MAKE IT OPEN

Preliminary plan for each Learning Scenario

Deliverable 2.2

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1. Introduction

This report includes a description of the topic selection and development process for 16 Learning Scenarios (LSs), as well as a brief description of each one. The LSs were developed in a co-design process by the 4 Practice Partners (PP) with pilot teachers in 4 countries. Of the 16 LSs, 8 have been completely developed and the other 8 are currently in advanced stages of development. The first 8 LSs (4 for primary school and 4 for secondary school) were written in accordance with the criteria and template jointly determined by the consortium (see D2.1 Template and Criteria for Learning Scenarios). The LSs were delivered by the pilot teachers to about 300 students in England, the Netherlands, Poland and Israel as part of the 1st pilot phase, which took place between March and June 2021. During the development and execution of the pilot program, feedback was solicited from the teachers and the PP through a Proof-of-Concept (PoC) evaluation process (done as part of WP5). Based on the feedback received, the template and LSs were revised accordingly.

In the report below we will describe the 1st pilot with the focus on important activities we conducted during the development stage. Next we present the guidelines for writing the LSs in the 2nd pilot phase. As the 1st pilot phase was being completed, the PPs and their teachers chose the topics for the following LSs, which would be developed in the 2nd pilot phase, as well as made decisions regarding which of the existing LSs would be implemented.

In addition, we report on the 2nd pilot stage, which will be carried out from Sep 2021 until early 2022, will include the execution of 16 LSs - 8 new ones (4 for primary school and 4 for secondary school), and the 8 existing ones (4 for primary school and 4 for secondary school) that were developed in the 1st pilot phase, and will be run by another country (each LS will be transferred to and run by any PP that has not yet carried it out).

2. 1st Pilot Phase

2.1. Monitoring the development and implementation of the 1st pilot phase

The following is the timeline of the LSs development process in the 1st pilot phase including important activities:

January 2021 - Selecting topics for LSs

In the first stage of development, each PP was asked to suggest two possible topics for the LSs for each age group (primary school and secondary school), from which one topic would be selected. The reason for requesting two topics was to provide an alternative option, in the case that another one of the PP proposed an overlapping or similar topic. It was important that the final 16 LSs would include a wide range of learning topics, would enable the use of all open schooling learning dimensions, and be adaptable to a variety of cultures and environments.

Early February 2021- Writing an initial script for two LSs for each age group

Each PP had several meetings with its pilot teachers to come up with two LS topics appropriate for each age group (two topics for primary school and two topics for secondary school). After choosing the topics, the teachers and the PP worked together in a co-design process to write the initial scripts for the four LSs. Each LS includes X number of Learning Units (LU). Each initial script included the following elements: The LS title, Student's age, The "Big Idea", Short abstract of the LS, General description of each LU including title and short explanation such as location, teaching roles, what students do, and STEM connections and finally a flow process of the LUs, according to the LS building-block framework: "Prepare", "Brief", "Research", "Create", and "Share".

February 11, 2021- Sharing ideas about LSs proposals among teachers and PP

As part of a consortium meeting, a joint workshop was held for pilot teachers and PP, with the aim of getting to know each other and sharing thoughts and ideas about their topic suggestions. The shared discourse, conducted in a relaxed and friendly atmosphere, gave teachers valuable feedback and additional ideas about the LSs content and development process, as well as about other aspects of the pilot that concerned them.

End of February 2021- Final topic selection for the LSs

The selection of suitable topics was made in a collaboration between BSMJ and the PP, according to the criteria of topic diversity (8 different topics were selected) and adaptability and transferability (the degree of adaptability and transferability of the LS for different places). Our goal was to develop LSs that represent a wide variety of STEM areas but that do not rely on a specific capability or infrastructure to be carried out. The aim was that the LSs should be able to work in any setting (country) and serve a large number of teachers with a variety of abilities and areas of interest. The selection was as follows:

For primary schools:

1. Exercise and Physical Activity (improve community well-being) (IL)
2. Forces of Nature (exploring motion by various means) (NL)
3. Air Pollution (How clean is our air?) (UK)
4. Food Travels) zero-waste kitchen) (PL)

For secondary schools:

5. Our Moving World: Physics Everywhere (IL)
6. Dealing with Waste (litter in a public environment) (NL)
7. Zero-Waste School (circular economy, 6R) (UK)
8. Sounds Around Us (noise and silence) (PL)

February - May 2021- Discussion and monitoring the development and transfer of the LSs
During the development and implementation period, BSMJ and the three PP conducted a series of email correspondences and two virtual meetings. The purpose of the meetings was to share, learn from each other, and work together to come up with solutions to the challenges that arose.

June 3, 2021- Sharing experiences and insights about the 1st pilot phase
As part of a consortium meeting, a joint workshop was held for the teachers and the PP, with the aim of sharing experiences and insights about the LSs they conducted in the 1st pilot phase.

Mid-June 2021- Meetings to review the 1st pilot phase
BSMJ held meetings with each of the three PP in order to summarize and review the 1st pilot phase in preparation for the 2nd pilot phase.

2.2. Guidelines for writing the LSs in the 2nd pilot phase

Based on the feedback gathered from the PP at the end of the 1st pilot phase and from a discussion with the Proof-of-Concept team (WP5), BSMJ formulated guidelines for writing the new LSs and updating the existing LSs. The guidelines included:

- A revised template (*see Appendix 1 Revised template*) in which the following changes were introduced:
    - Checkboxes in the appropriate sections

    - Licenses - a CC-BY license was added to each LS, to underscore the Open-Source idea of adaptability.
    - Teacher feedback (Aha moments, Uh-oh moments, general tips and media such videos and pictures)
    - Headings for the outline of the LS general structure (Prepare, Brief, Research, Create, Share)
    - Make (hands on) project
    - STEM related careers
- A note emphasizing the following important points:
    - Writing the course of activity in greater detail
    - Adding all the materials that were used for the LS under “materials and resources”. This will include links and downloadable material such as presentations and worksheets, if any were used.

In accordance with the new guidelines, all partners updated the LSs and sent them to BSMJ over the month of August.

3. 2nd pilot phase

In preparation for the 2nd pilot phase two processes took place:

1. Selecting which LSs from the 1st pilot phase would be re-used by a different country (each PP’s home country will carry out two LSs - one for each age group)
2. Selecting the topics for the new LSs. The process of modifying the LSs from the 1st pilot phase and developing the new LSs began in June 2021 to allow for implementation in the subsequent school year, between September-December 2021.

3.1. Choosing which LSs from the 1st pilot phase will be reused by a new PP/country

Several activities were managed to select LSs from the first pilot to be re-used by new partners and countries. During May 2021 we conducted the following:

1. Meeting with the Pilot teachers, providing information for selecting the LS they will carry over the next school year (Early May 2021). Each PP was asked to fill out a table providing detailed information about the LS developed to help teachers from the

other countries decide which LS they wanted to carry out in the subsequent school year. The table included the following details: The name of the LS, a link to the complete LS, the LS topic, and its two / three crucial points. (*See table in Appendix 2 - Information about 1st pilot LSs*)

2. LS adaptation rating by teachers (Mid - May 2021). Each pilot teacher was asked to rate the existing LSs according to their degree of suitability, using the following rankings:
    1. First priority
    2. Second priority
    3. Third priority
    4. We can't run

    (See table in Appendix 3 – Rating preferences of LSs)

3. Matching the LSs developed with the country that will deliver it (End of May 2021). The BSMJ team, in collaboration with the three PP, looked at each teacher's preferences regarding the different LSs and decided which LS would be transferred to which country. The selection was made so that each of the four PP countries received its first or second choice. After informing the teachers in each of the countries which LS they will receive, development teams comprised the pilot teachers, and PP began the adaptation process, which will continue until the 2nd pilot phase, which will take place between September-December 2021.

The following table shows the matches between the countries and the LSs:

Learning Scenario	Developed by	Country of Operation
Exercise for Thought	IL	NL
Forces of Nature	NL	PL
How Clean is Our Air?	UK	IL
Food Travel	PL	UK
Our Moving World: Physics Everywhere	IL	NL
Dealing with Waste	NL	PL
Zero-Waste School	UK	IL
Sounds Around Us	PL	UK

Table 1: Matches between the countries and the LSs

3.2. Selecting the topics for the new LSs

In June 2021, each PP had a brainstorming session with its teachers to develop two possible topics for each LSs from which one topic would be selected. The plan was for each PP and teachers to develop and implement two new LSs during the next school year. The process was designed to ensure that a wide range of topics were represented. For each topic, the PPs were required to send to BSMJ chapter headings that included:

- Title
- Topic and the core subject (for example: air pollution, physical sciences)
- The "Big Idea" (what the scenario is going to be all about, the main message, its importance to the community)
- Potential example/s for Make / citizen science / engaging with the community

By the end of June, a meeting was held between BSMJ and each PP to select the most suitable topics for the 8 new LSs. The selection criteria were:

- Diversity (i.e., to ensure a wide range of topics).
- Adaptability (adaptable/transferable for a variety of places and cultures).
- The preference of teachers (if any).

The decision made at the meeting was brought to the teachers for approval before the development process began. The following were the topics chosen:

Primary school

1. Energy Research (IL)
2. Let it Rain! - water cycle and weather (UK)
3. On Two Wheels - ways to encourage cycling (PL)
4. The A in STEAM: Transition between 2D and 3D (NL)

Secondary schools

5. Decision Making (IL)
6. Illicit Drugs (UK)
7. Biodiversity - How It Works (PL)
8. Healthy Snack (NL)

4. Preliminary plans for 16 Learning Scenarios

The current report includes the 16 preliminary plans for each of the LSs, including a brief description and additional details, written according to the updated LS's template[1].

- 8 former preliminary plans for the LSs that were already implemented during the 1st pilot phase will be reused in another PP's country, as part of the 2nd pilot phase in September-December 2021. These plans are final, as they have already been implemented in practice within a classroom.
- 8 new preliminary plans for the LSs that will be launched during the 2nd pilot phase in September-December 2021. These plans may still change after the operation in the next school year.

The following are the 16 preliminary plans:

- Preliminary plans for the 1st pilot phase 8 Learning Scenarios

  For primary schools:

  1. Exercise for Thought (IL)
  2. How Clean is Our Air? (UK)
  3. Food Travel (PL)
  4. Forces of Nature (NL)

  For secondary schools:

  5. Our Moving World: Physics Everywhere (IL)
  6. Zero Waste School (UK)
  7. Sounds Around Us (PL)
  8. Dealing with Waste (NL)

- Preliminary plans for the 2nd pilot phase 8 Learning Scenarios

  For primary schools:

  1. Energy Research (IL)
  2. Let it Rain! (UK)
  3. The A in STEAM: Transition between 2D and 3D (NL)
  4. On Two Wheels (PL)

  For secondary schools:

  5. Decision Making (IL)

[1] The preliminary plans are only a part of the updated template. At the end of the pilot, a fully updated template for all 16 LSs will be submitted in D2.3 (full description of the 16 LSs).

6. Illicit Drugs (UK)
7. Biodiversity - How It Works (PL)
8. Healthy Snack (NL)

Exercise for Thought

Developed by: BSMJ & Zvulun School, IL

The "Big Idea"

Exercise and physical activity affect the body and the mind and are vital to maintaining overall well-being. Unfortunately, during the COVID19 period, many of us were forced to sit for extended hours in front of screens. The reduced amount of physical activity caused a decline in many aspects of well-being. A two-pronged approach of raising awareness of the importance of movement while integrating movement into learning will contribute to a healthier and happier life.

The Challenge

Improve community well-being by raising awareness of the importance of physical activity in general- and posture-correcting exercises in particular- while engaging additional community members and kindergarten children.

A Short Abstract

The Learning Scenario will raise students' awareness about how they move and the importance of proper movement. Students will collect and analyse information gathered from the community regarding exercise-related habits and learn about how exercise contributes to health and quality of life. Additionally, students will:

- Experiment with their skeletal system.
- Meet with an occupational therapist who will demonstrate the correct way to move various body parts.
- Build models that show the mechanisms of skeletal movement.
- Work together to find technological solutions to joint movement limitations.

At the end of the Scenario, they will design and run a program for kindergarten children, in which they will experientially apply what they have learned.

Core STEM Subjects

- ☐ Life Sciences
- ☐ Engineering & Technology
- ☐ Design

Main Learning Goals

1. Raise awareness of the importance of exercise and performing correct movements in improving posture, concentration, and more.
2. Develop a positive attitude towards physical activity.
3. Gain familiarity and experience with the components of the skeletal system and the physical principles that enable movement.
4. Experiential learning through building models that demonstrate the mechanisms of stability and mobility of the skeleton.
5. Involve the community, both through meetings with community experts who contribute to the educational content and expose students to STEM-related professions, and through the students passing on the knowledge and experience they have acquired to the larger community.

Main Messages

1. Exercise is both fun and healthy.
2. Making correct movements with the body is always important, not only during exercise.
3. The joints allow the bones of the skeleton to move in specific directions, and thanks to them we can perform a wide range of necessary and daily motor actions.
4. Occupational therapy is a profession that combines different fields of knowledge: Physics, biology (anatomy and physiology), and cognition.
5. Paramedical therapists, such as occupational therapists, contribute to community well-being.
6. The stability of our skeleton is due to compressive forces acting on the bones and tensile forces acting on the muscles and tendons.

Make (hands on) project

Students will design models that show the mechanisms of skeletal movement. They will work together to find technological solutions to joint movement limitations.

Related STEM Careers

Occupational Therapist, Physiotherapist, Physician, Nurse

Students' Age

10-12 years old

Duration

7 LU (10 X 45 min.)

Period of Operation

Brief of the Learning Units

Prepare

Learning Unit 0: "Time to Move"- Conduct a survey on exercise-related habits

Students will create and distribute a survey to other students and members of the community regarding habits related to movement during the day (how long they sleep, sit, run, walk, etc.) in preparation for the Learning Scenario.

Brief

Learning Unit 1: Analyse the survey data and compare with that of other communities

Introductory lesson in which students will analyse the collected survey data, compare it to data from the literature, and discuss the importance of exercise.

Research

Learning Unit 2: Meet with an expert from the community - meeting with an occupational therapist

Meeting an expert in the field of STEM who specializes in movement and physical activity. During the session students will perform guided exercises while learning about the importance of physical activity and certain exercises to maintaining stability and improving mental concentration.

Learning Unit 2a: Reading a scientific article for youth on sports and health

Students will read and independently analyse a scientific paper for youth that focuses on the connection between health and sports: Muscling Up on Mental Illness: How Exercise Can Help Both Body and Mind

Learning Unit 3: Learning about the body – getting to know the skeletal system

Students will learn about the skeletal system- its function and the principles that allow for stability on one hand and flexibility on the other. Through building models and other accessories, students will learn about how muscles, tendons, ligaments, and the various types of joints function.

Learning Unit 4: Guided exercise session in a public fitness park, outside the school

Students will participate in a sports lesson at an outdoor fitness facility located off school grounds. During the lesson, the teacher will show the students how to perform various exercises using designated equipment while focusing on the different parts of the skeleton (muscles, joints, tendons).

Create

Learning Unit 5: Completing simple tasks with immovable joints

Students will be given daily tasks to complete while keeping their joints fixed in place to simulate impaired mobility. They will then design and build creative solutions to these challenges using simple equipment and materials. The experience will allow them to better understand the importance and function of the various joints in the body.

Share

Learning Unit 6: Activities with kindergarten children to raise awareness of proper body movement

This Unit is a summary of the entire Learning Scenario, and students will relay what they have learned with the help of the participation of kindergarten children. In the first part of the unit, students will prepare a lesson for the young children that includes guided exercises, that demonstrate the proper ways to move the body as well as the construction of a simple toy that shows how the joints work. In the second part, the students will take the kindergarten children to an open space and conduct exercises/activities in stations.

License

How Clean is Our Air?

Developed by: Forth & Jubilee School, UK

The "Big Idea"

Human activity is a massive cause of air pollution, especially in the world's largest cities. The human causes of air pollution include factories, power plants, cars, airplanes, chemicals, fumes from spray cans, and methane gas from landfills, among others. However, one of the principal human causes of air pollution is the burning of fossil fuels. We need to move towards more sustainable forms of energy and find innovative ways to reduce the amount of air pollution on our planet.

The Challenge

How can we improve the quality of our air and help the world in the process?

A Short Abstract

In this Learning Scenario, students will gain a deeper understanding about pollution- what it is, where it comes from, how it affects us, and how we can reduce it. After collecting and analysing data about the levels of air pollution in their school and their local community, students will design and create a model of a device to help solve the problem.

Core STEM Subjects

- Life Sciences
- Earth & Space Sciences
- Engineering and Technology

Main Learning Goals

1. Investigate the various causes of pollution
2. Understand the impact of pollution on life and health
3. Measure pollution levels in different ways (hi-tech /low tech)
4. Learn about if, and how, air can be cleaned
5. Design and create a model of a device to reduce pollution levels/mitigate its effects

Main Messages

1. What pollution is and the various forms it comes in

2. How pollution affects us personally and globally
3. What are the main sources of pollution
4. Why we need to work to reduce air pollution
5. Air pollution can be reduced, and the ways how.

Make (hands on) project

Students will investigate the filtering ability of different materials.

Related STEM Careers

Air Quality Engineer, Air Pollution Analyst, Chemical Engineer, Environmental Consultant, Environmental Health Officer, Atmospheric Scientist

Students' Age

9-11 years old

Duration

6 LU (9 X 30-90 min.)

Period of Operation

Apr-May 2021

Brief of the Learning Units:

Brief

Learning Unit 1: What do you know about Pollution?

In this activity, students will write down what they already know about pollution. They will work individually for 5-10 minutes before sharing their ideas with a small group. Groups will discuss the different ideas – the similarities and differences between them and whether they agree or disagree (5-10 min.), before sharing the ideas with the class. The teacher will address any misconceptions, and further explain some fundamentals of the subject.

Learning Unit 2: What can pollution do to me?

In this activity, students will meet with a local expert to learn about how air pollution affects our bodies (e.g. STEM ambassadors, community nurse, medical students, local doctor). The expert will show the children a diagram of the lungs and demonstrate what happens when we breathe in air and pollution. The children will use what they learned to draw and annotate a diagram.

Research

Learning Unit 3a: What does air pollution look like?

In this Unit, children will take part in a variety of classroom activities and experiments to learn about the different types of pollution. Five stations, each incorporating one of the five senses, will be set up:

- Oil spill simulation
- Real-world biodegradability testing
- Modelling pollution uptake by plants using celery
- Polluted display jars
- Collecting data/information from outside

Learning Unit 3b: What does air pollution look like (part 2)?

Students observe pollution over time (1 week) using low-tech pollution kits (O-zone badge testers). They will use the test kits in 3 different areas: Inside the classroom, on the playground, and in a local park. They will test each area at the beginning, middle, and end of the week to observe if the levels of pollution change over time. While, in the local park children will also go on a lichen hunt. Lichens are regarded as reliable pollution indicators because they are sensitive to sulphur dioxide (SO2) and do not grow in polluted areas; their presence indicates the absence of pollution, and their absence might indicate that the area is polluted.

Learning Unit 4a: How can we measure pollution?

Micro-trip to local area, teacher-led, practical research

Students will estimate the amount of local air pollution from vehicle emissions. The class will be split into two to explore two different areas outside of the school, and each group will count and categorise the vehicles they see. In the classroom, students will organise and analyse the data they have collected and estimate pollution levels in each area. Students will also create pictographs to show which types of vehicles are the worst pollutants (i.e., 10 cars are equal to 1 lorry).

Learning Unit 4b: How can we measure pollution- (part 2)?

In this Unit, students will calculate the amount of air pollution in their area. Over the course of a few days, students will put out sensors (e.g., DIY Vaseline sensors) and collect and analyse the data (1 hour). They will then calculate pollution levels using the Hackair app. Students will also learn how trees function as air-filters, and do a count of the trees in the same area. The students will combine this with their previous data to create graphs/infographics on the number of cars vs. trees. Finally, they will calculate the number of trees needed to counteract the amount of pollution produced from cars.

Create

Learning Unit 5a: How can filters help with pollution?

In this Unit, students will work as a group to investigate different materials to see how well they work as an air filter and learn about how these materials can help with pollution. Using common filters, such as gauze, stocking, a colander, etc., students will separate a powdered mixture comprised of differently sized granules. The children will then examine the finer filters with a magnifying glass/ microscope to understand how they work.

Learning Unit 5b: Where can I find filters in my school?

The children will go on a treasure hunt around the school looking for various types of filters (e.g., fans, masks, extractors, coffee filters, etc.) They will then examine different types of face masks. An expert in the field of construction will come to the class to talk about the advantages of mask wearing (safety, fumes, Covid19, if appropriate).

Share

Learning Unit 6: Finding a solution

In this final Unit, students will draw on what they learned to design a prototype of a device that will either help reduce pollution, or help mitigate its effects (e.g. air filtering buggy cover, special types of filters, innovative wearable air purifiers, etc.). Students will first make a smaller model of their device before making it larger and more detailed (community / parent makers may be invited to help students with building the second, larger model). To conclude, students will share their solutions with the rest of the class.

License

Food Travel

Developed by: CSC & Private primary school „Pracownia", Łódź & Primary school number 5, Sosnowiec, PL

The "Big Idea"

These days there is an increased focus on healthy food and eating. But while healthy food is now in fashion, we do not often realize, or appreciate, how much effort it takes to bring the food to our plates. We also don't notice it becomes too easy to waste food. We want our school community to learn the importance of these issues and offer them some solutions.

The Challenge

Come up with ways to waste less food.

A Short Abstract

Our aim in this project is to look at two specific points in the food chain- where the food starts, and where the food that isn't eaten ends up. Students will investigate where food is grown, how it gets to us, and how much is wasted. Students will learn how to reduce waste either through a change in eating habits (zero waste kitchen) or by recycling food waste into fertilizer. In the Scenario, students will create a blog/YouTube channel featuring zero-waste recipes, build a composter, and create fertilizer which will be offered to local farmers and the city council.

Core STEM Subjects

- Life Sciences
- Earth & Space Sciences
- Design

Main Learning Goals

1. Learn about the negative impact of global transport: Water and air pollution, and the decline of biodiversity.
2. Get familiar with composting- what it is, what is its role in the circulation of matter, and how it is used in agriculture and horticulture.
3. Experience conducting a biological experiment and understand the terms (test sample, control sample, hypothesis).
4. Learn how to set up a school garden.

Main Messages

1. Some waste can be managed in a different way than throwing it into the garbage bin.
2. Fertilization is an essential part of the food production process.
3. Micro and macro soil fauna and pollinators play an important role in the sustainable cultivation of plants.

Make (hands on) project

Students will construct a school composter and a vegetable garden.

Related STEM Careers

Biology Scientist, Food Technologist, Gardener

Students' Age

9 - 12 years old

Duration

7 LU (7 X 90-120 min.)

Period of Operation

May-June 2021

Brief of the Learning Units

Brief

Learning Unit 1: Introduction to food production

Students write down everything they ate the day before. Then, in groups, they research online for information about where their food originated and how many kilometres it had to travel before it reached their tables. Students will use string on a map to show their food's journey. At the end of the lesson, students will work in pairs to list how buying products from distant countries affects local and global ecosystems.

Learning Unit 2.1: What is composting?

Students meet with an expert in the field of composting. Before the meeting, students prepare questions related to the composting process, building composters, and the use of fertilizers. The expert talks about the composting process itself and answers student questions. During the meeting, the students use interesting illustrative techniques- such as a mind map, sketch-note, or poster- to summarize and convey the most important information.

Create

Learning Unit 2.2: Construction of a school composter

After an introduction by the teacher, students start building a composter. The work takes place in groups- each group is responsible for building a different part of the composter. After construction is completed, the materials to be composted are placed inside. Over the next 2 weeks, students check the compost level every 2 days, measure the temperature, and record their observations.

Research

Learning Unit 2.3: What happens in the composter?

Students conduct experiments about what can be composted, which products decompose faster, and which factors affect the speed of composting.

Learning Unit 3: Fertilizer for the farmer

Students will learn about how fertilization affects the nutritional value of the soil. After learning about and constructing a soil acid meter, students will go out "in the field" to collect soil samples from various sites, taking note of the number and type of plants at each site. At the end of the lesson, students will learn about the different types of fertilizers- mineral, natural, and plant residue- and will investigate how each type affects the pH of the soil samples.

Create

Learning Unit 4: Establishing a school garden

Students investigate the conditions needed for plants to grow. On the basis of their previous knowledge, they check whether they have all the necessary materials for the next tasks. They begin work on the garden.

Share

Learning Unit 5: Presentation of the results

Students prepare for a special event at the garden for parents and the local community: mounting panels with photos on the fence or placing them in the garden; making a movie or slide show to be projected onto the facade of the building; presentation of the first crops of the garden (if possible).

License

Forces of Nature

Developed by: WAAG & de Regenboog, primary school, NL

The "Big Idea"

Exploring the forces of nature and learning how they relate to motion

The Challenge

What makes something move and how can you explain the science behind it?

Short Abstract

In a series of experiments, students will explore the forces of nature related to motion and present their findings to an audience.

Core STEM Subjects

- ☐ Engineering & Technology
- ☐ Physical Sciences
- ☐ Design

Main Learning Goals

1. Learn about the different forces of nature: Gravity, wind, air pressure, movement
2. Conduct experiments to further understanding
3. Learn from existing theories
4. Get a "sneak-peak" of secondary school, in order to get a glimpse into their future

Main Messages

1. Experiments are a good way to learn
2. Good planning is integral to a successful experiment
3. Theory and knowledge are important as well, in addition to experiments

Make (hands on) project

Students will design, build and test simple rockets and two types of egg protectors -one that will allow the egg to land from a height without breaking and the other that will protect it from being hit by a stone.

Related STEM careers

Aeronautic Engineer; Mechanical Engineer; Civil Engineer

Students' Age

9 - 12 years old

Duration

7 Learning Units (3 hours per LU)

Period of Operation

March - May 2021

Brief of the Learning Units

Brief

Learning Unit 1: Building a balloon car- exploring forward motion

Students will build their own balloon-propelled car and experiment with forward motion and aerodynamics.

Learning Unit 2: Building a car- what wheels work best?

Students will experiment using different types of wheels and find out which work best.

Research

Learning Unit 3: Guest lecture- the forces of nature

A science teacher from the neighbourhood secondary school will give a guest lecture about the forces of nature.

Create

Learning Unit 4: Building a rocket, exploring air pressure

Students will build their own rockets and see which design flies best.

Learning Unit 5: Dropping an egg (without breaking it), exploring gravity

Students will design an egg protector and test which design protects the egg best.

Learning Unit 6: Dropping a stone on an egg (without breaking it), exploring gravity

Students will design a different kind of egg protector, and test which design protects the egg best.

Share

Learning Unit 7: Presentation of the results (pre-recorded or live)

Students will present their research and conclusions to the guest teacher and parents. Either via a live presentation or a short documentary, students will describe and explain their research process and connect it to the theory they have learned.

License

Our Moving World: Physics Everywhere

Developed by: BSMJ & IASA School, IL

The "Big Idea"

Playgrounds are a quintessential part of the childhood experience and also located in almost every neighbourhood. In addition to contributing to physical and motor development, playgrounds foster language development, social skills, a sense of personal independence, and overall health. While playgrounds are usually perceived as a place for outdoor play, and not as an educational space, when viewed through the right lens the play and enjoyment of the playground can be turned into a learning experience, drawing on what users already know and increasing their agency in the learning process.
In the Learning Scenario, we will create scientific captions explaining the physical principles of the playground equipment and offer simple experiments to playground users, without detracting from the free-play experience. The results will be shared with nearby elementary school students.

The Challenge

Presenting the principles of physics in an experiential and user-friendly way, in order to bring STEM to the wide range of people that use a playground located in a vulnerable neighbourhood.

A Short Abstract

During the Learning Scenario, students will experientially learn the principles of physics that can be observed on playgrounds in general and on playground equipment in particular. They will meet with an environmental design expert, visit a science museum, and apply what they have learned to formulate and design captioned plaques that include information and ideas for activities using the playground equipment. The captions, which will be designed and produced together with the science museum and other municipal bodies, will improve the playground experience while propagating knowledge and understanding of STEM fields. At the end of the Scenario, there will be a scientific playground inaugural event, to which the students of a nearby elementary school will be invited, and with whom the students will share their insights from the learning process.

Core STEM subjects

- Physical Sciences
- Engineering & Technology

Main Learning Goals

1. Raise awareness that science is everywhere and learning doesn't only take place within school walls.
2. Raise the neighbourhood's scientific capital by upgrading a regular playground to a "scientific playground".
3. Promote cooperation between schools in the community while strengthening ties with community actors.

Main Messages

1. The principles of physics in general- and Newton's laws of motion in particular- can be seen everywhere and are relevant to our daily lives (the playground as a research laboratory, etc....).
2. Newton's laws allow us to understand how the world around us works, and should be basic knowledge for every citizen in the 21st century.
3. Public spaces are designed according to their function and to accommodate a wide range of users.

Make (hands on) project

Students will investigate the degree of shock absorption of different materials in the context of playground floor coverings.

Related STEM careers

Physicist, Architect, Civil Engineer, Mechanical Engineer, Landscape Architect, Designer

Students' age

13-15 years old

Duration

7 LU (20 X 45 min.)

Period of Operation

May 2021

Brief of the Learning Units

Brief

Learning Unit 1: Science is everywhere- the science around us

Part A - Motivating students to participate in the Scenario through watching entertaining videos and discussing the everyday phenomena and experiences which can be explained through the laws of physics.

Part B- Preparation for a visit to a playground. Students will work in groups to formulate research questions and design experiments that can be conducted using the different types of playground equipment. Students will put their research questions, experiment plans, and hypotheses onto research cards that they will use during the visit to the playground at the next session.

Research

Learning Unit 2: Playing and researching on a public playground

Students explore the different parts of the playground. The session begins with an observation of the various elements in and around the playground designed to serve the users, such as benches, garbage cans, and shade coverings. Students will examine the types of flooring found on the various playground areas, before focusing on the specific playground equipment. Students will work in groups and explore each structure and area of the playground according to the research cards they prepared in the previous session.

Learning Unit 3: A learning moment- a visit to a science museum

Students visit the science museum where they will participate in a demonstration, take part in a guided tour, and work in independent groups. Students will experiment with Newton's laws and with the scientific and engineering principles associated with structural building. In addition, they will meet with a museum staff member (designer and / or curator) to learn about how to formulate and design explanatory captions. **Following the visit to the museum, students will prepare questions for an engineer, who they will meet with in the next session to discuss buildings in general, and playground structures in particular.*

Learning Unit 4a: Meeting with an expert - architect / structural engineer

A virtual or physical meeting with an architect / structural engineer who will explain how to design buildings and playgrounds, what factors and circumstances must be taken into account to maintain user safety, and how the laws of physics serve him/her in their work.

Learning Unit 4b: Meeting with an expert – landscape architect

A virtual or physical meeting with a landscape architect who will tell the students about the various aspects involved in the environmental planning of outdoor spaces in general and playgrounds in particular. Students will learn about how to create an open space that traverses the human-nature-city triangle, and how to take into account elements such as vegetation, shade planning, accessibility, and connection to the urban fabric. The lecture will focus on playgrounds and showcase interesting and innovative playgrounds from around the world.

Learning Unit 4c: Meeting with an expert – placemaking artist

A virtual or physical meeting with a placemaking artist. "*Placemaking is a multi-faceted approach to the planning, design, and management of public spaces. Place-making capitalizes on a local community's assets, inspiration, and potential, with the intention of creating public spaces that promote people's health, happiness, and well-being*" (Wikipedia). Our project of creating captions for a playground is intrinsically related to this idea of "placemaking", and as such, it is located in a broader cultural, social, and artistic context. In this session, we will meet with a placemaking artist, who will tell the students about projects he/she has carried out in different communities in order to expose them to this larger context and inspire ideas for our own project.

Create

Learning Unit 5: The physics of the fall - study of various ground coverings

This is an extension unit in physics. Playgrounds are places that allow children to take risks; run, swing, climb to great heights, and slide down fast. How can these risks be managed in a calculated manner? One of the ways to mitigate the risk of dangerous injuries on the playground (especially regarding falls from a height) is shock-absorbing flooring. In this unit, students will explore the properties of different types of playground ground-coverings, learn how they protect against injuries during a fall, and discover the surprising connection between them and successful (or unsuccessful!) spacecraft landings.

Share

Learning Unit 6: Designing a scientific playground for families

Using the knowledge gained during the Scenario, students will create captioned plaques for a neighbourhood playground. During this Unit, the students will formulate the explanations for the physical phenomena that occur when using the playground equipment as well as suggestions for further activities and experiments. Students will be assisted by experts from various fields (curators of an exhibition, experts in the field of safety and placemaking) to help them think about how the plaques can be installed in a safe and suitable way.

Learning Unit 7: Preparing for and holding a “scientific playground” inaugural event for neighbourhood primary school students

Students will plan a special event at the playground for primary school students in the neighbourhood. During the event, students will teach the younger children some simple principles of physics, show them how they can be observed during a game, reveal the new playground plaques, and take part in a fun joint activity.

License

Zero-Waste School

Developed by: Forth & Derby High School, UK

The "Big Idea"

All across the world, materials are routinely wasted as a by-product of industries, businesses, households, and government organisations. Understanding the different types of solid waste, its impact on the environment, and the many different ways it can be managed is the key to a more sustainable future.

The Challenge

How can we move our school closer to becoming a zero-waste school?

A Short Abstract

In this Learning Scenario, students will use their own school and neighbourhood as a case-study to learn more about how material waste– such as plastic, food and paper– is used and disposed. They will investigate the amount and type of waste produced by their school, learn how waste is managed by businesses, councils, and industries in their local area, and talk to local experts. Informed by this knowledge, students will devise solutions to move their school towards becoming a circular economy with as little waste left over as possible.

Core STEM Subjects

- ☐ Life Sciences
- ☐ Engineering & Technology
- ☐ Earth & space sciences
- ☐ Design

Main Learning Goals

1. Students will conduct primary and secondary research about waste issues within their local community to understand the context of this project.
2. Students will explore the different ways of dealing with waste by interacting with businesses, organisations and experts in their local community.
3. Students will create their own solutions for zero-waste schools / buildings and share their knowledge with the community.
4. Through this experience, students will understand that they are capable of initiating and taking active part in bringing about desirable change.

Main Messages

1. The waste we produce needs to be properly managed to make our community more sustainable and environmentally friendly.
2. Waste can be managed in different ways.
3. There are simple ways to reduce, recycle and reuse waste.

Make (hands on) project

Students will develop and prototype their own solutions towards reducing school waste (plastic, food and cardboard).

Related STEM Careers

Ecologist, Environmental Consultant, Waste Management, Food Waste Recycling Advisor, Materials Engineer, Product Designer

Students' Age

13-14 years old

Duration

7 LU (about 12 x 1 hr)

Period of operation

May 2021

Brief of the Learning Units:

Brief

Learning Unit 1: What sort of waste is in our local area?

To understand the concept of by-products, students will send out an emailed questionnaire to local businesses (e.g., cafes, fast food restaurants, corner shops, laundrettes, etc.) about the type, amount, and management of their waste. Students will collect and analyse the results, giving them a broader context before looking at how waste is managed in their immediate environment (school). (Science lesson)

Research

Learning Unit 2a: How is waste processed?

Students will visit / take a virtual tour of a local refuse centre to investigate the process of how waste is broken down and how recycled materials are separated, cleaned, and shredded. Through primary and secondary research, students will gain a deeper understanding of the scale of human waste production and disposal in their area.

Learning Unit 2b: How is waste processed?

Students will engage in scientific investigation of each of the principal types of waste:

- Food: Students will learn how food waste can be used as biofuel and analyse the energy content of different types of food. Using input from the school's Business Manager on the heating / energy costs of the building, students will compare the amount of energy from wasted food to the amount of energy used in the school, and explore the question, "How long could we heat the school using food waste?" (Science lesson)
- Paper: Students will question the school's business manager/waste collection company on the amount of paper waste produced. They will make their own paper from waste, and consider the energy needed to make paper and turnover raw materials. (Art lesson)
- Plastic: Students will conduct an investigation of single use vs. reusable bags, and standard plastic bags vs. biodegradable bags (mechanical properties, functionality, production and cost effectiveness). (D&T lesson)

Learning Unit 3a: Waste in industry- production of waste (part 1)

Students will visit a local manufacturer, such as The Rakem Group, which supplies specialty raw material to paper, coating, plastics, textile fibres, pharmaceutical and chemical industries, to understand how waste and sustainability is considered at a commercial level. Students discuss how this should impact the school's waste-management methods (previously discussed in LU2b). (Art lesson)

Learning Unit 3b: Waste in industry- reduction of waste (part 2)

Students will watch a video made by Harri, an employee of the Ellen MacArthur Foundation, who is trying to reduce waste in the design industry (e.g., fabric waste, waste from dying/colouring). Students will consider textiles used in fashion / art and will discuss what makes something 'waste' vs. recyclable. (Art lesson)

Learning Unit 3c: Repair, recycle and reduce waste

Students will learn about the different approaches to waste management (6Rs from D&T curriculum), and discuss which ones apply to the retail, industry and school examples looked at so far. A representative from Plantiful, a local plastic-free shop, will visit to explain some of the challenges they face staying plastic-free. Students will explore whether any of their methods could be replicated in school (i.e., school canteen), and discuss ideas for the upcoming project in LU5. (Science lesson)

Create

Learning Unit 4: Rethink, recycle and reuse

In this Unit, students will go through 3 activity stations to experience first-hand the different approaches to managing waste, as identified in LU3. Afterwards, they will use what they learned to devise their own solution towards reducing school waste (LU5).

- Plastic waste (recycle & repurpose): Students will generate, develop and prototype ideas for recycling / repurposing discarded plastic drink bottles. They will discuss how the

discarded bottles can be hacked (i.e., cut, melted, joined) and if / how they can create a new bottle design, using components sourced from discarded products / materials.

- Food waste (reduce & reuse): Students will investigate the product / process related to unused food in the school to facilitate redistribution to those in need. Questions they can consider: How can unused food be stored to prevent spoilage (i.e., cool box) and how can this be achieved in food-centred businesses / shops? How can spoiled food be processed (i.e., compost/worms)? Students will also consider how design, flat-pack delivery, assembly, material choice, structure and form enable efficient operation.
- Cardboard waste (rethink & recycle): Students will be challenged to design a useful item using discarded cardboard boxes. For example, cardboard boxes can be transformed into simple games / toys for children (a possible target market is children who are hospitalized or who are visiting patients in hospital, with limited access to toys). Questions to consider: Can the item be created using tools and materials that are readily available (i.e., scissors, tape, split pins)? Can you produce a set of instructions for DIY? (D&T lesson)

Learning Unit 5: Circular school economy challenge

Students will be introduced to the concept of a circular economy. They will choose one of the 3 areas of waste (plastic/ food / paper), and drawing on what they've learned so far, create and develop a product / solution based on one of the 6Rs (rethink, reuse, recycle, repair, reduce and refuse). They will follow the journey of their chosen waste to identify at which stages it can be improved or utilized, and develop ideas for products / systems that can reduce or eradicate the waste produced. (D&T and Art lessons)

Learning Unit 5b: Where can I find filters in my school?

Students will go on a treasure hunt around the school looking for various types of filters (e.g., fans, masks, extractors, coffee filters, etc.). They will then examine different types of face masks. An expert from the construction industry will come to talk about the advantages of mask-wearing (safety, fumes, Covid19, if appropriate).

Share

Learning Unit 6: Reducing waste - presentation

Students present- either in person or via Zoom- their ideas, models and prototypes to the head teacher and experts they have worked with. Students could also create a video showcasing how to make other buildings more sustainable, to be shared with their partner primary school and other organisations. Final presentations will include information learned over the course of the Scenario as well as models, technological projects and solutions.

Learning Unit 7: Implementing permanent zero-waste solutions (optional)

On completion of this LS, students will have the opportunity to become their school's eco-ambassadors, pitching a proposal to create a zero-waste school to a panel of local changemakers: Andy Burnham, Tamoor Tariq, Prof. Alice Larkin. The eco-ambassadors will lead the process of implementing a whole school approach for transformational change,

using leadership skills and scientific enterprise to open minds to new possibilities. The students will have 12 months to turn their school into a circular economy, and make a real difference. Additionally, the eco-ambassadors will produce monthly tutorials - that will be shared with a local partner primary school- exploring creative solutions to reduce waste. Along the way, their journey will be documented.

License

The Sounds Around Us

Developed by: CSC & School Complex No. 1, Tychy & Primary school number 5, Zabrze, PL

The "Big Idea"

Sounds surround us every day, in every moment of our lives. Some of them are pleasant, others are annoying, and some we do not pay attention to at all. While we rarely think about it, many sounds can be harmful to us, so it is worth knowing what intensity is safe, and what the noise levels are in the rooms where we spend most of our time.

The Challenge

How can we protect ourselves from harmful noise?

A Short Abstract

After sight, hearing is the most important sense with which we communicate with the outside world. We want to investigate the quantity and quality of sounds in our immediate environment and the impact of noise on our health. We will learn about the ear- how it functions, the importance of hygiene, how easily it can be damaged, and how to protect it. We will measure and analyse noise levels at different locations, and look for ways to minimize the noise around us. For this purpose, we will learn what a sound is and examine its wave properties- such as reflection, dispersion, overlapping sounds from several sources, sound energy and sound absorption. We will also build an acoustic screen for a mini-recording studio at school.

Core STEM Subjects

- Life Sciences
- Engineering & Technology
- Design

Main Learning Goals

1. Students will become familiar with sound as a physical phenomenon. They will learn about the qualities of sound (pitch, volume, timber, tone) and notice the differences and similarities between different sounds.
2. Students will be able to assess the acoustic conditions in their classroom or school hall and know how to improve them.

3. By experimenting, the students will determine what conditions are necessary for a sound to arise and why it does not propagate in a vacuum.
4. Students will be able to test sound intensity level and draw correct conclusions based on the result.
5. Students will know how to design a simple acoustic insulation.

Main Messages

1. The sounds which surround us in everyday life have an impact on our health and well-being.
2. Using appropriate sound-absorbing methods and materials, we can insulate ourselves from unwanted sounds and improve the acoustic comfort of rooms.
3. There are different types of sounds and we can measure them by taking into account different variables.

Make (hands on) project

Students will design and create an acoustic room for recording music in their school.

Related STEM careers

Environmental Engineer, Sound Engineer, Road Engineer

Students' Age

13-16 years old

Duration

12 learning units (18 lessons X 30 - 135 min.)

Period of Operation

May-June 2021

Brief of the Learning Units

Brief

Learning Unit 1.1: Introduction to sound

Students listen to different sounds and learn about what sound is and how it is produced. The students will learn the relationship between the pitch and the vibration frequency (the number of vibrations per second) as well as the relationship between the loudness and the amplitude of vibrations.

Learning Unit 1.2: What is a decibel?

The students will rank sounds by loudness, from the softest to the loudest. As the loudness of a sound is a subjective quality, students will learn to use an objective / measurable physical quantity- *sound intensity*- to describe it. The students will learn about what constitutes silence and noise, explore the concepts of the hearing and pain thresholds, and discuss the unit of sound intensity- how it relates to loudness and how to measure and use it. They will learn that a sound signal can be converted into an electrical signal and viewed on an oscilloscope (smartphone application, e.g., *Oscope*).

Learning Unit 2.1: The structure of the ear and the sounds it perceives

Students will learn about the structure of the ear and how it works. They will learn about the different types and sources of sound, such as infrasound and ultrasound, and learn the answers to questions such as: What range of sounds can a human hear? Which animals use infrasound and ultrasound, and how? Is infrasound safe for humans, and why is it being researched by the military? Where / how is ultrasound used? And how are infrasound and ultrasound created?

Learning Unit 3: What is noise?

During this Unit, the students will explore what noise is, and look for an answer to the question: Are all sounds, "noise"? They will classify noise according to its source (municipal, communication or industrial) and according to its time course (intermittent, impulse). They will suggest their own examples of noise (how many decibels does the rustling of leaves, whisper, vacuum cleaner, etc. generate?), describe the different sources of noises (communication, industrial, municipal), and discuss its harmful effects.

Research

Learning Unit 4: The sounds around us

During this Unit, students and their teachers visit various places and test the noise level using the decibel meter application on their smartphone. They can test the noise levels in the classroom, on a busy street, in a park, or at a construction site. They write down the results and draw conclusions.

Learning Unit 5: What is resonance?

By experimenting, students will learn about the phenomenon of mechanical resonance in everyday life. They will discuss the pros and cons of this phenomenon. During the lessons, attention will be paid to the external frequency of natural vibrations.

Learning Unit 6: The energy of sound waves

During the Unit, students will learn about sound waves as energy carriers. The following questions will be discussed: How big is this energy? Or maybe we should ask, how small? Can you break glass with the human voice? What is air compaction and how does it

affect pressure? Students will blow out candles using loudspeakers, make a glass vibrate with a damp finger, and build an acoustic cannon.

Learning Unit 7: How does distance from a sound source affect its intensity?

Students will test sound intensity at different distances from noise barriers. Based on the results, they will create graphs of the dependence of sound intensity on the distance from the source and draw conclusions.

Learning Unit 8: Wave properties of sounds

Students will learn the importance of wave phenomena and their properties in understanding the essence of sound. They will be divided into groups and conduct experiments with diffraction, tuning forks in water, interference, and “Chinese whispers”. They will also study how sound reflects in different rooms.

Learning Unit 9.1: Attenuation of background noise

Students will study sound-absorbing materials, such as glass, fabric, polystyrene, wood processing waste / shavings, acoustic foams, sponge, and granular materials. By measuring the sound intensity level, they will calculate a sound’s intensity before and after passing through a soundproofing chamber (cardboard shoe box, plastic container or metal can) filled with the tested material. Based on the results, they will calculate the sound absorption coefficients for the selected materials. Finally, they will design a model of a house with soundproofing and, if possible, make a mock-up of such a house.

Create

Learning Unit 9.2: Acoustic screens and room acoustics

During the lesson, students will learn about the acoustic requirements of rooms intended for listening to and recording music. They will learn about anechoic chambers and different types of noise disturbances in rooms, and how to minimize them. Through experimentation, students will try to find the best arrangement of equipment (furniture and loudspeakers) for sound quality, paying attention to wall, ceiling and floor coverings.

Share

Learning Unit 10: Presentation

The Unit is a summary of the students’ work in the form of a presentation for an audience (e.g., for parents and STEM teachers from various schools in the city). At the event, students will: Give demonstrations; present the results of their research in either a live presentation or a video; exhibit their sound-proof houses; share their knowledge about the best acoustic conditions for listening rooms and recording studios; and display their acoustic screens. The event may also take place as part of the Science Festival organized at the school.

License

Dealing with Waste

Developed by: WAAG & Ir. Lely Lyceum Secondary school, NL

The "Big Idea"

Littering is a big nuisance to people and a huge contributing factor to the "plastic soup" clogging our seas. How can we bring about a change in mentality towards littering?

The Challenge

Design a waste collection system that is fun to use and effective, while addressing the following questions:

- How can you prevent people from polluting their direct environment with litter?
- Is there a smarter and more effective way of collecting and separating waste?
- Can we make throwing things away properly a fun thing to do?

Short Abstract

In this LS, students will be introduced to behavioural design. They will research the problem of littering and analyse the meaning of the outcomes of their research. Based on their research, they will design and build a solution that will be tested in the school cafeteria. How will they persuade their fellow students to throw trash away properly? The outcome of the research and the solution will be presented to a relevant audience.

Core STEM Subjects

- ☐ Engineering & Technology
- ☐ Physical Sciences
- ☐ Design

Main Learning Goals

1. Gather information about waste.
2. Gather information about behaviour and opinions around waste disposal.

3. Work as a team to invent and test possible solutions.
4. Develop and improve design and building skills.
5. Learn about electronic circuits.

Main Messages

1. Desirable behaviour can be designed.
2. Caring for the public space can be a fun and positive experience.
3. Throwing waste away properly improves the public space.
4. Throwing waste away properly prevents plastic soup.

Make (hands on) project

Students will design and build their own waste-disposal solutions that will encourage people to throw trash away properly.

Related STEM Careers

Civil Engineer, Electrical Engineer, Environmental Scientist, Data Analytics Scientist

Students' Age

12-14 years old

Duration

10 LU (100 minutes per LU)

Period of Operation

April - June 2021

Brief of the Learning Units:

Brief

Learning Unit 1: Kick-off project, visit to an interesting place

The students visit a place of interest as a spectacular start of the project and are introduced to the LS's assignment.

Learning Unit 2: Making a waste timeline

Some collected (plastic) waste is put on a timeline: How long does it take to decompose?

Research

Learning Unit 3: Lesson on behavioural design

Lesson on behavioural design: How can you reshape behaviour and change bad habits?

Learning Unit 4: Creating a survey

Students will design a survey that will provide them with the insights they need for the project.

Learning Unit 5: Conducting the survey

Students will talk to people in the neighbourhood and ask their questions.

Learning Unit 6: Analysing the results of the survey

Students will analyse the surveys and make graphs from the results.

Create

Learning Unit 7: Designing the solution

Students will design and build their waste-disposal solution.

Learning Unit 8: Test (in the school cafeteria), evaluate and iterate

Students will test their solutions in the school cafeteria, and evaluate their ideas.

Learning Unit 9: Prepare presentation

The students prepare a presentation to share their research / solution.

Share

Learning Unit 10: Presentation

The students present their product designs to the client. They talk about the concepts and ideas that were incorporated into the design, explain the test results, and discuss possible improvements to the product. The presentation is given next to the designed object, without digital support (like a screen).

License

Energy Research

Developed by: BSMJ & Nativ Zvulun School, IL

The Big Idea

It is well-known that the world must transition to renewable energy sources. So why do we continue to rely on energy produced from non-renewable sources such as oil, coal, and gas? It turns out that the move to renewable energy carries a cost; less convenience, higher price, reduced efficiency, limited availability and more. In this Learning Scenario, students will learn about the subject through targeted learning and experiential activities, and meet with professionals who will help them gain a deeper understanding of the complexities involved in using renewable energy sources.

The Challenge

Design and construct models based on the various types of renewable energy sources. Draft a position paper for the community on the importance of saving energy at all levels- from the individual to the state.

A Short Abstract

In the Learning Scenario, students will learn through experiential activities and meetings with professionals about the advantages and disadvantages of renewable and fossil energy sources. Students will tour a power plant, meet with experts, and visit the Science Museum to learn about the many factors involved in producing energy from different sources. At the end of the Scenario, students will draw on what they learned to design and build a model depicting a renewable energy source and to draft a position paper for the community, expressing their stance on the use of renewable energy.

Core STEM subjects

- ☐ Life Sciences
- ☐ Engineering & Technology
- ☐ Earth & Space Sciences
- ☐ Physical Sciences
- ☐ Design

Main Learning Goals

1. Recognize and learn about renewable and non-renewable energy sources
2. Understand the complexities involved in the transition to renewable energy
3. Experience building a working model
4. Formulate a position and draft a document that expresses their view

regarding the use of renewable energy

Main Messages

1. The transition to renewable energy sources is a necessary reality so that humans can continue to live on Earth.
2. Fossil fuels deplete the Earth's resources and pollute the environment but have certain advantages over renewable energy sources, such as high efficiency and yield.
3. Renewable energy sources do not deplete the Earth's resources or pollute the environment but have certain disadvantages compared to fossil fuels, such as reduced efficiency and the need for continuous-use storage.

Make (hands on) project

Students will design and construct a model of a mechanism or device or facility that creates or uses renewable energy.

Related STEM Careers

Electrical, Material, Energy, or Mechanical Engineer, Researcher in Energy-Related Fields (physics, chemistry), Environmental Researcher, Solar Panel Installer.

Age of Students

11-12 years old

Duration

10 Learning Units (20-24 X 45 min.)

Period of Activity

December 2021

Brief of the Learning Units

Brief

Learning Unit 1 - Introducing the topic

Ascertaining students' prior knowledge of the concept of energy and the various types of energy that exist; Brief activity to demonstrate energy conversion

Research

Learning Unit 2 - Energy sources

Introduction with different types of energy by demonstrations, activities, and experiment; Learning about their sources

Learning Unit 3 – Visit to the Science Museum
Workshop and tour of exhibitions on electrical energy and energy conversion

Learning Unit 4 - Wind energy
Research workshop where students investigate which factors affect turbine output and efficiency

Learning Unit 5 - Meeting with an energy expert (either policy-maker or professional).

Learning Unit 6 - Electrical energy consumption at home (optional)
Activity with parents about the power consumption of various appliances in the home

Learning Unit 7- Visit to a power plant
Students will learn about the process and complexities of using different energy sources.

Create

Learning Unit 8 - Model building
Students will design and construct a model of a mechanism or device or facility that creates or uses renewable energy.

Learning Unit 9 – Drafting a position paper
Students will draft a position paper (which will be presented to the community and policy-makers) on the importance of saving energy.

Share

Learning Unit 10 - Special event
Planning and running a special event for students, parents, and community policy-makers to present the models and their position papers.

License

Let it Rain!

Developed by: Forth & Jubilee School, UK

The Big Idea

There are lots of benefits of being outdoors (e.g. wellbeing, fresh air), however enjoying and learning outdoors in all weathers can be a challenge. A way to get around this for schools is to create an outdoor classroom which takes into account the different types of weather students will face throughout the year.

The Challenge

Create an all-weather classroom.

A Short Abstract

In this Learning Scenario, children will learn about the difference between weather and climate. They will learn about all types of weather by collecting data about the weather in their country and then comparing their results to that of another country. Additionally, they will explore what stops us from being outside in all weathers (e.g. wind, rain and heat) and look at different materials which can protect us from harsh weather. At the end of the Scenario, students will design their own all-weather classroom for their school- with real materials in mind- and present their findings to a community panel.

Core STEM Subjects

- Engineering & Technology
- Earth & Space Sciences
- Physical Sciences
- Design

Main Learning Goals

1. Understand the difference between weather and climate and how they affect us
2. Collect data and compare the weather in their country with that of another country
3. Explore and test the properties of different materials
4. Design and 'build' and outdoor classroom
5. Present designs to a community panel

Main Messages

1. Different countries experience different weathers and climate throughout the year and this can affect how much time people spend outdoors.
2. There is a difference between weather and climate.

3. Different materials have different properties, and we can use this knowledge to protect ourselves from harsh weather conditions (e.g. wind, rain, cold, heat).

Make (hands on) project

Students will design an outdoor classroom with real materials and then discuss and figure out who has the most cost-effective design.

Related STEM Careers

Architect, Meteorologist, Climate Scientist, Structural Engineer, Civil Engineer, Thermal Engineer, Materials Scientist

Age of Students

9-11 years old

Duration

6 Learning Units (6 lessons between 30-90 min)

Period of Activity

Sep – Dec 2021

Brief of the Learning Units

Brief

Learning Unit 1 - What is weather?

This LU is a knowledge harvesting activity. Students will be asked what terms they already know before creating a map of ideas with a partner/group. As a class, students will compare their ideas and discuss which are similar / different. Students will then learn what climate is and how it's related to weather. They will then compare different climates across the world, discuss why/how they are different, and create a map and key of the various climates of the world. At the end of the Unit, students will spend time locating the UK on the map and discussing its climate.

Learning Unit 2 - Let's compare

Students will carry on their discussion from LU1 about what the weather is like in the UK, if it's the same all year round, and how it affects us. Students will then compare the weather in the UK with that of another country (ideally students will be linked with a primary school from another country in the MiO project - students will send daily emails for a week?). At the end of the Unit, students will make a weather diary to record weather-related variables such as: observed temperature (using an outdoor thermometer), precipitation levels and wind

speed (using data from an outdoor weather station), and cloud formation (by sketching the clouds and identifying the different types) over the course of a week.

Research

Learning Unit 3 – It's windy out there

Students will be introduced to the idea of an outdoor classroom, and will discuss what keeps us from being outside in all weathers. The class will listen to the story "The 3 Little Pigs", and think about the problems they faced. The class will then be split into 3 groups to make models of the pig's houses; the first group will construct a house using straw, the second group will use sticks, and the last group will use Legos. Students will test the houses for durability using Lego people and a desk fan to generate 'wind'. After the experiment, the students will discuss which house was the sturdiest, and why? What were the advantages and disadvantages of each?

Learning Unit 4 - Rain, rain, go away

When planning the outdoor classroom, students will think about another big factor - rain! Students will explore the difference between absorbance and water resistance, and investigate which materials have these properties. After the discussion, students will test a range of materials and record the results on a scale. They will then evaluate their results and identify which types of material would make a good roof.
After the lesson, students will have an opportunity to talk to an architect to discuss other aspects involved in building a roof, such as cost effectiveness, environment, etc. Did the children's findings correlate with the expert's advice?

Learning Unit 5 - Keep me warm!

Students will bring in items from home that they think will insulate/conduct heat. What they can put inside the all-weather classroom to keep them warm? How do they want to feel when they're in there? Students will learn about insulators and conductors of heat before testing various materials. At the end of the Unit, the class will discuss which materials can store heat and warm them up while still being environmentally friendly.

Create & Share

Learning Unit 6 - Design a classroom

Using all the ideas and knowledge that they have learnt throughout the unit, students will design an outdoor classroom with real materials in mind. Once they have thought about the materials, they will figure out how much it would cost to construct their classroom. Who has the most cost-effective design? They will then present ideas to a panel (architects, head teacher, business manager).

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On Two Wheels

Developed by: CSC & Private primary school "Pracownia", Łódź & Primary school number 5, Sosnowiec, PL

The Big Idea

According to reports, the inhabitants of Warsaw spend an average of 415 hours (over 17 days!) stuck in traffic jams a year. Is it worth wasting time standing in a traffic jam? What are the alternatives? How do traffic jams affect our environment? During this Scenario, we will answer all these questions, as well as learn about bicycle construction, bicycle maintenance, and road traffic regulations.

The Challenge

How can we safely use bicycles?

A Short Abstract

Many Polish cities are among the most polluted cities in Europe (air pollution). One of the factors contributing to this is road traffic. Traffic jams occur not only in large agglomerations but also in our immediate vicinity (e.g. near the school as parents drop off their children in the morning). During the Scenario, we want to focus on the issue of sustainable transport. We will see how cars affect the cleanliness of the air, and propose the use of a bicycle as an alternative. For this purpose, we will familiarize ourselves with road traffic regulations, as well as with basic bicycle maintenance.

Core STEM Subjects

- Life Sciences
- Engineering & Technology
- Earth & Space Sciences

Main Learning Goals

1. Presenting a range of transport possibilities, according to various needs (transport of people, goods, etc.)
2. Familiarizing students with how the various types of transport affect the environment
3. Showing the benefits of using a bicycle

Main Messages

1. You can reduce the level of air pollution by using bicycles.

2. Physical activity has a positive effect on health.
3. Our actions have a direct and indirect (long term) impact on our environment.

Make (hands on) project

Students will build a device for measuring the level of air pollution (using a Micro: bit microcontroller and a laser dust meter).

Related STEM Careers

Ecologist, Traffic Engineer, Architect, Environmental Scientist

Age of Students

9-11 years old

Duration

7 Learning Units (14-16 X 45 min.)

Period of Activity

Sep – Oct 2021

Brief of the Learning Units

Brief

Learning Unit 1 - Introduction

We show students newspaper headlines about the most polluted cities. We brainstorm ideas about where air pollution comes from, and discuss how cars "produce" air pollution.

Research

Learning Unit 2 - Mapping the access routes to school

We print a map of the area around the school. For the next few days, students colour-code the various routes that lead to the school, according to how people use them (cars, bicycles, roller skates, pedestrians, etc.). After analysing the map, we will discuss if the car routes are over-used, and if so, why.

Learning Unit 3 - How invisible dust can harm us

Meeting with an expert - Meeting with a doctor who will explain to the students how invisible dust harms our health.

Learning Unit 4 - Safe cycling according to road signs

Students learn about the road traffic regulations and road signs that allow us to ride bikes safely. Using chalk to draw the roads and signs of a "town" on the asphalt, students will pretend to be on bikes and move according to the signs.

Create

Learning Unit 5 – Building a device for measuring air pollution and analysing the data collected

During the lesson, we will build a cheap device for measuring levels of pollution in the air (using a Micro: bit microcontroller and a laser dust meter). Students will take measurements on the access roads to the school both during and after the morning rush hour and analyse the results. Students will also count the number of cars that pass near the school within a certain amount of time.

Learning Unit 6 - What parts make up a bike? Know, disassemble, and repair *(optional – requires tools)*

Students get to know the structure of a bicycle and learn its basic operation/maintenance - setting up a chain, adjusting brake cables and gears.

Share

Learning Unit 7 - A campaign to promote "car-free school day"

Part A: Preparing for a "car-free school day" - a campaign promoting the bicycle as a means of transport. Students will create a brochure, posters and social media posts. (180 minutes)
Part B: Measuring the impact of the "car-free school day". During the "car-free school day", students will take measurements as in LU5. They will count whether the number of cars in the vicinity of the school has changed and check the impact of any change on the level of air pollution.

License

The Art in STEAM – Transitions between 2D and 3D

Developed by: WAAG & de Regenboog, primary school, NL

The Big Idea

The 'Art' in STEAM represents the visual arts, social studies, history, physical arts, fine arts and music. It is about using creativity and imagination to promote the development of STEM's essential skills, as well as increasing flexibility, adaptability, productivity, responsibility and innovation – all required skills for a successful career in any field of study.

Inserting the arts into a student's STEM education has proven benefits such as: increased creativity, improved visual learning ability and academic performance, strengthened motor skills, better decision-making, and an enhanced overall learning experience.

In this Learning Scenario, we will take a brief trip through the history of art, and learn how the invention of photography changed art forever. Photography offered a new way of viewing the world through images. As painters began to look for things that photography couldn't show, art started to change. After a targeted study of photography, painting, storytelling and art, students will creatively explore how to work from 2D to 3D, using digital fabrication to produce a sculpture / installation.

The Challenge

How can students learn about digital fabrication by exploring the A in STEAM? Students will creatively dive into the history of art, visit a museum, learn how photography works, and design and create their own installation. At the end of the LS, students will take ownership of their work and exhibit their art in the community.

A Short Abstract

In this LS, students will explore the concepts of art and photography, and will design and create an installation using digital fabrication, such as laser cutters and 3D printers.

Core STEM Subjects

- Engineering & Technology
- Design
- Math - Geometry

Main Learning Goals

1. Learn about the "A" in STEAM, in connection to STEM; take a trip through history to discover how photography changed art
2. Promote creativity and design skills through prototyping, digital fabrication and 3D modelling
3. Enhance the learning experience with digital fabrication

Main Messages

1. There are various ways of approaching subjects / learning.
2. Hands-on learning is for everyone.
3. Getting inspired by- and giving back to- the community is fun and beneficial.

Make (hands on) project

Transition of a 2D painting into a 3D model - initially one made by hand and then using a digital production

Related STEM Careers

3D Modeller, Animator, Industrial Designer

Age of Students

6-10 years old

Duration

7 Learning Units (7 X 60 min.)

Period of Activity

Oct – Nov 2021

Brief of the Learning Units

Brief

Learning Unit 1 - Introduction

Part A - History class: How photography changed art (surrealistic/ expressionistic)
A dive into a brief history of art, with a focus on how the invention of photography changed art, by offering a new way to view the world in images.
Part B - The camera obscura - building a DIY pinhole camera and taking pictures with it.

Learning Unit 2 - Visiting a local art space/exhibition

Visiting a local art space/exhibition - exploring art in the neighbourhood

Research

Learning Unit 3 – Visit to a modern art museum

During this tour students explore the works of art and pick an expressionist or abstract painting and think of a story about the work of art. Together the students process their stories and paint them. They gather these paintings into a storybook.

Create

Learning Unit 4 - Sketching / painting

Students continue their paintings inspired by their museum visit; start thinking about how a 2D painting can be represented as a 3D model / installation.

Learning Unit 5 - Modelling / building

Students continue their paintings and study its shapes; start building 3D shapes / models.

Learning Unit 6 – Enhancing 3D modelling at makerspace

Students use digital fabrication to translate the handmade model into its final, enhanced version.

Share

Learning Unit 7 - Event at a local art space/ exhibition hall / elder care home

Event at a local art space/exhibition hall/elder care home to present the installations to the public.

License

Decision Making

Developed by: BSMJ & IASA School, IL

The Big Idea

Making decisions constitutes a significant part of our lives. Whether it's simple, every-day decisions, such as what to eat for breakfast or which friend to call, or more weighty decisions, such as choosing a school or deciding what to study, we invest a lot of time, thought, and energy in coming to decisions. Familiarity with the factors that influence decision-making will help students be aware of how they arrive at a decision and improve their ability to handle challenges and crossroads throughout their lives.

The Challenge

Build a model that represents how we arrive at a decision (to be chosen by each group), informed and inspired by decision-makers in the community, parents of students, animals and /or computers.

A Short Abstract

During the Learning Scenario, students will learn about decision-making through a targeted study of computer science, mathematics, psychology, neuroscience and biology. The inquiry and learning process will include, among other things: meetings with experts from the community who are involved in decision-making; interviews with parents regarding significant decisions they have made in their lives; simulation games; basic computer programming; a visit to a computer science exhibition at the Science Museum that will illustrate how computers learn and make decisions; and independent group learning on animal decision-making and biomimicry, technology modelled on the behaviour of animals. After learning about the various factors that go into decision-making, students will be asked to create a physical model representing any decision they choose (either at the individual level or at the class / school / state level). The model-building process will be accompanied by an art teacher and an artist or designer from the community. At the end of the Scenario, students will present their finished products to the students and parents of their school and the nearby elementary school.

Core STEM subjects:

- Life Sciences
- Engineering & Technology
- Design
- Art

Main Goals

1. Learn about the cognitive, psychological, and behavioural processes that influence our decision making
2. Understand and experience the way computers learn and make decisions (machine learning)
3. Compare our decision-making processes to those in the natural world (biomimicry) and in the world of computers, and discover what, and how, we can learn from them
4. Become familiar with the ways physical modelling can be used in learning and thinking processes and apply them in building a model for decision-making

Main Messages

1. Making an informed decision is based on gathering information and critically analysing it.
2. The learning and decision-making process can be understood at the individual level (in the brain) and at the community level (groups of humans and animals), as well as in computers.
3. Learning is a decision-making process that takes place in both living things and computers (Artificial Intelligence).

Make (hands on) project

Students will work in separate groups to build physical models that represent specific situations of decision-making. They will be inspired by examples of translations of abstract ideas into physical models that they will be exposed to during the LS.

Relate STEM Careers

Designer, Architect, Artist, Cognitive Psychology Researcher, Behavioural Economics Researcher, Computer Scientist (Artificial Intelligence)

Age of Students

14-15 years old

Duration of Activity

10 Learning Units (20-28 X 45 min.)

Period of Activity

Nov 2021

Brief of the Learning Units

Brief

Learning Unit 1 - Decision making

The LU includes a game to gain basic familiarity with the subject, a net diagram as a way of

depicting the decision-making process and presenting the challenge task.

Research

Learning Unit 2 - Machine learning

How computers learn and make decisions? Simulation games, discussion of ethical issues on the subject.

Learning Unit 3 - How do we decide?

Part A- Meeting with a psychologist, discussing and practicing decision-making strategies, examination of factors that influence our choices and decisions.
Part B- Why do people make irrational decisions? A selection of experiential activities *(Optional)*

Learning Unit 4 - A big decision

Part A- Students interview their parents regarding significant decisions they have made in their lives.
Part B- Meeting with a decision-maker in the community (school principal / parent who has a decision-maker role at the local / state level). *Optional*

Learning Unit 5 - Visit to the Science Museum

Workshops and tours of exhibitions on computer science and the human body – the focus will be on the coordination that happens between decisions that are made consciously and those that are not.

Learning Unit 6 - Decision-making in animals

Independent groups work on the various strategies animals use when making decisions, presenting the results to the rest of the class.

Create

Learning Unit 7 - How to build a model?

How to depict an idea or concept with a physical model - meeting with an artist / designer / architect

Learning Unit 8 - Building the model

Working in groups to build a physical model for decision-making, based on a decision chosen by the students (the decision-making situation can be at the individual level or at the level of the class / school / country).

Share

Learning Unit 9 - Special event

Presenting the model to students and parents of the school

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Illicit Drugs

Developed by: Forth & Derby High School, UK

The Big Idea

Illicit drugs can be a tricky subject to teach in schools. Globally, there is still a debate on whether certain illicit drugs should be legalised or not. To help students understand the different sides of this debate, and to encourage them to form their own opinions on the subject, it is important to teach them how drugs work, what they do to our bodies and minds, how humans can become dependent on them, and how society deals with the issue.

The Challenge

Create an interactive and engaging learning resource for other students to learn about illicit drugs.

A Short Abstract

In this Learning Scenario, students will learn what illicit drugs are made of, how they affect our bodies and minds, what role they play in society, how society deals with their negative effects, and how these effects can be measured and managed. With this acquired knowledge, students will work in groups to develop an app or animation to share an aspect of their learning with other young people their age.

Core STEM Subjects

- Life Sciences
- Engineering & Technology
- Design

Main Learning Goals

1. Understand how drugs can affect us (e.g. brain, mental health, body)
2. Understand how drugs are developed and made
3. Conduct independent research on the different effects of drugs on human health
4. Create an interactive and engaging learning resource for other students to learn about illicit drugs

Main Messages

1. There is still a debate on whether certain illicit drugs should be legalised or not.
2. Drugs can be made from natural sources such as plants.
3. Some drugs which are now illicit were previously legal and used as medicine.

4. Drugs have a profound effect on our minds and bodies and can be highly addictive.
5. Drugs have been part of society both past and present; we need to be well informed so we can deal innovatively with their negative effects on our society.

Make (hands on) project

Students will use their research and learning to plan, create, and present an app exploring the different effects of drugs.

Related STEM Careers

Doctor, Pharmacist, Biochemist, Clinical Scientist, Therapist, Histology Scientist, Analytical Scientist, Immunologist

Age of Students

13-14 years old

Duration

6 Learning Units (9 lessons X 60 min)

Period of Activity

Sep – Dec 2021

Brief of the Learning Units

Brief

Learning Unit 1 - Drugs and our health

Part A: Meeting with an Expert - Mental health nurse. Students will meet with a mental health nurse to explore how drug use impacts mental health. They will be shown brain scans that show how drugs affect the brain, and discuss the reasons why people might choose to take drugs.

Part B: How should we deal with drugs? Students will debate statements about the impact of drugs on individuals and society ('some drugs should be legalised', 'advertising of alcohol should be banned', 'random drug tests should be conducted in the workplace'), supported by expert information.

Research

Learning Unit 2 - Where do drugs come from?

Students will learn how the same plant can be processed differently to become either a drug or a material (e.g. cannabis/hemp baskets, opium /poppy seed buns), and take part in a hands-on activity where they guess which materials are made from the same plant. They will learn how different processing and methods can affect the purity of a drug (e.g. cocaine).

Learning Unit 3 – Drugs in history: Medicine & addiction

Students will explore the role medicine and drugs have played in different periods of history, and learn about the role of drugs in other cultures and religions. For example:

- Opium being used as a painkiller, leading to addiction and opening of Victorian opium dens (mentioned in popular literature, such as Sherlock Holmes)
- Religious/shamanistic use of drugs
- Morphine use in WW1
- Zopiclone as sleeping drug
- LSD used in scientific research, medicine, etc.

Learning Unit 4 - Measuring, analysing & presenting data

Part A: Students will talk to local experts (e.g. community police, police unit with drug-detecting dogs) about the devices and methods they use to find and measure drugs/alcohol. Students will then experiment with some of these devices and methods (e.g. "Beer goggles" which replicate drunk vision, breathalyser, walking along a straight line, anti-drink-spiking devices).

Part B: Students will be given a dataset (such as alcohol use and consequences in the UK) to analyse, and create a 3D visualisation of data/results. The class will then discuss what we can learn from the results.

Learning Unit 5 - How drugs affect the body & their impact on health

Students will engage in independent and guided research on the different effects of drugs on mind and body. This research will be used to develop their chosen app (LU 6).

Create & Share

Learning Unit 6 - Create an app or animation

Students will use their research and learning to plan, create, and present an app exploring the different effects of drugs. The aim is to move beyond the realm of adults preaching to teenagers. To do this, students will spend time understanding their target audience and thinking about the most suitable/effective/appropriate method of communication and content.

Experts: film-makers, storytellers to inspire and support the creative process.

License

Biodiversity - How it Works

Developed by: CSC & School Complex No. 1, Tychy & Primary school number 5, Zabrze, PL

The Big Idea

We often hear about biodiversity; that it is under threat and that it needs to be protected. But what exactly is biodiversity? What does it mean that in one place it is "high" and in another, "low"? What factors affect its level, and what can be done to preserve the biodiversity of our immediate surroundings? This project aims to familiarize students with ecological issues and encourage a pro-ecological mind-set.

The Challenge

How can we protect biodiversity?

A Short Abstract

During this Scenario, we will learn about biodiversity: what it is, how we can estimate it's level, and how to use keys to identify species. Students will identify and enumerate the various species of plants and animals living in the area around the school. In the classroom, we will create a model showing how population sizes can change according to environmental pressures. Finally, we will consider what actions we can take to protect biodiversity in the immediate vicinity.

Core STEM Subjects

- Life Sciences
- Earth & Space Sciences
- Design

Main Learning Goals

1. Presenting the concept of biodiversity, which is present everywhere around us and essential to our survival
2. Recognizing the factors that influence the degree of biodiversity
3. Familiarizing students with the basics of marking plants and animals (identification keys)

Main Messages

1. Ecology is a chain of interconnected dependencies, where each link is important.
2. The number of plant and animal species in the world is decreasing every year.
3. Our actions have a direct impact on the nature around us.

Make (hands on) project

Students will create simple models of physical solutions to protect biodiversity in urban environments (such as bird-feeders and bee houses).

Related STEM Careers

Biologist, Botanist, Ecologist, Zoologist, Veterinarian, Forester

Age of Students

12-15 years old

Duration

7 Learning Units (14 X 45 min.)

Period of Activity

Sep – Oct 2021

Brief of the Learning Units

Brief

Learning Unit 1 - Introduction

Familiarizing students with the term *biodiversity* and other terms used in ecology - A week before the class, groups of students will receive cards with the names of plants and animals. Their task is to arrange the cards into the longest food chain, or as many different food chains, as possible.

Research

Learning Unit 2 - Species in the immediate vicinity

Students are divided into groups. Each group receives a strictly defined area outside the school in which they try to identify all the plant species they can, using the Internet for help. The plants are also carefully photographed (in winter, it is possible instead to observe the bird-feeder and take pictures of all the birds that appear over a specified time, e.g. for 15 minutes).

Learning Unit 3 – Using species identification keys

In the classroom, students report if they were able to determine the species of plants / animals they encountered. We show students how the identification keys used by biologists can be used to verify their assumptions.

Learning Unit 4 - Meeting with an expert in the field of ornithology / botany

Meeting with an expert - an expert (botanist / ornithologist) will come to the class to check the results of our work, correct any errors, and explain what they may have resulted from.

Learning Unit 5 - How does evolution work?

Students are divided into groups and, using simple tools and materials, create and manipulate different kinds of environments. We check how various factors affect population sizes and draw conclusions (this is a simple game to show how evolution works).

Create

Learning Unit 6 - Solutions to protect the biodiversity in our vicinity

What can we do? Students discuss the ways we can protect biodiversity in the vicinity. We create proposals for various simple solutions and think about what impact they will have. We will also create simple models of physical solutions (bird-feeder, bee house, etc.).

Share

Learning Unit 7 - Sharing our ideas with the community

Students will prepare a short film explaining the most important issues related to biodiversity and present the ideas they developed for its protection. An alternative may be to prepare an informational brochure or a school campaign devoted to this issue.

License

Healthy Snack

Developed by: WAAG & Ir. Lely Lyceum, secondary school, NL

The Big Idea

Food and health are inextricably connected, a fact of which we are becoming increasingly aware. So why do our surroundings continue to offer mostly highly processed, high-calorie and high-sugar food choices? With huge advertising budgets, the food industry tries to tempt consumers to buy processed and sugary food. The reason for this is simple: the raw materials for soft drinks, cookies and candy are very cheap- this 'junk' food has a significantly higher profit margin than fruit and vegetables. The food industry does not benefit much if you eat healthy foods; it does, however, have a vested interest in you eating snacks! In fact, this is one of the main reasons for the dramatic increase in overweight in recent decades.

In this LS, students will explore their neighbourhood and surroundings with regard to food options, examine available snacks and packaging, learn about food and health from an expert, and present their findings with data visualisations. With the knowledge they gained, they will create a healthy, affordable and appealing snack made with local products and design a (honest) packaging.

At the end of the LS, students will organise a neighbourhood event and present their data visualisations, a recipe book, and the healthy snacks they created.

The Challenge

The word 'snack' has an unhealthy connotation because students often opt for an unhealthy snack instead of a healthy alternative. One reason for this is because it is often cheaper and easier to obtain. How can students create a healthy, locally-sourced alternative that is affordable as well as appealing?

A Short Abstract

In this LS, students will explore the concept of snacks and design healthy alternatives that are just as appealing. Working together with a local farm, dietician, packaging designer and restaurant, they will create their product, design sustainable packaging, compile a recipe book, and bring their product to (a small) market.

Core STEM Subjects

- Life Sciences
- Earth & Space Sciences
- Design

Main Learning Goals

1. Promote cooperation between the school and the neighbourhood
2. Encourage a positive attitude towards health and healthy food
3. Learn about production chains (local food vs. non-local food)
4. Raise awareness about how packaging is designed to attract you
5. Better understanding of students' own research by presenting findings in a visual and 3D format

Main Messages

1. Compiling a recipe book of healthy food can be fun and healthy.
2. All designs- including food packaging- are intentional, and you can design your own.
3. Data is just numbers- if you work with these numbers and present them visually you can get a better understanding of the data.

Make (hands on) project

Students will create healthy recipes, procure ingredients and produce snacks. In addition they will invent a clever tool and/or a food package.

Related STEM Careers

Packaging Designer, Dietician, Farmer, Cook, Food Engineer

Age of Students

13-15 years old

Duration

7 Learning Units (7 X 100 min.)

Period of Activity

Sep – Oct 2021

Brief of the Learning Units

Brief

Learning Unit 1 - Hey Snacks!

Part A - Introductory lesson about assignment. Intro into snack-culture (broad, diverse perspective)

Part B - Misleading packaging. Research packaging- is it always truthful? Compare products and packaging from the supermarket.

Research

Learning Unit 2 - On Food: Meetings with experts

Part A - Coaching (school teacher), instructional specialist (dietician), learning facilitator (restaurant owner, farmer). What kind of food does your body need? What is available in the area? (Comparative research, does it match? Yes / no? Why?)

Part B - Data visualization; making honest packaging to replace packaging from supermarkets. Presentation and evaluation

Learning Unit 3 – Working with food

Growing food (local farm), processing food (cooking), analysing food

Create

Learning Unit 4 - Making food

Creating a healthy recipe, procuring ingredients, producing snack

Learning Unit 5 - Making it

Inventing a clever tool and/or a recipe book

Learning Unit 6 - Selling it

Designing attractive and sustainable packaging

Share

Learning Unit 7 - Bon Appetite!

Presenting the snack to local partners at a special event

Learning Unit 8 - Change

What did we achieve?

License

5. Appendixes

Appendix 1: Revised template

LS revised template

- Title
- The “Big Idea"
- The challenge
- A short abstract
- Core STEM subjects: *(leave only what is applicable)*
  - ☐ Life Sciences
  - ☐ Engineering & Technology
  - ☐ Earth & space sciences
  - ☐ Physical Sciences
  - ☐ Design
  - ☐ Other:
- Main goals (3-5)
- Main messages (3-5)
- Make (hands on) project
- Related STEM careers:
- Students’ age
- Duration
- Brief of the Learning Units *(name and short abstract)*

  Prepare *(optional, delete if not relevant)*
  - ► LU0

  Brief
  - ► LU1

  Research
  - ► LU…

  Create
  - ► LU…

  Share
  - ► LU…

- License

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- Teacher feedback:[2]
  - ‘Aha and Uh-oh moments’
    ‘Aha and Uh-oh moments’ is a simple tool to describe situations that went well (“Aha”) and what didn’t go as planned (“Uh-oh”) It’s about observing the learner’s behaviour and describing what you did as a teacher/educator to guide the situation and what the result where afterwards. With the ‘Aha and Uh-Oh moments’ teachers can briefly describe and reflect on situations that occurred from their activity.
    - “Aha!” moment/s: a moment of sudden realization, inspiration, insight, recognition, or comprehension” (Merriam-Webster). An opportunity for reflection that what happened well was because you did something right.
      Write here:
    - “Uh oh!” moment/s - “The moment one realizes that something, somehow, didn’t go as planned. An opportunity for reflection about what could be improved in the activity.
      Write here:
  - General tips/ideas
  - Media - pictures, videos, scanned material…

LU template

What

- Title
- Abstract (same as brief from LS template)
- Students’ age
- Curriculum connections (subject/s)
- Specific goals
- Specific messages
- Main concepts

How

- Duration:
  - Preparation time:
  - Teaching time:
- Location: (leave only what is applicable)
  - ☐ Yard
  - ☐ Class
  - ☐ Lab
  - ☐ Make lab

[2] personal additions, reflections etc.to be added after the delivery of the LS

- ☐ Academy
- ☐ Industrial plant
- ☐ Field trip
- ☐ Other:

- Roles: (leave only what is applicable)
  - ☐ Teacher
  - ☐ Expert
  - ☐ Parent
  - ☐ Peer/ students from different age groups
  - ☐ Facilitators from informal organizations
  - ☐ Other:
- Engagement with the community (leave only what is applicable)
  - ☐ Other schools
  - ☐ Parents
  - ☐ Academy
  - ☐ Industry
  - ☐ Municipality
  - ☐ local businesses
  - ☐ Community garden
  - ☐ Other:
- Format/s: (leave only what is applicable)
  - ☐ Discussion
  - ☐ Demonstration
  - ☐ Experiment
  - ☐ Survey
  - ☐ Make workshop/ DIY experience
  - ☐ Working groups
  - ☐ Competition
  - ☐ Digital experiences
  - ☐ Event or festival
  - ☐ Other:
- Sources & resources:
  - ► Links:
  - ► Downloadable resources:
  - ► Tangible resources (kit/self-source):
  - ► Human resources:
  - ► Other:
- Preparation (organizing before the LU)
- Course of activity (detailing a set of activities)

Why

- STEM skills, and competencies: (leave only what is applicable)
  - ☐ Asking questions
  - ☐ Defining problems
  - ☐ Using models

- ☐ Conducting investigations
- ☐ Analysing data
- ☐ Using mathematics
- ☐ Constructing explanations
- ☐ Designing solutions
- ☐ Arguing from evidence
- ☐ Communicating information
- ☐ Other:

- Soft skills: (leave only what is applicable)
  - ☐ Team-work and collaboration
  - ☐ Dealing with uncertainty
  - ☐ Learning failure is part of learning
  - ☐ Growth mindset
  - ☐ Other:
- Management skills: (leave only what is applicable)
  - ☐ Planning work and use of resources
  - ☐ Awareness of value of resources
  - ☐ Dividing tasks and role
  - ☐ Other:

Information about 1st pilot LSs

Country	School Primary / Secondary	Topic	1-2 strengths
IL	P	Exercise for Thought (Improve community well-being)	- Hands on and make activities - Connected to STEM curriculum (human body)
	S	Our Moving World: Physics Everywhere	- Engagement with the community (experts from diverse background, impact on public space) - Relevant physics learning
NL	P	Forces of Nature (Exploring motion by various means)	- Teamwork, learning by doing, prototyping, science experiments. - Focusing on the development process.
	S	Dealing with waste (Litter in a public environment)	- Waste awareness, research in their own neighbourhood, statistics, influencing strategies, designing a waste system, making, electricity, testing, evaluating, collaborating.
UK	P	How Clean is Air? (Air pollution)	- Using cheap low-tech ways to measure pollution - Research outdoors in the local community (micro trips) - Engagement with experts in the local community
	S	Zero waste school (Circular economy, 6R)	- Making activities which can impact the school/ school culture - Engagement with experts in the local community
PL	P	Food travels (Zero waste kitchen)	- Ideal scenario for schools with a green yard. - Part of the lessons are conducted outside.
	S	Sounds around us (Noise and silence)	- A lot of physics. It explains how sound works. Really a lot of physics :)

Rating preferences of LSs

Country	School Primary / Secondary	Topic	Preferences of each country 1 – first priority 2 – second priority 3- third priority 4 – we can't run			
			IL	NL	UK	PL
IL	P	Exercise for Thought (Improve community well-being)		1	1	3
	S	Our Moving World: Physics Everywhere		1	2	1
NL	P	Forces of Nature (Exploring motion by various means)	2-3		3	1
	S	Dealing with waste (Litter in a public environment)	3		3	2
UK	P	How Clean is Air? (Air pollution)	1	2		2
	S	Zero waste school (Circular economy, 6R)	2-3	3		3
PL	P	Food travels (Zero waste kitchen)	4	4	2	
	S	Sounds around us (Noise and silence)	1	2	1	