



Learn STEM
Innovative Model of learning STEM
in secondary schools



Co-funded by
the European Union

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

ERASMUS+ KA220
Cooperation Partnerships in school education

**WP2: LearnSTEM Pedagogical Model
STEM Practices Implementation Handbook**

Carp Monica Mihaela

Saiz Ana

Signeanu Gabriel

**COLEGIUL TEHNIC „HARALAMB VASILIU”
PODU ILOAIEI, IAȘI,
ROMÂNIA**

Date:

28.03.2024

Reference Number:

2022-1-TR01-KA220-SCH-000087583



The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.



Learn STEM

Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

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.



Learn STEM

Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

1.1.2 Content

LearnSTEM Pedagogical Model	
Module 1: Collect and sort garbage	
Aim of the module/ learning unit	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.
Duration	50 minutes
Learning Objectives	At the end of the lesson, students will be able to: <ol style="list-style-type: none"> 1 Name the seven SPI codes specific to plastic materials; 2 Identify the different types of recyclable materials and associate them with the corresponding recycling symbols. 3 Develop practical and critical thinking skills through active participation in activities to identify and sort recyclable materials; 4 Identify and propose creative solutions for managing waste and promoting recycling in their community.
Resources&Materials Required (worksheet,charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.)	<ul style="list-style-type: none"> - - Printed codes; - - Laptop/Videoprojector; - - Recyclable materials collected (Cardboard boxes, plastic, aluminium, bags, plastic bottles, glass, PVC pipes, metal boxes, etc.) - - White or coloured paper; - - Writing objects; - - 5HP Quiz - - Didactic video material; - - Additional motivational video materials; - - Power Point presentation; - - Wheel of Names application;
Procedure	<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"> 1. View the didactic material; 2. Divide the students into groups; 3. Collection of recyclable garbage; 4. Establishing the rules of the game and starting the game. 5. Identify the type of recyclable garbage according to the specific code and position it appropriately. 6. Announcing the winning team. 7. Feedback.
Content Delivery Methods (lecture,discussions, research, group work, etc.)	Group work Explanation Practice demonstration Discussion



Learn STEM

Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

	Problematisation Brainstorming
Assessment Method	5HP Quiz Assessment based on achievements and practical results;
References	https://dictionary.cambridge.org/dictionary/english/garbage https://www.ldoceonline.com/dictionary/garbage https://www.oxfordlearnersdictionaries.com/definition/american_english/garbage https://www.roadrunnerwm.com/blog/history-of-garbage https://ecoresources.net.au/why-is-waste-sorting-important/ https://wheelofnames.com https://www.youtube.com/watch?v=b-0eajX7Xlo https://www.youtube.com/watch?v=3Lzsu8SXaWY



Learn STEM Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

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.



Learn STEM Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

1.2.2 Content

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



Learn STEM

Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

	<p>5. Balancing the balance scale using recyclable materials, after the teacher has added the standard object to one of the two 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>
<p>Content Delivery Methods (lecture, discussions, research, group work, etc.)</p>	<p>Teamwork Research Practical demonstration Discussions Explanation Brainstorming Problematisation Practical experiment</p>
<p>Assessment Method</p>	<p>H5P Quiz Assessment based on achievements and practical outcomes;</p>
<p>References</p>	<p>http://www.amathsdictionaryforkids.com/gr/b/balanceScales.html https://www.sciencea-z.com/main/ProcessResource/unit/33/process-science/grades-3-4/balance-scales https://schlaboratory.blog/balance-scale-definition-function-how-it-works-and-how-to-use-it/ https://www.youtube.com/watch?v= ZOX0yE8loc https://www.youtube.com/watch?v=J -DF5nYw7E&t=72s</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.



Learn STEM Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

1.3.2. Content

LearnSTEM Pedagogical Model	
Module 3: Composting in a bottle and creation of a composter - reuse of biodegradable waste	
Aim of the module/ learning unit	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.
Duration	50 min
Learning Objectives	<p>At the end of the class, students will be able to:</p> <ol style="list-style-type: none"> 1. Define compost; 2. Identify the types of household waste that can be used to make compost; 3. Make their own composter at home. 4. Know the importance of using compost and give examples of where it can be used. 5. Develop practical and creative thinking skills by actively participating in the construction of composters using recycled materials.
Resources&Materials Required (worksheet, charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.)	<ul style="list-style-type: none"> - - Plastic bottles; - - Organic household waste (leaves, plant resources) - - Soil; - - Water; - - Pieces of paper; - - Scissors - - Adhesive tape; - - Instructional video material; - - Laptop/Videoprojector; - - H5P Quiz; - - Additional video materials; - - Power Point Presentation;
Procedure	<p>The training steps students must follow: 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. Steps to follow:</p> <ol style="list-style-type: none"> 1. View the practical example; 2. Identify the materials needed to make the composter; 3. Divide the students into groups; 4. Making the composter; 5. Adding the raw material to obtain the compost; <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.</p>



Learn STEM

Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

	<p>Thus we have the following steps:</p> <ol style="list-style-type: none"> 1. Watering the compost - daily; 2. Checking the condition of the compost and changes in structure. 3. Proper use of compost. 4. Giving feedback.
<p>Content Delivery Methods (lecture, discussions, research, group work, etc.)</p>	<p>Group work Research Explanation Discussion Problematizing Practical demonstration Practical experiment Group project Brainstorming</p>
<p>Assessment Method</p>	<p>5HP Quiz Assessment based on achievements and practical results Continuous evaluation by observation</p>
<p>References</p>	<p>https://dictionary.cambridge.org/dictionary/english/compost https://www.collinsdictionary.com/dictionary/english/compost https://www.oxfordlearnersdictionaries.com/definition/english/compost_1 https://www.carryoncomposting.com/142941469.html https://www.nrdc.org/stories/composting-101#types https://www.youtube.com/watch?v=O4dl4YljMZk https://www.youtube.com/watch?v=pi-vsJOaduk</p>



Learn STEM Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

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.



Learn STEM Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

1.4.2. Content

LearnSTEM Pedagogical Model	
Module 4: Upcycling – Reuse of plastic	
Aim of the module/ learning unit	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.
Duration	50 min
Learning Objectives	At the end of the lesson, students will be able to: 1 Define upcycling; 2 Identify the dangers related to plastic particle pollution; 3 Enumerate the dangers to which seabirds are exposed. 4 Know the benefits of upcycling. 5 Give examples of seabirds that may ingest plastic. 6 Develop practical and creative thinking skills by actively participating in the construction of bird feeders.
Resources&Materials Required (worksheet,charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.)	<ul style="list-style-type: none"> - - Plastic bottles; - - Scissors; - - Cutter; - - Adhesive tape; - - String; - - Wire; - - Plastic plates; - - White and coloured paper; - - Writing instruments; - - Silicone glue gun; - - Wooden sticks; - - Screws and nuts; - - PowerPoint presentation; - - Instructional video material; - - Additional video material; - - 5HP Quiz; - - Laptop/Videoprojector;
Procedure	Steps to follow: 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. Working time: 40 minutes 1. Watch the video material; 2. Divide students into groups; 3. Identify the materials needed to build the feeders; 4. Building bird feeders 5. Presentation of the product made by each group and testing its conformity;



Learn STEM Innovative Model of learning STEM in secondary schools



Co-funded by
the European Union

	<p>After following the previous steps, the bird feeders should be 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"> 1. Counting and identifying birds visiting the feeders; 2. Photographing the birds visiting the feeders; 3. Presentation of the results; 4. Giving feedback.
<p>Content Delivery Methods (lecture, discussions, research, group work, etc.)</p>	<p>Working in groups Research Explanation Discussion Problematizing Practical experiment Group project Brainstorming</p>
<p>Assessment Method</p>	<p>5HP Quiz; Assessment based on practical achievements and results; Continuous assessment through observation;</p>
<p>References</p>	<p>https://www.oxfordlearnersdictionaries.com/definition/english/upcycle https://dictionary.cambridge.org/dictionary/english/upcycling https://www.treehugger.com/what-is-upcycling-5116081 https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/ https://www.futurelearn.com/info/courses/upcycling-for-change-from-green-ideas-to-startup-businesses/0/steps/67684 https://www.recyclingbins.co.uk/blog/upcycling-projects-to-try-bird-feeder/ https://www.youtube.com/watch?v=rd7qP9FdTal https://www.youtube.com/watch?v=P5OBWbZDZlc</p>