίρια. Οι ρύποι στον αέρα παίρνουν πολλές μορφές. Μπορεί να είναι αέρια, στερεά σωματίδια ή υγρά σταγονίδια.

Η ατμοσφαιρική ρύπανση μπορεί να προκύψει τόσο από ανθρώπινες όσο και από φυσικές ενέργειες. Φυσικά γεγονότα που μολύνουν τον αέρα περιλαμβάνουν δασικές πυρκαγιές, ηφαιστειακές εκρήξεις, αιολική διάβρωση, διασπορά γύρης, εξάτμιση οργανικών ενώσεων και φυσική ραδιενέργεια. Η ρύπανση από φυσικά φαινόμενα δεν είναι πολύ συχνά. Οι ανθρώπινες δραστηριότητες που έχουν ως αποτέλεσμα την ατμοσφαιρική ρύπανση περιλαμβάνουν εκπομπές από βιομηχανίες και μεταποιητικές δραστηριότητες, καύση ορυκτών καυσίμων και οικιακές και γεωργικές χημικές ουσίες. Για παράδειγμα, κοινές αιτίες της ατμοσφαιρικής ρύπανσης είναι οι εκπομπές από βιομηχανικές εγκαταστάσεις και ηλεκτρικές επιχειρήσεις κοινής ωφέλειας, καυσαέρια οχημάτων, ατμοί βενζίνης, χημικοί διαλύτες, σκόνη οδοστρώματος και καπνός.

Η ατμοσφαιρική ρύπανση μπορεί να προκαλέσει πολλά προβλήματα υγείας, όπως κάψιμο στα μάτια, καρκίνο, γενετικές ανωμαλίες, εγκεφαλική βλάβη ή ακόμα και θάνατο. Η ατμοσφαιρική ρύπανση μπορεί επίσης να βλάψει το περιβάλλον και την ιδιοκτησία, όπως καλλιέργειες τροφίμων, δέντρα, λίμνες και κτίρια.

Οι ρύποι είναι ανεπιθύμητες χημικές ουσίες ή άλλα υλικά που βρίσκονται στον αέρα, σε αρκετά υψηλές συγκεντρώσεις ώστε να θέσουν σε κίνδυνο το περιβάλλον και την υγεία των ανθρώπων. Οι εκπομπές είναι οι απορρίψεις ενός ρύπου από μια συγκεκριμένη πηγή (π.χ. ένα εργοστάσιο) ή ομάδα πηγών (π.χ. οχήματα) στον αέρα. Διεργασίες όπως η καύση ορυκτών καυσίμων στη βιομηχανία, τα μηχανοκίνητα οχήματα και τα κτίρια εκπέμπουν ρύπους που προκαλούν τοπική και περιφερειακή ρύπανση.

Η όξινη βροχή έχει εμφάνιση, αίσθηση και γεύση όπως η καθαρή βροχή. Το περπάτημα σε όξινη βροχή, ή ακόμα και το κολύμπι σε μια όξινη λίμνη, δεν είναι πιο επικίνδυνο για τους ανθρώπους από το περπάτημα ή το κολύμπι σε καθαρό νερό. Ωστόσο, ο αέρας που αναπνέει που περιέχει τους ρύπους που προκαλούν την όξινη βροχή μπορεί να βλάψει την ανθρώπινη υγεία. Το διοξείδιο του θείου ( $\text{SO}_2$ ), τα οξείδια του αζώτου ( $\text{NO}_x$ ), τα σωματίδια και το όζον όλα ερεθίζουν ή ακόμη και βλάπτουν τους πνεύμονές μας. Αυτές οι επιδράσεις εμφανίζονται κυρίως σε άτομα των οποίων οι πνεύμονες έχουν ήδη εξασθενήσει από αναπνευστική νόσο, αλλά ακόμη και υγιείς άνθρωποι μπορεί μερικές φορές να έχουν πόνο ή δυσκολία στην αναπνοή λόγω της ατμοσφαιρικής ρύπανσης.

Το  $\text{SO}_2$  και το  $\text{NO}_x$ , οι ρύποι που προκαλούν όξινη βροχή, μπορούν επίσης να μειώσουν την ορατότητα, περιορίζοντας την απόσταση που μπορούμε να δούμε. Αυτοί οι ρύποι σχηματίζουν μικρά σωματίδια στην ατμόσφαιρα. Αυτά τα σωματίδια μειώνουν την ορατότητα διασκορπίζοντας το φως. Η μειωμένη ορατότητα είναι πιο αισθητή σε μέρη όπως τα Εθνικά Πάρκα, όπου οι άνθρωποι πηγαίνουν για να δουν μερικά από τα πιο όμορφα τοπία της χώρας.

Η όξινη βροχή καταβροχθίζει την πέτρα, το μέταλλο, το χρώμα—σχεδόν οποιοδήποτε υλικό εκτίθεται στις καιρικές συνθήκες για μεγάλο χρονικό διάστημα. Τα ανθρώπινα υλικά φθείρονται σταδιακά ακόμα και όταν εκτίθενται σε αμόλυντη βροχή, αλλά η όξινη βροχή επιταχύνει τη διαδικασία. Η όξινη βροχή μπορεί να σκουριάσει μέταλλα και να κάνει τα μαρμάρια αγάλματα που σκαλίστηκαν εδώ και πολύ καιρό να χάσουν τα χαρακτηριστικά τους. Αυτό συμβαίνει επειδή το μάρμαρο αποτελείται από μια ένωση που ονομάζεται ανθρακικό ασβέστιο, το οποίο μπορεί να διαλυθεί από οξέα. Το ανθρακικό ασβέστιο βρίσκεται επίσης στον ασβεστόλιθο. Πολλά κτίρια και μνημεία είναι κατασκευασμένα από μάρμαρο και ασβεστόλιθο και έχουν υποστεί ζημιές από την όξινη βροχή. Η αποκατάσταση ζημιών από όξινη βροχή σε κτίρια και μνημεία μπορεί να κοστίσει δισεκατομμύρια ευρώ.





## 1.2.2 Περιεχόμενο

| Παιδαγωγικό μοντέλο LearnSTEM                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ενότητα 2 Ρύπανση: Το διοξείδιο του θείου καταστρέφει φυτά και κτίρια                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Στόχος της ενότητας/της μαθησιακής ενότητας</b>                                                                                                  | Ο στόχος αυτής της ενότητας είναι η χρήση ποικίλων δραστηριοτήτων για να βοηθήσει τους μαθητές να κατανοήσουν τα περιβαλλοντικά προβλήματα που δημιουργεί το διοξείδιο του θείου ως μια μορφή ρύπανσης που προκύπτει κυρίως από την καύση ορυκτών καυσίμων.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Διάρκεια</b>                                                                                                                                     | <b>90 – 120 λεπτά</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Στόχοι μάθησης</b>                                                                                                                               | Με την επιτυχή ολοκλήρωση αυτής της ενότητας/μαθησιακής ενότητας (LU), οι εκπαιδευόμενοι θα είναι σε θέση να:<br><ol style="list-style-type: none"><li>1. Προσδιορίσουν μερικές από τις κύριες αιτίες, επιπτώσεις και πηγές της ατμοσφαιρικής ρύπανσης.</li><li>2. Εξηγήσουν τις επιπτώσεις του Διοξειδίου του θείου στη βλάστηση</li><li>3. Εξηγήσουν τις επιδράσεις του διοξειδίου του θείου στο νερό</li><li>4. Εξηγήσουν τις επιδράσεις του διοξειδίου του θείου σε ανθρωπογενή αντικείμενα</li><li>5. Εξηγήσουν τις επιπτώσεις του διοξειδίου του θείου στον άνθρωπο</li><li>6. Περιγράψουν τι μπορεί να γίνει για να λυθεί το πρόβλημα του διοξειδίου του θείου</li></ol> |
| <b>Απαιτούνται πόροι και υλικά</b><br>(φύλλο εργασίας, γραφήματα, φυλλάδια, διδακτικό βίντεο, απόσπασμα από βιβλία/εγχειρίδια, χάρτες μυαλού κ.λπ.) | <ul style="list-style-type: none"><li>-διδακτικό βίντεο (WP2-P2-LearnSTEM-Learning resource-Pollution_Sulfur Dioxide Destroys Plants and Buildings_EN.mp4),</li><li>-PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Sulfur Dioxide Destroys Plants and Buildings_EN.pptx),</li><li>-πρόσθετοι πόροι (WP2-P2-LearnSTEM_text_Sulfur Dioxide Destroys Plants and Buildings-ADDITIONAL RESOURCES_EL.docx),</li><li>-αξιολόγηση (H5P) (WP2-P2-LearnSTEM_text_Sulfur Dioxide Destroys Plants and Buildings-H5P_EN.docx),</li><li>-πείραμα (παρόμοιο με το βίντεο που παρουσιάστηκε παραπάνω)</li></ul>                                                                             |
| <b>Διαδικασία</b>                                                                                                                                   | Εκπαιδευτικά βήματα που πρέπει να ακολουθήσουν οι εκπαιδευόμενοι:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |





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1. Παρουσίαση και συζήτηση: Τι είναι οι ατμοσφαιρικοί ρύποι; Πηγές Ατμοσφαιρικής Ρύπανσης. Πώς μας επηρεάζουν οι ατμοσφαιρικοί ρύποι; Θετικό οξύ σχηματίζεται όταν οι υδρατμοί αλληλεπιδρούν με τα οξείδια του θείου, ως υποπροϊόν της καύσης άνθρακα, από αέρια ηφαιστειών κ.λπ. Η όξινη βροχή αλλάζει το pH των υδάτινων συστημάτων. (20 λεπτά)

2. Εμφάνιση του βίντεο (10 λεπτά)

3. **Πείραμα 1 Όξινη βροχή σε κτίρια. (20-25 λεπτά)**

**Σκοπός**

Να καταδείξει την επίδραση της όξινης βροχής σε αγάλματα και κτίρια.

**Σκοπός**

Οι μαθητές θα μάθουν πώς η όξινη βροχή είναι ένα πρόβλημα ατμοσφαιρικής ρύπανσης.

**Υλικά**

Κιμωλία

Διαφανή κύπελλα, ποτήρια ή βάζα

Ξύδι

Προαιρετικά: Μακριά νύχια

**Διαδικασία**

Εξηγήστε ότι τα οξέα αντιδρούν χημικά με τον ασβεστόλιθο.

Εξηγήστε ότι το ξύδι είναι οξύ και ότι η κιμωλία είναι ασβεστόλιθος ή δώστε στους μαθητές σας χαρτί pH και ζητήστε τους να αξιολογήσουν εάν το ξύδι είναι οξύ ή βάση.

Δώστε σε κάθε ομάδα ένα κομμάτι κιμωλία και μπορείτε να επιλέξετε να τους δώσετε ένα μακρύ καρφί για να χαράξουν ένα σχέδιο στο πλάι της κιμωλίας. Συνήθως πηγαίνω με στρυμωγμένες γραμμές ή τα αρχικά των μαθητών. Αυτό θα κάνει την κιμωλία τους μοναδική και θα αντιπροσωπεύει το άγαλμά τους.

Προσθέστε ξύδι στο ποτήρι/κύπελλο/βάζο των ομάδων και ζητήστε τους να ρίξουν το άγαλμά τους, παρατηρώντας προσεκτικά.

Ρωτήστε τους μαθητές για τις παρατηρήσεις τους.

Ρωτήστε τους μαθητές τι θα συνέβαινε αν είχαν χρησιμοποιήσει όξινη βροχή αντί για ξύδι. Ίσως θελήσετε να τους υπενθυμίσετε σε αυτό το σημείο ότι το ξύδι είναι πιο όξινο από την όξινη βροχή.

**Πείραμα 2 Όξινη βροχή και φυτά (20-25 λεπτά)**

**Σκοπός**

Να καταδείξει την επίδραση της όξινης βροχής στα φυτά

**Σκοπός**

Οι μαθητές θα μάθουν πώς η όξινη βροχή είναι ένα πρόβλημα ατμοσφαιρικής ρύπανσης.



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|  | <p><b>Υλικά</b><br/>Ετικέτες<br/>Φυτά<br/>Μπουκάλια νερού ή μπουκάλια ψεκασμού<br/>Μεζούρα/κύλινδρος<br/>Στυλό<br/>χαρτί PH<br/>Ξύδι<br/>Νερό</p> <p><b>Διαδικασία</b><br/>Εξηγήστε στους μαθητές ότι πρόκειται να κάνουν ένα πείραμα σχετικά με οξέα, βάσεις και φυτά. Τι πιστεύουν ότι θα συμβεί αν ποτίσουμε φυτά με υγρά διαφορετικού pH; Τι αλλαγές περιμένουν να δουν; Πόσο καιρό πιστεύουν ότι θα χρειαστούν τα φυτά για να αλλάξουν;<br/>Χωρίστε τους μαθητές σε ομάδες.<br/>Δώστε σε κάθε ομάδα ένα φυτό και ένα μπουκάλι νερό/μπουκάλι ψεκασμού.<br/>Δώστε σε κάθε ομάδα τη συνταγή για το υγρό της (δείτε παρακάτω).<br/>Συνταγή για υγρά<br/>Ομάδα 1: νερό<br/>Ομάδα 2: 5 μέρη νερό, 1 μέρος ξύδι<br/>Ομάδα 3: 2 μέρη νερό, 1 μέρος ξύδι<br/>Ζητήστε από τις ομάδες να επισημάνουν το μπουκάλι νερό και το φυτό τους με τον αριθμό της ομάδας τους ή να τους επιτρέψουν να δημιουργήσουν ένα όνομα ομάδας.<br/>Ζητήστε από τις ομάδες να αναλάβουν την ευθύνη να ποτίζουν το φυτό τους κάθε μέρα και να κρατούν σημειώσεις σχετικά με το εάν θα παρατηρήσουν κάποια αλλαγή στο χρώμα, το φύλλωμα και την υγεία τις επόμενες δύο εβδομάδες.<br/>Στο τέλος των δύο εβδομάδων, ξεκινήστε μια συζήτηση σχετικά με τις διαφορές που παρατηρήθηκαν στα φυτά που φρόντισαν.<br/>Ρωτήστε τους μαθητές αν πρέπει να ανησυχούν για την όξινη βροχή; Γιατί; Πώς μπορούμε να προσπαθήσουμε να το αποτρέψουμε; (Θυμηθείτε τις πηγές, τα εργοστάσια, τα αυτοκίνητα και τις επιχειρήσεις κοινής ωφέλειας). Οι απαντήσεις θα πρέπει να σχετίζονται με την λιγότερη οδήγηση (συνοδεία αυτοκινήτου, λεωφορείο, ποδήλατο και περπάτημα), την εξοικονόμηση ενέργειας (σβήσιμο των φώτων, χαμηλό AC) και την αγορά λιγότερων πραγμάτων (τα 3 R: μείωση, επαναχρησιμοποίηση, ανακύκλωση).<br/>Ποιος νοιάζεται? Γιατί Χρειαζόμαστε Λύσεις Ρύπανσης;<br/>4. Αξιολόγηση (H5P) (10 λεπτά)<br/>5. Καθαρίστε τυχόν βρωμιές (5-10 λεπτά).</p> |
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|---------------------------------|------------------|---------------------------------------------------------------|
| <b>Μέθοδοι<br/>Περιεχομένου</b> | <b>Παράδοσης</b> | διάλεξη, συζήτηση, καταιγισμός ιδεών, έρευνα, ομαδική εργασία |
| <b>Μέθοδος Αξιολόγησης</b>      |                  | H5P                                                           |
| <b>Παραπομπές</b>               |                  |                                                               |

### 1.3 Μαθησιακή Ενότητα 3- Ρύπανση: Όξινη βροχή pH

#### 1.3.1 Ιστορικό

Δώστε μια σύντομη περίληψη του θέματος ή της έννοιας που θα καλυφθεί στο μάθημα. Συμπεριλάβετε τη σημασία και τη συνάφειά του με το πρόγραμμα σπουδών και γιατί είναι σημαντικό να μαθαίνουν οι μαθητές.

Μια ουσία που δεν είναι ούτε όξινη ούτε βασική είναι ουδέτερη. Η κλίμακα pH μετρά το όξινο ή βασικό επίπεδο μιας ουσίας. Η κλίμακα pH κυμαίνεται από 0 έως 14. Ένα pH 7 είναι ουδέτερο, ενώ ένα pH μικρότερο από 7 είναι όξινο και ένα pH μεγαλύτερο από 7 είναι βασικό. Το καθαρό νερό είναι ουδέτερο. Ωστόσο, όταν τα χημικά αναμιγνύονται με νερό, το μείγμα μπορεί να γίνει είτε όξινο είτε βασικό.

Η όξινη βροχή είναι βροχή που είναι πιο όξινη από όσο θα έπρεπε. Η όξινη βροχή είναι ένα περίπλοκο πρόβλημα που επηρεάζει τη χημεία του εδάφους και του νερού, καθώς και τους κύκλους ζωής των φυτών και των ζώων στην ξηρά και στο νερό.

Το νερό κινείται μέσα από τον αέρα, τα ρυάκια, τις λίμνες, τους ωκεανούς και κάθε ζωντανό φυτό και ζώο στον υδρολογικό κύκλο. Όταν σχηματίζονται σταγονίδια νερού και πέφτουν στη Γη, μαζεύουν σωματίδια όπως η σκόνη και οι χημικές ουσίες που επιπλέουν στον αέρα. Ακόμη και ο καθαρός, μη μολυσμένος αέρας περιέχει σωματίδια όπως σκόνη ή γύρη. Ο καθαρός αέρας περιέχει επίσης φυσικά αέρια όπως το διοξείδιο του άνθρακα (CO<sub>2</sub>). Η αλληλεπίδραση μεταξύ των σταγονιδίων νερού και του CO<sub>2</sub> στην ατμόσφαιρα δίνει στη βροχή pH 5,6, καθιστώντας ακόμη και την καθαρή βροχή ελαφρώς όξινη. Ωστόσο, όταν η βροχή περιέχει ρύπους, ειδικά SO<sub>2</sub> και NO<sub>x</sub>, το νερό της βροχής μπορεί να γίνει πολύ όξινο.

Η όξινη βροχή και η ατμοσφαιρική ρύπανση που την προκαλεί μπορούν να βλάψουν σοβαρά τα οικοσυστήματα.

Κάθε οικοσύστημα είναι πολύ διασυνδεδεμένο και οι οργανισμοί που ζουν εκεί βασίζονται σε μεγάλο βαθμό ο ένας στον άλλο. Για παράδειγμα, τα οικοσυστήματα έχουν τροφικούς ιστούς, όπου τα είδη εξαρτώνται το ένα από το άλλο για τροφή. Εάν κάποιο ζώο επηρεάζεται, το ίδιο συμβαίνει και με πολλά άλλα. Έτσι η όξινη βροχή μπορεί να επηρεάσει ολόκληρα οικοσυστήματα. Η όξινη βροχή μπορεί να βλάψει μόνο λίγους οργανισμούς σε ένα οικοσύστημα, αλλά οτιδήποτε άλλο επηρεάζεται έμμεσα. Η ζημιά που προκαλεί η όξινη βροχή μπορεί επίσης να πάρει χρόνια ή και δεκαετίες για να αντιστραφεί.



### 1.3.2 Περιεχόμενο

| <b>Παιδαγωγικό μοντέλο LearnSTEM</b>               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ενότητα 3: Ρύπανση: Όξινη βροχή pH</b>          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Στόχος της ενότητας/της μαθησιακής ενότητας</b> | Ο στόχος αυτής της ενότητας είναι να γνωρίζει γιατί είναι σημαντική η καταπολέμηση της όξινης βροχής                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Διάρκεια</b>                                    | <b>90 – 120 λεπτά</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Στόχοι μάθησης</b>                              | Με την επιτυχή ολοκλήρωση αυτής της ενότητας/μαθησιακής ενότητας (LU), οι εκπαιδευόμενοι θα είναι σε θέση να:<br><ol style="list-style-type: none"><li>1. περιγράψουν τι είναι η όξινη βροχή και το pH.</li><li>2. κατανοήσουν την έννοια της χημικής ισορροπίας (pH) ως έναν τρόπο για να διευκρινιστεί τι είναι και τι σημαίνει «οξύ» στο πλαίσιο της «όξινης βροχής».</li><li>3. προσδιορίσουν τη φυσική και ανθρωπογενή συμβολή στο σχηματισμό όξινης βροχής.</li><li>4. δείξουν κατανόηση της κλίμακας pH.</li><li>5. προσδιορίζουν τις επιπτώσεις της όξινης βροχής στο περιβάλλον και την ανθρώπινη υγεία.</li><li>6. εξερευνήσουν επιλογές για τη μείωση της ανθρωπογενούς συμβολής στον σχηματισμό όξινης βροχής.</li></ol> |
| <b>Απαιτούνται πόροι και υλικά</b>                 | - διδακτικό βίντεο (WP2-P2-LearnSTEM-Learning resource-Pollution_Acid Rain pH_EN.mp4),<br>- PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Acid Rain pH_EN.pptx),<br>- πρόσθετοι πόροι (WP2-P2-LearnSTEM_text_Acid Rain pH-ADDITIONAL RESOURCES_EN.docx),<br>- αξιολόγηση (H5P) (WP2-P2-LearnSTEM_text_Όξινη βροχή pH-H5P_EN.docx),<br>- πείραμα (παρόμοιο με το βίντεο που παρουσιάστηκε παραπάνω)                                                                                                                                                                                                                                                                                                                               |
| <b>Διαδικασία</b>                                  | Εκπαιδευτικά βήματα που πρέπει να ακολουθήσουν οι εκπαιδευόμενοι:<br><ol style="list-style-type: none"><li>1. Παρουσίαση και συζήτηση για το τι είναι όξινη βροχή; Ποια αέρια προκαλούν όξινη βροχή; Τι είδους ρύπανση προκαλεί όξινη βροχή; Τι είναι το pH; Σε ποια μορφή μπορεί να εμφανιστεί η όξινη βροχή; (υγρή, ξηρή). (15-20 λεπτά).</li><li>2. Αναφέρετε ορισμένες ανθρώπινες δραστηριότητες που προκαλούν ζημιές (10 λεπτά).</li><li>3. Εμφάνιση του βίντεο (10 λεπτά)</li><li>4. Δημιουργήστε ένα πείραμα (παρόμοιο με το βίντεο που</li></ol>                                                                                                                                                                             |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|  | <p>εμφανίζεται) για να δείξετε τις επιπτώσεις της όξινης βροχής στη θάλασσα, τη ζωή των ζώων, τα δάση, το έδαφος, τη βλάστηση, τα κτίρια, τα μνημεία και τους ανθρώπους. (20-30 λεπτά)</p> <p><b>ΠΕΙΡΑΜΑ</b></p> <p><b>Υλικά</b></p> <p>ξύδι<br/>νερό<br/>2 κομμάτια αυγού μεσαίου μεγέθους<br/>2 μικρά πράσινα φύλλα<br/>δύο συνδετήρες<br/>δύο δοχεία με καπάκι</p> <p><b>Διαδικασία</b></p> <p>Πριν από τη δραστηριότητα, κάντε προβλέψεις. Εάν το ξύδι περιέχει οξύ, τότε πώς θα αλλάξουν ορισμένα αντικείμενα που τοποθετούνται στο ξύδι; Εάν αυτά τα αντικείμενα τοποθετούνταν στο νερό, θα άλλαζαν με τον ίδιο τρόπο όπως στο ξύδι;</p> <ol style="list-style-type: none"> <li>1. Ρίξτε ξύδι σε ένα δοχείο. Τοποθετήστε ένα κομμάτι τσόφλι αυγού, ένα φύλλο και έναν συνδετήρα στο δοχείο. Βάλτε το καπάκι στο δοχείο.</li> <li>2. Ρίξτε νερό στο άλλο δοχείο. Τοποθετήστε ένα κέλυφος αυγού, ένα φύλλο και έναν συνδετήρα σε αυτό το δοχείο. Βάλτε το καπάκι στο δοχείο.</li> <li>3. Αφήστε τα δύο σφραγισμένα δοχεία να καθίσουν όλη τη νύχτα.</li> <li>4. Αφαιρέστε τα καπάκια του δοχείου. Παρατηρήστε τυχόν αλλαγές που έγιναν στα δύο δοχεία. Καταγράψτε τις παρατηρήσεις.</li> </ol> <p><b>Αποτελέσματα</b></p> <p>Στο δοχείο με νερό, τα αντικείμενα δεν θα εμφανίζουν αισθητές αλλαγές. Στο δοχείο με το ξύδι, το κέλυφος του αυγού θα είναι μαλακό, το φύλλο θα έχει καφέ κηλίδες πάνω του και ο συνδετήρας δεν θα παρουσιάζει αισθητή αλλαγή. Αυτή η δραστηριότητα δείχνει ότι τα όξινα διαλύματα μπορεί να είναι επιβλαβή.</p> <p><b>Επεκτάσεις</b></p> <p>Μετρήστε το οξύ σε διάφορα διαλύματα χρησιμοποιώντας φθηνά χαρτιά pH.<br/>Προτάσεις για λύσεις προς δοκιμή είναι:</p> <p>χυμός λεμονιού (pH 2,0)<br/>ξύδι (2,2)<br/>χυμός μήλου (3,0)<br/>χυμός ντομάτας (4.2)<br/>γάλα (6.2)<br/>καθαρό νερό (7.0)</p> <p>Συγκρίνετε τις τιμές pH του διαλύματος με όξινη βροχή</p> |
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|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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|                                       | <p>(κάτω από 5,6) και κανονική βροχή (πάνω από 5,6). Εξηγήστε ότι ορισμένα τρόφιμα που τρώμε έχουν υγιή οξέα όπως το κιτρικό οξύ, το οποίο δεν είναι επιβλαβές. Ωστόσο, υπάρχουν ισχυρότερα οξέα, τα οποία είναι προϊόντα εργοστασίων και βιομηχανιών, τα οποία είναι επιβλαβή.</p> <p>5. Συζητήστε τα ευρήματα και συσχετίστε με θέματα που έχουμε να αντιμετωπίσουμε στην πραγματική ζωή σχετικά με τη διάβρωση του εδάφους, την υποβάθμιση της θαλάσσιας ζωής, την υποβάθμιση των τοίχων, την εξαφάνιση δασών και ειδών, την υποβάθμιση της ανθρώπινης ζωής. (15-20 λεπτά).</p> <p>6. Αξιολόγηση (H5P) (10 λεπτά)</p> <p>7. Καθαρίστε τυχόν βρωμιές (5 λεπτά).</p> |
| <b>Μέθοδοι Παράδοσης Περιεχομένου</b> | διάλεξη, συζήτηση, καταιγισμός ιδεών, έρευνα, ομαδική εργασία                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Μέθοδος Αξιολόγησης</b>            | <b>H5P</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Παραπομπές</b>                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## 1.4 Μαθησιακή Ενότητα 4- Ρύπανση: Λιπάσματα, Όξινη βροχή και ανάπτυξη φυκιών

### 1.4.1 Ιστορικό

Δώστε μια σύντομη περίληψη του θέματος ή της έννοιας που θα καλυφθεί στο μάθημα. Συμπεριλάβετε τη σημασία και τη συνάφειά του με το πρόγραμμα σπουδών και γιατί είναι σημαντικό να μαθαίνουν οι μαθητές.

Οι επιπτώσεις της όξινης βροχής φαίνονται πιο ξεκάθαρα σε υδάτινα περιβάλλοντα όπως ρέματα, λίμνες και έλη. Η όξινη βροχή ρέει σε ρυάκια, λίμνες και έλη αφού πέσει σε δάση, χωράφια, κτίρια και δρόμους. Η όξινη βροχή πέφτει επίσης απευθείας στους υδρόβιους οικοτόπους.

Οι περισσότερες λίμνες και ρυάκια έχουν pH μεταξύ 6 και 8, επειδή η ρυθμιστική ικανότητα του εδάφους συνήθως εξουδετερώνει την ελαφρώς όξινη, καθαρή βροχή. Οι λίμνες και τα ρέματα γίνονται όξινα (η τιμή του pH μειώνεται) όταν το ίδιο το νερό της βροχής είναι τόσο όξινο που το περιβάλλον έδαφος δεν μπορεί να ρυθμίσει τη βροχή αρκετά για να την εξουδετερώσει. Για το λόγο αυτό, ορισμένες λίμνες σε περιοχές όπου το έδαφος δεν έχει μεγάλη ρυθμιστική ικανότητα είναι φυσικά όξινες ακόμη και χωρίς όξινη βροχή.

Καθώς οι λίμνες και τα ρυάκια γίνονται πιο όξινα, ο αριθμός και τα είδη των ψαριών και άλλων υδρόβιων φυτών και ζώων που ζουν σε αυτά τα νερά μειώνονται. Μερικοί τύποι φυτών και ζώων είναι σε θέση να ανέχονται τα όξινα νερά. Άλλα, ωστόσο, είναι ευαίσθητα στα οξέα και θα φύγουν ή θα πεθάνουν καθώς το pH μειώνεται.

Τα περισσότερα εμπορικά λιπάσματα περιέχουν υψηλά επίπεδα αζώτου, φωσφόρου και καλίου, καθώς η ανάπτυξη των φυτών περιορίζεται τυπικά από αυτά τα θρεπτικά συστατικά. Όταν





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το λίπασμα ξεπλένεται σε ένα φυσικό σώμα νερού, προκαλεί ταχεία ανάπτυξη μικροφυκών (φυτοπλαγκτόν) και μακροφυκών. Αυτή η περίσσεια άλγης προκαλεί πολλά προβλήματα.

#### 1.4.2 Περιεχόμενο

| Παιδαγωγικό μοντέλο LearnSTEM                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ενότητα 4: Ρύπανση: Λιπάσματα, Όξινη βροχή και ανάπτυξη φυκιών |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Στόχος της ενότητας/της μαθησιακής ενότητας</b>             | Ο στόχος αυτής της ενότητας είναι να ευαισθητοποιήσει την όξινη βροχή και τις επιπτώσεις της στον φυσικό κόσμο. Οι εκπαιδευόμενοι θα μπορούν επίσης να μάθουν για τον ευτροφισμό και την επιβλαβή ανάπτυξη φυκιών και τις συνέπειες στο περιβάλλον.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Διάρκεια</b>                                                | <b>90 - 120 λεπτά</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Στόχοι μάθησης</b>                                          | Με την επιτυχή ολοκλήρωση αυτής της ενότητας/μαθησιακής ενότητας (LU), οι εκπαιδευόμενοι θα είναι σε θέση: <ol style="list-style-type: none"><li>1. να γνωρίζουν τις δυσμενείς επιπτώσεις της όξινης βροχής και τους τρόπους με τους οποίους οι άνθρωποι επηρεάζουν το περιβάλλον.</li><li>2. να αναπτύξουν δεξιότητες κριτικής σκέψης αναλύοντας τις αιτίες και τις επιπτώσεις της όξινης βροχής.</li><li>3. να κατανοήσουν τον παγκόσμιο αντίκτυπο της όξινης βροχής και τη σημασία της διατήρησης του περιβάλλοντος.</li><li>4. να κατανοήσουν το πρόβλημα με τις επιβλαβείς ανθίσεις φυκιών</li><li>5. να εξηγήσει τη διαδικασία του ευτροφισμού και ποιοι παράγοντες μπορούν να τον μεγεθύνουν ή να τον μετριάσουν.</li><li>6. να αποκτήσουν περισσότερη περιβαλλοντική συνείδηση για δράση.</li></ol> |
| <b>Απαιτούνται πόροι και υλικά</b>                             | <ul style="list-style-type: none"><li>- διδακτικό βίντεο (WP2-P2-LearnSTEM-Learning resource_Fertilizer, Acid rain and algae growth_EN.mp4),</li><li>- PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Λιπάσματα, όξινη βροχή και ανάπτυξη φυκιών_EN.pptx),</li><li>-πρόσθετοι πόροι (WP2-P2-LearnSTEM_text_Λιπάσματα, όξινη βροχή και ανάπτυξη φυκιών_ΠΡΟΣΘΕΤΕΣ ΠΟΡΟΙ_EN.docx),</li><li>-αξιολόγηση (H5P) (WP2-P2-LearnSTEM_text_Fertilizer, Acid rain and algae growth-H5P_EN.docx),</li><li>-πείραμα (παρόμοιο με το βίντεο που παρουσιάστηκε παραπάνω)</li></ul>                                                                                                                                                                                                                                      |
| <b>Διαδικασία</b>                                              | Εκπαιδευτικά βήματα που πρέπει να ακολουθήσουν οι εκπαιδευόμενοι: <ol style="list-style-type: none"><li>1. Παρουσίαση και συζήτηση (15-20 λεπτά).</li><li>2. Εισαγωγή του θέματος του ευτροφισμού και της</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |



**Μάθετε STEM**  
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επιβλαβούς ανάπτυξης φυκών και των συνεπειών στο περιβάλλον. (10 λεπτά)

3. Εμφάνιση του βίντεο (10 λεπτά)

4. ΠΕΙΡΑΜΑ (30-40 λεπτά)

**Υλικά:**

πλαστικά μπουκάλια δύο λίτρων με κομμένα τα πάνω ή γυάλινα βάζα, απορρυπαντικό πλυντηρίου πιάτων με βάση το φωσφορικό άλας, ξύδι, λίπασμα, απεσταγμένο νερό, νερό βρύσης, νερό λίμνης.

**Διαδικασία:**

Προετοιμάστε τα μπουκάλια: Γεμίστε ένα μπουκάλι με απεσταγμένο νερό, ένα μπουκάλι με νερό βρύσης και μερικά μπουκάλια με νερό λίμνης.

Προσθέστε φωσφορικά άλατα σε μερικά μπουκάλια γεμάτα με νερό λίμνης προσθέτοντας το απορρυπαντικό πλυντηρίου πιάτων με υψηλή περιεκτικότητα σε φωσφορικά άλατα. Προσθέστε ξύδι και λίπασμα σε άλλα μπουκάλια. Προσθέστε διαφορετικές ποσότητες. Σημειώστε καθαρά τα μπουκάλια και ανακατέψτε καλά. Αφήστε ένα μπουκάλι νερό λίμνης ως έλεγχο.

Τοποθετήστε τα μπουκάλια μαζί σε ένα ζεστό μέρος που δέχεται άφθονο ηλιακό φως.

**Παρατηρήσεις:** Ορίστε έναν-δύο μαθητές να καταγράφουν τις παρατηρήσεις για κάθε μέρα στο Διάγραμμα Παρατήρησης. Οι μαθητές θα πρέπει να καταγράφουν τυχόν υποκειμενικές παρατηρήσεις που έχουν σχετικά με τις φιάλες. Τα πράγματα που πρέπει να αναζητήσετε περιλαμβάνουν: συνολική εμφάνιση, θολότητα, χρώμα, ιζήματα και οσμή.

Διατηρήστε τα επίπεδα του νερού σταθερά από μέρα σε μέρα προσθέτοντας αρκετό νερό για να αντικαταστήσετε την απώλεια από την εξάτμιση. Εκτός αν το νερό σας είναι πολύ χλωριωμένο, το νερό της βρύσης θα κάνει.

**Συζήτηση στην τάξη:** Στο τέλος δύο εβδομάδων, συγκεντρώστε την τάξη και συζητήστε τα αποτελέσματα. Ποια ήταν η σχέση μεταξύ των θρεπτικών ουσιών και της ανάπτυξης των φυκών; Τι έκαναν τα φύκια στην ποιότητα του νερού; Ποιος θα ήταν ο καλύτερος τρόπος για να μην αναπτυχθούν φύκια σε λίμνες και θάλασσες; Φροντίστε να αναφέρετε το θέμα της μη σημειακής ρύπανσης. Πώς μπορεί να προληφθεί;

**Επιλογές:**

Οι δάσκαλοι μπορεί να επιλέξουν να ζητήσουν από τους εκπαιδευόμενους να μετρήσουν τις συγκεντρώσεις των φυκών προετοιμάζοντας μικροσκοπικές διαφάνειες και στη συνέχεια μετρώντας τον αριθμό των φυκών που βρίσκονται σε ένα μικροσκοπικό πεδίο. Αυτά τα δεδομένα θα μπορούσαν στη συνέχεια να καταγραφούν και να γραφτούν σε ένα γράφημα.

Ένα μπουκάλι μπορεί να παρασκευαστεί πανομοιότυπα με ένα από τα άλλα, αλλά στη συνέχεια να τοποθετηθεί





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|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                       | <p>σε μια σκοτεινή περιοχή για να παράγει την επίδραση της απουσίας ηλιακού φωτός στην ανάπτυξη των φυκιών.</p> <p>5. Συζητήστε τα ευρήματα και συσχετίστε με θέματα που έχουμε να αντιμετωπίσουμε στην πραγματική ζωή σχετικά με τη διάβρωση του εδάφους, την υποβάθμιση της θαλάσσιας ζωής, την υποβάθμιση των τοίχων, την εξαφάνιση των δασών και των ειδών, την υποβάθμιση της ανθρώπινης ζωής. (15-20 λεπτά).</p> <p>6. Αξιολόγηση (H5P) (10 λεπτά)</p> <p>7. Καθαρίστε τυχόν βρωμιές (5 λεπτά).</p> |
| <b>Μέθοδοι Παράδοσης Περιεχομένου</b> | διάλεξη, συζήτηση, καταιγισμός ιδεών, έρευνα, ομαδική εργασία                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Μέθοδος Αξιολόγησης</b>            | H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Παραπομπές</b>                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |



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**Modelul pedagogic LearnSTEM**  
**Manualul de implementare a practicilor STEM**

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## 1. Resursele de învățare

### 1.1 Unitatea de învățare 1- Poluarea: Petrolierul deversează petrol

#### 1.1.1 Context

Oferiți un scurt rezumat al subiectului sau conceptului care va fi abordat în cadrul lecției. Includeți importanța și relevanța acestuia pentru curriculum și de ce este important ca elevii să-l învețe.

#### 1.1.2 Conținut

| <b>LearnSTEM Model pedagogic</b>                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Modulul 1: Poluarea: Petrolierul deversează petrol</b>                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Scopul modulului/unității de învățare</b>                                                                                                 | Scopul acestui modul este de a studia efectele pe care le au deversările de petrol asupra mediului și de a atrage atenția asupra curățării deversărilor de petrol și a importanței sale esențiale.                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Durata</b>                                                                                                                                | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Obiectivele învățării</b>                                                                                                                 | La finalizarea cu succes a acestui modul/unitate de învățare (UÎ), elevii vor fi capabili:<br><ol style="list-style-type: none"><li>1 Să înțeleagă efectele provocate de deversările de petrol asupra mediului.</li><li>2 Să înțeleagă diferitele metode de curățare a deversărilor de petrol.</li><li>3 Să lucreze în echipă pentru a identifica cea mai bună metodă (cele mai bune metode) de curățare a unui exemplu de deversare de petrol.</li><li>4 Să-și îmbunătățească abilitățile de comunicare prin participarea la discuțiile din clasă și prin prezentarea rezultatelor lor</li></ol> |
| <b>Resurse și materiale utilizate</b><br>(fișă de lucru, diagrame, fișe, videoclip didactic, fragment din cărți/manuale, hărți mentale etc.) | <ul style="list-style-type: none"><li>● material video didactic (WP2-P2-LearnSTEM- Learning resource-Pollution_The Tanker spills oil.mp4),</li><li>● PPT (WP2-P2-LearnSTEM-Learning resource- Pollution_The Tanker spills oil_RO.pptx),</li><li>● resurse suplimentare (WP2-P2-LearnSTEM_text_The Tanker spills oil-ADDITIONAL RESOURCES_RO.docx),</li><li>● evaluare (H5P) (WP2-P2-LearnSTEM_text_The Tanker spills oil-H5P_RO.docx),</li><li>● experiment (asemănător cu materialul video prezentat mai sus)</li></ul>                                                                          |
| <b>Procedura</b>                                                                                                                             | Etapele de instruire pe care trebuie să le urmeze elevii:<br><ol style="list-style-type: none"><li>1. Prezentarea și dezbaterile deversărilor de petrol. Invitați elevii să reamintească ce daune poate provoca o</li></ol>                                                                                                                                                                                                                                                                                                                                                                       |



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|                                                                                                | <p>deversare de petrol asupra mediului natural (15-20 min.).</p> <ol style="list-style-type: none"> <li>Prezentați provocările pe care le presupune curățarea unei deversări de petrol și ce metode se folosesc (10 min.).</li> <li>Prezentarea videoclipului (10 min.)</li> <li>Creați un model de deversare de petrol și discutați conceptul de model. Formați echipa și testați sistematic numeroasele metode diferite de curățare a modelului de deversare de petrol. Elevii ar trebui să își consemneze constatările. (30-40 min).</li> </ol> <p><b>Experiment - Curățarea deversărilor de petrol</b></p> <p><b>Materiale:</b></p> <ul style="list-style-type: none"> <li>Bile de bumbac</li> <li>Recipient</li> <li>Burete, sfoară</li> <li>Ulei vegetal: cantitatea depinde de recipient</li> <li>Linguri de plastic</li> <li>Detergent de vase</li> <li>Pahare de plastic: pentru a pune detergentul și bilele de bumbac în ele</li> <li>Pudră de cacao: pentru a o amesteca cu ulei și a face să arate ca și cum ar fi petrol brut</li> <li>Pene de pasăre</li> </ul> <p><b>Procedura:</b></p> <p>Fiecare grupă va trebui să curețe "uleiul" de la o scurgere de petrol simulată, incluzând pene pentru a reprezenta viața marină. Activitatea se poate relua în diferite moduri, în funcție de constrângerile clasei. S-ar putea stabili o limită de timp pentru a le permite elevilor să curețe cât mai mult posibil scurgerea de petrol și penele. Se discută apoi provocările cu care se confruntă diversele metode și materiale folosite pentru a încerca eliminarea petrolului. Deoarece uleiul este separat de apă, pot fi observate și măsurate comparații calitative, care pot fi apoi folosite pentru a finaliza problemele matematice legate de această activitate. Discutați constatările și decideți ce metode au funcționat cel mai bine. Explicați modul în care diferitele metode din cadrul experimentului au legătură cu metodele folosite în viața reală.</p> <ol style="list-style-type: none"> <li>Evaluare (H5P) (10 min)</li> <li>Eliminați uleiul modelului deversat și curățați orice murdărie (5-10 min).</li> </ol> |
| <p><b>Metode de învățare</b></p> <p>(prelegere, discuții, cercetare, lucru în echipă etc.)</p> | <p>prelegere, discuții, brainstorming, cercetare, lucru în echipă</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <p>Metodă de evaluare</p>                                                                      | <p>H5P</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |



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|                               |  |
| Referințe (dacă este necesar) |  |

## 1.2 Unitatea de învățare 2- Poluarea: Dioxidul de sulf distruge plantele și clădirile

### 1.2.1 Context

Oferiți un scurt rezumat al subiectului sau conceptului care va fi abordat în cadrul lecției. Includeți importanța și relevanța acestuia pentru curriculum și de ce este important ca elevii să-l învețe.

### 1.2.2 Conținut

| <b>LearnSTEM Model pedagogic</b><br><b>Modulul 2: Poluarea: Dioxidul de sulf distruge plantele și clădirile</b>                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Scopul modulului/unității de învățare</b>                                                                                                 | Scopul acestui modul este de a-i ajuta pe elevi să înțeleagă, prin intermediul unei varietăți de activități, problemele de mediu pe care le provoacă dioxidul de sulf ca formă de poluare ce rezultă în principal din arderea combustibililor fosili.                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Durata</b>                                                                                                                                | <b>90 – 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Obiectivele învățării</b>                                                                                                                 | La finalizarea cu succes a acestui modul/unitate de învățare (UÎ), elevii vor fi capabili: <ol style="list-style-type: none"><li>1. Să identifice unele dintre principalele cauze, efecte și surse ale poluării aerului.</li><li>2. Să explice efectele dioxidului de sulf asupra vegetației.</li><li>3. Să explice efectele dioxidului de sulf asupra apei.</li><li>4. Să explice efectele dioxidului de sulf asupra obiectelor create de om.</li><li>5. Să explice efectele dioxidului de sulf asupra oamenilor.</li><li>6. Să descrie ce se poate face pentru a rezolva problema dioxidului de sulf.</li></ol>     |
| <b>Resurse și materiale utilizate</b><br>(fișă de lucru, diagrame, fișe, videoclip didactic, fragment din cărți/manuale, hărți mentale etc.) | <ul style="list-style-type: none"><li>• Material video didactic (WP2-P2-LearnSTEM-Learning resource-Pollution_Sulfur Dioxide Destroys Plants and Buildings_EN.mp4),</li><li>• PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Sulfur Dioxide Destroys Plants and Buildings_RO.pptx),</li><li>• resurse suplimentare (WP2-P2-LearnSTEM_text_Sulfur Dioxide Destroys Plants and Buildings-ADDITIONAL RESOURCES_RO.docx),</li><li>• evaluare (H5P) (WP2-P2-LearnSTEM_text_Sulfur Dioxide Destroys Plants and Buildings-H5P_RO.docx),</li><li>• experiment (asemănător cu materialul video prezentat mai sus)</li></ul> |



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### Procedura

Etapele de instruire pe care trebuie să le urmeze elevii:

1. Prezentare și discuții: Ce sunt poluanții atmosferici? Surse de poluare a aerului. Cum ne afectează poluanții atmosferici? Acidul sulfuric se formează atunci când vaporii de apă interacționează cu oxizii de sulf, ca produs secundar al arderii cărbunelui, din gazele vulcanilor etc. Ploile acide modifică pH-ul sistemelor acvatice. (20 min.)
2. Vizualizarea materialului video (10 min.)

#### **Experimentul 1 Ploaie acidă asupra clădirilor. (20-25 min)**

##### **Scopul**

Să demonstreze efectul ploilor acide asupra statuiilor și clădirilor.

##### **Obiectivul**

Elevii vor învăța cum ploaia acidă este o problemă de poluare a aerului.

##### **Materiale**

Cretă

Pahare, cești sau borcane transparente

Oțet

Opțional: Cuie lungi

##### **Procedura**

Explicați că acizii reacționează chimic cu calcarul.

Explicați că oțetul este un acid iar creta este calcar, sau dați-le elevilor hârtie de pH și rugați-i să determine dacă oțetul este un acid sau o bază.

Dați fiecărui grup o bucată de cretă și puteți alege să le dați un cui lung pentru a grava un desen pe partea laterală a cretei. De obicei, aleg linii neregulate sau inițialele elevilor. Acest lucru va face ca creta lor să fie unică și va reprezenta statuia lor.

Adăugați oțet în paharul/ceasca/borcanel grupurilor și rugați-i să-și scufunde statuia, observând cu atenție.

Întrebați elevii despre observațiile lor.

Întrebați elevii ce s-ar fi întâmplat dacă ar fi folosit ploaie acidă în locul oțetului. Poate doriți să le reamintiți în acest moment faptul că oțetul este mai acid decât ploaia acidă.

#### **Experimentul 2 Ploaia acidă și plantele (20-25 min)**

##### **Scopul**

Să demonstreze efectul ploilor acide asupra plantelor

##### **Obiectivul**

Elevii vor învăța cum ploaia acidă este o problemă de poluare a aerului.

##### **Materiale**

Etichete

Plante

Sticle de apă sau sticle cu pulverizator



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|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                | <p>Cană de măsurat/cilindru<br/>Pixuri<br/>Hârtie de pH<br/>Oțet<br/>Apă</p> <p><b>Procedura</b></p> <p>Explicați-le elevilor că vor face un experiment despre acizi, baze și plante. Ce cred ei că se va întâmpla dacă udăm plantele cu lichide cu pH-uri diferite? Ce schimbări se așteaptă să observe? Cât timp cred ei că le va lua plantelor să se modifice?</p> <p>Împărțiți elevii în grupuri.</p> <p>Dați fiecărui grup câte o plantă și o sticlă de apă/pulverizator.</p> <p>Dați fiecărui grup rețeta pentru lichidul lor (a se vedea mai jos).</p> <p>Rețetă pentru lichide</p> <p>Grupa 1: apă<br/>Grupa 2: 5 părți apă, 1 parte oțet<br/>Grupa 3: 2 părți apă, 1 parte oțet</p> <p>Cereți grupelor să eticheteze sticla de apă și planta cu numărul grupei lor sau permiteți-le acestora să-și stabilească un nume de grup.</p> <p>Rugați grupele să își asume responsabilitatea de a-și uda planta în fiecare zi și să ia notițe pentru a observa dacă a apărut vreo schimbare în ceea ce privește culoarea, frunzișul și starea de sănătate în următoarele două săptămâni.</p> <p>La sfârșitul celor două săptămâni, purtați o discuție despre diferențele observate la plantele pe care le-au îngrijit.</p> <p>Întrebați elevii dacă ar trebui să-i îngrijoreze ploile acide? De ce? Cum putem încerca să o prevenim? (Amintiți-vă sursele, fabrici, automobile și utilități). Răspunsurile ar trebui să se refere la a conduce mai puțin (folosirea în comun a mașinii, autobuzul, bicicleta și mersul pe jos), la economisirea energiei (stingerea luminilor, reducerea consumului de aer condiționat) și la a cumpăra mai puține lucruri (cei 3 R: reducere, reutilizare, reciclare). Cui îi pasă? De ce avem nevoie de soluții pentru poluare?</p> <p>4. Evaluarea (H5P) (10 min)<br/>5. Faceți ordine și curățenie. (5-10 min).</p> |
| <p><b>Metode de învățare</b></p> <p>(prelegere, discuții, cercetare, lucru în echipă etc.)</p> | <p>prelegere, discuție, brainstorming, cercetare, lucru în echipă</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p>Metodă de evaluare</p>                                                                      | <p>H5P</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |



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| Referințe (dacă este necesar) |  |

### 1.3 Unitatea de învățare 3 - Poluarea: Ploaia acidă - Controlul acidității și al valorilor pH-ului

#### 1.3.1 Context

Oferiți un scurt rezumat al subiectului sau conceptului care va fi abordat în cadrul lecției. Includeți importanța și relevanța acestuia pentru curriculum și de ce este important ca elevii să-l învețe.

#### 1.3.2 Conținut

| LearnSTEM Model pedagogic<br>Modulul 3: Poluarea: Ploaia acidă - Controlul acidității și al valorilor pH-ului                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Scopul modulului/unității de învățare</b>                                                                                    | Scopul acestui modul este de a afla de ce este importantă combaterea ploilor acide.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Durata</b>                                                                                                                   | <b>90 – 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Obiectivele învățării</b>                                                                                                    | <p>La finalizarea cu succes a acestui modul/unitate de învățare (UÎ), elevii vor fi capabili:</p> <ol style="list-style-type: none"> <li>1. să explice ce sunt ploile acide și pH-ul.</li> <li>2. să înțeleagă conceptul de echilibru chimic (pH) ca o modalitate de a clarifica ce este și ce înseamnă "acid" în contextul "ploilor acide".</li> <li>3. să determine contribuțiile naturale și antropice la formarea ploilor acide.</li> <li>4. să demonstreze că înțeleg scara pH-ului.</li> <li>5. să determine care sunt efectele ploilor acide asupra mediului și asupra sănătății umane.</li> <li>6. să exploreze opțiunile de reducere a contribuției omului la formarea ploilor acide.</li> </ol> |
| <b>Resurse și materiale utilizate</b><br>(fișă de lucru, diagrame, fișe, videoclip didactic, fragment din cărți/manuale, hărți) | <ul style="list-style-type: none"> <li>• material video didactic (WP2-P2-LearnSTEM-Learning resource-Pollution_Acid Rain pH_EN.mp4),</li> <li>• PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Acid Rain pH_RO.pptx),</li> <li>• resurse suplimentare (WP2-P2-LearnSTEM_text_Acid Rain</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                      |





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| mentale etc.)    | <p>pH-ADDITIONAL RESOURCES_RO.docx),</p> <ul style="list-style-type: none"><li>● evaluare (H5P) (WP2-P2-LearnSTEM_text_Acid Rain pH-H5P_RO.docx),</li><li>● experiment (asemănător cu materialul video prezentat mai sus)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Procedura</b> | <p>Etapele instruirii pe care trebuie să le urmeze elevii:</p> <ol style="list-style-type: none"><li>1. Prezentare și discuții despre ce este ploaia acidă. Care sunt gazele care provoacă ploile acide? Ce tip de poluare cauzează ploile acide? Ce este pH-ul? Sub ce formă pot apărea ploile acide (umedă, uscată). (15-20 min.).</li><li>2. Menționați câteva activități ale omului care produc daune (10 min.).</li><li>3. Prezentarea materialului video (10 min.).</li><li>4. Creați un experiment (similar cu cel prezentat în video) pentru a demonstra impactul ploilor acide asupra mediului marin, a faunei, pădurilor, solului, vegetației, clădirilor, monumentelor și oamenilor. (20-30 min.)</li></ol> <p><b>EXPERIMENT</b></p> <p><b>Materiale</b></p> <p>oțet<br/>apă<br/>2 bucăți de coajă de ou de mărime medie<br/>2 frunze verzi mici<br/>două agrafe pentru hârtie<br/>două recipiente cu capac</p> <p><b>Procedura</b></p> <p>Înainte de începerea activității, faceți predicții. Dacă oțetul conține acid, atunci cum se vor schimba unele obiecte introduse în oțet? Dacă aceste obiecte ar fi introduse în apă, s-ar schimba în același mod ca și în oțet?</p> <ol style="list-style-type: none"><li>1. Se toarnă oțet într-un recipient. Așezați în recipient o coajă de ou, o frunză și o agrafă pentru hârtie. Puneți capacul pe recipient.</li><li>2. Se toarnă apă în celălalt recipient. Așezați în acest recipient o coajă de ou, o frunză și o agrafă pentru hârtie. Puneți capacul pe recipient.</li><li>3. Se lasă cele două recipiente închise ermetic să stea peste noapte.</li><li>4. Îndepărtați capacele recipientelor. Observați schimbările care au avut loc în cele două recipiente. Notați observațiile.</li></ol> <p><b>Rezultate</b></p> <p>În recipientul cu apă, obiectele nu vor prezenta modificări notabile. În recipientul cu oțet, coaja de ou va fi moale, frunza va avea pete maronii pe ea, iar agrafa nu va prezenta o schimbare notabilă. Această activitate indică</p> |



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|                                                                                                | <p>faptul că soluțiile acide pot fi dăunătoare.</p> <p><b>Extensii</b></p> <p>Măsurați acidul din mai multe soluții folosind hârtii de pH ieftine.</p> <p>Sugestiile pentru soluțiile ce trebuie testate sunt:</p> <p>suc de lămâie (pH de 2,0)</p> <p>oțet (2,2)</p> <p>suc de mere (3,0)</p> <p>suc de roșii (4,2)</p> <p>lapte (6,2)</p> <p>apă pură (7,0)</p> <p>Comparați valorile pH-ului soluției în cazul unei ploii acide (sub 5,6) și al unei ploii normale (peste 5,6). Explicați că unele alimente pe care le consumăm au acizi sănătoși, cum ar fi acidul citric, care nu este dăunător. Cu toate acestea, există acizi mai puternici, care sunt produsele fabricilor și industriilor și care sunt dăunători.</p> <p>5. Discutați concluziile și faceți o corelare cu problemele cu care ne confruntăm în viața reală: eroziunea solului, degradarea vieții marine, degradarea zidurilor, pădurile și dispariția speciilor, degradarea vieții umane. (15-20 min.).</p> <p>6. Evaluarea (H5P) (10 min)</p> <p>7. Faceți ordine și curățenie (5 min).</p> |
| <p><b>Metode de învățare</b></p> <p>(prelegere, discuții, cercetare, lucru în echipă etc.)</p> | <p>prelegere, discuție, brainstorming, cercetare, lucru în echipă</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p>Metodă de evaluare</p>                                                                      | <p><b>H5P</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p>Referințe (dacă este necesar)</p>                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |



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#### 1.4 Unitatea de învățare 4- Poluarea: Fertilizatorul, ploaia acidă și creșterea algelor

##### 1.4.1 Context

Oferiți un scurt rezumat al subiectului sau conceptului care va fi abordat în cadrul lecției. Includeți importanța și relevanța acestuia pentru curriculum și de ce este important ca elevii să-l învețe.

##### 1.4.2 Conținut

| LearnSTEM Model pedagogic                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| Modulul 4: Poluarea: Fertilizatorul, ploaia acidă și creșterea algelor                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Scopul modulului/unității de învățare</b>                                                                                                 | Scopul acestui modul este acela de a atrage atenția asupra ploilor acide și a efectelor acestora asupra mediului înconjurător. De asemenea, elevii vor putea învăța despre eutrofizare și creșterea algelor dăunătoare și despre consecințele acestora asupra mediului.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Durata</b>                                                                                                                                | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Obiectivele învățării</b>                                                                                                                 | <p>La finalizarea cu succes a acestui modul/unitate de învățare (UÎ), cursanții vor fi capabili:</p> <ol style="list-style-type: none"> <li>1. să fie conștienți de efectele negative ale ploilor acide și de modul în care oamenii pot afecta mediul înconjurător.</li> <li>2. să își dezvolte gândirea critică prin analiza cauzelor și efectelor ploilor acide.</li> <li>3. să dobândească o înțelegere a impactului global al ploilor acide și a importanței conservării mediului.</li> <li>4. să înțeleagă problema legată de înmulțirea algelor dăunătoare</li> <li>5. să explice procesul de eutrofizare și care sunt factorii care îl pot amplifica sau atenua.</li> <li>6. să devină mai conștient de mediul înconjurător pentru a acționa.</li> </ol> |
| <b>Resurse și materiale utilizate</b><br>(fișă de lucru, diagrame, fișe, videoclip didactic, fragment din cărți/manuale, hărți mentale etc.) | <ul style="list-style-type: none"> <li>• material video didactic (WP2-P2-LearnSTEM-Learning resource_Fertilizer, Acid rain and algae growth_EN.mp4),</li> <li>• PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Fertilizer, Acid rain and algae growth_RO.pptx),</li> <li>• resurse suplimentare (WP2-P2-LearnSTEM_text_Fertilizer, Acid rain and algae growth_ADDITIONAL RESOURCES_RO.docx),</li> <li>• evaluare (H5P) (WP2-P2-LearnSTEM_text_Fertilizer, Acid rain and algae growth-H5P_RO.docx),</li> <li>• experiment (asemănător cu materialul video prezentat mai sus)</li> </ul>                                                                                                                                                                       |



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| <b>Procedura</b> | <p>Etapele instruirii pe care trebuie să le urmeze elevii:</p> <ol style="list-style-type: none"><li>1. Prezentare și discuții (15-20 min).</li><li>2. Introduceți problema eutrofizării și a creșterii algelor dăunătoare, precum și consecințele asupra mediului. (10 min)</li><li>3. Prezentarea materialului video (10 min.)</li><li>4. <b>EXPERIMENT (30-40 min)</b></li></ol> <p><b>Materiale:</b><br/>sticle de plastic de doi litri cu partea superioară tăiată sau borcane de sticlă, detergent de vase pe bază de fosfați, oțet, îngrășământ, apă distilată, apă de la robinet, apă dintr-un lac.</p> <p><b>Procedura:</b><br/>Pregătiți sticlele: Umpleți o sticlă cu apă distilată, o sticlă cu apă de la robinet și câteva sticle cu apă provenită dintr-un lac.</p> <p>Adăugați fosfați în unele sticle umplute cu apă din lac prin adăugarea detergentului de spălat vase cu conținut ridicat de fosfați. Adăugați oțet și îngrășământ în alte sticle. Adăugați cantități diferite. Etichetați sticlele în mod clar și amestecați bine. Lăsați o sticlă cu apă din lac pentru control.</p> <p>Așezați sticlele împreună într-un loc cald, care să primească multă lumină solară.</p> <p><b>Observații:</b> Desemnați unul sau doi elevi pentru a înregistra observațiile pentru fiecare zi pe fișa de observații. Elevii ar trebui să noteze orice observații subiective pe care le au despre sticle cu apă. Lucrurile la care trebuie să fie atenți sunt: aspectul general, turbiditatea, culoarea, sedimentele și mirosul.</p> <p>Mențineți nivelurile de apă constante de la o zi la alta, adăugând suficientă apă pentru a înlocui pierderile cauzate de evaporare. Cu excepția cazului în care apa dumneavoastră este puternic clorurată, apa de la robinet este suficientă.</p> <p><b>Discuții în clasă:</b> La sfârșitul celor două săptămâni, întruniți clasa și discutați rezultatele. Care a fost relația dintre nutrienți și creșterea algelor? Care a fost efectul algelor asupra calității apei? Care ar fi cea mai bună modalitate de a împiedica creșterea algelor în lacuri și mări? Nu uitați să aduceți în discuție subiectul poluării din surse neidentificate. Cum poate fi ea prevenită?</p> <p><b>Opțiuni:</b> Profesorii ar putea alege ca elevii să măsoare concentrațiile algelor pregătind lamele microscopice și apoi contorizând numărul de alge găsite într-un câmp microscopic. Aceste date pot fi apoi înregistrate și reprezentate pe un grafic.</p> <p>O sticlă poate fi pregătită în mod identic cu una dintre</p> |



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|                                                                                     | <p>celelalte, dar apoi plasată într-o zonă întunecată pentru a produce efectul lipsei luminii solare asupra creșterii algelor.</p> <p>5. Discutați concluziile și faceți conexiuni cu problemele cu care trebuie să ne confruntăm în viața de zi cu zi, cum ar fi eroziunea solului, degradarea vieții marine, degradarea zidurilor, pădurile și dispariția speciilor, degradarea vieții umane. (15-20 min.).</p> <p>6. Evaluarea (H5P) (10 min)</p> <p>7. Faceți ordine și curățenie (5 min).</p> |
| <b>Metode de învățare</b><br>(prelegere, discuții, cercetare, lucru în echipă etc.) | prelegere, discuție, brainstorming, cercetare, lucru în echipă                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Metodă de evaluare                                                                  | H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Referințe (dacă este necesar)                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |



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in weiterführenden Schulen*

ERASMUS+ KA220  
Kooperationspartnerschaften in der Schulbildung

**LearnSTEM**  
**Handbuch zur Umsetzung von MINT-Praktiken**

Kalliopi Ntolou  
IEK Kavallas, Kavala, Griechenland

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**Referenznummer:**  
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## 1 Lernressourcen

### 1.1 Modul 1- Umweltverschmutzung: Der Tanker verschüttet Öl

#### 1.1.1 Hintergrund

Eine Ölpest ist die Freisetzung eines flüssigen Erdölkohlenwasserstoffs in die Umwelt, insbesondere in Meeresgebiete, aufgrund menschlicher Aktivitäten. Der Begriff wird in der Regel für Ölunfälle im Meer verwendet, bei denen Öl in den Ozean oder in Küstengewässer gelangt, aber auch an Land kann es zu Ölunfällen kommen.

Obwohl sie nicht so zerstörerisch sind wie der vom Menschen verursachte globale Klimawandel, können die durch eine Ölpest verursachten Umweltschäden verheerend für die Ökosysteme sein. In dieser Lektion werden einige Grundlagen der aquatischen Ökosysteme vorgestellt und es wird erläutert, wie sie durch die Einleitung von Erdöl verändert werden können.

In dieser Lektion lernen die Schüler\*innen etwas über Ölverschmutzungen in verschiedenen Gewässern und die ökologischen und sozialen Auswirkungen auf die umliegenden Gebiete, einschließlich indigener Gemeinschaften. Anhand praktischer Aktivitäten erkunden die Schüler\*innen die verschiedenen Technologien, die bei der Reinigung und Sanierung eingesetzt werden.

#### 1.1.2 Inhalt

| LearnSTEM                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modul 1: Umweltverschmutzung: Der Tanker verschüttet Öl |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Ziel des Moduls/der Lerneinheit</b>                  | Ziel dieses Moduls ist es, die Auswirkungen von Ölverschmutzungen auf die Umwelt zu untersuchen und ein Bewusstsein für die Beseitigung von Ölverschmutzungen und ihre überragende Bedeutung zu schaffen.                                                                                                                                                                                                                                                                                         |
| <b>Dauer</b>                                            | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Lernziele</b>                                        | Nach erfolgreichem Abschluss dieses Moduls/der Lerneinheit (LU) sind die Schüler*innen in der Lage:<br>1 Die Umweltauswirkungen von Ölverschmutzungen zu verstehen.<br>2 Die verschiedenen Methoden zur Reinigung von Ölverschmutzungen zu verstehen.<br>3 In Teamarbeit die beste(n) Methode(n) zur Beseitigung eines Ölteppichs im Modell zu ermitteln.<br>4 Ihre Kommunikationsfähigkeiten zu verbessern, indem sie an Diskussionen in der Klasse teilnehmen und ihre Ergebnisse präsentieren. |
| <b>Erforderliche</b>                                    | <ul style="list-style-type: none"><li>• didaktisches Video (WP2-P2-LearnSTEM-Learning</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                   |



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| <p><b>Ressourcen/Materialien</b></p> <p>(Arbeitsblatt, Schaubilder, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.)</p> | <p>resource-Pollution_The Tanker spills oil_EN.mp4),</p> <ul style="list-style-type: none"> <li>• PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_The Tanker spills oil_EN.pptx),</li> <li>• zusätzliche Ressourcen (WP2-P2-LearnSTEM_text_The Tanker spills oil-ADDITIONAL RESOURCES_EN.docx),</li> <li>• Bewertung (H5P) (WP2-P2-LearnSTEM_text_The Tanker spills oil-H5P_EN.docx),</li> <li>• Experiment (ähnlich dem oben vorgestellten Video)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <p><b>Verfahren</b></p>                                                                                                                                | <p>Anleitungsschritte, die die Schüler*innen befolgen müssen:</p> <ol style="list-style-type: none"> <li>1. Präsentation und Diskussion über Ölverschmutzungen. Lassen Sie die Schüler*innen sich an die Schäden erinnern, die eine Ölpest in der Natur anrichten kann (15-20 Minuten).</li> <li>2. Stellen Sie die Herausforderungen bei der Beseitigung einer Ölpest vor und erläutern Sie, welche Methoden dabei zum Einsatz kommen (10 Minuten).</li> <li>3. Anzeige des Videos (10 Minuten)</li> <li>4. Erstellen Sie ein Modell einer Ölpest und diskutieren Sie das Konzept eines Modells.</li> </ol> <p>Stellen Sie das Team zusammen und testen Sie systematisch die vielen verschiedenen Methoden zur Beseitigung der Ölpest im Modell. Die Schüler*innen sollten ihre Ergebnisse festhalten. (30-40 min).</p> <p><b>Experiment - Reinigung von Ölverschmutzungen</b></p> <p><b>Materialien:</b></p> <ul style="list-style-type: none"> <li>Wattebällchen</li> <li>Container</li> <li>Schwamm, Schnur</li> <li>Pflanzenöl: Menge je nach Behälter</li> <li>Plastiklöffel</li> <li>Dawn Spülmittel</li> <li>Plastikbecher: zum Einfüllen von Seife und Wattebällchen</li> <li>Kakaopulver: zum Mischen mit Öl, damit es aussieht wie</li> <li>Rohöl</li> <li>Vogelfedern</li> </ul> <p><b>Verfahren:</b></p> <p>Jede Gruppe muss "Öl" von einer simulierten Ölkatastrophe beseitigen, die Federn enthält, die Meereslebewesen darstellen. Die Aktivität kann auf verschiedene Weise fortgesetzt werden, je nach den Einschränkungen der Klasse. Es könnte ein Zeitlimit gesetzt werden, damit die Schüler*innen die Ölpest und</p> |





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|                                                                                                      | <p>die Federn so weit wie möglich beseitigen können. Diskutieren Sie anschließend die Herausforderungen, die sich aus den verschiedenen Methoden und Materialien ergeben, die zur Beseitigung des Öls verwendet werden. Da das Öl vom Wasser getrennt ist, können qualitative Vergleiche beobachtet und gemessen werden, die dann zur Lösung von mathematischen Aufgaben im Zusammenhang mit dieser Aktivität verwendet werden. Diskutieren Sie die Ergebnisse und entscheiden Sie, welche Methoden am besten funktioniert haben. Erläutern Sie, wie die verschiedenen Methoden des Experiments mit den im wirklichen Leben verwendeten Methoden zusammenhängen.</p> <ol style="list-style-type: none"> <li>5. Bewertung (H5P) (10 min)</li> <li>6. Entsorgen Sie das ausgelaufene Modellöl und beseitigen Sie eventuelle Verschmutzungen (5-10 Minuten).</li> </ol> |
| <b>Methoden zur Vermittlung der Inhalte</b> (Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.) | Vortrag, Diskussion, Brainstorming, Recherche, Gruppenarbeit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Bewertungsmethode</b>                                                                             | H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Referenzen (falls erforderlich)</b><br>(bitte APA-Stil verwenden)                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |



## 1.2 Lerneinheit 2 - Umweltverschmutzung: Schwefeldioxid zerstört Pflanzen und Gebäude

### 1.2.1 Hintergrund

Luftverschmutzung entsteht durch die Anreicherung einer oder mehrerer Chemikalien oder Stoffe in der Luft in ausreichend hohen Konzentrationen, um Menschen, andere Tiere, Pflanzen oder Materialien zu schädigen. Luftverschmutzung besteht aus Chemikalien oder Partikeln in der Luft, die die Gesundheit von Menschen, Tieren und Pflanzen schädigen können. Sie schädigt auch Gebäude. Schadstoffe in der Luft treten in vielen Formen auf. Es kann sich um Gase, feste Partikel oder flüssige Tröpfchen handeln.

Luftverschmutzung kann sowohl durch menschliche als auch durch natürliche Einwirkungen entstehen. Zu den natürlichen Ereignissen, die die Luft verschmutzen, gehören Waldbrände, Vulkanausbrüche, Winderosion, Pollenflug, Verdunstung organischer Verbindungen und natürliche Radioaktivität. Die Verschmutzung durch natürliche Ereignisse ist nicht sehr häufig. Zu den menschlichen Aktivitäten, die zur Luftverschmutzung führen, gehören Emissionen aus Industrie und Fertigung, die Verbrennung fossiler Brennstoffe sowie Chemikalien aus Haushalt und Landwirtschaft. Häufige Ursachen für Luftverschmutzung sind beispielsweise Emissionen von Industrieanlagen und Stromversorgern, Kraftfahrzeugabgase, Benzindämpfe, chemische Lösungsmittel, Straßenstaub und Rauch.

Luftverschmutzung kann viele Gesundheitsprobleme wie Augenbrennen, Krebs, Geburtsfehler, Hirnschäden oder sogar den Tod verursachen. Luftverschmutzung kann auch die Umwelt und Sachwerte wie Lebensmittelkulturen, Bäume, Seen und Gebäude schädigen.

Schadstoffe sind unerwünschte Chemikalien oder andere Materialien, die in der Luft in ausreichend hohen Konzentrationen vorkommen, um die Umwelt und die Gesundheit der Menschen zu gefährden. Emissionen sind Freisetzungen eines Schadstoffs aus einer bestimmten Quelle (z. B. einer Fabrik) oder einer Gruppe von Quellen (z. B. Fahrzeugen) in die Luft. Bei Prozessen wie der Verbrennung fossiler Brennstoffe in der Industrie, in Kraftfahrzeugen und Gebäuden werden Schadstoffe freigesetzt, die lokale und regionale Verschmutzungen verursachen.

Saurer Regen sieht genauso aus, fühlt sich genauso an und schmeckt genauso wie sauberer Regen. Ein Spaziergang im sauren Regen oder sogar das Schwimmen in einem sauren See ist für den Menschen nicht gefährlicher als ein Spaziergang oder ein Bad in sauberem Wasser. Allerdings kann das Einatmen von Luft, die die Schadstoffe enthält, die sauren Regen verursachen, der menschlichen Gesundheit schaden. Schwefeldioxid ( $\text{SO}_2$ ), Stickoxide ( $\text{NO}_x$ ), Feinstaub und Ozon reizen oder schädigen die Lunge. Diese Auswirkungen treten vor allem bei Menschen auf, deren Lungen bereits durch Atemwegserkrankungen geschwächt sind, aber auch gesunde Menschen können manchmal Schmerzen oder Atembeschwerden aufgrund von Luftverschmutzung haben.

$\text{SO}_2$  und  $\text{NO}_x$ , die Schadstoffe, die den sauren Regen verursachen, können auch die Sicht beeinträchtigen, d. h. die Sicht in die Ferne einschränken. Diese Schadstoffe bilden kleine Partikel in der Atmosphäre. Diese Partikel verringern die Sicht, indem sie das Licht streuen. Eine verringerte



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Sichtweite macht sich vor allem an Orten wie den Nationalparks bemerkbar, wo die Menschen einige der schönsten Landschaften des Landes besuchen.

Saurer Regen zerfrisst Stein, Metall, Farbe - fast alle Materialien, die über einen längeren Zeitraum dem Wetter ausgesetzt sind. Von Menschenhand geschaffene Materialien verfallen allmählich, auch wenn sie unverschmutztem Regen ausgesetzt sind, aber saurer Regen beschleunigt diesen Prozess. Saurer Regen kann Metalle rosten lassen und dazu führen, dass Marmorstatuen, die vor langer Zeit gemeißelt wurden, ihre Merkmale verlieren. Dies geschieht, weil Marmor aus einer Verbindung namens Kalziumkarbonat besteht, die durch Säuren aufgelöst werden kann. Kalziumkarbonat findet sich auch in Kalkstein. Viele Gebäude und Denkmäler bestehen aus Marmor und Kalkstein und werden durch sauren Regen beschädigt. Die Beseitigung von Schäden durch sauren Regen an Gebäuden und Denkmälern kann Milliarden von Euro kosten.

### 1.2.2 Inhalt

| LearnSTEM                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Modul 2 Umweltverschmutzung: Schwefeldioxid zerstört Pflanzen und Gebäude                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| <b>Ziel des Moduls/der Lerneinheit</b>                                                                                                                  | Ziel dieses Moduls ist es, den Schüler*innen durch eine Vielzahl von Aktivitäten die Umweltprobleme zu verdeutlichen, die Schwefeldioxid als eine Form der Umweltverschmutzung verursacht, die hauptsächlich durch die Verbrennung fossiler Brennstoffe verursacht wird.                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| <b>Dauer</b>                                                                                                                                            | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| <b>Lernziele</b>                                                                                                                                        | <p>Nach erfolgreichem Abschluss dieses Moduls/der Lerneinheit (LU) sind die Schüler*innen in der Lage:</p> <ol style="list-style-type: none"> <li>1. Einige der wichtigsten Ursachen, Auswirkungen und Quellen der Luftverschmutzung zu nennen.</li> <li>2. Die Auswirkungen von Schwefeldioxid auf die Vegetation zu erklären.</li> <li>3. Die Auswirkungen von Schwefeldioxid auf Wasser zu erklären.</li> <li>4. Die Auswirkungen von Schwefeldioxid auf vom Menschen geschaffene Objekte zu erklären.</li> <li>5. Die Auswirkungen von Schwefeldioxid auf den Menschen zu erklären.</li> <li>6. Was getan werden kann, um das Schwefeldioxidproblem zu lösen, zu beschreiben.</li> </ol> |  |
| <b>Erforderliche Ressourcen/Materialien</b><br>(Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.) | <ul style="list-style-type: none"> <li>• didaktisches Video (WP2-P2-LearnSTEM-Learning resource-Pollution_Sulfur Dioxide Destroys Plants and Buildings_EN.mp4),</li> <li>• PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Sulfur Dioxide Destroys Plants and Buildings_EN.pptx),</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                               |  |



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|                  | <ul style="list-style-type: none"> <li>• zusätzliche Ressourcen (WP2-P2-LearnSTEM_text_Sulfur Dioxide Destroys Plants and Buildings-ADDITIONAL RESOURCHES_EN.docx),</li> <li>• Bewertung (H5P) (WP2-P2-LearnSTEM_text_Sulfur Dioxide Destroys Plants and Buildings-H5P_EN.docx),</li> <li>• Experiment (ähnlich dem oben vorgestellten Video)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Verfahren</b> | <p>Anleitungsschritte, die die Schüler*innen befolgen müssen:</p> <ol style="list-style-type: none"> <li>1. Vortrag und Diskussion: Was sind Luftschadstoffe? Quellen der Luftverschmutzung. Wie wirken sich Luftschadstoffe auf uns aus? Schwefelsäure entsteht, wenn Wasserdampf mit Schwefeloxiden interagiert, die als Nebenprodukt bei der Kohleverbrennung, aus Vulkangasen usw. entstehen. Saurer Regen verändert den pH-Wert von Gewässern. (20 Minuten)</li> <li>2. Anzeige des Videos (10 Minuten)</li> <li>3. <b>Experiment 1 Saurer Regen auf Gebäuden. (20-25 min)</b></li> </ol> <p><b>Zweck</b><br/>Demonstration der Auswirkungen von saurem Regen auf Statuen und Gebäude.</p> <p><b>Zielsetzung</b><br/>Die Schüler*innen lernen, dass saurer Regen ein Problem der Luftverschmutzung ist.</p> <p><b>Materialien</b><br/>Kreide<br/>Klare Tassen, Gläser oder Dosen<br/>Essig<br/>Optional: Lange Nägel</p> <p><b>Verfahren</b><br/>Erklären Sie, dass Säuren chemisch mit Kalkstein reagieren.<br/>Erklären Sie, dass Essig eine Säure und Kreide ein Kalkstein ist, oder geben Sie Ihren Schüler*innen pH-Papier und lassen Sie sie beurteilen, ob Essig eine Säure oder eine Base ist.<br/>Geben Sie jeder Gruppe ein Stück Kreide, und Sie können ihnen einen langen Nagel geben, mit dem sie ein Muster auf die Seite der Kreide ritzen können, bspw. verschnörkelte Linien oder die Initialen der Schüler*innen. Das macht ihre Kreide einzigartig und repräsentiert ihre Statue.<br/>Geben Sie Essig in die Gläser/Tassen/Krüge der Gruppen und bitten Sie sie, ihre Statue unter genauer Beobachtung hineinfallen zu lassen.<br/>Fragen Sie die Schüler*innen nach ihren Beobachtungen.<br/>Fragen Sie die Schüler*innen, was passieren würde,</p> |



wenn sie sauren Regen statt Essig verwendet hätten. Sie können sie an dieser Stelle daran erinnern, dass Essig saurer ist als saurer Regen.

### **Experiment 2: Saurer Regen und Pflanzen (20-25 min)**

#### **Zweck**

Demonstration der Auswirkungen von saurem Regen auf Pflanzen

#### **Zielsetzung**

Die Schüler\*innen lernen, dass saurer Regen ein Problem der Luftverschmutzung ist.

#### **Materialien**

Etiketten  
Pflanzen  
Wasserflaschen oder Sprühflaschen  
Messbecher/Zylinder  
Stifte  
PH-Papier  
Essig  
Wasser

#### **Verfahren**

Erklären Sie den Schüler\*innen, dass sie ein Experiment über Säuren, Basen und Pflanzen durchführen werden. Was glauben sie, wird passieren, wenn wir Pflanzen mit Flüssigkeiten mit unterschiedlichen pH-Werten gießen? Welche Veränderungen erwarten sie zu sehen? Wie lange, glauben sie, brauchen die Pflanzen, um sich zu verändern?

Teilen Sie die Schüler\*innen in Gruppen ein.

Geben Sie jeder Gruppe eine Pflanze und eine Wasserflasche/Sprühflasche.

Geben Sie jeder Gruppe ihr Rezept für ihre Flüssigkeit (siehe unten).

Rezept für Flüssigkeiten

Gruppe 1: Wasser

Gruppe 2: 5 Teile Wasser, 1 Teil Essig

Gruppe 3: 2 Teile Wasser, 1 Teil Essig

Bitten Sie die Gruppen, ihre Wasserflaschen und Pflanzen mit ihrer Gruppennummer zu beschriften oder lassen Sie sie einen Gruppennamen erfinden.

Bitten Sie die Gruppen, die Verantwortung für die tägliche Bewässerung ihrer Pflanze zu übernehmen und zu notieren, ob sie in den nächsten zwei Wochen eine Veränderung der Farbe, des Blattwerks und der Gesundheit feststellen.

Führen Sie am Ende der zwei Wochen eine Diskussion über die Unterschiede, die sie bei den Pflanzen, die sie gepflegt haben, beobachtet haben.

Fragen Sie die Schüler\*innen, ob sie über sauren



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|                                                                                                       | <p>Regen besorgt sein sollten? Warum? Wie können wir versuchen, ihn zu verhindern? (Erinnern Sie sich an die Quellen: Fabriken, Automobile und Versorgungsunternehmen). Die Antworten sollten sich darauf beziehen, weniger Auto zu fahren (Fahrgemeinschaften, Bus, Fahrrad und zu Fuß gehen), Energie zu sparen (Lichter ausschalten, Klimaanlage herunterdrehen) und weniger Dinge zu kaufen (die 3 Rs: reduzieren, wiederverwenden, recyceln).</p> <p>Wen interessiert das? Warum brauchen wir Lösungen für die Umweltverschmutzung?</p> <p>4. Bewertung (H5P) (10 min)</p> <p>5. Eventuelle Verschmutzungen aufräumen (5-10 Minuten).</p> |
| <b>Methoden zur Vermittlung von Inhalten</b> (Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.) | Vortrag, Diskussion, Brainstorming, Recherche, Gruppenarbeit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Bewertungsmethode                                                                                     | H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Referenzen (falls erforderlich)<br>(bitte APA-Stil verwenden)                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |



## 1.3 Lerneinheit 3 - Umweltverschmutzung: Saurer Regen pH-Wert

### 1.3.1 Hintergrund

Ein Stoff, der weder sauer noch basisch ist, ist neutral. Die pH-Skala misst den sauren oder basischen Grad einer Substanz. Die pH-Skala reicht von 0 bis 14. Ein pH-Wert von 7 ist neutral, während ein pH-Wert von weniger als 7 sauer und ein pH-Wert von mehr als 7 basisch ist. Reines Wasser ist neutral. Wenn jedoch Chemikalien mit Wasser gemischt werden, kann die Mischung entweder sauer oder basisch werden.

Saurer Regen ist Regen, der säurehaltiger ist als er sein sollte. Saurer Regen ist ein kompliziertes Problem, das die Boden- und Wasserchemie sowie die Lebenszyklen von Pflanzen und Tieren an Land und im Wasser beeinflusst.

Wasser bewegt sich im Wasserkreislauf durch die Luft, Flüsse, Seen, Ozeane und alle lebenden Pflanzen und Tiere. Wenn sich Wassertröpfchen bilden und auf die Erde fallen, nehmen sie Partikel wie Staub und Chemikalien auf, die in der Luft schweben. Selbst saubere, unverschmutzte Luft enthält Partikel wie Staub oder Pollen. Saubere Luft enthält auch natürlich vorkommende Gase wie Kohlendioxid (CO<sub>2</sub>). Durch die Wechselwirkung zwischen den Wassertröpfchen und dem CO<sub>2</sub> in der Atmosphäre hat Regen einen pH-Wert von 5,6, wodurch selbst sauberer Regen leicht sauer ist. Wenn der Regen jedoch Schadstoffe enthält, insbesondere SO<sub>2</sub> und NO<sub>x</sub>, kann das Regenwasser sehr sauer werden.

Saurer Regen und die durch ihn verursachte Luftverschmutzung können Ökosysteme schwer schädigen.

Jedes Ökosystem ist eng miteinander verbunden, und die darin lebenden Organismen sind stark voneinander abhängig. Ökosysteme haben zum Beispiel Nahrungsnetze, in denen die Arten voneinander abhängig sind. Wenn ein Tier betroffen ist, sind es mehrere andere auch. Auf diese Weise kann saurer Regen ganze Ökosysteme beeinträchtigen. Saurer Regen schädigt vielleicht nur einige wenige Organismen in einem Ökosystem, aber alles andere ist indirekt betroffen. Außerdem kann es Jahre oder sogar Jahrzehnte dauern, bis die Schäden, die der saure Regen verursacht, behoben sind.

### 1.3.2 Inhalt

| LearnSTEM                                          |              |                                                                                             |  |
|----------------------------------------------------|--------------|---------------------------------------------------------------------------------------------|--|
| Modul 3: Umweltverschmutzung: Saurer Regen pH-Wert |              |                                                                                             |  |
| Ziel des Lerneinheit                               | Moduls/der   | Ziel dieses Moduls ist es, zu erfahren, warum es wichtig ist, den sauren Regen zu bekämpfen |  |
| Dauer                                              | 90 - 120 min |                                                                                             |  |



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| <b>Lernziele</b>                                                                                                                                            | <p>Nach erfolgreichem Abschluss dieses Moduls/der Lerneinheit (LU) sind die Schüler*innen in der Lage:</p> <ol style="list-style-type: none"> <li>1. Zu beschreiben, was saurer Regen und der pH-Wert sind.</li> <li>2. Das Konzept des chemischen Gleichgewichts (pH-Wert) zu verstehen, um zu klären, was "Säure" im Zusammenhang mit "saurem Regen" ist und bedeutet.</li> <li>3. Die natürlichen und vom Menschen verursachten Beiträge zur Bildung von saurem Regen zu ermitteln.</li> <li>4. Das Verständnis der pH-Skala nachzuweisen.</li> <li>5. Die Auswirkungen des sauren Regens auf die Umwelt und die menschliche Gesundheit zu ermitteln.</li> <li>6. Möglichkeiten zur Verringerung des vom Menschen verursachten Beitrags zur Bildung von saurem Regen zu untersuchen.</li> </ol>                                                                                  |
| <b>Erforderliche Ressourcen/Materialien</b><br><br>(Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.) | <ul style="list-style-type: none"> <li>• didaktisches Video (WP2-P2-LearnSTEM-Learning resource-Pollution_Acid Rain pH_EN.mp4),</li> <li>• PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Acid Rain pH_EN.pptx),</li> <li>• zusätzliche Ressourcen (WP2-P2-LearnSTEM_text_Acid Rain pH-ADDITIONAL RESOURCES_EN.docx),</li> <li>• Bewertung (H5P) (WP2-P2-LearnSTEM_text_Acid Rain pH-H5P_DE.docx),</li> <li>• Experiment (ähnlich dem oben vorgestellten Video)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Verfahren</b>                                                                                                                                            | <p>Anleitungsschritte, die die Schüler*innen befolgen müssen:</p> <ol style="list-style-type: none"> <li>1. Präsentation und Diskussion darüber, was saurer Regen ist. Welche Gase verursachen sauren Regen? Welche Art von Verschmutzung verursacht sauren Regen? Was ist der pH-Wert? In welcher Form kann saurer Regen auftreten (nass, trocken)? (15-20 min).</li> <li>2. Nennen Sie einige menschliche Aktivitäten, die Schäden verursachen (10 Minuten).</li> <li>3. Anzeige des Videos (10 Minuten)</li> <li>4. Erstellen Sie ein Experiment (ähnlich dem gezeigten Video), um die Auswirkungen des sauren Regens auf das Meer, die Tierwelt, die Wälder, den Boden, die Vegetation, Gebäude, Denkmäler und Menschen zu demonstrieren. (20-30 min)</li> </ol> <p><b>EXPERIMENT</b></p> <p><b>Materialien</b></p> <p>Essig<br/>Wasser<br/>2 mittelgroße Eierschalenstücke</p> |





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2 kleine grüne Blätter  
zwei Büroklammern  
zwei Behälter mit Deckeln

### Verfahren

Treffen Sie vor der Aktivität Vorhersagen. Wenn Essig Säure enthält, wie werden sich dann einige Gegenstände, die in Essig gelegt werden, verändern? Wenn diese Gegenstände in Wasser gelegt würden, würden sie sich dann genauso verändern wie in Essig?

1. Gieße Essig in ein Gefäß. Lege ein Stück Eierschale, ein Blatt und eine Büroklammer in den Behälter. Setze den Deckel auf den Behälter.
2. Gieße Wasser in den anderen Behälter. Lege eine Eierschale, ein Blatt und eine Büroklammer in diesen Behälter. Setze den Deckel auf den Behälter.
3. Die beiden verschlossenen Behälter über Nacht stehen lassen.
4. Nimm die Deckel der Behälter ab. Beobachte alle Veränderungen, die in den beiden Behältern stattgefunden haben. Notiere deine Beobachtungen.

### Ergebnisse

In dem Behälter mit Wasser werden die Gegenstände keine merklichen Veränderungen aufweisen. In dem Behälter mit Essig wird die Eierschale weich, das Blatt hat braune Flecken und die Büroklammer zeigt keine merkliche Veränderung. Diese Aktivität zeigt, dass säurehaltige Lösungen schädlich sein können.

### Erweiterungen

Messen Sie die Säure in mehreren Lösungen mit preiswerten pH-Papieren.

Vorschläge für zu prüfende Lösungen sind:

Zitronensaft (pH-Wert von 2,0)

Essig (2.2)

Apfelsaft (3,0)

Tomatensaft (4.2)

Milch (6.2)

reines Wasser (7,0)

Vergleichen Sie die pH-Werte der Lösung mit saurem Regen (unter 5,6) und normalem Regen (über 5,6). Erklären Sie, dass einige Lebensmittel, die wir essen, gesunde Säuren wie Zitronensäure enthalten, die nicht schädlich sind. Es gibt jedoch stärkere Säuren, die in Fabriken und Industrien entstehen und schädlich sind.

5. Diskutieren Sie die Ergebnisse und stellen Sie einen Bezug zu den Problemen her, mit denen wir im wirklichen Leben konfrontiert sind: Bodenerosion, Verschlechterung der



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|                                                                                                              | <p>Lebensbedingungen im Meer, Verschlechterung des Zustands der Wände, Aussterben von Wäldern und Arten, Verschlechterung der Lebensbedingungen der Menschen. (15-20 Minuten).</p> <p>6. Bewertung (H5P) (10 min)</p> <p>7. Aufräumen (5 Minuten).</p> |
| <p><b>Methoden zur Vermittlung von Inhalten</b> (Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.)</p> | Vortrag, Diskussion, Brainstorming, Recherche, Gruppenarbeit                                                                                                                                                                                           |
| Bewertungsmethode                                                                                            | <b>H5P</b>                                                                                                                                                                                                                                             |
| Referenzen (falls erforderlich)<br>(bitte APA-Stil verwenden)                                                |                                                                                                                                                                                                                                                        |



## 1.4 Lerneinheit 4 - Umweltverschmutzung: Düngemittel, saurer Regen und

### Algenwachstum

#### 1.4.1 Hintergrund

Die Auswirkungen des sauren Regens zeigen sich am deutlichsten in Gewässern wie Bächen, Seen und Sümpfen. Saurer Regen fließt in Bäche, Seen und Sümpfe, nachdem er auf Wälder, Felder, Gebäude und Straßen gefallen ist. Saurer Regen fällt auch direkt auf aquatische Lebensräume.

Die meisten Seen und Bäche haben einen pH-Wert zwischen 6 und 8, da die Pufferkapazität des Bodens normalerweise leicht sauren, sauberen Regen neutralisiert. Seen und Bäche werden sauer (der pH-Wert sinkt), wenn das Regenwasser selbst so sauer ist, dass der umgebende Boden den Regen nicht ausreichend puffern kann, um ihn zu neutralisieren. Aus diesem Grund sind einige Seen in Gegenden, in denen der Boden nicht viel Pufferkapazität hat, auch ohne sauren Regen von Natur aus sauer.

Wenn Seen und Flüsse immer saurer werden, nimmt die Zahl und Art der Fische und anderer Wasserpflanzen und -tiere ab, die in diesen Gewässern leben. Einige Pflanzen- und Tierarten können saures Wasser tolerieren. Andere hingegen sind säureempfindlich und wandern ab oder sterben, wenn der pH-Wert sinkt.

Die meisten Handelsdünger enthalten hohe Mengen an Stickstoff, Phosphor und Kalium, da das Pflanzenwachstum in der Regel durch diese Nährstoffe begrenzt wird. Wenn der Dünger in ein natürliches Gewässer gespült wird, verursacht er ein schnelles Wachstum von Mikroalgen (Phytoplankton) und Makroalgen. Diese überschüssigen Algen verursachen viele Probleme.

#### 1.4.2 Inhalt

| LearnSTEM                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modul 4: Verschmutzung: Düngemittel, saurer Regen und Algenwachstum |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Ziel des Moduls/der Lerneinheit</b>                              | Ziel dieses Moduls ist es, ein Bewusstsein für den sauren Regen und seine Auswirkungen auf die Natur zu schaffen. Die Schüler*innen werden auch in der Lage sein, etwas über Eutrophierung und schädliches Algenwachstum und die Folgen für die Umwelt zu lernen.                                                                                                                                                                                                                         |
| <b>Dauer</b>                                                        | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Lernziele</b>                                                    | Nach erfolgreichem Abschluss dieses Moduls/der Lerneinheit (LU) sind die Schüler*innen in der Lage: <ol style="list-style-type: none"><li>1. Sich der schädlichen Auswirkungen des sauren Regens und der Art und Weise, wie der Mensch die Umwelt beeinflusst, bewusst zu sein.</li><li>2. Entwicklung von Fähigkeiten zum kritischen Denken durch Analyse der Ursachen und Auswirkungen des sauren Regens.</li><li>3. Ein Verständnis für die globalen Auswirkungen des sauren</li></ol> |



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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                    | <p>Regens und die Bedeutung des Umweltschutzes zu entwickeln.</p> <ol style="list-style-type: none"> <li>Das Problem der schädlichen Algenblüte zu verstehen.</li> <li>Den Prozess der Eutrophierung und die Faktoren, die ihn verstärken oder abschwächen können, zu erklären.</li> <li>Ein größeres Umweltbewusstsein zu entwickeln und zu handeln.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>Erforderliche Ressourcen/Materialien</b></p> <p>(Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.)</p> | <ul style="list-style-type: none"> <li>didaktisches Video (WP2-P2-LearnSTEM-Learning resource_Fertilizer, Acid rain and algae growth_EN.mp4),</li> <li>PPT (WP2-P2-LearnSTEM-Learning resource-Pollution_Fertilizer, Acid rain and algae growth_EN.pptx),</li> <li>zusätzliche Ressourcen (WP2-P2-LearnSTEM_text_Fertilizer, Acid rain and algae growth_ADDITIONAL RESOURCES_EN.docx),</li> <li>Bewertung (H5P) (WP2-P2-LearnSTEM_text_Fertilizer, Acid rain and algae growth-H5P_EN.docx),</li> <li>Experiment (ähnlich dem oben vorgestellten Video)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p><b>Verfahren</b></p>                                                                                                                                            | <p>Anleitungsschritte, die die Schüler*innen befolgen müssen:</p> <ol style="list-style-type: none"> <li>Präsentation und Diskussion (15-20 min).</li> <li>Führen Sie in die Problematik der Eutrophierung und des schädlichen Algenwachstums und die Folgen für die Umwelt ein. (10 min)</li> <li>Anzeige des Videos (10 Minuten)</li> <li><b>EXPERIMENT (30-40 min)</b></li> </ol> <p><b>Materialien:</b></p> <p>Zwei-Liter-Plastikflaschen mit abgeschnittenem Deckel oder Glasgefäße, Geschirrspülmittel auf Phosphatbasis, Essig, Dünger, destilliertes Wasser, Leitungswasser, Seewasser.</p> <p><b>Verfahren:</b></p> <p>Bereiten Sie die Flaschen vor: Füllen Sie eine Flasche mit destilliertem Wasser, eine Flasche mit Leitungswasser und einige Flaschen mit Seewasser.</p> <p>Fügen Sie einigen mit Seewasser gefüllten Flaschen Phosphate hinzu, indem Sie das phosphathaltige Geschirrspülmittel hinzufügen. Füge anderen Flaschen Essig und Dünger hinzu. Füge unterschiedliche Mengen hinzu. Beschriften Sie die Flaschen deutlich, und mischen Sie sie gut durch. Lassen Sie eine Flasche mit Seewasser als Kontrolle stehen.</p> <p>Stellen Sie die Flaschen zusammen an einen warmen Ort, der viel Sonnenlicht erhält.</p> <p><b>Beobachtungen:</b> Ernennen Sie einen oder zwei</p> |



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|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                              | <p>Schüler*innen, die die Beobachtungen für jeden Tag in die Beobachtungstabelle eintragen. Die Schüler*innen sollten alle subjektiven Beobachtungen, die sie an den Flaschen machen, aufzeichnen. Zu den Dingen, auf die man achten sollte, gehören: Gesamterscheinung, Trübung, Farbe, Sedimente und Geruch.</p> <p>Halten Sie den Wasserstand von Tag zu Tag konstant, indem Sie so viel Wasser nachfüllen, dass der Verdunstungsverlust ausgeglichen wird. Sofern Ihr Wasser nicht stark gechlort ist, reicht Leitungswasser aus.</p> <p><b>Diskussion in der Klasse:</b> Setzen Sie sich nach zwei Wochen mit der Klasse zusammen und diskutieren Sie die Ergebnisse. Welche Beziehung bestand zwischen den Nährstoffen und dem Algenwachstum? Wie haben sich die Algen auf die Wasserqualität ausgewirkt? Was wäre die beste Methode, um das Algenwachstum in Seen und Meeren zu verhindern? Sprechen Sie auch das Thema der Verschmutzung durch nicht punktuelle Quellen an. Wie kann sie verhindert werden?</p> <p><b>Optionen:</b></p> <p>Die Lehrkräfte könnten die Schüler*innen die Algenkonzentration messen lassen, indem sie mikroskopische Präparate anfertigen und dann die Anzahl der Algen in einem mikroskopischen Feld zählen. Diese Daten können dann aufgezeichnet und in einem Diagramm dargestellt werden.</p> <p>Eine Flasche kann genauso vorbereitet werden wie eine der anderen, aber dann in einen dunklen Bereich gestellt werden, um den Effekt des fehlenden Sonnenlichts auf das Algenwachstum zu erzeugen.</p> <p>5. Diskutieren Sie die Ergebnisse und stellen Sie einen Bezug zu den Problemen her, mit denen wir im wirklichen Leben konfrontiert sind: Bodenerosion, Verschlechterung der Lebensbedingungen im Meer, Verschlechterung des Zustands der Wälder, Aussterben von Wäldern und Arten, Verschlechterung der Lebensbedingungen der Menschen. (15-20 Minuten).</p> <p>6. Bewertung (H5P) (10 min)</p> <p>7. Räumt eventuelle Unordnung auf (5 Minuten).</p> |
| <p><b>Methoden zur Vermittlung von Inhalten</b> (Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.)</p> | <p>Vortrag, Diskussion, Brainstorming, Recherche, Gruppenarbeit</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p><b>Bewertungsmethode</b></p>                                                                              | <p>H5P</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p><b>Referenzen (falls erforderlich)</b><br/>(bitte APA-Stil verwenden)</p>                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



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Modello innovativo di apprendimento delle STEM  
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# **Imparare le STEM**

## *Modello innovativo di apprendimento delle STEM nelle scuole secondarie*

ERASMUS+ KA220  
Partenariati di cooperazione nell'istruzione scolastica

# **Modello pedagogico LearnSTEM**

## **Manuale di implementazione delle pratiche STEM**

Kalliopi Ntolou  
IEK Kavallas, Kavala, Grecia

**Data:**  
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**Numero di riferimento:**  
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## 1 Risorse didattiche

### 1.1 Modulo 1- Inquinamento: La petroliera sversa petrolio

#### 1.1.1 Sfondo

Fornite un breve riassunto dell'argomento o del concetto che verrà trattato nella lezione. Includete la sua importanza e la sua rilevanza per il programma di studio e il motivo per cui è importante che gli studenti imparino.

#### 1.1.2 Contenuto

| Modello pedagogico LearnSTEM                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulo 1: Inquinamento: La petroliera sversa petrolio                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Obiettivo del modulo/unità di apprendimento</b>                                                                                            | L'obiettivo di questo modulo è studiare gli effetti ambientali delle fuoriuscite di petrolio e creare una consapevolezza sulla pulizia delle fuoriuscite di petrolio e sulla sua importanza fondamentale.                                                                                                                                                                                                                                                                                                                                                             |
| <b>Durata</b>                                                                                                                                 | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Obiettivi di apprendimento</b>                                                                                                             | Una volta completato con successo questo modulo/unità di apprendimento (LU), i discenti saranno in grado di: <ol style="list-style-type: none"><li>1 Comprendere gli effetti ambientali delle fuoriuscite di petrolio.</li><li>2 Comprendere i diversi metodi di pulizia delle fuoriuscite di petrolio.</li><li>3 Lavorare in gruppo per identificare i metodi migliori per ripulire un modello di fuoriuscita di petrolio.</li><li>4 Migliorare le proprie capacità comunicative partecipando alle discussioni in classe e presentando i propri risultati.</li></ol> |
| <b>Risorse e materiali necessari</b><br>(fogli di lavoro, grafici, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"><li>● video didattico (WP2-P2-LearnSTEM-Risorsa didattica-Inquinamento_La petroliera sversa petrolio_IT.mp4),</li><li>● PPT (WP2-P2-LearnSTEM-Risorse didattiche-Inquinamento_La petroliera sversa petrolio_IT.pptx),</li><li>● risorse aggiuntive (WP2-P2-LearnSTEM_text_The Tanker spills oil-ADDITIONAL RESOURCES_EN.docx),</li><li>● (WP2-P2-LearnSTEM_text_The Tanker spills oil-H5P_EN.docx),</li><li>● esperimento (simile al video presentato sopra)</li></ul>                                                              |
| <b>Procedura</b>                                                                                                                              | Fasi di istruzione che i discenti devono seguire: <ol style="list-style-type: none"><li>1. Presentazione e discussione delle fuoriuscite di petrolio. Chiedete agli studenti di ricordare i danni che una fuoriuscita di petrolio può provocare all'ambiente</li></ol>                                                                                                                                                                                                                                                                                                |



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|                                                                                                     | <p>naturale (15-20 minuti).</p> <ol style="list-style-type: none"> <li>Introdurre le sfide della bonifica di una fuoriuscita di petrolio e i metodi utilizzati (10 min).</li> <li>Visualizzazione del video (10 min)</li> <li>Creare un modello di fuoriuscita di petrolio e discutere il concetto di modello.</li> </ol> <p>Riunire la squadra e testare sistematicamente i diversi metodi per ripulire il modello di fuoriuscita di petrolio. Gli studenti devono registrare le loro scoperte. (30-40 min).</p> <p><b>Esperimento - Pulizia delle fuoriuscite di petrolio</b></p> <p><b>Materiali:</b></p> <ul style="list-style-type: none"> <li>Palline di cotone</li> <li>Contenitore</li> <li>Spugna, spago</li> <li>Olio vegetale: la quantità dipende dal contenitore</li> <li>Cucchiaini di plastica</li> <li>Sapone per piatti Dawn</li> <li>Bicchieri di plastica: per mettere sapone e batuffoli di cotone.</li> <li>Cacao in polvere: da mescolare con l'olio per ottenere l'aspetto di petrolio greggio</li> <li>Piume di uccelli</li> </ul> <p><b>Procedura:</b></p> <p>Ogni gruppo dovrà ripulire il "petrolio" da una fuoriuscita di petrolio simulata che include piume per rappresentare la vita marina. L'attività può riprendere in diversi modi, a seconda dei vincoli della classe. Si potrebbe stabilire un limite di tempo per consentire ai partecipanti di ripulire il più possibile la fuoriuscita di petrolio e le piume. Quindi discutere le sfide affrontate con i diversi metodi e materiali utilizzati per cercare di eliminare l'olio.</p> <p>Poiché l'olio è separato dall'acqua, è possibile osservare e misurare i confronti qualitativi e utilizzarli per completare i problemi matematici relativi a questa attività. Discutere i risultati e decidere quali metodi hanno funzionato meglio. Spiegare in che modo i diversi metodi dell'esperimento si riferiscono ai metodi utilizzati nella vita reale.</p> <ol style="list-style-type: none"> <li>Valutazione (H5P) (10 min)</li> <li>Eliminare le fuoriuscite di olio del modello e ripulire eventuali pasticci (5-10 min).</li> </ol> |
| <p><b>Metodi di erogazione dei contenuti</b> (lezioni, discussioni, ricerche, lavori di gruppo,</p> | <p>lezione, discussione, brainstorming, ricerca, lavoro di gruppo</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |





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| ecc.)                                                   |     |
| Metodo di valutazione                                   | H5P |
| Riferimenti (se necessari)<br>(utilizzare lo stile APA) |     |

## 1.2 Unità didattica 2- Inquinamento: Il biossido di zolfo distrugge piante ed edifici

### 1.2.1 Sfondo

Fornite un breve riassunto dell'argomento o del concetto che verrà trattato nella lezione. Includete la sua importanza e la sua rilevanza per il programma di studio e il motivo per cui è importante che gli studenti imparino.

### 1.2.2 Contenuto

| Modello pedagogico LearnSTEM                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulo 2 Inquinamento: Il biossido di zolfo distrugge piante ed edifici                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Obiettivo del modulo/unità di apprendimento</b>                                                                                            | L'obiettivo di questo modulo è quello di aiutare gli studenti a comprendere i problemi ambientali creati dal biossido di zolfo come forma di inquinamento derivante principalmente dalla combustione di combustibili fossili.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Durata</b>                                                                                                                                 | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Obiettivi di apprendimento</b>                                                                                                             | Una volta completato con successo questo modulo/unità di apprendimento (LU), i discenti saranno in grado di: <ol style="list-style-type: none"> <li>1. Identificare alcune delle principali cause, effetti e fonti dell'inquinamento atmosferico.</li> <li>2. Spiegare gli effetti del biossido di zolfo sulla vegetazione</li> <li>3. Spiegare gli effetti del biossido di zolfo sull'acqua</li> <li>4. Spiegare gli effetti del biossido di zolfo sugli oggetti costruiti dall'uomo.</li> <li>5. Spiegare gli effetti del biossido di zolfo sull'uomo</li> <li>6. Descrivere cosa si può fare per risolvere il problema del biossido di zolfo.</li> </ol> |
| <b>Risorse e materiali necessari</b><br>(fogli di lavoro, grafici, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"> <li>• video didattico (WP2-P2-LearnSTEM-Risorsa didattica-Inquinamento_Il biossido di zolfo distrugge le piante e gli edifici_IT.mp4),</li> <li>• PPT (WP2-P2-LearnSTEM-Risorse didattiche-Inquinamento_Il biossido di zolfo distrugge impianti ed</li> </ul>                                                                                                                                                                                                                                                                                                                                                            |



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|                  | <p>edifici_EN.pptx),</p> <ul style="list-style-type: none"> <li>• risorse aggiuntive (WP2-P2-LearnSTEM_text_Sulfur Dioxide Destroys Plants and Buildings-ADDITIONAL RESOURCES_EN.docx),</li> <li>• (WP2-P2-LearnSTEM_text_Sulfur Dioxide Destroys Plants and Buildings-H5P_EN.docx),</li> <li>• esperimento (simile al video presentato sopra)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Procedura</b> | <p>Le fasi di istruzione che i discenti devono seguire:</p> <ol style="list-style-type: none"> <li>1. Presentazione e discussione: Cosa sono gli inquinanti atmosferici? Fonti di inquinamento atmosferico. In che modo gli inquinanti atmosferici ci influenzano? L'acido solforico si forma quando il vapore acqueo interagisce con gli ossidi di zolfo, come sottoprodotto della combustione del carbone, dai gas dei vulcani, ecc. Le piogge acide modificano il pH dei sistemi acquatici. (20 min)</li> <li>2. Visualizzazione del video (10 min)</li> <li>3. <b>Esperimento 1 Pioggia acida sugli edifici. (20-25 min)</b></li> </ol> <p><b>Scopo</b><br/>Per dimostrare l'effetto delle piogge acide su statue ed edifici.</p> <p><b>Obiettivo</b><br/>Gli studenti impareranno che le piogge acide sono un problema di inquinamento atmosferico.</p> <p><b>I materiali</b><br/>Gesso<br/>Tazze, bicchieri o barattoli trasparenti<br/>Aceto<br/>Opzionale: Unghie lunghe</p> <p><b>Procedura</b><br/>Spiegare che gli acidi reagiscono chimicamente con il calcare.<br/>Spiegate che l'aceto è un acido e che il gesso è calcare, oppure date agli studenti la carta del pH e fateli valutare se l'aceto è un acido o una base.<br/>Date a ogni gruppo un pezzo di gesso e potete scegliere di dare loro un chiodo lungo per graffiare un disegno sul lato del gesso. Io di solito scelgo linee a ghirigori o le iniziali degli studenti. Questo renderà il loro gesso unico e rappresenterà la loro statua.<br/>Aggiungete l'aceto nel bicchiere/tazza/barattolo dei gruppi e chiedete loro di far cadere la loro statua, osservando attentamente.<br/>Chiedete agli studenti di raccontare le loro osservazioni.<br/>Chiedete agli studenti cosa sarebbe successo se avessero usato la pioggia acida invece dell'aceto. A</p> |



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questo punto si può ricordare che l'aceto è più acido della pioggia acida.

#### **Esperimento 2 Piogge acide e piante (20-25 min)**

##### **Scopo**

Dimostrare l'effetto delle piogge acide sulle piante

##### **Obiettivo**

Gli studenti impareranno che le piogge acide sono un problema di inquinamento atmosferico.

##### **I materiali**

Etichette

Piante

Bottiglie d'acqua o bottiglie spray

Bicchieri/cilindro di misurazione

Penne

Carta PH

Aceto

Acqua

##### **Procedura**

Spiegate agli studenti che faranno un esperimento su acidi, basi e piante. Cosa pensano che succederà se innaffiamo le piante con liquidi di pH diverso? Quali cambiamenti si aspettano di vedere? Quanto tempo pensano che le piante impiegheranno per cambiare?

Dividete gli studenti in gruppi.

Consegnate a ogni gruppo una pianta e una bottiglia d'acqua/spray.

Consegnate a ogni gruppo la ricetta del liquido (vedi sotto).

Ricetta per i liquidi

Gruppo 1: acqua

Gruppo 2: 5 parti di acqua, 1 parte di aceto

Gruppo 3: 2 parti di acqua, 1 parte di aceto

Chiedete ai gruppi di etichettare la bottiglia d'acqua e la pianta con il numero del gruppo o di creare un nome per il gruppo.

Chiedete ai gruppi di assumersi la responsabilità di annaffiare la propria pianta ogni giorno e di prendere nota di eventuali cambiamenti di colore, foglie e salute nelle due settimane successive.

Alla fine delle due settimane, discutete delle differenze osservate nelle piante di cui si sono presi cura.

Chiedete agli studenti se devono preoccuparsi delle piogge acide. Perché? Come possiamo cercare di prevenirle? (Ricordate le fonti: fabbriche, automobili e servizi pubblici). Le risposte devono riguardare la riduzione della guida (car pooling, autobus, bicicletta e passeggiate), il risparmio energetico (spegnere le luci, abbassare l'aria condizionata) e l'acquisto di meno cose



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|                                                                                                    | (le 3 R: ridurre, riutilizzare, riciclare).<br>A chi interessa? Perché abbiamo bisogno di soluzioni per l'inquinamento?<br>4. Valutazione (H5P) (10 min)<br>5. Pulire eventuali pasticci (5-10 min) |
| <b>Metodi di erogazione dei contenuti</b> (lezioni, discussioni, ricerche, lavori di gruppo, ecc.) | lezione, discussione, brainstorming, ricerca, lavoro di gruppo                                                                                                                                      |
| Metodo di valutazione                                                                              | H5P                                                                                                                                                                                                 |
| Riferimenti (se necessari)<br>(utilizzare lo stile APA)                                            |                                                                                                                                                                                                     |

### 1.3 Unità didattica 3- Inquinamento: Pioggia acida pH

#### 1.3.1 Sfondo

Fornite un breve riassunto dell'argomento o del concetto che verrà trattato nella lezione. Includete la sua importanza e la sua rilevanza per il programma di studio e il motivo per cui è importante che gli studenti imparino.

#### 1.3.2 Contenuto

| Modello pedagogico LearnSTEM                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulo 3: Inquinamento: Piogge acide pH            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Obiettivo del modulo/unità di apprendimento</b> | L'obiettivo di questo modulo è di sapere perché è importante combattere le piogge acide.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Durata</b>                                      | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Obiettivi di apprendimento</b>                  | Una volta completato con successo questo modulo/unità di apprendimento (LU), i discenti saranno in grado di: <ol style="list-style-type: none"> <li>1. per descrivere cosa sono le piogge acide e il pH.</li> <li>2. comprendere il concetto di equilibrio chimico (pH) per chiarire cosa sia e cosa significhi "acido" nel contesto delle "piogge acide".</li> <li>3. determinare i contributi naturali e antropici alla formazione delle piogge acide.</li> <li>4. dimostrare la comprensione della scala del pH.</li> </ol> |



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|                                                                                                                                               | <ol style="list-style-type: none"><li>determinare gli effetti delle piogge acide sull'ambiente e sulla salute umana.</li><li>esplorare le opzioni per ridurre il contributo dell'uomo alla formazione delle piogge acide.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Risorse e materiali necessari</b><br>(fogli di lavoro, tabelle, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"><li>video didattico (WP2-P2-LearnSTEM-Risorsa didattica-Inquinamento_Pioggia acida pH_IT.mp4),</li><li>PPT (WP2-P2-LearnSTEM-Risorse didattiche-Inquinamento_Pioggia acida pH_IT.pptx),</li><li>risorse aggiuntive (WP2-P2-LearnSTEM_text_Acid Rain pH-ADDITIONAL RESOURCES_EN.docx),</li><li>valutazione (H5P) (WP2-P2-LearnSTEM_text_Acid Rain pH-H5P_EN.docx),</li><li>esperimento (simile al video presentato sopra)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Procedura</b>                                                                                                                              | <p>Le fasi di istruzione che i discenti devono seguire:</p> <ol style="list-style-type: none"><li>Presentazione e discussione su cosa sono le piogge acide? Quali gas causano le piogge acide? Quale tipo di inquinamento causa le piogge acide? Che cos'è il pH? In quale forma possono manifestarsi le piogge acide (umide, secche). (15-20 min).</li><li>Citare alcune attività umane che causano danni (10 min).</li><li>Visualizzazione del video (10 min)</li><li>Creare un esperimento (simile al video mostrato) per dimostrare l'impatto delle piogge acide sull'ambiente marino, sulla fauna, sulle foreste, sul suolo, sulla vegetazione, sugli edifici, sui monumenti e sull'uomo. (20-30 min)</li></ol> <p><b>ESPERIMENTO</b></p> <p><b>I materiali</b></p> <p>aceto<br/>acqua<br/>2 pezzi di guscio d'uovo di media grandezza<br/>2 piccole foglie verdi<br/>due graffette<br/>due contenitori con coperchio</p> <p><b>Procedura</b></p> <p>Prima dell'attività, fate delle previsioni. Se l'aceto contiene acido, come cambieranno alcuni oggetti messi nell'aceto? Se questi oggetti venissero messi in acqua, cambierebbero come nell'aceto?</p> <ol style="list-style-type: none"><li>Versate l'aceto in un contenitore. Mettete nel contenitore un pezzo di guscio d'uovo, una foglia e una graffetta. Mettete il coperchio sul contenitore.</li><li>Versate dell'acqua nell'altro contenitore. Mettete in</li></ol> |



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|                                                                                                    | <p>questo contenitore un guscio d'uovo, una foglia e una graffetta. Mettete il coperchio sul contenitore.</p> <p>3. Lasciare riposare i due contenitori sigillati per una notte.</p> <p>4. Rimuovere i coperchi dei contenitori. Osservate i cambiamenti avvenuti nei due contenitori. Scrivere le osservazioni.</p> <p><b>Risultati</b></p> <p>Nel contenitore dell'acqua, gli oggetti non mostreranno cambiamenti evidenti. Nel contenitore dell'aceto, il guscio d'uovo sarà morbido, la foglia avrà delle macchie marroni e la graffetta non mostrerà cambiamenti evidenti. Questa attività indica che le soluzioni acide possono essere dannose.</p> <p><b>Estensioni</b></p> <p>Misurare l'acido in diverse soluzioni utilizzando carte per il pH poco costose.</p> <p>I suggerimenti per le soluzioni da testare sono:</p> <p>succo di limone (pH 2,0)</p> <p>aceto (2.2)</p> <p>succo di mela (3.0)</p> <p>succo di pomodoro (4.2)</p> <p>latte (6,2)</p> <p>acqua pura (7.0)</p> <p>Confrontate i valori di pH delle soluzioni con pioggia acida (inferiore a 5,6) e pioggia normale (superiore a 5,6). Spiegate che alcuni alimenti che mangiamo hanno acidi sani, come l'acido citrico, che non è dannoso. Esistono invece acidi più forti, prodotti da fabbriche e industrie, che sono dannosi.</p> <p>5. Discutete i risultati e metteteli in relazione con i problemi che dobbiamo affrontare nella vita reale, come l'erosione del suolo, il degrado della vita marina, il degrado delle pareti, l'estinzione delle foreste e delle specie, il degrado della vita umana. (15-20 min).</p> <p>6. Valutazione (H5P) (10 min)</p> <p>7. Pulire eventuali pasticci (5 min).</p> |
| <b>Metodi di erogazione dei contenuti</b> (lezioni, discussioni, ricerche, lavori di gruppo, ecc.) | lezione, discussione, brainstorming, ricerca, lavoro di gruppo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Metodo di valutazione                                                                              | <b>H5P</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Riferimenti (se necessari)                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



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(utilizzare lo stile APA)

#### 1.4 Unità didattica 4 - Inquinamento: Fertilizzanti, piogge acide e crescita delle alghe

##### 1.4.1 Sfondo

Fornite un breve riassunto dell'argomento o del concetto che verrà trattato nella lezione. Includete la sua importanza e la sua rilevanza per il programma di studio e il motivo per cui è importante che gli studenti imparino.

##### 1.4.2 Contenuto

| Modello pedagogico LearnSTEM                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| Modulo 4: Inquinamento: Fertilizzanti, piogge acide e crescita delle alghe                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Obiettivo del modulo/unità di apprendimento</b>                                                                                            | L'obiettivo di questo modulo è creare consapevolezza sulle piogge acide e sui loro effetti sul mondo naturale. I tirocinanti potranno inoltre conoscere l'eutrofizzazione e la crescita di alghe nocive e le conseguenze sull'ambiente.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Durata</b>                                                                                                                                 | <b>90 - 120 min</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Obiettivi di apprendimento</b>                                                                                                             | Una volta completato con successo questo modulo/unità di apprendimento (LU), i discenti saranno in grado di: <ol style="list-style-type: none"><li>1. essere consapevoli degli effetti negativi delle piogge acide e dei modi in cui l'uomo influisce sull'ambiente.</li><li>2. sviluppare le capacità di pensiero critico analizzando le cause e gli effetti delle piogge acide.</li><li>3. comprendere l'impatto globale delle piogge acide e l'importanza della conservazione dell'ambiente.</li><li>4. comprendere il problema delle fioriture algali dannose</li><li>5. spiegare il processo di eutrofizzazione e quali fattori possono amplificarlo o mitigarlo.</li><li>6. diventare più consapevoli dell'ambiente per agire.</li></ol> |
| <b>Risorse e materiali necessari</b><br>(fogli di lavoro, grafici, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"><li>• video didattico (WP2-P2-LearnSTEM-Risorsa didattica_Fertilizzante, piogge acide e crescita delle alghe_IT.mp4),</li><li>• PPT (WP2-P2-LearnSTEM-Risorse didattiche-Inquinamento_Fertilizzanti, piogge acide e crescita delle alghe_EN.pptx),</li><li>• risorse aggiuntive (WP2-P2-LearnSTEM_text_Fertilizer, Acid rain and algae growth_ADDITIONAL RESOURCES_EN.docx),</li></ul>                                                                                                                                                                                                                                                                                                                       |



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|                  | <ul style="list-style-type: none"> <li>• (H5P) (WP2-P2-LearnSTEM_text_Fertilizer, Acid rain and algae growth-H5P_EN.docx),</li> <li>• esperimento (simile al video presentato sopra)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Procedura</b> | <p>Fasi di istruzione che i discenti devono seguire:</p> <ol style="list-style-type: none"> <li>1. Presentazione e discussione di (15-20 min).</li> <li>2. Introdurre il tema dell'eutrofizzazione e della crescita di alghe nocive e le conseguenze sull'ambiente. (10 min)</li> <li>3. Visualizzazione del video (10 min)</li> <li>4. <b>ESPERIMENTO (30-40 min)</b></li> </ol> <p><b>Materiali:</b><br/>bottiglie di plastica da due litri con il tappo tagliato o barattoli di vetro, detersivo per lavastoviglie a base di fosfati, aceto, fertilizzante, acqua distillata, acqua di rubinetto, acqua di lago.</p> <p><b>Procedura:</b><br/>Preparare le bottiglie: Riempire una bottiglia con acqua distillata, una bottiglia con acqua di rubinetto e alcune bottiglie con acqua di lago.<br/>Aggiungete i fosfati ad alcune bottiglie riempite con l'acqua del lago, aggiungendo il detersivo per lavastoviglie ad alto contenuto di fosfati. Aggiungete aceto e fertilizzante ad altre bottiglie. Aggiungete quantità diverse. Etichettare chiaramente le bottiglie e mescolare bene. Lasciate una bottiglia di acqua di lago come controllo.<br/>Posizionate le bottiglie insieme in un luogo caldo che riceva molta luce solare.</p> <p><b>Osservazioni:</b> Nominare uno-due studenti per registrare le osservazioni di ogni giorno sulla Tabella delle osservazioni. Gli studenti devono annotare tutte le osservazioni soggettive che hanno sui palloni. Tra gli elementi da osservare: aspetto generale, torbidità, colore, sedimenti e odore.<br/>Mantenete il livello dell'acqua costante di giorno in giorno, aggiungendo una quantità d'acqua sufficiente a sostituire la perdita per evaporazione. A meno che l'acqua non sia fortemente clorata, l'acqua del rubinetto è sufficiente.</p> <p><b>Discussione in classe:</b> Al termine delle due settimane, riunite la classe e discutete i risultati. Qual è stata la relazione tra i nutrienti e la crescita delle alghe? Cosa hanno fatto le alghe alla qualità dell'acqua? Quale sarebbe il modo migliore per evitare che le alghe crescano nei laghi e nei mari? Assicuratevi di sollevare il tema dell'inquinamento da fonti non puntuali. Come si può prevenire?</p> <p><b>Opzioni:</b><br/>Gli insegnanti potrebbero scegliere di far misurare agli</p> |





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|                                                                                                    | <p>allievi le concentrazioni di alghe preparando vetrini microscopici e contando il numero di alghe trovate in un campo microscopico. I dati possono essere registrati e riportati su un grafico.</p> <p>Una bottiglia può essere preparata in modo identico a una delle altre, ma poi collocata in un'area buia per produrre l'effetto dell'assenza di luce solare sulla crescita delle alghe.</p> <p>5. Discutete i risultati e metteteli in relazione con i problemi che dobbiamo affrontare nella vita reale, come l'erosione del suolo, il degrado della vita marina, il degrado delle pareti, l'estinzione delle foreste e delle specie, il degrado della vita umana. (15-20 min).</p> <p>6. Valutazione (H5P) (10 min)</p> <p>7. Pulire eventuali disordini (5 min).</p> |
| <b>Metodi di erogazione dei contenuti</b> (lezioni, discussioni, ricerche, lavori di gruppo, ecc.) | lezione, discussione, brainstorming, ricerca, lavoro di gruppo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Metodo di valutazione                                                                              | H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Riferimenti (se necessari)<br>(utilizzare lo stile APA)                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



# Innovative Model of learning STEM in secondary schools



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## **Learn STEM**

*Innovative Model of learning STEM  
in secondary schools*

ERASMUS+ KA220

Cooperation Partnerships in school education

## **LearnSTEM Pedagogical Model**

### **STEM Practices Implementation Handbook**

Demet Şener Çanlı

Mehmet Aydın

Hayriye Torunoğlu

**Yusuf Demir Science And Art Center**

**Kırşehir**

**TÜRKİYE**

***Date***

08.06.2024

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## 1. Learning Resources

### 1.1 Learning Unit – **Design A Solar Panel**

#### 1.1.1 Background

Having a basic level of Arduino Uno control board programming knowledge before this course would be beneficial for students to create more effective designs.

A short video is shown to students to draw their attention to the importance of solar energy, a renewable energy source. After attracting the students' attention, conceptual information is given about what solar energy is and how solar panels work. Students are then asked what can be done to get more efficiency from solar panels. Students are asked to put forward different ideas on this subject. Then, students are shown examples of different solar panel designs used around the world.

By touching on the way solar panels work, it is shown how the angle of sunlight falling affects the electricity obtained from the solar panel using a flashlight, voltmeter and solar panel. It is mentioned that the angle of the sun's rays falling on the earth may change and this may affect the energy obtained from solar panels. Students are asked to think about what can be done to ensure the continuity of the sun's rays perpendicular to the solar panel. Students are asked to explain their ideas to other students. They are asked to discuss among themselves. After the students' opinions are collected, a sample study that has been done previously on this subject is shown and how they can benefit from different materials.

For this; the use of the 3D design program Tinkercad and how to get a print from a 3D printer are shown. It is then shown how the resulting parts and other electronic parts are connected. An example program is shown on how to control electronic parts with Arduino Uno. Finally, the prepared work is tested and its success is evaluated with the students.



### 1.1.2 Content

| <b>LearnSTEM Pedagogical Model</b><br><b>Module 1: Design a Solar Panel</b>                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Aim of the module/ learning unit</b>                                                                                                  | <b>The purpose of this module is to emphasize the importance of utilizing solar energy, which is a renewable energy source.</b>                                                                                                                                                                                                                                                                                                                         |
| <b>Duration</b>                                                                                                                          | <b>40' x 8</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Learning Objectives</b>                                                                                                               | <ul style="list-style-type: none"> <li>• Students will be able to know what solar energy is.</li> <li>• Students will be able to explain how solar panels work.</li> <li>• Students will be able to discover different solar panel designs.</li> <li>• Students will be able to know what can be done to get more efficiency from solar panels.</li> <li>• Students will be able to design a solar panel to make better use of solar energy.</li> </ul> |
| <b>Resources&amp;Materials Required</b><br><br>(worksheet,charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.) | <ul style="list-style-type: none"> <li>• For Design: (3D design program and 3D printer) or (plywood, cardboard and silicon gun)</li> <li>• For Electronics: Servo motor, light sensor, jumper cable, resistor, voltmeter, Arduino uno, soldering iron</li> </ul>                                                                                                                                                                                        |
| <b>Procedure</b>                                                                                                                         | instructional steps:<br>1. Capture students' attention to the topic.<br>2. Provide information about solar energy.<br>3. Show examples of solar panel designs.<br>4. Demonstrate the use of Tinkercad and how to obtain output from a 3D printer.<br>5. Show how electronic components are connected.<br>6. Evaluate the success of the prepared work through testing with                                                                              |



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|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                       | students.<br>7. Feedback.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Content Delivery Methods</b><br>(lecture, discussions, research, group work, etc.) | Group work<br>Explanation<br>Practice demonstration<br>Discussion<br>Brainstorming                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Assessment Method</b>                                                              | H5P Exam                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>References</b>                                                                     | <p>Almadhhachi, M., Seres, I., &amp; Farkas, I. (2022). Significance of solar trees: Configuration, operation, types and technology commercialization. <i>Energy Reports</i>, 8, 6729-6743.</p> <p>Bakirci, K. (2012). General models for optimum tilt angles of solar panels: Turkey case study. <i>Renewable and Sustainable Energy Reviews</i>, 16(2012), 6149-6159.<br/><a href="http://dx.doi.org/10.1016/j.rser.2012.07.009">http://dx.doi.org/10.1016/j.rser.2012.07.009</a></p> <p>Dal, A. R. (2021). Güneş enerji panellerindeki optimum eğim açısının verime etkisinin incelenmesi. <i>Bilecik Şeyh Edebali Üniversitesi Fen Bilimleri Dergisi</i>, 8(1), 241-250.<br/><a href="https://doi.org/10.35193/bseufbd.878795">https://doi.org/10.35193/bseufbd.878795</a></p> <p>Le Roux, W. G. (2016). Optimum tilt and azimuth angles for fixed solar collectors in South Africa using measured data. <i>Renewable Energy</i>, 96, 603-612. <a href="http://dx.doi.org/10.1016/j.renene.2016.05.003">http://dx.doi.org/10.1016/j.renene.2016.05.003</a></p> <p>Melhem, R., &amp; Shaker, Y. (2023). Optimum tilt angle and solar radiation of photovoltaic modules for gulf collaboration council countries. <i>International Journal of Energy Research</i>, 2023.<br/><a href="https://doi.org/10.1155/2023/8381696">https://doi.org/10.1155/2023/8381696</a></p> <p>Tang, R. &amp; Wu, T. (2004). Optimal tilt-angles for solar collectors used in China. <i>Applied energy</i>, 79(2004), 239-248.<br/><a href="https://doi.org/10.1016/j.apenergy.2004.01.003">https://doi.org/10.1016/j.apenergy.2004.01.003</a></p> <p><a href="https://www.greenprophet.com/2015/11/solar-palm-trees-3d-printed-dubai/">https://www.greenprophet.com/2015/11/solar-palm-trees-3d-printed-dubai/</a></p> <p><a href="https://www.britannica.com/science/solar-energy">https://www.britannica.com/science/solar-energy</a></p> <p><a href="https://education.nationalgeographic.org/resource/solar-energy/">https://education.nationalgeographic.org/resource/solar-energy/</a></p> <p><a href="https://dictionary.cambridge.org/dictionary/english/solar-energy">https://dictionary.cambridge.org/dictionary/english/solar-energy</a></p> <p><a href="https://www.nrel.gov/news/video/solar-energy-basics-text.html">https://www.nrel.gov/news/video/solar-energy-basics-text.html</a></p> <p><a href="https://www.energy.gov/eere/solar/how-does-solar-work">https://www.energy.gov/eere/solar/how-does-solar-work</a></p> <p><a href="https://www.energy.gov/eere/solar/solar-photovoltaic-system-design-basics">https://www.energy.gov/eere/solar/solar-photovoltaic-system-design-basics</a></p> <p><a href="https://www.energy.gov/eere/solar/concentrating-solar-thermal-power-basics">https://www.energy.gov/eere/solar/concentrating-solar-thermal-power-basics</a></p> <p><a href="https://www.energysage.com/blog/most-common-solar-energy-uses/">https://www.energysage.com/blog/most-common-solar-energy-uses/</a></p> <p><a href="https://pib.gov.in/PressReleasePage.aspx?PRID=1650102">https://pib.gov.in/PressReleasePage.aspx?PRID=1650102</a></p> |



## 1.2 Learning Unit – Multiplication of Yeasts as Bioorganisms

### 1.2.1 Background

Yeast; oval in shape, colorless and smooth, converts carbohydrates to alcohol during fermentation, reproduces through budding, used in baking industry and in the production of ethanol, e.g. *Saccharomyces cerevisiae* (Baker's yeast). Yeast is a single-celled organism from the fungi kingdom. There are more than 500 species and thousands of variants of yeast. Yeast can be found in the soil, in sugary liquids (fruit and flowers), and on the surface of plants and animals. Yeast has several applications in biotechnology and plays a significant part in producing bread and alcoholic beverages.

In food manufacture, yeast is used to cause fermentation and leavening. The fungi feed on sugars, producing alcohol (ethanol) and carbon dioxide; in beer and wine manufacture the former is the desired product, in baking it is the latter.

In yeast, budding usually occurs during the abundant supply of nutrition. In this process of reproduction, a small bud arises as an outgrowth of the parent body. Later the nucleus of the parent yeast is separated into two parts and one of the nuclei shifts into the bud. The newly created bud.

Factors affecting yeast proliferation are:

- Temperature
- pH
- O<sub>2</sub> Exchange
- Carbon source and concentration
- Nutrient media combination
- Mixing speed etc...

The behavior of the dough during fermentation can be presented as sigmoidal curves using different mathematical models. Bread making is fundamentally a temperature dependent two step progression, consisting of fermentation, in which CO<sub>2</sub> production linked with yeast activity is manifested in porous dough structure with the development of dough volume during baking where yeast activity is ended and the bread structure is finalized.



### 1.2.1 Content

| LearnSTEM Pedagogical Model                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| Module 2: Multiplication of Yeasts as Bioorganisms                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Aim of the module/ learning unit</b>                                                                                                     | <b>The purpose of this module is to demonstrate how yeast proliferates under favorable conditions.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Duration</b>                                                                                                                             | <b>40'x 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Learning Objectives</b>                                                                                                                  | Students will be able to explain that yeasts multiply under suitable conditions and show them through experiments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Resources&amp;Materials Required</b><br><b>(worksheet,charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.)</b> | <ul style="list-style-type: none"> <li>• For Experiment 1:Yeasts, hot water, warm water, cold water, sugar, spon, graduated cylinder.</li> <li>• For Experiment 2:Yeasts, warm water, sugar, spon, graduated cylinder.</li> <li>• PowerPoint presentations</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Procedure</b>                                                                                                                            | <ul style="list-style-type: none"> <li>• In order to do this activity, students must know microscopic creatures in advance and be able to give examples. These topics are repeated and the activity begins.</li> <li>• The materials required for Experiment 1 are prepared in advance and brought to the classroom and placed in a place where every student can see. Students are divided into random groups of 3-4 people. Using these materials, they are asked to create a mechanism in which we can compare the proliferation of yeasts in hot, cold and warm environments. The mechanisms made by the groups are compared with other groups (Figure 1). Students are asked in which environment yeast can grow best and the answers are discussed.</li> <li>• In the next lesson, the materials required for Experimental 2 are brought to the classroom. Students are divided into random groups of 3-4 people. Students are asked to create a mechanism in which we can compare the growth of yeasts in sugary and sugar-free environments.</li> <li>• Students are then asked what other conditions are required for yeasts to multiply.</li> <li>• Presentations and videos prepared on the subject are</li> </ul> |



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|                                                                                   | shown to students.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Content Delivery Methods<br>(lecture, discussions,<br>research, group work, etc.) | Teamwork<br>Research<br>Practical demonstration<br>Discussions<br>Explanation<br>Brainstorming<br>Problematisation<br>Practical experiment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Assessment Method                                                                 | H5P Quiz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| References                                                                        | <p>Ali, A., Shehzad, A., Khan, M. R., Shabbir, M. A., &amp; Amjid, M. R. (2012). Yeast, its types and role in fermentation during bread making process- A. <i>Pakistan Journal of Food Sciences</i>, 22(3), 171-179.</p> <p>Koçak, F. 2019. Farklı Havalandırma Profillerinde Maya Çoğalmasının Betaglukan Verimine Etkisinin İncelenmesi. Ankara Üniversitesi. Fen Bilimleri Enstitüsü. Unpublish Master Thesis.</p> <p>Pamir, H. 1985. Fermantasyon Mikrobiyolojisi. Ankara Üniversitesi Ziraat Fakültesi Yayınları, No:936, Ankara.</p> <p>Walker, G. M. 1998. Yeast Physiology and Biotechnology. John Wiley &amp; Sons Ltd., 1-7, Scotland.</p> <p><a href="https://www.britannica.com/dictionary/yeast">https://www.britannica.com/dictionary/yeast</a></p> <p><a href="https://www.merriam-webster.com/dictionary/yeast">https://www.merriam-webster.com/dictionary/yeast</a></p> <p><a href="https://dictionary.cambridge.org/dictionary/english/yeast">https://dictionary.cambridge.org/dictionary/english/yeast</a></p> <p><a href="https://www.slideshare.net/shiningpearl18/fungiyeastmolds">https://www.slideshare.net/shiningpearl18/fungiyeastmolds</a></p> <p><a href="https://tr.wikipedia.org/wiki/Maya_%28biyoloji%29">https://tr.wikipedia.org/wiki/Maya_%28biyoloji%29</a></p> <p><a href="https://byjus.com/neet/yeast-diagram/">https://byjus.com/neet/yeast-diagram/</a></p> <p><a href="https://www.britannica.com/science/yeast-fungus">https://www.britannica.com/science/yeast-fungus</a></p> <p><a href="https://www.youtube.com/watch?v=XY6akiB-IYk&amp;t=4s">https://www.youtube.com/watch?v=XY6akiB-IYk&amp;t=4s</a></p> <p><a href="https://www.seriousseats.com/all-about-dry-yeast-instant-active-dry-fast-acting-and-more">https://www.seriousseats.com/all-about-dry-yeast-instant-active-dry-fast-acting-and-more</a></p> <p><a href="https://mobil.diatek.com.tr/Makale-Yontem/Gida-Hijyeni-ve-Guvenligi/Maya-Cesitleri-Nelerdir_3580.htm">https://mobil.diatek.com.tr/Makale-Yontem/Gida-Hijyeni-ve-Guvenligi/Maya-Cesitleri-Nelerdir_3580.htm</a></p> <p><a href="https://wiki.yeastgenome.org/index.php/What_are_yeast%3F">https://wiki.yeastgenome.org/index.php/What_are_yeast%3F</a></p> <p><a href="https://byjus.com/biology/budding/">https://byjus.com/biology/budding/</a></p> <p><a href="https://www.youtube.com/watch?v=iyWtp_L0Kzc&amp;t=191s">https://www.youtube.com/watch?v=iyWtp_L0Kzc&amp;t=191s</a></p> <p><a href="https://mindthegraph.com/blog/tr/sigmoid-pattern/">https://mindthegraph.com/blog/tr/sigmoid-pattern/</a></p> |

### 1.3 Learning Unit 3 **Leaves Transport and Evaporate Water**

#### 1.3.1. Background

The leaf is the energy factory of the plant, and clearly it is indispensable for its survival. Photosynthesis converts light energy to sugar, which in turn is transported to the photosynthetically inactive parts of the plant, such as the roots (Katifori, 2018).





Leaves are generally the major plant interface for gas exchange, and they are distally located to the main source of water, that is, the soil. As a result, they are the most dehydrated plant organ and ultimately control transpiration rates. The network of veins in the leaf carries water from the stems to the leaves. Glucose produced is also sent to the other parts of the plant from the leaves through the veins.

The stomata (tiny holes underneath the leaf) allow air in and out of the leaf. Stomata are usually at the bottom surface of the leaf.

The stomata close in the night to retain gases and moisture in the leaf cells and opens during the day for gaseous exchange to continue.

The osmotic push of water molecules from the soil into the roots causes an upwards pressure, which is known as root pressure. Because of this pressure, the water absorbed from the soil is pushed upwards through the xylem tissue of the stem. The xylem is the vascular tissue responsible for transporting water and dissolved minerals from the roots up to the stem and leaves of the plant. The water is transported the rest of the way by transpiration, which provides most of the force needed for water transport in plants.

Like all living organism, plants also require an excretory system to discharge excess water from their body. This process of elimination of excess water from the plant body is known as transpiration. It is generally the evaporation of water from the surface of the leaves.

## 1.3.2. Content

| LearnSTEM Pedagogical Model                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Module 3 : Leaves Transport and Evaporate Water                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Aim of the module/ learning unit</b>                                                                                           | The purpose of this module is to enable students to learn how leaves transport and evaporate water.                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Duration</b>                                                                                                                   | <b>40x 4 dakika</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Learning Objectives</b>                                                                                                        | <ul style="list-style-type: none"> <li>Students will be able to explain the phenomenon of transporting water to the leaves and demonstrates it through experiments.</li> <li>Students will be able to explain the evaporation of water from the surface of the plant's leaves and demonstrates it with experiments.</li> </ul>                                                                                                                                                |
| <b>Resources&amp;Materials Required (worksheet,charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.)</b> | <ul style="list-style-type: none"> <li>Experiment 1: Water, food coloring, flowers or leaves</li> <li>Experiment 2: Aluminium foil, glass jar and flower</li> <li>PowerPoint presentations</li> </ul>                                                                                                                                                                                                                                                                         |
| <b>Procedure</b>                                                                                                                  | <ul style="list-style-type: none"> <li>In order to implement this activity, students must know the basic parts and functions of plants and be able to give examples. These topics are repeated and then the activity begins.</li> <li>The materials required for Experiment 1 are prepared in advance and brought to the classroom and put in a place where each student can see them. Students are divided into random groups of 3-4. Using these materials, they</li> </ul> |



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|                                                                                   | <p>are asked to create a mechanism where we can observe how plants transport water. The mechanisms designed by groups are compared with each other (Figure 1). Students are asked and discussed how plants and leaves transport water. The veins in the leaves and their functions are explained.</p> <ul style="list-style-type: none"> <li>• Students are told that it will be observed how plants evaporate water in the next lesson. They are asked to think about what can be done about this issue.</li> <li>• In the next lesson, the materials required for Experimental 2 are prepared in advance and brought to the classroom. The materials of students who bring different materials are also evaluated.</li> <li>• Students are divided into random groups of 3-4 people. Students are asked to prepare a mechanism to observe how leaves evaporate water. The mechanisms prepared by the groups are compared. Students are asked how leaves evaporate water. The structure of stomata is explained and how water evaporates from the surface of the leaves is explained.</li> <li>• Presentations and videos prepared on the subject are shown to students.</li> </ul>                                                                                                                                                                                                                                                                                                                                      |
| Content Delivery Methods<br>(lecture, discussions,<br>research, group work, etc.) | <p>Teamwork<br/>Research<br/>Practical demonstration<br/>Discussions<br/>Explanation<br/>Brainstorming<br/>Problematisation<br/>Practical experiment</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Assessment Method                                                                 | <p>H5P Quiz<br/>Continuous evaluation by observation</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| References                                                                        | <p>Boanares, D., Isaias, R. R. M. S., de Sousa, H. C., &amp; Kozovits, A. R. (2018). Strategies of leaf water uptake based on anatomical traits. <i>Plant Biology</i>, 20(5), 848-856. <a href="https://doi.org/10.1111/plb.12832">https://doi.org/10.1111/plb.12832</a><br/> Guzmán-Delgado, P., Mason Earles, J., &amp; Zwieniecki, M. A. (2018). Insight into the physiological role of water absorption via the leaf surface from a rehydration kinetics perspective. <i>Plant, cell &amp; environment</i>, 41(8), 1886-1894. <a href="https://doi.org/10.1111/pce.13327">https://doi.org/10.1111/pce.13327</a><br/> Katifori, E. (2018). The transport network of a leaf, <i>Comptes Rendus Physique</i>, 19(4), 244-252. <a href="https://doi.org/10.1016/j.crhy.2018.10.007">https://doi.org/10.1016/j.crhy.2018.10.007</a><br/> <a href="https://kids.britannica.com/kids/article/leaf/433080">https://kids.britannica.com/kids/article/leaf/433080</a><br/> <a href="https://www.collinsdictionary.com/dictionary/english/leaf">https://www.collinsdictionary.com/dictionary/english/leaf</a><br/> <a href="https://www.merriam-webster.com/dictionary/leaf">https://www.merriam-webster.com/dictionary/leaf</a><br/> <a href="https://dictionary.cambridge.org/dictionary/english/leaf">https://dictionary.cambridge.org/dictionary/english/leaf</a><br/> <a href="https://www.passmyexams.co.uk/GCSE/biology/structure-of-leaf.html">https://www.passmyexams.co.uk/GCSE/biology/structure-of-leaf.html</a></p> |



<https://eschooltoday.com/learn/leaf-structure/>  
<https://www.britannica.com/video/152187/overview-leaf-structure-functions-plant>  
<https://www.nagwa.com/en/presentations/638126046213/>  
<https://www.britannica.com/video/73123/Plants-osmosis-roots-water-transpiration-leaves-moisture>  
<https://www.science-sparks.com/changing-colour-flowers-with-transpiration/>  
<https://www.science-sparks.com/changing-colour-flowers-with-transpiration/>  
<https://www.stem.org.uk/rx34bv>  
<https://eschooltoday.com/learn/transpiration/>  
<https://byjus.com/biology/transpiration/>  
<https://www.britannica.com/science/transpiration>  
[https://as1.ftcdn.net/v2/img/04/28/25/36/1000\\_F\\_428253637\\_KXsq3ZhVTtYAZnVtDMYALVZgWtZRDffN.jpg](https://as1.ftcdn.net/v2/img/04/28/25/36/1000_F_428253637_KXsq3ZhVTtYAZnVtDMYALVZgWtZRDffN.jpg)

## 1.4 Learning Unit 4- Growth of Plants and Salinity

### 1.4.1 Background

Factors affecting plant growth are; light, water, carbon dioxide, air, temperature, the availability of essential nutrients, the pH of the soil, and the space to grow. Water is one of the primary elements required by plants. When you think of gardening, you generally think of water, soil and sunlight. Plants can suffer when any of these are compromised. The importance of water to your plants goes beyond merely keeping them alive. Water is also a necessary element to help plants thrive. Water is what allows for the uptake of vital nutrients from the soil. It is also water that helps to carry sugar and other elements that may be required by flowers or fruit.

Soluble salts can be easily taken up by plants. Depending on the type and amount of salt compounds entering the plant, they become harmful to the plant when they exceed a certain concentration. They have a poisonous effect on the plant by disrupting nutrition and metabolism. In addition, as the salt concentration in the soil increases, it becomes difficult for the plant to absorb water from the soil, the structure of the soil deteriorates and plant development slows down or even stops. Various undesirable effects appear because of high salt concentration. Ion imbalance is one of the major consequences. A high concentration of Na and Cl ions, as an example, can lead to biochemical processes which can prove to be fatal for the plants. Sodium and chloride toxicity not only induce nutritional disorders but also cause physiological drought by lowering the osmotic potential of the soil solutions.

Salinity caused by NaCl is one of the most common abiotic stress affecting plant physiology. Salt stress causes several plants disorders (nutrient ion imbalance, decrease in stomatal conductance, low photosynthetic activity, etc.) morphological alteration (reduction in leaves number, plant size,



roots length and fruit production), and secondary metabolites changes (signal molecules, hormones and oxidative compounds). Therefore, the use of saline water for plant cultivation requires the identification specie-specific thresholds at which crops show sensitivity to salinity.

#### 1.4.2 Content

| LearnSTEM Pedagogical Model                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| Module 4: Growth of Plants and Salinity                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Aim of the module/ learning unit</b>                                                                                              | <b>The aim of this module is to enable students to explain the salinity levels in soil affecting plant growth.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Duration</b>                                                                                                                      | <b>40'x 8</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Learning Objectives</b>                                                                                                           | Students will be able to explain the importance of soil salinity for the growth of plants and demonstrates it through experiments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Required Resources&amp;Materials</b><br>(worksheet,charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.) | <ul style="list-style-type: none"> <li>• For Experiment 1:Pot, soil, lentils, water</li> <li>• For Experiment 2:Lentils seedling, salt, water</li> <li>• For Experiment 3:Lentils seedling, fertilized, water</li> <li>• PowerPoint presentations</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Procedure</b>                                                                                                                     | <ul style="list-style-type: none"> <li>• In order to do this activity, students must know the conditions necessary for the growth of plants and be able to give examples. These topics are repeated and the activity starts.</li> <li>• The materials required for Experiment 1 are prepared in advance and brought to the classroom. Students are divided into random groups of 3-4 people. Using the materials, students are asked to plant lentil seeds in 4 pots under the same conditions and grow them by watering them equally. After about 5 weeks the plants are observed and compared. At this stage, the plant seedlings are expected to be the same height.</li> <li>• In the next lesson, water with different salinity levels is prepared for Experiment 2. Groups observe their seedlings for 7 days by watering them in equal amounts. Plants of the groups are compared. Students are asked which plant grows better and whether the amount of growth of the plant changes as the salinity of the irrigation water increases, and the answers are discussed.</li> <li>• In the 3rd phase of the experiment, excessive fertilization is applied to the soil of one of two equally grown plants</li> </ul> |



## Innovative Model of learning STEM in secondary schools



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|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                   | <p>and observed for 7 days. The effect of excessive fertilization on plant growth is discussed.</p> <ul style="list-style-type: none"> <li>• Tables are created and graphs are drawn to compare plant growth.</li> <li>• Presentations and videos prepared on the subject are shown to students.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Content Delivery Methods<br>(lecture, discussions,<br>research, group work, etc.) | <p>Teamwork<br/>Research<br/>Practical demonstration<br/>Discussions<br/>Explanation<br/>Brainstorming<br/>Problematisation<br/>Practical experiment</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Assessment Method                                                                 | <p>5HP Quiz<br/>Assessment based on practical achievements and results<br/>Continuous assessment through observation</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| References                                                                        | <ul style="list-style-type: none"> <li>• EKMEKÇİ, E., Mehmet, A. P. A. N., &amp; Tekin, K. A. R. A. (2005). Tuzluluğun bitki gelişimine etkisi. <i>Anadolu tarım bilimleri dergisi</i>, 20(3), 118-125.</li> <li>• Kotuby, J., Koenig, R., &amp; Kitchen, B. (1997). Salinity and Plant Tolerance. Utah State University Extension. AG-SO-03., Utah.</li> <li>• Petretto, G. L., Urgeghe, P. P., Massa, D., &amp; Melito, S. (2019). Effect of salinity (NaCl) on plant growth, nutrient content, and glucosinolate hydrolysis products trends in rocket genotypes. <i>Plant Physiology and Biochemistry</i>, 141, 30-39. <a href="https://doi.org/10.1016/j.plaphy.2019.05.012">https://doi.org/10.1016/j.plaphy.2019.05.012</a></li> <li>• Shahid, M. A., Sarkhosh, A., Khan, N., Balal, R. M., Ali, S., Rossi, L., ... &amp; Garcia-Sanchez, F. (2020). Insights into the physiological and biochemical impacts of salt stress on plant growth and development. <i>Agronomy</i>, 10(7), 938. <a href="https://doi.org/10.3390/agronomy10070938">https://doi.org/10.3390/agronomy10070938</a></li> </ul> <p><a href="https://www.britannica.com/dictionary/plant">https://www.britannica.com/dictionary/plant</a><br/> <a href="https://www.collinsdictionary.com/dictionary/english/plant">https://www.collinsdictionary.com/dictionary/english/plant</a><br/> <a href="https://www.merriam-webster.com/dictionary/plant">https://www.merriam-webster.com/dictionary/plant</a><br/> <a href="https://dictionary.cambridge.org/dictionary/english/plant">https://dictionary.cambridge.org/dictionary/english/plant</a><br/> <a href="https://www.agrowtronics.com/plant-growth-stages-an-overview/">https://www.agrowtronics.com/plant-growth-stages-an-overview/</a><br/> <a href="https://aehinnovativehydrogel.com/news/what-are-the-requirements-for-plant-growth/">https://aehinnovativehydrogel.com/news/what-are-the-requirements-for-plant-growth/</a><br/> <a href="https://swanhose.com/blogs/general-watering/how-does-water-its-amount-its-quality-affect-plant-growth">https://swanhose.com/blogs/general-watering/how-does-water-its-amount-its-quality-affect-plant-growth</a><br/> <a href="https://youtu.be/7-eFcMJYIXk">https://youtu.be/7-eFcMJYIXk</a><br/> <a href="https://www.sorhocam.com/konu.asp?sid=4321&amp;bitkilerde-tuz-stresi-nedir.html">https://www.sorhocam.com/konu.asp?sid=4321&amp;bitkilerde-tuz-stresi-nedir.html</a><br/> <a href="https://atlas-scientific.com/blog/how-does-electrical-conductivity-affect-plant-growth/">https://atlas-scientific.com/blog/how-does-electrical-conductivity-affect-plant-growth/</a></p> |



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ERASMUS+ KA220 Συνεργασίες Συνεργασίας στη σχολική εκπαίδευση

**LearnSTEM Pedagogical Model**  
**Εγχειρίδιο εφαρμογής STEM Practices**

Demet Şener Çanlı

Mehmet Aydın

Hayriye Torunoğlu

**Κέντρο Επιστήμης και Τέχνης Yusuf Demir**

**Κιρσεχίρ**

**ΤΟΥΡΚΙΑ**

**Ημερομηνία**

08.06.2024

**Αριθμός αναφοράς:**

2022-1-TR01-KA220-SCH-000087583



Η υποστήριξη της Ευρωπαϊκής Επιτροπής για την παραγωγή αυτής της δημοσίευσης δεν συνιστά έγκριση του περιεχομένου που αντικατοπτρίζει μόνο τις απόψεις των συγγραφέων και η Επιτροπή δεν μπορεί να θεωρηθεί υπεύθυνη για οποιαδήποτε χρήση των πληροφοριών που περιέχονται σε αυτήν.



## 1. Πόροι μάθησης

### 1.1 Εκπαιδευτική Ενότητα – Σχεδιασμός ηλιακού πάνελ

#### 1.1.1 Ιστορικό

Η κατοχή ενός βασικού επιπέδου γνώσεων προγραμματισμού πίνακα ελέγχου Arduino Uno πριν από αυτό το μάθημα θα ήταν ωφέλιμη για τους μαθητές ώστε να δημιουργήσουν πιο αποτελεσματικά σχέδια.

Ένα σύντομο βίντεο παρουσιάζεται στους μαθητές για να επιστήσει την προσοχή τους στη σημασία της ηλιακής ενέργειας, μιας ανανεώσιμης πηγής ενέργειας. Αφού τραβήξουν την προσοχή των μαθητών, δίνονται εννοιολογικές πληροφορίες για το τι είναι η ηλιακή ενέργεια και πώς λειτουργούν τα ηλιακά πάνελ. Στη συνέχεια οι μαθητές ερωτώνται τι μπορεί να γίνει για να επιτευχθεί μεγαλύτερη απόδοση από τα ηλιακά πάνελ. Ζητείται από τους μαθητές να υποβάλουν διαφορετικές ιδέες για αυτό το θέμα. Στη συνέχεια, παρουσιάζονται στους μαθητές παραδείγματα διαφορετικών σχεδίων ηλιακών πάνελ που χρησιμοποιούνται σε όλο τον κόσμο.

Αγγίζοντας τον τρόπο λειτουργίας των ηλιακών συλλεκτών, φαίνεται πώς η γωνία πτώσης του ηλιακού φωτός επηρεάζει την ηλεκτρική ενέργεια που λαμβάνεται από το ηλιακό πάνελ χρησιμοποιώντας φακό, βολτόμετρο και ηλιακό πάνελ. Αναφέρεται ότι η γωνία των ακτινών του ήλιου που πέφτουν στη γη μπορεί να αλλάξει και αυτό να επηρεάσει την ενέργεια που λαμβάνεται από τα ηλιακά πάνελ. Οι μαθητές καλούνται να σκεφτούν τι μπορεί να γίνει για να διασφαλιστεί η συνέχεια των ακτινών του ήλιου κάθετα στο ηλιακό πάνελ. Οι μαθητές καλούνται να εξηγήσουν τις ιδέες τους σε άλλους μαθητές. Καλούνται να συζητήσουν μεταξύ τους. Αφού συγκεντρωθούν οι απόψεις των μαθητών, παρουσιάζεται ένα δείγμα μελέτης που έχει γίνει στο παρελθόν για αυτό το θέμα και πώς μπορούν να επωφεληθούν από διαφορετικά υλικά.

Για αυτό, παρουσιάζεται η χρήση του προγράμματος τρισδιάστατης σχεδίασης Tinkercad και ο τρόπος λήψης μιας εκτύπωσης από έναν τρισδιάστατο εκτυπωτή. Στη συνέχεια παρουσιάζεται πώς συνδέονται τα εξαρτήματα που προκύπτουν και άλλα ηλεκτρονικά μέρη. Παρουσιάζεται ένα παράδειγμα προγράμματος σχετικά με τον τρόπο ελέγχου ηλεκτρονικών εξαρτημάτων με το Arduino Uno. Τέλος, η προετοιμασμένη εργασία δοκιμάζεται και η επιτυχία της αξιολογείται με τους μαθητές.



### 1.1.2 Περιεχόμενο

| <b>Παιδαγωγικό μοντέλο LearnSTEM</b><br><b>Ενότητα 1: Σχεδιάστε ένα ηλιακό πάνελ</b>                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Στόχος της ενότητας/της μαθησιακής ενότητας</b>                                                                                                  | Σκοπός αυτής της ενότητας είναι να τονίσει τη σημασία της αξιοποίησης της ηλιακής ενέργειας, η οποία είναι μια ανανεώσιμη πηγή ενέργειας.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Διάρκεια</b>                                                                                                                                     | 40' x 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Στόχοι μάθησης</b>                                                                                                                               | <ul style="list-style-type: none"><li>• Οι μαθητές θα είναι σε θέση να γνωρίζουν τι είναι η ηλιακή ενέργεια.</li><li>• Οι μαθητές θα είναι σε θέση να εξηγήσουν πώς λειτουργούν τα ηλιακά πάνελ.</li><li>• Οι μαθητές θα είναι σε θέση να ανακαλύψουν διαφορετικά σχέδια ηλιακών πάνελ.</li><li>• Οι μαθητές θα είναι σε θέση να γνωρίζουν τι μπορεί να γίνει για να αποκτήσουν μεγαλύτερη απόδοση από τα ηλιακά πάνελ.</li><li>• Οι μαθητές θα είναι σε θέση να σχεδιάσουν ένα ηλιακό πάνελ για να κάνουν καλύτερη χρήση της ηλιακής ενέργειας.</li></ul> |
| <b>Απαιτούνται πόροι και υλικά</b><br>(φύλλο εργασίας, γραφήματα, φυλλάδια, διδακτικό βίντεο, απόσπασμα από βιβλία/εγχειρίδια, χάρτες μυαλού κ.λπ.) | <ul style="list-style-type: none"><li>• Για Σχεδίαση: (πρόγραμμα σχεδίασης 3D και εκτυπωτής 3D) ή (κόντρα πλακέ, χαρτόνι και πιστόλι σιλικόνης)</li><li>• Για Ηλεκτρονικά: Σερβοκινητήρας, αισθητήρας φωτός, καλώδιο βραχυκυκλωτήρα, αντίσταση, βολτόμετρο, Arduino uno, κολλητήρι</li></ul>                                                                                                                                                                                                                                                               |
| <b>Διαδικασία</b>                                                                                                                                   | εκπαιδευτικά βήματα:<br>1. Τραβήξτε την προσοχή των μαθητών στο θέμα.<br>2. Δώστε πληροφορίες για την ηλιακή ενέργεια.                                                                                                                                                                                                                                                                                                                                                                                                                                     |





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|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                            | <p>3. Δείξτε παραδείγματα σχεδίων ηλιακών πάνελ.</p> <p>4. Δείξτε τη χρήση του Tinkercad και τον τρόπο λήψης εξόδου από έναν τρισδιάστατο εκτυπωτή.</p> <p>5. Δείξτε πώς συνδέονται τα ηλεκτρονικά εξαρτήματα.</p> <p>6. Αξιολογήστε την επιτυχία της προετοιμασμένης εργασίας μέσω δοκιμών με μαθητές.</p> <p>7. Ανατροφοδότηση.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Μέθοδοι παράδοσης περιεχομένου</b> (διάλεξη, συζητήσεις, έρευνα, ομαδική εργασία κ.λπ.) | <p>Ομαδική δουλειά</p> <p>Εξήγηση</p> <p>Εξάσκηση επίδειξης</p> <p>Συζήτηση</p> <p>καταιγισμός ιδεών</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Μέθοδος Αξιολόγησης</b>                                                                 | <p>Εξέταση H5P</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Βιβλιογραφικές αναφορές</b>                                                             | <p>Almadhhachi, M., Seres, I., &amp; Farkas, I. (2022). Σημασία ηλιακών δέντρων: Διαμόρφωση, λειτουργία, τύποι και εμπορευματοποίηση τεχνολογίας. <i>Energy Reports</i>, 8, 6729-6743.</p> <p>Bakirci, K. (2012). Γενικά μοντέλα για βέλτιστες γωνίες κλίσης ηλιακών συλλεκτών: Μελέτη περίπτωσης Τουρκίας. <i>Renewable and Sustainable Energy Reviews</i>, 16 (2012), 6149-6159.<a href="http://dx.doi.org/10.1016/j.rser.2012.07.009">http://dx.doi.org/10.1016/j.rser.2012.07.009</a></p> <p>Dal, AR (2021). Güneş enerji panellerindeki optimum eğim açısının verime etkisinin incelenmesi. <i>Bilecik Şeyh Edebali Üniversitesi Fen Bilimleri Dergisi</i>, 8(1), 241-250.<a href="https://doi.org/10.35193/bseufbd.878795">https://doi.org/10.35193/bseufbd.878795</a></p> <p>Le Roux, WG (2016). Βέλτιστες γωνίες κλίσης και αζιμουθίου για σταθερούς ηλιακούς συλλέκτες στη Νότια Αφρική με χρήση δεδομένων μέτρησης. <i>Ανανεώσιμες πηγές ενέργειας</i>, 96, 603-612.<a href="http://dx.doi.org/10.1016/j.renene.2016.05.003">http://dx.doi.org/10.1016/j.renene.2016.05.003</a></p> <p>Melhem, R., &amp; Shaker, Y. (2023). Βέλτιστη γωνία κλίσης και ηλιακή ακτινοβολία φωτοβολταϊκών μονάδων για χώρες του συμβουλίου συνεργασίας του Κόλπου. <i>International Journal of Energy Research</i>, 2023.<a href="https://doi.org/10.1155/2023/8381696">https://doi.org/10.1155/2023/8381696</a></p> <p>Tang, R. &amp; Wu, T. (2004). Βέλτιστες γωνίες κλίσης για ηλιακούς συλλέκτες που χρησιμοποιούνται στην Κίνα. <i>Εφαρμοσμένη ενέργεια</i>, 79(2004), 239-248.<a href="https://doi.org/10.1016/j.apenergy.2004.01.003">https://doi.org/10.1016/j.apenergy.2004.01.003</a><br/><a href="https://www.greenprophet.com/2015/11/solar-palm-trees-3d-printed-dubai/">https://www.greenprophet.com/2015/11/solar-palm-trees-3d-printed-dubai/</a><br/><a href="https://www.britannica.com/science/solar-energy">https://www.britannica.com/science/solar-energy</a><br/><a href="https://education.nationalgeographic.org/resource/solar-energy/">https://education.nationalgeographic.org/resource/solar-energy/</a><br/><a href="https://dictionary.cambridge.org/dictionary/english/solar-energy">https://dictionary.cambridge.org/dictionary/english/solar-energy</a><br/><a href="https://www.nrel.gov/news/video/solar-energy-basics-text.html">https://www.nrel.gov/news/video/solar-energy-basics-text.html</a><br/><a href="https://www.energy.gov/eere/solar/how-does-solar-work">https://www.energy.gov/eere/solar/how-does-solar-work</a><br/><a href="https://www.energy.gov/eere/solar/solar-photovoltaic-system-design-basics">https://www.energy.gov/eere/solar/solar-photovoltaic-system-design-basics</a><br/><a href="https://www.energy.gov/eere/solar/concentrating-solar-thermal-">https://www.energy.gov/eere/solar/concentrating-solar-thermal-</a></p> |



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## 1.2 Μαθησιακή Ενότητα – Πολλαπλασιασμός Ζυμομυκήτων ως Βιοοργανισμών

### 1.2.1 Ιστορικό

Μαγιά, ωειδές σχήμα, άχρωμο και λείο, μετατρέπει τους υδατάνθρακες σε οινόπνευμα κατά τη ζύμωση, αναπαράγεται μέσω εκβλάστησης, χρησιμοποιείται στην αρτοποιία και στην παραγωγή αιθανόλης, π.χ. *Saccharomyces cerevisiae* (Μαγιά Baker). Η μαγιά είναι ένας μονοκύτταρος οργανισμός από το βασίλειο των μυκήτων. Υπάρχουν περισσότερα από 500 είδη και χιλιάδες παραλλαγές μαγιάς. Η μαγιά μπορεί να βρεθεί στο έδαφος, σε ζαχαρούχα υγρά (φρούτα και άνθη) και στην επιφάνεια φυτών και ζώων. Η μαγιά έχει πολλές εφαρμογές στη βιοτεχνολογία και παίζει σημαντικό ρόλο στην παραγωγή ψωμιού και αλκοολούχων ποτών.

Στην παρασκευή τροφίμων, η μαγιά χρησιμοποιείται για να προκαλέσει ζύμωση και διόγκωση. Οι μύκητες τρέφονται με σάκχαρα, παράγοντας αλκοόλη (αιθανόλη) και διοξείδιο του άνθρακα. στην παραγωγή μπύρας και κρασιού το πρώτο είναι το επιθυμητό προϊόν, στο ψήσιμο είναι το δεύτερο.

Στη μαγιά, η εκβλάστηση εμφανίζεται συνήθως κατά την άφθονη παροχή τροφής. Σε αυτή τη διαδικασία της αναπαραγωγής, ένα μικρό μπουμπούκι προκύπτει ως απόφυση του γονικού σώματος. Αργότερα ο πυρήνας της μητρικής μαγιάς χωρίζεται σε δύο μέρη και ένας από τους πυρήνες μετατοπίζεται στον οφθαλμό. Το νεοδημιουργημένο μπουμπούκι.

Παράγοντες που επηρεάζουν τον πολλαπλασιασμό της ζύμης είναι:

- Θερμοκρασία
- pH
- Ανταλλαγή O<sub>2</sub>
- Πηγή και συγκέντρωση άνθρακα
- Συνδυασμός θρεπτικών μέσων
- Ταχύτητα ανάμειξης κλπ

Η συμπεριφορά της ζύμης κατά τη διάρκεια της ζύμωσης μπορεί να παρουσιαστεί ως σιγμοειδείς καμπύλες χρησιμοποιώντας διαφορετικά μαθηματικά μοντέλα. Η παρασκευή του ψωμιού είναι βασικά μια εξαρτώμενη από τη θερμοκρασία εξέλιξη δύο σταδίων, που αποτελείται από ζύμωση, στην οποία η παραγωγή CO<sub>2</sub> που συνδέεται με τη δραστηριότητα της ζύμης εκδηλώνεται σε πορώδη δομή ζύμης με την ανάπτυξη του όγκου της ζύμης κατά το ψήσιμο όπου η δραστηριότητα της ζύμης τελειώνει και η δομή του ψωμιού ολοκληρώνεται.



1.2.1 Περιεχόμενο

| <b>Παιδαγωγικό μοντέλο LearnSTEM</b>                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ενότητα 2: Πολλαπλασιασμός Ζυμομυκήτων ως Βιοοργανισμών</b>                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Στόχος της ενότητας/της μαθησιακής ενότητας</b>                                                                                                  | <b>Ο σκοπός αυτής της ενότητας είναι να δείξει πώς η μαγιά πολλαπλασιάζεται κάτω από ευνοϊκές συνθήκες.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Διάρκεια</b>                                                                                                                                     | <b>40' x 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Στόχοι μάθησης</b>                                                                                                                               | Οι μαθητές θα είναι σε θέση να εξηγήσουν ότι οι ζύμες πολλαπλασιάζονται κάτω από κατάλληλες συνθήκες και να τις δείξουν μέσω πειραμάτων.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Απαιτούνται πόροι και υλικά</b><br>(φύλλο εργασίας, γραφήματα, φυλλάδια, διδακτικό βίντεο, απόσπασμα από βιβλία/εγχειρίδια, χαρτες μυαλού κ.λπ.) | <ul style="list-style-type: none"><li>• Για το πείραμα 1: Μαγιάς, ζεστό νερό, χλιαρό νερό, κρύο νερό, ζάχαρη, κουτάλι, βαθμονομημένος κύλινδρος.</li><li>• Για το πείραμα 2: Μαγιά, χλιαρό νερό, ζάχαρη, κουτάλι, βαθμονομημένος κύλινδρος.</li><li>• Παρουσιάσεις PowerPoint</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Διαδικασία</b>                                                                                                                                   | <ul style="list-style-type: none"><li>• Για να κάνουν αυτή τη δραστηριότητα, οι μαθητές πρέπει να γνωρίζουν εκ των προτέρων τα μικροσκοπικά πλάσματα και να μπορούν να δίνουν παραδείγματα. Αυτά τα θέματα επαναλαμβάνονται και η δραστηριότητα ξεκινά.</li><li>• Τα υλικά που απαιτούνται για το Πείραμα 1 προετοιμάζονται εκ των προτέρων και μεταφέρονται στην τάξη και τοποθετούνται σε μέρος όπου μπορεί να δει κάθε μαθητής. Οι μαθητές χωρίζονται σε τυχαίες ομάδες των 3-4 ατόμων. Χρησιμοποιώντας αυτά τα υλικά, τους ζητείται να δημιουργήσουν έναν μηχανισμό με τον οποίο μπορούμε να συγκρίνουμε τον πολλαπλασιασμό των ζυμών σε ζεστά, κρύα και ζεστά περιβάλλοντα. Οι μηχανισμοί που κατασκευάζονται από τις ομάδες συγκρίνονται με άλλες ομάδες (Εικόνα 1). Οι μαθητές ερωτώνται σε ποιο περιβάλλον η μαγιά μπορεί να αναπτυχθεί καλύτερα και συζητούνται οι απαντήσεις.</li><li>• Στο επόμενο μάθημα, τα υλικά που απαιτούνται για το Πειραματικό 2 μεταφέρονται στην τάξη. Οι μαθητές χωρίζονται σε τυχαίες ομάδες των 3-4 ατόμων. Ζητείται</li></ul> |



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|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                    | <p>από τους μαθητές να δημιουργήσουν έναν μηχανισμό με τον οποίο μπορούμε να συγκρίνουμε την ανάπτυξη των ζυμών σε περιβάλλοντα με ζάχαρη και χωρίς ζάχαρη.</p> <ul style="list-style-type: none"><li>• Στη συνέχεια οι μαθητές ερωτώνται ποιες άλλες συνθήκες απαιτούνται για να πολλαπλασιαστούν οι ζυμομύκητες.</li><li>• Παρουσιάσεις και βίντεο που ετοιμάζονται για το θέμα προβάλλονται στους μαθητές.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Μέθοδοι παράδοσης περιεχομένου(διάλεξη, συζητήσεις, έρευνα, ομαδική εργασία κ.λπ.) | ΟΜΑΔΙΚΗ ΔΟΥΛΕΙΑ<br>Έρευνα<br>Πρακτική επίδειξη<br>Συζητήσεις<br>Εξήγηση<br>καταιγισμός ιδεών<br>Προβληματοποίηση<br>Πρακτικό πείραμα                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Μέθοδος Αξιολόγησης                                                                | Κουίζ H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Βιβλιογραφικές αναφορές                                                            | <p>Ali, A., Shehzad, A., Khan, MR, Shabbir, MA, &amp; Amjid, MR (2012). Η μαγιά, τα είδη και ο ρόλος της στη ζύμωση κατά τη διαδικασία παρασκευής ψωμιού-A. Pakistan Journal of Food Sciences, 22(3), 171-179.</p> <p>Koçak, F. 2019. Farklı Havalandırma Profillerinde Maya Çoğalmasının Betaglukan Verimine Etkisinin İncelenmesi. Ankara Üniversitesi. Fen Bilimleri Enstitüsü. Katάργηση δημοσίευσης Μεταπτυχιακής Διατριβής.</p> <p>Pamir, H. 1985. Fermentasyon Mikrobiyolojisi. Ankara Üniversitesi Ziraat Fakóltesi Yayınları, No:936, Ankara.</p> <p>Walker, GM 1998. Yeast Physiology and Biotechnology. John Wiley &amp; Sons Ltd., 1-7, Σκωτία.</p> <p><a href="https://www.britannica.com/dictionary/yeast">https://www.britannica.com/dictionary/yeast</a></p> <p><a href="https://www.merriam-webster.com/dictionary/yeast">https://www.merriam-webster.com/dictionary/yeast</a></p> <p><a href="https://dictionary.cambridge.org/dictionary/english/yeast">https://dictionary.cambridge.org/dictionary/english/yeast</a></p> <p><a href="https://www.slideshare.net/shiningpearl18/fungiyeastmolds">https://www.slideshare.net/shiningpearl18/fungiyeastmolds</a></p> <p><a href="https://tr.wikipedia.org/wiki/Maya_%28biyoloji%29">https://tr.wikipedia.org/wiki/Maya_%28biyoloji%29</a></p> <p><a href="https://byjus.com/neet/yeast-diagram/">https://byjus.com/neet/yeast-diagram/</a></p> <p><a href="https://www.britannica.com/science/yeast-fungus">https://www.britannica.com/science/yeast-fungus</a></p> <p><a href="https://www.youtube.com/watch?v=XY6akiB-IYk&amp;t=4s">https://www.youtube.com/watch?v=XY6akiB-IYk&amp;t=4s</a></p> <p><a href="https://www.seriousseats.com/all-about-dry-yeast-instant-active-dry-fast-acting-and-more">https://www.seriousseats.com/all-about-dry-yeast-instant-active-dry-fast-acting-and-more</a></p> <p><a href="https://mobil.diatek.com.tr/Makale-Yontem/Gida-Hijyeni-ve-Guvenligi/Maya-Cesitleri-Nelerdir_3580.htm">https://mobil.diatek.com.tr/Makale-Yontem/Gida-Hijyeni-ve-Guvenligi/Maya-Cesitleri-Nelerdir_3580.htm</a></p> <p><a href="https://wiki.yeastgenome.org/index.php/What_are_yeast%3F">https://wiki.yeastgenome.org/index.php/What_are_yeast%3F</a></p> <p><a href="https://byjus.com/biology/budding/">https://byjus.com/biology/budding/</a></p> <p><a href="https://www.youtube.com/watch?v=iyWtp_L0Kzc&amp;t=191s">https://www.youtube.com/watch?v=iyWtp_L0Kzc&amp;t=191s</a></p> <p><a href="https://mindthegraph.com/blog/tr/sigmoid-pattern/">https://mindthegraph.com/blog/tr/sigmoid-pattern/</a></p> |



### 1.3 Εκπαιδευτική Ενότητα 3 Φύλλα, Μεταφορά και Εξάτμιση Νερού

#### 1.3.1. Ιστορικό

Το φύλλο είναι το ενεργειακό εργοστάσιο του φυτού, και σαφώς είναι απαραίτητο για την επιβίωσή του. Η φωτοσύνθεση μετατρέπει την φωτεινή ενέργεια σε ζάχαρη, η οποία με τη σειρά της μεταφέρεται στα ανενεργά φωτοσυνθετικά μέρη του φυτού, όπως οι ρίζες (Katifori, 2018).

Τα φύλλα είναι γενικά η κύρια διεπαφή των φυτών για την ανταλλαγή αερίων και βρίσκονται σε απόσταση από την κύρια πηγή νερού, δηλαδή το έδαφος. Ως αποτέλεσμα, είναι το πιο αφυδατωμένο φυτικό όργανο και τελικά ελέγχουν τους ρυθμούς διαπνοής. Το δίκτυο των φλεβών στο φύλλο μεταφέρει νερό από τους μίσχους στα φύλλα. Η παραγόμενη γλυκόζη αποστέλλεται επίσης στα άλλα μέρη του φυτού από τα φύλλα μέσω των φλεβών.

Τα στόματα (μικροσκοπικές τρύπες κάτω από το φύλλο) επιτρέπουν τον αέρα μέσα και έξω από το φύλλο. Τα στομάχια βρίσκονται συνήθως στην κάτω επιφάνεια του φύλλου.

Τα στόματα κλείνουν τη νύχτα για να συγκρατούν αέρια και υγρασία στα κύτταρα των φύλλων και ανοίγουν κατά τη διάρκεια της ημέρας για να συνεχιστεί η ανταλλαγή αερίων.

Η οσμωτική ώθηση των μορίων του νερού από το έδαφος προς τις ρίζες προκαλεί μια πίεση προς τα πάνω, η οποία είναι γνωστή ως πίεση ρίζας. Λόγω αυτής της πίεσης, το νερό που απορροφάται από το έδαφος ωθείται προς τα πάνω μέσω του ιστού ξυλώματος του στελέχους. Το ξύλιο είναι ο αγγειακός ιστός που είναι υπεύθυνος για τη μεταφορά του νερού και των διαλυμένων μετάλλων από τις ρίζες μέχρι το στέλεχος και τα φύλλα του φυτού. Το νερό μεταφέρεται στην υπόλοιπη διαδρομή μέσω της διαπνοής, η οποία παρέχει το μεγαλύτερο μέρος της δύναμης που απαιτείται για τη μεταφορά του νερού στα φυτά.

Όπως όλοι οι ζωντανοί οργανισμοί, τα φυτά απαιτούν επίσης ένα απεκκριτικό σύστημα για να αποβάλλει το υπερβολικό νερό από το σώμα τους. Αυτή η διαδικασία αποβολής της περίσσειας νερού από το σώμα του φυτού είναι γνωστή ως διαπνοή. Γενικά είναι η εξάτμιση του νερού από την επιφάνεια των φύλλων.

#### 1.3.2. Περιεχόμενο

| Παιδαγωγικό μοντέλο LearnSTEM                |                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ενότητα 3: Φύλλα Μεταφορά και Εξάτμιση Νερού |                                                                                                                                                                                                                                                                                                                     |
| Στόχος της ενότητας/της μαθησιακής ενότητας  | Ο σκοπός αυτής της ενότητας είναι να δώσει τη δυνατότητα στους μαθητές να μάθουν πώς τα φύλλα μεταφέρουν και εξατμίζουν το νερό.                                                                                                                                                                                    |
| Διάρκεια                                     | 4 x 40λεπτά                                                                                                                                                                                                                                                                                                         |
| Στόχοι μάθησης                               | <ul style="list-style-type: none"><li>Οι μαθητές θα μπορούν να εξηγήσουν το φαινόμενο της μεταφοράς νερού στα φύλλα και να το καταδείξουν μέσα από πειράματα.</li><li>Οι μαθητές θα μπορούν να εξηγήσουν την εξάτμιση του νερού από την επιφάνεια των φύλλων του φυτού και να το επιδείξουν με πειράματα.</li></ul> |
| Απαιτούνται πόροι και υλικά                  | <ul style="list-style-type: none"><li>Πείραμα 1: Νερό, χρωστικές τροφίμων, λουλούδια ή</li></ul>                                                                                                                                                                                                                    |



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|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(φύλλο εργασίας, γραφήματα, φυλλάδια, διδακτικό βίντεο, απόσπασμα από βιβλία/εγχειρίδια, χάρτες μυαλού κ.λπ.)</p> | <p>φύλλα</p> <ul style="list-style-type: none"> <li>Πείραμα 2: Αλουμινόχαρτο, γυάλινο βάζο και λουλούδι</li> <li>Παρουσιάσεις PowerPoint</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p>Διαδικασία</p>                                                                                                    | <ul style="list-style-type: none"> <li>Για να υλοποιήσουν αυτή τη δραστηριότητα, οι μαθητές πρέπει να γνωρίζουν τα βασικά μέρη και τις λειτουργίες των φυτών και να μπορούν να δίνουν παραδείγματα. Αυτά τα θέματα επαναλαμβάνονται και μετά ξεκινά η δραστηριότητα.</li> <li>Τα υλικά που απαιτούνται για το Πείραμα 1 προετοιμάζονται εκ των προτέρων και μεταφέρονται στην τάξη και τοποθετούνται σε ένα μέρος όπου μπορεί να τα δει κάθε μαθητής. Οι μαθητές χωρίζονται σε τυχαίες ομάδες των 3-4. Χρησιμοποιώντας αυτά τα υλικά, τους ζητείται να δημιουργήσουν έναν μηχανισμό όπου μπορούμε να παρατηρήσουμε πώς τα φυτά μεταφέρουν το νερό. Οι μηχανισμοί που σχεδιάζονται από ομάδες συγκρίνονται μεταξύ τους (Εικόνα 1). Οι μαθητές ερωτώνται και συζητούν πώς τα φυτά και τα φύλλα μεταφέρουν το νερό. Επεξηγούνται οι φλέβες στα φύλλα και οι λειτουργίες τους.</li> <li>Λέγεται στους μαθητές ότι θα παρατηρηθεί πώς τα φυτά εξατμίζουν το νερό στο επόμενο μάθημα. Τους ζητείται να σκεφτούν τι μπορεί να γίνει για αυτό το θέμα.</li> <li>Στο επόμενο μάθημα προετοιμάζονται εκ των προτέρων τα υλικά που απαιτούνται για το Πείραμα 2 και μεταφέρονται στην τάξη. Αξιολογούνται επίσης τα υλικά των μαθητών που φέρνουν διαφορετικά υλικά.</li> <li>Οι μαθητές χωρίζονται σε τυχαίες ομάδες των 3-4 ατόμων. Ζητείται από τους μαθητές να προετοιμάσουν έναν μηχανισμό για να παρατηρήσουν πώς τα φύλλα εξατμίζουν το νερό. Συγκρίνονται οι μηχανισμοί που παρασκευάζονται από τις ομάδες. Οι μαθητές ερωτώνται πώς τα φύλλα εξατμίζουν το νερό. Επεξηγείται η δομή των στομάτων και εξηγείται πώς εξατμίζεται το νερό από την επιφάνεια των φύλλων.</li> <li>Παρουσιάσεις και βίντεο που ετοιμάζονται για το θέμα προβάλλονται στους μαθητές.</li> </ul> |
| <p>Μέθοδοι παράδοσης περιεχομένου(διάλεξη, συζητήσεις, έρευνα, ομαδική εργασία κ.λπ.)</p>                            | <p>ΟΜΑΔΙΚΗ ΔΟΥΛΕΙΑ</p> <p>Έρευνα<br/>Πρακτική επίδειξη<br/>Συζητήσεις<br/>Εξήγηση<br/>καταιγισμός ιδεών</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |





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|                         | Προβληματοποίηση<br>Πρακτικό πείραμα                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Μέθοδος Αξιολόγησης     | Κουίζ H5P<br><br>Συνεχής αξιολόγηση με παρατήρηση                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Βιβλιογραφικές αναφορές | <p>Boanares, D., Isaias, RRMS, de Sousa, HC, &amp; Kozovits, AR (2018). Στρατηγικές πρόσληψης νερού από φύλλα με βάση τα ανατομικά χαρακτηριστικά. <i>Plant Biology</i>, 20(5), 848-856. <a href="https://doi.org/10.1111/plb.12832">https://doi.org/10.1111/plb.12832</a></p> <p>Guzmán-Delgado, P., Mason Earles, J., &amp; Zwieniecki, MA (2018). Διερεύνηση του φυσιολογικού ρόλου της απορρόφησης νερού μέσω της επιφάνειας των φύλλων από την άποψη της κινητικής επανυδάτωσης. <i>Plant, cell &amp; περιβάλλον</i>, 41(8), 1886-1894. <a href="https://doi.org/10.1111/pce.13327">https://doi.org/10.1111/pce.13327</a></p> <p>Katifori, E. (2018). Το δίκτυο μεταφοράς ενός φύλλου, <i>Comptes Rendus Physique</i>, 19(4), 244-252. <a href="https://doi.org/10.1016/j.crhy.2018.10.007">https://doi.org/10.1016/j.crhy.2018.10.007</a><br/><a href="https://kids.britannica.com/kids/article/leaf/433080">https://kids.britannica.com/kids/article/leaf/433080</a><br/><a href="https://www.collinsdictionary.com/dictionary/english/leaf">https://www.collinsdictionary.com/dictionary/english/leaf</a><br/><a href="https://www.merriam-webster.com/dictionary/leaf">https://www.merriam-webster.com/dictionary/leaf</a><br/><a href="https://dictionary.cambridge.org/dictionary/english/leaf">https://dictionary.cambridge.org/dictionary/english/leaf</a><br/><a href="https://www.passmyexams.co.uk/GCSE/biology/structure-of-leaf.html">https://www.passmyexams.co.uk/GCSE/biology/structure-of-leaf.html</a><br/><a href="https://eschooltoday.com/learn/leaf-structure/">https://eschooltoday.com/learn/leaf-structure/</a><br/><a href="https://www.britannica.com/video/152187/overview-leaf-structure-functions-plant">https://www.britannica.com/video/152187/overview-leaf-structure-functions-plant</a><br/><a href="https://www.nagwa.com/en/presentations/638126046213/">https://www.nagwa.com/en/presentations/638126046213/</a><br/><a href="https://www.britannica.com/video/73123/Plants-osmosis-roots-water-transpiration-leaves-moisture">https://www.britannica.com/video/73123/Plants-osmosis-roots-water-transpiration-leaves-moisture</a><br/><a href="https://www.science-sparks.com/changing-colour-flowers-with-transpiration/">https://www.science-sparks.com/changing-colour-flowers-with-transpiration/</a><br/><a href="https://www.science-sparks.com/changing-colour-flowers-with-transpiration/">https://www.science-sparks.com/changing-colour-flowers-with-transpiration/</a><br/><a href="https://www.stem.org.uk/rx34bv">https://www.stem.org.uk/rx34bv</a><br/><a href="https://eschooltoday.com/learn/transpiration/">https://eschooltoday.com/learn/transpiration/</a><br/><a href="https://byjus.com/biology/transpiration/">https://byjus.com/biology/transpiration/</a><br/><a href="https://www.britannica.com/science/transpiration">https://www.britannica.com/science/transpiration</a><br/><a href="https://as1.ftcdn.net/v2/jpg/04/28/25/36/1000_F_428253637_KXsq3ZhVTtYAZnVtDMYALVZgWtZRDffN.jpg">https://as1.ftcdn.net/v2/jpg/04/28/25/36/1000_F_428253637_KXsq3ZhVTtYAZnVtDMYALVZgWtZRDffN.jpg</a></p> |

#### 1.4 Μαθησιακή Ενότητα 4- Growth of Plants and Salinity

##### 1.4.1 Ιστορικό

Οι παράγοντες που επηρεάζουν την ανάπτυξη των φυτών είναι: φως, νερό, διοξείδιο του άνθρακα, αέρας, θερμοκρασία, διαθεσιμότητα βασικών θρεπτικών συστατικών, το pH του εδάφους και ο χώρος ανάπτυξης. Το νερό είναι ένα από τα πρωταρχικά στοιχεία που απαιτούνται από τα φυτά. Όταν σκέφτεστε την κηπουρική, σκέφτεστε γενικά το νερό, το έδαφος και το φως του ήλιου. Τα φυτά μπορεί να υποφέρουν όταν κάποιο από αυτά είναι σε κίνδυνο. Η σημασία του νερού για τα φυτά σας υπερβαίνει το να τα κρατάτε στη ζωή. Το νερό είναι επίσης απαραίτητο στοιχείο για να βοηθήσει τα





φυτά να ευδοκιμήσουν. Το νερό είναι αυτό που επιτρέπει την πρόσληψη ζωτικών θρεπτικών συστατικών από το έδαφος. Είναι επίσης το νερό που βοηθά στη μεταφορά ζάχαρης και άλλων στοιχείων που μπορεί να απαιτούνται από τα λουλούδια ή τα φρούτα.

Τα διαλυτά άλατα μπορούν εύκολα να προσληφθούν από τα φυτά. Ανάλογα με τον τύπο και την ποσότητα των ενώσεων αλάτων που εισέρχονται στο φυτό, γίνονται επιβλαβείς για το φυτό όταν υπερβαίνουν μια ορισμένη συγκέντρωση. Έχουν δηλητηριώδη επίδραση στο φυτό διαταράσσοντας τη διατροφή και το μεταβολισμό. Επιπλέον, καθώς αυξάνεται η συγκέντρωση αλατιού στο έδαφος, γίνεται δύσκολο για το φυτό να απορροφήσει νερό από το έδαφος, η δομή του εδάφους επιδεινώνεται και η ανάπτυξη των φυτών επιβραδύνεται ή και σταματά. Διάφορες ανεπιθύμητες ενέργειες εμφανίζονται λόγω της υψηλής συγκέντρωσης άλατος. Η ανισορροπία ιόντων είναι μια από τις σημαντικότερες συνέπειες. Μια υψηλή συγκέντρωση ιόντων Na και Cl, για παράδειγμα, μπορεί να οδηγήσει σε βιοχημικές διεργασίες που μπορεί να αποδειχθούν θανατηφόρες για τα φυτά. Η τοξικότητα από νάτριο και χλωριούχα όχι μόνο προκαλεί διατροφικές διαταραχές αλλά προκαλεί επίσης φυσιολογική ξηρασία μειώνοντας το ωσμωτικό δυναμικό των εδαφικών διαλυμάτων.

Η αλατότητα που προκαλείται από το NaCl είναι ένα από τα πιο κοινά αβιοτικά στρες που επηρεάζουν τη φυσιολογία των φυτών. Το στρες στο αλάτι προκαλεί αρκετές διαταραχές στα φυτά (ανισορροπία θρεπτικών ιόντων, μείωση της στοματικής αγωγιμότητας, χαμηλή φωτοσυνθετική δραστηριότητα κ.λπ.), μορφολογική αλλοίωση (μείωση αριθμού φύλλων, μέγεθος φυτού, μήκος ριζών και παραγωγή καρπού) και δευτερογενείς μεταβολές μεταβολιτών (μόρια σήματος, ορμόνες και οξειδωτικές ενώσεις). Ως εκ τούτου, η χρήση αλατούχου νερού για την καλλιέργεια φυτών απαιτεί τον προσδιορισμό των ειδικών για κάθε είδος κατωφλίων στα οποία οι καλλιέργειες εμφανίζουν ευαισθησία στην αλατότητα.

#### 1.4.2 Περιεχόμενο

| Παιδαγωγικό μοντέλο LearnSTEM               |                                                                                                                                                             |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ενότητα 4: Ανάπτυξη φυτών και αλατότητα     |                                                                                                                                                             |
| Στόχος της ενότητας/της μαθησιακής ενότητας | Ο στόχος αυτής της ενότητας είναι να δώσει τη δυνατότητα στους μαθητές να εξηγήσουν τα επίπεδα αλατότητας στο έδαφος που επηρεάζουν την ανάπτυξη των φυτών. |
| Διάρκεια                                    | 40' x 8                                                                                                                                                     |



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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Στόχοι μάθησης                                                                                                                                                                | Οι μαθητές θα είναι σε θέση να εξηγήσουν τη σημασία της αλατότητας του εδάφους για την ανάπτυξη των φυτών και να την καταδείξουν μέσω πειραμάτων.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Απαιτείται</b><br><b>Πόροι &amp; Υλικά</b><br>(φύλλο εργασίας,<br>γραφήματα, φυλλάδια,<br>διδακτικό βίντεο,<br>απόσπασμα από<br>βιβλία/εγχειρίδια, χάρτες<br>μυαλού κ.λπ.) | <ul style="list-style-type: none"><li>• Για το πείραμα 1: Γλάστρα, χώμα, φακές, νερό</li><li>• Για το πείραμα 2: Φακές, αλάτι, νερό</li><li>• Για το Πείραμα 3: Σπορόφυτο φακής, λίπασμα, νερό</li><li>• Παρουσιάσεις PowerPoint</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Διαδικασία</b>                                                                                                                                                             | <ul style="list-style-type: none"><li>• Για να κάνουν αυτή τη δραστηριότητα, οι μαθητές πρέπει να γνωρίζουν τις απαραίτητες συνθήκες για την ανάπτυξη των φυτών και να μπορούν να δίνουν παραδείγματα. Αυτά τα θέματα επαναλαμβάνονται και η δραστηριότητα ξεκινά.</li><li>• Τα υλικά που απαιτούνται για το Πείραμα 1 προετοιμάζονται εκ των προτέρων και μεταφέρονται στην τάξη. Οι μαθητές χωρίζονται σε τυχαίες ομάδες των 3-4 ατόμων. Χρησιμοποιώντας τα υλικά, οι μαθητές καλούνται να φυτέψουν σπόρους φακής σε 4 γλάστρες υπό τις ίδιες συνθήκες και να τους καλλιεργήσουν ποτίζοντάς τους εξίσου. Μετά από περίπου 5 εβδομάδες τα φυτά παρατηρούνται και συγκρίνονται. Σε αυτό το στάδιο τα σπορόφυτα των φυτών αναμένεται να έχουν το ίδιο ύψος.</li><li>• Στο επόμενο μάθημα, προετοιμάζεται νερό με διαφορετικά επίπεδα αλατότητας για το Πείραμα 2. Οι ομάδες παρατηρούν τα σπορόφυτά τους για 7 ημέρες ποτίζοντάς τα σε ίσες ποσότητες. Τα φυτά των ομάδων συγκρίνονται. Οι μαθητές ερωτώνται ποιο φυτό αναπτύσσεται καλύτερα και αν η ποσότητα ανάπτυξης του φυτού αλλάζει καθώς αυξάνεται η αλατότητα του νερού άρδευσης και συζητούνται οι απαντήσεις.</li><li>• Στην 3η φάση του πειράματος, εφαρμόζεται υπερβολική λίπανση στο έδαφος ενός από δύο ισόποσα φυτά και παρατηρείται για 7 ημέρες. Η επίδραση της υπερβολικής λίπανσης στην ανάπτυξη των φυτών συζητείται.</li><li>• Δημιουργούνται πίνακες και σχεδιάζονται γραφήματα για σύγκριση της ανάπτυξης των φυτών.</li><li>• Παρουσιάσεις και βίντεο που ετοιμάζονται για το θέμα προβάλλονται στους μαθητές.</li></ul> |



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|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Μέθοδοι παράδοσης περιεχομένου(διάλεξη, συζητήσεις, έρευνα, ομαδική εργασία κ.λπ.) | ΟΜΑΔΙΚΗ ΔΟΥΛΕΙΑ<br>Έρευνα<br>Πρακτική επίδειξη<br>Συζητήσεις<br>Εξήγηση<br>καταιγισμός ιδεών<br>Προβληματοποίηση<br>Πρακτικό πείραμα                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Μέθοδος Αξιολόγησης                                                                | Κουίζ 5 HP<br>Αξιολόγηση βασισμένη σε πρακτικά επιτεύγματα και αποτελέσματα<br>Συνεχής αξιολόγηση μέσω παρατήρησης                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Βιβλιογραφικές αναφορές                                                            | <ul style="list-style-type: none"><li>• EKMEKÇİ, E., Mehmet, APAN, &amp; Tekin, KARA (2005). Tuzluluğun bitki gelişimine etkisi. Anadolu tarım bilimleri dergisi, 20(3), 118-125.</li><li>• Kotuby, J., Koenig, R., &amp; Kitchen, B. (1997). Αλατότητα και Ανοχή Φυτών. Επέκταση του Πολιτειακού Πανεπιστημίου της Γιούτα. AG-SO-03., Γιούτα.</li><li>• Petretto, GL, Urgeghe, PP, Massa, D., &amp; Melito, S. (2019). Επίδραση της αλατότητας (NaCl) στην ανάπτυξη των φυτών, την περιεκτικότητα σε θρεπτικά συστατικά και τις τάσεις των προϊόντων υδρόλυσης γλυκοσινολικών σε γονότυπους πυραύλων. Plant Physiology and Biochemistry, 141, 30-39.<a href="https://doi.org/10.1016/j.plaphy.2019.05.012">https://doi.org/10.1016/j.plaphy.2019.05.012</a></li><li>• Shahid, MA, Sarkhosh, A., Khan, N., Balal, RM, Ali, S., Rossi, L., ... &amp; Garcia-Sanchez, F. (2020). Πληροφορίες σχετικά με τις φυσιολογικές και βιοχημικές επιπτώσεις του στρες αλατιού στην ανάπτυξη των φυτών. Agronomy, 10(7), 938.<a href="https://doi.org/10.3390/agronomy10070938">https://doi.org/10.3390/agronomy10070938</a></li></ul> <p><a href="https://www.britannica.com/dictionary/plant">https://www.britannica.com/dictionary/plant</a><br/><a href="https://www.collinsdictionary.com/dictionary/english/plant">https://www.collinsdictionary.com/dictionary/english/plant</a><br/><a href="https://www.merriam-webster.com/dictionary/plant">https://www.merriam-webster.com/dictionary/plant</a><br/><a href="https://dictionary.cambridge.org/dictionary/english/plant">https://dictionary.cambridge.org/dictionary/english/plant</a><br/><a href="https://www.agrowtronics.com/plant-growth-stages-an-overview/">https://www.agrowtronics.com/plant-growth-stages-an-overview/</a><br/><a href="https://aehinnovativehydrogel.com/news/what-are-the-requirements-for-plant-growth/">https://aehinnovativehydrogel.com/news/what-are-the-requirements-for-plant-growth/</a><br/><a href="https://swanhose.com/blogs/general-watering/how-does-water-its-amount-its-quality-affect-plant-growth">https://swanhose.com/blogs/general-watering/how-does-water-its-amount-its-quality-affect-plant-growth</a><br/><a href="https://youtu.be/7-eFcMJYIXk">https://youtu.be/7-eFcMJYIXk</a><br/><a href="https://www.sorhocam.com/konu.asp?sid=4321&amp;bitkilerde-tuz-stresi-nedir.html">https://www.sorhocam.com/konu.asp?sid=4321&amp;bitkilerde-tuz-stresi-nedir.html</a><br/><a href="https://atlas-scientific.com/blog/how-does-electrical-conductivity-affect-plant-growth/">https://atlas-scientific.com/blog/how-does-electrical-conductivity-affect-plant-growth/</a></p> |

**LearnSTEM**

*Innovatives Modell des MINT-Lernens  
in Sekundarschulen*

ERASMUS+ KA220  
Kooperationspartnerschaften in der Schulbildung

**LearnSTEM**

**Handbuch zur Umsetzung von MINT-Praktiken**

Demet Şener Çanlı

Mehmet Aydın

Hayriye Torunoğlu

**Yusuf Demir Zentrum für Wissenschaft und Kunst**

**Kırşehir**

**TÜRKİYE**

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## 1. Lernressourcen

### 1.1 Lerneinheit - **Konstruktion eines Solarmoduls**

#### 1.1.1 Hintergrund

Grundlegende Kenntnisse in der Programmierung der Arduino Uno Steuerplatine vor diesem Kurs wären für die Schüler\*innen von Vorteil, um effektivere Designs zu erstellen.

Den Schüler\*innenn wird ein kurzes Video gezeigt, um ihre Aufmerksamkeit auf die Bedeutung der Solarenergie, einer erneuerbaren Energiequelle, zu lenken. Nachdem die Aufmerksamkeit der Schüler\*innen geweckt wurde, werden konzeptionelle Informationen darüber gegeben, was Solarenergie ist und wie Solarzellen funktionieren. Anschließend werden die Schüler\*innen gefragt, was getan werden kann, um die Effizienz von Solarzellen zu erhöhen. Die Schüler\*innen werden gebeten, verschiedene Ideen zu diesem Thema vorzubringen. Anschließend werden den Schüler\*innen Beispiele für verschiedene Solarmodule gezeigt, die auf der ganzen Welt eingesetzt werden.

Anhand der Funktionsweise von Solarmodulen wird gezeigt, wie der Einfallswinkel des Sonnenlichts die vom Solarmodul gewonnene Elektrizität beeinflusst, indem eine Taschenlampe, ein Voltmeter und ein Solarmodul verwendet werden. Es wird erwähnt, dass sich der Winkel, in dem die Sonnenstrahlen auf die Erde fallen, ändern kann, was sich auf die von Solarzellen gewonnene Energie auswirken kann. Die Schüler\*innen sollen überlegen, was getan werden kann, um die Kontinuität der Sonnenstrahlen senkrecht zum Solarmodul zu gewährleisten. Die Schüler\*innen werden gebeten, ihre Ideen anderen Schüler\*innen zu erklären. Sie werden gebeten, untereinander zu diskutieren. Nachdem die Meinungen der Schüler\*innen gesammelt wurden, wird eine Beispielstudie gezeigt, die bereits zu diesem Thema durchgeführt wurde und wie sie von verschiedenen Materialien profitieren können.

Dazu wird die Verwendung des 3D-Konstruktionsprogramms Tinkercad gezeigt und wie man einen Druck von einem 3D-Drucker erhält. Dann wird gezeigt, wie die entstandenen Teile und andere elektronische Teile miteinander verbunden werden. Es wird ein Beispielprogramm gezeigt, wie man elektronische Teile mit dem Arduino Uno steuern kann. Abschließend wird die vorbereitete Arbeit getestet und ihr Erfolg mit den Schüler\*innen bewertet.

### 1.1.2 Inhalt

| <b>LearnSTEM</b><br><b>Modul 1: Entwurf eines Solarmoduls</b>                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ziel des Moduls/der Lerneinheit</b>                                                                                                                  | <b>Ziel dieses Moduls ist es, die Bedeutung der Nutzung der Solarenergie, einer erneuerbaren Energiequelle, hervorzuheben.</b>                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Dauer</b>                                                                                                                                            | <b>40' x 8</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Lernziele</b>                                                                                                                                        | <ul style="list-style-type: none"> <li>• Die Schüler*innen wissen, was Solarenergie ist.</li> <li>• Die Schüler*innen können erklären, wie Solarzellen funktionieren.</li> <li>• Die Schüler*innen können verschiedene Designs von Solarzellen entdecken.</li> <li>• Die Schüler*innen werden wissen, was man tun kann, um die Effizienz von Solarzellen zu erhöhen.</li> <li>• Die Schüler*innen werden in der Lage sein, ein Solarmodul zu entwerfen, um die Sonnenenergie besser zu nutzen.</li> </ul>            |
| <b>Erforderliche Ressourcen/Materialien</b><br>(Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.) | <ul style="list-style-type: none"> <li>• Für die Konstruktion: (3D-Konstruktionsprogramm und 3D-Drucker) oder (Sperrholz, Karton und Silikonpistole)</li> <li>• Für Elektronik: Servomotor, Lichtsensor, Überbrückungskabel, Widerstand, Voltmeter, Arduino uno, Lötkolben</li> </ul>                                                                                                                                                                                                                                |
| <b>Verfahren</b>                                                                                                                                        | Unterrichtseinheiten:<br>1. Wecken Sie die Aufmerksamkeit der Schüler*innen für das Thema.<br>2. Bereitstellung von Informationen über Solarenergie.<br>3. Zeigen Sie Beispiele für die Gestaltung von Solarmodulen.<br>4. Demonstrieren Sie die Verwendung von Tinkercad und wie man die Ausgabe von einem 3D-Drucker erhält.<br>5. Zeigen Sie, wie elektronische Bauteile miteinander verbunden sind.<br>6. Bewerten Sie den Erfolg der vorbereiteten Arbeit durch Tests mit den Schüler*innen.<br>7. Rückmeldung. |
| <b>Methoden zur Vermittlung</b>                                                                                                                         | Gruppenarbeit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| von Inhalten (Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.) | Erläuterung<br>Praktische Demonstration<br>Diskussion<br>Brainstorming                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Bewertungsmethode                                                     | H5P-Prüfung                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Referenzen                                                            | <p>Almadhhachi, M., Seres, I., &amp; Farkas, I. (2022). Die Bedeutung von Solarbäumen: Konfiguration, Betrieb, Typen und Kommerzialisierung der Technologie. <i>Energy Reports</i>, 8, 6729-6743.</p> <p>Bakirci, K. (2012). Allgemeine Modelle für optimale Neigungswinkel von Solarmodulen: Turkey case study. <i>Renewable and Sustainable Energy Reviews</i>, 16(2012), 6149-6159.<br/> <a href="http://dx.doi.org/10.1016/j.rser.2012.07.009">http://dx.doi.org/10.1016/j.rser.2012.07.009</a></p> <p>Dal, A. R. (2021). Güneş enerji panellerindeki optimum eğim açısının verime etkisinin incelenmesi. <i>Bilecik Şeyh Edebali Üniversitesi Fen Bilimleri Dergisi</i>, 8(1), 241-250.<br/> <a href="https://doi.org/10.35193/bseufbd.878795">https://doi.org/10.35193/bseufbd.878795</a></p> <p>Le Roux, W. G. (2016). Optimale Neigungs- und Azimutwinkel für feststehende Solarkollektoren in Südafrika anhand gemessener Daten. <i>Renewable Energy</i>, 96, 603-612.<br/> <a href="http://dx.doi.org/10.1016/j.renene.2016.05.003">http://dx.doi.org/10.1016/j.renene.2016.05.003</a></p> <p>Melhem, R., &amp; Shaker, Y. (2023). Optimaler Neigungswinkel und Sonneneinstrahlung von Photovoltaik-Modulen für die Länder des Golf-Kooperationsrates. <i>International Journal of Energy Research</i>, 2023.<br/> <a href="https://doi.org/10.1155/2023/8381696">https://doi.org/10.1155/2023/8381696</a></p> <p>Tang, R. &amp; Wu, T. (2004). Optimale Neigungswinkel für Solarkollektoren in China. <i>Applied Energy</i>, 79(2004), 239-248.<br/> <a href="https://doi.org/10.1016/j.apenergy.2004.01.003">https://doi.org/10.1016/j.apenergy.2004.01.003</a></p> <p><a href="https://www.greenprophet.com/2015/11/solar-palm-trees-3d-printed-dubai/">https://www.greenprophet.com/2015/11/solar-palm-trees-3d-printed-dubai/</a></p> <p><a href="https://www.britannica.com/science/solar-energy">https://www.britannica.com/science/solar-energy</a></p> <p><a href="https://education.nationalgeographic.org/resource/solar-energy/">https://education.nationalgeographic.org/resource/solar-energy/</a></p> <p><a href="https://dictionary.cambridge.org/dictionary/english/solar-energy">https://dictionary.cambridge.org/dictionary/english/solar-energy</a></p> <p><a href="https://www.nrel.gov/news/video/solar-energy-basics-text.html">https://www.nrel.gov/news/video/solar-energy-basics-text.html</a></p> <p><a href="https://www.energy.gov/eere/solar/how-does-solar-work">https://www.energy.gov/eere/solar/how-does-solar-work</a></p> <p><a href="https://www.energy.gov/eere/solar/solar-photovoltaic-system-design-basics">https://www.energy.gov/eere/solar/solar-photovoltaic-system-design-basics</a></p> <p><a href="https://www.energy.gov/eere/solar/concentrating-solar-thermal-power-basics">https://www.energy.gov/eere/solar/concentrating-solar-thermal-power-basics</a></p> <p><a href="https://www.energysage.com/blog/most-common-solar-energy-uses/">https://www.energysage.com/blog/most-common-solar-energy-uses/</a></p> <p><a href="https://pib.gov.in/PressReleasePage.aspx?PRID=1650102">https://pib.gov.in/PressReleasePage.aspx?PRID=1650102</a></p> |

## 1.2 Lerneinheit - Vermehrung von Hefen als Bioorganismen

### 1.2.1 Hintergrund

Hefe; oval, farblos und glatt, wandelt bei der Gärung Kohlenhydrate in Alkohol um, vermehrt sich durch Knospung, wird in der Backindustrie und bei der Herstellung von Ethanol verwendet, z. B. *Saccharomyces cerevisiae* (Bäckerhefe). Hefe ist ein einzelliger Organismus aus dem Reich der Pilze. Es gibt mehr als 500 Arten und Tausende von Varianten von Hefe. Hefe findet sich im Boden, in zuckerhaltigen Flüssigkeiten (Obst und Blumen) und auf der Oberfläche von Pflanzen und Tieren. Hefe hat mehrere Anwendungen in der Biotechnologie und spielt eine wichtige Rolle bei der Herstellung von Brot und alkoholischen Getränken.

In der Lebensmittelherstellung wird Hefe verwendet, um Gärung und Sauerteig zu erzeugen. Die Pilze ernähren sich von Zuckern und produzieren Alkohol (Ethanol) und Kohlendioxid; bei der Bier- und Weinherstellung ist das erstere das gewünschte Produkt, beim Backen ist es das letztere.

Bei der Hefe erfolgt die Knospung in der Regel bei reichlicher Nährstoffzufuhr. Bei diesem Fortpflanzungsprozess entsteht eine kleine Knospe als Auswuchs des Mutterkörpers. Später wird der Kern der Mutterhefe in zwei Teile geteilt und einer der Kerne wandert in die Knospe. Die neu entstandene Knospe.

Faktoren, die die Hefevermehrung beeinflussen, sind:

- Temperatur
- pH-Wert
- O<sub>2</sub> Austausch
- Kohlenstoffquelle und -konzentration
- Nährstoff-Medien-Kombination
- Mischgeschwindigkeit usw...

Das Verhalten des Teigs während der Gärung kann mit Hilfe verschiedener mathematischer Modelle als Sigmoidalkurven dargestellt werden. Die Brotherstellung ist grundsätzlich ein temperaturabhängiger zweistufiger Prozess, der aus der Gärung besteht, bei der sich die mit der Hefeaktivität verbundene CO<sub>2</sub>-Produktion in einer porösen Teigstruktur manifestiert, und der Entwicklung des Teigvolumens während des Backens, bei der die Hefeaktivität beendet und die Brotstruktur fertiggestellt wird.



### 1.2.1 Inhalt

| LearnSTEM                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modul 2: Vermehrung von Hefen als Bioorganismen                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Ziel des Moduls/der Lerneinheit                                                                                                                             | Mit diesem Modul soll gezeigt werden, wie sich Hefe unter günstigen Bedingungen vermehrt.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Dauer                                                                                                                                                       | 40'x 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Lernziele                                                                                                                                                   | Die Schüler*innen können erklären, dass sich Hefen unter geeigneten Bedingungen vermehren, und dies anhand von Experimenten zeigen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Erforderliche Ressourcen/Materialien</b><br><br>(Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.) | <ul style="list-style-type: none"> <li>• Für Experiment 1: Hefen, heißes Wasser, warmes Wasser, kaltes Wasser, Zucker, Schwamm, Messzylinder.</li> <li>• Für Experiment 2: Hefen, warmes Wasser, Zucker, Schwamm, Messzylinder.</li> <li>• PowerPoint-Präsentationen</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Verfahren                                                                                                                                                   | <ul style="list-style-type: none"> <li>• Um diese Aktivität durchführen zu können, müssen die Schüler*innen mikroskopische Lebewesen bereits kennen und Beispiele nennen können. Diese Themen werden wiederholt und die Übung beginnt.</li> <li>• Die für Experiment 1 benötigten Materialien werden im Voraus vorbereitet und in den Klassenraum gebracht, wo sie für alle Schüler*innen gut sichtbar platziert werden. Die Schüler*innen werden in zufällige Gruppen von 3-4 Personen eingeteilt. Mit Hilfe dieser Materialien sollen sie einen Mechanismus erstellen, mit dem wir die Vermehrung von Hefepilzen in warmen, kalten und heißen Umgebungen vergleichen können. Die von den Gruppen erstellten Mechanismen werden mit anderen Gruppen verglichen (Abbildung 1). Die Schüler*innen werden gefragt, in welcher Umgebung Hefe am besten wachsen kann, und die Antworten werden diskutiert.</li> <li>• In der nächsten Stunde werden die für Experiment 2 benötigten Materialien in den Klassenraum gebracht. Die Schüler*innen werden in zufällige Gruppen von 3-4 Personen eingeteilt. Die Schüler*innen werden gebeten, einen Mechanismus zu entwickeln, mit dem wir das Wachstum von Hefen in zuckerhaltiger und zuckerfreier Umgebung vergleichen können.</li> <li>• Die Schüler werden dann gefragt, welche anderen Bedingungen für die Vermehrung von Hefen erforderlich</li> </ul> |

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|                                                                                                         | <p>sind.</p> <ul style="list-style-type: none"> <li>• Den Schüler*innen werden Präsentationen und Videos zu diesem Thema gezeigt.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Methoden zur Vermittlung von Inhalten ( <b>Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.</b> ) | <p>Teamarbeit<br/>Forschung<br/>Praktische Demonstration<br/>Diskussionen<br/>Erläuterung<br/>Brainstorming<br/>Problematisierung<br/>Praktisches Experiment</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Bewertungsmethode                                                                                       | H5P-Quiz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Referenzen                                                                                              | <p>Ali, A., Shehzad, A., Khan, M. R., Shabbir, M. A., &amp; Amjid, M. R. (2012). Hefe, ihre Arten und ihre Rolle bei der Fermentation während des Brotbackprozesses - A. <i>Pakistan Journal of Food Sciences</i>, 22(3), 171-179.</p> <p>Koçak, F. 2019. Farklı Havalandırma Profillerinde Maya Çoğalmasının Betaglukan Verimine Etkisinin İncelenmesi. Ankara Üniversitesi. Fen Bilimleri Enstitüsü. Unveröffentlichte Master Thesis.</p> <p>Pamir, H. 1985. Fermentasyon Mikrobiyolojisi. Ankara Üniversitesi Ziraat Fakültesi Yayınları, No:936, Ankara.</p> <p>Walker, G. M. 1998. Hefephysiologie und Biotechnologie. John Wiley &amp; Sons Ltd., 1-7, Schottland.</p> <p><a href="https://www.britannica.com/dictionary/yeast">https://www.britannica.com/dictionary/yeast</a><br/> <a href="https://www.merriam-webster.com/dictionary/yeast">https://www.merriam-webster.com/dictionary/yeast</a><br/> <a href="https://dictionary.cambridge.org/dictionary/english/yeast">https://dictionary.cambridge.org/dictionary/english/yeast</a><br/> <a href="https://www.slideshare.net/shiningpearl18/fungiyeastmolds">https://www.slideshare.net/shiningpearl18/fungiyeastmolds</a><br/> <a href="https://tr.wikipedia.org/wiki/Maya_%28biyoloji%29">https://tr.wikipedia.org/wiki/Maya_%28biyoloji%29</a><br/> <a href="https://byjus.com/neet/yeast-diagram/">https://byjus.com/neet/yeast-diagram/</a><br/> <a href="https://www.britannica.com/science/yeast-fungus">https://www.britannica.com/science/yeast-fungus</a><br/> <a href="https://www.youtube.com/watch?v=XY6akiB-lYk&amp;t=4s">https://www.youtube.com/watch?v=XY6akiB-lYk&amp;t=4s</a><br/> <a href="https://www.seriousseats.com/all-about-dry-yeast-instant-active-dry-fast-acting-and-more">https://www.seriousseats.com/all-about-dry-yeast-instant-active-dry-fast-acting-and-more</a><br/> <a href="https://mobil.diatek.com.tr/Makale-Yontem/Gida-Hijyeni-ve-Guvenligi/Maya-Cesitleri-Nelerdir_3580.htm">https://mobil.diatek.com.tr/Makale-Yontem/Gida-Hijyeni-ve-Guvenligi/Maya-Cesitleri-Nelerdir_3580.htm</a><br/> <a href="https://wiki.yeastgenome.org/index.php/What_are_yeast%3F">https://wiki.yeastgenome.org/index.php/What_are_yeast%3F</a><br/> <a href="https://byjus.com/biology/budding/">https://byjus.com/biology/budding/</a><br/> <a href="https://www.youtube.com/watch?v=iyWtp_L0Kzc&amp;t=191s">https://www.youtube.com/watch?v=iyWtp_L0Kzc&amp;t=191s</a><br/> <a href="https://mindthegraph.com/blog/tr/sigmoid-pattern/">https://mindthegraph.com/blog/tr/sigmoid-pattern/</a></p> |

### 1.3 Lerneinheit 3 Blätter transportieren und verdampfen Wasser

#### 1.3.1. Hintergrund

Das Blatt ist die Energiefabrik der Pflanze und für ihr Überleben unverzichtbar. Durch die Photosynthese wird Lichtenergie in Zucker umgewandelt, der wiederum zu den photosynthetisch inaktiven Teilen der Pflanze, wie den Wurzeln, transportiert wird (Katifori, 2018).

Die Blätter sind in der Regel die wichtigste Schnittstelle der Pflanze für den Gasaustausch, und sie sind distal zur Hauptwasserquelle, d. h. zum Boden, gelegen. Daher sind sie das am stärksten entwässerte Pflanzenorgan und steuern letztlich die Transpirationsrate. Das Netzwerk der Blattadern transportiert Wasser von den Stängeln zu den Blättern. Auch die produzierte Glukose wird von den Blättern über die Adern zu den anderen Teilen der Pflanze geleitet.

Die Spaltöffnungen (winzige Löcher an der Unterseite des Blattes) lassen Luft in das Blatt hinein und aus ihm heraus. Die Spaltöffnungen befinden sich normalerweise an der Unterseite des Blattes.

Die Spaltöffnungen schließen sich in der Nacht, um Gase und Feuchtigkeit in den Blattzellen zurückzuhalten, und öffnen sich tagsüber, um den Gasaustausch fortzusetzen.

Der osmotische Druck von Wassermolekülen aus dem Boden in die Wurzeln verursacht einen Aufwärtsdruck, der als Wurzeldruck bezeichnet wird. Aufgrund dieses Drucks wird das aus dem Boden aufgenommene Wasser durch das Xylemgewebe des Stammes nach oben gedrückt. Das Xylem ist das

Gefäßgewebe, das für den Transport von Wasser und gelösten Mineralien von den Wurzeln hinauf zum Stamm und den Blättern der Pflanze verantwortlich ist. Das Wasser wird den Rest des Weges durch die Transpiration transportiert, die den größten Teil der für den Wassertransport in Pflanzen benötigten Kraft liefert.

Wie alle lebenden Organismen benötigen auch Pflanzen ein Ausscheidungssystem, um überschüssiges Wasser aus ihrem Körper auszuschcheiden. Dieser Prozess der Ausscheidung von überschüssigem Wasser aus dem Pflanzenkörper wird als Transpiration bezeichnet. Im Allgemeinen handelt es sich dabei um die Verdunstung von Wasser von der Oberfläche der Blätter.

#### 1.3.2. Inhalt

| LearnSTEM                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modul 3: Blätter transportieren und verdampfen Wasser                                                                                     |                                                                                                                                                                                                                                                                                                                                                             |
| <b>Ziel des Moduls/der Lerneinheit</b>                                                                                                    | In diesem Modul sollen die Schüler*innen lernen, wie Blätter Wasser transportieren und verdampfen.                                                                                                                                                                                                                                                          |
| <b>Dauer</b>                                                                                                                              | <b>40x 4 dakika</b>                                                                                                                                                                                                                                                                                                                                         |
| <b>Lernziele</b>                                                                                                                          | <ul style="list-style-type: none"><li>Die Schüler*innen sind in der Lage, das Phänomen des Wassertransports zu den Blättern zu erklären und durch Experimente zu demonstrieren.</li><li>Die Schüler*innen sind in der Lage, die Verdunstung von Wasser von der Oberfläche der Pflanzenblätter zu erklären und durch Experimente zu demonstrieren.</li></ul> |
| <b>Erforderliche Ressourcen/Materialien (Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind</b> | <ul style="list-style-type: none"><li>Experiment 1: Wasser, Lebensmittelfarbe, Blumen oder Blätter</li><li>Experiment 2: Aluminiumfolie, Glasgefäß und Blume</li><li>PowerPoint-Präsentationen</li></ul>                                                                                                                                                    |

|                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| Maps usw.)                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Verfahren                                                                                               | <ul style="list-style-type: none"> <li>• Um diese Aktivität durchführen zu können, müssen die Schüler*innen die grundlegenden Teile und Funktionen von Pflanzen kennen und Beispiele nennen können. Diese Themen werden wiederholt und dann beginnt die Aktivität.</li> <li>• Die für Experiment 1 benötigten Materialien werden im Voraus vorbereitet und in den Klassenraum gebracht, wo sie für die Schüler*innen sichtbar aufbewahrt werden. Die Schüler*innen werden in zufällige Gruppen von 3-4 Personen eingeteilt. Mit diesen Materialien sollen sie einen Mechanismus entwerfen, mit dem wir beobachten können, wie Pflanzen Wasser transportieren. Die von den Gruppen entworfenen Mechanismen werden miteinander verglichen (Abbildung 1). Die Schüler*innen werden gefragt und diskutieren, wie Pflanzen und Blätter Wasser transportieren. Die Adern in den Blättern und ihre Funktionen werden erklärt.</li> <li>• Den Schüler*innen wird gesagt, dass in der nächsten Lektion beobachtet werden soll, wie Pflanzen Wasser verdunsten. Sie werden gebeten, darüber nachzudenken, was in diesem Bereich getan werden kann.</li> <li>• In der nächsten Stunde werden die für Experiment 2 benötigten Materialien vorbereitet und in den Klassenraum gebracht. Die Materialien der Schüler*innen, die verschiedene Materialien mitbringen, werden ebenfalls bewertet.</li> <li>• Die Schüler*innen werden in zufällige Gruppen von 3-4 Personen aufgeteilt. Die Schüler*innen sollen einen Mechanismus vorbereiten, um zu beobachten, wie Blätter Wasser verdampfen. Die von den Gruppen vorbereiteten Mechanismen werden verglichen. Die Schüler*innen werden gefragt, wie Blätter Wasser verdampfen. Die Struktur der Spaltöffnungen wird erklärt, und es wird erläutert, wie Wasser von der Oberfläche der Blätter verdunstet.</li> <li>• Den Schüler*innen werden Präsentationen und Videos zu diesem Thema gezeigt.</li> </ul> |
| Methoden zur Vermittlung von Inhalten ( <b>Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.</b> ) | Teamarbeit<br>Forschung<br>Praktische Demonstration<br>Diskussionen<br>Erläuterung<br>Brainstorming<br>Problematisierung<br>Praktisches Experiment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Bewertungsmethode                                                                                       | H5P-Quiz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|            | Kontinuierliche Bewertung durch Beobachtung                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Referenzen | <p>Boanares, D., Isaias, R. R. M. S., de Sousa, H. C., &amp; Kozovits, A. R. (2018). Strategien der Wasseraufnahme von Blättern basierend auf anatomischen Merkmalen. <i>Plant Biology</i>, 20(5), 848-856.<br/> <a href="https://doi.org/10.1111/plb.12832">https://doi.org/10.1111/plb.12832</a></p> <p>Guzmán-Delgado, P., Mason Earles, J., &amp; Zwieniecki, M. A. (2018). Einblicke in die physiologische Rolle der Wasseraufnahme über die Blattoberfläche aus der Perspektive der Rehydratationskinetik. <i>Plant, Cell &amp; Environment</i>, 41(8), 1886-1894.<br/> <a href="https://doi.org/10.1111/pce.13327">https://doi.org/10.1111/pce.13327</a></p> <p>Katifori, E. (2018). The transport network of a leaf, <i>Comptes Rendus Physique</i>, 19(4), 244-252. <a href="https://doi.org/10.1016/j.crhy.2018.10.007">https://doi.org/10.1016/j.crhy.2018.10.007</a><br/> <a href="https://kids.britannica.com/kids/article/leaf/433080">https://kids.britannica.com/kids/article/leaf/433080</a><br/> <a href="https://www.collinsdictionary.com/dictionary/english/leaf">https://www.collinsdictionary.com/dictionary/english/leaf</a><br/> <a href="https://www.merriam-webster.com/dictionary/leaf">https://www.merriam-webster.com/dictionary/leaf</a><br/> <a href="https://dictionary.cambridge.org/dictionary/english/leaf">https://dictionary.cambridge.org/dictionary/english/leaf</a><br/> <a href="https://www.passmyexams.co.uk/GCSE/biology/structure-of-leaf.html">https://www.passmyexams.co.uk/GCSE/biology/structure-of-leaf.html</a><br/> <a href="https://eschooltoday.com/learn/leaf-structure/">https://eschooltoday.com/learn/leaf-structure/</a><br/> <a href="https://www.britannica.com/video/152187/overview-leaf-structure-functions-plant">https://www.britannica.com/video/152187/overview-leaf-structure-functions-plant</a><br/> <a href="https://www.nagwa.com/en/presentations/638126046213/">https://www.nagwa.com/en/presentations/638126046213/</a><br/> <a href="https://www.britannica.com/video/73123/Plants-osmosis-roots-water-transpiration-leaves-moisture">https://www.britannica.com/video/73123/Plants-osmosis-roots-water-transpiration-leaves-moisture</a><br/> <a href="https://www.science-sparks.com/changing-colour-flowers-with-transpiration/">https://www.science-sparks.com/changing-colour-flowers-with-transpiration/</a><br/> <a href="https://www.science-sparks.com/changing-colour-flowers-with-transpiration/">https://www.science-sparks.com/changing-colour-flowers-with-transpiration/</a><br/> <a href="https://www.stem.org.uk/rx34bv">https://www.stem.org.uk/rx34bv</a><br/> <a href="https://eschooltoday.com/learn/transpiration/">https://eschooltoday.com/learn/transpiration/</a><br/> <a href="https://byjus.com/biology/transpiration/">https://byjus.com/biology/transpiration/</a><br/> <a href="https://www.britannica.com/science/transpiration">https://www.britannica.com/science/transpiration</a><br/> <a href="https://as1.ftcdn.net/v2/img/04/28/25/36/1000_F_428253637_KXsq3ZhVTtYAZnVtDMYALVZgWtZRDffN.jpg">https://as1.ftcdn.net/v2/img/04/28/25/36/1000_F_428253637_KXsq3ZhVTtYAZnVtDMYALVZgWtZRDffN.jpg</a></p> |

## 1.4 Lerneinheit 4 - Wachstum von Pflanzen und Salzgehalt

### 1.4.1 Hintergrund

Faktoren, die das Pflanzenwachstum beeinflussen, sind: Licht, Wasser, Kohlendioxid, Luft, Temperatur, die Verfügbarkeit wichtiger Nährstoffe, der pH-Wert des Bodens und der Platz zum Wachsen. Wasser ist eines der wichtigsten Elemente, die Pflanzen benötigen. Wenn man an Gartenarbeit denkt, denkt man im Allgemeinen an Wasser, Boden und Sonnenlicht. Pflanzen können leiden, wenn eines dieser Elemente beeinträchtigt ist. Die Bedeutung von Wasser für Pflanzen geht über die bloße Erhaltung ihrer Lebensfähigkeit hinaus. Wasser ist auch ein notwendiges Element für das Gedeihen von Pflanzen. Wasser ermöglicht die Aufnahme von lebenswichtigen Nährstoffen aus dem Boden. Außerdem trägt Wasser zum Transport von Zucker und anderen Elementen bei, die von Blumen oder Früchten benötigt werden.

Lösliche Salze können von den Pflanzen leicht aufgenommen werden. Je nach Art und Menge der Salzverbindungen, die in die Pflanze gelangen, werden sie bei Überschreiten einer bestimmten Konzentration für die Pflanze schädlich. Sie haben eine giftige Wirkung auf die Pflanze, indem sie die Ernährung und den Stoffwechsel stören. Außerdem kann die Pflanze mit zunehmender Salzkonzentration im Boden nur noch schwer Wasser aus dem Boden aufnehmen, die Bodenstruktur verschlechtert sich und die Pflanzenentwicklung verlangsamt sich oder kommt sogar zum Stillstand. Die hohe Salzkonzentration hat verschiedene unerwünschte Auswirkungen. Ein Ionenungleichgewicht ist eine der wichtigsten Folgen. Eine hohe Konzentration von Na- und Cl-Ionen beispielsweise kann zu biochemischen Prozessen führen, die für die Pflanzen tödlich sein können. Die Natrium- und Chloridtoxizität führt nicht nur zu Ernährungsstörungen, sondern auch zu physiologischer Trockenheit, indem sie das osmotische Potenzial der Bodenlösungen senkt.

Der durch NaCl verursachte Salzgehalt ist einer der häufigsten abiotischen Stressfaktoren, die die Pflanzenphysiologie beeinflussen. Salzstress führt zu verschiedenen Störungen der Pflanzen (Ungleichgewicht der Nährstoffionen, Verringerung der stomatären Leitfähigkeit, geringe photosynthetische Aktivität usw.), zu morphologischen Veränderungen (Verringerung der Anzahl der Blätter, der Pflanzengröße, der Länge der Wurzeln und der Fruchtbildung) und zu Veränderungen der Sekundärmetaboliten (Signalmoleküle, Hormone und oxidative Verbindungen). Die Verwendung von Salzwasser für den Pflanzenanbau erfordert daher die Ermittlung artspezifischer Schwellenwerte, ab denen die Pflanzen empfindlich auf den Salzgehalt reagieren.

#### 1.4.2 Inhalt

| LearnSTEM                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modul 4: Wachstum von Pflanzen und Salzgehalt                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Ziel des Moduls/der Lerneinheit</b>                                                                                                                  | <b>Ziel dieses Moduls ist es, die Schüler*innen in die Lage zu versetzen, die Auswirkungen des Salzgehalts im Boden auf das Pflanzenwachstum zu erklären.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Dauer</b>                                                                                                                                            | <b>40'x 8</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Lernziele</b>                                                                                                                                        | Die Schüler*innen sind in der Lage, die Bedeutung des Salzgehalts im Boden für das Wachstum von Pflanzen zu erklären und durch Experimente zu demonstrieren.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Erforderlich Ressourcen&amp;Materialien (Arbeitsblatt, Diagramme, Handouts, didaktisches Video, Auszüge aus Büchern/Handbüchern, Mind Maps usw.)</b> | <ul style="list-style-type: none"> <li>• Für Experiment 1: Topf, Erde, Linsen, Wasser</li> <li>• Für Experiment 2: Linsensetzling, Salz, Wasser</li> <li>• Für Experiment 3: Linsensämlinge, gedüngt, Wasser</li> <li>• PowerPoint-Präsentationen</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Verfahren</b>                                                                                                                                        | <ul style="list-style-type: none"> <li>• Um diese Aktivität durchführen zu können, müssen die Schüler*innen die für das Wachstum von Pflanzen notwendigen Bedingungen kennen und Beispiele nennen können. Diese Themen werden wiederholt und die Aktivität beginnt.</li> <li>• Die für Experiment 1 benötigten Materialien werden im Voraus vorbereitet und in den Klassenraum gebracht. Die Schüler*innen werden in zufällige Gruppen von 3-4 Personen eingeteilt. Mit Hilfe der Materialien werden die Schüler*innen gebeten, Linsensamen in 4 Töpfe unter den gleichen Bedingungen zu pflanzen und sie durch gleichmäßiges Gießen wachsen zu lassen. Nach etwa 5 Wochen werden die Pflanzen beobachtet und verglichen. Zu diesem Zeitpunkt sollten die Setzlinge die gleiche Höhe haben.</li> <li>• In der nächsten Lektion wird Wasser mit unterschiedlichem Salzgehalt für Experiment 2 vorbereitet. Die Gruppen beobachten ihre Setzlinge 7 Tage lang, indem sie sie gleichmäßig gießen. Die Pflanzen der Gruppen werden verglichen. Die Schüler*innen werden gefragt, welche Pflanze besser wächst und ob sich das Wachstum der Pflanze mit zunehmendem Salzgehalt des Bewässerungswassers verändert.</li> <li>• In der 3. Phase des Versuchs wird der Boden einer von zwei gleich großen Pflanzen übermäßig gedüngt und 7 Tage lang beobachtet. Die Auswirkungen der</li> </ul> |

|                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                         | <p>Überdüngung auf das Pflanzenwachstum werden diskutiert.</p> <ul style="list-style-type: none"> <li>• Es werden Tabellen erstellt und Diagramme gezeichnet, um das Pflanzenwachstum zu vergleichen.</li> <li>• Den Schüler*innen werden Präsentationen und Videos zu diesem Thema gezeigt.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Methoden zur Vermittlung von Inhalten ( <b>Vorlesung, Diskussionen, Forschung, Gruppenarbeit usw.</b> ) | <p>Teamarbeit<br/>Forschung<br/>Praktische Demonstration<br/>Diskussionen<br/>Erläuterung<br/>Brainstorming<br/>Problematisierung<br/>Praktisches Experiment</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Bewertungsmethode                                                                                       | <p>H5P-Quiz<br/>Bewertung auf der Grundlage von praktischen Leistungen und Ergebnissen<br/>Kontinuierliche Bewertung durch Beobachtung</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Referenzen                                                                                              | <ul style="list-style-type: none"> <li>• EKMEKÇİ, E., Mehmet, A. P. A. N., &amp; Tekin, K. A. R. A. (2005). Tuzluluğun bitki gelişimine etkisi. <i>Anadolu tarım bilimleri dergisi</i>, 20(3), 118-125.</li> <li>• Kotuby, J., Koenig, R., &amp; Kitchen, B. (1997). Salzgehalt und Pflanzentoleranz. Utah State University Extension. AG-SO-03., Utah.</li> <li>• Petretto, G. L., Urgeghe, P. P., Massa, D., &amp; Melito, S. (2019). Wirkung von Salzgehalt (NaCl) auf das Pflanzenwachstum, den Nährstoffgehalt und die Entwicklung von Glucosinolat-Hydrolyseprodukten bei Rucola-Genotypen. <i>Plant Physiology and Biochemistry</i>, 141, 30-39.<br/><a href="https://doi.org/10.1016/j.plaphy.2019.05.012">https://doi.org/10.1016/j.plaphy.2019.05.012</a></li> <li>• Shahid, M. A., Sarkhosh, A., Khan, N., Balal, R. M., Ali, S., Rossi, L., ... &amp; Garcia-Sanchez, F. (2020). Einblicke in die physiologischen und biochemischen Auswirkungen von Salzstress auf Pflanzenwachstum und -entwicklung. <i>Agronomy</i>, 10(7), 938.<br/><a href="https://doi.org/10.3390/agronomy10070938">https://doi.org/10.3390/agronomy10070938</a></li> </ul> <p> <a href="https://www.britannica.com/dictionary/plant">https://www.britannica.com/dictionary/plant</a><br/> <a href="https://www.collinsdictionary.com/dictionary/english/plant">https://www.collinsdictionary.com/dictionary/english/plant</a><br/> <a href="https://www.merriam-webster.com/dictionary/plant">https://www.merriam-webster.com/dictionary/plant</a><br/> <a href="https://dictionary.cambridge.org/dictionary/english/plant">https://dictionary.cambridge.org/dictionary/english/plant</a><br/> <a href="https://www.agrowtronics.com/plant-growth-stages-an-overview/">https://www.agrowtronics.com/plant-growth-stages-an-overview/</a><br/> <a href="https://aehinnovativehydrogel.com/news/what-are-the-requirements-for-plant-growth/">https://aehinnovativehydrogel.com/news/what-are-the-requirements-for-plant-growth/</a><br/> <a href="https://swanhose.com/blogs/general-watering/how-does-water-its-amount-its-quality-affect-plant-growth">https://swanhose.com/blogs/general-watering/how-does-water-its-amount-its-quality-affect-plant-growth</a><br/> <a href="https://youtu.be/7-eFcMJYIXk">https://youtu.be/7-eFcMJYIXk</a><br/> <a href="https://www.sorhocam.com/konu.asp?sid=4321&amp;bitkilerde-tuz-stresi-nedir.html">https://www.sorhocam.com/konu.asp?sid=4321&amp;bitkilerde-tuz-stresi-nedir.html</a><br/> <a href="https://atlas-scientific.com/blog/how-does-electrical-conductivity-affect-plant-growth/">https://atlas-scientific.com/blog/how-does-electrical-conductivity-affect-plant-growth/</a> </p> |





# Modello innovativo di apprendimento delle STEM nelle scuole secondarie



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## **Imparare le STEM**

*Modello innovativo di apprendimento delle STEM  
nelle scuole secondarie*

ERASMUS+ KA220

Cooperazione Partenariati nell'istruzione scolastica

## **WP2: Modello pedagogico LearnSTEM**

### **Manuale di implementazione delle pratiche STEM**

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**Yusuf Demir Science And Art Center**

**Kırşehir**

**TURCHIA**

***Data***

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## 1. Risorse didattiche

### 1.1 Unità didattica - **Progettare un pannello solare**

#### 1.1.1 Sfondo

Avere una conoscenza di base della programmazione della scheda di controllo Arduino Uno prima di questo corso sarebbe utile agli studenti per creare progetti più efficaci.

Agli studenti viene mostrato un breve video per attirare la loro attenzione sull'importanza dell'energia solare, una fonte di energia rinnovabile. Dopo aver attirato l'attenzione degli studenti, vengono fornite informazioni concettuali su cosa sia l'energia solare e sul funzionamento dei pannelli solari. Agli studenti viene poi chiesto cosa si può fare per ottenere una maggiore efficienza dai pannelli solari. Agli studenti viene chiesto di proporre diverse idee su questo argomento. In seguito, agli studenti vengono mostrati esempi di diversi modelli di pannelli solari utilizzati in tutto il mondo.

Toccando il funzionamento dei pannelli solari, viene mostrato come l'angolo di caduta della luce solare influisce sull'elettricità ottenuta dal pannello solare utilizzando una torcia, un voltmetro e un pannello solare. Viene detto che l'angolo di caduta dei raggi solari sulla terra può cambiare e questo può influire sull'energia ottenuta dai pannelli solari. Agli studenti viene chiesto di pensare a cosa si può fare per garantire la continuità dei raggi solari perpendicolari al pannello solare. Agli studenti viene chiesto di spiegare le loro idee agli altri studenti. Si chiede loro di discutere tra loro. Dopo aver raccolto le opinioni degli studenti, viene mostrato uno studio esemplificativo che è stato fatto in precedenza su questo argomento e come si può beneficiare di diversi materiali.

A tale scopo, viene mostrato l'uso del programma di progettazione 3D Tinkercad e come ottenere una stampa da una stampante 3D. Viene poi mostrato come vengono collegate le parti risultanti e altre parti elettroniche. Viene mostrato un programma di esempio su come controllare le parti elettroniche con Arduino Uno. Infine, il lavoro preparato viene testato e il suo successo viene valutato con gli studenti.



| <b>Modello pedagogico LearnSTEM</b>                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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| <b>Modulo 1: Progettazione di un pannello solare</b>                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Obiettivo del modulo/unità di apprendimento</b>                                                                                                | <b>Lo scopo di questo modulo è quello di sottolineare l'importanza di utilizzare l'energia solare, che è una fonte di energia rinnovabile.</b>                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Durata</b>                                                                                                                                     | <b>40' x 8</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Obiettivi di apprendimento</b>                                                                                                                 | <ul style="list-style-type: none"><li>• Gli studenti saranno in grado di sapere cos'è l'energia solare.</li><li>• Gli studenti saranno in grado di spiegare il funzionamento dei pannelli solari.</li><li>• Gli studenti potranno scoprire diversi design di pannelli solari.</li><li>• Gli studenti saranno in grado di sapere cosa si può fare per ottenere una maggiore efficienza dai pannelli solari.</li><li>• Gli studenti saranno in grado di progettare un pannello solare per sfruttare meglio l'energia solare.</li></ul> |
| <b>Risorse e materiali necessari</b><br><br>(fogli di lavoro, grafici, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"><li>• Per la progettazione: (programma di progettazione 3D e stampante 3D) o (compensato, cartone e pistola al silicone)</li><li>• Per l'elettronica: Servomotore, sensore di luce, cavo di collegamento, resistenza, voltmetro, Arduino uno, saldatore.</li></ul>                                                                                                                                                                                                                                 |
| <b>Procedura</b>                                                                                                                                  | fasi istruttive:<br><ol style="list-style-type: none"><li>1. Catturare l'attenzione degli studenti sull'argomento.</li><li>2. Fornire informazioni sull'energia solare.</li><li>3. Mostrare esempi di progettazione di pannelli solari.</li><li>4. Dimostrare l'uso di Tinkercad e come ottenere risultati da una stampante 3D.</li><li>5. Mostrare come sono collegati i componenti elettronici.</li><li>6. Valutare il successo del lavoro preparato attraverso una prova con gli studenti.</li><li>7. Feedback.</li></ol>         |
| <b>Metodi di erogazione dei contenuti</b> (lezioni, discussioni, ricerche, lavori di gruppo, ecc.)                                                | Lavoro di gruppo<br>Spiegazione<br>Dimostrazione pratica<br>Discussione<br>Brainstorming                                                                                                                                                                                                                                                                                                                                                                                                                                             |



## Modello innovativo di apprendimento delle STEM nelle scuole secondarie



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| Metodo di valutazione | Esame H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| Riferimenti           | <p>Almadhhachi, M., Seres, I. e Farkas, I. (2022). Importanza degli alberi solari: Configurazione, funzionamento, tipi e commercializzazione della tecnologia. <i>Energy Reports</i>, 8, 6729-6743.</p> <p>Bakirci, K. (2012). Modelli generali per gli angoli di inclinazione ottimali dei pannelli solari: Un caso di studio in Turchia. <i>Renewable and Sustainable Energy Reviews</i>, 16(2012), 6149-6159. <a href="http://dx.doi.org/10.1016/j.rser.2012.07.009">http://dx.doi.org/10.1016/j.rser.2012.07.009</a></p> <p>Dal, A. R. (2021). Güneş enerjisi panellerindeki optimum eğim açısının verime etkisinin incelenmesi. <i>Bilecik Şeyh Edebali Üniversitesi Fen Bilimleri Dergisi</i>, 8(1), 241-250. <a href="https://doi.org/10.35193/bseufbd.878795">https://doi.org/10.35193/bseufbd.878795</a></p> <p>Le Roux, W. G. (2016). Angoli ottimali di inclinazione e azimut per collettori solari fissi in Sudafrica utilizzando dati misurati. <i>Renewable Energy</i>, 96, 603-612. <a href="http://dx.doi.org/10.1016/j.renene.2016.05.003">http://dx.doi.org/10.1016/j.renene.2016.05.003</a></p> <p>Melhem, R., &amp; Shaker, Y. (2023). Angolo di inclinazione e radiazione solare ottimale dei moduli fotovoltaici per i Paesi del Consiglio di collaborazione del Golfo. <i>International Journal of Energy Research</i>, 2023. <a href="https://doi.org/10.1155/2023/8381696">https://doi.org/10.1155/2023/8381696</a></p> <p>Tang, R. &amp; Wu, T. (2004). Angoli di inclinazione ottimali per i collettori solari utilizzati in Cina. <i>Applied energy</i>, 79(2004), 239-248. <a href="https://doi.org/10.1016/j.apenergy.2004.01.003">https://doi.org/10.1016/j.apenergy.2004.01.003</a></p> <p><a href="https://www.greenprophet.com/2015/11/solar-palm-trees-3d-printed-dubai/">https://www.greenprophet.com/2015/11/solar-palm-trees-3d-printed-dubai/</a></p> <p><a href="https://www.britannica.com/science/solar-energy">https://www.britannica.com/science/solar-energy</a></p> <p><a href="https://education.nationalgeographic.org/resource/solar-energy/">https://education.nationalgeographic.org/resource/solar-energy/</a></p> <p><a href="https://dictionary.cambridge.org/dictionary/english/solar-energy">https://dictionary.cambridge.org/dictionary/english/solar-energy</a></p> <p><a href="https://www.nrel.gov/news/video/solar-energy-basics-text.html">https://www.nrel.gov/news/video/solar-energy-basics-text.html</a></p> <p><a href="https://www.energy.gov/eere/solar/how-does-solar-work">https://www.energy.gov/eere/solar/how-does-solar-work</a></p> <p><a href="https://www.energy.gov/eere/solar/solar-photovoltaic-system-design-basics">https://www.energy.gov/eere/solar/solar-photovoltaic-system-design-basics</a></p> <p><a href="https://www.energy.gov/eere/solar/concentrating-solar-thermal-power-basics">https://www.energy.gov/eere/solar/concentrating-solar-thermal-power-basics</a></p> <p><a href="https://www.energysage.com/blog/most-common-solar-energy-uses/">https://www.energysage.com/blog/most-common-solar-energy-uses/</a></p> <p><a href="https://pib.gov.in/PressReleasePage.aspx?PRID=1650102">https://pib.gov.in/PressReleasePage.aspx?PRID=1650102</a></p> |



## 1.2 Unità di apprendimento - **Moltiplicazione dei lieviti come bioorganismi**

### 1.2.1 Contesto

Lievito; di forma ovale, incolore e liscio, converte i carboidrati in alcol durante la fermentazione, si riproduce per gemmazione, viene utilizzato nell'industria della panificazione e nella produzione di etanolo, ad esempio *Saccharomyces cerevisiae* (lievito del fornaio). Il lievito è un organismo unicellulare del regno dei funghi. Esistono più di 500 specie e migliaia di varianti di lievito. I lieviti si trovano nel suolo, nei liquidi zuccherini (frutta e fiori) e sulla superficie di piante e animali. Il lievito ha diverse applicazioni in biotecnologia e svolge un ruolo importante nella produzione di pane e bevande alcoliche.

Nella produzione alimentare, il lievito viene utilizzato per provocare la fermentazione e la lievitazione. I funghi si nutrono di zuccheri, producendo alcol (etanolo) e anidride carbonica; nella produzione di birra e vino il primo è il prodotto desiderato, nella panificazione il secondo.

Nel lievito, la gemmazione avviene di solito in presenza di un abbondante apporto di nutrimento. In questo processo riproduttivo, una piccola gemma si forma come un'escrecenza del corpo madre. In seguito il nucleo del lievito madre si separa in due parti e uno dei nuclei si sposta nella gemma. La gemma appena creata.

I fattori che influenzano la proliferazione del lievito sono:

- Temperatura
- pH
- Scambio O<sub>2</sub>
- Fonte e concentrazione di carbonio
- Combinazione di supporti nutritivi
- Velocità di miscelazione, ecc.

Il comportamento dell'impasto durante la fermentazione può essere presentato come curve sigmoidali utilizzando diversi modelli matematici. La panificazione è fondamentalmente un processo a due fasi, dipendente dalla temperatura, che consiste nella fermentazione, in cui la produzione di CO<sub>2</sub> legata all'attività del lievito si manifesta in una struttura porosa dell'impasto, e nello sviluppo del volume dell'impasto durante la cottura, in cui l'attività del lievito termina e la struttura del pane si perfeziona.



1.2.1 Contenuto

| Modello pedagogico LearnSTEM                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| Modulo 2: Moltiplicazione dei lieviti come bioorganismi                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Obiettivo del modulo/unità di apprendimento</b>                                                                                            | <b>Lo scopo di questo modulo è dimostrare come il lievito prolifera in condizioni favorevoli.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Durata</b>                                                                                                                                 | <b>40'x 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Obiettivi di apprendimento</b>                                                                                                             | Gli studenti saranno in grado di spiegare che i lieviti si moltiplicano in condizioni adeguate e di dimostrarlo attraverso esperimenti.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Risorse e materiali necessari</b><br>(fogli di lavoro, tabelle, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"> <li>• Per l'esperimento 1: lieviti, acqua calda, acqua tiepida, acqua fredda, zucchero, spon, cilindro graduato.</li> <li>• Per l'esperimento 2: lieviti, acqua calda, zucchero, spon, cilindro graduato.</li> <li>• Presentazioni di PowerPoint</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Procedura</b>                                                                                                                              | <ul style="list-style-type: none"> <li>• Per svolgere questa attività, gli studenti devono conoscere in anticipo le creature microscopiche ed essere in grado di fornire esempi. Questi argomenti vengono ripetuti e l'attività ha inizio.</li> <li>• Il materiale necessario per l'Esperimento 1 viene preparato in anticipo, portato in classe e collocato in un luogo visibile a tutti gli studenti. Gli studenti vengono divisi in gruppi casuali di 3-4 persone. Utilizzando questi materiali, viene chiesto loro di creare un meccanismo che consenta di confrontare la proliferazione dei lieviti in ambienti caldi, freddi e caldi. I meccanismi realizzati dai gruppi vengono confrontati con altri gruppi (Figura 1). Agli studenti viene chiesto in quale ambiente il lievito può crescere meglio e le risposte vengono discusse.</li> <li>• Nella lezione successiva, i materiali necessari per l'Esperimento 2 vengono portati in classe. Gli studenti vengono divisi in gruppi casuali di 3-4 persone. Agli studenti viene chiesto di creare un meccanismo che consenta di confrontare la crescita dei lieviti in ambienti zuccherati e senza zucchero.</li> <li>• Agli studenti viene chiesto quali altre condizioni sono necessarie per la moltiplicazione dei lieviti.</li> <li>• Agli studenti vengono mostrati presentazioni e video preparati sull'argomento.</li> </ul> |
| <b>Metodi di erogazione dei contenuti (lezioni, discussioni, ricerche, lavori di gruppo, ecc.)</b>                                            | Lavoro di squadra<br>Ricerca<br>Dimostrazione pratica<br>Discussioni<br>Spiegazione                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |



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|                       | Brainstorming<br>Problematizzazione<br>Esperimento pratico                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Metodo di valutazione | Quiz H5P                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Riferimenti           | <p>Ali, A., Shehzad, A., Khan, M. R., Shabbir, M. A., &amp; Amjid, M. R. (2012). Il lievito, i suoi tipi e il suo ruolo nella fermentazione durante il processo di panificazione-A. <i>Pakistan Journal of Food Sciences</i>, 22(3), 171-179.</p> <p>Koçak, F. 2019. Farklı Havalandırma Profillerinde Maya Çoğalmasının Betaglukan Verimine Etkisinin İncelenmesi. Ankara Üniversitesi. Fen Bilimleri Enstitüsü. Tesi di Master non pubblicata.</p> <p>Pamir, H. 1985. Fermentasyon Mikrobiyolojisi. Ankara Üniversitesi Ziraat Fakültesi Yayınları, No:936, Ankara.</p> <p>Walker, G. M. 1998. Fisiologia e biotecnologia del lievito. John Wiley &amp; Sons Ltd., 1-7, Scozia.</p> <p><a href="https://www.britannica.com/dictionary/yeast">https://www.britannica.com/dictionary/yeast</a></p> <p><a href="https://www.merriam-webster.com/dictionary/yeast">https://www.merriam-webster.com/dictionary/yeast</a></p> <p><a href="https://dictionary.cambridge.org/dictionary/english/yeast">https://dictionary.cambridge.org/dictionary/english/yeast</a></p> <p><a href="https://www.slideshare.net/shiningpearl18/funghiyeastmolds">https://www.slideshare.net/shiningpearl18/funghiyeastmolds</a></p> <p><a href="https://tr.wikipedia.org/wiki/Maya_%28biyoloji%29">https://tr.wikipedia.org/wiki/Maya_%28biyoloji%29</a></p> <p><a href="https://byjus.com/neet/yeast-diagram/">https://byjus.com/neet/yeast-diagram/</a></p> <p><a href="https://www.britannica.com/science/yeast-fungus">https://www.britannica.com/science/yeast-fungus</a></p> <p><a href="https://www.youtube.com/watch?v=XY6akiB-IYk&amp;t=4s">https://www.youtube.com/watch?v=XY6akiB-IYk&amp;t=4s</a></p> <p><a href="https://www.seriousseats.com/all-about-dry-yeast-instant-active-dry-fast-acting-and-more">https://www.seriousseats.com/all-about-dry-yeast-instant-active-dry-fast-acting-and-more</a></p> <p><a href="https://mobil.diatek.com.tr/Makale-Yontem/Gida-Hijyeni-ve-Guvenligi/Maya-Cesitleri-Nelerdir_3580.htm">https://mobil.diatek.com.tr/Makale-Yontem/Gida-Hijyeni-ve-Guvenligi/Maya-Cesitleri-Nelerdir_3580.htm</a></p> <p><a href="https://wiki.yeastgenome.org/index.php/What_are_yeast%3F">https://wiki.yeastgenome.org/index.php/What_are_yeast%3F</a></p> <p><a href="https://byjus.com/biology/budding/">https://byjus.com/biology/budding/</a></p> <p><a href="https://www.youtube.com/watch?v=iyWtp_L0Kzc&amp;t=191s">https://www.youtube.com/watch?v=iyWtp_L0Kzc&amp;t=191s</a></p> <p><a href="https://mindthegraph.com/blog/tr/sigmoid-pattern/">https://mindthegraph.com/blog/tr/sigmoid-pattern/</a></p> |

### 1.3 Unità didattica 3 Le foglie trasportano ed evaporano l'acqua

#### 1.3.1. Sfondo

La foglia è la fabbrica di energia della pianta e chiaramente è indispensabile per la sua sopravvivenza. La fotosintesi converte l'energia luminosa in zucchero, che a sua volta viene trasportato alle parti della pianta inattive dal punto di vista fotosintetico, come le radici (Katifori, 2018).

Le foglie sono generalmente la principale interfaccia della pianta per lo scambio di gas e si trovano in posizione distale rispetto alla principale fonte di acqua, cioè il suolo. Di conseguenza, sono l'organo vegetale più disidratato e, in ultima analisi, controllano i tassi di traspirazione. La rete di vene della foglia trasporta l'acqua dagli steli alle foglie. Anche il glucosio prodotto viene inviato alle altre parti della pianta dalle foglie attraverso le vene.

Gli stomi (piccoli fori sotto la foglia) permettono all'aria di entrare e uscire dalla foglia. Gli stomi si trovano solitamente sulla superficie inferiore della foglia.

Gli stomi si chiudono durante la notte per trattenere i gas e l'umidità nelle cellule della foglia e si aprono durante il giorno per continuare gli scambi gassosi.

La spinta osmotica delle molecole d'acqua dal suolo alle radici provoca una pressione verso l'alto, nota come pressione radicale. A causa di questa pressione, l'acqua assorbita dal terreno viene spinta verso l'alto attraverso il tessuto xilematico del fusto. Lo xilema è il tessuto vascolare responsabile del trasporto dell'acqua e dei minerali disciolti dalle radici fino al fusto e alle foglie della pianta. L'acqua viene trasportata per il resto del percorso dalla traspirazione, che fornisce la maggior parte della forza necessaria per il trasporto dell'acqua nelle piante.



Come tutti gli organismi viventi, anche le piante necessitano di un sistema escretore per scaricare l'acqua in eccesso dal loro corpo. Questo processo di eliminazione dell'acqua in eccesso dal corpo vegetale è noto come traspirazione. Si tratta generalmente dell'evaporazione dell'acqua dalla superficie delle foglie.

### 1.3.2. Contenuto

| Modello pedagogico LearnSTEM                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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| Modulo 3: Le foglie trasportano ed evaporano l'acqua                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Obiettivo del modulo/unità di apprendimento                                                                                         | Lo scopo di questo modulo è quello di far apprendere agli studenti come le foglie trasportano ed evaporano l'acqua.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Durata                                                                                                                              | 40x 4 dakika                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Obiettivi di apprendimento                                                                                                          | <ul style="list-style-type: none"><li>• Gli studenti saranno in grado di spiegare il fenomeno del trasporto dell'acqua alle foglie e di dimostrarlo attraverso esperimenti.</li><li>• Gli studenti saranno in grado di spiegare l'evaporazione dell'acqua dalla superficie delle foglie delle piante e di dimostrarla con esperimenti.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Risorse e materiali necessari (fogli di lavoro, grafici, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"><li>• Esperimento 1: acqua, colorante alimentare, fiori o foglie</li><li>• Esperimento 2: Foglio di alluminio, barattolo di vetro e fiore</li><li>• Presentazioni di PowerPoint</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Procedura                                                                                                                           | <ul style="list-style-type: none"><li>• Per realizzare questa attività, gli studenti devono conoscere le parti e le funzioni fondamentali delle piante ed essere in grado di fornire esempi. Questi argomenti vengono ripetuti e poi inizia l'attività.</li><li>• Il materiale necessario per l'Esperimento 1 viene preparato in anticipo, portato in classe e messo in un posto dove ogni studente possa vederlo. Gli studenti vengono divisi in gruppi casuali di 3-4 persone. Utilizzando questi materiali, viene chiesto loro di creare un meccanismo che consenta di osservare come le piante trasportano l'acqua. I meccanismi progettati dai gruppi vengono confrontati tra loro (Figura 1). Agli studenti viene chiesto e discusso come le piante e le foglie trasportano l'acqua. Vengono spiegate le vene delle foglie e le loro funzioni.</li><li>• Agli studenti viene detto che nella prossima lezione verrà osservato come le piante evaporano l'acqua. Viene chiesto loro di pensare a cosa si può fare per questo problema.</li><li>• Nella lezione successiva, i materiali richiesti per l'Esperimento 2 vengono preparati in anticipo e portati in classe. Si valutano anche i materiali degli studenti che portano materiali diversi.</li><li>• Gli studenti vengono divisi in gruppi casuali di 3-4 persone. Agli studenti viene chiesto di preparare un meccanismo per osservare come le foglie evaporano l'acqua. I meccanismi preparati dai gruppi vengono confrontati. Agli studenti viene chiesto come fanno le foglie a evaporare l'acqua. Viene spiegata la struttura degli stomi e come l'acqua evapora dalla superficie delle foglie.</li><li>• Agli studenti vengono mostrati presentazioni e video preparati</li></ul> |





|                                                                                                      | sull'argomento.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| Metodi di erogazione dei contenuti ( <b>lezioni, discussioni, ricerche, lavori di gruppo, ecc.</b> ) | Lavoro di squadra<br>Ricerca<br>Dimostrazione pratica<br>Discussioni<br>Spiegazione<br>Brainstorming<br>Problematizzazione<br>Esperimento pratico                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Metodo di valutazione                                                                                | Quiz H5P<br><br>Valutazione continua tramite osservazione                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Riferimenti                                                                                          | Boanares, D., Isaias, R. R. M. S., de Sousa, H. C., & Kozovits, A. R. (2018). Strategie di assorbimento idrico delle foglie basate su tratti anatomici. <i>Plant Biology</i> , 20(5), 848-856. <a href="https://doi.org/10.1111/plb.12832">https://doi.org/10.1111/plb.12832</a><br>Guzmán-Delgado, P., Mason Earles, J., & Zwieniecki, M. A. (2018). Approfondimento del ruolo fisiologico dell'assorbimento di acqua attraverso la superficie fogliare da una prospettiva di cinetica di reidratazione. <i>Plant, cell &amp; environment</i> , 41(8), 1886-1894. <a href="https://doi.org/10.1111/pce.13327">https://doi.org/10.1111/pce.13327</a><br>Katifori, E. (2018). La rete di trasporto di una foglia, <i>Comptes Rendus Physique</i> , 19(4), 244-252. <a href="https://doi.org/10.1016/j.crhy.2018.10.007">https://doi.org/10.1016/j.crhy.2018.10.007</a><br><a href="https://kids.britannica.com/kids/article/leaf/433080">https://kids.britannica.com/kids/article/leaf/433080</a><br><a href="https://www.collinsdictionary.com/dictionary/english/leaf">https://www.collinsdictionary.com/dictionary/english/leaf</a><br><a href="https://www.merriam-webster.com/dictionary/leaf">https://www.merriam-webster.com/dictionary/leaf</a><br><a href="https://dictionary.cambridge.org/dictionary/english/leaf">https://dictionary.cambridge.org/dictionary/english/leaf</a><br><a href="https://www.passmyexams.co.uk/GCSE/biology/structure-of-leaf.html">https://www.passmyexams.co.uk/GCSE/biology/structure-of-leaf.html</a><br><a href="https://eschooltoday.com/learn/leaf-structure/">https://eschooltoday.com/learn/leaf-structure/</a><br><a href="https://www.britannica.com/video/152187/overview-leaf-structure-functions-plant">https://www.britannica.com/video/152187/overview-leaf-structure-functions-plant</a><br><a href="https://www.nagwa.com/en/presentations/638126046213/">https://www.nagwa.com/en/presentations/638126046213/</a><br><a href="https://www.britannica.com/video/73123/Plants-osmosis-roots-water-transpiration-leaves-moisture">https://www.britannica.com/video/73123/Plants-osmosis-roots-water-transpiration-leaves-moisture</a><br><a href="https://www.science-sparks.com/changing-colour-flowers-with-transpiration/">https://www.science-sparks.com/changing-colour-flowers-with-transpiration/</a><br><a href="https://www.science-sparks.com/changing-colour-flowers-with-transpiration/">https://www.science-sparks.com/changing-colour-flowers-with-transpiration/</a><br><a href="https://www.stem.org.uk/rx34bv">https://www.stem.org.uk/rx34bv</a><br><a href="https://eschooltoday.com/learn/transpiration/">https://eschooltoday.com/learn/transpiration/</a><br><a href="https://byjus.com/biology/transpiration/">https://byjus.com/biology/transpiration/</a><br><a href="https://www.britannica.com/science/transpiration">https://www.britannica.com/science/transpiration</a><br><a href="https://as1.ftcdn.net/v2/img/04/28/25/36/1000_F_428253637_KXsq3ZhVTtYAZnVtDMYALVZgWtZRDffN.jpg">https://as1.ftcdn.net/v2/img/04/28/25/36/1000_F_428253637_KXsq3ZhVTtYAZnVtDMYALVZgWtZRDffN.jpg</a> |

#### 1.4 Unità didattica 4 - Crescita delle piante e salinità

##### 1.4.1 Contesto

I fattori che influenzano la crescita delle piante sono: la luce, l'acqua, l'anidride carbonica, l'aria, la temperatura, la disponibilità di nutrienti essenziali, il pH del terreno e lo spazio per crescere. L'acqua è uno degli elementi principali richiesti dalle piante. Quando si pensa al giardinaggio, generalmente si pensa all'acqua, al terreno e alla luce del sole. Le piante possono soffrire quando uno di questi elementi viene compromesso. L'importanza dell'acqua per le piante va oltre il semplice mantenimento in vita. L'acqua è anche un elemento necessario per



far crescere le piante. L'acqua permette di assorbire i nutrienti vitali dal terreno. È anche l'acqua che aiuta a trasportare lo zucchero e altri elementi che possono essere richiesti dai fiori o dai frutti.

I sali solubili possono essere facilmente assorbiti dalle piante. A seconda del tipo e della quantità di composti salini che entrano nella pianta, diventano dannosi per la pianta quando superano una certa concentrazione. Hanno un effetto velenoso sulla pianta, interrompendo la nutrizione e il metabolismo. Inoltre, con l'aumento della concentrazione di sale nel terreno, diventa difficile per la pianta assorbire l'acqua dal suolo, la struttura del terreno si deteriora e lo sviluppo della pianta rallenta o addirittura si arresta. A causa dell'elevata concentrazione di sale si manifestano diversi effetti indesiderati. Lo squilibrio ionico è una delle conseguenze principali. Un'elevata concentrazione di ioni Na e Cl, ad esempio, può portare a processi biochimici che possono rivelarsi fatali per le piante. La tossicità del sodio e del cloruro non solo induce disturbi nutrizionali, ma causa anche siccità fisiologica abbassando il potenziale osmotico delle soluzioni del suolo.

La salinità causata da NaCl è uno degli stress abiotici più comuni che influenzano la fisiologia delle piante. Lo stress salino causa diversi disturbi alle piante (squilibrio degli ioni nutritivi, diminuzione della conduttanza stomatica, bassa attività fotosintetica, ecc.), alterazioni morfologiche (riduzione del numero di foglie, delle dimensioni della pianta, della lunghezza delle radici e della produzione di frutti) e cambiamenti nei metaboliti secondari (molecole segnale, ormoni e composti ossidativi). Pertanto, l'uso di acqua salina per la coltivazione delle piante richiede l'identificazione di soglie specifiche per ogni specie a partire dalle quali le colture mostrano sensibilità alla salinità.

#### 1.4.2 Contenuto

| Modello pedagogico LearnSTEM                                                                                                                            |                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulo 4: Crescita delle piante e salinità                                                                                                              |                                                                                                                                                                                                                                                                                           |
| <b>Obiettivo del modulo/unità di apprendimento</b>                                                                                                      | <b>L'obiettivo di questo modulo è di consentire agli studenti di spiegare i livelli di salinità nel suolo che influenzano la crescita delle piante.</b>                                                                                                                                   |
| Durata                                                                                                                                                  | <b>40'x 8</b>                                                                                                                                                                                                                                                                             |
| Obiettivi di apprendimento                                                                                                                              | Gli studenti saranno in grado di spiegare l'importanza della salinità del suolo per la crescita delle piante e di dimostrarla attraverso esperimenti.                                                                                                                                     |
| <b>Richiesto</b><br><b>Risorse e materiali</b><br>(fogli di lavoro, grafici, dispense, video didattici, estratti da libri/manuali, mappe mentali, ecc.) | <ul style="list-style-type: none"><li>• Per l'esperimento 1: vaso, terra, lenticchie, acqua.</li><li>• Per l'Esperimento 2: Pianta di lenticchie, sale, acqua.</li><li>• Per l'Esperimento 3: Piantine di lenticchie, concimazione, acqua</li><li>• Presentazioni di PowerPoint</li></ul> |
| <b>Procedura</b>                                                                                                                                        | <ul style="list-style-type: none"><li>• Per svolgere questa attività, gli studenti devono conoscere le condizioni necessarie per la crescita delle piante ed essere in grado di fornire esempi. Questi argomenti vengono ripetuti e l'attività ha inizio.</li></ul>                       |



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|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                             | <ul style="list-style-type: none"> <li>Il materiale necessario per l'Esperimento 1 viene preparato in anticipo e portato in classe. Gli studenti vengono divisi in gruppi casuali di 3-4 persone. Utilizzando i materiali, si chiede agli studenti di piantare semi di lenticchie in 4 vasi nelle stesse condizioni e di farli crescere annaffiandoli in egual misura. Dopo circa 5 settimane le piante vengono osservate e confrontate. A questo punto, le piantine dovrebbero avere la stessa altezza.</li> <li>Nella lezione successiva si prepara l'acqua con diversi livelli di salinità per l'Esperimento 2. I gruppi osservano le loro piantine per 7 giorni innaffiandole in quantità uguali. I gruppi osservano le loro piantine per 7 giorni annaffiandole in quantità uguali. Le piante dei gruppi vengono confrontate. Si chiede agli studenti quale pianta cresca meglio e se la quantità di crescita della pianta cambi all'aumentare della salinità dell'acqua di irrigazione e si discutono le risposte.</li> <li>Nella terza fase dell'esperimento, si applica una fertilizzazione eccessiva al terreno di una delle due piante cresciute in egual misura e la si osserva per 7 giorni. Si discute l'effetto della concimazione eccessiva sulla crescita delle piante.</li> <li>Vengono create tabelle e disegnati grafici per confrontare la crescita delle piante.</li> <li>Agli studenti vengono mostrati presentazioni e video preparati sull'argomento.</li> </ul>                                                                                                                                                                                               |
| Metodi di erogazione dei contenuti (lezioni, discussioni, ricerche, lavori di gruppo, ecc.) | Lavoro di squadra<br>Ricerca<br>Dimostrazione pratica<br>Discussioni<br>Spiegazione<br>Brainstorming<br>Problematicizzazione<br>Esperimento pratico                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Metodo di valutazione                                                                       | Quiz 5HP<br>Valutazione basata sulle realizzazioni e sui risultati pratici<br>Valutazione continua attraverso l'osservazione                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Riferimenti                                                                                 | <ul style="list-style-type: none"> <li>EKMEKÇİ, E., Mehmet, A. P. A. N., &amp; Tekin, K. A. R. A. (2005). Tuzluluğun bitki gelişimine etkisi. <i>Anadolu tarım bilimleri dergisi</i>, 20(3), 118-125.</li> <li>Kotuby, J., Koenig, R. e Kitchen, B. (1997). Salinità e tolleranza delle piante. Utah State University Extension. AG-SO-03., Utah.</li> <li>Petretto, G. L., Urgeghe, P. P., Massa, D., &amp; Melito, S. (2019). Effetto della salinità (NaCl) sulla crescita delle piante, sul contenuto di nutrienti e sull'andamento dei prodotti di idrolisi dei glucosinolati in genotipi di rucola. <i>Fisiologia e biochimica delle piante</i>, 141, 30-39. <a href="https://doi.org/10.1016/j.plaphy.2019.05.012">https://doi.org/10.1016/j.plaphy.2019.05.012</a></li> <li>Shahid, M. A., Sarkhosh, A., Khan, N., Balal, R. M., Ali, S., Rossi, L., ... &amp; Garcia-Sanchez, F. (2020). Approfondimenti sugli impatti fisiologici e biochimici dello stress salino sulla crescita e sullo sviluppo delle piante. <i>Agronomia</i>, 10(7), 938. <a href="https://doi.org/10.3390/agronomy10070938">https://doi.org/10.3390/agronomy10070938</a></li> </ul> <p> <a href="https://www.britannica.com/dictionary/plant">https://www.britannica.com/dictionary/plant</a><br/> <a href="https://www.collinsdictionary.com/dictionary/english/plant">https://www.collinsdictionary.com/dictionary/english/plant</a><br/> <a href="https://www.merriam-webster.com/dictionary/plant">https://www.merriam-webster.com/dictionary/plant</a><br/> <a href="https://dictionary.cambridge.org/dictionary/english/plant">https://dictionary.cambridge.org/dictionary/english/plant</a> </p> |



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|  | <p><a href="https://www.agrowtronics.com/plant-growth-stages-an-overview/">https://www.agrowtronics.com/plant-growth-stages-an-overview/</a></p> <p><a href="https://aehinnovativehydrogel.com/news/what-are-the-requirements-for-plant-growth/">https://aehinnovativehydrogel.com/news/what-are-the-requirements-for-plant-growth/</a></p> <p><a href="https://swanhose.com/blogs/general-watering/how-does-water-its-amount-its-quality-affect-plant-growth">https://swanhose.com/blogs/general-watering/how-does-water-its-amount-its-quality-affect-plant-growth</a></p> <p><a href="https://youtu.be/7-eFcMJYIXk">https://youtu.be/7-eFcMJYIXk</a></p> <p><a href="https://www.sorhocam.com/konu.asp?sid=4321&amp;bitkilerde-tuz-stresi-nedir.html">https://www.sorhocam.com/konu.asp?sid=4321&amp;bitkilerde-tuz-stresi-nedir.html</a></p> <p><a href="https://atlas-scientific.com/blog/how-does-electrical-conductivity-affect-plant-growth/">https://atlas-scientific.com/blog/how-does-electrical-conductivity-affect-plant-growth/</a></p> |
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