Co-funded by
the European Union

Learn STEM

Innovative Model of learning STEM
in secondary schools

ERASMUS+ KA220
Cooperation Partnerships in school education

WP2: Learn STEM Pedagogical Model

STEM Practices Implementation Handbook

ALİ ERDEM

KIRŞEHİR AHI EVRAN ANADOLU LISESI

Kırşehir/ TÜRKİYE

Date:
01.04.2023

Reference Number:
2022-1-TR01-KA220-SCH-000087583

1 Learning Resources

1.1 Module 1- Design a Skyscraper resisting the Wind

1.1.1 Background

Provide a brief summary of the topic or concept that will be covered in the lesson. Include its importance and relevance to the curriculum and why it's important for students to learn.

Skyscraper, a very tall multistoried building. The name first came into use during the 1880s, shortly after the first skyscrapers were built, in the United States. Weather conditions like wind speed can have dramatic impacts on the buildings, depending on their design and built up.

Skyscrapers are built to last and hence, the question arises what wind speed can skyscrapers withstand? They are basically designed to bear very severe conditions and high wind speeds. They are constructed by using techniques and procedures so that they are stronger and more durable.The skyscraper has been engineered to resist extreme conditions and can withstand a wind force of up to 100 to 170 miles per hour. It is built by considering the local regulations in order to be sure that the structure is made in accordance to the local conditions of that area.

This lesson is part of the Climate Action in LEARN STEM . In this lesson, learners will learn the features, history of the skyscrapers and how do they manage to withstand the force of the wind? This lesson plan includes the objectives, prerequisites, and exclusions of the lesson teaching students how to identify skyscrapers and the he purpose of the building's shape in terms of wind resistance.They will make an experiment and build their own skyscraper that can withstand wind.They will test the results and discuss with their friends.

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.

Before starting the practical activity, students will watch a video how do skyscrapers manage to withstand the force of the wind

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.

This interdisciplinary and interactive lesson is designed to inspire and educate students about the purpose of the building's shape in terms of wind resistance, What factors influence the design of a skyscraper to resist wind?

After this lesson, student should be able to:

- Identify several different structural engineering principles relating to skyscrapers.
- Match design principles with famous skyscrapers.
- How is the foundation of a skyscraper designed to resist wind?

LESSON CONTENT

1.Didactic Video (WP2-P2-Learnstem-Learning Resource- Design A Skyscraper Resisting The Wind

2.PPT (WP2-P2-Learnstem-Learning Resource- Design A Skyscraper Resisting The Wind),

3.Additional Resources (WP2-P2-Learnstem_Text_The Design A Skyscraper Resisting The Wind), additional videos from the YouTube platform

4.Assessment (H5P) (WP2-P2-Learnstem_Text_ Design A Skyscraper Resisting The Wind L-H5P_EN.Docx),

5.Experiment

1.1.2 Content

LearnSTEM Pedagogical Model Module 1: Design a Skyscraper resisting the Wind	
Aim of the module/ learning unit	The aim of this module is to : 1.In this lesson, students will examine images of buildings to understand the unique characteristics of skyscrapers, evaluate the elements of tall building construction, and consider how skyscrapers shape the urban environment and skyline. 2. They will learn the purpose of the building's shape in terms of wind resistance, What factors influence the design of a skyscraper to resist wind?
Duration	80 min.
Learning Objectives	1. Students will •learn about skyscrapers; •explore facts and figures about the world's tallest buildings; graph the height of the 10 tallest buildings in the world. 2.Students will: • Identify the characteristics of skyscrapers • Evaluate images to distinguish skyscrapers from other structures 3.Students will learn : • How is the foundation of a skyscraper designed to resist wind?
Resources & Materials Required (worksheet,charts, handouts, didactic video, excerpts from books/manuals, mind maps, etc.)	1.Didactic Video (WP2-P2-Learnstem-Learning Resource- Design A Skyscraper Resisting The Wind 2.PPT (WP2-P2-Learnstem-Learning Resource- Design A Skyscraper Resisting The Wind), 3.Additional Resources (WP2-P2-Learnstem_Text_The Design A Skyscraper Resisting The Wind), 4.Assessment (H5P) (WP2-P2-Learnstem_Text_ Design A Skyscraper Resisting The Wind L-H5P_EN.Docx), 5.Experiment
Procedure	**Instructional steps which learners need to follow:** **1.PRESENTATION AND DISCUSSION (10 MIN) ;** 1. Definition of skyscraper 2. Origin of skyscraper 3. Prominent example of skyscraper 4. Features of skyscraper 5. Skyscraper and wind **2. EXTENSION ACTIVITY(10 MIN)** Encourage students to discuss and/or debate these questions: How tall can or should office buildings or apartment houses be? What purpose do skyscrapers serve? Do we still need them? What are the advantages and disadvantages of very tall buildings? Explore facts and figures about the world's tallest buildings; graph the height of the 10 tallest buildings in the world. **3. DISPLAY THE VIDEO (10 MIN)** https://www.youtube.com/watch?v=tHMPR7flpf4 How Tall Buildings Tame the Wind

	4. EXPERIMENT AND DISCUSSING (40 MIN) Be an architect and engineer your own skyscraper that can withstand all sorts of conditions.Students build their own newspaper towers in a competition for height, while also being able to withstand a simulated "hurricane" wind force. **Materials** Scissors drawing paper ruler Notebook paper and pencil for design planning **Procedure:** Working individually or in pairs, students compete to design, create, test and redesign free-standing, weight-bearing towers. The challenge is to build the tallest tower while meeting the design criteria and minimizing the amount of material used—all within a time limit. Students experiment with different geometric shapes used in structural designs and determine how design choices affect the height and strength of structures, becoming comfortable with the concepts of structural members and modeling. After this activity, students should be able to: Describe and design models for free-standing weight-bearing towers. Identify effective geometric shapes used in tower design. Can this skyscraper withstand the wind and rain of a typhoon? Students experiment with a building model of the famous Taipei 101 to test and improve safety in what monsoon season brings.  1. Put your skyscraper to the test to see if it remains intact. Wind: Aim a hair dryer or fan at your skyscraper. Earthquake: Gently shake the table your building is on. Weight: Add weights to the top of your skyscraper. 2. Brainstorm ways to improve your skyscraper. What works? What doesn't? What modifications are needed? Rebuild and test it again to see if you've made it better! **5.ASSESSMENT (H5P) (10 MIN)**
Content Delivery Methods (lecture,discussions, research, group work, etc.)	• the expository methods: lecture; • programmed learning: via computer, e-textbook; • practical learning: exercises on the subject; • individual activity, activity in pairs, and collective activity.

Assessment Method	• 5HP Quiz • Assessment based on achievements and practical results • Continuous evaluation by observation
References (if necessary) (please use APA Style)	https://www.builderspace.com/the-skyscraper-construction-process-explained How skyscrapers work - http://science.howstuffworks.com/skyscraper4.htm How tall can skyscrapers be? - http://www.wisegeek.com/how-tall-can-skyscrapers-be.htm https://www.youtube.com/watch?v=tHMPR7flpf4 How skyscrapers work - http://science.howstuffworks.com/skyscraper4.htm How tall can skyscrapers be? - http://www.wisegeek.com/how-tall-can-skyscrapers-be.htm

1.2 Learning Unit 2- Smog and temperature inversions

1.2.1 Background

Provide a brief summary of the topic or concept that will be covered in the lesson. Include its importance and relevance to the curriculum and why it's important for students to learn.

Smog is defined as widespread air pollution that reduces visibility. The term “smog” is a combination of two words: “smoke” and “fog”, which are meant to describe its appearance. Originally, what is now known as sulphurous smog was common in industrial areas as it came from the sulphur oxides released by burning fossil fuels such as coal.Today, photochemical smog, also called ground-level ozone or summer smog, is much more common. It predominantly occurs in urban areas, as the nitrogen oxides necessary for its creation come from car exhaust. Usually, the higher the altitude, the lower the temperature of the air. Temperature inversion is a meteorological phenomenon that develops when cool air is trapped at the ground under a layer of warm air. Temperature inversions are more common during the winter in the northern hemisphere due to high pressure, clear skies, and long nights, which allow heat to dissipate easily from the ground. This leads to a phenomenon called winter smog, which is further exacerbated by homes burning wood and coal for warmth.

This lesson is part of the Climate Action in LEARN STEM . In this lesson, learners will learn one of the effects of environmental pollution smog,and Temperature inversionThis lesson plan includes the objectives, prerequisites, and exclusions of the lesson teaching students smog,and Temperature inversion.They will make an experiment on temprature inversion and smoke.They will test the results

and discuss with their friends.

After this lesson the students will

•explain the concepts of: temperature inversion, temperature variation, diurnal temperature variation, annual temperature variation;

•describe the relation between the height above sea level and the temperature;

•describe how inversion contributes to the formation of such phenomena as fog and smog.

LESSON CONTENT

- Didactic Video (WP2-P2-Learnstem-Learning Resource- Smog And Temperature İnversions)
- PPT (WP2-P2-Learnstem-Learning Resource- Smog And Temperature İnversions),
- Additional Resources (WP2-P2-Learnstem_ Smog And Temperature İnversions), additional videos from the YouTube platform
- Assessment (H5P) (WP2-P2-Learnstem_ Smog And Temperature İnversions),
- Experiment

1.2.2 Content

LearnSTEM Pedagogical Model Module 1: Smog and temperature inversions	
Aim of the module/ learning unit	The aim of this module is to demonstrate the importance of air for human health by defining its characteristics and main dangerous pollutants. Objective 1: To observe how temperature inversions are formed and how inversions influence air pollution levels. Objective 2: To discuss the health effects of air pollutants and how the Clean Air Act is a tool to reduce air pollution in the world Objective 3: To introduce students to actions that they and/or other members of our community can take to reduce air pollution.
Duration	**80 Min.**
Learning Objectives	On successful completion of this module/learning unit (LU), trainees will be able to: 1. learn the reasons for the differences in air temperature in different parts of the world. 2. After having completed the demonstration lesson, students should be able to: ● describe how a temperature inversion occurs ● name two primary sources of air pollutants that can become trapped in a temperature inversion ● understand how the activities of people interact with natural events concerning the air in our environment ● apply information from the demonstration model of a temperature inversion to such an occurrence in the real world, using key words: pollutant, air pollution, temperature inversion, and smog. 3. To acquaint children with the general subjects related to air - the phenomenon of spreading, the phenomenon of breathing and the importance of these phenomena for a human being, -To familiarize children with the basics of the problem of air pollution and the prevalence of its occurrence, also in rural areas, -To acquaint children with the causes of poor air quality and the harmfulness of burning coal and wood.
Resources &Materials Required (worksheet,charts, handouts, didactic video, excerpts from books/manuals, mind maps, etc.)	● Didactic Video (WP2-P2-Learnstem-Learning Resource- Smog And Temperature İnversions) ● PPT (WP2-P2-Learnstem-Learning Resource- Smog And Temperature İnversions), ● Additional Resources (WP2-P2-Learnstem_ Smog And Temperature İnversions), ● Assessment (H5P) (WP2-P2-Learnstem_ Smog And Temperature İnversions), ● Experiment (Similar To The Video Presented Above)
Procedure	**Instructional steps which trainees need to follow:** **1. PRESENTATION AND DISCUSSION** **(**20 min.) What Is Smoke And Temperature Inversions "Smog and Temperature." Instructional steps which trainees need to follow: 1.Criteria of success

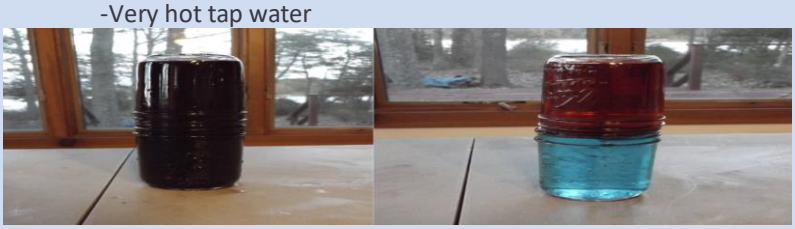
•explain the concepts of: temperature inversion, temperature variation, diurnal temperature variation, annual temperature variation;
•describe the relation between the height above sea level and the temperature;
•describe how inversion contributes to the formation of such phenomena as fog and smog.

1.Smog
2.How is Smog formed? Major Causes of Smog
3. Impact of Smog on Health and Environment
4.London Smog
5. Temperature inversion.
6. Causes of temperature inversion
7.How do temperature inversions exacerbate smog?
8.Effects of Temperature Inversion

2. DISPLAY THE VIDEO
(10 min) video 1952 London "Great Smog" Temperature inversion
The Great Smog of London, or Great Smog of 1952, was a severe air pollution event that affected London, England, in December 1952.
https://www.youtube.com/watch?v=hmrjwAkMveE
https://www.youtube.com/watch?v=jTrZZvnIHl8

3.(40 MIN.) SCIENCE EXPERIMENT
(Let's understand temperature inversion through simple experiment)
Identify sources of pollution which might particularly contribute to cold air (wintertime) inversion

Materials
-4 identical small, clear glass jars (baby food jars work well)
-Ice water
-Index cards large enough to cover the mouth of the jars
-Red food coloring
-Shallow pans or baking dishes (for spillage)
-Very hot tap water



Procedure
1. To simulate normal conditions, place both jars in a shallow pan or baking dish to catch any spills.
2. Fill one jar with hot water and one jar with ice water (no ice). Fill the jars to the brim. Put several drops of red food coloring in the jar with the hot water, to represents pollutants in the air near the earth.
3. Place the index card over the top of the jar with the cold (clear) water and quickly flip the jar on top of the jar with hot, polluted (red) water. Make sure the openings of the two jars are perfectly aligned and hold them in that position while you quickly but carefully pull the index card out. Let the Jars stand.
4. Inversion conditions: Repeat the above procedure, except in this case place the red food coloring in the jar of cold water. Then place the index

	card over the top of the jar with the hot (clear) water and invert it over the jar full of cold, polluted (red) water. Let the jars stand. 5. What happens in the first instance? The hot (red) and cold (clear) water mix immediately, moving some of the red food coloring (pollutant) into the upper jar, which becomes red. At the same time, the red (pollution) in the lower jar is diluted. This mixing of the warmer, colored water shows how warm air near the earth can move upward into the colder upper atmosphere and disperse pollutants. In the second instance, the cold (red) water is trapped and can't escape upward. The jar of hot water on top (clear) has "trapped" the dirty (red) cold air, just as warm air can trap a layer of cold, polluted air and create unhealthful air quality conditions. 6. Now Iam Asking you to identify sources of pollution which might particularly contribute to cold air (wintertime) inversion **4.ASSESSMENT (H5P) (10 MIN)**
Content Delivery Methods (lecture,discussions, research, group work, etc.)	lecture, discussion, brainstorming, research, group work
Assessment Method	H5P
References (if necessary) (please use APA Style)	https://www.youtube.com/watch?app=desktop&v=L7i7N-je-aM https://www.youtube.com/watch?v=T_U3TXHBt-0 https://www.youtube.com/watch?v=a8Y6xX_OSzo https://www.youtube.com/watch?v=Dk9VHHFUbqo https://www.youtube.com/watch?app=desktop&v=L7i7N-je-aM https://www.youtube.com/watch?v=T_U3TXHBt-0 https://www.youtube.com/watch?v=a8Y6xX_OSzo https://www.youtube.com/watch?v=Dk9VHHFUbqo

1.3 Learning Unit 3- STORMS AND TEMPERATURES

1.3.1 Background

Provide a brief summary of the topic or concept that will be covered in the lesson. Include its importance and relevance to the curriculum and why it's important for students to learn.

Climate change is increasing the frequency of extreme weather events such as droughts, heat waves, and storms in many regions of the world.Storm is an extreme weather condition with very strong wind, heavy rain, and often thunder and lightning. Storm, violent atmospheric disturbance, characterized by low barometric pressure, cloud cover, precipitation, strong winds, and possibly lightning and thunder.

Storm is a generic term, popularly used to describe a large variety of atmospheric disturbances, ranging from ordinary rain showers and snowstorms to thunderstorms, wind and wind-related disturbances, such as gales, tornadoes, tropical cyclones, and sandstorms.

Types of storms

1.Blizzards

2.Hail

3.Heavy rain

4.Ice storms

5.Lightning

6.Thunderstorms

7.Wind

This lesson is part of the Climate Action in LEARN STEM .It explores storms and its types. In this lesson, learners explain the difference between climate and weather and they will explain the types of stormsIn this integrated skills lesson, students will work on the topic of climate change, particularly considering how it affects the lives of people. They will make predictions, watch a short video and answer questions, then consider and discuss how climate change has affected where they live, and how it may affect where they live in the future.

LESSON CONTENT

- Didactic Video (WP2-P2-Learnstem-Learning Resource- Storms And Temperatures),
- PPT (WP2-P2-Learnstem-Learning Resource- Storms And Temperatures),
- Additional Resources (WP2-P2-Learnstem_Text_ Storms And Temperatures Ph-ADDITIONAL RESOURCHES_EN.Docx),
- Assessment (H5P) (WP2-P2-Learnstem_ Storms And Temperatures Ph-H5P_EN.Docx),
- Experiment

1.3.2 Content

LearnSTEM Pedagogical Model Module 1: STORMS AND TEMPERATURES	
Aim of the module/ learning unit	Objective: Students will be able to: 1. Explain the difference between climate and weather. 2. Explain the factors that determine climate. 3. Explain how some of these factors work together to determine regional climates. 4.They will explain the yypes of storms
Duration	80 min.
Learning Objectives	Students will be able to ● explain what a weather hazard is, ● describe the features of storms, floods, and droughts, ● describe different types of storm including blizzards, tropical storms, hurricanes, thunderstorms, and tornadoes, ● describe the role of weather forecasts in predicting weather hazards, ● name ways in which people can prepare for and protect against weather hazards, including floodwalls, levees, window boards, lightning rods, and seawalls.
Resources&Materials Required	● Didactic Video (WP2-P2-Learnstem-Learning Resource- Storms And Temperatures),

(worksheet,charts, handouts, didactic video, excerpt from books/manuals, mind maps, etc.)	• PPT (WP2-P2-Learnstem-Learning Resource- Storms And Temperatures), • Additional Resources (WP2-P2-Learnstem_Text_ Storms And Temperatures Ph-ADDITIONAL RESOURCHES_EN.Docx), • Assessment (H5P) (WP2-P2-Learnstem_ Storms And Temperatures Ph-H5P_EN.Docx), • Experiment (Similar To The Video Presented Above)
Procedure	**1.(20 MIN.) PPT PRESENTATION** Storms And Temperatures **Introduce weather-related collocations** 1.Drought – many parts of the world are affected, e.g. India, Africa. 2.Flooding – many parts of the world are affected, e.g. Europe, Latin America, Bangladesh. 3.Snowstorm/blizzards, e.g. Canada, Northern Europe and Russia, Japan, etc. 4.Tornadoes, e.g. the US or Canada 1.Storm and Climate 2.What Causes Weather? 3.Definition of Climate (The Main Types of Climates) 4.What Are Storm and Storm Kinds? 5.Hurricane 6.Tornadoes 7.Flooding **2.(10 MIN.) WATCH VIDEO IN OUR CLASSROOM:** Brainstorm some of the effects of climate change with our students. https://emtv.com.pg/wp-content/uploads/2016/06/IPCC-Empathetic-onPacific-Threat-media.jpg http://asiafoundation.org/wpcontent/uploads/2016/04/BangladeshKhulna.jpg students **3. (40 MIN.) SCIENTIFIC EXPERIMENT (THUNDERSTORM SCIENCE EXPERİMENT)** Supplies Needed: Clear Rectangular Container Room Temperature Water Ice Cube Tray Red and Blue Food Coloring **How To Make A Thunderstorm Simulation** 1. Make some blue ice cubes. 2. Fill a clear rectangular container with room temperature water. 3. Set blue ice cubes and red food coloring in the water. 4. The blue and red water will collide and create a cold front where thunderstorms form. **Step 1: Make Some Blue Ice Cubes** We will need to make some ice cubes for this experiment, so it's a good idea to do this step ahead of time to give the ice plenty of time to form. Go ahead and fill an ice cube tray with water and then put one drop of blue food coloring into each slot in the tray.

	We only need about 5 blue ice cubes, so just put coloring in 5 slots in the tray if you don't want to waste your food coloring.Then use a spoon to mix the food coloring up in the tray and then stick the tray into the freezer **Step 2: Fill A Clear Rectangular Container With Water** When the blue ice cubes are frozen, you are ready to move on to the next step by filling a clear rectangular container with room temperature water. I used a clear glass casserole dish, but you could also use a large plastic Tupperware dish too. The important thing is that the container is transparent and rectangular so that you can see the thunderstorm science experiment in action! Now pour enough room temperature water into the container to fill it about 3/4 of the way to the top. The water needs to be at room temperature for the experiment to work properly. Too hot or too cold and our thunderstorm experiment will fail! **Step 3: Set Blue Ice Cubes and Red Food Coloring in The Water** Now gently place 4 or 5 blue ice cubes in the water on one side of the container. At the same time drop several drops of red food coloring into the water on the opposite side of the container. It might be helpful to have a second person helping with this part to make it easier to put the ice cubes and red coloring in at the same time. **Step 4: The Blue and Red Water Collide and Create a Cold Front Where Thunderstorms Can Form** Watch and enjoy as the beginning stages of a cold front start to form in the water.First, you will see blue water melting from the ice cubes and sinking to the bottom while spreading towards the red water on the other side.Then the blue and the red water will collide in the center of the container.The colder, blue water is denser than the warmer, red water, so the blue water will stay on the bottom while forcing the red water to move up towards the top of the water! This thunderstorm science experiment is a great simulation of how cold fronts and thunderstorms work in the wonderful world of weather! The blue water represents the cold and dense air behind a cold front that forces the warmer, less dense air ahead of the cold front to rise. As warm, moist air rises into the sky along a cold front, it cools and condenses into clouds and can eventually grow into thunderstorms! **Thunderstorm Science Experiment | Weather Science Experiments** Supplies needed to create your own thunderstorm science experiment: Clear Rectangular Container Room Temperature Water Ice Cube Tray Red and Blue Food Coloring This weather science experiment is such a fun way to visualize what actually happens when a cold front pushes warm air out ahead of it and up into the sky to form thunderstorms! The science behind how thunderstorms form: This thunderstorm science experiment is a great simulation of how cold fronts and thunderstorms work in the wonderful world of weather! The blue water represents the cold and dense air behind a cold front that forces the warmer, less dense air ahead of the cold front to rise. As warm, moist air rises into the sky along a cold front, it cools and condenses into clouds and can eventually grow into thunderstorms!

	4 ASSESSMENT (H5P) (10 MIN)
Content Delivery Methods (lecture,discussions, research, group work, etc.)	lecture, discussion, brainstorming, research, group work
Assessment Method	**H5P**
References (if necessary) (please use APA Style)	Thunderstorm Science Experiment | Weather Science Experiments https://www.youtube.com/watch?v=X2h523mCeQU Tornado Experiment | Weather Science Experiments https://www.youtube.com/watch?v=F7nMV6JUsRA Eye of a hurricane https://www.youtube.com/watch?v=F7MQIgFxRFI https://playingwithrain.com/thunderstorm-science-experiment/ How to make a: TORNADO IN A BOTTLE https://www.youtube.com/watch?v=j-denwzjib0

1.4 Learning Unit 4- Seasons and Ecliptic Simulator

1.4.1 Background

Provide a brief summary of the topic or concept that will be covered in the lesson. Include its importance and relevance to the curriculum and why it's important for students to learn.

A season is a period of the year that is distinguished by special climate conditions.A season is a period of the year that is distinguished by special climate conditions. The four seasons—spring, summer, fall, and winter—follow one another regularly. Each has its own light, temperature, and weather patterns that repeat yearly.

Seasons occur because Earth is tilted on its axis relative to the orbital plane, the invisible, flat disc where most objects in the solar system orbit the sun. Earth's axis is an invisible line that runs through its center, from pole to pole. Earth rotates around its axis.

The Earth has seasons due to the tilt of Earth's axis, which is a line through the south to north pole. The Earth's axis tilts towards and away from the Sun's rays as it travels in a circle around the sun.The 4 seasons come from Earth's tilt.Because the Earth is tilted on its axis, it's the main reason why we have 4 seasons.

This lesson plan includes the objectives, prerequisites, and exclusions of the lesson teaching students how to identify the seasons as an example of patterns in nature, explain the cause of the seasons, and describe how they differ from one another.

LESSON CONTENT

- Didactic Video (WP2-P2-Learnstem-Learning Resource_ Seasons and Ecliptic Simulator),
- PPT (WP2-P2-Learnstem-Learning Resource- Seasons and Ecliptic Simulator),
- Additional Resources (WP2-P2-Learnstem_Text_ Seasons and Ecliptic Simulator _ADDITIONAL RESOURCHES_EN. Docx),
- Assessment (H5P) (WP2-P2-Learnstem_Text_ Seasons and Ecliptic Simulator),
- Experiment and Ecliptic Simulator

1.4.2 Content

LearnSTEM Pedagogical Model Module 1: Seasons and Ecliptic Simulator	
Aim of the module/ learning unit	The aim of this module is to Students will understand: • How Earth's curvature produces latitudinal differences in insolation. • How the tilt of Earth's axis produces seasonal changes. • Why the southern and northern hemispheres experience opposite seasons. • How changes in the axial tilt angle affect seasonal temperatures. • How Earth's axis does not change orientation during one orbital revolution. • How Earth's yearly orbit produces the observed seasonal changes.
Duration	**80 min.**
Learning Objectives	On successful completion of this module/learning unit (LU), trainees will be able to: Students will be able to: 1.Explain why solar and lunar eclipses occur 2.Explain why Earth has seasons 3.Draw and manipulate models of solar and lunar eclipses 4.Draw a model of Earth's location during various seasons
Resources &Materials Required (worksheet,charts, handouts, didactic video, excerpts from books/manuals, mind maps, etc.)	• Didactic Video (WP2-P2-Learnstem-Learning Resource_ Seasons and Ecliptic Simulator), • PPT (WP2-P2-Learnstem-Learning Resource- Seasons and Ecliptic Simulator), • Additional Resources (WP2-P2-Learnstem_Text_ Seasons and Ecliptic Simulator _ADDITIONAL RESOURCHES_EN. Docx), • Assessment (H5P) (WP2-P2-Learnstem_Text_ Seasons and Ecliptic Simulator), • Experiment (Like the Video Presented Above)
Procedure	Instructional steps which trainees need to follow: **1 . PRESENTATION AND DISCUSSION POWERPOINT (30 MIN)** 1.Definition of the season 2.Why do we have seasons? 3. Tilt 4.Summer Solstice 5.Autumnal Equinox 6.Winter Solstice 7.Vernal Equinox 8.In Summary 9.Task for learner (Season web application) 10.Task for learner (HP5 questions)

11. Seasons modeling (design your own season model)

2 .VIDEO WEB APPLICATION (10 MIN)
https://astro.unl.edu/naap/motion1/animations/seasons_ecliptic.html

Type Web Application
Description The Nebraska Astronomy Applet Project provides online laboratories targeting the undergraduate introductory astronomy audience. Each lab consists of background materials and one or more simulators that students use as they work through a student guide.
https://astro.unl.edu/naap/motion1/animations/seasons_ecliptic.html
This simulation is part of a larger lab that covers terrestrial coordinates and the celestial equatorial coordinate system, allowing users to explore the motion of the sun and how it relates to seasons. Comments from expert scientist:
You can also download the SWF file and open with a flash player

3 .STUDENT EXPERIMENT (30 MIN)
Materials
- A light source (preferably a light bulb, but a flashlight works as well)
- Globe
- Pictures of some seasonal constellations (e.g. Orion)
- Star Maps

1. Set up the light bulb in the middle of the room. Place the globe on the floor. Have students representing various constellations (perhaps the zodiac) situated in order around the room.
2. Ask students to imagine being on the globe facing the sun. Explain to them that this is what they see in the day.
3. Discuss the idea of not being able to see the constellations "behind the sun".
4. Have the students then move to the "night" side of the globe. Ask them to look at the "sky" and explain what they can see, i.e. have them list the constellations they can see.
5. Next, move the students through the seasons, each time noting which constellations they can see at night. Have the students write down certain constellation they can "see" at each season.
6. Have students compare these constellations to the ones they were able to see on observing nights, noting specifically when they were able to see the constellations.

Student Task #1
- Use flashlight and ball-on-stick to represent the Sun and Earth respectively. (For this demonstration, keep the stick vertical.)
  - How does the distribution of incoming sunlight vary between the Equator and the Poles? (Can you explain why the equator is hotter than the poles?)

Student Task #2
- Use flashlight and ball-on-stick to represent the Sun and Earth respectively. (For this demonstration, tilt the stick.)
  - What effect does tilting the stick (Earth's axis) have on the distribution of incoming solar radiation (insolation)?
  - Use the model to show the relative positions of Earth and Sun for our winter and summer.

	○ What happens when you rotate Earth on its axis? What are you demonstrating? **Student Task #3** ● Use flashlight and ball-on-stick to represent the Sun and Earth respectively. (For this demonstration, tilt the stick.) ○ Demonstrate the annual orbit of Earth around the Sun and use the model to explain: ▪ Why it can be winter in the U.S. when it is summer in Australia; ▪ The contrasting positions of the Earth and Sun for each season in the U.S. ▪ What happens to seasonal temperatures at various locations if the tilt angle increases or decreases? **4. ASSESSMENT (H5P) (10 MIN)**
Content Delivery Methods (lecture,discussions, research, group work, etc.)	**lecture, discussion, brainstorming, research, group work**
Assessment Method	**H5P**
References (if necessary) (please use APA Style)	https://www.youtube.com/watch?v=5LOju_jd3O4 https://www.youtube.com/watch?v=L7i7N-je-aM&t=33s https://www.youtube.com/watch?v=fgYlxbUtZ98 https://education.nationalgeographic.org/resource/season/ https://www.britannica.com/science/season https://spaceplace.nasa.gov/seasons/en/ https://www.livescience.com/25202-seasons.html https://www.timeanddate.com/astronomy/seasons-causes.html https://education.nationalgeographic.org/resource/season/