WP3

SDG'S Lesson Plans

Co-funded by the European Union

STEAMing up the Sustainability with Sustainable Development Goals (SDG'S)

Contents

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INTRODUCTION

Welcome to our digital book, a fantastic resource for teachers at all levels, from primary to tertiary. This book is intended to inspire and provide educators with various STEAM (Science, Technology, Engineering, Arts, and Mathematics) lesson plans that incorporate interdisciplinary, cross-curricular, and transdisciplinary approaches. We want to build a generation of inventive thinkers and problem solvers prepared to face the challenges of the twenty-first century by leveraging the power of STEAM education.

Interdisciplinary, Cross-Curricular, and Trans curricular Lesson Plans

Interdisciplinary lesson plans seamlessly integrate different disciplines, blurring the barriers between traditional topic areas. Teachers collaborate in an interdisciplinary approach to create learning experiences that incorporate multiple subjects, allowing students to grasp the interconnection of information and gain a holistic understanding of complicated issues.

On the other hand, cross-curricular lesson plans use linkages between specific topic areas, focusing on the transfer of knowledge and abilities from one discipline to another. Teachers use a cross-curricular approach to develop lessons that intentionally include concepts and practices from multiple topics, facilitating deeper learning and improving students' capacity to transfer information across domains.

Transdisciplinary lesson plans cross subject boundaries, concentrating on overarching themes or real-world situations that necessitate insights from multiple disciplines. These lessons teach students to think critically, analyse information from various viewpoints, and apply knowledge and skills in numerous circumstances. Transdisciplinary techniques generate a deeper appreciation for the interconnectedness of knowledge and promote a holistic understanding of complicated challenges.

STEAM Teaching Models and the SDGs

Within the STEAM framework, the project promotes the integration of STEM (Science, Technology, Engineering, and Mathematics) education with the Sustainable Development Goals (SDGs). The SDGs are 17 global goals adopted by the United Nations to address social, economic, and environmental challenges. By aligning STEAM teaching with the SDGs, educators can positively empower students to impact their communities and contribute to a sustainable future.

Our digital book explores various STEAM teaching models incorporating the SDGs, such as problem-based learning, project-based learning, design thinking, and inquiry-based learning. These models provide teachers with a roadmap for designing engaging and meaningful learning experiences that promote critical thinking, collaboration, and innovation.

The secondary and tertiary level lesson plans follow the 5E Model of Instruction, which includes five phases:

1. *Engage*: teacher works to gain an understanding of the students' prior knowledge and identify any knowledge gaps. It is also important to foster an interest in the upcoming concepts so students will be ready to learn. Teachers might task students with asking opening questions or writing down what they already know about the topic. This is also when the concept is introduced to students for the first time.

2. *Explore:* During the exploration phase, students actively explore the new concept through concrete learning experiences. They might be asked to go through the scientific method and communicate with their peers to make observations. This phase allows students to learn in a hands-on way.

3. *Explain:* This is a teacher-led phase that helps students synthesise new knowledge and ask questions if they need further clarification. In this phase students also share what they learned during the Explore phase before introducing technical information in a more direct manner. After the sharing of findings, teachers utilise video, computer software, or other aides to boost understanding.

4. *Elaborate:* The elaboration phase of the 5E Model focuses on giving students space to apply what they have learned. This helps them to develop a deeper understanding. Teachers may ask students to create presentations or conduct additional investigations to reinforce new skills. This phase allows students to reinforce their knowledge before evaluation.

5. *Evaluate*: The 5E Model allows for both formal and informal assessment. During this phase, teachers can observe their students and see whether they have a complete grasp of the core concepts. It is also helpful to note whether students approach problems in a different way based on what they learned. Other helpful elements of the Evaluate phase include self-assessment, peer-assessment, writing assignments, and exams.

The 5E model provides a carefully planned sequence of instruction that places students at the centre of learning. It encourages all students to explore, construct understanding of scientific concepts, and relate those understandings to phenomena or engineering problems.

Benefits

Based on research, the 5E Model of Instruction promotes active learning. Students are involved in more than listening and reading. They learn to ask questions, observe, model, analyse, explain, draw conclusions, argue from evidence, and talk about their own understanding. Students work collaboratively with peers to construct explanations, solve problems, and plan and carry out investigations.

One of the main benefits of the 5E model is that student leads the learning and the teacher acts as a guide. Through open-ended questions, real-life experiences, guided investigations, hands-on projects and research, students gain a deep understanding of the scientific topics that are covered in the unit. Each stage of the model serves as a foundation to the next, creating a coherent model that frames lessons, activities, and units.

Inquiry-based models allow students to develop higher order thinking skills. These types vary on how much involvement the teacher has in the process. In the purest form of inquiry, the teacher plays almost no role. In guided discovery, however, the teacher has a plan for the direction of student learning. The teacher is the facilitator of the learning. The 5E Model of Instruction takes care of the difficulty of implementing guided inquiry-based science instruction.

Innovative Teaching

Your role as an educator is crucial in influencing the future of education. This digital book is a collection of ready-to-use lesson plans and a guide for enhancing your STEAM teaching skills. We empower you to develop innovative lesson plans by providing insights, strategies, and practical advice to support your professional growth.

Explore the lesson plans in this book, modify them to suit the needs of your students, and adopt interdisciplinary, cross-curricular, and trans curricular approaches. Let's embark on this STEAM journey together, cultivating imagination, critical thinking, and a love of lifelong learning.

ABOUT OUR PROJECT

Education is crucial in assisting the general population in comprehending the effects of climate change and in promoting the attitude and behaviour changes needed to combat climate change.

By educating students about the SDGs through STEAM teaching methodologies, we:

- Empower them to understand and contribute to solutions for these challenges, fostering a sense of global citizenship and responsibility.
- Equip them with the knowledge and skills needed to build a sustainable future.
- Enable them to develop Critical Thinking and Problem-Solving Skills so they learn to analyse complex problems, explore innovative solutions, and apply interdisciplinary approaches to address sustainability challenges.
- Enhance their career opportunities, as there is a growing demand for professionals with green skills and expertise in sustainable development.
- Empower them to become active agents of change, advocating for sustainable practices and influencing policy decisions towards a more sustainable society.

PROJECT TOPICS

Digital Content, Technologies and Practices

Environment And Climate Change

Green Skills

About the SDG'S ERASMUS+ PROJECT

SDG'S is an ERASMUS+ project with the title "STEAMing up the Sustainability with Sustainable Development Goals" and project number 2021-1-SE01-KA220-SCH-000023584. SDG'S aims to improve the skills of our educators by developing learning and teaching resources in the forms of a Massive Open Online Course (MOOC) and supplementary lesson plans, so that educators can integrate SDGs into their curriculum, at 3 different levels, primary, secondary and tertiary.

This 2-year project focuses on school education, with the main objectives of providing professional development opportunities for educators and promoting a green transition, where educators are equipped with the necessary competencies, knowledge and digital tools and resources to help their students understand the importance of sustainable development, and its varied challenges that nations face.

The SDG'S project focuses on six specific goals:

6. Clean Water and Sanitation
7. Affordable and Clean Energy
12. Responsible Consumption and Production
13. Climate Action
14. Life Below Water
15. Life On Land

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YENİŞEHİR ANADOLU İMAM HATİP LİSESİ
Erasmus+
2021-SE01-KA220 SCH-000023584
STEAMing up the sustainability with
Sustainable Development Goals

SDG 6
CLEAN WATER AND SANITATION

PRIMARY SCHOOL LEVEL

Title	Clean water and sanitation (SDG 6)
Subject	Chemistry
Topic	Purify water
Grade Level	School year 1-6
Age of Students	6-12
Allocated Time	80 min (1 lesson)
Lesson Objective	To learn how to carry out a water purification experiment
Expected Outcomes	To be able to engage in the water purification experiment both verbally and actively.
Curriculum Alignment	Ability to utilise chemistry to review information, discuss, and take a stand on environmental and health issues, as well as to be able to conduct systematic chemical studies. Reference to Swedish curriculum
Interdisciplinary Cooperation	Swedish and chemistry
Differentiation Strategies	We begin with the entire group and then work on the experiment in small groups.
Teaching Methodology to Be Used	Purify the water with carbon filters.
Materials/Tools **Health & Safety**	An empty PET bottle (0.5 l) Sphagnum moss Peat Charcoal (crushed charcoal) Pebble Scissors Dirty water

Resources Used	https:// vvshjaltarna.se/bygg-en-vattenrenare/
Scenario	You are lost in the woods and have been for a long time. You have no drinking water left, and the water in the forest is dirty. What can you do?

Learning Teaching Process		
Activity	**Procedure**	**Time**
1. Introduction, brainstorming	Instruct pupils to discuss water purification in pairs. Finish with a discussion as a class.	15 min
2. **Key words: charcoal, white moss, dirty water, pebbles,**	Teacher led discussion with picture/ hands-on with pictures (widget)	10 min
3. **Explain the experiment**	Go through the different steps of the experiment	15 min
4. Implementation of the experiment after step 1, 2 and 3.	• Cut off the bottom of the PET bottle and turn it over. • Fill one-third of the bottle with white moss. • Then fill the second-third of the bottle with a mixture of peat and charcoal powder • Fill the remaining space with pebbles • Make holes in the cork so that the water you want to purify flows out slowly, about one decilitre (100ml) per minute.	40 min
Assessment	Follow the instructions and conduct the experiment to obtain the correct product. Teacher can opt for the following assessment types: • Observation • Performance based assessment • Reflection and analysis • Written assessment	

SECONDARY SCHOOL LEVEL

TITLE	Investigate the Causes of Pothole Creation		
AREA OF SCIENCE	Hydrology, Chemistry, Biology, Geography		
TEACHING METHODOLOGY TO BE USED	• Discussion • Question and answer • Brainstorming • Problem- solving		
GRADE LEVEL	8-9		
AGE OF STUDENTS	14–15-year-olds		
TOTAL TIME	2 hours (3 lessons)	**PREPARATION TIME:** 40minutes	**TEACHING TIME:** 80mins

Overview

To promote awareness regarding water scarcity, have the pupils watch the following film:

https://youtu.be/w4fFjndoxKc

Student mission

You work as a water resource engineer for a water science firm and You were tasked with investigating the causes of pothole creation in certain places. You are in charge of discovering solutions to water scarcity and its consequences.

21st century technical skills gained through this activity

- The science of hydrology
- Creativity
- Critical thinking

Related job roles

- Water resource engineer
- Environmental engineer
- Civil engineer

Differentiation strategies to meet diverse learning needs:

- Hands-on learning and realia
- Higher order thinking

Expected Learning Outcomes

- To develop cognitive skills by employing personal techniques to think, organise, learn, and conduct.
- To be able to apply the scientific method by formulating a hypothesis, designing the experiment, collecting data, and drawing conclusions based on their observations.
- To be able to analyse and interpret the collected data, identifying patterns, trends, and relationships between the watered and non-watered plants.
- Engage in critical thinking skills to evaluate the impact of water scarcity on plant growth and identify factors contributing to the creation of potholes in specific locations.
- To conduct research on water scarcity, pothole formation, and potential solutions, utilising various resources such as scientific articles, reports, and online databases.
- To enhance students' communication skills by presenting their findings, explaining the experiment methodology, and effectively conveying information on water scarcity, its causes, and potential solutions.
- To be able to work collaboratively in groups, promoting teamwork, division of tasks, and sharing of responsibilities to create a cohesive and well-rounded presentation.
- To develop an understanding of water scarcity as a global issue, its consequences for ecosystems and human communities, and the need for sustainable water management practices.

Prior knowledge and vocabulary

- Water scarcity
- Water sanitation
- Clean water
- Ecosystem health

Science and Engineering/Math Practices

Provide students with the printout of the science of hydrology, and develop a short project for real life problems about water scarcity.

Curriculum Alignment

1. **Introduction to Hydrology Science and The Importance of Water**

    - Because of the emphasis on real-world applications and the cross-disciplinary nature of modern hydrology, problem-based learning (PBC) works effectively in hydrological science.
    - Defining Data
        - Identify the concepts of hydrology science, water scarcity, and ecosystem health.
        - Explain hydrologic data (surface water, groundwater, water quality)
        - Identify the causes of water scarcity and drought, as well as the negative effects on ecosystem health.
        - Examine how water scarcity is measured.
        - Examine the causes of water scarcity.
    - Data Control Structures:
        - Consider how to mitigate the negative consequences of water shortage on ecosystem health.
        - Brain storm how to supply clean water and sanitation for all (rainforests, harvesting, water reuse, water conservation)
    - Data Structures:
        - Examine and contrast various facts regarding water.
        - Identify possible solutions to use less water in different household activities.
        - Reduce water pollution
        - Preserve ecological health.
        - Explain ways to protect water sources, limit water pollution, and protect ecosystem health.

2. **Methods to mitigate the detrimental consequences of insufficient water and sanitation on ecosystem health.**
    - Define what ecosystem health is
    - Discuss the ecosystem and the importance of ecosystem health
    - Understand the need of water for ecosystem health.
    - Understand that it is a concept that integrates environmental conditions with the effects of anthropogenic activities in order to provide knowledge for sustainable resource use and management.
    - Understand that water for the environment is utilised to achieve certain results for plants or animals by supplying the appropriate amount of water at the appropriate time for them to feed, breed, and grow.
    - Investigate methods for preserving ecological health:
        - Reservoirs and dams
        - Collection of rainfall
        - Desalination
        - Water conservation

Lesson

Engage: The teacher asks important questions concerning students' prior knowledge of water scarcity and ecological health. After answering the essential questions, the class watches a movie about water shortage and ecosystem health. Then they discuss the video and the principles they have learnt.
https://www.youtube.com/watch?v=vB68xvRb2T4

Materials: Video links, notes with embedded questioning
Preparation: 2 mins
Facilitation of Learning Experience: 10 mins
Transition: 2 mins

Explore: The teacher guides the pupils through a tangible learning experience to examine the new subject by requiring students to communicate with their peers and make observations of the two plants. One of the plants is irrigated, whereas the other is not. Students compare and contrast these two plants to determine their differences.

Materials: Two plants
Preparation: 5 Minutes
Facilitation of Learning Experience: 20 Minutes
Transition: 2 Minutes

Explain: Students conduct research in order to gather knowledge for use in the discussion section. They argue on what they believe is the best way to reduce water scarcity. The teacher responds to the students' queries regarding the topic and guides students to talk about what they just learnt.

Materials: Pencil and paper, PCs
Preparation: 6 Minutes
Facilitation of Learning Experience: 20 Minutes

Elaborate: To reinforce new skills and knowledge, the teacher assigns students to develop presentations or conduct additional investigations. By getting the opportunity to put the newly learnt concepts into practise, students gain a better comprehension.

Materials: Power point
Preparation: 10 Minutes
Facilitation of Learning Experience: 10 Minutes

Evaluate: Teacher observes students to determine whether they have a thorough understanding of the basic concepts, either as students deliver their presentations or carry out further investigations (as per the instructions given to students during the "Elaborate" phase). Teacher takes note of whether pupils approach problems differently as a result of the activities of the "Explain" phase.

Materials: Projector/Smart Board
Preparation: 10 Minutes
Facilitation of Learning Experience: 10 Minutes

Independent learning tasks (ILT):

- Students research real life applications of what they learned within the classroom.
- Students enhance their knowledge and complete related online quizzes.

Student feedback

Students will be given feedback on a one-to-one basis in a timely manner. The feedback will reference the skills outcomes that the assessment was designed to test and whether students met these outcomes.
Students provide oral feedback about the lesson.

Curriculum mapping of outcomes attained

The knowledge gained in this lesson can be mapped against geography and biology.

Assessment

Practical, student presentation, time bound assessment;

Materials

- PC
- Smart board or projector
- Worksheets
- Videos
- Plants
- Online quiz

Preparation

Provide students with the video links and links to online quizzes.

Team Work

Students work in groups to research the topics, and prepare and deliver a presentation in to their classmates. They rotate in order to get experience in the skills required for each job.

When conducting an inquiry or practical investigation, please have your students use the “Test Your Idea Organiser” located in Annex I., so that they can formulate a testable hypothesis and demonstrate the logical connections between the scientific concepts guiding a hypothesis and the design of an experiment.

TITLE	Exploring Water's Vital Role in Ecosystem Health		
AREA OF SCIENCE	Hydrology, Biology, Chemistry, Geography, Ecology		
TEACHING METHODOLOGY TO BE USED	• Discussion • Question and answer • Brainstorming • Problem solving		
GRADE LEVEL	8-9th grades		
AGE OF STUDENTS	14-15 years		
TOTAL TIME	2 hours 30 mins (2-3 lessons)	**PREPARATION TIME:** 30 minutes	**TEACHING TIME:** 2 hours

Overview

Students will watch a video about clean water and sanitation.

Student mission

You are part of a team studying a local ecosystem that is experiencing water scarcity and drought. Your goal is to assess the impact of these conditions on the ecosystem's health and devise solutions.

You are working in groups and each group is provided with relevant data and resources to conduct their investigation. You are encouraged to work collaboratively, apply critical thinking, and identify key concepts related to hydrology science, water scarcity, and ecosystem health.

21st century technical skills gained through this activity

- Productivity
- Creativity
- Critical thinking
- Collaboration
- Communication

Related job roles

- Water resources engineer
- Environmental engineer

Differentiation strategies to meet diverse learning needs:

- Hands-on learning
- Higher order thinking
- Collaboration

Time to complete Lesson

Two 50 mins lessons

Expected Learning Outcomes

- Understand hydrology science and the importance of water
- Enhanced Problem-Solving and Critical Thinking Skills by assessing the impact of water scarcity and drought on ecosystem health and analysing data and information to draw conclusions about the effects of water scarcity on ecosystems.
- Understand the concepts of water scarcity and ecosystem health
- Demonstrate creativity and innovation in their presentations to showcase their understanding of hydrology concepts and ecosystem health by creating multimedia presentations, infographics, or posters.
- Understand the importance of sustainable water management:
- Be able to define ecosystem health
- Enhanced communication and presentation skills
- Appreciate the cross-disciplinary nature of modern hydrology and its relevance in addressing real-world challenges, such as water scarcity and ecosystem health.

Prior knowledge and vocabulary

- Ecosystem health
- Water sanitation
- Clean water
- Water shortage

Science and Engineering/Math Practices

- How to plan and carry out investigations
- How to analyse and interpret data
- How to design solutions and optimise designs
- How to use mathematics and Computational Thinking

Curriculum Alignment

1. Introduction to Hydrology Science and The Importance of Water
2. Problem-based learning (PBC) due to real world applications and cross-disciplinary nature of modern hydrology.
3. Testing the hypothesis that non-traditional assessment associated with PBL better reflects the ability of the students.
4. Identify the concepts about hydrology science, water scarcity, ecosystem health.
5. Identify the reasons of water scarcity and drought and also the bad effects of it to ecosystem health.
6. Ways to reduce the negative effects of inadequate water and sanitation on ecosystem health.
7. Defining ecosystem health

Lesson

Engage: The teacher engages students with a thought-provoking question: "Why do you think water is often referred to as the 'lifeblood' of ecosystems?", then inquiries about simple methods for obtaining clean water and sanitation. The teacher attempts to draw students' attention to the need of clean water and sanitation. The teacher then requires students to watch a video in order to create awareness about the ideas of water scarcity and ecosystem health.
https://www.youtube.com/watch?v=yPxMOzN0Uq4

Materials: Video
Preparation: 5 mins
Facilitation of Learning Experience: 10 mins
Transition: 2 mins

Explore: To provide a hands-on learning experience, the teacher brings two bottles of water to class. In one of the bottles some soil is placed and students are put into groups to make observations. Each group is provided with relevant data and resources to conduct their investigation. Students are encouraged to work collaboratively, apply critical thinking, and identify key concepts related to hydrology science, water scarcity, and ecosystem health by comparing and contrasting these two bottles.

Materials: Two bottles of water, soil
Preparation: 30 Minutes
Facilitation of Learning Experience: 10 Minutes
Transition: 2 Minutes

Explain: Students carry out online research to collect further information to be used in the discussion and in their presentations. Students debate the topics around what they believe should be done to reduce water contamination. The teacher responds to the students' queries regarding the topic. The teacher guides students to talk about what they learnt and the key take aways at the end of the discussion section.

Materials: Pencil and paper, PCs
Preparation: 30 Minutes
Facilitation of Learning Experience: 5 Minutes

Elaborate: Teacher encourages a discussion on:

- The negative effects of inadequate water and sanitation on ecosystem health, including the impact on flora, fauna, and overall biodiversity.
- Various strategies to reduce the negative effects of inadequate water and sanitation on ecosystem health.

- The importance of sustainable water management practices, conservation efforts, and responsible water usage.

Students are asked to develop their presentations using the newly gained information in order to develop a deeper understanding of the topic.

Materials: Computers
Preparation: 60 Minutes
Facilitation of Learning Experience: 10 Minutes

Evaluate: Each group will present their PBL findings. Teacher encourages open discussions, questions, and peer feedback to deepen the understanding of hydrology concepts and ecosystem health.
Teacher concludes the lesson by collectively defining ecosystem health based on the knowledge gained throughout the class and highlighting the interconnectedness of ecosystems and the crucial role water plays in maintaining their health.

Materials: Questions
Preparation: 10 Minutes
Facilitation of Learning Experience: 5 Minutes

Independent learning tasks (ILT):

- How can cleaner water be obtained, and how can sanitation be made easier?
- Research real-world examples of successful water management projects that have positively impacted ecosystem health and to prepare a short presentation on your findings for the next class.

Student feedback

Teacher and Peer feedback is given at the end of the lesson.

Curriculum mapping of outcomes attained

The knowledge gained in this lesson can be mapped to the geography and biology curriculum.

Assessment

- Student presentations
- Teacher observation

Materials

- Computers
- Paper
- Pens
- Two bottles of water
- Soil
- Smartboard

Preparation

Explain to students that, to reflect the cross-disciplinary nature of hydrology and their problem-solving skills, they will be assessed through a non-traditional method. For example, students could create multimedia presentations, infographics, or posters to showcase their findings, solutions, and the concepts they've learned. Emphasise that creativity and innovation will be highly valued in the assessment process.

Provide the video link(s) to students.

Team Work

Students work in teams to make observations, research the topics and prepare their presentations for the class.

When conducting an inquiry or practical investigation, please have your students use the “Test Your Idea Organiser” located in Annex I., so that they can formulate a testable hypothesis and demonstrate the logical connections between the scientific concepts guiding a hypothesis and the design of an experiment.

TERTIARY LEVEL

TITLE	Water Quality Assessment and Pollution Sources in Ireland: Clean Water and Sanitation for All (SDG 6)		
AREA OF SCIENCE	Environmental Science, Water Resources Management		
TEACHING METHODOLOGY TO BE USED	This project will deploy group work exercises in the context of laboratory-based work as the primary teaching methodology. When group work is conducted via the discussion of case studies, it is usually text based. Whilst this is a useful skill to develop, the addition of practical skills learned in a laboratory context further improves teaching approaches that already incorporate critical thinking, problem solving and inquiry-based learning. Through this, students can improve their problem-solving skills as well as understanding how their lab-based skills are used in the real world.		
GRADE LEVEL	Tertiary level		
AGE OF STUDENTS	18 + Years		
TOTAL TIME	1 – 2 weeks of class	**PREPARATION TIME:** n/a	**TEACHING TIME:** 5 class sessions
KEY CONCEPTS	Water Quality and Sources of pollution		

Overview

In this project, students will explore the importance of water quality assessment in environmental management. They will learn about key parameters and indicators for assessing water quality and become familiar with national and international regulations and standards. Through engaging discussions, exploration of case studies, interactive activities, and practical laboratory techniques, students will develop a strong foundation in water quality assessment and its significance for sustainable water resource management in Ireland.

Student mission

Lake Bled, once a popular location for fishing, swimming, and picnicking, has recently been under scrutiny due to reports from locals about unusual algal blooms, fish die-offs, and skin irritations after swimming. The local Environmental Management Committee (EMC) has called for an immediate water quality assessment to determine the extent of the problem and potential solutions. You are part of the research team to brainstorm the possible consequences for both the environment and the local community if Lake Bled's water quality is compromised. You will work in teams and each team will share their findings, drawing connections between the environment, economy, and public health.

Through this, you will:

- Understand the broader implications of poor water quality and the importance of water quality assessment in environmental management.
- Become familiar with key parameters and indicators for water quality assessment.
- Learn about national and international regulations and standards for water quality.
- Gain practical laboratory techniques for water quality assessment.

21st century technical skills gained through this activity.

- Critical thinking
- Environmental awareness
- Problem solving

Related job roles

- Water resources engineer
- Environmental engineer
- Civil engineer

Differentiation strategies to meet diverse learning needs:

Hands on learning through practical laboratory work, group exercises

Time to complete Lesson.

5 class sessions

Expected Learning Outcomes

- Understand the importance of water quality assessment in environmental management.
- Become familiar with key parameters and indicators for water quality assessment.
- Learn about national and international regulations and standards for water quality.
- Gain practical laboratory techniques for water quality assessment.

Prior knowledge and vocabulary

N/A

Science and Engineering/Math Practices

Provide students with the printout of the hydrology science and develop a small program for real life problems about water scarcity.

Curriculum Alignment

The series of this lesson are aligned with SDG 6 of the European Union
They can be aligned to the following subjects based on your curricular learning outcomes:

- Chemistry
- Biology
- Agriculture
- Environmental Science
- Geography
- Civics / Political Science
- Health Education

Lesson

Session 1: Importance of Water Quality Assessment **(Engage, Explore, Explain)**

- Engage (5 minutes): Present a real-life scenario highlighting the consequences of poor water quality. Ask students to discuss potential impacts and why water quality assessment is crucial.
- Explore (15 minutes): Conduct a class brainstorming session on the reasons why water quality assessment is essential. Encourage students to share their ideas and experiences related to water pollution.
- Explain (25 minutes): Introduce the module's objectives and provide an overview of the topics to be covered. Present key concepts, such as the significance of water quality for ecosystem health and human well-being.

Session 2: Parameters and Indicators for Water Quality Assessment **(Engage, Explore, Explain)**

- Engage (10 minutes): Display visual representations of different water quality parameters (e.g., pH, dissolved oxygen, nitrates, phosphates). Ask students to identify and briefly explain each parameter.
- Explore (20 minutes): Provide handouts or digital resources with information on common water quality parameters and their significance. In small groups, students discuss and summarize the key points related to each parameter.
- Explain (30 minutes): Facilitate a class discussion, highlighting the importance of each parameter in assessing water quality. Discuss the acceptable ranges, potential sources of pollution, and the ecological and human health implications of deviations.

Session 3: Regulations and Standards for Water Quality **(Engage, Explore, Explain**)

- Engage (10 minutes): Share examples of national and international regulations and standards for water quality. Discuss their purpose and influence on environmental management.
- Explore (20 minutes): Divide students into small groups and assign them different regulations or standards. In their groups, they research and summarize the key requirements, goals, and implications of their assigned regulation or standard.
- Explain (30 minutes): Each group presents their findings, providing an overview of the assigned regulation or standard. Lead a class discussion to compare and contrast the different guidelines and address any questions or concerns raised by the students.

Session 4: Practical Laboratory Techniques for Water Quality Assessment (Engage, Explore, Explain)

- Engage (10 minutes): Introduce the importance of practical laboratory techniques in water quality assessment. Discuss the significance of accurate measurements and precise data collection.
- Explore (20 minutes): Demonstrate and explain various laboratory techniques for water quality assessment, such as sample collection, chemical analysis, and use of instrumentation. Students observe and take notes on the procedures.
- Explain (30 minutes): Divide students into small groups and provide them with water samples. In the laboratory, they perform water quality assessments using the techniques given out by your lecturer. Students record and interpret the results, identifying potential pollution sources.

Session 5: Assessment and Review (Engage, Explore, Explain)

- Engage (10 minutes): Conduct a class review game or quiz, using the water quality parameters, regulations, and standards covered in the previous sessions. This will help reinforce the students' understanding and retention.
- Explore (20 minutes): Assign individual or group activities that involve analysing case studies or real-world scenarios related to water quality assessment and regulations. Students should apply their knowledge and critical thinking skills to assess the given situations.
- Explain (30 minutes): Facilitate a class discussion to review the answers and discuss the outcomes of the case studies or scenarios. Summarize the key takeaways from the module, including both theoretical knowledge and practical laboratory techniques, and address any remaining questions or concerns.

Independent learning tasks (ILT):

- Students must think critically within group discussions around the topic, improving their problem solving and debating abilities.
- Students must work among themselves to brainstorm ideas

Student feedback
Students will receive feedback on their work in the practical as well as in their group led discussions

Curriculum mapping of outcomes attained.

The knowledge gained in this lesson can be mapped against geography and biology.

Assessment

- Class participation and engagement during discussions, activities, and laboratory sessions.
- Completion of individual or group assignments on water quality parameters, regulations, and laboratory techniques.
- Performance in the class review game or quiz.
- Accuracy and precision in conducting water quality assessments during the practical laboratory session.

Materials

- Presentation slides or visual aids.
- Handouts or digital resources on water quality parameters and regulations.
- Case studies or real-world scenarios related to water quality assessment.
- Water samples for the practical laboratory session.
- Laboratory equipment and instrumentation for water quality assessment. (Although not specifically specified each educational institution will have the required equipment to carry out experiments to determine the following: pH, dissolved oxygen, nitrates, phosphates. See appendix one for some common laboratory techniques.)
- Assessment materials (quizzes, assignments).

Preparation

- Guest speakers from regulatory agencies or environmental organisations can be invited to provide insights and real-world perspectives, particularly during the session on regulations and standards.
- Field trips to water treatment plants or environmental monitoring stations can enhance students' understanding of water quality assessment practices and expose them to real-life applications.
- Incorporating practical laboratory techniques allows students to gain hands-on experience in water quality assessment, reinforcing their understanding and skills.
- It is important to provide clear instructions and safety guidelines for the practical laboratory session to ensure a safe and productive learning environment.
- Encourage students to critically analyse and interpret the data collected during the laboratory session, fostering their analytical and problem-solving skills.

Annex of Water Quality Assessment and Pollution Sources in Ireland

Descriptions of the techniques commonly used to determine the levels of pH, dissolved oxygen, nitrates, and phosphates in water samples at the university level:

1. **pH Measurement Techniques:**

   a. Potentiometric Method:

   - Principle: This method utilizes a pH meter equipped with a glass electrode and a reference electrode. The glass electrode measures the potential difference between the sample and reference electrode, which is converted into pH units.
   - Procedure: The glass electrode is immersed in the water sample, and the pH meter displays the pH value. Prior to measurement, the pH meter should be calibrated using standard buffer solutions of known pH.

   b. Colorimetric Method:

   - Principle: pH indicators, such as universal indicator or pH paper, can be used to visually determine the pH based on colour changes. These indicators change colour over a specific pH range, allowing estimation of the pH level.
   - Procedure: A small volume of the water sample is added to a container, and a few drops of the pH indicator are added. The resulting colour is compared to a colour chart or colour standards to estimate the pH value.

2. **Dissolved Oxygen Measurement Techniques:**

   a. Winkler Titration:

   - Principle: This classic titration method is based on the reaction of dissolved oxygen with manganese (II) sulphate and alkali iodide in the presence of sulfuric acid. The reaction forms an iodine complex, which is titrated with a standardized sodium thiosulfate solution.
   - Procedure: The water sample is collected and fixed with manganese (II) sulphate and alkali iodide. After allowing the reaction to occur, the excess iodine is titrated with a sodium thiosulfate solution using a starch indicator to determine the endpoint.

   b. Electrochemical Method:

   - Principle: The most common technique is the use of a dissolved oxygen probe, also known as an oxygen electrode or Clark electrode. The probe consists of a cathode and an anode, which measure the oxygen concentration based on electrochemical principles.
   - Procedure: The dissolved oxygen probe is immersed in the water sample, and the meter connected to the probe displays the dissolved oxygen concentration. Calibration of the probe with standardized solutions is necessary before measurement.

3. **Nitrate Measurement Techniques:**

a. Spectrophotometric Method:

- Principle: This method is based on the formation of a coloured complex between nitrates and a reagent, such as Griess reagent, under specific conditions. The absorbance of the coloured complex is measured using a spectrophotometer at a specific wavelength.
- Procedure: A known volume of the water sample is mixed with the Griess reagent, and the mixture is allowed to develop colour. The absorbance of the coloured complex is measured using a spectrophotometer, and the concentration of nitrates is determined from a calibration curve.

b. Ion Chromatography (IC):

- Principle: IC is a powerful technique for the separation and quantification of ions, including nitrates. It involves the use of a specialized chromatography system with an ion-selective column and a conductivity detector.
- Procedure: The water sample is injected into the IC system, where the nitrate ions are separated from other species based on their affinity for the ion-selective column. The separated nitrate ions are then detected by the conductivity detector, and their concentration is quantified.

4. **Phosphate Measurement Techniques:**

a. Molybdenum Blue Method:

- Principle: This method utilizes the reaction between phosphates and ammonium molybdate in an acidic medium, resulting in the formation of a blue-coloured complex. The absorbance of the complex is measured using a spectrophotometer at a specific wavelength.
- Procedure: A known volume of the water sample is mixed with ammonium molybdate and an acidic reagent. The mixture is allowed to develop the blue-coloured complex, and the absorbance is measured using a spectrophotometer. The concentration of phosphates is determined from a calibration curve.

b. Flow Injection Analysis (FIA):

- Principle: FIA is a rapid and automated technique that involves the injection of a sample and reagents into a continuous flow system. Phosphates react with specific reagents, leading to a colour change or fluorescence that can be measured.
- Procedure: The water sample is injected into the FIA system, where it mixes with the reagent. A detector detects and quantifies the colour change or fluorescence that results from the reaction between phosphates and the reagent in a reaction coil or reaction cell.

These techniques provide reliable and accurate measurements of pH, dissolved oxygen, nitrates, and phosphates in water samples at the university level. They are widely used in research, environmental monitoring, and water quality assessment to understand the condition of water resources and to inform management and conservation efforts.

Assignment: Research Paper

Objective:
To demonstrate a comprehensive understanding of the importance of clean water and sanitation for achieving SDG 6, analyse the causes and consequences of water and sanitation issues, evaluate challenges and opportunities in providing access to safe water and sanitation, recognize the link between water, sanitation, and other SDGs, and assess technologies and solutions for improving access to clean water and sanitation.

Instructions:
Choose one specific region or country and research its water and sanitation situation. Collect relevant data, research papers, reports, and case studies on the water and sanitation challenges faced by the chosen region or country.
Write a research paper addressing the following aspects:

- Introduction:
    - Provide an overview of the importance of clean water and sanitation for achieving SDG 6 and its significance in addressing global challenges.
    - Introduce the chosen region or country and explain its relevance in the context of water and sanitation issues.
- Section 1: Causes and Consequences of Water and Sanitation Issues
    - Explain the issues related to water scarcity, water pollution, and inadequate sanitation facilities in the chosen region or country.
    - Demonstrate an understanding of the causes and consequences of these issues and how they affect different regions and populations.
    - Utilize relevant data and research to support your analysis and evaluation of the water and sanitation challenges.
- Section 2: Challenges and Opportunities in Providing Access to Safe Water and Sanitation
    - Identify and explain the obstacles and opportunities in ensuring access to safe water and sanitation for all people in the chosen region or country, considering factors such as location, economic status, and other relevant factors.
    - Evaluate the various challenges in providing access to safe water and sanitation and propose potential solutions and strategies to overcome these challenges.
    - Interpret relevant data and research on the challenges and opportunities of providing access to safe water and sanitation, using it to support your analysis and evaluation.
- Section 3: Water and Sanitation's Role in Achieving Sustainable Development
    - Explain how access to safe water and sanitation is critical for achieving a range of sustainable development goals, including those related to health, economic growth, and environmental protection.
    - Evaluate the ways in which water and sanitation are linked to sustainable development and the role they play in achieving sustainable development goals.
    - Interpret relevant data and research on the importance of water and sanitation in achieving sustainable development, using it to support your analysis and evaluation.
- Section 4: Linkages between Water, Sanitation, and Other SDGs
    - Explain how access to safe water and sanitation is critical for achieving a range of sustainable development goals, identifying the connections and interdependencies between water, sanitation, and other SDGs.

    - Evaluate the relationship between water, sanitation, and other SDGs, and discuss how they support or hinder progress towards achieving sustainable development.
    - List creative solutions and ideas to link water and sanitation to other SDGs, providing examples and justifications.
- Section 5: Technologies, Approaches, and Solutions for Improving Access to Clean Water and Sanitation
    - Explain the various technologies, approaches, and solutions available for improving access to clean water and sanitation, both at the national and international level.
    - Evaluate the effectiveness and limitations of these technologies and approaches, suggesting ways in which they could be improved.
    - Interpret relevant data and research regarding solutions available for improving access to clean water and sanitation, using it to support your analysis and evaluation.
- Conclusion:
    - Summarise the key findings and insights from your research.
    - Reflect on the overall importance of clean water and sanitation for sustainable development and the challenges that lie ahead.
    - Provide recommendations for future actions and policies to ensure universal access to clean water and sanitation.

TITLE	**Water pollution: main causes and the impact they have on the environment and populations.**		
AREA OF SCIENCE	Environmental Engineering		
TEACHING METHODOLOGY TO BE USED	The lesson is divided in two periods of 90 minutes + 90 minutes. The first period will be theoretical exploration. In the second period the class will be split up into teams consisting of three to five students. They will work within their teams to complete the activities. Each group will carry out a presentation to justify their conclusions.		
GRADE LEVEL	University Level - Graduation		
AGE OF STUDENTS	18+		
TOTAL TIME	180 minutes	**PREPARATION TIME:** 10	**TEACHING TIME:** 170
KEY CONCEPTS	Water pollution; Pollutant; Concentration; Effluent; Eutrophication; Nutrients; Data Analysis		

Overview

It is acknowledged that water possesses renewable characteristics; yet, it is imperative to recognise that its utilisation can also be conducted in an unsustainable manner, despite its regenerative nature. Understanding the concept of water pollution, identifying its primary causes, and comprehending its impact on both the environment and human beings are crucial aspects to consider.

Student mission

You are employed as an environmental engineer inside a municipal setting. The river's current state exhibits altered visual and olfactory characteristics, accompanied by a decline in fish population. It is vital to comprehend the concept of water pollution and discern the primary factors contributing to the current state of the river.

21st century technical skills gained through this activity

- Problem Solving
- Practical analysis
- Critical thinking
- Drawing conclusions based on fact
- Inquiry based learning
- Computational Thinking

Related job roles

- Environmental Engineering
- Biologist
- Environmental technician

Differentiation strategies to meet diverse learning needs:

To enhance the completion of tasks for students with different levels of proficiency, a peer mentoring strategy will be adopted, pairing high-achieving students with those in need of further assistance.

Time to complete Lesson

Two 90-minute lessons (If your lessons are shorter or longer, you can either break this sequence into more lessons or less).

Expected Learning Outcomes

- Students will understand several concepts and definitions link to water pollution
- Students will comprehend the importance of knowing the concentration of a pollutant
- Students will be able to identify the main sources of water pollution
- Students will understand how water pollution affects us and the environment
- Students will understand how to perform data analysis

Prior knowledge and vocabulary

Water cycle, ecosystems, biosphere, basic concepts on physics, chemistry, biology and mathematics.

Science and Engineering/Math Practices

Provide students with the STEAM model for a real-life example of water pollution.

Curriculum Alignment

- Limits to water
- Water trends
- Water pollution
    - Types of water pollution
    - Most common sources/causes of water pollution
- How does water pollution affect the environment
- How does water pollution affect us

Lesson
Engage: Prior to the commencement of the class, students are provided with a video link. Students will independently watch the film at home and then take an online quiz related to its topic. **Materials: Computer, Projector, Video link, online quiz** **Preparation: [2] Minutes** **Facilitation of Learning Experience: [5] Minutes** **Transition: [2] Minutes** **Teacher will:** summarise the concepts of the video and provide the quiz solutions **Students will:** listen and take notes Before the first period watch the video: https://www.youtube.com/watch?v=Zk1J2EW-nmQ
Explore: In reference to the film, students will generate their own inquiries and concepts, which will be facilitated by the instructor through scenario-driven exercises inside the instructional session. Participating in the activity of formulating and answering questions, as well as constructing ideas, can improve students' understanding of effective problem-solving methods. **Materials: No need for materials** **Preparation: [2] Minutes** **Facilitation of Learning Experience: [13] Minutes** **Transition: [2] Minutes** **Teacher will:** facilitate the discussion **Students will:** ask questions in the form of hypothesis. At the same time, they will take notes
Explain: The teacher will utilise a PowerPoint presentation to elucidate the following concepts: the constraints of water, water patterns, the definition of water pollution, various forms of water pollution, its origins, and the primary causes of water pollution. The teacher will incorporate various activities while providing explanations. **Materials: Computer with PowerPoint, projector** **Preparation: [2] Minutes** **Facilitation of Learning Experience: [60] Minutes** **Transition: [2] Minutes** **Teacher will:** further explain the theory behind water pollution **Students will:** listen intently, take notes, ask questions and participate in the activities
Elaborate: At the beginning of the phase, students are directed to participate in collaborative work and perform thorough study on the subject matter. Students will receive a hands-on practise that requires them to analyse and respond. **Materials: computer with excel, word and PowerPoint** **Preparation: [2] Minutes** **Facilitation of Learning Experience: [30] Minutes** **Transition: [2] Minutes** **Teacher will:** present and explain the exercise **Students will:** resolve the exercise using the knowledge apprehended before

Evaluate: Students will then prepare a short presentation and teach the class about the primary outcomes of the exercise.

Materials: computer with PowerPoint and projector
Preparation: [2] Minutes
Facilitation of Learning Experience: [42] Minutes
Transition: [2] Minutes
Teacher will: Evaluate the presentations given by the students on what they found
Students will: Present to the class and will answer relevant questions by the teacher to assess their level of understanding.

Independent learning tasks (ILT):

- Students will watch the video links given to them by the teacher to enhance their knowledge and complete the related quizzes
- Students will research real life applications of what they have learned within the classroom
- Students will work in groups to prepare presentations and to present them to their class
- Students will apply data analysis in a real-life situation
- Students will answer post class questions

Student feedback

Students will be given feedback on a one-to-one basis in a timely manner. The feedback will reference the skills outcomes that the assessment was designed to test and if the student met those outcomes. It will also take into account feedback from the student on how they found the lesson.

Curriculum mapping of outcomes attained

The knowledge gained in this lesson can be mapped against chemistry, biology, physics, mathematics curricula.

Assessment

Practical, student presentation, time bound assessment and Q&A.

Materials

- Computers
- Projector
- Excel
- Word
- PowerPoint

Preparation

It is recommended that students engage with the accompanying video link and afterwards undertake the online quiz. In addition, it is advisable for students to engage in question-solving activities within their notes. Furthermore, the teacher should facilitate question and answer sessions to assess the students' comprehension of the ideas prior to commencing the exercise.

Teamwork

Students will be grouped into teams to conduct research on the assigned topics and thereafter create a presentation to present to the full class regarding the practical activity. This platform functions as an extension of the current knowledge repository, necessitating students to actively pursue more research on environmental matters.

Rubrics

Assessment of:

- Autonomy
- Understanding of the associated concepts
- The link between the concepts
- Interdisciplinarity between the STEAM areas
- Problem solving capacity (computational thinking)

TITLE	Active Citizenship and SDG 6
Subject	Geography
Topic	Active Citizenship
Grade Level	SDG no. 6
Age of Students	18+ adults (a group of teachers)
Allocated Time	90 mins
Lesson Objective	• Participants will gain knowledge about the significance of water, its conservation, and water autonomy. Slovenia has abundant water resources, making it difficult to fathom the possibility of water scarcity in the future. Nevertheless, even Slovenia may face water scarcity if we persist in our current wasteful practices. The lesson examines a hypothetical situation in which persons are confronted with a severe constraint on water usage, namely the challenge of surviving on a daily allowance of 25 litres of water. We will employ critical thinking and critical media literacy to assess the various possibilities for redirecting clean water towards purposes other than drinking, as well as the consequences of its scarcity for human consumption in the future. • Methods to enhance consumer awareness and modify water usage and consumption patterns to adopt a more sustainable lifestyle.
Expected Outcomes	• Participants will comprehend the significant influence that responsible consumption and water resource preservation have on individuals and the environment. They will develop the ability to differentiate between sustainable and unsustainable water usage. They will shift their mentality towards consumption, actively seeking ways to decrease water usage and safeguard it for future generations.
Curriculum Alignment	Teacher Training – Professional Development

Interdisciplinary Cooperation	The exercise integrates the fields of Geography, Biology, Chemistry, and other related disciplines, allowing participants to gain knowledge about the interconnected aspects of these subjects while engaging in the activities.
Differentiation Strategies	Teams will consist of participants with diverse knowledge backgrounds, and they will utilise a peer mentoring approach to assist each other in completing activities.
Teaching Methodology to Be Used	The participants will be divided into teams, and each team will collaborate to accomplish the activities. Every group will conduct a presentation on the principles of sustainable production and consumption.
Materials/Tools **Health & Safety**	• Smart Board • Internet connection, Laptop/Mobile phones • Any practical work, which they carry out is in accordance with current regulations related to health and safety.
Resources Used	The activities are followed by a self-assessment sheet. The various resources are listed below: • 25 Litre documentary drama (English subtitles): https://www.youtube.com/watch?v=w4pPjndoxKc&t=2165s, • Slovenia referendum on changes to Water Law: https://www.youtube.com/watch?v=HXSNFnN7PCg, • Cape Town Came Close To Day Zero: https://www.youtube.com/watch?v=V_ppxRmTHHY&t=9s • Shortage of drinking water in Slovenian Istria (Pomanjkanje vode v slovenski Istri): https://www.youtube.com/watch?v=5IsvCu_6GRQ • Roma community in Slovenia with no access to drinking water (Dobruška vas): https://www.youtube.com/watch?v=SD11SUf-fco,
Scenario	Participants are representatives of an NGO, well-versed in SDG no.6. They are assigned to conduct two workshops for teachers at a local school. The topic is delivered via a brainstorming process, which fosters critical thinking and enhances necessary media literacy abilities. Before the session, teachers are tasked to conduct research and gather data relating to the current status of drinking water in Slovenia: • Is access to safe drinking water in Slovenia considered a guaranteed right? • Is the constitutional right to get potable water guaranteed? • Is the ownership of drinking water public or private? • Is clean drinking water accessible to anyone in Slovenia? • What poses a threat to the preservation of uncontaminated water sources? • Do people in Slovenia have more fortune regarding water-related matters than other regions globally?

	• Examine the significance of preserving and ensuring access to uncontaminated drinking water and compile a selection of instances illustrating this importance. • Explore Slovenia's contribution to advancing potable water protection, conservation, and availability. According to the findings, groups must provide concise presentations for the workshop, acting as representatives of the NGO. This will allow for the discussion of the findings during the workshop.

Learning Teaching Process		
Activity	**Procedure**	**Time**
Introduction / Warm Up	25 Litre documentary drama (English subtitles) video introduction: https://www.youtube.com/watch?v=w4pPjndoxKc&t=2165s	15 mins
Discussion & Group Work	Discuss the impact of water shortage in our daily life and its consequences in your area, in Koper or the Roma unofficial settlement in Slovenia, in the EU, and worldwide. Discuss the findings of participating teachers. Start with brainstorming activity preparation. Divide participating teachers into groups. They will use critical thinking and critical media literacy skills to recognise various threats to clean drinking water. They will also discuss renewable energies, clean drinking water, water rationing due to severe drought.	35 mins
Group discussion	The participants create a screenplay detailing survival strategies with a daily water ratio of 25 litres. They divide the screenplay into three sections: the initial setup, the halfway, and the resolution. The setup serves as the initial phase of the first act, encompassing the introductory image of the narrative, the presentation of the primary characters, the play's underlying theme, and the plot's overarching purpose. The trigger, a call to action, follows next and is the incident that propels the hero into the story. Next comes the midpoint, where the stakes are heightened, and the performers' capabilities are demonstrated. During the redemption phase, artists formulate a successful strategy and regain enough energy to overcome the difficulty. Ultimately, the story concludes with the performers sustaining themselves with a daily allowance of 25 litres, at least for a certain period. • Does anyone in Slovenia have access to potable water? • What poses a threat to the preservation of uncontaminated water sources? • Do individuals in Slovenia experience more favourable outcomes in the domain of water challenges compared to other regions globally? • Examine the significance of preserving and ensuring access to uncontaminated drinking water and compile a selection of illustrative instances.	30 mins

	• Examine Slovenia's contribution to safeguarding, conserving, and ensuring the availability of uncontaminated potable water. According to the findings, groups must provide concise presentations for the workshop, acting as representatives of the NGO. This will ensure that the findings are addressed and debated throughout the workshop.	
Conclusion	Discussion about the content of the play: • Will the solution or activities undertaken by performers be realistic in a daily life or in the circumstances where we face a grave water shortage? • Are there any alternatives to the activities undertaken in this day zero scenario?	5 mins
Assessment	Assessment of the workshop Homework for Teachers to prepare similar lesson plan.	5 mins

SDG 7
AFFORDABLE AND CLEAN ENERGY

PRIMARY SCHOOL LEVEL

Title	Affordable and clean energy (SDG 7)
Subject	Nature and science
Topic	Renewable energy
Grade Level	School year 1-6
Age of Students	6-12
Allocated Time	70 min
Lesson Objective	• Be able to explain the difference between fossil fuels and renewable energies.
Expected Outcomes	• Developing an awareness of the reasons for the need to save energy might transform our energy production and consumption practices. By adopting this approach, we can ensure a more secure and sustainable means of accessing electricity for all individuals while minimising environmental harm.
Curriculum Alignment	Through an environmental perspective, students get the opportunity to take responsibility for the environment they can influence directly and to acquire a personal approach to overall and global environmental issues. The teaching should highlight how society's functions and our way of living and working can be adapted to create sustainable development. Swedish curriculum for primary school as well as for the pre-school class and the leisure center.
Interdisciplinary Cooperation	Nature and science
Differentiation Strategies	Whole class with small group discussions and activities.

Teaching Methodology to Be Used	Teacher-led lecture discussing the advantages and disadvantages of fossil fuels and renewable energy. Teacher led discussions with students regarding the issue. Collage providing guidance on effectively promoting and disseminating the information regarding renewable energy, emphasising the universal impact that **everyone** may have. Assessment: Four corner-exercise with different points of views. The students will act and debate over their choice of “corner”.
Materials/Tools **Health & Safety**	This link is to get access to: • Energikällor PP • Energy sources (Key template) • Energy sources (Worksheet)
Resources Used	https://www.fortum.se/om-oss/vart-foretag/var-strategi/en-renare-varld/hallbar-omstallning/vilken-energikalla-ar-bast https://www.naturskyddsforeningen.se/faktablad/miljopaverkan-fran-el-och-varmeproduktionen/
Scenario	URGENT MESSAGE FROM THE NEWS! We must save energy! Everyone must take action. Each household is allocated a daily energy allowance of two hours. The government will conduct the measures, and after the allocated hours are consumed, the energy supply will be terminated.

Learning Teaching Process

Activity	Procedure	Time
1. Introduction	What can you do to save energy?	30min
2. Key words	PowerPoint with selected keywords	10 min
3. Collage	Creating a collage to spread the message about renewable energy and what you can do as an individual to save energy and make a difference.	30 min
Assessment	Four corner-exercise with different points of views. The students will act and debate over their choice of “corner”.	

SECONDARY SCHOOL LEVEL

TITLE	**Affordable and clean energy**		
AREA OF SCIENCE	Physics, energy geography, chemistry, climatology and biology		
TEACHING METHODOLOGY TO BE USED	Students' current knowledge and readiness to learn new material will be measured by a brainstorming session. The teacher will present the foundational knowledge or basic information necessary for understanding the topic then basic. The teacher will utilise digital tools in the forms of online animations and videos to enhance understanding and retention of the subject matter.		
GRADE LEVEL	9		
AGE OF STUDENTS	14 - 15		
TOTAL TIME	120 mins (40+40+40)	**PREPARATION TIME:** **40 mins**	**TEACHING TIME:** 80 mins
KEY CONCEPTS	Renewable energy, safe energy, wind energy, solar energy, wave energy, hydrogen energy, bioenergy, hydroelectric energy, kinetic energy, and potential energy.		

Overview

Introduction to the lesson. By asking the following questions, attention is drawn to the lesson:

- What would you do if there were no electricity for one day in your life?
- Do you know how energy is met in uninhabited areas for caravans?
- What do you think might change if renewable energy sources were used instead of fossil fuels?

Student mission

Students are assigned to investigate the pollution caused by a thermal power plant. They have to take a photo of the pollution and determine its extent.

21st century technical skills gained through this activity

- Critical thinking,
- Problem solving,
- Environmental awareness,
- Global citizenship,
- Promoting sustainability and environmental responsibility.

Related job roles

- Energy engineer,
- Climatologist,
- Hydrologist,
- Physical engineer,
- Biologist

Differentiation strategies to meet diverse learning needs:

Use of technology; hands-on learning; varied instructional methods, use of visual aids, tiered assignments and scaffolded learning.

Time to complete Lesson

3x40 mins

Expected Learning Outcomes

By the end of this lesson, students will be able to:

- Explain the importance of being an environmentally conscious citizen and how to demonstrate ways to practice environmental consciousness in daily life
- Identify various renewable energy sources and understand how these can be used more effectively in daily life.
- Understand the significance of saving energy and suggest practical methods for energy conservation in their homes and community.
- Identify renewable and non-renewable energy sources, highlighting the advantages of renewable energy in terms of sustainability and environmental impact.

Prior knowledge and vocabulary

Global warming, globalization, power plants, savings, fossil fuel, energy tours, Kyoto protocol

Science and Engineering/Math Practices

What are renewable energy sources?

Make a concept map of renewable energy tours.

Share the results of the research on the environmental damage caused by non-renewable energy sources with the class

Curriculum Alignment

Physics lesson 9th grade 4th unit Renewable and non-renewable energy sources, 5th unit measures to be taken against global warming,

Geography lesson 9th grade natural systems unit

Biology grade 9 biomass

Lesson

Engage: The teacher helps students reflect on what they already know and identify any knowledge gaps. It is important to foster an interest in the upcoming concepts so that students will be ready to learn. Teachers might task students with asking opening questions or writing down what they know about the topic. This is also the time when the concept is introduced to the students for the first time.
Materials:
Preparation: 20 Minutes
Facilitation of Learning Experience: 10 Minutes
Transition: 2 Minutes

Teacher will: Lead a class discussion:

- What do you think constitutes nature-friendly energy sources?
- Should a solar power plant be used instead of a coal-fired thermal power plant?
- How should the transformation into zero-energy buildings be approached?
- Do fossil fuels contribute to global warming?
- What is the function of the ozone layer?
- Can household waste be recycled to obtain energy?

Students will: Students answer the teacher's questions, create concept maps about renewable energy, conduct research on the subject on the Internet, and make mock-ups.

Explore: During the exploration phase, students actively explore the new concept through concrete learning experiences. They might be asked to go through the scientific method and communicate with their peers to make observations. This phase allows students to learn in a hands-on way.

Materials: Tablet, smart board, computer
Preparation: 10 Minutes
Facilitation of Learning Experience: 10 Minutes
Transition: 3 Minutes
Teacher will: Using Kahoot, questions about the subject are posed, and a competition is held. The students are then divided into groups, where they ask each other questions about the subject and are expected to answer them. They are tasked with conducting research and preparing presentations using various sources. On-site learning is facilitated through organised trips to power plants and facilities that utilise renewable energy sources.

Students will: Prepare questions to ask each other. Conduct research on the subject. Share observations about what was seen during the trips with the class.

Explain: This is a teacher-led phase that helps students synthesise new knowledge and ask questions if they need further clarification. The teacher will ask students to prepare to share what they have learned during the discovery phase with their classmates. Divide the students into groups, instruct them to discuss within their group first, and then have a representative from each group present to the class.

Materials:
Preparation: 10 Minutes
Facilitation of Learning Experience: 10 Minutes
Transition: 5 Minutes
Teacher will: lead this phase and ask questions.
Students will: They will share their impressions and observations about what they saw during the trips the class, following the teacher's direction.

Elaborate: The groups formed in the previous stage are asked to prepare a presentation about renewable energy. Afterwards, they engage in a Kahoot activity on renewable energy.

Materials: Tablet, smart board
Preparation: 10 Minutes
Facilitation of Learning Experience: 10 Minutes
Transition: 5 Minutes
Teacher will: ask students to prepare a presentation, then lead the Kahoot quiz.
Students will: prepare their presentations in groups. They participate in a Kahoot quiz on renewable energy and create a concept map on this topic.

Evaluate: The teacher will observer the students, and take notes about their learning situations. Tests are prepared. As a result of the activities, students are asked to write down what they remember about the subject. A survey is conducted using Google Documents.
Materials: Laptop, Google Docs
Preparation: 5 Minutes
Facilitation of Learning Experience: 5 Minutes
Transition: 5 Minutes
Teacher will: Observe
Students will: Participate in tests. Perform the assigned tasks.

Independent learning tasks (ILT):

- **Energy Audit at Home:** Conduct a simple energy audit of their home. Students should identify where and how energy is used in their home, make a note of any energy-saving practices already in place, and suggest at least three new ways their family could conserve energy or use renewable energy sources.
- **Creative Representation:** Create a poster, collage, or digital presentation that illustrates the impact of renewable energy on the environment. This could include visual representations of the differences between renewable and non-renewable energy sources, their effects on the environment, and the importance of transitioning to greener energy solutions.

Student feedback

Research-examination, review of students' work and continues feedback.

Curriculum mapping of outcomes attained

Physics, geography, biology, and chemistry.

Assessment

Survey, Kahoot, test, and written exam.

Materials

Tablet, computer, smart board, textbook, online resources, Google Docs.

Preparation

Preparing questions for the Kahoot quiz and the survey

Teamwork

Understand the benefits of using renewable energy, learn about the harm of fossil fuels to the environment, and can make simple models.
A printable name badge featuring a 21st-century skills occupation is provided for students to wear during work-based scenarios. It is recommended that students rotate roles to experience the skills required for each job role.

Rubrics
Include a scoring guide to evaluate the quality of students' assessment responses. Test 40 Model 20 Presentation 20 Survey 20

TITLE	AFFORDABLE AND CLEAN ENERGY		
AREA OF SCIENCE	Geography, Hydrology, Biology		
TEACHING METHODOLOGY TO BE USED	Discussion, Role play, Sample Lesson Presentation		
GRADE LEVEL	8-9		
AGE OF STUDENTS	13-15		
TOTAL TIME	2,5 hours	**PREPARATION TIME: 30 min**	**TEACHING TIME: 2 hours**
KEY CONCEPTS	Affordable energy, Sustainability, Renewable energy sources		

Overview
Mind map about Affordable and Clean Energy.

Student mission
Students are assigned a project to investigate the reasons for affordable and clean energy and to assess the environmental practices in their school. They are responsible for creating a presentation on how green their school is and proposing ways to make it greener.

21st century technical skills gained through this activity
Productivity, Critical Thinking, Collaboration, Communication

Related job roles
Engineering, Teaching

Differentiation strategies to meet diverse learning needs:
Use of technology, collaboration and cooperation

Time to complete Lesson.
2 hours

Expected Learning Outcomes
By the end of the lesson, students will be able to: • Explain the concept of affordable and clean energy, including its importance and benefits. • Conduct research to investigate the reasons for using affordable and clean energy. • Assess how green their school is by evaluating current environmental practices and energy usage • Create and deliver a presentation that outlines their findings on the school's environmental status and propose actionable steps to enhance its green initiatives. • Analyse their school's current environmental impact and suggest practical solutions for making the school greener

Prior knowledge and vocabulary
SDG 1, SDG2, SDG 3, SDG 4, SDG 5, SDG 6.

Science and Engineering/Math Practices
Conducting experiments and observational studies to understand energy sources and their impact on the environment. Data analysis and interpretation. Application of scientific theories and models. Design Thinking Problem-Solving with Real-world Constraints: Statistical Analysis Quantitative Reasoning

Curriculum Alignment
1. Introduction to Affordable and Clean Energy Sources. 2. Getting to know different energy sources (renewable and non-renewable). 4. Understanding the concept of energy efficiency and sufficiency. 5. Understanding how policies can influence the development of energy production, supply and demand. 6. Understanding how unsustainable energy production effects the Earth. 7. Understanding the need for new and innovative technologies.

Lesson
Engage*:* The teacher asks students about the key words related to affordable energy sources to create a mind map, which helps the students think about the topic and get an idea about the lesson **Materials:** Board, Pen **Preparation:** [2} Minutes **Facilitation of Learning Experience:** [8] Minutes **Transition:** [2] Minutes
Explore*:* The teacher brings two pictures of the environment to the classroom — one depicting a clean environment and the other a polluted one — and asks students questions about these pictures. The teacher's aim is to captivate students' focus on the importance of a clean environment and how to afford energy while maintaining environmental cleanliness. **Materials:** two pictures **Preparation**: [10] Minutes **Facilitation of Learning Experience**: [30] Minutes **Transition:** [2] Minutes
Explain*:* The teacher instructs the students to view a video on the topics of environmental sustainability and cost-effective energy. Subsequently, the teacher prompts students to articulate their viewpoints regarding the video. The teacher inquires whether students require a rewatch of the video. Students are divided into two groups, each advocating for their own stance on the impact of energy generation on the environment. They endeavour to generate innovative concepts for the production of sustainable energy. **Materials:** pencil, paper and computer **Preparation:** [10] Minutes **Facilitation of Learning Experience:** [30] Minutes **Transition**: [2] Minutes
Elaborate: The teacher instructs the two groups to create presentations on the topic of accessible and sustainable energy. Students are expected to apply their prior knowledge in the presentations throughout this phase. The groups prepare their presentations and deliver them to the whole class. By following this approach, students enhance their knowledge and acquire a more profound comprehension of the subject matter. **Materials:** pen, paper, computer, smartboard **Preparation:** [30] Minutes **Facilitation of Learning Experience:** [60] Minutes **Transition:** [2] Minutes
Evaluate: The teacher instructs the students to provide feedback on what they have learned from the class for a formal assessment. Simultaneously, the teacher monitors the students' conduct during the lesson to informally assess their behaviour. **Materials:** pen and paper **Preparation:** [2] Minutes **Facilitation of Learning Experience:** [10] Minutes **Transition: [**2] Minutes

Independent learning tasks (ILT): Students are given two questions to search for:

Students are asked to prepare a multimedia presentation based on the following questions:

- **What could be the affordable energy sources in the future?**
- How can these energy sources be utilised for benefit?

Student feedback

Peer-feedback at the end of the lesson

Curriculum mapping of outcomes attained.

Geography, Biology, Ecology

Assessment

Presentations; teacher and peer feedback

Materials

- Pictures
- Pen
- Paper
- Smartboard

Preparation

Students should be informed about the topic and asked to research specific information.

Team Work

Students work in teams to research the topics and prepare a presentation.

Rubrics

Likert scale (1-5) is used.

TERTIARY LEVEL

Title	Green Washing Dirty Energy
Subject	Active Citizenship
Topic	SDG no.7
Grade Level	N/A
Age of Students	18+ (adult)- group of teachers
Allocated Time	90 mins
Lesson Objective	• Participants will gain knowledge about the current definition of clean energy, which includes nuclear and gas as green energy sources according to the European Commission. The session will explore the environmental impact of these sources and discuss how governments can effectively utilise the European Commission's decision to promote their nuclear and LNG gas agenda, potentially undermining the progress made towards achieving the Sustainable Development Goals. For instance, Slovenia has extended the operation of its first nuclear power station and has plans to construct a second one. Additionally, the Russian-Ukrainian war has had significant consequences in the energy sector. • Discover the drawbacks and limitations of renewable energy sources. • To cultivate critical thinking and enhance critical media literacy abilities, it is essential to engage with a diverse range of sources, including mainstream media as well as environmental activists and civil society.
Expected Outcomes	• Participants will understand the renewable sources of energy, including their advantages and disadvantages, and will develop a critical mindset for evaluating the benefits and shortcomings of transitioning to renewables. They will also identify the factors to consider for achieving a sustainable transition. • Participants will become familiar with non-formal education approaches and methods that enable them to address this controversial issue in the context of learning processes.
Curriculum Alignment	Teacher training

Interdisciplinary Cooperation	The activity integrates biology, chemistry, history, and other disciplines, allowing participants to explore the interconnectedness of these subjects during the activities.
Differentiation Strategies	Teams will consist of participants with diverse knowledge backgrounds, and they will be partnered together. The peer mentoring approach will be utilised to assist them in completing exercises.
Teaching Methodology to Be Used	The group will be split up into teams of participants. They will work within their teams to complete the activities. Each group will carry out a presentation about their viewpoint on renewables and SDG No. 7.
Materials/Tools **Health & Safety**	• Smart Board • Internet connection, Laptop/Mobile phones • Any practical work, which they carry out is in accordance with current regulations related to health and safety
Resources Used	The activities are followed by a self-assessment sheet. The various resources are listed below: • EU moves to label nuclear, gas energy green: https://www.youtube.com/watch?v=qFo-l2OUMeQ, • Did U.S. Bomb Nord Stream Pipeline? https://www.youtube.com/watch?v=I2E-LQUKIHg, • Why nuclear energy is not green? (in Slovene language) https://focus.si/zakaj-jedrska-energija-ni-zelena/, • Imported LNG gas creates 10 times more emissions than Russian piped gas: https://www.dw.com/en/lng-for-germany-uae-delivers-first-shipment/a-64292879, • Europe buying more nuclear fuel from Russia: https://www.youtube.com/watch?v=7eg3p6oDHEY,

Scenario	Teachers in a school will be visited by an NGO representative with expertise in green energy for two workshop lessons. The topic will be combined with that of climate change. The interconnection between these two topics will be explored through the outcomes of the Russian-Ukrainian war, specifically how EU countries switched to imports of non-Russian LNG gas, non-renewable coal, and nuclear energy. Despite Western sanctions, the West continues to purchase Russian gas through third countries and even more nuclear fuel from Russia. Before the workshop, teachers are assigned to conduct research and collect the following data: • What are renewable sources of energy (ODA), and what do they involve? Discuss why they are important and provide some examples. Find out the role of the European Union and Slovenia in transitioning to renewable sources of energy. • How does the transition to renewable sources of energy affect the EU and Slovenia? What are your views on the European Commission's decision to include nuclear and natural gas among green energy sources? How do you view the extended life of the first nuclear power station and plans to build a second one in Slovenia? • Are there any controversies regarding renewable sources of energy? Where and how can waste from renewable energy sources be disposed of?

Learning Teaching Process		
Activity	**Procedure**	**Time**
Introduction/Warm Up	• EU moves to label nuclear, gas energy green https://www.youtube.com/watch?v=qFo-l2OUMeQ, • Europe buying more nuclear fuel from Russia Simple questions and answers: https://www.youtube.com/watch?v=7eg3p6oDHEY,	15 mins
Group Discussion	Discuss the consequences of transitioning to renewable sources of energy in your area, within the EU, and globally. Reflect on the findings shared by participating teachers. Delve into what renewable sources of energy are, including what they encompass, and share your opinion on whether including nuclear energy and natural gas as renewables is the right decision. Also, address the controversies surrounding clean sources of energy, such as solar, hydro, and wind power, and consider whether they have negative impacts on the environment and climate change. Furthermore, discuss the consequences of the Russian-Ukrainian war on the implementation of SDG No. 7.	30 mins

Team work	• Assume the role of an advocate either for maintaining the use of fossil fuels or for transitioning to renewable sources. In the debate, use both pro and contra arguments, highlighting the advantages and disadvantages of both renewables and non-renewables in the current situation. • Explore the reasons why NGOs do not support the classification of nuclear and gas energy as green energy. Discuss what has been learned during the workshop. What would be the most sustainable methods to achieve SDG No. 7	35 mins
Evaluation	• Discuss the learning outcomes of the workshop. • What would be the most sustainable ways to achieve SDG No. 7?	5 mins

TITLE	**Solar and Biomass Project: Promoting Affordable and Clean Energy in Ireland** **SDG 7 - Affordable and Clean Energy**		
AREA OF SCIENCE	Physics, Geography		
TEACHING METHODOLOGY TO BE USED	This module will employ group work exercises in the context of case-study work as the primary teaching methodology. Students will examine case studies to understand the barriers to sustainable energy and will be able to discern the reasons behind these barriers. They will collaborate to comprehend the connections between this SDG and others, as well as the EU Green Deal, and how they mutually influence each other in relation to this topic. Group discussion will be a major component of this lesson, as there is a broad range of opinions and perspectives regarding the topic. Teachers should encourage debate in these group discussions to develop students' critical analysis skills.		
GRADE LEVEL	Tertiary level		
AGE OF STUDENTS	18 + Years		
TOTAL TIME	1 – 2 weeks of class	**PREPARATION TIME:** n/a	**TEACHING TIME:** 5 class sessions
KEY CONCEPTS	Understanding different forms of energy supply and their pros and cons. Understanding the role of various players in the access to renewable energy resources.		

Overview

In this module, students will explore the importance of affordable and clean energy for the achievement of Sustainable Development Goal (SDG) 7. They will learn about the benefits of affordable and clean energy, global energy access disparities, challenges and barriers to achieving universal access, interlinkages with other SDGs, and available technologies and solutions. Through a Solar and Biomass project, students will analyse the potential of renewable energy sources and evaluate their effectiveness, cost, and scalability in promoting sustainable development in Ireland.

Student mission

You are hired by the local Renewable Energy Group to carry out research on the importance of affordable and clean energy. The team consist of four groups and each group is tasked with the following:

- Group 1 takes the lead in researching and writing about the role of affordable and clean energy in promoting sustainable development and reducing poverty. Group 1 explores case studies where energy access has directly impacted communities' economic and social well-being.
- Group 2 focuses on understanding the current global situation regarding access to affordable and clean energy. This group uses global energy reports and datasets to analyse trends and identify regions with significant energy disparities.
- Group 3 tackles the challenges and barriers to achieving universal access to affordable and clean energy. This group conducts interviews with experts and reviews policy papers to understand these obstacles better.
- Group 4 explores the connections between affordable and clean energy and other Sustainable Development Goals (SDGs) like economic development, health, and education. This group creates a visual map showing these interlinkages using data visualization tools.

The four groups collaboratively evaluate various technologies, approaches, and solutions for improving access to affordable and clean energy. They compare traditional and emerging technologies, considering factors like cost, scalability, and environmental impact. The culmination of their project is a comprehensive presentation to local professors. The groups combine their individual research into a cohesive narrative, highlighting the critical role of energy in sustainable development and proposing innovative solutions to the challenges identified.

21st century technical skills gained through this activity.

- Critical thinking,
- Environmental awareness,
- Understanding the role of politics on the environment,
- Economical awareness,
- Problem solving

Related job roles

- Energy Engineer,
- Environmental engineer,
- Environmental Law,
- Politician,
- Civil Servant

Differentiation strategies to meet diverse learning needs:

Hands on learning through practical work, group exercises

Time to complete Lesson.
5 class sessions

Expected Learning Outcomes
• Students will understand the importance of affordable and clean energy in promoting sustainable development and reducing poverty. • Students will comprehend the current global situation regarding access to affordable and clean energy. • Students will analyse the challenges and barriers to achieving universal access to affordable and clean energy. • Students will understand the interlinkages between affordable and clean energy and other SDGs, such as economic development, health, and education. • Students will evaluate the various technologies, approaches, and solutions available for improving access to affordable and clean energy.

Prior knowledge and vocabulary
Understanding of the general terminology around the topic

Science and Engineering/Math Practices
Understanding the different means in which we can generate energy as a resource.

Curriculum Alignment
This module is in alignment with SDG 7 of the European Union

Lesson
Session 1: Importance of Affordable and Clean Energy (Engage, Explore, Explain) • **Engage (10 minutes):** Present a case study highlighting the positive impacts of affordable and clean energy on economic development, health, and education. Discuss the importance of SDG 7 in promoting sustainable development and reducing poverty. • **Explore (20 minutes):** In small groups, students discuss the benefits of affordable and clean energy, such as improved health, increased economic productivity, and reduced environmental degradation. Each group presents their findings to the class.

- **Explain (30 minutes):** Facilitate a class discussion on the interlinkages between affordable and clean energy and other SDGs, such as health, education, and gender equality. Emphasize the significance of energy access in achieving multiple development goals.

Session 2: Global Energy Access Disparities and Current Trends (Engage, Explore, Explain)

- **Engage (10 minutes):** Present data on global access to affordable and clean energy, highlighting disparities between developed and developing countries. Discuss the implications of these disparities.
- **Explore (20 minutes):** Provide students with data on energy consumption and production trends, renewable energy sources, and reliance on fossil fuels. In pairs, students classify the data and identify patterns and trends.
- **Explain (30 minutes):** Lead a class discussion on the current status of energy access in different regions of the world. Address the challenges, opportunities, and potential strategies for increasing access to affordable and clean energy.

Session 3: Challenges and Barriers to Universal Energy Access (Engage, Explore, Explain)

- **Engage (10 minutes):** Present various challenges and barriers to increasing access to affordable and clean energy, such as lack of infrastructure, limited resources, and lack of political will. Discuss the implications of these challenges.
- **Explore (20 minutes):** In small groups, students examine the economic, social, and political factors contributing to the lack of energy access in different regions of the world. They identify specific case studies and examples.
- **Explain (30 minutes):** Facilitate a class discussion on potential solutions and approaches for overcoming these challenges and barriers. Encourage students to consider technological innovations, policy changes, and community-based initiatives.

Session 4: Interlinkages with Other SDGs (Engage, Explore, Explain)

- **Engage (10 minutes):** Discuss the relationship between access to affordable and clean energy and economic development, health, and education. Highlight the positive and negative impacts of energy access on these SDGs.

- **Explore (20 minutes):** In small groups, students examine case studies and research articles that demonstrate the interlinkages between affordable and clean energy and other SDGs. They identify specific examples of how energy access influences economic development, health outcomes, and educational opportunities.

- **Explain (30 minutes):** Facilitate a class discussion on the potential strategies for leveraging the interlinkages between affordable and clean energy and other SDGs to achieve sustainable development. Encourage students to think critically about how addressing energy access can have a ripple effect on other development goals.

Session 5: Evaluating Technologies for Affordable and Clean Energy (Engage, Explore, Explain)

- **Engage (10 minutes):** Engage students in a discussion about the various technologies, approaches, and solutions available for increasing access to affordable and clean energy. Discuss renewable energy sources, energy efficiency measures, and energy access programs.

- **Explore (20 minutes):** Provide students with information on different technologies and their strengths, limitations, effectiveness, cost, and scalability. In pairs or small groups, students summarise the key points and prepare to share their findings.

- **Explain (30 minutes):** Students present their summaries, highlighting the strengths and limitations of the technologies discussed. Facilitate a class discussion on the importance of considering local contexts and tailoring solutions to specific communities. Discuss the potential of these technologies, approaches, and solutions to contribute to sustainable development and reduce poverty.

Independent learning tasks (ILT):

- Students must think critically within group discussions around the topic, improving their problem solving and debating abilities.
- Students must work among themselves to brainstorm ideas.
- Students must consider the external factors politically and socially in the way of improving energy supplies

Student feedback

Students will have feedback in the form of group representations to the class when reviewing case studies, as well as the results of the research paper.

Curriculum mapping of outcomes attained.

The knowledge gained in this lesson can be mapped against Geography, Politics, Economics and Physics.

Assessment

- Class participation and engagement during discussions and activities.
- Group presentations on the interlinkages between affordable and clean energy and other SDGs.
- Written reflections or research papers analysing case studies and proposing solutions for increasing energy access.
- Evaluation of the strengths and limitations of technologies for affordable and clean energy.

Materials

- Presentation slides or visual aids
- Case studies and research articles on energy access disparities, challenges, and solutions
- Data on global energy consumption, production, and renewable energy trends
- Handouts or digital resources on technologies for affordable and clean energy

- Assessment materials (reflection prompts, research paper guidelines)

Preparation

- Encourage students to explore local renewable energy initiatives and projects in Ireland as part of their research and reflection activities.
- Consider inviting guest speakers from relevant organisations or renewable energy companies to share their expertise and experiences with the students.
- Field trips to renewable energy installations or community energy projects can provide hands-on learning opportunities and enrich the students' understanding of sustainable energy practices.

Teamwork

Students will work in groups

Rubrics

Likert scale (1-5) is used.

TITLE	**The danger of keep on going fossil. What is the current status of energy access?**		
AREA OF SCIENCE	Environmental Engineering		
TEACHING METHODOLOGY TO BE USED	The lesson is divided in two periods of 90 minutes + 90 minutes. The first period will be theoretical exploration. In the second period the class will be split up into teams consisting of three to five students. They will work within their teams to complete the activities. Each group will carry out a presentation to justify their conclusions.		
GRADE LEVEL	University Level - Graduation		
AGE OF STUDENTS	18+		
TOTAL TIME	180 minutes	**PREPARATION TIME: 10**	**TEACHING TIME:** 170
KEY CONCEPTS	Fossil fuels; Pollutant; Concentration; Greenhouse gases; Carbon Cycle; Clean Energy; Decarbonisation; Data Analysis		

Overview

Human society is dependent upon a continuous flow of energy. Most of the energy consumed by humans comes from fossil fuels. However, almost 60% of oil and gas reserves and 90% of coal must remain in the ground to keep global warming below 1.5C.
Thus, it is important to understand the current status of energy access.

Student mission

You are an environmental engineer working in a government and you need to understand the fundamental shifts necessary to decarbonise the economy: decarbonising the world's power supply; switching to electricity and other low-carbon fuels in the transportation, industry, and buildings sectors; increasing energy efficiency in each of these sectors; increasing carbon sequestration; and reducing non-carbon climate pollutants such as methane.

21st century technical skills gained through this activity

- Problem Solving
- Practical analysis
- Critical thinking
- Drawing conclusions based on fact
- Inquiry based learning
- Computational Thinking

Related job roles

- Environmental Engineering
- Biologist
- Environmental technician

Differentiation strategies to meet diverse learning needs:

Students of different abilities will be paired together in teams; peer mentoring method will be employed to help less able students to complete activities.

Time to complete Lesson

Two 90 minutes periods (If your lessons are shorter or longer, you can either break this sequence into more lessons or less).

Expected Learning Outcomes

- Students will understand several concepts and definitions link to the fossil fuel consumption.
- Students will comprehend the importance of transitioning to cleaner energy
- Students will be able to identify the main sources of renewable energy
- Students will understand how fossil fuels affects us and the environment
- Students will understand how to perform data analysis

Prior knowledge and vocabulary

Carbon cycle, ecosystems, biosphere, basic concepts on physics, chemistry, biology and mathematics.

Science and Engineering/Math Practices

Provide students with the STEAM model for a real-life example of renewable energies.

Curriculum Alignment

- The origin of fossil fuels
- Human use of fossil fuels
- Why we must stop burning fossil fuels
- An overview of the current global energy situation
- Alternative energy sources and energy conservation

Lesson

Engage: Students are given a video link prior to the class. Students will look at the video at home and complete an online quiz relating to the video.

Materials: Computer, Projector, Video *link, online quiz*
Preparation: [2] Minutes
Facilitation of Learning Experience: [5] Minutes
Transition: [2] Minutes
Teacher will: summarises the concepts of the video and provide the quiz solutions
Students will: listen and take notes
Before the first period watch the video: https://www.youtube.com/watch?v=IaqAyc_Q9mM

Explore: During the exploration phase, students actively explore the new concept through concrete learning experiences. Relating to the video, they will form their own questions and ideas, which will be prompted by the teacher through scenario-based exercises during the lesson. The idea of asking and answering questions, formulating ideas will give the student a better understanding of the real-life solutions towards problems they will be solving.

Materials: No need for materials
Preparation: [2] Minutes
Facilitation of Learning Experience: [10] Minutes
Transition: [2] Minutes
Teacher will: facilitate the discussion
Students will: ask questions in the form of hypothesis. At the same time, they will take notes

Explain: This is a teacher-led phase that helps students synthesise new knowledge and ask questions if they need further clarification. With the use of a PowerPoint presentation the teacher will explain the:

- The origin of fossil fuels;
- Human use of fossil fuels;
- Why we must stop burning fossil fuels;
- An overview of the current global energy situation;
- Alternative energy sources and energy conservation.

The teacher will implement activities during explanation.

Materials: Computer with PowerPoint, projector
Preparation: [2] Minutes
Facilitation of Learning Experience: [60] Minutes
Transition: [2] Minutes
Teacher will: further explain the theory behind the energy situation

Students will: listen intently, take notes, ask questions and participate in the activities

Elaborate: In the beginning of the second period students are asked to work in groups and research the topic in more detail. They will be presented with a practical exercise that they have to analyse and answer.

Materials: computer with excel, word and PowerPoint
Preparation: [2] Minutes
Facilitation of Learning Experience: [30] Minutes
Transition: [1] Minutes
Teacher will: present and explain the exercise
Students will: resolve the exercise using the knowledge apprehended before

Evaluate: Students will then prepare a short presentation and teach the class about the main results of the exercise.

Materials: computer with PowerPoint and projector
Preparation: [2] Minutes
Facilitation of Learning Experience: [60] Minutes
Transition: [] Minutes
Teacher will: Evaluate the presentations given by the students on what they found
Students will: Present to the class and will answer relevant questions by the teacher to assess their level of understanding.

Independent learning tasks (ILT):

- Students will watch the video links given to them by the teacher to enhance their knowledge and complete the related quizzes.
- Students will research real life applications of what they have learned within the classroom.
- Students will work in groups to prepare presentations and to present them to their class
- Students will apply data analysis in a real-life situation
- Students will answer post class questions

Student feedback

Students will be given feedback on a one-to-one basis in a timely manner. The feedback will reference the skills outcomes that the assessment was designed to test and if the student met those outcomes. It will also take into account feedback from the student on how they found the lesson.

Curriculum mapping of outcomes attained

The knowledge gained in this lesson can be mapped against chemistry, biology, physics, mathematics curricula.

Assessment

Practical, student presentation, time bound assessment and Q&A.

Materials

- Computers
- Projector
- Excel
- Word
- PowerPoint

Preparation

Students should look at the video link provided and complete the online quiz. They should also attempt questions in their notes, Q&A should be conducted by the teacher to ascertain if the students understand the concepts before starting the exercise.

Team Work

Students will work in teams to research the topics and prepare a presentation for the class regarding the practical exercise. This is an extension of the knowledge base, where students have to research more about environmental problems.

Rubrics

Assessment of:

- Autonomy
- Understanding of the associated concepts
- The link between the concepts
- Interdisciplinarity between the STEAM areas
- Problem solving capacity (computational thinking)

SDG 12
RESPONSIBLE CONSUMPTION AND PRODUCTION

PRIMARY SCHOOL LEVEL

Title	Responsible consumption and production (SDG 12)
Subject	Science
Topic	The life cycle of t-shirts
Grade Level	School year 1-6
Age of Students	6-12
Allocated Time	75 min
Lesson Objective	Describe the life cycle of the t-shirts
Expected Outcomes	Be able to describe the life cycle of t-shirts, from cotton production to the finished t-shirts in the store. Have knowledge of, and provide some suggestions for, what to do with clothes that have not been used for a long time instead of throwing them away.
Curriculum Alignment	One of the key missions of preschools and schools is to help children and students understand the meaning of social, economic, and ecologically sustainable development. The teaching should provide tools that enable everyone to live and work sustainably. Sustainable Development from the Swedish curriculum
Interdisciplinary Cooperation	Science
Differentiation Strategies	Discussions regarding the video.
Teaching Methodology to Be Used	Video discussion using name sticks. Working in pairs on the task concerning the life cycle of t-shirts, depicted on paper. The students will create their own life cycle diagrams for a t-shirt or other clothing item. Presentation of the life cycles to the entire class.

Materials/Tools **Health & Safety**	Create a collage on paper where students use their knowledge to illustrate the t-shirt's life cycle.
Resources Used	E.Ferntoft, S.Ecim, I.Teiner, S.Stenvall, U.Moser & AS.Hagberg, 2023.
Scenario	You need a new T-shirt and have to choose between two options: one expensive and one cheap. Which one would you pick? Prepare questions for the staff at the clothing factory regarding the t-shirt manufacturing process.

Learning Teaching Process		
Activity	**Procedure**	**Time**
Introduction	Prepare questions for the staff at the clothing factory about the t-shirt manufacturing process.	5min
Video + keywords: life cycle	Show the video: https://www.youtube.com/watch?v=BiSYoeqb_VY Explain the word life cycle.	15 min
Creating an own clothing life cycle	 Students will create a life cycle of clothing similar to the example provided above.	30 min
Presentation	Discussion: Allow students to reformulate one question based on the knowledge they have acquired.	25min
Assessment	Do a presentation about the life cycle and formulate a new question with the new knowledge from the lesson.	

SECONDARY SCHOOL LEVEL

TITLE	The effects of recycling on reducing pollution		
AREA OF SCIENCE	English language teaching, Technology, Science		
TEACHING METHODOLOGY TO BE USED	The teaching methodology employed will be student-centred/project-based, prioritising the active involvement of students in the design, execution, and evaluation of their learning. The students will engage in exercises focused on the vocabulary related to recycling, responsible consumption, and manufacturing, which are the key terms covered in this subject. These exercises will take up two lecture periods. The learners also engage in tasks that involve acquiring knowledge, conducting research, engaging in critical thinking, evaluating, analysing, making decisions, and collaborating.		
GRADE LEVEL	8th grade students		
AGE OF STUDENTS	13 years		
TOTAL TIME	1 hour 20 mins	PREPARATION TIME: 50 mins	TEACHING TIME: 30 mins
KEY CONCEPTS	Introduction of the new vocabulary of the unit's topic, recycling. The lesson commences with extracting concepts of ethical consumption and production through web2 tools such as Mentimeter, Canva, and PowerPoint. Employing 21st-century skills enables students to effectively communicate their ideas. The learners will be involved in solving real-life problems, and the projects will facilitate the development of their abilities in areas such as research and problem-solving, particularly in real-world contexts. Therefore, students will enhance their knowledge by inquiring, examining, collaborating, engaging with others, and contemplating upon these encounters.		

Overview
Introduction to the lesson (5 min) The teacher asks questions such as: • 'What does pollution mean?' • 'What does pollutant mean?' • 'How can we protect and preserve our environment?' • 'How was our city planned in the past, and how could it be planned in the future?' This will be done by eliciting ideas from the students via Menti. The key stages will be carried out to develop knowledge, understanding, and solutions for this real-life problem.

Student mission

As a group, you are responsible for creating slogans that highlight environmental damage and raise awareness about the potential for action in environmental protection and conservation. Focus on the possible harm and effects of air, water, and soil pollution, and explore ways of reusing and recycling materials. Additionally, you must write a letter to the town council and attend a meeting to express your opinions as part of the project.

21st century technical skills gained through this activity

- Problem solving
- Collaborating
- Cooperating
- Critical thinking
- Drawing conclusions based on fact

Related job roles

- Reporter
- Project creator
- Journalist

Differentiation strategies to meet diverse learning needs:

Solving real-life problems, collaborating, cooperating

Time to complete Lesson

Two lesson time (1 hour 20 min.)

Expected Learning Outcomes

Introduction to the vocabulary of the unit 'Environment', focusing on recycling, reusing, and pollution.

- Creating slogans.
- Writing a letter to the town council.
- Expressing ideas on a radio channel.

Prior knowledge and vocabulary

- Reusing
- Recycling
- Pollution

Science and Engineering/Math Practices

Creating slogans for real life problems to raise learners' awareness about environment and the importance of recycling.

Curriculum Alignment

- To explain terms such as 'pollution' and 'pollutant'.
- To be able to make responsible and informed decisions about the environment, consumption, and production.
- To find ways of reusing and recycling materials.
- To create slogans.
- To write a letter.
- To publicly express their opinions.
- To identify problems related to consumption and production and the potential dangers they pose to human life in the future.

Lesson

Engage: The teacher asks students questions such as, 'What does pollution mean?' 'What does pollutant mean?' 'How can we protect and preserve our environment?' and 'How was our city planned in the past, and how could it be planned in the future?' to elicit ideas via Menti. After raising awareness about the topic, the teacher introduces some pictures or flashcards related to key words of the topic, like recycling, reusing, air pollution, soil pollution and so on.

Materials: Menti, flashcards
Preparation: [15] Minutes
Facilitation of Learning Experience: [10] Minutes
Transition: [5] Minutes
Teacher will: lead using web-2 tool (Menti)*, ask questions*
Students will: answer questions, share ideas, express their opinions, listen intently

Explore: During the exploration phase, students actively explore the new concept through concrete learning experiences. This phase allows students to learn in a hands-on way.

Materials: paper, coloured pens, laptops, PCs
Preparation: [15] Minutes
Facilitation of Learning Experience: [10] Minutes
Transition: [5] Minutes
Teacher will: First, facilitate understanding of the topic, then divide the class into groups. Lead the students to create slogans or brochures using Canva, or if they prefer, they can also use pen and paper for this task.
Students will: Collaboratively create slogans; Cooperate with each other; Use the web 2.0 tool Canva for designing their slogans.

Explain: The teacher will play a video about the importance of recycling materials to enhance understanding. Then, the teacher will assign students topics such as air pollution, soil pollution, water pollution, recycling, etc. The students will work on these topics to prepare a presentation, discuss the issues, and find solutions related to the given topic.

Materials: smart board, Pcs, laptops, PowerPoint
Preparation: [20] Minutes
Facilitation of Learning Experience: [10] Minutes
Transition: [10] Minutes
Teacher will: Enhance the students' understanding through a video, then divide the class into groups. Have them prepare a PowerPoint presentation to find solutions, share their ideas about their topic, and emphasise the importance of responsible consumption and production.
Students will: Watch the video and then apply their ideas and knowledge by preparing a presentation. This presentation will include their own ideas and solutions about pollution, recycling, reusing materials, and responsible consumption and production.
Present their slides as a group to the rest of the class."
The video link: https://youtu.be/RX2elsVjY-c

Elaborate: The teacher asks the learners to write a letter to the town council about responsible consumption and production. Learners can collaborate in small groups or pairs. They will discuss their findings and apply their acquired knowledge. Through peer-assisted learning, they can write the letter collaboratively, sharing and discussing their findings and ideas.
Materials: pen and paper
Preparation: [20] Minutes
Facilitation of Learning Experience: [19 Minutes
Transition: [1] Minutes
Teacher will: Lead students to write a letter about responsible consumption and production to the town council and observe the groups during the task.
Students will:

- Share and express their ideas,
- Work collaboratively,
- Find solutions to real-life problems.

Evaluate: After the presentations, students will suggest ideas to the other groups regarding their topics. The teacher will facilitate this by writing each group's topic on the board and encouraging learners to stick post-its with their suggestions and questions on the board related to these topics. After viewing the questions on the post-its, the class will discuss the topics collectively and share their opinions together.

Materials: post-its, pens
Preparation: [10] Minutes
Facilitation of Learning Experience: [8] Minutes
Transition: [2] Minutes
Teacher will: Direct students to share ideas, brainstorm and ask questions.
Students will: Find solutions to real life problems, brainstorm and ask the other groups about their topics.

Independent learning tasks (ILT):

Students will visit recycling centres and write their observations after the visit. They will also create an informative video about their topic.

Student feedback

Strategies for student feedback within the lesson will include the use of colourful cards (yellow, red, and green). If students understand the lesson very well and enjoyed the topic, they will raise the green card. If they are unsure about the lesson, they will raise the yellow one. If the learners need more practice or do not understand the lesson, they will raise the red card. This method is also an effective way to assess how confident the students are in their understanding and allows them to self-assess.

Curriculum mapping of outcomes attained

- Language Arts and Literacy Standards: Reading Comprehension; Writing and Communication.
- Critical Thinking and Analysis: Aligning with language arts standards on argumentation and evidence-based reasoning.
- Research Skills
- Collaboration and Teamwork
- Speaking and Listening Skills
- Media and Technology Literacy: Using digital tools like Canva and video editing software for creating presentations and videos, which integrates technology literacy objectives.
- Global and Environmental Awareness
- SEL (Social-Emotional Learning) Competencies: Developing self-awareness and self-assessment skills through activities like the colour card feedback system.
- 21st-Century Skills: Encouraging creativity in slogan creation and video production, aligning with curriculum goals on innovation and creativity.

Assessment

Student presentations and diagnostic assessments will be used to gauge student knowledge and engage the whole classroom. This will be facilitated through student reflections and classroom discussions.

Materials

- Menti
- Canva
- PowerPoint
- Video (YouTube)

Preparation

Students should review the vocabulary related to the unit. They should also take notes and prepare questions before the lesson.

Teamwork

Provide a printable name badge featuring a 21st-century skills occupation for students to wear during work-based scenarios. It is recommended that students rotate roles to experience the skills required for each job.
Students will work in groups or pairs collaboratively, which will enhance their teamwork skills and team spirit, teach them to respect others' ideas, and enable discussion of their own ideas.
Through researching and creating slogans, students will also develop their creativity.

Rubrics

Holistic rubrics combine various criteria into a single score level. When teachers provide more options to students, it creates greater opportunities for problem-based learning and independent learning.

TERTIARY LEVEL

Title	**Changing Habits to Save the Rainforest**
Subject	Geography
Topic	Active Citizenship
Grade Level	SDG no.12 Responsible Consumption and Production
Age of Students	18+ adults (a group of teachers)
Allocated Time	90 mins
Lesson Objective	• Participants will learn about responsible consumption and production, as well as the role of consumer preferences in the destruction of nature. The sustainable living and production practices of Amazon communities will be contrasted with the activities of large cattle farms, soy production, and gold mining in the Amazon, which destroy nature and the livelihoods of local indigenous communities. • How to raise awareness as a consumer and change habits and consumer priorities
Expected Outcomes	Participants will understand that responsible consumption and production greatly impact both us and our environment. They will learn to distinguish between sustainable and unsustainable habits and will begin to change their consumption habits, seeking products produced without harming nature.
Curriculum Alignment	Teacher training

Interdisciplinary Cooperation	The activity combines elements of Sociology, History, Biology, and other disciplines, as participants will learn about their interconnections while carrying out the activities.
Differentiation Strategies	Participants with diverse knowledge backgrounds will be paired together in teams, and the peer mentoring method will be employed to help them complete the activities.
Teaching Methodology to Be Used	The group will be split up into teams of participants. They will work within their teams to complete the activities. Each group will then present on practices of responsible production and consumption.
Materials/Tools **Health & Safety**	Smart Board Internet connection, Laptop/Mobile phones, Any practical work, which participants carry out is in accordance with current regulations related to health and safety.
Resources Used	The activities are followed by self-assessment. The various resources are listed below: • Alice Pataxo in Slovenia: https://365.rtvslo.si/arhiv/odmevi/174878611, • Trailer of the Territory movie: https://www.imdb.com/title/tt16378164/, • Blog about the situation in Bolivian Amazon: https://focus.si/med-neposredno-demokracijo-agrozivilskimi-multinacionalkami-in-skupnostnim-ekoturizmom/,
Scenario	Teachers at a school will be visited by an NGO representative knowledgeable about the topic of Responsible Consumption and Production for two workshop lessons. The topic will be integrated with a pro et contra activity designed to stimulate creativity in defending or advocating one's position, and on the other hand, in using critical thinking and critical media literacy skills. Before the workshop, teachers are assigned to conduct research and collect the following data: • What is Responsible Consumption, and what does it involve? • What is Responsible Production, and what does it involve? Discuss why they are important and gather some examples. Investigate the role of the European Union and Slovenia in promoting responsible consumption and production. • Discuss the impact of intensive industrial farming, especially in the tropical rainforest region. Consider whether cattle ranching and soy plantations are beneficial for the environment and local indigenous people. Based on their findings, groups are required to prepare short presentations for the workshop. The NGO representative will ensure that these findings are discussed during the workshop.

Learning Teaching Process		
Activity	**Procedure**	**Time**
Introduction / Warm Up	Alice Pataxo, Brazilian indigenous activist's visit to Slovenia: https://365.rtvslo.si/arhiv/odmevi/174878611	10 mins
Group discussion and team work	Discuss the impact of responsible consumption and production, and their consequences in your area, in the EU, and globally. Reflect on the findings of participating teachers. Begin with the preparation for a pro et contra activity. Divide the participating teachers into two groups. One group will represent local indigenous communities in the tropical rainforest who live sustainably, practicing responsible production and consumption. The other group will represent ranchers, businessmen, and settlers who aim to clear the rainforest for cattle pastures, soy plantations, and gold mining. Both groups will prepare arguments to advocate for their respective stances.	35 mins
Each group speaks about their arguments. Group discussion and team work. Various opinions are presented.	Each group presents their arguments, facilitating group discussion and teamwork. Various opinions are shared. The activity culminates in advocating these arguments in a simulated court setting. Participants are divided into two groups: the pro and contra groups. One group represents the local indigenous community fighting for their sustainable way of life, which includes practices like wild harvesting and organic tropical forest gardening. The other group represents big cattle ranchers and soy producers, backed by powerful local politicians, multinationals, and settlers.	30 mins
Conclusion	Discussion about the arguments presented by each group will follow. A participant in the role of the judge will decide the outcome of the dispute.	5 mins
Assessment	• Assessment of the workshop • Homework for Teachers to prepare similar lesson plan.	10 mins

TITLE	**Circular Economy as the new way to reinforce the need for responsible production and consumption**		
AREA OF SCIENCE	Environmental Engineering		
TEACHING METHODOLOGY TO BE USED	The lesson is divided in two periods of 90 minutes + 90 minutes. The first period will be theoretical exploration. In the second period the class will be split up into teams consisting of three to five students. They will work within their teams to complete the activities. Each group will carry out a presentation to justify their conclusions.		
GRADE LEVEL	University Level - Graduation		
AGE OF STUDENTS	18+		
TOTAL TIME	180 minutes	**PREPARATION TIME: 10**	**TEACHING TIME:** 170
KEY CONCEPTS	Linear Economy; Circular Economy; Material Flow Management; Waste; Sustainable Production; Sustainable Consumption; Data Analysis		

Overview

Today, economic growth is primarily contingent on increased resource consumption. In this linear economic approach, organisations harvest or extract materials, use them to create products, and then sell those products to consumers who generally incinerate or send to landfill the materials that no longer serve their original purpose. As the population grows and the negative environmental impact of resource extraction continues, this "take, make, waste" model is quickly reaching its limits.

Circular economy is a new production and consumption model that ensures sustainable growth over time. With the circular economy, we can drive the optimisation of resources, reduce the consumption of raw materials, and recover waste by recycling or giving it a second life as a new product.

Student mission

You are an environmental engineer working in a government and you need to understand the fundamental shifts necessary to have responsible production and consumption.

21st century technical skills gained through this activity

- Problem Solving
- Practical analysis
- Critical thinking
- Drawing conclusions based on fact
- Inquiry based learning
- Computational Thinking

Related job roles

- Environmental Engineering
- Biologist
- Environmental technician

Differentiation strategies to meet diverse learning needs:

Students of different abilities will be paired together in teams; peer mentoring method will be employed to help less able students to complete activities.

Time to complete Lesson

Two 90 minutes periods (If your lessons are shorter or longer, you can either break this sequence into more lessons or less).

Expected Learning Outcomes

- Students will understand several concepts and definitions linked to the linear economy.
- Students will understand how an irresponsible production and consumption affects us and the environment
- Students will comprehend the importance of transitioning to a more circular economy
- Students will be able to identify the main strategies of circularity
- Students will understand how to perform data analysis

Prior knowledge and vocabulary

Sustainability, ecosystems, biosphere, basic concepts on physics, chemistry, biology and mathematics.

Science and Engineering/Math Practices

Provide students with the STEAM model for a real-life example of circular economy.

Curriculum Alignment

- The pitfalls of linear economy and the traditional business models
- The origins and fundamentals of the circular economy. A framework to understand the circular economy
- The practical application of the circular economy in a responsible production and consumption way
- Benefits expected from a transition to circular economy

Lesson

Engage: Provide a link for online participation in Word Clouds and challenge the students to come up with ideas on the topic. The words chosen by the students will be projected onto a smart board or TV

Materials: Computer, Projector*, online word clouds (Mentimeter)*
Preparation: [2] Minutes
Facilitation of Learning Experience: [10] Minutes
Transition: [2] Minutes
Teacher will: Introduce the topic and ask students to in a word what they mean by circular economy
Students will: choose a word or words that define the theme and write it in Menti.

Explore: Watch the video and the challenge will be issued to the students.
Challenge:

1. Identify a problem based on the video.
2. Find a solution, taking into consideration both the biological cycle and the technical cycle.

Link to video: https://www.youtube.com/watch?v=zCRKvDyyHml&t=51s

In relation to the video, students will form their own ideas, which will prompt critical thinking in groups. By drawing solutions based on facts, students will gain a better understanding of real-life solutions to the problems they will be addressing.

Materials: Computer, Projector
Preparation: [2] Minutes
Facilitation of Learning Experience: [30] Minutes
Transition: [2] Minutes
Teacher will: facilitate the discussion
Students will: identify problems and find solution

Explain: With the use of a PowerPoint presentation the teacher will explain the:

- The pitfalls of linear economy and the traditional business models;
- The origins and fundamentals of circular economy. A framework to understand the circular economy;
- The practical application of the circular economy in a responsible production and consumption way;
- The benefits expected from a transition to circular economy.

Materials: Computer with PowerPoint, projector
Preparation: [2] Minutes
Facilitation of Learning Experience: [40] Minutes
Transition: [2] Minutes

Teacher will: further explain the theory regarding responsible production and consumption
Students will: listen intently, take notes, ask questions and participate in the activities

Elaborate: In the beginning of the second period students are asked to work in groups and analyse the works of the other groups.
Phases of group work:

1) Choose the group that will do analysis of another group's work;
2) Each group will do the analysis using the technique PMI - Plus, Minus, Interesting
3) At the end, each group will present their analysis

Materials: paper
Preparation: [2] Minutes
Facilitation of Learning Experience: [25] Minutes
Transition: [1] Minutes
Teacher will: present and explain the activity
Students will: complete the activity using the knowledge apprehended before

Evaluate: Through Mentimeter, students simultaneously answer various types of open and closed questions, including multiple-choice questions. The students respond and participate in the subjects with which they are most comfortable. During this time, teachers encourage those who are less inclined to answer and analyse what has been learned. Teachers should use this stage to reinforce points that have not been fully understood, adding examples and facts to help students comprehend the concepts and their relevance to real life.

Materials: computer with PowerPoint and projector
Preparation: [2] Minutes
Facilitation of Learning Experience: [60] Minutes
Transition: [] Minutes
Teacher will: Evaluate the presentations given by students.
Students will: Present to the class and will answer relevant questions by the teacher to assess their level of understanding.

Independent learning tasks (ILT):

- Students will watch the video links given to them by the teacher to enhance their knowledge and complete the related quizzes.
- Students will research real life applications of what they have learned within the classroom.
- Students will work in groups to prepare presentations and to present them to their class
- Students will apply data analysis in a real-life situation
- Students will answer post class questions

Student feedback

Students will be given feedback on a one-to-one basis in a timely manner. The feedback will reference the skills outcomes that the assessment was designed to test and if the student met those outcomes. It will also take into account feedback from the student on how they found the lesson.

Curriculum mapping of outcomes attained

The knowledge gained in this lesson can be mapped against chemistry, biology, physics, mathematics curricula.

Assessment

Practical, student presentation, time bound assessment and Q&A.

Materials

- Computers
- Projector
- Excel
- Word
- PowerPoint

Preparation

Students should look at the video link provided and complete the online quiz. They should also attempt questions in their notes, Q&A should be conducted by the teacher to ascertain if the students understand the concepts before starting the exercise.

Teamwork

Students will work in teams to research the topics and prepare a presentation for the class regarding the practical exercise. This is an extension of the knowledge base, where students must research more about environmental problems.

Rubrics

Assessment of:

- Autonomy
- Understanding of the associated concepts
- The link between the concepts
- Interdisciplinarity between the STEAM areas
- Problem solving capacity (computational thinking)

TITLE	Integrating Sustainable Development Principles into Education and Promoting Sustainable Consumption in Ireland		
AREA OF SCIENCE	Geography, Economy		
TEACHING METHODOLOGY TO BE USED	This module will deploy group work exercises as the primary teaching methodology.		
GRADE LEVEL	Tertiary level		
AGE OF STUDENTS	18 + Years		
TOTAL TIME	1 – 2 weeks of class	**PREPARATION TIME:** n/a	**TEACHING TIME:** 5 class sessions
KEY CONCEPTS	Understanding what SDGs are and the linkage between them, and how they affect the other. Understanding what we can do to help actualise them in Ireland.		

Overview

In this module, students will explore the concept of sustainable consumption and production (SCP) and its linkages to other SDGs. They will analyse the impacts of unsustainable consumption and production, evaluate sustainable consumption and production technologies and approaches, understand the importance of consumer behaviour, and apply skills in sustainable consumption and production strategies. Through projects and discussions, students will learn how to integrate sustainable development principles into education and promote responsible consumption and production in the context of Ireland.

Student mission

A local company, GreenTech Innovations, is looking to transition towards more sustainable practices. They have approached the university's Sustainable Development course for help. The students in the course are tasked with acting as sustainability consultants for this project. You are part of a consultancy team and your team's mission is to guide the company through the process of adopting sustainable practices in their operations. Your consultancy project will involve the following:

- Initial Assessment: Conduct an audit of GreenTech Innovations' current practices to understand their environmental impact. Identify the main areas where improvements can be made in terms of sustainable consumption and production.
- Understanding Interconnections with SDGs: Analyse how making changes in the company's practices can contribute to various Sustainable Development Goals. Prepare a

report showing these linkages and the potential impact of sustainable practices on broader social and environmental goals.

- Technology and Strategy Recommendations: Research and propose technologies and approaches that GreenTech Innovations can adopt. This might include innovations in energy efficiency, waste reduction, and sustainable supply chain management.
- Consumer Behaviour Analysis: Develop a survey or study to understand the consumer base of GreenTech Innovations. How can the company encourage its customers to adopt sustainable practices? What consumer behaviours should the company be aware of to promote sustainability?
- Strategic Plan Development: Create a comprehensive sustainable consumption and production strategy for GreenTech Innovations. This plan should include short-term and long-term goals, detailed recommendations, and a roadmap for implementation.
- Presentation to GreenTech Innovations: At the end of the project, your team will present the strategic plan to the management of GreenTech Innovations. This presentation should convincingly argue for the adoption of your recommendations and demonstrate the potential benefits.

21st century technical skills gained through this activity.

- Critical thinking,
- Awareness of Consumption,
- Economical awareness,
- Problem solving

Related job roles

- Environmental engineer,
- Conservationist,
- Environmental Law,
- Politician,
- Civil Servant,
- Educator

Differentiation strategies to meet diverse learning needs:

Hands on learning through practical work, group exercises

Time to complete Lesson.

5 class sessions

Expected Learning Outcomes

- Students will understand the concept of sustainable consumption and production, including its principles, drivers, and challenges.
- Students will evaluate the linkages between sustainable consumption and production and other SDGs.
- Students will analyse sustainable consumption and production technologies and approaches.
- Students will understand the importance of consumer behaviour in promoting sustainable consumption and production.
- Students will apply skills in sustainable consumption and production strategies.

Prior knowledge and vocabulary

Understanding of the general terminology around the topic

Science and Engineering/Math Practices

N/A

Curriculum Alignment

This module is in alignment with SDG 12 of the European Union

Lesson

Session 1: Impacts of Unsustainable Consumption and Production (Engage, Explore, Explain)

- **Engage (10 minutes):** Present examples and case studies highlighting the negative impacts of unsustainable consumption and production. Discuss environmental degradation, loss of natural resources, and social and economic inequality.
- **Explore (20 minutes):** In small groups, students discuss and share their insights on the negative impacts and consequences of unsustainable consumption and production. They present their findings to the class.
- **Explain (30 minutes):** Facilitate a class discussion on the importance of addressing unsustainable consumption and production for achieving sustainable development. Emphasise the need to consider the environmental, social, and economic aspects of SCP.

Session 2: Linkages between Sustainable Consumption and Production and Other SDGs (Engage, Explore, Explain)

- **Engage (10 minutes):** Discuss the interlinkages between sustainable consumption and production and other SDGs, such as SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 13 (Climate Action). Highlight the importance of considering these linkages in the context of sustainable development.

- **Explore (20 minutes):** In small groups, students examine specific examples that demonstrate the linkages between sustainable consumption and production and other SDGs. They analyse how SCP impacts poverty reduction, food security, and climate action.

- **Explain (30 minutes):** Lead a class discussion to summarise the positive and negative impacts of SCP on other SDGs. Encourage students to think critically about the complexities and trade-offs involved in promoting responsible consumption and production.

Session 3: Sustainable Consumption and Production Technologies and Approaches (Engage, Explore, Explain)

- **Engage (10 minutes):** Present the concept of sustainable consumption and production technologies and approaches, such as circular economy, sustainable materials management, and green procurement. Discuss their relevance to promote SCP.

- **Explore (20 minutes):** In small groups, students categorise the various technologies and approaches available for promoting sustainable consumption and production. They identify specific examples and discuss their strengths and weaknesses.

- **Explain (30 minutes):** Facilitate a class discussion to compare and contrast the different technologies and approaches. Highlight their similarities, differences, and potential for reducing environmental impacts and promoting sustainability.

Session 4: Importance of Consumer Behaviour (Engage, Explore, Explain)

- **Engage (10 minutes):** Summarise the importance of consumer behaviour in promoting sustainable consumption and production. Discuss the role of individual and collective action in driving change.

- **Explore (20 minutes):** In small groups, students identify specific examples of individual and collective actions that have driven change in consumer behaviour. They discuss the importance of these actions in promoting SCP and present their findings to the class.

- **Explain (30 minutes):** Facilitate a class discussion on the barriers to change in consumer behaviour, such as lack of awareness, cultural norms, and economic constraints.

  Engage students in making recommendations on how these barriers can be overcome through education, awareness campaigns, and policy interventions.

Session 5: Applying Sustainable Consumption and Production Strategies (Engage, Explore, Explain)

- **Engage (10 minutes):** Discuss the importance of integrating sustainable development principles into education and promoting responsible consumption and production. Highlight the role of educators in driving change among students.

- **Explore (20 minutes**): In small groups, students choose one of the project topics: implementing energy-efficient technologies in buildings, adopting green procurement policies, implementing sustainable production processes, promoting sustainable transport, or implementing effective waste management systems. They brainstorm ideas

and discuss how sustainable consumption and production strategies can be applied to their chosen project.

- **Explain (30 minutes):** Students present their project proposals, explaining how their chosen strategies align with sustainable consumption and production principles. Facilitate a class discussion to provide feedback and suggestions for further improvement.

Student feedback

Students will have feedback in the form of group representations to the class when reviewing case studies, as well as the results of the research paper.

Curriculum mapping of outcomes attained.

The knowledge gained in this lesson can be mapped against Geography, Politics and Economics.

Assessment

- Class participation and engagement during discussions and activities.
- Group presentations on the linkages between sustainable consumption and production and other SDGs.
- Written reflections or research papers analysing the impacts of unsustainable consumption and production and proposing solutions.

- Evaluation of project proposals and their alignment with sustainable consumption and production principles.

Materials

- Presentation slides or visual aids
- Case studies and research articles on unsustainable consumption and production, sustainable technologies, and consumer behaviour change
- Handouts or digital resources on sustainable consumption and production technologies and approaches

- Assessment materials (reflection prompts, project guidelines)

Preparation

- Encourage students to research and explore local initiatives and projects related to sustainable consumption and production in Ireland.
- Consider inviting guest speakers from relevant organisations or businesses to share their experiences and insights on sustainable consumption and production.
- Field trips to sustainable businesses or recycling facilities can provide students with hands-on learning experiences and enhance their understanding of responsible consumption and production practices.

Teamwork

Students will work in teams as part of their projects.

Rubrics

Likert scale (1-5) is used.

SDG 13
CLIMATE ACTION

PRIMARY SCHOOL LEVEL

Title	**Climate action (SDG 13)**
Subject	Geography and Science
Topic	Global warming and its consequences
Grade Level	School year 1-6
Age of Students	6-12
Allocated Time	90min
Lesson Objective	• Define climate change and its causes • Name some important measures to stop global warming • To identify ways in which climate change affects the environment and humans • To encourage students to take actions that can help mitigate climate change
Expected Outcomes	• Show ability to identify causes of climate change • Be able to discuss what can be done to mitigate climate change
Curriculum Alignment	The teaching should give students the conditions to develop knowledge about environmental and development issues linked to climate change, human access to and use of natural resources, as well as population issues and living conditions in different parts of the world. Swedish curriculum geography.
Interdisciplinary Cooperation	Science

Differentiation Strategies	Whole class instruction and small group work – flexible grouping. Using a mix of teaching techniques to address different learning preferences, such as visual, auditory, or hands-on learning. Continuous assessment.
Teaching Methodology to Be Used	Discussions will be held together in the class about the pictures. The class will divide itself by choosing a picture with a climate change topic. Role play
Materials/Tools **Health & Safety**	Pictures of climate change printed.
Resources Used	https://www.istockphoto.com/se/search/2/image?phrase=climate+change
Scenario	It's the year 2050, and the world looks very different from what you know. The effects of climate change have become more severe, and the world has become a much harder place to live in.

Learning Teaching Process

Activity	Procedure	Time
1. Introduction: Emotion pictures	Place the pictures on a table. Let the students choose one picture that makes them feel something.	20 min
2. Teacher led discussion	Keywords: global warming, natural disasters, carbon dioxide emissions, climate change, flooding, drought, climate refugees, carbon footprint.	10 min
3. Drama/Role play	Short drama session about the selected photo and a scenario that matches the picture.	30 min
4. Showtime!	Play your drama session for the class. Important that there is a discussion what we can do to make a change after each play.	30 min
Assessment	The plays from each group as well as the discussions after.	

SECONDARY SCHOOL LEVEL

TITLE	Climate Action		
AREA OF SCIENCE	Economy, Chemistry, Biology, Geography, History. Sociology		
TEACHING METHODOLOGY TO BE USED	Discussion, Question and answer, brain storming, solving problem Project based learning		
GRADE LEVEL	8-9		
AGE OF STUDENTS	14–15-year-olds		
TOTAL TIME	2 hours (3 lessons)	**PREPARATION TIME: 40minutes**	**TEACHING TIME:80 mins**
KEY CONCEPTS	Climate action, sustainable practices, Environmental impact of human activities; technological solutions.		

Overview

Students are introduced to the fundamentals of climate action, explaining key terms and concepts. Utilising Problem-Based Learning (PBL), students will be engaged in projects and group work based on real-world scenarios. students create posters or digital presentations to express their understanding and viewpoints on climate action.

Student mission

You are part of a Climate Action Consultancy team, hired by the local council to develop a sustainable action plan. Your city is a medium-sized one facing various environmental challenges, including high carbon emissions, waste management issues, and energy inefficiency. Your role as a consultant is to analyse the city's current environmental challenges, propose sustainable solutions, and develop a comprehensive action plan.

21st century technical skills gained through this activity

- Critical thinking,
- Self-awareness,
- Achieve global consciousness

Related job roles

- Engineer
- Environmental engineer
- Civil engineer
- Chemist
- Biologist

Differentiation strategies to meet diverse learning needs:

Inclusion, Paired and Cooperative Learning, Hands-on learning

Time to complete Lesson

Three 40 mins lessons

Expected Learning Outcomes

Students will be able to:

- Identify and analyse key environmental challenges faced by an urban area, such as energy consumption, waste management, and carbon emissions.
- Develop the ability to conduct comprehensive research
- Apply critical thinking to propose practical and innovative solutions for sustainable urban development, energy efficiency, and waste reduction.
- Understanding diverse stakeholder perspectives, essential for effective environmental planning.
- Develop climate action plans, outlining specific strategies, timelines, and measurable goals.
- Enhance their ability to present to an audience
- Enhance their teamwork and collaboration
- Recognise the interdisciplinary nature of climate action, involving aspects of environmental science, economics, sociology, and urban planning.

Prior knowledge and vocabulary

- Climate Action
- Climate change
- Ecosystem health
- Deterioration

Science and Engineering/Math Practices

Provide students with a handout detailing climate action and current efforts to address it. Include real-life statistics and ask them to assess these numbers in their own words.

Curriculum Alignment

1. Introduction to Climate Action
    - Utilise Problem-Based Learning (PBL) due to its focus on real-world applications and the cross-discipline nature of climate issues.
    - Conduct a brief lecture followed by a test to gauge students' existing knowledge.
2. Defining Data:
    - Identify key concepts related to Climate Action.
    - Explain terms associated with climate action such as renewable energy, air pollution, conservation, nuclear power, the greenhouse effect, carbon neutrality, and carbon footprint.
    - Discuss the content of Climate Action and its effects on different areas.
    - Examine how climate action is implemented.
    - Analyse the pros and cons of Climate Action.
3. Data Control Structures:
    - Consider various methods of climate action and potential solutions.
    - Engage in brainstorming about climate action efforts.
4. Objects:
    - Display and discuss a poster on climate action in the classroom.
5. Data Structures:
    - Investigate and compare different facts about climate action.
    - Seek productive solutions for implementing climate action.
    - Promote awareness and the preservation of ecosystem health.
    - Discuss methods to protect the environment and the atmosphere.
    - Ways to Reduce the Negative Effects of Carbon Footprint and Pollution
    - Outline steps to align national policies with goals for reducing carbon footprints.
    - Emphasise the importance of environmental health.
    - Recognise the integration of environmental conditions and anthropogenic activities for sustainable natural resource management.
6. Understanding Events:
    - Acknowledge the need for sustainable energy to maintain environmental health.
    - Realise the specific outcomes needed from climate action and the necessary procedures to achieve them.
    - Explore methods for environmental protection.
    - Focus on energy resources, planning and implementation, monitoring and evaluation, and nature conservation.

Lesson
Engage: The teacher asks key questions about what the students already know regarding climate and environmental health. Students attempt to answer these questions and then watch a video to learn more about the concepts of Climate Action. Afterward, they discuss the video and the concepts they have learned. **Materials:** Video links, notes with embedded questioning **Preparation:** 20 mins **Facilitation of Learning Experience:** 10 mins **Transition:** 2 mins
Explore: The teacher instructs students to explore the new concept via group discussions. The teacher presents climate action samples from different countries and asks students to comment on them highlighting the differences. **Materials:** posters **Preparation:** 20 Minutes **Facilitation of Learning Experience:** 10 Minutes **Transition:** 2 Minutes
Explain: Then students are asked to research the current environmental status, focusing on areas like energy consumption, waste production, and carbon emissions. They need to identify and propose practical and innovative solutions for energy efficiency, waste reduction, and sustainable urban development. Class discussion on the findings. **Materials:** Cardboards, Pencil and paper, highlighters, crayons, PCs **Preparation:** 10 Minutes **Facilitation of Learning Experience:** 6 Minutes
Elaborate: Students are required to conduct further research and to develop their detailed climate action plan outlining specific strategies, timelines, and goals for the action plan. **Materials:** Canva website **Preparation:** 10 Minutes **Facilitation of Learning Experience:** 10 Minutes
Evaluate: Teacher observes the students whilst they are working on their action plan and presentations; and provides guidance or feedback regarding the use Canva. Students present their findings and action plan to class – who is pretending to be the local city council. Students argue the benefits of each proposed solution in terms of environmental impact, economic feasibility, and community well-being. **Materials:** Evaluation Sheets, PCs, Canva, Projector **Preparation:** 10 Minutes **Facilitation of Learning Experience:** 10 Minutes

Independent learning tasks (ILT):

- Organise community surveys or focus groups to understand the residents' perspectives on environmental issues and their willingness to adopt sustainable practices.

Student feedback

Students will receive individual feedback in a timely manner. This feedback will serve as a reference related to the skills and outcomes that the assessment is designed to measure. Students will be encouraged to share their ideas about the lesson.

Curriculum mapping of outcomes attained

The knowledge gained in this lesson can be mapped to geography, environmental science, economics, social sciences, science, sociology, political science, economics, business studies and technology and engineering.

Assessment

Practical, student presentation, time bound assessment

Materials

- PCs
- Canva
- Worksheets
- Videos
- Statistics
- Articles and surveys
- Online quizzes

Preparation

Students should watch the video links provided and complete the online tests. They should also prepare questions in their notes.

Teamwork

Students work in teams to research the topics and prepare their action plan and presentation.

Rubrics

SLA Standard Rubric is used.

TITLE	Climate Action		
AREA OF SCIENCE	Economy, Chemistry, Biology, Geography, History. Sociology		
TEACHING METHODOLOGY TO BE USED	Discussion, Question and answer, brain storming, solving problem Project based learning		
GRADE LEVEL	7-11		
AGE OF STUDENTS	12-16		
TOTAL TIME	2 hours (3 lessons)	**PREPARATION TIME: 40minutes**	**TEACHING TIME:80 mins**
KEY CONCEPTS	• Climate change and its global impact • Interdisciplinary approach to climate studies. • Role of professionals in climate action • Sustainable practices and technologies • The science of climate change • Problem-solving and critical thinking • Action planning and advocacy		

Overview

Provide students with a comprehensive understanding of climate change from various disciplinary perspectives and to develop practical solutions for local and global environmental challenges.

Student mission

You are part of a special team at your Secondary School, called the "Climate Action Task Force". The school has launched a challenge to understand and address climate change issues affecting your local community and beyond. Your task is to develop a comprehensive climate action plan for your school and community.

21st century technical skills gained through this activity

- Creativity
- Critical thinking
- Taking responsibility
- Learning by doing

Related job roles

- Engineer
- Environmental engineer
- Civil engineer
- Chemist
- Biologist

Differentiation strategies to meet diverse learning needs:

Varied instructional methods; flexible grouping; tiered activities; scaffolded learning; use of technology; ongoing assessment and feedback

Time to complete Lesson

Three 40 mins lessons

Expected Learning Outcomes

By the end of the lesson, students will:

- Understanding the causes, effects, and global impact of climate change.
- Understand how different disciplines like Economy, Chemistry, Biology, Geography, History, and Sociology contribute to the study and understanding of climate action.
- Understand the roles and responsibilities of various professionals (engineers, chemists, biologists, etc.) in combating climate change and implementing sustainable practices.
- Be able to think critically about environmental issues and devise practical solutions to address climate change challenges.
- Enhance their research abilities by gathering, analysing, and interpreting data related to climate action.
- Improve their collaboration and teamwork skills, learning to work effectively in diverse groups.
- Be able to communicate their ideas clearly and effectively, both in written form (through action plans and reports) and orally (through presentations and discussions)

Prior knowledge and vocabulary

- Climate Action
- Climate change
- Ecosystem health
- Protection of the environment

Science and Engineering/Math Practices

Students are given puzzles related to climate change. They are asked to interpret the complete picture formed from the assembled puzzle.

Curriculum Alignment

1. Introduction to Climate Action:
   - Problem-Based Learning (PBL) may be effective for this subject due to its focus on real-world applications and the cross-disciplinary nature of climate issues.
   - Conduct an assessment to test students' knowledge after a brief lecture.
2. Defining Data:
   - Identify key concepts related to Climate Action.
   - Explain terms associated with climate action, such as renewable energy, air pollution, conservation, nuclear power, the greenhouse effect, carbon neutrality, and carbon footprint.
   - Analyse the content of Climate Action and its effects on different areas.
   - Investigate how climate action is implemented.
   - Evaluate the pros and cons of Climate Action.
3. Data Control Structures:
   - Consider various methods of climate action and potential solutions.
   - Engage in brainstorming sessions about climate action efforts.
   - Objects:
   - Display a poster in the classroom and ask students to provide their insights on it.
4. Data Structures:
   - Examine and challenge different facts about climate action.
   - Seek productive solutions for implementing climate action.
   - Raise awareness about ecosystem health.
   - Discuss how to protect the environment and the atmosphere.
5. Ways to Reduce the Negative Effects of Carbon Footprint and Pollution:
   - Outline the steps to align national policies with environmental goals.
   - Emphasise the importance of environmental health.
   - Understand that integrating environmental conditions with the impacts of human activities is crucial for sustainable use and management of natural resources without harming the environment.
6. Understanding Events:
   - Recognise the need for sustainable energy for environmental health.
   - Acknowledge the necessity of climate action to achieve specific outcomes for the planet.
   - Explore strategies for environmental protection.
   - Focus on energy resources, planning and implementation, monitoring and evaluation, and nature conservation.

Lesson

Lesson 1: The basics of Climate Action and its global impact

- **Engage (10 minutes):** Start with a word cloud on climate action and continue with a discussion on recent climate changes students have noticed. Show a short video about global climate change to capture interest.
- **Explore (10 minutes):** Students research different aspects of climate change in assigned subjects (Economy, Chemistry, etc.) in small groups. Each group is assigned different roles (economists, chemists, biologists, geographers, historians, sociologists). As a historian, they might explore how past climate events shaped civilizations, whilst as a biologist, they could examine the effects of climate change on local ecosystems.
- **Explain (10 minutes):** Each group shares their findings, highlighting how their subject relates to climate action.
- **Elaborate (5 minutes):** Discuss the role of various professionals (engineers, chemists, etc.) in combating climate change.
- **Evaluate (5 minutes):** Quick quiz or reflection activity on what they've learned.

Materials: presentation links, word cloud, badges for the different job roles
Preparation: 20 minutes
Facilitating the Learning Experience: 10 minutes
Transition: 2 minutes

Lesson 2: The science behind Climate Action

- **Engage (10 minutes):** Interactive activity demonstrating the greenhouse effect using simple experiments. For example: Simulate the greenhouse effect using two clear plastic boxes and thermometers, placing one box under a covered top to trap heat, like greenhouse gases in the atmosphere. Record temperature changes in both boxes under a lamp to demonstrate the warming effect and discuss the impact of human activities on global warming.

- **Explore (10 minutes):** Group activity: Students explore the causes and effects of climate change in Biology and Chemistry. They set up the experiments, collect data and discuss how the experiment relates to biological processes like the impact of temperature changes on ecosystems, plant growth, and animal behaviour.

- **Explain (10 minutes):** Groups explain how climate change affects biological systems and chemical processes.

- **Elaborate (5 minutes):** Discuss technological solutions (like renewable energy) and their scientific basis.
- **Evaluate (5 minutes):** Short assessment on the science of climate change.

Materials: Two clear plastic boxes (or large glass jars); two thermometers; a lamp with an incandescent bulb (to simulate the sun); black construction paper; a piece of cardboard; tape; a stopwatch or timer
Preparation: 20 Minutes
Facilitation of Learning Experience: 40 Minutes
Transition: 5 Minutes

Lesson 3: Historical and sociological perspectives and action plan

- **Engage (8 minutes):** Discuss historical climate change events and their social impact.
- **Explore (10 minutes):** Research activity: How have societies historically responded to environmental changes? Students work in groups.
- **Explain (2 minutes):** Teacher instructs students to develop the action plan.
- **Elaborate (15 minutes):** Students work in groups to design a mock action plan for climate change mitigation, integrating knowledge from all subjects. They will combine their findings from the first two lessons to develop their climate action plan for their school and community.
- **Evaluate (5 minutes):** Peer review of action plans and a final group discussion on interdisciplinary approaches to climate action.

Materials: PC, posters, banners, visual materials
Preparation: 10 Minutes
Facilitation of Learning Experience: 40 Minutes

Independent learning tasks (ILT):

- Students research real-life applications of what they have learned in the classroom.
- Students enhance their knowledge and complete related online tests

Student feedback

Students receive regular feedback on their learning processes. They make self-evaluations using the feedback from their teachers and contact their teachers to address any deficiencies.

Curriculum mapping of outcomes attained.

The series of these lessons, can be mapped to Economy, Chemistry, Biology, Geography, History. And Sociology.

Assessment

Practical, student presentation, time bound assessment

Materials

- PCs
- Worksheets
- Videos
- Statistics
- Articles and surveys
- Online quizzes

Preparation

- Gather materials for the greenhouse simulation experiment (boxes, thermometers, lamp, etc.) and any additional resources for group activities.
- Plan interactive activities
- Develop online tests, quizzes, and feedback forms for student self-evaluation.
- Compile videos, articles, and real-life case studies on climate action for students to study.
- Ensure tools like Mentimeter or online quiz platforms are ready for use.
- Outline group work structures
- Develop a presentation guide
- Prepare for classroom discussion

Team Work

Students work in groups to carry out research and hands-on experiments. They also develop an action plan in groups and present their plan to the entire class.

Rubrics

SLA Standard Rubric is used.

TERTIARY LEVEL

TITLE	**Carbon Footprint Measurement of Various Energy Sources: Understanding Climate Change and Mitigation Strategies**		
AREA OF SCIENCE	Geography, Physics, Biology		
TEACHING METHODOLOGY TO BE USED	This module will deploy group work exercises as the primary teaching methodology. Students will work together to understand the impact that Energy sources have on carbon levels in the atmosphere, and subsequently will work to determine a solution		
GRADE LEVEL	Tertiary level		
AGE OF STUDENTS	18 + Years		
TOTAL TIME	1 – 2 weeks of class	**PREPARATION TIME:** n/a	**TEACHING TIME:** 5 class sessions
KEY CONCEPTS	Understanding Climate change as a concept and its causes and impact. Understanding the ways, we can reduce climate change in Ireland.		

Overview

In this module, students will explore the concept of climate change, its causes, impacts, and the need for immediate action to reduce greenhouse gas emissions. They will understand the targets agreed upon by the international community and the risks associated with inaction. Students will apply their knowledge by researching climate mitigation strategies and planning a strategy using available technologies. Through a hands-on activity of measuring the carbon footprint of various energy sources, students will evaluate the relationship between climate mitigation and adaptation strategies in the context of Ireland.

Student mission

You are tasked with a comprehensive project on climate change. Working in teams, you need to research:

- The concept of climate change, its causes, and global impacts.
- International targets for emission reduction and the consequences of inaction.
- Various climate mitigation strategies

Each group selects a strategy and plans how it can be implemented using current technologies. You will engage in a hands-on activity to measure the carbon footprint of different energy

sources. You will develop a proposal and critically evaluate each other's proposals, considering the unique environmental and socio-economic context of Ireland.

In the last phase of the project, you will plan a small-scale campaign or initiative to promote climate action on campus or in the local community.

21st century technical skills gained through this activity.

- Critical thinking,
- Awareness of Consumption,
- Economical awareness,
- Problem solving

Related job roles

- Energy Engineer,
- Conservationist,
- Educator,
- Environmental engineer,
- Environmental Law,
- Politician,
- Civil Servant

Differentiation strategies to meet diverse learning needs:

Hands on learning through practical work, group exercises, group discussion

Time to complete Lesson.

5 class sessions

Expected Learning Outcomes

- Students will understand climate change, including its causes, impacts, and challenges.
- Students will understand the need for immediate and sustained action to reduce greenhouse gas emissions and limit global temperature rise.
- Students will apply their knowledge of climate mitigation strategies and technologies.
- Students will evaluate the relationship between various climate adaptation strategies.
- Students will engage in individual and collective actions aimed at reducing greenhouse gas emissions and limiting global temperature rise.

Prior knowledge and vocabulary

- Basic environmental science concepts
- General awareness of Climate Change
- Understanding of greenhouse gases
- Familiarity with energy sources
- Mathematical skills for data analysis

Science and Engineering/Math Practices

- Scientific Inquiry and Research
- Environmental science applications
- Design Thinking and Problem Solving:
- Developing and planning climate mitigation strategies using engineering principles.
- Sustainable Engineering and Design
- Data analysis
- Quantitative Analysis
- Statistical Evaluation

Curriculum Alignment

This module is in alignment with SDG 13 of the European Union

Lesson

Session 1: Understanding Climate Change (Engage, Explore, Explain)

- **Engage (10 minutes):** Initiate a discussion on climate change, asking students to share examples and causes of climate change. Encourage them to think about the impacts of climate change on people, ecosystems, and the planet.
- **Explore (20 minutes):** In small groups, students conduct research to gather information on the impacts of climate change on various sectors and regions, such as human health, agriculture, water resources, and ecosystems. They present their findings to the class.
- **Explain (30 minutes):** Facilitate a class discussion to summarise the causes, impacts, and challenges of climate change. Emphasise the need for immediate action and the importance of addressing climate change to ensure a sustainable future.

Session 2: Climate Targets and Mitigation Strategies (Engage, Explore, Explain)

- **Engage (10 minutes):** Discuss the climate targets agreed upon by the international community, including limiting global temperature rise to well below 2 degrees Celsius and pursuing efforts to limit the increase to 1.5 degrees Celsius. Highlight the risks associated with continued inaction on climate change.
- **Explore (20 minutes):** In small groups, students research and gather information on various pathways for reducing greenhouse gas emissions, such as transitioning to renewable energy, improving energy efficiency, and reducing emissions from transportation and agriculture. They discuss the technologies and approaches associated with each pathway.
- **Explain (30 minutes**): Facilitate a class discussion on the time-sensitive actions that must be taken to reduce greenhouse gas emissions and limit global temperature rise. Emphasize the importance of transitioning to low-carbon energy sources, improving energy efficiency, and reducing deforestation.

Session 3: Climate Mitigation Strategies and Technologies (Engage, Explore, Explain)

- **Engage (10 minutes):** Discuss the importance of individual and collective actions in reducing greenhouse gas emissions and limiting global temperature rise. Introduce the concept of measuring carbon footprint.
- **Explore (20 minutes):** In small groups, students research and gather information on climate mitigation strategies and technologies, such as renewable energy, energy efficiency, and sustainable agriculture. They compare and contrast the strengths and limitations of each strategy and technology.
- **Explain (30 minutes):** Facilitate a class discussion on the interlinkages between climate mitigation strategies and the importance of their implementation in the context of Ireland. Introduce the hands-on activity of measuring the carbon footprint of various energy sources.

Session 4: Measuring Carbon Footprint (Engage, Explore, Explain)

- **Engage (10 minutes):** Explain the concept of carbon footprint and its relevance to climate change. Discuss the importance of measuring the carbon footprint of different energy sources.
- **Explore (20 minutes**): In small groups, students measure the carbon footprint of various energy sources commonly used in Ireland. They gather data on emissions associated with each source and calculate the carbon footprint.
- **Explain (30 minutes):** Students present their findings to the class, discussing the differences in carbon footprints between energy sources. Facilitate a class discussion to analyse the results and evaluate the environmental impact of each energy source

Session 5: Evaluating Climate Adaptation Strategies (Engage, Explore, Explain)

- **Engage (10 minutes):** Introduce the concept of climate adaptation strategies, such as early warning systems, disaster risk reduction, and coastal zone management. Discuss their relevance in the context of climate change impacts.
- **Explore (20 minutes):** In small groups, students compare and contrast various climate adaptation strategies, examining their strengths, weaknesses, and applicability to different regions. They gather examples of each strategy and discuss their effectiveness.
- **Explain (30 minutes):** Facilitate a class discussion on the relationship between climate mitigation and adaptation strategies. Discuss the importance of implementing both strategies to address the challenges of climate change. Lecturer explains the small-scale campaign or initiative students need to plan based on the results of the previous sessions. This campaign or imitative needs to promote climate action on campus or in the local community. The presentation of campaign / imitative will be presented at the next lesson by each group.

Student feedback

Students will have feedback in the form of group representations to the class when reviewing case studies or in response to their written reflections or research paper submission.

Curriculum mapping of outcomes attained.

The knowledge gained in this lesson can be mapped against Geography, Politics and Economics

Assessment

- Class participation and engagement during discussions and activities.
- Group presentations on the impacts of climate change on various sectors and regions.
- Written reflections or research papers analysing climate mitigation strategies and technologies.
- Measurement and analysis of the carbon footprint of different energy sources.
- Evaluation of climate adaptation strategies and their interlinkages with climate mitigation.
- Group presentation of small-scale campaign or imitative

Materials

- Presentation slides or visual aids
- Research articles and case studies on climate change, mitigation strategies, and adaptation strategies
- Handouts or digital resources on carbon footprint measurement and calculation
- Measurement tools for carbon footprint activity (such as carbon calculators)
- Assessment materials (reflection prompts, project guidelines)

Preparation

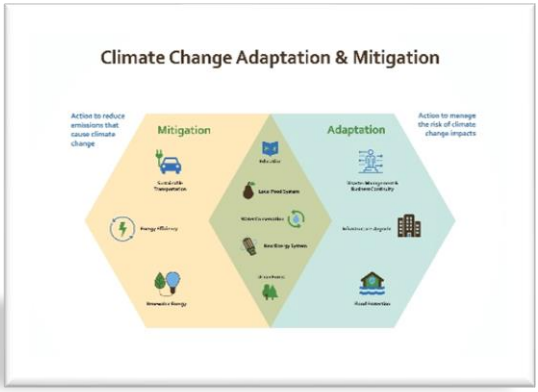
- Encourage students to explore local initiatives and projects related to climate change mitigation and adaptation in Ireland.
- Consider inviting guest speakers from relevant organisations or climate experts to share their experiences and insights.
- Field trips to renewable energy installations or climate-resilient communities can provide students with real-world examples and enhance their understanding of climate action.

Teamwork

Students will work in groups, they will carry out research, develop their small-scale campaign or imitative and deliver presentations.

Rubrics

Likert scale (1-5) is used.



TITLE	Climate change adaptation plans as the key to a successful climate action		
AREA OF SCIENCE	Environmental Engineering		
TEACHING METHODOLOGY TO BE USED	The lesson is divided into two periods of 90 minutes + 90 minutes. The first period will be theoretical exploration. In the second period the class will be split up into teams consisting of three to five students. They will work within their teams to complete the activities. Each group will carry out a presentation to justify their conclusions.		
GRADE LEVEL	University Level - Graduation		
AGE OF STUDENTS	18+		
TOTAL TIME	180 minutes	**PREPARATION TIME: 10**	**TEACHING TIME:** 170
KEY CONCEPTS	Climate Change; Greenhouse Gases; Mitigation; Adaptation; Nature-based solutions; Data Analysis		

Overview

Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850–1900 in 2011–2020. Global greenhouse gas emissions have continued to increase, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and among individuals.

Rapid and far-reaching transitions across all sectors and systems are necessary to achieve deep and sustained emissions reductions and secure a liveable and sustainable future for all. These system transitions involve a significant upscaling of a wide portfolio of mitigation and adaptation options. Feasible, effective, and low-cost options for mitigation and adaptation are already available, with differences across systems and regions.

Accelerated and equitable action in mitigating and adapting to climate change impacts is critical to sustainable development. Mitigation and adaptation actions have more synergies than trade-offs with Sustainable Development Goals. Synergies and trade-offs depend on context and scale of implementation.

Student mission

You are an environmental engineer working in a government or municipality and you need to understand the causes and consequences of climate change and how to implement mitigation and adaptation strategies.

21st century technical skills gained through this activity

- Problem Solving
- Practical analysis
- Critical thinking
- Drawing conclusions based on fact
- Inquiry based learning
- Computational Thinking

Related job roles

- Environmental Engineering
- Biologist
- Environmental technician

Differentiation strategies to meet diverse learning needs:

Students of different abilities will be paired together in teams; peer mentoring method will be employed to help less able students to complete activities.

Time to complete Lesson

Two 90-minute periods (If your lessons are shorter or longer, you can either break this sequence into more lessons or less).

Expected Learning Outcomes

- Students will understand several concepts and definitions linked to the physical science and basis of Climate Change.
- Students will understand how the emissions of greenhouse gases affects us and the environment
- Students will comprehend the importance of climate action
- Students will be able to identify the main mitigation and adaptation strategies
- Students will understand how to perform data analysis

Prior knowledge and vocabulary

- Sustainability, ecosystems,
- Biosphere,
- Basic concepts on physics,
- Chemistry,
- Biology
- Mathematics.

Science and Engineering/Math Practices

Provide students with the STEAM model for a real-life example of climate change adaptation.

Curriculum Alignment

- The Physical science basis of Climate Change
- Mitigation of Climate Change
- Impacts, adaptation and vulnerability
- Nature-based solutions as adaptation strategies

Lesson

Engage: Students are given a video link prior to the class. Students will watch the video at home and complete an online quiz relating to the video.

Materials: Computer, Projector, Video *link, online quiz*
Preparation: [2] Minutes
Facilitation of Learning Experience: [5] Minutes
Transition: [2] Minutes
Teacher will: summarises the concepts of the video and provide the quiz solutions
Students will: listen and take notes
Before the first period watch the video: https://www.youtube.com/watch?v=A47M9wXs6Yg

Explore: Relating to the video, they will form their own questions and ideas, which will be prompted by the teacher through scenario-based exercises during the lesson. The idea of asking and answering questions, formulating ideas will give the student a better understanding of the real-life solutions towards problems they will be solving.

Materials: No need for materials
Preparation: [2] Minutes
Facilitation of Learning Experience: [10] Minutes
Transition: [2] Minutes
Teacher will: facilitate the discussion
Students will: ask questions in the form of hypothesis. At the same time, they will take notes

Explain: With the use of a PowerPoint presentation the teacher will explain the:

- The physical science basis of Climate Change;
- Mitigation of Climate Change;
- Impacts, adaptation and vulnerability;
- Nature-based solutions as adaptation strategies

The teacher will implement activities during explanation.

Materials: Computer with PowerPoint, projector
Preparation: [2] Minutes
Facilitation of Learning Experience: [60] Minutes
Transition: [2] Minutes
Teacher will: further explain the theory behind climate change

Students will: listen intently, take notes, ask questions and participate in the activities

Elaborate: In the beginning of the second period students are asked to work in groups and research the topic in more detail. They will be presented with a practical exercise that they have to analyse and answer.

Materials: computer with excel, word and PowerPoint
Preparation: [2] Minutes
Facilitation of Learning Experience: [30] Minutes
Transition: [1] Minutes
Teacher will: present and explain the exercise
Students will: resolve the exercise using the knowledge apprehended before

Evaluate: Students will prepare a short presentation and teach the class about the main results of the exercise.

Materials: computer with PowerPoint and projector
Preparation: [2] Minutes
Facilitation of Learning Experience: [60] Minutes
Transition: [] Minutes
Teacher will: Evaluate the presentations given by the students on what they found
Students will: Present to the class and will answer relevant questions by the teacher to assess their level of understanding.

Independent learning tasks (ILT):

- Students will watch the video given to them by the teacher to enhance their knowledge and complete the related quizzes.
- Students will research real life applications of what they have learned within the classroom.
- Students will work in groups to prepare presentations and to present them to their class
- Students will apply data analysis in a real-life situation
- Students will answer post class questions

Student feedback

Students will be given feedback on a one-to-one basis in a timely manner. The feedback will reference the skills outcomes that the assessment was designed to test and if the student met those outcomes. It will also take into account feedback from the student on how they found the lesson.

Curriculum mapping of outcomes attained

The knowledge gained in this lesson can be mapped against chemistry, biology, physics, mathematics curricula.

Assessment

Practical, student presentation, time bound assessment and Q&A.

Materials

- Computers
- Projector
- Excel
- Word
- PowerPoint

Preparation

Students should watch the video provided and complete the online quiz. They should also attempt questions in their notes, Q&A should be conducted by the teacher to ascertain if the students understand the concepts before starting the exercise.

Teamwork

Students will work in teams to research the topics and prepare a presentation for the class regarding the practical exercise. This is an extension of the knowledge base, where students must research more about environmental problems.

Rubrics

Assessment of:

- Autonomy
- Understanding of the associated concepts
- The link between the concepts
- Interdisciplinarity between the STEAM areas
- Problem solving capacity (computational thinking)

Title	**Official Development Assistance For Climate Change Mitigation**
Subject	Active Citizenship
Topic	Climate Change- SDG no.13
Grade Level	University
Age of Students	18+ (adult)- group of teachers
Allocated Time	90 mins
Lesson Objective	• Participants will be able to learn about climate change effects, and the role of Official Development Assistance for climate change mitigation in the Global South • How to raise awareness about climate change issues through activism and empathy
Expected Outcomes	• Participants will understand the impact of climate change, identify the areas most heavily affected, and learn how Official Development Assistance can mitigate these impacts in the Global South. • Participants will become familiar with non-formal education approaches and methods, enabling them to address global challenges and sensitive issues within learning processes
Curriculum Alignment	Teacher training
Interdisciplinary Cooperation	The activity will combine Sociology, History and biology and other disciplines as participants will learn aspects of their interconnection when carrying out the activities.
Differentiation Strategies	Participants with diverse knowledge backgrounds will be paired together in teams, and the peer mentoring method will be employed to help them complete the activities.

Teaching Methodology to Be Used	The group will be split up into teams of participants. They will work within their teams to complete the activities. Each group will carry out a presentation about good practices of Official Development Assistance for Climate Change mitigation.
Materials/Tools **Health & Safety**	• Smart Board • Internet connection, • Laptop/Mobile phones, • More Than One Story cards • Any practical work, which they carry out is in accordance with current regulations related to health and safety
Resources Used	The activities are followed by a self-assessment sheet. The various resources are listed below: • Cards: More Than One Story: https://www.morethanonestory.org/en, • Climate Change Refugees: https://climateofchange.info/ • Latest data on ODA, December 2021: https://public.flourish.studio/story/1759356/
Scenario	Teachers at a school will be visited by an NGO representative knowledgeable about the topic of Official Development Assistance (ODA) for two workshop lessons. The sessions will focus on the connection between ODA and climate change. The theme 'Official Development Assistance for Climate Change Mitigation' will cover aid from developed countries, primarily the EU and Slovenia, to developing countries for climate change mitigation-related activities. Before the workshop, teachers are tasked with researching and collecting data on several key points: • Understanding what Official Development Assistance is and what it involves. They will discuss its importance and gather examples, particularly focusing on the role of the European Union and Slovenia in providing ODA. • Investigating how climate change impacts the EU, Slovenia, and other continents. They will explore the concept of climate refugees and the latest developments from the COP summit in Sharm el Sheikh, Egypt, especially concerning funds for climate change mitigation. Based on their findings, groups will prepare short presentations for the workshop. The NGO representative will ensure these findings are discussed during the workshop.

Learning Teaching Process		
Activity	**Procedure**	**Time**
Introduction/Warm Up	Climate Refugees video: https://www.youtube.com/watch?v=EPo1BN7EAsI Simple questions and answers	10 mins
Group discussion and team work	Discuss the consequences of climate change locally, within the EU, and globally. Reflect on the findings presented by participating teachers. Delve into the concept of Official Development Assistance (ODA), its scope, and whether developed countries (the Global North) should assist developing countries (the Global South) in combating the effects of climate change. Additionally, address the issue of refugees, with a particular focus on climate refugees, considering that aid for refugees is also encompassed within ODA.	30 mins
Group discussion and team work	Assume the role of a climate refugee and use the 'More Than One Story' cards, each containing specific tasks, to share your experiences. These cards are designed to facilitate the integration of foreigners and to enhance communication among group members. Each participant should take one card and complete the task on it.	35 mins
Discussions	Discuss what has been learned at the workshop. Should we assist developing countries in climate change mitigation through Official Development Assistance (ODA)?	5 mins
Assessment	• Assessment of the workshop • Homework for Teachers to prepare a similar lesson plan.	10 mins

SDG 14
LIFE BELOW WATER

PRIMARY SCHOOL LEVEL

Title	**Life below water (SDG 14)**
Subject	Science, chemistry
Topic	Water Pollution
Grade Level	School year 1-6
Age of Students	6-12 years
Allocated Time	90 minutes
Lesson Objective	• Gather knowledge about how water pollution affects our oceans, marine resources and ecosystems. • To build an understanding that all pollutants in water cannot be cleaned. • Reflect on what students themselves can do to prevent toxins from ending up in our waters in the future. Which environmental label can help us choose products that do not contain toxins? • To develop critical thinking skills by exploring solutions to prevent water pollution.
Expected Outcomes	• The students will write a lab report during the water cleaning/purification process. • The students will participate in the water cleaning experiment. • The students will be able to give examples of pollutants that can and cannot be cleaned.
Curriculum Alignment	**School year 1-3:** “Some mixtures and how they can be broken down into their various components, for example by evaporation and filtration.” **School year 4-6:** “Common household chemicals. Their use and impact on the environment and man and how they are labelled and should be handled.”

	"The student seeks answers to questions by carrying out systematic investigations." Reference to the Swedish curriculum
Interdisciplinary Cooperation	Science, Chemistry
Differentiation Strategies	The teacher divides the students into pairs. In this way, the students can help each other and use each other as learning resources during conversation, experiment and documentation.
Teaching Methodology to Be Used	*The practical part (step 4):* The students will work in pairs cleaning "polluted" water from plastic (cut up straw), gravel, sand, cooking oil and sugar. The students will use different tools to clean the polluted water. The process will be documented in a lab report.
Materials/Tools **Health & Safety**	• Large see through containers • Water • cut up straw • gravel • sand • cooking oil • sugar • tweezers • paper towel • Cotton balls • Coffee filter • Cups
Resources Used	Film of a plastic filled beach: https://www.youtube.com/watch?v=7KKR4qDhCng Lab report template
Scenario	You are walking on a beach. At the shoreline, you see plastic bags, bottles, medicine containers, and white foam. Dead fish are floating on the surface, making you feel uneasy. Your thoughts start spinning: Can you swim here? Why are the fish dead? Can you fish here and safely eat the catch? What is the white foam?

Learning Teaching Process		
Activity	**Procedure**	**Time**
1. Introduction	Watch the video about water pollution.	10 min
2. Brainstorming and discussion	Teacher led discussions, Individual reflection, discussions in pairs and groups.	10 min
3. Difficult words (A widget-sheet with key words)	Worksheet for difficult words for better understanding.	10 min
4. Implementing 1, 2 and 3	The practical part. Conduct the experiment and write the lab report, incorporating the key words provided.	40 min
Assessment	Assessment will be based on students' participation in class discussions and group work. Students will also be assessed based on their worksheet about water pollution and its prevention, which includes key words and the lab report. The assessment criteria will include creativity, critical thinking, and understanding of the topic.	

SECONDARY SCHOOL LEVEL

TITLE	Life below water		
AREA OF SCIENCE	Hydrology, chemistry, biology, geography		
TEACHING METHODOLOGY TO BE USED	The students will watch a video to learn more about water scarcity, water pollution and drought, and the potential dangers to sea life.		
GRADE LEVEL	8. class		
AGE OF STUDENTS	14		
TOTAL TIME	160 min (three 40 min lessons)	**PREPARATION TIME: 40 mins**	**TEACHING TIME: 120 min**
KEY CONCEPTS	groundwater, seas, oceans, rivers		

Overview

In this 'Life Below Water' lesson, students are tasked with measuring and monitoring oxygen levels in marine environments to understand aquatic ecosystems. They will learn to collect and analyse data accurately, applying scientific and mathematical principles to assess the health of marine life. The lesson emphasises the importance of environmental factors affecting oxygen levels and their impact on underwater ecosystems. Through this hands-on experience, students will develop critical thinking and problem-solving skills, gaining insights into marine conservation and environmental science.

Student mission

You have been hired to measure and monitor the oxygen levels in the seas and conduct research on the aquatic ecosystem. Your primary responsibility is to manage oxygen measurements. Your goal is to maintain the oxygen levels at a certain threshold, which is necessary for the survival of living creatures underwater.

21st century technical skills gained through this activity

- Problem solving,
- Creativity,
- Questioning method

Related job roles

- Diver
- Aquaculture engineering,
- Hydrologist

Differentiation strategies to meet diverse learning needs

Use of technology; hands-on learning; varied instructional methods, use of visual aids, tiered assignments and scaffolded learning.

Time to complete Lesson

Three 40 minutes lessons

Expected Learning Outcomes

Students will:

- **Understand the marine ecosystems**
- Be able to accurately measure and monitor oxygen levels in water, and analyse the collected data to draw conclusions about the health of the ecosystem.
- Understand how various environmental factors, both natural and human-induced, can affect oxygen levels in marine environments.
- Enhance their critical thinking and problem-solving skills
- Be able to apply scientific principles
- Enhance their ability to communicate scientific findings

Prior knowledge and vocabulary

Sea, oxygen, groundwater, hydrology, biology, ecosystem

Science and Engineering / Maths Practices

- **Observation and measurement**
- Environmental science applications
- Experimentation and hypothesis testing
- Interpretation of data
- Ecological understanding
- Data analysis and representation

Curriculum Alignment

This lesson can be mapped to the 8th grade curriculum.

Lesson

Lesson 1: Water scarcity and pollution

Engage: Watch the video, followed by a class discussion on the importance of oxygen for living things and methods of measuring oxygen in water.

Explore: Conduct a hands-on experiment to measure oxygen levels in water using the provided materials (lantern, fish, live coral, oxygen machine). Students learn how to measure oxygen in water and understand the effects of water scarcity and pollution on oxygen levels.

Elaborate: Class discussion to deepen the understanding of how water pollution affects marine life. Students research real-life examples of water scarcity and pollution, focusing on causes, effects, and potential solutions.

Evaluate Phase: Short quiz or reflective writing on the importance of oxygen in aquatic environments and the impact of water scarcity and pollution.

Materials: Lantern, fish, live coral, oxygen measurement device
Preparation: 20 mins.
Facilitation of Learning Experience: Utilise a visual and direct instructional model to facilitate easier learning for students
Transition: 5 mins
Teacher will: The teacher will demonstrate the experiment.
Students will: Students will collect numerical data using their observational skills.

Lesson 2: Drought and its impact

Engage: Use a simulation game or story to illustrate the onset of a drought and its immediate effects on an ecosystem. Then engage students in a group discussion. Students share their initial reactions and relate the simulation to real-world drought scenarios.

Explore: Students research the causes and effects of drought on both natural ecosystems and human communities. In groups, students explore how drought conditions affect different regions and species.

Explain: Presentation by Teacher: Explain the science behind droughts, including climatic patterns and water cycle disruptions. Student Presentations: Groups explain their research findings, focusing on specific aspects of drought's impact.

Elaborate: Case study analysis: Students analyse case studies of historical droughts and their long-term consequences. Problem-Solving activity: engage in a class project to devise strategies for drought resilience and management.

Evaluate: Students take a quiz or write an essay on drought and its implications. Students reflect on what they've learned about the prevention and management of droughts and discuss ways to apply this knowledge.
Materials: online game or simulation, case studies, PowerPoint, online quiz
Preparation: 10 mins.
Facilitation of Learning Experience: Utilise a visual and direct instructional model to facilitate easier learning for students
Transition: 5 mins

Lesson 3: The Danger to Sea Life

Engage: The teacher shows images or a video showcasing various marine species and how they are affected by changing water conditions. Then students brainstorm potential threats to these species, focusing on issues related to water quality and availability.

Explore: Students observe live specimens (if available) or study case examples to note responses to different oxygen levels and pollutants. Each group researches a particular aspect of sea life endangerment, such as the impact of pollutants or ocean acidification.

Explain: Instructor-Led discussion: The teacher explains the relationship between water conditions and marine life health, emphasizing ecological balance. Student presentations: Groups present their research on specific dangers to sea life, explaining their findings and implications.

Elaborate: Debate or panel discussion: Engage in a class discussion or debate on the effectiveness of current marine conservation efforts and policies. Project work: Students work on a project proposing new methods or improvements for protecting marine life.

Evaluate: Students complete a quiz or assignment assessing their understanding of the threats to marine life and the importance of water quality. Peer review: Students provide feedback on each other's projects, focusing on the feasibility and creativity of the proposed conservation methods.

Materials: images or video, live specimens or images/videos, PowerPoint, online quiz
Preparation: 10 mins.
Facilitation of Learning Experience: Utilise a visual and direct instructional model to facilitate easier learning for students
Transition: 5 mins

Student feedback

Comparing the measurements and results of the experiment, and analyzing the causes and consequences of any differences.

Assessment

Mini-tests, achievement tests, open-ended tests, quiz, assignment / essay, peer review

Materials

- **Bell,**
- **Fish,**
- **Coral reef,**
- **Water,**
- **Oxygen meter,**
- **Aquarium oxygen engine**
- **Computer,**
- **Projector,**
- **Concept maps,**
- **Video,**
- **Images**
- **PowerPoint**

Preparation

The teacher prepares for the lesson by watching short films and documentaries, and reading research articles on the subject.

Team Work

Through questioning, problem-solving, and analytical thinking, students will be able to compare the outcomes observed in team experiments. Specifically, they will contrast the situations that occur when the amount of oxygen in the lanterns decreases with those that occur when it increases.

Rubrics

A scoring guide of 10 questions was created.
1 to 3 correct answers: 2 points
4-6 correct answers: 5 points
7-10 correct answers: 8 points

TITLE	Climate Action		
AREA OF SCIENCE	Economy, Chemistry, Biology, Geography, History, Sociology		
TEACHING METHODOLOGY TO BE USED	Discussion, Question and answer, brain storming, solving problem Project based learning		
GRADE LEVEL	7--11		
AGE OF STUDENTS	12-16 yrs.		
TOTAL TIME	2 hours (3 lessons)	**PREPARATION TIME: 40minutes**	**TEACHING TIME:80 mins**
KEY CONCEPTS	• Aquatic Ecosystems. • Environmental Impact • Conservation Strategies • Sustainable Practices • Interdisciplinary Approach		

Overview

This series of three 40-minute lessons aims to educate secondary school students about aquatic ecosystems, the impact of human activities on these environments, and the importance of conservation. The lessons cover the introduction to aquatic life, the effects of pollution on marine ecosystems, and the strategies for conservation and protection of aquatic habitats.

Student mission

You are interns at an environmental NGO dedicated to protecting aquatic life. Their mission is to research, develop, and present strategies for conserving local aquatic ecosystems. You need to investigate the current ecological status, the biodiversity it supports, and the primary environmental threats it faces.

You will develop a conservation plan tailored to your assigned water body. This plan needs to include pollution reduction strategies, biodiversity protection measures, and community engagement initiatives.

At the end of the project, you will present your conservation strategies to your classmates and a panel of 'NGO executives' (teachers or invited guests), simulating a real NGO project presentation.

21st century technical skills gained through this activity

- Research Skills
- Data Analysis
- Digital Literacy
- Technical Writing
- Project Management
- Critical Thinking and Problem Solving
- Technology Utilization in Environmental Science
- Public Speaking and Communication

Related job roles

- Marine Biologist
- Environmental Scientist
- Conservationist
- Water Quality Technician
- Ecologist
- Environmental Policy Maker
- Aquatic Veterinarian
- Environmental Educator

Differentiation strategies to meet diverse learning needs:

- Varied Instructional Methods
- Flexible Grouping
- Tiered Assignments
- Use of Technology
- One-on-One Support
- Independent Research Opportunities
- Peer Teaching:
- Regular Feedback and Assessment:

Time to complete Lesson

Three 40 mins lessons

Expected Learning Outcomes

By the end of the lesson series, students will be able to:

- Describe the different types of aquatic ecosystems and the variety of life they support.
- Understand and explain how pollution, climate change, and other human activities affect aquatic environments.
- Create and present plans or projects aimed at conserving and protecting aquatic life and habitats.
- Demonstrate the ability to collect, analyse, and interpret data related to water quality, biodiversity, and ecosystem health.
- Identify and describe sustainable practices that can reduce the negative impact on aquatic ecosystems.
- Communicate their research findings and conservation strategies through written reports, presentations, or digital media.
- Engage in critical thinking
- Understand global and local challenges facing aquatic ecosystems and the importance of addressing these issues

Prior knowledge and vocabulary

- Prior Knowledge:
    - Basic Ecosystem Concepts
    - Fundamental Biology Principles
    - General Environmental Awareness
    - Basic Geography.
- Vocabulary:
    - Aquatic
    - Ecosystem
    - Biodiversity
    - Pollution
    - Conservation
    - Sustainable
    - Marine
    - Habitat
    - Carbon Footprint
    - Climate Change:

Science and Engineering/Math Practices

- Data Collection and Analysis
- Problem-Solving and Design Thinking
- Application of Biological Concepts
- Use of Technology and Tools in Research
- Mathematical Modelling

Curriculum Alignment

- Introduction to the Subject of Life in Water:
    - Employ Problem-Based Learning (PBL) to provide an understanding of the subject with examples, using an interdisciplinary approach.
    - Apply a comprehension test at the end of the lesson to assess understanding.
- Data Identification:
    - Define concepts related to life in water.
    - Explain terms associated with aquatic life.
    - Discuss aquatic life content and its effects in various areas.
    - Examine methodologies of studies on life in water.
    - Analyse the results of these studies, including their pros and cons.
- Data Control Structures:
    - Consider ways and solutions to address issues related to aquatic life.
    - Brainstorm about efforts to preserve aquatic life.
- Objects:
    - Display a poster in the classroom and ask students to comment on it.
- Data Structures:
    - Examine and challenge different facts about aquatic life.
    - Attempt to find practical solutions for issues related to aquatic ecosystems.
    - Raise awareness about ecosystem health.
    - Discuss methods to protect the environment and atmosphere.
- Ways to Reduce the Carbon Footprint and Negative Effects of Pollution:
    - Identify steps for aligning national policies with goals of reducing environmental impact.
    - Discuss the importance of environmental health.
    - Understand that integrating environmental conditions with the effects of human activities is crucial for sustainable resource management.
- Understanding Events:
    - Recognise the need for sustainable energy in maintaining environmental health.
    - Acknowledge the importance of aquatic life in achieving desired outcomes for the planet.
    - Explore methods to protect the environment.
    - Focus on energy resources, their planning, and implementation.
    - Implement monitoring and evaluation techniques.
    - Promote nature conservation.

Lesson

Lesson 1: Introduction to Aquatic Life

Engage: Watch an introductory video about aquatic ecosystems. Discuss initial thoughts and questions about life in water.

Explore: Conduct problem-based learning activities, focusing on real-world examples of aquatic life aging and processing.

Explain: Define key concepts and terms related to aquatic life. Teacher-led discussion on various aspects of aquatic life and its effects.

Elaborate: Examine case studies or research on aquatic life. Group activity to brainstorm solutions for challenges faced by aquatic ecosystems.

Evaluate: Comprehension test to assess students' understanding. Reflective discussion on the poster shown in class.

Materials: Video, Case studies, assessment
Preparation: 20 mins
Facilitation of Learning Experience: 40 mins
Transition: 2 mins

Lesson 2: Impact of Pollution on Aquatic Life

Engage: Discuss the impact of pollution on aquatic life, using images or news articles. Introduce the concept of the carbon footprint and its effects on marine environments.

Explore: Research how different types of pollution affect aquatic ecosystems.

Explain: Discuss the steps for harmonising national policies to reduce pollution. Explore the integration of environmental conditions with human activities.

Elaborate: Develop a small project or presentation on reducing the carbon footprint to protect aquatic life. Group discussion on sustainable energy sources for environmental health.

Evaluate: Assessment through quiz or presentation feedback. Discuss and evaluate the importance of environmental health.

Materials: Video, images, news articles, PowerPoint, quiz
Preparation: 20 mins
Facilitation of Learning Experience: 40 mins
Transition: 2 mins

Lesson 3: Conservation and Protection of Aquatic Ecosystems

Engage: Initiate a conversation about the importance of protecting aquatic ecosystems. Explore the concept of nature conservation and its significance.

Explore: Investigate various conservation methods and their effectiveness in protecting aquatic life.

Explain: Teacher-led explanation of energy resources, planning, implementation, monitoring, and evaluation in the context of aquatic life conservation.

Elaborate: Students develop a plan or campaign for aquatic ecosystem conservation. Role-play or simulation activity on implementing conservation strategies.

Evaluate: Students present their conservation plans. Peer review and teacher feedback to assess understanding and creativity

Materials: Video, PCs, PowerPoint
Preparation: 20 mins
Facilitation of Learning Experience: 40 mins
Transition: 2 mins

Independent learning tasks (ILT):

- Research project on local water bodies - local river, lake, or coastal area - focusing on its ecological status, the species it supports, and any current environmental challenges it faces, such as pollution or habitat destruction. They compile their findings in a report or presentation.
- DIY water quality testing on samples from nearby water sources using simple testing kits. They document parameters like pH, turbidity, and possibly the presence of certain pollutants, and analyse the implications of their findings for aquatic life health.

Student feedback

Students are given timely and regular feedback. Students are also encouraged to provide feedback on their learning experience, reflecting on their understanding of the topics covered, the effectiveness of the teaching methods used, and the materials and resources utilised.

Curriculum mapping of outcomes attained.

This lesson can be mapped to Biology, Environmental Science, Chemistry, Geography, Earth Science, Social Studies, Civics and Ethics.

Assessment

Practical, student presentation, time bound assessment

Materials

- Documentary Videos
- Research Articles
- Posters:
- Water Testing Kits
- Experiment Equipment: Basic lab equipment for any in-class experiments (e.g., beakers, test tubes, microscopes).
- Computers/Tablets
- Interactive Games or Simulations
- Art Supplies: For creating posters or models, including paper, markers, glue, and possibly recycled materials for model ecosystems.
- Worksheets and Handouts
- Projector or Smartboard

Preparation

- Organise experiment supplies such as water testing kits and lab equipment
- Create interactive activities e.g., interactive games, simulations
- Prepare visual aids, posters and other visual materials.
- Test and set up any necessary technology, such as computers, tablets, projectors, or smartboards.
- Create quizzes, worksheets, and other assessment tools to evaluate student understanding throughout the lesson series.
- Plan group activities.
- Review and plan for any safety procedures related to experiments or field trips.

Team Work

Students work in groups for various activities, enhancing their collaborative skills. They engage in joint research projects, where each member contributes to gathering and analyzing information about aquatic ecosystems and pollution. During experiments, such as water quality testing, students share responsibilities and work together to collect and interpret data. In developing conservation strategies, they brainstorm and pool ideas, leveraging diverse perspectives to create comprehensive plans.

Rubrics

SLA Standard Rubric is used.

TERTIARY LEVEL

TITLE	**Reducing Plastic Waste: Addressing Plastic Pollution in our Oceans**		
AREA OF SCIENCE	Geography, Biology, Marine Biology		
TEACHING METHODOLOGY TO BE USED	These lesson series will deploy group work exercises as the primary teaching methodology. Students will work together to understand the impact that plastic pollution has on our oceans and subsequently will work to determine a solution.		
GRADE LEVEL	Tertiary level		
AGE OF STUDENTS	18 + Years		
TOTAL TIME	1 – 2 weeks of class	**PREPARATION TIME:** n/a	**TEACHING TIME:** 5 class sessions
KEY CONCEPTS	Understanding Plastic pollution as a concept and its causes and impact. Understanding the ways, we can prevent this and recycle our waste		

Overview
In these series of lessons, students will explore the global issue of plastic pollution in our oceans and its impacts on marine life and ecosystems. They will understand the sources of marine plastic pollution and the need for individual and collective actions to reduce plastic usage and waste. Through hands-on activities and discussions, students will analyse the effectiveness of plastic reduction and waste management measures and propose alternative solutions. The focus will be on reducing plastic waste in Ireland and promoting sustainable practices.

Student mission

You are given a real-world mission as an environmental consultant for a project titled "Clean Oceans, Green Future." Your task is to develop a comprehensive plan to combat plastic pollution in Ireland's coastal and marine environments.

You need to conduct in-depth research on the current state of plastic pollution in Ireland's oceans, identifying major sources and assessing its impact on marine life and ecosystems. You will engage with local communities, businesses, and authorities in coastal areas of Ireland to gather insights and data on plastic usage and disposal practices. This includes conducting surveys or interviews to understand public awareness and attitudes towards plastic pollution.

You will develop innovative solutions and alternative practices to reduce plastic waste, focusing on both individual actions (like consumer choices) and collective efforts (like policy recommendations and community initiatives) and will present the report to a panel comprising university faculty, environmental experts, and potentially local government representatives, simulating a real consultancy presentation.

21st century technical skills gained through this activity.

- Critical thinking,
- Awareness of Consumption,
- Economical awareness,
- Problem solving

Related job roles

- Marine Biologist,
- Conservationist,
- Educator,
- Coastguard,
- Environmental Law,
- Politician,
- Civil Servant

Differentiation strategies to meet diverse learning needs:

Hands on learning through practical work, group exercises, group discussion

Time to complete Lesson.

5 class sessions

Expected Learning Outcomes

- Students will understand the global issue of plastic pollution in our oceans and its impacts on marine life and ecosystems.
- Students will analyse the sources of marine plastic pollution and their relative importance.

1. Students will evaluate the need for reducing plastic usage and waste through individual and collective actions.
2. Students will evaluate the effectiveness of plastic reduction and waste management measures.
3. Students will propose alternative solutions to reduce plastic waste and promote sustainable practices in Ireland.

Prior knowledge and vocabulary

Understanding of the general terminology around the topic

Science and Engineering/Math Practices

- Scientific Research and Inquiry
- Data Analysis
- Engineering Solutions
- Environmental Impact Assessment

Curriculum Alignment

This module is in alignment with SDG 14 of the European Union

Lesson

Session 1: Understanding Plastic Pollution (Engage, Explore, Explain)

- **Engage (10 minutes):** Initiate a discussion on plastic pollution in our oceans, asking students to share their observations and experiences. Highlight the impacts of plastic pollution on marine life and ecosystems.

- **Explore (20 minutes):** In small groups, students conduct research on the sources of marine plastic pollution, such as single-use plastics, microplastics, and plastic waste from land-based activities. They gather examples and statistics to support their findings.

- **Explain (30 minutes):** Facilitate a class discussion on the relative importance of different sources of marine plastic pollution. Discuss the environmental, economic, and social impacts of plastic pollution, emphasising the need for immediate action.

Session 2: Reducing Plastic Usage and Waste (Engage, Explore, Explain)

- **Engage (10 minutes):** Discuss the importance of reducing plastic usage and waste through individual and collective actions. Introduce the concept of a plastic-free lifestyle.
- **Explore (20 minutes):** In small groups, students research and gather information on practical strategies for reducing plastic usage and waste, such as using reusable bags, bottles, and containers, and choosing plastic-free alternatives. They discuss the benefits and challenges of adopting these practices.
- **Explain (30 minutes):** Facilitate a class discussion on the effectiveness of plastic reduction measures. Encourage students to share their own experiences and success stories in reducing plastic usage and waste.

Session 3: Evaluating Plastic Reduction Measures (Engage, Explore, Explain)

- **Engage (10 minutes):** Introduce the concept of waste management and its role in reducing plastic pollution. Discuss the importance of recycling and proper disposal of plastic waste.
- **Explore (20 minutes**): In small groups, students research and gather information on existing plastic reduction and waste management measures, such as recycling programs, waste segregation, and community initiatives. They analyse the effectiveness of these measures and their impact on reducing plastic pollution. Develop interview/survey questions.
- **Explain (30 minutes):** Facilitate a class discussion on the strengths and limitations of plastic reduction and waste management measures in Ireland. Encourage students to propose alternative solutions and strategies to enhance the effectiveness of these measures.

Session 4: Proposing Sustainable Practices (Engage, Explore, Explain)

- **Engage (10 minutes):** Discuss the role of policies, laws, and community-based initiatives in reducing plastic waste and promoting sustainable practices.
- **Explore (20 minutes):** In small groups, students brainstorm and propose sustainable practices to reduce plastic waste in Ireland. They consider the role of government, businesses, educational institutions, and individuals in implementing these practices.
- **Explain (30 minutes):** Students present their proposed sustainable practices to the class, explaining the rationale behind their choices and discussing the potential impact of these practices on reducing plastic waste. Facilitate a class discussion to evaluate the feasibility and effectiveness of the proposed practices.

Session 5: Action Plan and Reflection (Elaborate, Evaluate)

- **Elaborate (30 minutes):** In small groups, students develop an action plan for implementing one or more sustainable practices to reduce plastic waste. They outline specific steps, responsibilities, and timelines for their action plan.

- **Evaluate (20 minutes):** Students reflect on their learning throughout the module and evaluate the effectiveness of their proposed solutions. They discuss the potential challenges and opportunities in implementing their action plan and suggest ways to overcome obstacles.

Student feedback

Students will have feedback in the form of group representations to the class when reviewing case studies or in response to their written reflections or research paper submission.

Curriculum mapping of outcomes attained.

The knowledge gained in this lesson can be mapped against Geography, Politics and Economics

Assessment

- Class participation and engagement during discussions and activities.
- Research and analysis of the sources of marine plastic pollution.
- Written reflections or research papers on the impacts of plastic pollution and the need for reducing plastic usage and waste.
- Group presentations on proposed sustainable practices to reduce plastic waste.
- Evaluation of the effectiveness of plastic reduction and waste management measures.

- Action plan for implementing sustainable practices to reduce plastic waste in Ireland

Materials

- Presentation slides or visual aids
- Research articles, case studies, and statistics on plastic pollution and waste management
- Handouts or digital resources on practical strategies for reducing plastic usage and waste.
- Assessment materials (reflection prompts, project guidelines)
- Materials for group activities and presentations

Preparation

- Encourage students to engage in community-based initiatives or campaigns to raise awareness about plastic pollution and promote sustainable practices.
- Consider inviting guest speakers from environmental organisations or waste management authorities to share their expertise and experiences.
- Explore opportunities for field trips or visits to recycling facilities, waste management centres, or sustainable businesses to provide students with real-world examples and insights.

Teamwork

Students collaborate in groups to research and analyse the issue of plastic pollution in oceans. They work together to gather data, discuss findings, and brainstorm potential solutions. Teams also engage in constructive debates to evaluate the effectiveness of existing waste management measures and propose innovative approaches. Ultimately, each group combines their efforts to develop a comprehensive plan or proposal, harnessing the collective skills and knowledge of all members.

Rubrics

Likert scale (1-5) is used.

TITLE	The main causes and impacts of ocean acidification		
AREA OF SCIENCE	Environmental Engineering		
TEACHING METHODOLOGY TO BE USED	The lesson is divided into two periods of 120 minutes +120 minutes. After the diagnostic assessment the class will be split up into cooperative learning groups consisting of four or five students. Each group will carry out a presentation to justify their conclusions.		
GRADE LEVEL	University Level - Graduation		
AGE OF STUDENTS	18+		
TOTAL TIME	240	**PREPARATION TIME: 16**	**TEACHING TIME:** 224
KEY CONCEPTS	Ocean acidification; Greenhouse Gases; Climate Change; Nature-based solutions; Data Analysis		

Overview

Ocean acidification is caused by carbon dioxide gas in the atmosphere dissolving into the ocean. This leads to a lowering of the water's pH, making the ocean more acidic. The rising concentration of carbon dioxide in the atmosphere is driving up ocean surface temperatures and causing ocean acidification. Although warming and acidification are different phenomena, they interact to the detriment of marine ecosystems.
The impacts of ocean acidification include damage to marine ecosystems such as coral reefs and fisheries. It can also affect marine organisms' ability to build shells and skeletons.

Student mission

You are an environmental engineer working in a marine institution and you need to understand the causes and consequences of ocean acidification.

21st century technical skills gained through this activity

- Problem Solving
- Practical analysis
- Critical thinking
- Drawing conclusions based on fact
- Inquiry based learning
- Computational Thinking

Related job roles

- Environmental Engineering
- Biologist
- Environmental technician

Differentiation strategies to meet diverse learning needs:

Students of different abilities will be paired together in teams; peer mentoring methods will be employed to help less able students to complete activities.

Time to complete Lesson

240-minute periods (If your lessons are shorter or longer, you can either break this sequence into more lessons or less).

Expected Learning Outcomes

- Students will understand several concepts and definitions linked to ocean acidification.
- Students will understand how ocean acidification affects us and the environment
- Students will comprehend the importance of reduce greenhouse gases
- Students will be able to identify the main contributors to ocean acidification
- Students will understand how to perform data analysis

Prior knowledge and vocabulary

Sustainability, ecosystems, biosphere, basic concepts on physics, chemistry, biology and mathematics.

Science and Engineering/Math Practices

Provide students with the STEAM model for a real-life example of ocean acidification.

Curriculum Alignment

- Ocean Basics: Know Your Ocean
- Ocean Acidification: concepts and definitions
- Main causes of ocean acidification
- Impacts of ocean acidification

Lesson
Engage: The teacher presents the lesson plan, highlighting the various work stages. The first step then begins: diagnostic assessment. It is important for the teacher to understand the students' level of knowledge related to the theme to be addressed, as the class will unfold through the articulation of this knowledge with the syllabus. Students will be asked what they already know about the concept of ocean acidification. **Materials:** Computer, Projector, Mentimeter, mobile phone **Preparation:** [5] Minutes **Facilitation of Learning Experience:** [2] Minutes **Transition:** [3] Minutes **Teacher will:** introduce the ocean's acidification concept via Menti's word cloud function **Students will:** listen and take notes
Explore: During the exploration phase, students actively explore various elements that help in understanding the phenomenon of ocean acidification, such as its definition, effects on the environment, the importance of reducing the greenhouse effect, and the main contributors. This exploration is done through reading research papers in cooperative learning groups, using the Jigsaw Method. This approach not only enhances the development of knowledge but also fosters critical thinking and social skills. **Materials:** research papers; guide with task rule; note cards, google drive, FRISCO grid. **Preparation:** [5] Minutes **Facilitation of Learning Experience:** [25+50+25=100] Minutes **Transition:** [2] Minutes **Teacher will:** facilitate the discussion **Students will:** text analysis, identification of concepts, construction, and sharing of word cloud, construction of basic questions, group discussion, sharing and deepening of questions, and discussion of ideas.
Explain: Using a PowerPoint presentation, the teacher will explain several key topics: • Ocean Basics: Know Your Ocean, • Ocean Acidification: Concepts and Definitions, • Main Causes of Ocean Acidification, and • Impacts of Ocean Acidification. During the explanation, the teacher will also implement various activities. **Materials:** Computer with PowerPoint, projector **Preparation:** [2] Minutes **Facilitation of Learning Experience:** [40] Minutes **Transition:** [3] Minutes **Teacher will:** further explain the theory behind ocean acidification **Students will:** listen intently, take notes, ask questions and participate in the activities

Elaborate: In this phase, students are asked to regroup as they were previously organised and rephrase their working question, incorporating new information based on the teacher's explanation. They will then present their updated findings.

Materials: computer, projector and PowerPoint
Preparation: [2] Minutes
Facilitation of Learning Experience: [30] Minutes
Transition: [2] Minutes
Teacher will: listen and facilitate the debate
Students will: Reformulation of results, synthesis, and debate of ideas. Oral presentation of the results of teamwork.

Evaluate: Students prepare a short presentation and teach the class about the main results of the exercise.

Materials: computer with PowerPoint and projector
Preparation: [2] Minutes
Facilitation of Learning Experience: [40] Minutes
Transition: [2] Minutes
Teacher will: Evaluate the presentations given by the students on what they found, facilitate the debate and peer discussion and assessment
Students will: Present to the class and will answer relevant questions by the teacher to assess their level of understanding and sharing of evaluation (self and hetero-evaluation).

Independent learning tasks (ILT):

- Students will research real-life applications of what they have learned in the classroom.
- Students will work in groups to prepare presentations and then present them to their class.
- Students will apply data analysis skills in a real-life situation.
- Students will answer questions after the class

Student feedback

Students will be given feedback on a one-to-one basis in a timely manner. The feedback will reference the skills outcomes that the assessment was designed to test and if the student met those outcomes. It will also take into account feedback from the students on how they found the lesson.

Curriculum mapping of outcomes attained

The knowledge gained in this lesson can be mapped against chemistry, biology, physics, mathematics and environmental engineering curricula.

Assessment

Practical, student presentation, time bound assessment and Q&A.

Materials

- Computers
- Projector
- Excel
- Word
- PowerPoint

Preparation

Students should watch the video using the provided link and complete the online quiz. They should also attempt the questions in their notes. A Q&A session should be conducted by the teacher to ascertain whether the students understand the concepts before starting the exercise.

Team Work

Students will work in teams to research the topics and prepare a presentation for the class regarding the practical exercise. This is an extension of the knowledge base, where students must research more about environmental problems.

Rubrics

Assessment of:

- Autonomy
- Understanding of the associated concepts
- The link between the concepts
- Interdisciplinarity between the STEAM areas
- Problem solving capacity (computational thinking)

Title	Marine Cultural Heritage Within Sustainable Development
Subject	Geography, History, Biology
Topic	Active Citizenship
Grade Level	SDG no.14
Age of Students	18+ adults (a group of teachers)
Allocated Time	90 mins
Lesson Objective	• Describe the importance of marine cultural heritage in informing responses to global challenges and enhancing the sustainable development of coastal zones, in accordance with SDG No. 14. This includes considerations of heritage tourism, coastal development and infrastructure, climate change, coastal management, fisheries, and the offshore industry. • Define the interconnection between culture and nature within this specific SDG

Expected Outcomes	Participants will be able to: • Understand the importance of sea contact for human development, both in the past and for future progress. They will recognise that successful future sea management and sustainable development require a deep time perspective informed by humanity's past. This includes respecting the cultural traditions of communities who have lived by the sea for millennia and using historical insights to forge a new way of coexisting with the sea, also considering future needs. • Comprehend that submerged and coastal cultural heritage is part of a broader biocultural heritage approach. In this approach, cultural heritage — encompassing language, cultural memory, traditional ecological knowledge, and the values of local and indigenous communities — is interrelated and indivisible from the biodiversity of landscapes. This understanding can help promote ethical development in marine infrastructure and offshore industry projects. • Recognise that establishing sustainable fishing practices is a crucial goal of SDG14 and essential for food security. This includes identifying resilient species historically exploited by human groups in specific areas or reintroducing native species to rebuild over-fished stocks. • Understand that the current marine biodiversity and the ecological composition of coastal environments result from sustained human action over millennia. Therefore, information from past human activity in the marine zone should inform future actions in the same area. • Realise that tangible remains such as archaeological sites and landscapes contain vital information for understanding human responses to climate change over time and the development of coastal ecosystems. This can be achieved through adequate reconstructions of past sea level changes and past human responses to those changes.

Curriculum Alignment	Teacher training
Interdisciplinary Cooperation	The activity combines Geography, History, Biology, and other disciplines, enabling participants to learn about the interconnections between these subjects while carrying out the activities.
Differentiation Strategies	Participants with diverse knowledge backgrounds will be paired together in teams, and the peer mentoring method will be employed to help them complete the activities.
Teaching Methodology to Be Used	The group will be split up into teams of participants, who will work within their teams to complete the activities. Each group will then carry out a presentation on practices of responsible production and consumption.
Materials/Tools **Health & Safety**	• Smart Board • Internet connection, • Laptop/Mobile phones, • Any practical work, which they carry out is in accordance with current regulations related to health and safety
Resources Used	YouTube videos, please see links below.
Scenario	Teachers will receive a visit from an NGO representative with expertise in SDG No. 15 for two workshop lessons. The topic will be integrated with a brainstorming activity designed to stimulate creativity and enhance critical thinking and media literacy skills to address challenges. Before the workshop, teachers are tasked with researching and gathering data on several key points: • Understanding what 'Life Below Water' involves. • Examining the current human impact on life below water. • Investigating how humans have affected the marine environment in the past. • Exploring whether useful insights can be gained from the impact of past coastal communities on their environment. • Discussing the importance of integrating marine cultural heritage with natural sciences in SDG 15, and identifying the roles of the European Union and Slovenia in this context. • Exploring the cultural heritage in the coastal area of Slovenia, including submerged archaeological sites, and considering how these can be promoted for tourism and economic development, such as the Roman seafront villa with its port in the bay of San Simon, Izola, Slovenia, and the salt pans in Sečovlje, Slovenia. Based on their findings, groups are required to prepare short presentations for the workshop. These presentations will be discussed during the workshop with the NGO representative.

Learning Teaching Process		
Activity	**Procedure**	**Time**
Introduction/Warm Up	• Digital reconstruction of Roman villa in bay of San Simon, Izola (in Slovene language): https://www.youtube.com/watch?v=84Sj7EPYVPg • Saltpans where people still harvest salt using a 700-year-old method: https://www.youtube.com/watch?v=7oBNZLLzm8M, • Archaeological research in Piran Bay at Fizine, Slovenia: https://zapa.si/projects/arheoloske-raziskave-v-fizinah-v-letih-2017-2018-in-2021/	10 mins

Group discussion and team work	• Discuss the Impact of Cultural Heritage and Practices:
	  ○ Examine how the cultural heritage and practices of coastal populations impact the coastal environment and climate change.
	  ○ Delve into the importance of preserving and promoting cultural heritage, including coastal and marine archaeological sites.
	• Slovenian-Croatian Maritime Border Dispute:
	  ○ Explore the significance of settling the Slovenian-Croatian maritime border dispute.
	  ○ Discuss the broader implications of this dispute on both nations and their coastal environments.
	• Analysis of Teacher Findings:
	  ○ Review and discuss the findings and insights gathered by participating teachers on these topics.
	• Pro et Contra Activity Preparation:
	  ○ Prepare for a pro et contra debate focusing on the final bilateral settlement of the Slovenian-Croatian maritime border dispute.
	• Presentation of Views and Innovative Solutions:
	  ○ Each group presents their respective views on the maritime dispute.
	  ○ Propose innovative solutions for joint bilateral activities that address the dispute.
	  ○ Both groups develop arguments to support their respective stances.
		35 mins

Advocating arguments	○ Each group speaks about their arguments. Group discussion and team work. Various opinions are presented.	30 mins
Conclusion	Facilitate a discussion about the arguments presented by each group. A participant, assuming the role of a judge, will decide the outcome of the dispute based on these arguments.	5 mins
Assessment	Assessment of the workshop Homework for Teachers to prepare a similar lesson plan.	10 mins

SDG 15
LIFE ON LAND

PRIMARY SCHOOL LEVEL

Title	Life on land (SDG 15)
Subject	Science/ Biology
Topic	Ecosystems
Grade Level	School year 1-6
Age of Students	6 – 12
Allocated Time	85 min (1 lesson)
Lesson Objective	• Describe nature's ecosystem services and their importance. • "Participate in the experiment.
Expected Outcomes	• Be able to explain how nature's ecosystem services are essential for all life.
Curriculum Alignment	Year 1-3: The student demonstrates basic knowledge of nature. Year 4-6: /../ With some use of the concepts and explanatory models, the student describes simple biological relationships in nature /../ reference to Swedish curriculum
Interdisciplinary Cooperation	Swedish and biology
Differentiation Strategies	Working in groups, in pairs and individually. TPS - think - pair - share

Teaching Methodology to Be Used	Small groups create their own ecosystem in glass cans.
Materials/Tools **Health & Safety**	• Glass can • Clay marbles • Soil • Plants, sticks and rocks • Water
Resources Used	Lab report template https://www.naturskyddsforeningen.se/skola/bygg-ett-minikretslopp/
Scenario	You have been entrusted with the last soil on Earth, and with it, the responsibility to maintain our ecosystem. This ecosystem is crucial for soil fertility and contributes to clean air, laying the foundation for a healthy planet. Now, it's up to us to preserve and sustain our ecosystem for the future

Learning Teaching Process

Activity	Procedure	Time
1. Introduction: Brainstorming	Post its on a wonderwall/mini whiteboards	10 min
2. Key words: cycle, photosynthesis, combustion, ecological connection.	Teacher led discussion with pictures/hand-outs with pictures (widget)	10 min
3. Theoretical part: the learning objectives for the lesson and facts.	Teacher displays the learning objectives on the smartboard, accompanied by short films and texts. Meanwhile, the class takes notes.	15 min
4. Implementation after 1, 2 and 3.	Take a large glass jar, preferably with a wide opening and a large lid. Place a layer of play balls at the bottom.	50 min

	Fill the jar one-third full with soil. Plant some plants in the soil; if it's difficult to reach into the jar, use sticks to help position the plants. Water the plants lightly. Feel free to decorate with a stone and some sticks. Securely put the lid on the jar and ensure it's tightly closed. Write the date on the jar. Place the jar in a bright area but avoid excessive direct sunlight. Do not open the jar! You have now created a mini-cycle and a model of the Earth's biosphere within the glass jar. Observe the changes that occur inside the jar over time.	
Assessment	1-3: Presentation of the ecosystem in each group. 4-6: Quiz	

SECONDARY SCHOOL LEVEL

TITLE	**What are the major factors affecting deforestation?**		
AREA OF SCIENCE	GEOGRAPHY		
TEACHING METHODOLOGY TO BE USED	Problem-Based learning (PBL); Hands-on activities; Field trips and virtual tours; Group projects and collaborative learning; Interactive discussions and brainstorming sessions; Reflective writing		
GRADE LEVEL	Grade		
AGE OF STUDENTS	17 Yrs.		
TOTAL TIME	160 Minutes (4 Lessons)	**PREPARATION TIME: 20**	**TEACHING TIME: 140**
KEY CONCEPTS	Ecological importance of trees; Seed planting and biodiversity; Water conservation:; Characteristics of arid environment		

Overview

This project is focusing on environmental sustainability and conservation. Key topics include the ecological importance of trees, seed planting, water conservation, and understanding arid environments. While the project covers broader themes of environmental sustainability and conservation, understanding the ecological importance of trees and the impacts of water conservation and arid environments are directly relevant to the causes and consequences of deforestation. By educating students about these interconnected environmental topics, the project can enhance their understanding of how deforestation occurs and its wide-ranging effects on global ecosystems. This knowledge, in turn, can inform and inspire actions and policies aimed at mitigating deforestation. Overall, the project aims to foster an appreciation for environmental stewardship and promote practical skills in environmental conservation among students.

Student mission

You are a team of young environmental consultants hired by an NGO to develop a comprehensive conservation strategy for a coastal ecosystem in your region. The NGO aims to address the pressing issues of deforestation, water conservation, and biodiversity loss.

You need to:

- Conduct field research on local coastal ecosystems, focusing on current conditions, biodiversity, and the impact of human activities.
- Analyse data on deforestation rates, water pollution levels, and the status of native plant and animal species.
- Interact with local communities to understand their relationship with the coastal environment and gather insights on traditional conservation practices.
- Develop a conservation plan that includes reforestation initiatives, sustainable water management practices, and biodiversity preservation strategies.
- Present your conservation strategy to the NGO, local government bodies, and community leaders.

21st century technical skills gained through this activity

- **Critical thinking and problem-solving:**
- Collaboration and teamwork
- Communication skills
- Digital literacy
- Environmental literacy
- Creativity and innovation
- Global and cultural awareness
- Civic literacy

Related job roles

- **Environmental Scientist**
- Urban Planner
- Conservationist
- Agricultural Scientist
- Water Resource Specialist
- Climate Change Analyst
- Ecologist
- Environmental Educator
- Geographer
- Sustainability Coordinator

Differentiation strategies to meet diverse learning needs:

Varied instructional methods; Flexible grouping; Choice-based assignments; Tiered tasks; Use of technology; One-on-one support; Independent research opportunities; Peer mentoring; Ongoing assessment and feedback

Time to complete Lesson

Four 40 minutes lessons (If your lessons are shorter or longer, you can either break this sequence into more lessons or less).

Expected Learning Outcomes

By the end of this project students will be able to:

- Understand and articulate the characteristics and importance of coastal ecosystems, including their biodiversity and the environmental challenges they face.
- Assess the extent and impact of human activities on coastal environments, particularly focusing on deforestation, water pollution, and habitat destruction.
- Formulate conservation plans that include reforestation initiatives, sustainable water management practices, and biodiversity preservation methods.
- Demonstrate project management skills, including planning, executing, monitoring, and adjusting conservation projects.
- Enhance their presentation and communication skills
- Understand and discuss the ethical considerations in environmental conservation and the importance of sustainable practices.
- Advocate for and contribute to environmental stewardship, showing a commitment to preserving and improving coastal ecosystems for future generations.

Prior knowledge and vocabulary

- **Basic ecology concepts**
- Fundamental environmental science such as pollution, climate change, and conservation efforts.
- Geographical understanding
- Biology basics such as plant and animal life, particularly focusing on how living organisms interact with their environment.
- Awareness of sustainability practices such as recycling, water conservation, and reducing carbon footprints.
- Basic research skills

Science and Engineering/Math Practices

- **Scientific research and inquiry.**
- Data analysis and interpretation
- Engineering design and problem solving
- Mathematical modelling
- Technology and instrumentation in science

Lesson
Lesson 1: The Importance of Trees in Ecosystems **Engage:** Discussion: What role do trees play in our environment and daily lives? Video: Short documentary on deforestation and its impact. **Explore:** Activity: Analyse satellite images of deforestation over time in different regions. Group Work: Research the ecological benefits of trees. **Explain:** Presentation: Teacher explains the global importance of trees and reforestation efforts. Discussion: Connect trees' role to larger ecological systems. **Elaborate:** Project: Plan a tree-planting activity or a virtual reforestation campaign. **Evaluate:** Reflection: Write about how individual actions can impact global deforestation. **Materials:** video link, images, PCs, PowerPoint **Preparation: [**15] Minutes **Facilitation of Learning Experience**: [40] Minutes **Transition:** [2] Minutes
Lesson 2: Seed Planting and Its Impact **Engage:** Discussion: Benefits of planting fruit seeds – from waste to resource. Demonstration: Show how to plant seeds from common fruits. **Explore:** Hands-On Activity: Students plant fruit seeds in small pots. **Explain:** Lecture: Discuss the lifecycle of a plant and the importance of biodiversity**.** **Elaborate:** Research Assignment: Investigate how fruit trees can benefit local ecosystems**.** **Evaluate:** Journal Entry: Reflect on the experience of planting and growing a seed**.** **Materials:** seeds from common fruits, pots, soil, PCs **Preparation:** [10] Minutes **Facilitation of Learning Experience:** [40] Minutes **Transition:** [3] Minutes
Lesson 3: Protecting Clean Water Sources **Engage:** Interactive Quiz: Test knowledge about water pollution and its sources. **Explore:** Field Trip or Virtual Tour: Visit a local water treatment plant or a river. **Explain:** Teacher-Led Discussion: The significance of clean water sources and their conservation. **Elaborate:** Group Project: Develop a campaign to promote water conservation practices. **Evaluate:** Group Presentations: Share and critique conservation campaign plans. **Materials:** Quiz, PowerPoint, PC, link for water treatment plant **Preparation:** [10] Minutes

Facilitation of Learning Experience: [40] Minutes
Transition: [5] Minutes

Lesson 4: Understanding the Arid World

Engage: Brainstorming: Discuss what students know about arid regions.

Explore: Research: Study the characteristics and challenges of arid environments.

Explain: Lecture: Delve into the meaning of 'arid world' and its global significance.

Elaborate: Case Study Analysis: Examine life and adaptation strategies in arid regions.

Evaluate: Essay: Write about the importance of understanding and protecting arid ecosystems**.**

Materials: research links, case study, essay outline
Preparation: [10] Minutes
Facilitation of Learning Experience: [40] Minutes
Transition: [5] Minutes

Independent learning tasks (ILT):

To foster deeper understanding and personal engagement with the subject matter, the following tasks are recommended:

- Students individually select a specific environmental issue (e.g., deforestation, water pollution) and conduct in-depth research. They would prepare a report or presentation detailing causes, impacts, and potential solutions.
- Keeping an environmental diary over a set period to record their daily environmental practices, observations of their local environment, and reflections on how they can contribute to sustainability.
- Assign students to watch an environmental documentary and write a review or reflection, discussing the key points, their learning, and how the documentary changed or reinforced their views on environmental issues.
- Analyse a case study of a successful environmental conservation project, identifying key strategies used, outcomes achieved, and lessons that can be applied to other contexts.
- Design a campaign (like a series of social media posts, a website, or a video) to raise awareness about a specific environmental concern, focusing on engaging their community or peers. Publish this on the school's official social media accounts.
- Develop a proposal for a sustainable practice or innovation that could be implemented in their school or community to address a local environmental issue.

Student feedback

Regular feedback sessions; Interactive Platforms such as online surveys or educational forums where students can anonymously submit their feedback and suggestions; Reflection journals; Group discussions; Ongoing dialogue

Curriculum mapping of outcomes attained

These lesson series can be mapped to the following subjects and topics of the curriculum:

- Environmental science: ecosystems, biodiversity, pollution, and sustainable practices
- Geography: characteristics of different ecosystems, particularly focusing on coastal regions, and the global impact of environmental issues.
- Biology: Biological principles e.g., flora and fauna within ecosystems, the interdependence of species, and the biological implications of environmental changes.
- Chemistry: chemical aspects of environmental science, such as the study of pollutants and their effects on ecosystems.
- Civics/Social studies: societal and ethical dimensions of environmental stewardship, including the role of policy, community action, and individual responsibility in environmental conservation.
- Mathematics: Elements of the series may involve mathematical skills, particularly in data analysis, statistical evaluation of environmental data, and mathematical modelling of ecosystems and conservation strategies.
- Technology and engineering: The use of technology for environmental monitoring, data collection, and analysis, as well as the application of engineering principles in designing solutions for environmental problems, are integral to the series.

Assessment

Research project evaluation; Environmental diary analysis; Documentary review feedback; Case study presentation grading; Awareness campaign assessment; Participation and engagement; Q&A

Materials

- **Research papers and articles**
- Environmental documentaries
- Diary or journal
- Digital tools: For creating awareness campaigns (like video editing software, website builders, or graphic design tools).
- Local maps for ecosystem study projects.
- PowerPoint or other digital presentation software.
- Smartboard or projector
- PCs

Preparation

- Curate resources;
- Set up digital platforms;
- Organise materials;
- Design assessment tools: create rubrics and assessment criteria for projects, presentations, and diary entries.

Teamwork
Group discussions; Project collaboration; Peer review and Cooperative learning

Rubrics
The outcomes are evaluated on a scale from 1 to 5. The following achievements are assessed: • Participation in teamwork. • Effective self-expression. • Listening to others. • Adherence to discussion rules. • Recording results and taking notes. • Effective use of technology.

TERTIARY LEVEL

TITLE	**Exploring Biodiversity and Ecosystems: A Case Study**		
AREA OF SCIENCE	Geography, Biology,		
TEACHING METHODOLOGY TO BE USED	The teacher will deploy a case study-based learning approach for this lesson. Students will be able to compare and contrast the studies to further understand the impacts of deforestation on ecosystems, and how that impacts our own lives.		
GRADE LEVEL	Tertiary level		
AGE OF STUDENTS	18 + Years		
TOTAL TIME	1 – 2 weeks of class	**PREPARATION TIME:** n/a	**TEACHING TIME:** 5 class sessions
KEY CONCEPTS	Understanding deforestation as a concept and its causes and impact. Understanding the ways, we can protect our ecosystems in Ireland.		

Overview

In this project, students will delve into the importance of biodiversity and ecosystems, the threats they face, and the role of human activities in causing and mitigating these threats. Through a case study approach, students will examine a specific example of biodiversity and ecosystem preservation in Ireland. They will understand the causes and impacts of deforestation and land degradation, explore the effectiveness of land use practices, and discuss the role of protected areas and conservation. The focus will be on promoting sustainable land use practices and preserving biodiversity and ecosystems in Ireland.

Student mission

As students of Environmental Science at a tertiary institution, you are assigned to a project called "Eco-Warriors: Shaping a Sustainable Future." This project is a deep dive into understanding and actively participating in the preservation of biodiversity and ecosystems, specifically focusing on Ireland's unique environment. Your mission is to carry out research on different ecosystems found globally and in Ireland; to create a proposal for a new or improved protected area in Ireland, considering local biodiversity; to plan and simulate a reforestation project in an Irish region affected by deforestation and to develop a sustainable land use plan for a local community, promoting biodiversity and sustainable practices. You will need to present your findings, proposals, and plans to a panel of environmental experts, showcasing your journey as Eco-Warriors and your contributions to preserving Ireland's natural beauty and ecological balance.

21st century technical skills gained through this activity.

- Critical thinking,
- Awareness of consumption,
- Economical awareness,
- Problem solving

Related job roles

- Biologist,
- Conservationist,
- Educator,
- Coastguard,
- Urban and Regional Planner,
- Environmental Scientist,
- Politician,
- Forestry manger,
- Civil Servant,
- Sustainability consultant,
- Environmental Policy Analyst,
- Ecologist

Differentiation strategies to meet diverse learning needs:

Hands on learning through practical work, group exercises, group discussion, Case study analysis

Time to complete Lesson.

5 class sessions

Expected Learning Outcomes

By the end of these lesson, students will:

- Understand the importance of biodiversity and ecosystems, the threats they face, and the role of human activities in causing and mitigating these threats.
- Be able to examine the causes and impacts of deforestation and land degradation and explore the effectiveness of various land use practices.
- Understand the role of protected areas and conservation in preserving biodiversity and ecosystems.
- Be able to explore the potential of restoration and reforestation as a means to mitigate climate change.
- Understand the importance of sustainable land use practices and their role in promoting biodiversity, mitigating climate change, and improving livelihoods.

Prior knowledge and vocabulary

Understanding of the general terminology around the topic

Science and Engineering/Math Practices

- Scientific research and analysis
- Environmental monitoring and assessment
- Geographic Information Systems (GIS)
- Mathematical Modelling
- Engineering design
- Data interpretation and statistics
- Technology integration
- Problem-solving
- Ecological impact assessment
- Sustainability engineering

Curriculum Alignment

This module is in alignment with SDG 15 of the European Union

Lesson

Lesson 1: Introduction to Biodiversity and Ecosystems

Engage: Discussion: What is biodiversity? Why are ecosystems important?
Video: Short documentary on global biodiversity.

Explore: Activity: Explore various ecosystems through interactive maps. Group Discussion: How do human activities impact these ecosystems?

Explain: Lecture: Teacher explains the concepts of biodiversity and the importance of ecosystems.

Elaborate: Research: Assign students to research different ecosystems and their unique characteristics.

Evaluate: Quiz: Assess understanding of biodiversity and ecosystem basics.

Materials: Interactive maps, documentary video, quiz materials.
Preparation: 15 Minutes
Facilitation of Learning Experience: 30 Minutes
Transition: 5 Minutes

Lesson 2: Understanding Deforestation

Engage: Brainstorming: What causes deforestation? What are its impacts?

Explore: Case Study: Examine a case study on deforestation in Ireland. Group Work: Identify causes and impacts in the case study.

Explain: Discussion: Teacher leads a discussion on the broader implications of deforestation.

Elaborate: Debate: Students debate the effectiveness of different land use practices.

Evaluate: Reflective Writing: Students write a short piece on their learnings about deforestation.

Materials: Case study documents, debate materials, writing supplies.
Preparation: 20 Minutes
Facilitation of Learning Experience: 35 Minutes
Transition: 5 Minutes

Lesson 3: Conservation and Protected Areas

Engage: Interactive Quiz: Test students' knowledge on conservation efforts.

Explore: Research Assignment: Investigate different conservation areas in Ireland.

Explain: Presentation: Teacher explains the role of protected areas in conservation.

Elaborate: Project: Students develop a plan for a hypothetical protected area.

Evaluate: Presentation Review: Assess students' conservation area plans.

Materials: Interactive quiz tool, research assignment resources, project supplies.
Preparation: 15 Minutes
Facilitation of Learning Experience: 40 Minutes
Transition: 5 Minutes

Lesson 4: Restoration and Reforestation

Engage: Discussion: How can restoration and reforestation mitigate climate change?

Explore: Activity: Study examples of successful restoration projects.

Explain: Lecture: Discuss the potential and challenges of restoration efforts.

Elaborate: Simulation: Students simulate a reforestation project planning.

Evaluate: Group Feedback: Review and provide feedback on reforestation plans.

Materials: Examples of restoration projects, simulation tools, planning materials.
Preparation: 20 Minutes
Facilitation of Learning Experience: 30 Minutes
Transition: 10 Minutes

Lesson 5: Sustainable Land Use Practices

Engage: Scenario Analysis: Discuss scenarios of sustainable vs. unsustainable land use.

Explore: Group Activity: Research sustainable land use practices in various countries.

Explain: Group Presentations: Students present findings on sustainable practices.

Elaborate: Plan Development: Develop a sustainable land use plan for a local area.

Evaluate: Plan Assessment: Evaluate and provide feedback on the sustainable land use plans.

Materials: Scenario analysis cases, research materials, presentation tools.
Preparation: 25 Minutes
Facilitation of Learning Experience: 45 Minutes
Transition: 5 Minutes

Student feedback

Students will provide feedback in the form of group presentations to the class, particularly when reviewing case studies, and also in response to their written reflections or research paper submissions.

Curriculum mapping of outcomes attained.

The knowledge gained in this lesson can be mapped against Geography, Politics and Economics

Assessment

- Class participation and engagement during discussions and activities.
- Research and analysis of the case study on biodiversity and ecosystem preservation in Ireland.
- Group presentations on sustainable land use practices and their benefits.
- Written reflections or research papers on the causes and impacts of deforestation and land degradation.
- Evaluation of the effectiveness of protected area management approaches and restoration projects.
- Reflection on the importance of sustainable land use practices and their role in promoting biodiversity and mitigating climate change.

Materials

- Presentation slides or visual aids
- Research articles, case studies, and statistics on biodiversity, ecosystems, deforestation, and sustainable land use practices
- Handouts or digital resources on the case study and specific land use practices
- Assessment materials (reflection prompts, project guidelines)
- Materials for group activities and presentations

Preparation

- Encourage students to connect the concepts and knowledge gained in this module to real-life situations and local environmental issues.
- Invite guest speakers from conservation organizations, forestry departments, or land management agencies to share their experiences and insights.
- Explore opportunities for field trips or visits to protected areas, restoration sites, or sustainable land use projects to provide students with practical examples and hands-on experiences.
- Plan an end-of-module event where students can showcase their projects and findings to the school community or the public.
- Utilise technology, such as creating digital models or simulations, to understand environmental processes and impacts.
- Pair students with peers or mentors for additional support and knowledge exchange.

Teamwork

- Group research projects
- Case study analysis
- Peer feedback sessions
- Collaborative field trips
- Role-playing and simulations
- Joint presentation preparation
- Workshops and interactive sessions where students collaboratively engage in hands-on activities, such as mapping exercises, ecological surveys, or sustainability audits.
- Group discussions and brainstorming:

Rubrics

Likert scale (1-5) is used.

TITLE	**Nature-Based solutions as a way to value natural resources**		
AREA OF SCIENCE	Environmental Engineering		
TEACHING METHODOLOGY TO BE USED	The lesson is divided into two periods of 90 minutes + 90 minutes. The first period will be theoretical exploration. In the second period the class will be split up into teams consisting of three to five students. They will work within their teams to complete the activities. Each group will carry out a presentation to justify their conclusions.		
GRADE LEVEL	University Level - Graduation		
AGE OF STUDENTS	18+		
TOTAL TIME	180 minutes (two 90 minutes lectures)	**PREPARATION TIME: 10**	**TEACHING TIME:** 180
KEY CONCEPTS	Nature-based solutions; Natural Resources; Nature-based solutions; Data Analysis		

Overview

Nature-based solutions (NBS) are approaches that reverse natural resource degradation and biodiversity loss while promoting sustainable development. Across ecosystems, many NBS can also protect people and nature from climate impacts, including shorter-term hazards such as flooding and longer-term threats like desertification. NBS can be used to provide critical services such as wetlands for flood mitigation or mangroves to reduce the impact of waves, storm surge, and coastal erosion.

Student mission

You are an environmental engineer working in a municipality and you need to understand how and why to implement Nature-Based Solutions.

21st century technical skills gained through this activity

- Problem solving
- Practical analysis
- Critical thinking
- Drawing conclusions based on fact
- Inquiry based learning
- Computational thinking

Related job roles

- Environmental engineer
- Biologist
- Environmental technician
- Conservationist
- Ecologist
- Urban Planner
- Climate change scientist
- Hydrologist
- Sustainability consultant

Differentiation strategies to meet diverse learning needs:

Students of different abilities will be paired together in teams; peer mentoring method will be employed to help less able students to complete activities.

Time to complete Lesson

Two 90-minute periods (If your lessons are shorter or longer, you can either break this sequence into more lessons or less).

Expected Learning Outcomes

By the end of these lesson, students will:

- Understand several concepts and definitions linked to the principles of resource management.
- Understand how the patterns of resource depletion affects us and the environment
- Understand the importance of nature-based solution
- Be able to identify the main contributors to resource overuse
- Understand how to perform data analysis

Prior knowledge and vocabulary

Sustainability, ecosystems, biosphere, basic concepts on physics, chemistry, biology and mathematics.

Science and Engineering/Math Practices

Provide students with the STEAM model for a real-life example of resource management.

Curriculum Alignment

- Abiotic and biotic natural resources
- Basic principles of resource management
- Usage of resources, effects on the environment and our health, ecological resilience.
- Nature-based solutions, ecosystem services, natural capital, ecological processes, and biological diversity.

Lesson

Lesson 1: Theoretical Exploration of Nature-Based Solutions (NBS)

Engage (15 minutes): Students are given a video link prior to the class, which they will watch at home and will complete an online quiz relating to the video.
Activity: Introduce NBS with a brief discussion on current environmental challenges and how NBS could address these issues.
Questioning: Encourage students to share their initial thoughts on the potential of NBS.

Explore (20 minutes): Lecture: Present key concepts of NBS, natural resource management, and their role in ecosystems. Use diagrams and case studies to illustrate NBS in action.

Explain (25 minutes): Discussion: Delve deeper into the principles of resource management and the patterns of resource depletion. Provide real-life examples of effective NBS implementation.

Elaborate (15 minutes): Research: Students conduct quick research on various NBS and their applications in different environmental scenarios.

Evaluate (15 minutes); Reflection: Students write a short reflection on what they learned and how NBS can be integrated into resource management.

Materials: Computer, Projector, Video link, online quiz
Preparation: [5] Minutes
Facilitation of Learning Experience: [90] Minutes
Transition: [2] Minutes
Before the first period watch the video: https://www.youtube.com/watch?v=C_MCp-Iu2Fw

Lesson 2: Practical Application and Team Presentations

Engage (10 minutes): Recap: Quick review of the previous lesson's key points. Introduction: Explain the format and objectives of the team activity.

Explore (30 minutes): Team Activity: Form teams and assign each a specific NBS scenario to analyse, focusing on implementation, benefits, and challenges.

Explain (20 minutes): Guidance: Offer insights and help teams as they work through their scenarios.

Elaborate (20 minutes): Presentation Preparation: Teams prepare their findings and conclusions in a presentation format.

Evaluate (10 minutes): Presentations: Each team presents their NBS scenario analysis to the class. Peer Review: Conduct a peer review session where students provide feedback on each other's presentations.

Materials: NBS scenarios, PowerPoint
Preparation: [10] Minutes
Facilitation of Learning Experience: [90] Minutes
Transition: [2] Minutes
Teacher will: facilitate the discussion
Students will: ask questions in the form of hypothesis. At the same time, they will take notes

Independent learning tasks (ILT):

Students will:

- Watch the video given to them to enhance their knowledge and complete the related quizzes.
- Research various nature-based solutions implemented globally and write a report on one that particularly interests them
- Work in groups to prepare their presentation or infographic that outlines a proposed nature-based solution for a school or community issue, detailing the expected benefits and challenges.
- Reach out to a local expert in environmental science or a related field to discuss the application of nature-based solutions. Summarise the interview in a report or presentation.
- Answer post class questions

Student feedback

Students will be given feedback on a one-to-one basis in a timely manner. The feedback will reference the skills outcomes that the assessment was designed to test and if the student met those outcomes. It will also take into account feedback from the student on how they found the lesson.

Curriculum mapping of outcomes attained

The knowledge gained in this lesson can be mapped against chemistry, biology, physics, mathematics curricula.

Assessment

Practical, student presentation, time bound assessment and Q&A.

Materials

- Computers
- Projector
- Excel
- Word
- PowerPoint

Preparation

Students should look at the video link provided and complete the online quiz. They should also attempt questions in their notes, Q&A should be conducted by the teacher to ascertain if the students understand the concepts before starting the exercise.

Teamwork

Students will work in teams to research the topics and prepare a presentation for the class regarding the practical exercise. This is an extension of the knowledge base, where students must research more about environmental problems.

Rubrics

Assessment of:

- Autonomy
- Understanding of the associated concepts
- The link between the concepts
- Interdisciplinarity between the STEAM areas
- Content accuracy
- Case study analysis: comprehension and critical thinking

Title	30x30
Subject	Active Citizenship
Topic	Life on Land- SDG no.15
Grade Level	University Level
Age of Students	18+ (adult)- group of teachers
Allocated Time	90 mins
Lesson Objective	Participants will have the opportunity to learn about: • The crucial role of indigenous peoples in implementing SDG No. 15, Life on Land. Indigenous peoples have long been defenders of nature, recognising the importance of biodiversity before it became a global concern. • The history of protected areas and the violence against Indigenous communities. This includes forced evictions, land-grabbing, and exclusion from ancestral grounds for fishing, hunting, and spiritual practices. In the 20th century, 20 million people were displaced from their traditional homelands for conservation purposes, with 14 million of these in Africa alone. • Contemporary controversial schemes like the COP15 Biodiversity Summit's targets. These involve setting aside 30 percent of the world's lands and oceans for nature by 2030 to protect biodiversity. However, these targets fail to commit to protecting the rights of Indigenous Peoples and local communities living in these areas. The 30x30 target may lead to the eviction of Indigenous Peoples and local communities from their ancestral lands, denying them access to essential resources for sustaining their rights to food, health, and land. During the COP meeting in Montreal, the EU proposed that 10% of the 30×30 target be under “strict protection,” allowing extractive industries in the remaining 20%, which are significant drivers of biodiversity loss. It's vital to ensure that protected areas are created with the free, prior, and informed consent of Indigenous Peoples and that they are involved in managing these areas and provided with necessary financial resources. • The importance of protecting biodiversity without compromising the rights and well-being of local communities. • The effective management practices of Triglav National Park, Slovenia’s only national park, which covers 840 km² or 4% of Slovenia. • Ways to raise awareness about SDG No. 15 through activism and empathy.

Expected Outcomes	By the end of this lesson, learners will be able to: • Articulate the pivotal role of indigenous peoples in the implementation of SDG No. 15, Life on Land • Critically analyse the historical context of protected areas • Evaluate contemporary controversial conservation schemes • Debate the importance of balancing biodiversity protection with the rights and needs of local communities • Assess the concept of 'strict protection' versus extractive industry allowances within conservation targets • Identify good practice examples of national park management • Develop strategies to raise awareness about SDG No. 15
Curriculum Alignment	Teacher training
Interdisciplinary Cooperation	The activity combines Sociology, History, Environmental science, Political scince, Human rights and biology. These interdisciplinary connections highlight the complexity of implementing SDG No. 15 and the importance of considering various perspectives and fields of study in developing effective and equitable conservation strategies.
Differentiation Strategies	Several differentiation strategies can be employed to accommodate diverse learning styles and needs, including varied instructional methods, use of technology and media, small group discussions, hands-on activities, tiered assessment, regular feedback and cultural sensitivity.
Teaching Methodology to Be Used	The participants will be divided into teams, each responsible for completing the activities. Each group will deliver a presentation on effective strategies for Official Development Assistance in mitigating Climate Change.
Materials/Tools **Health & Safety**	• Smart Board • Internet connection, Laptop/Mobile phones, • Any practical work, which they carry out is in accordance with current regulations related to health and safety
Resources Used	The activities are followed by a self-assessment sheet. The various resources are listed below: • About Triglav NP (in Slovene language): https://www.delo.si/novice/slovenija/razkosje-gozdov-dolin-planin-in-bistre-vode/ • 30x30 target controversy: https://redd-monitor.org/2022/12/16/the-harsh-reality-of-30x30-the-eu-is-keen-to-allow-extractivism-in-the-30x30-target-but-not-indigenous-peoples-territories/, • 30x30 target controversy: https://www.echo.net.au/2023/02/protecting-biodiversity-will-take-more-than-just-the-30x30-target/, • 30x30 target controversy: https://www.oxfam.org/en/press-releases/cop15-target-30x30-threat-rights-indigenous-peoples-oxfam,

Scenario	An NGO representative with expertise in the theme of Life on Land visits a school to conduct two workshop lessons with the teachers. Prior to the session, teachers are tasked with conducting research and gathering the subsequent data: • What is SDG Life on Land and what does it involve? Discuss why topics of Life on Land are important and collect some examples. Find the role of the European Union and Slovenia in SDG no.15. • What is the impact of nature conservation on the European Union and Slovenia? What is the impact on other continents? Does environmental protection consistently yield favourable outcomes for local populations or indigenous communities? • What are the potential negative consequences that can arise when the local populace is not adequately informed about the establishment of a national park? • Can the conservation aim of 30x30 be attained? According to the findings, it is necessary for groups to provide concise presentations for the workshop, acting as representatives of the NGO. This will allow for the discussion of the findings during the workshop.

Learning Teaching Process

Activity	Procedure	Time
Introduction/Warm Up	• Is the ambitious 30x30 conservation target achievable? https://www.youtube.com/watch?v=EYk0h4ej3ec • Indigenous activist Txai Suruí's full speech at COP26 https://www.youtube.com/watch?v=TP5Nbc5P0GM, • Simple questions and answers	10 mins
Group discussion and team work	• Discuss the consequences of conservation target 30x30 in your area, in the EU, worldwide. • Discuss the findings of participating teachers. • Discuss what constitutes to SDG no.15. Describe the best practices and also practices of mismanagement of nature conservation. Discuss the topic from the point of view of states and from the point of views of local/indigenous population. • Why are they the most efficient protectors of nature?	30 mins
Group discussion and team work	Play the role of participants at the COP conference. Divide participants into representative of states and representatives of civil society groups.	35 mins
Discussion	Discuss what they have learned at the COP conference. Should we continue with 30x30 target and what should we include in it?	5 mins

Assessment	Assessment of the workshop Homework for Teachers to prepare similar lesson plan.	10 mins

Annex I.

Test Your Idea Organiser

Topics	
Investigative Question Your question should relate the manipulated variable to the responding variable.	
Hypothesis Your hypothesis should be written as an "IF, THEN, BECAUSE" statement.	
Variables Manipulated Variable (What you will change) Responding Variable (What you will measure) Controlled Variables (What will remain constant throughout the test)	
Materials Create a list of all materials you need.	
Procedure Should include… Manipulated Variable Responding Variable Controlled Variables Logical, Repeatable Steps Recording of Specific Data Repeated Trials	
Data Design a table for organising data you will be collecting during your test. Use your procedure to collect and record data. Display your data using appropriate graphs and/or charts.	
Conclusion State your conclusion relating the manipulated variable to the responding variable. Use data to justify your conclusion. State whether your hypothesis can be accepted or rejected based on observed data.	
Analysis Discuss potential sources of error and the potential influence on your results.	

Provide ideas on how and why the experimental design might be improved. Describe surprising data. List ideas for revising your test idea or new related ideas to test.	
Present your findings to your class.	

Contact Details

SDG'S PROJECT

Web: http://www.steamsustainablegoals.eu/

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