

WP3: ECOTEACH Virtual Classroom



HANDS-ON EXERCISES
Practical Activities for
Environment-Based STEM Learning



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Teaching Science and Maths through Innovative Models of Environment-Based Learning for Disadvantaged Schools and Students (ECOTEACH)

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Summary

This document presents the Hands-On Exercises developed under Work Package 3 / Activity 5 (WP3/A5) of the ECOTEACH project. It provides a collection of practical educational activities designed to support teachers and educators in implementing Environment-Based Learning (EBL) approaches to Science and Mathematics, particularly in disadvantaged schools and educational contexts.

The Hands-On Exercises are organised around the six ECOTEACH Learning Units established within the Learning Outcomes Framework. They cover a diverse range of environmental and sustainability topics and combine STEM learning with observation, experimentation, data collection and analysis, problem-solving, digital tools, project-based learning and community engagement.

Each activity provides practical guidance for implementation, including its learning objectives, competences, target group, duration, materials and resources, implementation procedure, inclusion and adaptation considerations, and assessment suggestions. The activities are designed to be flexible, inclusive and transferable, allowing teachers to adapt them to different learners, educational settings and available resources.

As part of the ECOTEACH Virtual Classroom, the Hands-On Exercises translate the project's pedagogical principles and Learning Outcomes into practical learning experiences, helping learners connect Science and Mathematics with real environmental challenges and their local surroundings.

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Introduction

The ECOTEACH Hands-On Exercises (WP3/A5) have been developed to translate the project's pedagogical framework and Learning Outcomes into practical Environment-Based STEM learning experiences. They provide teachers and educators with ready-to-use activities that connect Science and Mathematics with environmental issues, sustainability challenges and learners' everyday surroundings.

The activities promote active, experiential and inquiry-based learning, encouraging learners to observe, investigate, measure, experiment, analyse data, solve problems and collaborate. Depending on the activity, they may take place in the classroom, school grounds, outdoor environments or the wider community and may incorporate digital tools and resources where appropriate.

Particular attention is given to inclusion and adaptability. The exercises are designed to support different age groups, learning needs, school contexts and levels of access to materials and technology, with specific consideration for disadvantaged learners and low-resource educational environments.

The collection is organised according to the six ECOTEACH Learning Units, ensuring direct continuity between the Learning Outcomes Framework, the Conceptual and Pedagogical Framework and the practical implementation of Environment-Based Learning within the ECOTEACH Virtual Classroom.

Purpose and Use of the Hands-On Exercises

The ECOTEACH Hands-On Exercises are designed as practical and adaptable resources for teachers and educators wishing to integrate Environment-Based Learning into Science and Mathematics education. They can be used to complement regular classroom teaching, support specific Learning Units or provide stand-alone activities linked to environmental and sustainability challenges.

Teachers may select the exercises according to the age and needs of their learners, curriculum objectives, available time, resources and educational context. Activities can be implemented individually or combined with other ECOTEACH resources and may be adapted to classroom, outdoor, school or community-based learning environments.

The exercises are not intended as rigid lesson plans. Educators are encouraged to adapt their duration, materials, level of complexity, digital tools and implementation procedures while maintaining the main Learning Objectives and pedagogical purpose of each activity. Particular attention should be given to ensuring meaningful participation for disadvantaged learners and students with different learning needs.

Through their practical application, the Hands-On Exercises aim to strengthen the connection between STEM knowledge, environmental awareness and real-life experience, promoting active participation, collaboration, critical thinking, problem-solving and learner engagement.

Structure of the Hands-On Exercises

All ECOTEACH Hands-On Exercises follow a common structure to ensure consistency, usability and easy adaptation across the six Learning Units. Each activity provides the essential information teachers and educators need to understand, prepare, implement and evaluate the proposed learning experience.

Each Hands-On Exercise includes:

- Activity overview: title, Learning Unit, target age group, STEM area(s), environmental topic and estimated duration.
- Learning objectives and competences: the main knowledge, skills and competences addressed through the activity.
- Activity description: a concise explanation of the purpose, context and expected learning experience.
- Materials and resources: equipment, materials, digital tools and supporting resources required for implementation.
- Implementation procedure: clear steps for preparing, carrying out and completing the activity.
- Inclusion and adaptation: guidance for adapting the activity to different learners, educational contexts, available resources and levels of digital access.
- Assessment: suggested methods for observing, reflecting on or evaluating learners' participation, progress and learning.
- Supporting materials: additional worksheets, links, templates or resources where relevant.

This common structure allows educators to quickly identify suitable activities and adapt them to their own teaching context, while maintaining alignment with the ECOTEACH Learning Outcomes and pedagogical principles.

Overview of the Hands-On Exercises

The ECOTEACH Hands-On Exercises provide a diverse collection of practical activities organised around the **six Learning Units of the project**. Together, they address different dimensions of Environment-Based STEM learning, including environmental observation, experimentation, Mathematics and data analysis, digital technologies, sustainability, community engagement and assessment.

The following overview presents the activities included in each Learning Unit and provides a quick reference for educators before exploring the complete activity sheets.

ECOTEACH Hands-On Exercises — Overview by Learning Unit

Learning Unit	Hands-On Exercises
LU1 – Foundations of Environment-Based Learning (EBL) in STEM Education	● My school as an environmental laboratory ● Environmental detectives: Spot the sustainability challenge ● Where do we see mathematics in nature? ● Our daily water journey
LU2 – Designing Inclusive STEM Learning Activities through EBL	● Eco-Art: How can nature's palette inspire sustainable art? ● Which soil helps plants grow better? ● How can native plants help us create a pollinator-friendly school garden? ● Eco-Odyssey: Reimagining Homer's Islands through STEM, biodiversity and sustainable Design ● 30-Minute Bio-Blitz ● Water Detectives
LU3 – Integrating Mathematics and STEM Content into EBL	● Measuring water waste at school ● How can our school save energy? (Measuring and Saving Energy at School) ● Measuring and redesigning a sustainable schoolyard ● How can we represent nature using scale?

Learning Unit	Hands-On Exercises
LU4 – Digital Tools and Resources for Enhancing EBL in STEM	● Climate change data detectives: exploring local climate trends through digital data analysis ● Smart biodiversity mapping: exploring local ecosystems with digital tools ● Air quality detectives: investigating urban pollution through digital environmental monitoring ● Design a smart sustainable school: A digital STEM innovation challenge
LU5 – Community Engagement and Project-Based Learning in EBL	● Biodiversity detectives: exploring local ecosystems through environmental observation ● Food miles investigation: From farm to plate ● Community waste audit: Investigating waste generation and promoting circular economy ● Adopt a green space: A community action project for biodiversity and sustainability
LU6 – Assessment and Impact Evaluation of EBL in Disadvantaged Contexts	● Co-design of an EBL observation checklist ● Reflection circles ● Measuring connection to nature using the inclusion of nature in self (INS) scale ● Evaluating an EBL Activity Using the NAAEE eeVAL Libraries

Learning Unit 1: Foundations of Environment-Based Learning (EBL) in STEM Education

Learning Unit 1 introduces the practical application of Environment-Based Learning (EBL) by using the school and its surroundings as real-world contexts for STEM learning. The Hands-On Exercises encourage learners to observe, investigate and interpret environmental phenomena while connecting Science and Mathematics with everyday experiences.

Through activities focused on the school environment, sustainability challenges, patterns in nature and water use, learners develop environmental awareness, inquiry skills, problem-solving and the ability to connect STEM concepts with their local surroundings.

Learning Unit 1: Hands-On Exercise 1 *My school as an environmental laboratory*

Field	Activity information
Target age group / educational level	11–14
STEM area(s)	Interdisciplinary STEM
Environmental topic / sustainability theme	Sustainability / Environmental Awareness
Learning objectives	• Develop students' understanding of the school environment as a meaningful learning space for STEM education through Environment-Based Learning (EBL). • Investigate natural and human-made environmental features by conducting structured observations and simple inquiry activities within the school environment. • Recognise relationships between environmental quality, sustainability, and everyday human behaviours by identifying both positive practices and environmental challenges.

	● Strengthen scientific observation, questioning, data recording, and evidence-based discussion skills through collaborative environmental exploration. ● Foster environmental responsibility, teamwork, and critical thinking by proposing practical and achievable actions that could improve the sustainability of the school environment.
Competences developed	<u>STEM competences</u> ● Scientific observation and inquiry. ● Data collection, recording, classification, and interpretation. ● Application of STEM concepts to authentic environmental contexts. <u>Environmental competences</u> ● Awareness of local environmental issues. ● Appreciation of the school as a living environmental laboratory. <u>Digital competences</u> ● Digital documentation through photographs or short videos. <u>Transversal competences</u> ● Collaboration and teamwork. ● Critical and reflective thinking. ● Communication and presentation skills. ● Creativity in proposing sustainable solutions. ● Active citizenship and shared responsibility.
Estimated duration	2 Lesson Hours (90 minutes) ● 30 minutes for preparation and introduction ● 40 minutes for environmental investigation ● 20 minutes for group presentations and reflection
Activity overview	Students transform their school into an authentic environmental laboratory by conducting a structured exploration of different school areas, including classrooms, corridors, playgrounds, gardens, cafeterias, and outdoor spaces. Working collaboratively in heterogeneous groups, they observe environmental conditions, identify examples of sustainable and unsustainable practices, and document their findings using observation sheets and digital photographs. Groups analyse their observations and develop realistic recommendations to improve the environmental sustainability of their school. Rather than focusing on identifying "correct"

	answers, students engage in inquiry, discussion, and evidence-based reasoning while recognising the strong connections between STEM learning and their everyday surroundings. The activity promotes inclusive, low-cost, and place-based learning, allowing every student to actively participate regardless of academic level or available resources. Students compile their observations into a collaborative digital sustainability board using Padlet, creating a shared environmental profile of their school.
Materials and resources	● Environmental Observation Worksheet ● Clipboards or notebooks ● Pencils and coloured markers ● School map (optional) ● Smartphones or tablets for photographs ● Sticky notes ● Large poster paper for group presentations
Digital tools	● Smartphones or tablets for photographing observations. ● Padlet for creating a collaborative "Our Sustainable School" digital wall. ● Google Maps or Google Earth (optional) to explore the wider neighbourhood and compare environmental features. ● Canva (optional) for designing digital sustainability posters.
Implementation procedure	<u>1. Preparation</u> The teacher introduces the concept of Environment-Based Learning (EBL) and explains that the school itself can become a valuable STEM learning environment. Students discuss the driving question: <i>"How environmentally sustainable is our school, and how can we make it even better?"</i> The teacher presents examples of environmental aspects students should observe, such as biodiversity, waste management, energy use, water use, green spaces, and environmental cleanliness. Students are organised into heterogeneous groups and each group is assigned a different observation area. <u>2. Implementation</u>

	Each group conducts a structured environmental investigation using the observation worksheet. Students identify both positive environmental practices and areas needing improvement by observing features such as recycling bins, green areas, lighting, water use, litter, biodiversity, and evidence of sustainable behaviours. Students document their findings through notes, sketches, measurements (where appropriate), and photographs. Group members discuss the possible causes of the environmental issues they identify and collaboratively develop practical recommendations for improvement. Following the field investigation, groups organise their findings into a simple sustainability report highlighting: ● environmental strengths, ● environmental challenges, ● proposed solutions, ● expected positive impacts. <u>3. Follow-up</u> Each group presents its sustainability report to the class. Students compare similarities and differences among the investigated areas and discuss which recommendations could realistically be implemented within the school. Groups upload selected photographs, observations, and improvement ideas to a shared Padlet wall, creating a collaborative digital "Environmental Profile of Our School." As an extension activity, students may present their recommendations to school administrators or organise a small environmental awareness campaign within the school community.
Inclusion and adaptation	Flexible group roles (Observer, Photographer, Recorder, Presenter, Sustainability Advisor) allow every learner to contribute according to their strengths and preferences. Students with language barriers or learning difficulties may communicate through photographs, drawings, symbols, or oral explanations rather than lengthy written reports. Indoor observation routes can be used where outdoor access is limited, ensuring full participation regardless of school infrastructure or weather conditions.

Assessment	Assessment is formative and focuses on inquiry, participation, and collaborative learning rather than factual recall. The main assessment tool is the <u>School Sustainability Observation Portfolio</u>, where teachers evaluate the quality of observations, evidence collected, environmental reasoning, and feasibility of the proposed recommendations.
Additional resources	● School Environmental Observation Worksheet ● Sustainability Investigation Checklist ● School Mapping Template ● Padlet Collaborative Board

Learning Unit 1: Hands-On Exercise 2

Environmental detectives: spot the sustainability challenge

Field	Activity information
Target age group / educational level	11–14
STEM area(s)	Science
Environmental topic / sustainability theme	Sustainability / Pollution
Learning objectives	● Investigate the school environment to identify examples of sustainable and unsustainable everyday practices through structured observation and inquiry. ● Develop scientific observation and critical thinking skills by analysing how human behaviours influence environmental quality. ● Strengthen problem-solving abilities by identifying realistic environmental challenges and proposing practical, evidence-based solutions. ● Promote environmental awareness by recognising the connections between daily actions, resource consumption, waste generation, and sustainability.

	● Foster collaboration, communication, and shared responsibility through cooperative environmental investigation and decision-making.
Competences developed	<u>STEM competences</u> ● Identification and classification of environmental issues. ● Problem-solving through inquiry-based learning. ● Evidence collection and interpretation. <u>Environmental competences</u> ● Recognition of local environmental challenges. ● Development of environmentally responsible attitudes and behaviours. <u>Digital competences</u> ● Digital documentation using photographs or short videos. ● Collaborative presentation of findings using digital platforms. <u>Transversal competences</u> ● Teamwork and collaborative decision-making. ● Critical and reflective thinking. ● Communication and presentation skills.
Estimated duration	2 Lesson Hours (90 minutes) ● 20 minutes for preparation and introduction ● 40 minutes for environmental investigation ● 20 minutes for group discussion, presentations and reflection
Activity overview	Students become "Environmental Detectives" and investigate different areas of their school to identify environmental challenges and examples of sustainable behaviour. Working in heterogeneous teams, they examine locations such as classrooms, hallways, playgrounds, gardens, cafeterias, and school entrances using an environmental investigation checklist. Groups search for evidence of issues such as unnecessary energy use, excessive waste, littering, water wastage, lack of recycling facilities, or positive sustainability practices already implemented within the school. Students collect evidence through observation, notes, sketches, and photographs before discussing the possible causes and environmental impacts of their findings.

	Each group prepares an "Environmental Investigation Report" summarising the challenges identified and proposing realistic actions that could improve the sustainability of the school. Their reports are shared through a collaborative Padlet wall, creating a digital collection of student-led sustainability recommendations.
Materials and resources	● Environmental Investigation Checklist ● Clipboards or notebooks ● Pencils and coloured markers ● Sticky notes ● Smartphones or tablets for documentation ● Large poster paper ● Printed school map (optional)
Digital tools	● Smartphones or tablets for photographing environmental observations. ● Padlet for sharing investigation reports and sustainability recommendations. ● Canva (optional) for creating digital awareness posters. ● Google Forms (optional) for collecting and comparing group findings.
Implementation procedure	<u>1. Preparation</u> The teacher introduces the concept of environmental sustainability and explains that students will become "Environmental Detectives" responsible for investigating how sustainable their school environment is. Students are introduced to the investigation checklist, which includes examples such as energy use, waste management, recycling, water use, green spaces, and environmental cleanliness. The teacher organises students into heterogeneous groups and assigns each group a specific investigation area. <u>2. Implementation</u> Working collaboratively, each group investigates its assigned area using the checklist. Students carefully observe their surroundings and record examples of both sustainable and unsustainable practices. They may identify overflowing bins, unnecessary lights left on, leaking taps, litter, damaged plants, recycling facilities, or environmentally friendly initiatives already in place. They then prioritise the most significant challenges and collaboratively develop realistic, low-cost recommendations

	that could improve environmental sustainability within the school. Finally, each group prepares an "Environmental Investigation Report" summarising: • environmental strengths; • sustainability challenges; • supporting evidence; • suggested improvement actions. <u>3. Follow-up</u> Groups present their investigation reports to the class, explaining both the evidence they collected and the reasoning behind their recommendations. Students compare findings from different areas of the school and discuss which actions would have the greatest positive environmental impact. The reports and photographs are uploaded to a shared Padlet wall, creating a collaborative digital "School Sustainability Investigation." As an extension activity, students may present their recommendations to school administrators or organise a student-led environmental awareness campaign encouraging positive behavioural change.
Inclusion and adaptation	This activity is designed to maximise participation by focusing on observation, discussion, and collaborative problem-solving rather than written academic performance. Because the investigation relies on everyday school environments and low-cost materials, it is highly suitable for disadvantaged schools and resource-limited educational settings.
Assessment	The primary assessment tool is the Environmental Investigation Report, where teachers evaluate the quality of observations, evidence collected, environmental analysis, and practicality of the proposed sustainability actions. Peer feedback and short self-reflection activities may also be included to encourage students to evaluate both their learning process and their contribution to the investigation.
Additional resources	• Padlet Investigation Wall • School Eco-Audit Poster Template

Learning Unit 1: Hands-On Exercise 3

Where do we see Mathematics in Nature?

Field	Activity information
Target age group / educational level	11–14
STEM area(s)	Mathematics
Environmental topic / sustainability theme	Sustainability / Nature
Learning objectives	• Explore how mathematical concepts can be observed and applied in natural environments through direct observation and measurement. • Recognise geometric shapes, symmetry, patterns, proportions, and measurement opportunities within the schoolyard or local environment. • Develop mathematical reasoning by collecting, comparing, estimating, and interpreting real-world environmental data. • Strengthen observation and inquiry skills by connecting mathematics to authentic environmental phenomena. • Foster appreciation of the role of mathematics in understanding, describing, and protecting the natural world through collaborative outdoor learning.
Competences developed	• Mathematical observation and reasoning • Measurement, estimation and comparison • Awareness of natural patterns and biodiversity • Understanding relationships between mathematical structures and environmental systems
Estimated duration	60-75 minutes • 10-15 minutes for introduction • 30-40 minutes for investigation • 10-20 minutes for discussion and presentations
Activity overview	Students investigate how mathematics is embedded in the natural world by exploring the schoolyard or another nearby

	outdoor environment. Working in heterogeneous groups, they search for examples of mathematical concepts such as symmetry, geometric shapes, repeating patterns, angles, proportions, measurements, shadows, and estimation opportunities. Students record their observations through notes, sketches, measurements, and photographs before discussing how mathematical ideas help scientists understand natural systems. The activity demonstrates that mathematics is not confined to textbooks but serves as a practical tool for observing, describing, and interpreting the environment. Groups present their discoveries through mathematical posters or digital presentations, encouraging reflection on the close relationship between mathematics, science, and sustainability.
Materials and resources	● Rulers ● Measuring tapes ● Notebooks ● Pencils and colored markers ● Digital cameras or smartphones ● Natural objects collected from the school garden
Digital tools	● GeoGebra for exploring geometric relationships and measurements. ● Google Photos or smartphone cameras for documenting mathematical examples in nature. ● Canva (optional) for creating digital mathematics posters. ● Padlet (optional) for sharing group findings.
Implementation procedure	<u>1. Preparation</u> The teacher introduces the idea that mathematics exists naturally in the environment and encourages students to observe the world through a mathematical perspective. Students review examples of mathematical concepts that may appear outdoors, including symmetry, geometric shapes, repeating patterns, measurement, estimation, angles, and proportional relationships. The teacher organises students into heterogeneous groups and distributes observation sheets and measuring equipment. <u>2. Implementation</u>

	Groups explore their assigned outdoor area, searching for examples of mathematics within natural and built environmental features. Students investigate objects such as leaves, flowers, tree trunks, branches, stones, spider webs, shadows, pavements, and buildings. Groups identify examples of bilateral symmetry, repeating patterns, circles, triangles, angles, spirals, and other geometric forms. Students discuss how these mathematical patterns help scientists describe, measure, and better understand environmental systems. Each group prepares a short presentation highlighting the mathematical concepts they identified and explaining how these concepts appear in nature. Students compare observations between groups and discuss similarities and differences in the mathematical patterns they discovered.
Inclusion and adaptation	If outdoor access is limited, the activity can be adapted by using natural materials collected beforehand or by analysing photographs of local environments within the classroom. This flexibility makes the activity suitable for disadvantaged schools and diverse learning contexts.
Assessment	Assessment evidence may include observation sheets, recorded measurements, photographs, mathematical diagrams, group presentations, and individual reflections on how mathematics supports environmental understanding.
Additional resources	• GeoGebra Activities • Nature Geometry Identification Cards

Learning Unit 1: Hands-On Exercise 4

Our daily water journey

Field	Activity information
Target age group / educational level	8-10/ 11–14

STEM area(s)	Interdisciplinary STEM
Environmental topic / sustainability theme	Water conservation
Learning objectives	● Investigate how water is supplied, used, and managed within the school environment through observation and inquiry. ● Develop systems thinking by exploring the journey of water from its source to its different points of use and disposal. ● Understand the importance of responsible water consumption and identify opportunities to reduce water waste in everyday school life. ● Strengthen scientific observation, data collection, and communication skills through collaborative environmental investigation. ● Foster environmental responsibility by proposing realistic and sustainable water conservation actions for the school community.
Competences developed	● Problem-solving through real-life environmental contexts. ● Awareness of water conservation opportunities. ● Development of environmentally responsible behaviors. ● Collaboration and teamwork. ● Digital creation of water flow diagrams and visual presentations.
Estimated duration	60-80 minutes ● 15-20 minutes for preparation and introduction ● 30-40 minutes for environmental observation and investigation ● 10-20 minutes for group presentations and reflection
Activity overview	Students investigate the journey of water throughout their school by observing where water comes from, how it is used, and what happens after it has been consumed. Working in heterogeneous groups, students explore different locations such as bathrooms, drinking fountains, cafeterias, gardens, and outdoor areas to identify how water supports everyday school activities. Groups create a simple water flow diagram illustrating the movement of water through the school environment and identify

	locations where water may be wasted or used inefficiently. Based on their observations, students develop practical recommendations for reducing water consumption and promoting sustainable water use. The activity helps students understand water as part of an interconnected environmental system while demonstrating how STEM can support sustainable resource management through real-life investigation.
Materials and resources	● Water Journey Observation Worksheet ● Clipboards or notebooks ● Large sheets of paper ● Markers or colored pencils ● Smartphones or tablets for photographs ● Sticky notes
Digital tools	● Canva for designing digital water flow diagrams or awareness posters. ● Google Drawings for creating water system maps. ● Smartphones or tablets for documenting observations through photographs. ● Padlet (optional) for sharing group findings and conservation ideas.
Implementation procedure	<u>1. Preparation</u> The teacher introduces the importance of freshwater as a limited natural resource and explains how understanding water systems can help people use water more responsibly. Students discuss their initial ideas before being organised into heterogeneous groups. Each group receives an observation worksheet and is assigned one or more locations within the school where water is used. <u>2. Implementation</u> Groups investigate different areas of the school, including bathrooms, drinking fountains, cafeterias, gardens, and outdoor spaces. Students observe how water is used, identify possible sources of water waste, and record their observations through notes, sketches, or photographs. After completing the investigation, students collaboratively create a simple water journey diagram showing the movement of water through the school.

	Each group presents its water journey diagram and explains the main opportunities they identified for improving water conservation. Students compare findings across different school locations and discuss which recommendations would have the greatest positive environmental impact.
Inclusion and adaptation	As the activity relies primarily on observation and inexpensive classroom materials, it is highly adaptable to disadvantaged schools and low-resource educational settings. If access to outdoor areas is limited, students can investigate indoor water use or analyse photographs and school plans instead.
Assessment	Teachers may assess students using a <u>Water Journey Investigation Rubric</u> , considering: understanding water flow systems, identification of water conservation opportunities, effectiveness of collaboration.
Additional resources	• Canva water infographic template

Learning Unit 2: Designing Inclusive STEM Learning Activities through Environment-Based Learning

Learning Unit 2 focuses on the practical application of inclusive Environment-Based Learning (EBL), ensuring that STEM activities are accessible, engaging and meaningful for learners with different needs, abilities and backgrounds. The Hands-On Exercises encourage active participation through flexible, collaborative and experiential learning approaches connected to real environmental contexts.

Through activities combining environmental exploration, experimentation, creativity and problem-solving, learners develop STEM competences while working together in inclusive learning environments. Particular attention is given to participation, accessibility and adaptation, allowing every learner to contribute according to their abilities, strengths and learning needs.

Learning Unit 2: Hands-On Exercise 1 Eco-Art: How can Nature's palette inspire sustainable art?

Field	Activity information
Target age group / educational level	11–14
STEM area(s)	Science (Organic Chemistry and Biology of Plant Pigments), Arts (Visual Arts & Eco-Design)
Environmental topic / sustainability theme	Waste Reduction, Circular Economy, Biodegradable Materials, Natural Resource Awareness
Learning objectives	- Investigate how natural pigments can be extracted from local flora and organic waste through sustainable methods. - Understand the chemical and biological concepts behind natural pigments (e.g., chlorophyll and anthocyanins) and explore their environmental advantages compared to synthetic dyes.

	● Develop artistic skills by experimenting with non-traditional, eco-friendly mediums and textures. ● Foster creative communication and problem-solving skills by designing visual art with a clear environmental message. ● Work effectively in collaborative, heterogeneous groups to share resources, ideas, and responsibilities
Competences developed	<u>STEM/Arts competences:</u> Inquiry and extraction techniques, scientific observation of organic matter, artistic composition, and creative expression. <u>Environmental competences:</u> Deep awareness of resource lifecycle, appreciation for natural alternatives to chemical pollutants, and commitment to zero-waste practices. <u>Digital competences:</u> Digital documentation of experimental stages and collaborative online sharing. <u>Transversal competences:</u> Teamwork, appreciation for diverse creative perspectives, critical thinking, and social responsibility through environmental art activism.
Estimated duration	Approximately 4 teaching periods (2 periods for collection and pigment extraction, 2 periods for art creation and presentation).
Activity overview	Students explore the intersection of science and visual arts by creating eco-friendly paints from local natural resources and household organic waste. Working in heterogeneous teams, they collect leaves, flower petals, soil, or kitchen scraps (e.g., onion skins, coffee grounds, turmeric) and use basic inquiry methods (crushing, filtering) to extract vibrant natural pigments. Using these handmade watercolor paints, groups collaborate to design a poster or collage that communicates a powerful message about environmental sustainability and conservation. The activity highlights inclusive, low-cost learning, allowing all students to actively participate and excel through hands-on, sensory creativity, regardless of their academic background or resource availability. The final artwork and the extraction process are documented on a shared Padlet wall, forming a digital eco-art exhibition.
Materials and resources	● Organic materials from the school yard (leaves, fallen petals, soil)

	● Kitchen food waste (onion skins, red cabbage scraps, used coffee grounds, turmeric powder) ● Mortars and pestles (or smooth stones/cups for crushing) ● Warm water, small strainers or coffee filters, and small containers/jars ● Heavy drawing paper or recycled cardboard Paintbrushes (or natural tools like twigs and cotton swabs) ● Smartphones or tablets for documentation
Digital tools	● Smartphones or tablets for photo and video documentation of the extraction process. ● Padlet for sharing the final artwork and creating a collaborative digital eco-art gallery.
Implementation procedure	<u>1. Preparation</u> The teacher introduces the historical context of natural dyes and discusses the environmental impact of chemical paints. Students are introduced to the driving question: "How can we use nature's hidden palette to create art that protects the planet?" Students bring organic kitchen scraps from home or collect fallen plant material from the school grounds. <u>2. Implementation</u> In heterogeneous groups, students sort their materials by color. They crush the organic matter using mortars or simple tools, mix it with a small amount of warm water, and filter the mixture to obtain clean, liquid pigments. Groups experiment with the intensity of their colors on paper. Once ready, they brainstorm and collaboratively paint a large poster or canvas illustrating a specific environmental theme (e.g., climate action, biodiversity). <u>3. Follow-up</u> Groups present their "Eco-Masterpieces" to the class, explaining the science behind their color palette (which material produced which color) and the artistic choices behind their sustainability message. Students photograph their artwork and the step-by-step extraction process, uploading them to a shared Padlet wall to host a virtual, school-wide eco-art exhibition. The artworks may also be displayed in a school eco-art exhibition to raise awareness about sustainable consumption, waste reduction and the creative reuse of natural resources.

Inclusion and adaptation	This highly sensory and tactile activity removes traditional academic and language barriers, making it exceptionally accessible to kinesthetic learners, students with diverse learning needs, or neurodivergent students. Since the materials are completely free and sourced from nature or waste, the exercise ensures total equity and inclusion in low-resource educational settings. Group roles are flexibly assigned (e.g., Material Collector, Pigment Extractor, Lead Designer, Presenter) to highlight and value the unique strengths of every individual student.
Assessment	Assessment is formative and balances artistic effort, scientific inquiry, and collaboration. The main evaluation tool is the <u>Group Eco-Art & Process Portfolio (on Padlet)</u> , where teachers look at the experimental approach to making the paints and the clarity of the environmental message. A <u>Eco-Art Creation & Collaboration Rubric</u> will evaluate inclusive cooperation, resource sharing, and peer support during the group tasks.
Additional resources	• Natural Pigment Extraction Cards • Eco-Art Planning Sheet • Padlet Gallery • Eco-Art Exhibition Template

Learning Unit 2: Hands-On Exercise 2

Which soil helps plants grow better?

Field	Activity information
Target age group / educational level	11–14
STEM area(s)	Science
Environmental topic / sustainability theme	Biodiversity, Sustainability
Learning objectives	• Investigate how different soil types affect plant growth through hands-on experimentation.

	● Identify the characteristics of different soils and explore their suitability for supporting plant life. ● Understand the importance of soil quality for biodiversity, sustainable agriculture and environmental sustainability. ● Develop inquiry, observation and problem-solving skills through collaborative scientific investigation. ● Work effectively in groups to share ideas, compare observations and draw conclusions based on evidence.
Competences developed	<u>STEM competences</u> ● Inquiry and experimentation skills ● Observation and scientific investigation skills ● Problem-solving skills in environmental contexts <u>Environmental competences</u> ● Understanding the role of soil in supporting plant life and biodiversity ● Awareness of sustainable environmental practices and natural resource management <u>Digital competences</u> ● Basic use of digital tools for documenting observations and sharing findings <u>Transversal competences</u> ● Collaboration and teamwork ● Inclusive participation and respect for diverse perspectives ● Communication and critical thinking skills ● Responsibility and active engagement in environmental issues
Estimated duration	Approximately 4 teaching periods implemented over a two-week period.
Activity overview	Students investigate how different soil types influence plant growth through a hands-on environmental experiment. Working in heterogeneous groups, they plant seeds in different soil samples and observe their development over a two-week period. Through observation, discussion and collaborative inquiry, students explore the relationship between soil quality, plant health and environmental sustainability. The activity promotes inclusive STEM learning by providing meaningful participation opportunities for learners with diverse abilities, backgrounds and learning needs. Using low-cost and easily accessible materials, the activity can be implemented in disadvantaged and low-resource educational settings, ensuring

	that all students can actively engage in scientific investigation and collaborative learning. The activity culminates in the creation of a shared Padlet wall where each group uploads photos, observations, plant growth records and evidence-based conclusions, creating a collaborative digital portfolio of the class investigation.
Materials and resources	● Recycled plastic cups, yoghurt containers or small pots ● Different soil samples collected from the local environment ● Low-cost seeds (e.g., beans or lentils) ● Water ● Labels and markers ● Observation worksheet ● Ruler ● Student notebook
Digital tools	● Smartphones or tablets with mobile applications for photo documentation. ● Padlet for sharing observations, photos, and reflections throughout the activity. ● Google Classroom (optional) for communication and sharing materials, platforms or multimedia resources ● Google Sheets or Excel (optional) for recording plant growth observations
Implementation procedure	<u>1. Preparation</u> The teacher introduces the inquiry question and explains the purpose of the investigation. Students are invited to bring different soil samples from their home gardens, neighbourhoods or local environments, as well as recycled containers that can be used as plant pots. The teacher prepares seeds, observation sheets and the materials required for the activity. <u>2. Implementation</u> Working in heterogeneous groups, students plant the same type of seeds in different soil samples and predict which soil will support plant growth more effectively. Over a two-week period, they observe the plants, record changes in their science notebooks and upload photos, observations and reflections to a shared Padlet wall. Students compare observations, discuss differences in plant development and reflect on possible explanations.

	<u>3. Follow-up</u> Groups present their findings to the class and discuss how soil quality influences plant growth, biodiversity, and environmental sustainability. Students compare their initial predictions with the final results and reflect on the importance of healthy soils for ecosystems and sustainable agriculture. Finally, students synthesize their quantitative data (e.g., calculating the average growth rate across different samples) and upload their final charts and conclusions to the shared Padlet wall, completing their collaborative digital portfolio.
Inclusion and adaptation	Students work in heterogeneous groups with clearly assigned roles such as observer, recorder, gardener and presenter, ensuring meaningful participation for all learners. Instructions are provided both orally and in written form, while observation sheets can be simplified or supported with visual cues when needed. The activity uses low-cost and easily accessible materials, making it suitable for disadvantaged learners and low-resource school settings. Soil samples can be collected from local environments, while recycled containers can be used instead of commercial plant pots. The activity can be implemented in both rural and urban schools and can be adapted to different educational levels by adjusting the complexity of the inquiry questions and the observation tasks. In disadvantaged educational settings, where access to digital tools may be limited, the shared Padlet can be replaced by a classroom display board where students present their handwritten observation sheets, photographs, plant growth records and conclusions.
Assessment	Assessment is formative and continuous throughout the 2-week period. The primary evaluation tool is the <u>Student Plant Growth Journal</u>, where teachers assess the accuracy of students' daily measurements, data organization, and evidence-based conclusions. Additionally, teachers can utilize a structured <u>Soil Investigation Observation Rubric</u> to monitor active collaboration, inquiry skills, and individual engagement during group tasks. Peer-assessment and self-reflection are also encouraged through short reflection questions at the end of the activity.

Additional resources	• Educational videos on plant growth, soil types and biodiversity (e.g., National Geographic Education, BBC Bitesize, SciShow Kids). • Local environmental education resources related to soil, agriculture and biodiversity. • Observation worksheets and plant growth journals developed by the teacher. • Padlet wall containing students' photos, observations and reflections throughout the investigation. • Optional multimedia resources on sustainable agriculture and healthy soils. • Shared Padlet wall containing students' photos, observations, plant growth records and evidence-based conclusions.
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Learning Unit 2: Hands-On Exercise 3
**How can native plants help us create a
 Pollinator-Friendly School Garden?**

Field	Activity information
Target age group / educational level	11–14
STEM area(s)	Science / Biology/ Interdisciplinary STEM
Environmental topic / sustainability theme	Biodiversity, Pollinator Protection, Native Plants, Sustainable School Environments
Learning objectives	• Investigate the characteristics of native plant species and their role in supporting local biodiversity. • Explore the relationship between flowering plants and pollinators such as bees, butterflies and other insects. • Understand the importance of native plants for sustainable ecosystems and environmental conservation. • Develop inquiry, observation, research and problem-solving skills through collaborative investigation.

	• Participate in the design and creation of a pollinator-friendly school garden using environmentally responsible practices. • Work collaboratively to collect information, share ideas and communicate findings.
Competences developed	<u>STEM competences</u> Inquiry and research skills Observation and data collection skills Environmental problem-solving skills Design thinking and planning skills <u>Environmental competences</u> • Understanding biodiversity and ecosystem services • Awareness of pollinator conservation • Knowledge of native plant species and sustainable landscaping practices <u>Digital competences</u> • Information searching and evaluation • Digital documentation of findings • Use of collaborative digital tools <u>Transversal competences</u> • Collaboration and teamwork • Communication skills • Critical thinking • Active citizenship and environmental responsibility
Estimated duration	Approximately 4 teaching periods plus optional implementation time for garden creation and maintenance.
Activity overview	Students investigate native plant species that are well adapted to their local environment and explore how these plants support pollinators such as bees and butterflies. Working in heterogeneous groups, they research plant characteristics, flowering periods, water requirements and ecological benefits. Based on their findings, students collaboratively design and create a small pollinator-friendly school garden. Informational signs are prepared for each plant, presenting key environmental information and raising awareness within the school community. The activity promotes inclusive STEM learning through authentic environmental action and community engagement.
Materials and resources	• Native plant species (e.g. thyme, sage, dittany, rosemary, lavender, olive, carob tree) • Plant pots, garden beds or available planting area

	● Gardening tools ● Labels and markers ● Information sheets ● Student notebooks ● Camera or smartphone ● Recycled materials for signs and decorations
Digital tools	● Padlet for sharing research findings and documenting progress ● Smartphone or tablet for photo documentation ● Canva for creating informational plant signs ● Google Classroom (optional) for communication and resource sharing
Implementation procedure	<u>1. Preparation</u> The teacher introduces the concept of Environment-Based Learning (EBL) and explains that the school itself can become a valuable STEM learning environment. Students discuss the driving question: <i>"How environmentally sustainable is our school, and how can we make it even better?"</i> The teacher presents examples of environmental aspects students should observe, such as biodiversity, waste management, energy use, water use, green spaces, and environmental cleanliness. Students are organised into heterogeneous groups and each group is assigned a different observation area. <u>2. Implementation</u> Each group conducts a structured environmental investigation using the observation worksheet. Students identify both positive environmental practices and areas needing improvement by observing features such as recycling bins, green areas, lighting, water use, litter, biodiversity, and evidence of sustainable behaviours. Students document their findings through notes, sketches, measurements (where appropriate), and photographs. Group members discuss the possible causes of the environmental issues they identify and collaboratively develop practical recommendations for improvement. Following the field investigation, groups organise their findings into a simple sustainability report highlighting: ● environmental strengths, ● environmental challenges,

	• proposed solutions, • expected positive impacts. <u>3. Follow-up</u> Each group presents its sustainability report to the class. Students compare similarities and differences among the investigated areas and discuss which recommendations could realistically be implemented within the school. Groups upload selected photographs, observations, and improvement ideas to a shared Padlet wall, creating a collaborative digital "Environmental Profile of Our School." As an extension activity, students may present their recommendations to school administrators or organise a small environmental awareness campaign within the school community.
Inclusion and adaptation	Flexible group roles (Observer, Photographer, Recorder, Presenter, Sustainability Advisor) allow every learner to contribute according to their strengths and preferences. Students with language barriers or learning difficulties may communicate through photographs, drawings, symbols, or oral explanations rather than lengthy written reports. Indoor observation routes can be used where outdoor access is limited, ensuring full participation regardless of school infrastructure or weather conditions.
Assessment	Assessment is formative and focuses on students' participation, environmental understanding and collaborative learning throughout the activity. Teachers may assess students' active participation in group tasks, their contribution to research and discussions, and their ability to identify native plant species and explain their importance for biodiversity and pollinator conservation. Students' competences can be evaluated through the quality of their Plant Investigation Sheets, the accuracy of the information presented on the plant signs, and their contribution to the creation of the pollinator-friendly garden.

	The shared Padlet portfolio, including photographs, research findings, observations and reflections, may serve as additional evidence of learning progress and environmental awareness. Teachers may also use a simple Pollinator Garden Observation Sheet or Collaboration Rubric to monitor teamwork, inclusive participation, communication skills, environmental responsibility and engagement in the inquiry process. Self-assessment and group reflection activities can be used to encourage students to reflect on what they learned about native plants, pollinators, biodiversity and sustainable environmental practices.
Additional resources	● Plant Investigation Sheet (teacher-created worksheet) ● Shared Padlet wall for documenting research findings, photographs and observations ● Canva templates for creating informational plant signs ● Local biodiversity or native plant identification guides ● Educational videos or multimedia resources about pollinators, biodiversity and native plants

Learning Unit 2: Hands-On Exercise 4

Eco-Odyssey: Reimagining Homer's Islands through STEM, Biodiversity and Sustainable Design

Field	Activity information
Target age group / educational level	11–14 years old (1st Grade of Lower Secondary School). The activity is designed for students attending the first grade of Lower Secondary Education and integrates Literature, Environmental Education and STEM through inquiry-based and collaborative learning. The educational design allows students with different learning profiles, interests and abilities to participate actively by assuming differentiated roles within heterogeneous teams.
STEM area(s)	<u>Science</u> ● Ecology ● Biodiversity ● Mediterranean Ecosystems

	● Climate Change ● Environmental Science <u>Technology</u> ● Digital Mapping (Google Earth / Google My Maps) ● Digital Storytelling ● Data Collection and Visualization ● Multimedia Production <u>Engineering</u> ● Sustainable Ecosystem Design ● Environmental Problem Solving ● Engineering Design Thinking ● Eco-friendly Infrastructure Planning <u>Mathematics</u> ● Environmental Data Collection ● Biodiversity Data Analysis ● Tables and Graphs ● Percentages and Comparisons ● Interpretation of Environmental Indicators
Environmental topic / sustainability theme	● Biodiversity Conservation ● Mediterranean Ecosystems ● Climate Change Adaptation ● Sustainable Communities ● Ecosystem Preservation ● Environmental Citizenship ● Cultural Heritage and Sustainability ● Responsible Use of Natural Resources
Learning objectives	By the end of this activity, students will be able to: ● Investigate descriptions of flora, fauna and natural landscapes in selected passages from Homer's Odyssey and recognize how ancient Greek literature reflects environmental awareness and the relationship between humans and nature. ● Identify, classify and research Mediterranean plant and animal species mentioned in the epic using reliable scientific sources, understanding their ecological role and their importance for biodiversity conservation. ● Collect, organize and analyze environmental data by creating biodiversity inventories, observation tables, graphs and simple statistical representations that

	describe the ecological characteristics of Homeric islands. ● Use digital technologies such as Google Earth, Google My Maps, Canva, Padlet and spreadsheets to map ecosystems, visualize environmental information and communicate scientific findings effectively. ● Apply Engineering Design Thinking to redesign one of Homer's islands as a sustainable ecosystem capable of addressing current environmental challenges such as climate change, biodiversity loss, water scarcity and forest degradation. ● Develop problem-solving skills by investigating authentic environmental scenarios and proposing evidence-based solutions that promote ecosystem resilience and sustainable resource management. ● Strengthen critical thinking by comparing the environmental values reflected in ancient Greek literature with contemporary sustainability challenges and discussing how cultural heritage can inspire responsible environmental action. ● Create a collaborative digital product (comic, podcast, digital story or multimedia presentation) that integrates scientific knowledge, environmental awareness and creative storytelling to communicate sustainability messages to a wider audience. ● Develop environmental citizenship by recognizing their personal responsibility for protecting biodiversity and promoting sustainable practices within their local community. ● Collaborate effectively in heterogeneous teams, assuming different scientific and creative roles while respecting diversity, sharing responsibilities and supporting inclusive participation throughout the inquiry process.
Competences developed	<u>STEM competences:</u> Students investigate biodiversity, collect and analyze environmental data, create tables and graphs, and apply engineering design principles to propose sustainable solutions for environmental challenges. <u>Environmental competences:</u> Students develop awareness of biodiversity conservation, ecosystem protection and climate change while connecting cultural heritage with environmental sustainability.

	<u>Digital competences:</u> Students use digital tools such as Google Earth, Google My Maps, Canva and spreadsheets to collect, analyze, visualize and communicate environmental information through interactive digital products. <u>Engineering competences:</u> Students apply the Engineering Design Thinking process to develop sustainable solutions for Homeric islands, integrating biodiversity conservation, renewable energy and responsible resource management. <u>Mathematical competences:</u> Students organize environmental data, create tables and graphs, compare biodiversity indicators and use simple mathematical reasoning to support evidence-based decisions. <u>Transversal competences:</u> Students strengthen collaboration, creativity, communication and critical thinking by working in heterogeneous teams and exploring how classical literature can inspire sustainable solutions for contemporary environmental challenges.
Estimated duration	Approximately 4–5 teaching periods • 1st teaching period: Introduction to Homeric ecosystems, inquiry question and literary-environmental investigation. • 2nd teaching period: Biodiversity research, environmental data collection and eco-mapping. • 3rd teaching period: Climate Challenge and Sustainable Island Engineering Design. • 4th teaching period: Digital storytelling and STEM Portfolio development. • Optional 5th teaching period: Presentations, peer assessment and reflection.
Activity overview	"Eco-Odyssey: Reimagining Homer's Islands through STEM, Biodiversity and Sustainable Design" is an interdisciplinary Environment-Based Learning (EBL) activity that combines classical literature with STEM education and environmental sustainability. Inspired by selected passages from <i>Homer's Odyssey</i>, students investigate Mediterranean ecosystems and compare ancient descriptions of nature with present-day environmental challenges. Working in heterogeneous teams, students assume different STEM roles, such as Environmental Scientist, Biodiversity Researcher, GIS Specialist and Sustainability Engineer. They

	analyze literary excerpts to identify references to flora, fauna, landscapes and natural resources, then research their ecological importance using reliable scientific sources. Using Google Earth, Google My Maps and spreadsheets, students create eco-maps, collect biodiversity data and present their findings through tables and graphs. Each group then faces a realistic climate challenge affecting its assigned island and applies Engineering Design Thinking to propose sustainable solutions, including biodiversity conservation, renewable energy, water management and ecosystem restoration. Finally, students communicate their ideas through a digital comic, podcast or multimedia presentation created with Canva or similar tools. Their work is compiled into an Eco-Odyssey STEM Portfolio and shared on a collaborative Padlet wall, promoting environmental awareness, digital creativity, teamwork and active citizenship while demonstrating how cultural heritage can inspire innovative solutions for today's environmental challenges.
Materials and resources	Printed materials ● Selected excerpts from <i>Homer's Odyssey</i> ● Biodiversity Investigation Worksheet ● Eco-Mapping Worksheet ● Climate Challenge Cards ● Sustainable Island Blueprint Worksheet ● STEM Portfolio templates ● Reflection Journal ● Peer Assessment Sheet Classroom materials ● Large maps of Greece and the Mediterranean ● A3 paper and recycled cardboard ● Colour pencils, markers and sticky notes ● Scissors, rulers and glue ● Flipchart paper for brainstorming ● Calculators (optional) Digital equipment ● Computers, laptops or tablets (one per group) ● Internet connection ● Projector or interactive whiteboard ● Smartphones (optional for documentation)

	Scientific resources • Mediterranean flora and fauna identification guides • Biodiversity fact sheets • Climate change infographics • Environmental indicator cards • Natura 2000 information resources
Digital tools	The activity integrates accessible digital tools that support environmental investigation, collaboration and digital creativity. • Google Earth: Students explore Homeric landscapes and compare ancient descriptions with real Mediterranean ecosystems. • Google My Maps: Students create interactive biodiversity maps of their assigned Homeric island. • Google Sheets or Microsoft Excel: Students organize environmental data and create simple tables and graphs. • Canva: Students design digital presentations, infographics or sustainable island blueprints. • Storyboard That (optional): Students create digital comics inspired by Homer's Odyssey and environmental challenges. • Padlet: Students publish their Eco-Odyssey STEM Portfolios in a collaborative digital gallery. • QR Code Generator (optional): Each group creates a QR code linking directly to its digital portfolio, allowing visitors to access the project during classroom or school exhibitions.
Implementation procedure	<u>1. Preparation:</u> The teacher introduces the concepts of Environment-Based Learning (EBL) and biodiversity through selected passages from Homer's Odyssey. Students are presented with the driving question: "If Odysseus returned today, would he recognize the natural environment of his islands?". Working in heterogeneous teams, students are assigned one Homeric island and different STEM roles (e.g., Environmental Scientist, Biodiversity Researcher, GIS Specialist). They analyze literary excerpts to identify references to plants, animals, water resources and landscapes. <u>2. Implementation:</u>

	Students investigate the biodiversity of their assigned island using scientific resources and digital tools such as Google Earth, Google My Maps and spreadsheets. They organize their findings into simple tables and graphs and compare ancient ecosystems with current environmental conditions. Each group then receives a Climate Challenge Card and applies Engineering Design Thinking to propose sustainable solutions, including biodiversity conservation, renewable energy, water management and ecosystem restoration. Finally, students present their ideas through a digital comic, podcast or multimedia presentation using Canva or similar tools. <u>3. Follow-up:</u> Groups present their Eco-Odyssey STEM Portfolios, including biodiversity findings, eco-maps, environmental data and sustainable island designs. All projects are uploaded to a shared Padlet, creating a collaborative digital exhibition. The activity concludes with peer feedback and a classroom discussion on how cultural heritage can inspire biodiversity conservation and sustainable development.
Inclusion and adaptation	This activity promotes <u>inclusive STEM education</u> by encouraging students with different interests and abilities to participate through complementary roles such as Environmental Scientist, GIS Specialist, Data Analyst or Digital Storyteller. Multiple forms of expression, including digital storytelling, mapping, presentations and visual design, allow all learners to contribute according to their strengths. For students with learning difficulties, literary texts may be simplified, supported with visual or audio resources, and digital activities can be replaced by printed maps, hand-drawn comics or role-playing. The use of free digital tools and low-cost materials makes the activity suitable for disadvantaged schools and diverse educational contexts.
Assessment	Assessment is <u>formative and collaborative</u>, focusing on both the learning process and the final product. Students are evaluated through their <u>Eco-Odyssey STEM Portfolio</u>, which includes biodiversity research, eco-maps, environmental data, sustainable island designs and digital storytelling products. A teacher rubric assesses scientific understanding, environmental awareness, problem-solving, collaboration, creativity and effective use of digital tools. Self- and peer-assessment

	encourage reflection and active participation throughout the project.
Additional resources	• Homeric Biodiversity Investigation Sheet • Eco-Mapping Worksheet • Climate Challenge Cards • Sustainable Island Blueprint • Eco-Odyssey STEM Portfolio Template • Assessment Rubric • Padlet Gallery

Learning Unit 2: Hands-On Exercise 5

30-minute Bio-Blitz

Field	Activity information
Target age group / educational level	8–10 / 11–14
STEM area(s)	Interdisciplinary STEM
Environmental topic / sustainability theme	Biodiversity
Learning objectives	• Observe and record signs of nature and signs of human impact within a defined area (i.e. the school grounds). • Organise observations into simple categories such as tallies, bar charts, percentages, etc. as appropriate • Compare biodiversity indicators between two different micro-habitats, such as a shaded area and a sunny area. • Propose an action that could support biodiversity on the school site.
Competences developed	• Scientific observation • Classification of information • Data handling • Mathematical analysis

	● Visualisation of information ● Teamwork
Estimated duration	90 – 120 minutes. ● This would be split across a series of specific sessions (approximately 20-30 minutes per session). ● This may or may not include a classroom session. This could also be run over a number of days.
Activity overview	Students working in small, mixed-ability groups are assigned a specific section of a school or schoolyard to survey. This could also include an area outside of the school (assuming this safe, students are supervised, etc). Groups are given a specific set of nature-based elements to survey for their specific section. This may or may not involve a template or checklist (these could also be picture-based depending on the age or capacity of the students). Elements to be surveyed could include insects, birds, flowers, weeds, etc. As appropriate, the checklist elements within each section could potentially also include “signs of human impact” (such as litter, paved surfaces or traffic noise). In the classroom, students should organise their findings into simple data (i.e. mathematical representation of their findings). Students should then be encouraged to interrogate and represent this data in various formats. This could include representation of the checklist elements as percentages, as data visualisation (charts, etc), as bar charts, etc. Students could also use these charts to create “posters” which provide both descriptive information on the checklist elements alongside the quantitative data. The class could further discuss what the findings suggest about biodiversity on the school and actions which could help.
Materials and resources	● Nature checklists (envisaged as printed, picture-based observation checklists) ● Card or clipboards (ideally recycled) with pencils, pens, etc. ● Coloured pens or pencils for chart-making ● Large sheets of paper or a whiteboard for displaying group results, creating posters ● Mathematical papers or stationary to calculate data

	● String or chalk to mark out areas ● Simple cameras to photograph checklist elements ● Calculators to calculate data ● Stationary tools to represent data (compass to create pie charts, rulers to create bar charts, etc)
Digital tools	None are required. A smartphone, tablet camera or other form of camera could be used to photograph checklist elements (plants, insects, etc). Smartphone or tablet apps could be used to automatically identify plants, insects, etc. Calculators may be useful to help analyse data and perform calculations.
Implementation procedure	<u>Preparation:</u> Put the students into their groups. Explain the purpose of the task and agree the specific sections or areas and assign to the groups. Demonstrate the checklist and outline one or two example entries (i.e. “insect” or “plants”). Distribute the checklists and any associated resources to the groups. <u>Observation:</u> As appropriate/ required, accompany the groups into their specific sections/ areas and encourage them to begin the process of analysing these areas against their checklists. If appropriate or part of the process, encourage them to document their findings (photography, etc). <u>Data organisation:</u> Back in the classroom, have the groups tally the results of their findings against the checklists to order and/ or calculate the data. This could be done within groups or you could encourage groups to compare findings between groups (this may involve creating “stations” or breaking students up into specific groups, i.e. an “insects” group who tallies the “insect” findings of all groups to create a cross-group analysis) <u>Data representation:</u> Have students express their data in a visual format. This could involve differentiated roles within each group: i.e. one student to count and sorts the tallies, one student to draw simple bar chart or pie charts of the results, one student to write up the overall findings, one student to create the poster layout, etc. <u>Discussion and action:</u>

	Once all results have been gathered, groups could present their charts briefly to the class. This could be followed by a short discussion to analyse the findings and the analysis on biodiversity health, etc. for the school. This discussion could also include additional elements such as means to enhance biodiversity in the school, based on the findings.
Inclusion and adaptation	• The checklist should be as accessible as possible to students, so – depending on the age of the students, could include visual icons or representations. This may be relevant also for students who may face any language difficulties or visual disabilities. • The depth of the analysis of the checklist items could be made more or less complex depending on the age and abilities of the students. It may be appropriate to simply have students identify if “insects” are present in their assigned area. Alternatively, it may be more appropriate to have students identify if specific types of insects are present. • The depth or complexity of the analysis of findings should be scaled up or down depending on the age and ability of the students. Students could be encouraged to do a simple calculation (i.e. % of spaces which have plants) or a more complex analysis. This is true also for the visualisation of this data. • Group roles (recorder, chart-maker, calculator, presenter) can be assigned according to confidence and ability rather than fixed by the teacher in advance, so every student has a meaningful and achievable task. • Findings can be shared orally, through drawing or in writing, allowing students to choose the format in which they feel most confident, in line with the principles of Universal Design for Learning.
Assessment	• Depending on how the activity is conducted, assessment can be based on: • A final output, e.g. each group’s developed poster • A final activity, e.g. a group’s presentation of their findings to the rest of the class • A specific students’ role, e.g. a student’s role in their group (chart-maker, data analyst, presenter, etc.) • A combination or breakdown of the above elements.

Additional resources	A free, downloadable bio-blitz planning guide is available from National Geographic Education at: https://education.nationalgeographic.org/resource/do-it-yourself-bioblitz/
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Learning Unit 2: Hands-On Exercise 6

Water detectives

Field	Activity information
Target age group / educational level	8–10 / 11–14
STEM area(s)	Interdisciplinary STEM
Environmental topic / sustainability theme	Water conservation
Learning objectives	● Explain, in simple terms, what a water footprint is and why it matters for the environment. ● Measure or estimate the flow rate of a single tap using basic, recycled equipment. ● Calculate average and total water use for a small set of everyday school activities. ● Compare the class's results with national average figures and identify realistic water-saving actions for the school.
Competences developed	● Scientific observation ● Scientific inquiry ● Data handling ● Mathematical reasoning ● Mathematical analysis ● Visualisation of information ● Teamwork ● Problem-solving
Estimated duration	90 – 120 minutes. ● This would be split across a series of specific sessions (approximately 20-30 minutes per session).

	This may or may not include a classroom session. This could also be run over a number of days.
Activity overview	Students use a recycled measuring jug and a simple timer to find out how much water flows from a classroom or school tap in a set time. They use this, together with reference figures for activities such as handwashing or a toilet flush, to estimate the water footprint of a typical school day. Working in groups with differentiated roles, including a 'Lead Scientist' who takes the measurement, a 'Data Journalist' who records and presents the figures, and a 'Calculator' who works out averages. Students compare their findings with national benchmark figures and design a short, practical water-saving action plan for the school.
Materials and resources	- A recycled jug or plastic bottle marked with volume measurements - A stopwatch, classroom clock with a second hand, or phone timer - Printed reference sheet with typical water-use figures for common activities - Recording sheets and pencils - Calculators, optional depending on age group - Poster paper or card for the water-saving action plan
Digital tools	None are required. Calculators may be useful to help analyse data and perform calculations. A free spreadsheet application such as Google Sheets or Excel could be used to record results and generate simple charts. Where appropriate, the free online Water Footprint Calculator (watercalculator.org) could be used to compare students' own daily habits with average figures.
Implementation procedure	<u>Preparation:</u> Put the students into their groups. Explain the purpose of the task and agree the specific roles and assign these within the groups.. Demonstration: Use a simple example, such as the water used to brush teeth or wash hands, to introduce the idea of a water footprint. <u>Measurement:</u>

	Time how long it takes to fill the measuring jug from a classroom or corridor tap and use this to calculate the flow rate in litres per minute. <u>Analysis:</u> Groups are given reference figures for activities they cannot safely measure directly, such as a toilet flush or a drinking fountain, and use these, together with their own tap measurement, to estimate water use for a typical school day. <u>Data organisation:</u> Within their assigned roles, students undertake the analysis of the data – e.g. the “Lead Scientist” manages the measurement and checks the working, the “Data Journalist” records and writes up the results, and the “Calculator” works out totals and averages, etc. <u>Data representation:</u> Have students express their data in a visual format. This could involve differentiated roles within each group: i.e. one student to count and sorts the tallies, one student to draw simple bar chart or pie charts of the results, one student to write up the overall findings, one student to create the poster layout, etc. <u>Discussion and action:</u> Once all results have been gathered, groups could present their charts briefly to the class. This could be followed by a short discussion to analyse the findings. The class could also discuss to agree on two or three practical, low-cost water-saving actions for the school, which groups present as a short poster or announcement for the wider school community.
Inclusion and adaptation	● Calculation tasks should be differentiated within each group. Some students focus on counting and recording, while others take on averaging or percentage work, allowing students with different levels of mathematical confidence to contribute meaningfully. ● Recording sheets should use clear headings and simple sentence starters to support students with language difficulties or barriers to reading/ writing. ● For schools where measuring a real tap is not practical, for reasons of hygiene, safety or access, the activity can

	be run entirely using teacher-provided sample data, with groups still carrying out the calculation and action-planning stages.
Assessment	Teacher observation of role engagement during the group work provides ongoing formative evidence, focusing on participation rather than the accuracy of the final figure. The water-saving action plan can be assessed informally against a simple, shared set of success criteria agreed with the class beforehand, such as clarity, feasibility and a clear link to the data collected. Peer feedback between groups, focused on one strength and one suggestion for each poster, offers an additional low-stakes form of assessment.
Additional resources	A reference sheet of typical household water-use figures (US-based) and a free online water footprint calculator are available from the Water Footprint Calculator website: • https://www.dropbox.com/scl/fi/3w5e5hk8f5txfqnbvmkwe/WF_MS_L1-My-Water-Footprint-Stats-Student-Worksheet-Updated.pdf?rlkey=q5iz8bioqzqk5exgvwzyg39tm&e=1&dl=0 • https://watercalculator.org/resource/teaching-conservation-with-water-footprint-calculator/

Learning Unit 3: Integrating Mathematics and STEM Content into EBL

Learning Unit 3 focuses on the practical integration of Mathematics and STEM concepts into Environment-Based Learning (EBL), using real environmental situations as meaningful contexts for investigation and problem-solving. The Hands-On Exercises encourage learners to measure, calculate, collect and analyse data, identify patterns and apply mathematical and scientific knowledge to environmental challenges. Through activities related to water use, energy consumption, sustainable spaces and scale, learners develop mathematical reasoning, data literacy, critical thinking and problem-solving skills while exploring their school and local environment. The activities help make abstract STEM concepts more tangible by connecting them with real-world environmental issues and practical decision-making.

Learning Unit 3: Hands-On Exercise 1 Measuring water waste at school

Field	Activity information
Target age group / educational level	11–14
STEM area(s)	Mathematics, Interdisciplinary STEM
Environmental topic / sustainability theme	Water Conservation, Sustainability
Learning objectives	• Measure and compare the volume of water collected from different school taps using standard units of measurement. • Apply mathematical concepts such as volume, unit conversion (mL and L) and proportional reasoning in a real-world environmental investigation. • Collect, organise and represent data using tables and simple graphs.

	- Analyse water consumption patterns and identify opportunities to reduce water waste at school. - Use evidence from measurements and calculations to propose practical water-conservation actions for the school community.
Competences developed	<u>STEM competences</u> - Volume measurement skills - Data collection and analysis - Mathematical reasoning and problem-solving - Interpretation of quantitative information <u>Environmental competences</u> - Awareness of water conservation - Understanding sustainable use of natural resources - Environmental responsibility <u>Digital competences</u> - Use of digital tools for recording and sharing findings - Creation of simple digital awareness materials <u>Transversal competences</u> - Collaboration and teamwork - Communication and presentation skills - Critical thinking - Decision-making based on evidence
Estimated duration	Approximately 4 teaching periods.
Activity overview	Students investigate water consumption and potential water waste in their school by measuring the amount of water released from different taps over specific time intervals. Working collaboratively, they collect and compare volume measurements, organise their findings and analyse differences in water flow. Through mathematical calculations and data interpretation, students explore the importance of water conservation and identify practical actions that can reduce water waste. The activity connects mathematics with a real environmental challenge while encouraging responsible and sustainable behaviour.
Materials and resources	- Empty plastic bottles (330 mL, 500 mL, 1L, 1.5 L and 2 L) - Measuring jugs or graduated containers - School water taps - Stopwatch or timer - Observation and recording worksheets - Markers and labels - Student notebooks

Digital tools	● Padlet for sharing measurements, calculations, photos and conclusions ● Microsoft Excel or Google Sheets for organising, analysing and visualising data ● Canva for creating posters, infographics and awareness materials for the “<u>Every Drop Counts</u>” campaign ● Smartphone or tablet for photo documentation
Implementation procedure	<u>Preparation:</u> The teacher introduces the issue of water conservation and discusses the importance of reducing water waste. Students are asked to predict how much water may be wasted when taps are left running unnecessarily. Groups are formed and observation sheets are distributed. <u>Implementation:</u> Each group is assigned a different tap within the school. Using a stopwatch and measuring containers, students collect and measure the volume of water released over three different time intervals (5 seconds, 10 seconds and 15 seconds). The measurements are recorded and uploaded to a shared Padlet space. Students compare the results obtained from different taps and investigate possible reasons for variations in water flow. <u>Follow-up:</u> Students transfer their measurements to the school computer laboratory, where they organise and analyse the collected data using spreadsheets. They create tables, calculate totals and averages, and represent their findings through simple charts and graphs. Based on the results, students identify patterns of water consumption and discuss practical ways to reduce water waste. Finally, they design digital awareness materials using Canva and launch the “Every Drop Counts” campaign for the school community.
Inclusion and adaptation	Students work in heterogeneous groups with clearly assigned roles such as timekeeper, measurer, recorder and presenter, ensuring meaningful participation for all learners. Instructions are provided both orally and in written form, and recording sheets can be adapted using visual supports where necessary. The activity uses low-cost and easily accessible materials, making it suitable for disadvantaged learners and low-resource school settings. It can be implemented in both rural and urban

	schools and adapted to different educational levels by adjusting the complexity of calculations and data analysis tasks.
Assessment	Assessment can be based on students' participation in data collection, the accuracy of measurements, collaboration within groups and the quality of data organisation and interpretation. Teachers may also evaluate students' ability to propose realistic water-conservation solutions and communicate their findings through the "Every Drop Counts" campaign. Padlet contributions, presentations and reflection activities may serve as evidence of learning and engagement.
Additional resources	• World Water Day educational resources • Water conservation awareness materials • Padlet wall containing measurements, photos, calculations and campaign products • Posters and infographics created by students as part of the "Every Drop Counts" campaign • Videos related to sustainable water use and water conservation practices

Learning Unit 3: Hands-On Exercise 2
How can our school save energy?
 (Measuring and saving energy at school)

Field	Activity information
Target age group / educational level	11–14
STEM area(s)	Mathematics, Interdisciplinary STEM
Environmental topic / sustainability theme	Energy Conservation, Sustainability
Learning objectives	• To measure and compare energy usage indicators in different school classrooms. • To apply mathematical and science concepts such as energy use, temperature measurement, the Celsius scale, data collection, data interpretation and

	mathematical reasoning in a real-world environmental investigation through energy audits. ● To collect, organise and represent data using tables and simple graphs. ● To analyse energy consumption patterns and identify opportunities to improve energy consumption habits at school. ● To increase pupils' knowledge and awareness about saving energy at school and fighting against climate change. ● To involve the educational community and change energy consumption habits. ● To promote co-responsibility: pupils and teachers work together in favour of energy sustainability.
Competences developed	<u>STEM competences</u> ● Energy, light and temperature measurement skills ● Data collection and analysis ● Mathematical reasoning and problem-solving ● Interpretation of quantitative information <u>Environmental competences</u> 4. Identifying environmental issues and the need for more sustainable policies 5. Awareness of energy saving and sustainability 6. Understanding practical use of natural resources / tracking the effectiveness of certain solutions 7. Environmental responsibility <u>Digital competences</u> ● Use of digital tools for recording and sharing findings ● Monitoring progress ● Creation of simple digital awareness materials <u>Transversal competences</u> ● Collaboration and teamwork / delegation of tasks ● Communication and presentation skills ● Critical thinking /forward thinking ● Decision-making based on evidence ● Promoting awareness and knowledge ● Promoting training and skills acquisition ● Education for action and sharing new values
Estimated duration	2 teaching periods
Activity overview	Students organise energy audits and investigate electricity consumption and potential thermal energy waste in their school by measuring electricity use, lighting conditions and classroom

	temperature over specific time intervals. Working collaboratively, they collect and compare measurements, organise their findings and analyse differences in energy consumption levels. Through mathematical calculations and data interpretation, students explore the importance of energy saving and identify practical actions that can reduce energy waste. The activity connects mathematics with a real environmental challenge while encouraging the implementation of good practices.
Materials and resources	● Stopwatch or timer ● Observation and recording worksheets ● Markers and labels ● Student notebooks ● Infrared thermometer ● Energy meter (optional, if available) ● Light meter
Digital tools	● E-pack with resources, materials, websites to help raise awareness on energy issues ● Padlet for sharing planning, measurements, calculations, photos, ideas and conclusions ● Microsoft Excel or Google Sheets for organising, analysing and visualising data ● PowerPoint or Google Slides for creating and presenting the School Energy Saving Guide. ● Smartphone or tablet for photo documentation
Implementation procedure	<u>Preparation</u> The teacher introduces the issue of energy conservation and discusses the importance of reducing energy waste. Students are asked to predict how much energy may be wasted when electrical appliances are not turned off, classrooms and windows are left open when central heating is on or when the lights are unnecessarily on when it is sunny. Groups are formed and observation sheets are distributed. <u>Implementation</u> Each group is assigned a classroom within the school. Using a stopwatch and measuring tools, students collect and measure energy levels over three different time intervals (before classes begin, during a long break in the middle of the school day and after classes). The measurements are recorded and uploaded to a shared Padlet space. Students compare the results obtained from different classrooms and investigate possible

	reasons for variations in energy levels. The teacher may provide a recent school electricity bill to instigate discussion and connect students' findings with real energy consumption data. <u>Follow-up</u> Students transfer their measurements to the school computer laboratory, where they organise and analyse the collected data using spreadsheets. They create tables, calculate totals and averages, and represent their findings through simple charts and graphs. Based on the results, students identify patterns of energy consumption and discuss practical ways to reduce energy waste. They repeat the measurements in the same classrooms after adopting energy saving practices and compare their findings with the initial measurements. Finally, students create a School Energy Saving Guide containing practical recommendations for reducing energy consumption at school and promoting sustainable energy habits.
Inclusion and adaptation	Students work in heterogeneous groups with clearly assigned roles such as timekeeper, measurer, recorder and presenter, ensuring meaningful participation for all learners. Instructions are provided both orally and in written form, and recording sheets can be adapted using visual supports where necessary. The activity uses easily accessible materials, making it suitable for disadvantaged learners and low-resource school settings. It can be implemented in both rural and urban schools and adapted to different educational levels by adjusting the complexity of calculations and data analysis tasks. In contexts where technical equipment such as infrared thermometers or light meters is unavailable, the activity can be easily adapted to ensure zero-cost implementation. Teachers can encourage students to use free mobile applications (such as smartphone-based Lux Meter apps) to measure lighting conditions, or alternative qualitative methods can be applied. For instance, instead of digital readings, students can use subjective observation scales (e.g., scoring classroom brightness or thermal comfort on a scale from 1 to 5), ensuring that schools with limited resources can fully participate without any financial barriers.
Assessment	Assessment can be based on students' participation in data collection, the accuracy of measurements, collaboration within groups and the quality of data organisation and interpretation. Teachers may also evaluate students' ability to propose realistic

	energy-conservation solutions and communicate their findings throughout the project. Self-evaluation or peer-evaluation templates could encourage self-reflection, facilitate constructive dialogue and track growth and development through the promotion of good practices. Padlet contributions, presentations, active participation and reflection activities may serve as evidence of learning and engagement.
Additional resources	• E-pack with resources, materials, websites to help raise awareness on energy issues • Padlet wall containing measurements, photos, calculations and ideas • Posters and infographics created by students as part of their project • School Energy Saving Guide created by students as part of the project// school legacy.

Learning Unit 3: Hands-On Exercise 3

Measuring and redesigning a sustainable schoolyard

Field	Activity information
Target age group / educational level	12 years old/ 7 th -grade students
STEM area(s)	Mathematics/Technology/Engineering
Environmental topic / sustainability theme	Climate Change / Creating Green Spaces
Learning objectives	<u>Cognitive objectives:</u> • 1) Calculating the area of simple geometric shapes, • 2) Using fractions and converting them to percentages, • 3) Understanding the importance of green spaces for sustainability and quality of life. <u>Skills:</u> • 1) Collaborating to solve problems,

	● 2) Collecting, organizing, and recording data, ● 3) Using digital tools, <u>Attitudes and values:</u> ● 1) Fostering environmental awareness, ● 2) Appreciating the importance of sustainable management of school grounds
Competences developed	STEM: Measurements in a real-world environment, observation and drawing conclusions, designing a sustainable schoolyard, using digital tools, understanding the relationship between humans and the environment
Estimated duration	2 class periods
Activity overview	Students are asked to first measure the total area of the schoolyard and then the area covered by the green space within it, calculate the percentage that the green space occupies, and then redesign the schoolyard by adding more green elements (school garden, flowers, trees).
Materials and resources	Measuring tape, paper, pen, whiteboard, marker, graph paper, thick cardboard for making models.
Digital tools	Computer, projector, simple design software (such as “SketchUp for Schools” or Tinkercad), use of Excel
Implementation procedure	<u>1st class period:</u> The teacher, inside the classroom, explains to the students that they are going to measure the area of the schoolyard. Through a question-and-answer session, they review the formula for calculating area and write it on the board. The teacher explains the steps of the activity to the students, and then they go out into the schoolyard. The teacher has printed out a sheet with the students’ names, which has two columns next to them labeled “step length” and “number of steps.” Using a measuring tape, each child first measures the length of their stride, and the teacher records it in the corresponding column. Then, one child after another, they take steps in both directions across the playground (length and width), and the teacher records the number of steps taken by each child in the corresponding column. This method of measurement was chosen so that all students could participate.

The measurement process is repeated using a measuring tape for comparison and verification. Then, to save time, they use a measuring tape to measure the dimensions of the green space in the schoolyard (the teacher records the data). Next, they go into the classroom and calculate the distance corresponding to each student (e.g., 3 steps $\times$ 0.65 m).

They then compare the result with the tape measure reading, followed by a discussion about the difference between the two values and the reliability of each method, and then they calculate the area of the schoolyard. Using the same mathematical formula, they calculate the area of the green spaces in the courtyard, then express this as a fraction and determine what percentage of the courtyard's total area these spaces occupy.

This data is recorded in a table, and the students create bar charts. They can use Excel to create a pie chart showing the percentage of green space relative to the area of the schoolyard.

2nd class period:

First, a discussion is held with the students to analyze the data that was collected. Students express their opinions on whether there is enough green space and discuss how increasing greenery can lower the temperature in the schoolyard, support biodiversity, and improve the quality of life at school.

Next, through a brainstorming session, they propose ways to increase the percentage of green space (school garden, flower beds, tree planting). For each option they propose to increase greenery, they recalculate the green coverage percentage of the schoolyard and create a new bar chart on the board or a pie chart in Excel.

Then, with the teacher's help and guidance, the students are divided into two heterogeneous groups, consisting of students with different learning levels (including students with learning difficulties), backgrounds, and levels of computer proficiency. Roles are assigned, such as one student recording ideas on paper while another handles the digital documentation, etc.

	Then, using simple design software or the “SketchUp for Schools” or “Tinkercad” applications, they can create a floor plan of the schoolyard, generate a 3D rendering of it, add trees, benches, playgrounds, and flower beds, and take a virtual tour of the space. Alternatively, students can draw the new schoolyard/playground on millimeter paper or build a three-dimensional model out of stiff cardboard. In this way, students act as designers of sustainable school spaces, examining different proposals for redesigning the playground and selecting the one they consider most appropriate based on environmental, functional, and social criteria. At the end, a self-assessment questionnaire is provided, which students complete either by hand on paper or electronically via Google Forms. By proposing alternative implementation methods, the activity can be adapted to any school, regardless of size or available digital resources.
Inclusion and adaptation	This activity promotes inclusion, as it is designed to be implemented in a rural school with a small number of students. Furthermore, it is designed within the framework of inclusive education; therefore, when measuring the two dimensions of the schoolyard, the active participation of all students is encouraged. It is also implemented through the creation of heterogeneous groups, the assignment of roles, and the option to choose between digital and non-digital tools.
Assessment	Completion of a self-assessment questionnaire via Google Forms or a printed worksheet, and drawing of conclusions. Students are given the option to complete the questionnaire in different formats (online or on paper) so that all students can participate, in the context of inclusive education. Additionally, the teacher may also use a student assessment rubric.
Additional resources	Google Forms, rubric in digital or printed format

Learning Unit 3: Hands-On Exercise 4

How can we represent Nature using scale?

Field	Activity information
Target age group / educational level	11–14
STEM area(s)	Natural Sciences, Mathematics, Technology
Environmental topic / sustainability theme	Biodiversity/Sustainability/Climate Change
Learning objectives	<u>Cognitive objectives:</u> - to understand the concept of scale as the ratio between actual dimensions and represented dimensions, - to relate the measurements of real objects to their corresponding representations in a drawing or poster, - to engage with biodiversity through brief identification or classification of the plant species they will study. <u>Skills:</u> - to accurately measure the length and width of leaves, - apply scale conversions (e.g., 1:2, 1:3, 2:1) when drawing or presenting the leaves, - use proportions to create enlarged or reduced representations, - organize their data and present it on a poster in a clear and aesthetically pleasing manner. <u>Attitudes and Values:</u> - understand the importance of teamwork, the division of responsibilities, and democratic decision-making following discussion, - to understand the usefulness of mathematics in observing and studying the natural environment, - to appreciate the connection between science, mathematics, and art.
Competences developed	STEM competences, mathematical reasoning, measurement and proportional thinking, environmental awareness, teamwork, digital competence and biodiversity identification.

Estimated duration	Approximately 2 teaching periods
Activity overview	The students visit a nearby wooded area, observe the ecosystem, and collect leaves from plants and trees. Then, after measuring and making the necessary scale conversions, they create a poster. Alternatively, the activity can be carried out in the schoolyard, the school garden, a park, or any green space near the school.
Materials and resources	Whiteboard, marker, paper, pen, box for collecting leaves, graph paper, pencil, Canson cardstock, glue stick, ruler
Digital tools	A computer, projector, cell phone or camera, a printer, the Canva app, Google Sheets or Excel for recording measurements, organising data and performing scale calculations.
Implementation procedure	<u>1st teaching period:</u> The teacher informs the students that they will go on a field trip to a nearby wooded area to observe the ecosystem and collect leaves. Next, the teacher divides the students into four heterogeneous groups, each including students of both high and low academic achievement, foreign students, students with special educational needs, and students who are proficient computer users. The teacher explains to the students that, after studying the area, each group will collect leaves from a plant or tree, which they will store in the collection box. Roles are assigned to each group, but these roles are rotated among all members (e.g., recording measurements, collecting samples, taking photographs, performing scale calculations, creating a poster, presenting results), so that all students have equal opportunities to participate. The field trip takes place, and then the students return to school. <u>2nd teaching period:</u> One student from each group is assigned to present the sheet they selected to the whole class. The teacher asks the students to describe them and classify them by species. This is followed by a discussion on the region's biodiversity (e.g., plants, evergreens, deciduous trees, shrubs, etc.), as well as the importance of plants in the local ecosystem and their role in sustainability and climate resilience. Next, the teacher introduces the concept of scale.

	Working in groups, students use a ruler to measure the dimensions of the leaves and record their actual dimensions on the classroom chart. To ensure the data is organized systematically, the measurements are recorded in a special “measurement chart.” The measurement chart consists of four columns in which the following are recorded: leaf length, leaf width, selection of an appropriate scale, and new leaf dimensions; it is completed for all four leaves collected by the groups. Alternatively, the measurement table for recording and calculating the scale can also be created in Excel or Google Sheets. The groups compare their results. Then, once the calculations have been completed, the tree leaves are drawn on paper (graph paper is recommended). If the leaf is small (e.g., an olive leaf), they draw it larger (enlargement); if it is large (e.g., a plane tree leaf), they draw it smaller (reduction). Then, after the students have experimented with changing the size using scale, the groups verify their scale conversions and create a poster. It is recommended that the project will be created digitally, using Canva. Students place the photos they took in the field, as well as photos of the leaves under study, in the background, and in all four corners, they draw the leaves they collected, having scaled their dimensions to the appropriate scale. Alternatively, students can create a poster on Canson cardstock by gluing the leaves onto it, along with printed photographs from those they took. In the lower right corner of the poster, a legend lists the actual dimensions of each leaf, the scale used, and the final dimensions after the conversion. It should also include brief information about the plant species. Each group presents its poster to the class, explaining the selected plant species, the measurements taken, scale applied and final representation.
Inclusion and adaptation	The activity is carried out by forming heterogeneous groups, assigning roles, and allowing participants to choose between digital and non-digital media. The groups include students with special educational needs, foreign students, students with strong computer skills, and students with low or high academic achievement. It can be implemented in both urban and rural schools, with or without technological equipment, as the poster can be created using either Canva app or Canson cardstock.

Assessment	Completion of a self-assessment questionnaire via Google Forms or a printed worksheet, and drawing of conclusions. Students are given the option to complete the questionnaire in different formats (online or on paper) to ensure accessibility for all students within the context of inclusive education. As an authentic performance assessment tool, the “measurement chart” is reviewed by the teacher as well as by all groups. In addition the teacher uses the Measurement Chart as an authentic performance assessment tool and a rubric to evaluate both students' work and the final poster. The rubric for the poster focuses on: a) accuracy of measurements and correct application of the scale, b) quality of presentation, c) teamwork.
Additional resources	Google Forms, Excel, Google Sheets, Canva, Rubric (in digital or printed form)

Learning Unit 4: Digital Tools and Resources for Enhancing EBL in STEM

Learning Unit 4 focuses on the practical use of digital tools and resources to enhance Environment-Based Learning (EBL) in STEM education. The Hands-On Exercises encourage learners to collect, analyse and represent real environmental data, explore their surroundings using digital technologies and use technology as a tool for investigation, problem-solving and communication. Through activities related to climate data, biodiversity, air quality and sustainable school design, learners develop digital literacy, data analysis, scientific inquiry and critical thinking skills. The activities connect technology with real environmental challenges, helping learners use digital tools in meaningful, collaborative and sustainability-oriented ways.

Learning Unit 4: Hands-On Exercise 1 Climate change data detectives: exploring local climate trends through digital data analysis

Field	Activity information
Target age group / educational level	11–14 / 15–18
STEM area(s)	Science / Mathematics / Digital STEM / Interdisciplinary STEM
Environmental topic / sustainability theme	Climate change / Sustainability / Environmental observation / Data analysis
Learning objectives	Students will: ● investigate real climate data using reliable digital sources; ● identify long-term temperature and precipitation trends; ● interpret graphs and environmental datasets; ● understand the relationship between climate data and local environmental changes; ● develop evidence-based conclusions about climate change; ● communicate scientific findings using digital tools.

Competences developed	<u>STEM competences</u> ● Scientific inquiry ● Data interpretation ● Mathematical reasoning ● Graph analysis ● Evidence-based problem solving <u>Environmental competences</u> ● Climate literacy ● Sustainability awareness ● Environmental responsibility ● Critical understanding of climate change <u>Digital competences</u> ● Searching reliable scientific databases ● Working with spreadsheets ● Creating digital charts ● Presenting digital results <u>Transversal competences</u> ● Critical thinking ● Teamwork ● Communication ● Problem solving ● Digital collaboration
Estimated duration	3–4 teaching periods (approximately 180 minutes)
Activity overview	Students become "Climate Detectives" by analysing authentic climate datasets from their local region. Working in small collaborative groups, they explore historical temperature and precipitation records using open-access environmental databases. They organise the collected information in spreadsheets, generate graphs, identify climate trends and discuss possible environmental impacts on their community. Finally, each group presents evidence-based conclusions and proposes local actions that may contribute to climate change mitigation or adaptation.
Materials and resources	● Computers or tablets ● Internet connection ● Student worksheet ● Calculator ● Notebook ● Projector (optional)
Digital tools	● Copernicus Climate Data Store ● Copernicus Browser

	● AEMET Open Climate Data ● Google Sheets / Microsoft Excel ● Canva ● Google Slides
Implementation procedure	<u>Preparation</u> The teacher introduces the concepts of climate change, weather and climate trends. Students discuss how climate change may affect their local environment and formulate initial hypotheses. <u>Investigation</u> Working in groups, students access climate databases to collect historical temperature and precipitation data from their region. They organise the information into tables and create graphs showing long-term trends. <u>Analysis</u> Students compare datasets, identify significant changes and discuss possible environmental, social and economic consequences linked to climate change. <u>Presentation</u> Each group prepares a short digital presentation summarising their findings and suggesting practical climate actions that schools or local communities could implement.
Inclusion and adaptation	The activity can be adapted by: ● providing simplified datasets; ● assigning differentiated roles within each group; ● allowing collaborative work; ● using visual supports; ● selecting shorter datasets for younger learners.
Assessment	Assessment may include: ● participation during investigation; ● correct interpretation of climate data; ● quality of graphs and visualisations; ● scientific reasoning; ● teamwork; ● final presentation.
Additional resources	The following resources may support the implementation of the activity:

	• Copernicus Climate Change Service (C3S) – https://climate.copernicus.eu/ • Copernicus Browser – https://browser.dataspace.copernicus.eu/ • AEMET Open Data (or the corresponding national meteorological service) • NASA Climate Kids – https://climatekids.nasa.gov/ • Google Sheets (for organising and analysing climate data) • Canva or Google Slides (for preparing the final presentation)
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Learning Unit 4: Hands-On Exercise 2

Smart biodiversity mapping: exploring local ecosystems with digital tools

Field	Activity information
Target age group / educational level	11–14 / 15–18
STEM area(s)	Science / Digital STEM / Interdisciplinary STEM / Geography / Interdisciplinary STEM
Environmental topic / sustainability theme	Biodiversity / Local Ecosystems / Environmental Observation / Nature Conservation
Learning objectives	Students will: • identify plant and animal species in their local environment; • develop observation and classification skills using digital tools; • understand the importance of biodiversity for healthy ecosystems; • create collaborative digital biodiversity maps; • interpret environmental observations and propose actions to protect local biodiversity. • communicate scientific findings using digital tools.

Competences developed	<u>STEM competences</u> • Scientific observation • Species identification • Data collection and classification • Environmental analysis <u>Environmental competences</u> • Biodiversity awareness • Nature conservation • Ecosystem understanding • Sustainable environmental behaviour <u>Digital competences</u> • Mobile data collection • Digital mapping • Use of collaborative online platforms • Digital documentation through photographs <u>Transversal competences</u> • Teamwork • Critical thinking • Communication • Problem solving • Collaborative learning
Estimated duration	2–3 teaching periods (approximately 150 minutes) • 20 minutes: Introduction • 60 minutes: Outdoor biodiversity observation • 40 minutes: Digital mapping • 30 minutes: Presentation and reflection
Activity overview	Students become biodiversity explorers by investigating the natural environment around their school or community. Working in collaborative groups, they observe and document local plant and animal species using mobile devices or tablets. Each observation is recorded with photographs, basic ecological information and geographical location. Students then create a collaborative digital biodiversity map that allows them to analyse species diversity, identify environmental patterns and discuss the importance of protecting local ecosystems.
Materials and resources	• Smartphones or tablets (optional but recommended) • Printed observation sheets • Clipboards • Pencils • Camera (if mobile devices are unavailable) • Field guides for local species (optional)

Digital tools	● iNaturalist – https://www.inaturalist.org ● Google My Maps – https://www.google.com/mymaps ● Google Lens (optional) – https://lens.google ● Padlet – https://padlet.com ● Canva – https://www.canva.com
Implementation procedure	<u>Preparation</u> The teacher introduces biodiversity concepts and explains how digital tools can support environmental observation and scientific investigation. <u>Field Investigation</u> Students explore the school grounds, a nearby park or another natural area. Working in small heterogeneous groups, they observe and identify local plant and animal species using digital tools. Students collect evidence through photographs, notes and environmental observations before analysing their findings collaboratively. <u>Digital Mapping</u> Each group uploads their observations to a collaborative digital map, including photographs, species names and locations. Students compare findings and identify areas with greater biodiversity. <u>Reflection and Discussion</u> Groups analyse their biodiversity maps, discuss environmental threats affecting local ecosystems and propose practical conservation actions that could be implemented by the school or local community. Students compare their findings, identify biodiversity patterns and discuss possible actions to protect local ecosystems based on the evidence collected.
Inclusion and adaptation	The activity can be adapted by: ● Mixed-ability groups with differentiated responsibilities. ● Printed observation sheets for students with limited digital access. ● Visual identification guides to support learners with different abilities. ● Adaptation of observation routes for students with reduced mobility. ● Collaborative participation ensuring every student contributes to the investigation.
Assessment	Assessment may include:

	• participation during field investigation; • accuracy of species identification; • quality of digital biodiversity map; • collaborative work; • environmental reflection; • final presentation.
Additional resources	• iNaturalist – https://www.inaturalist.org • Google My Maps – https://www.google.com/mymaps • European Environment Agency (EEA) – https://www.eea.europa.eu • UNESCO – Biodiversity Education Resources – https://www.unesco.org

Learning Unit 4: Hands-On Exercise 3

Air quality detectives: investigating urban pollution through digital environmental monitoring

Field	Activity information
Target age group / educational level	11–14 / 15–18
STEM area(s)	Science / Mathematics / Digital STEM
Environmental topic / sustainability theme	Air Pollution / Environmental Monitoring / Climate / Sustainability
Learning objectives	Students will: • investigate local air quality; • interpret environmental indicators; • compare different urban locations; • understand the impact of human activities on air quality; • propose sustainable solutions for healthier environments.
Competences developed	<u>STEM</u> • Environmental measurement • Scientific inquiry • Data interpretation

	<u>Environmental</u> • Air quality awareness • Sustainable mobility • Environmental responsibility <u>Digital</u> • Digital environmental monitoring • Online data interpretation • Collaborative data analysis <u>Transversal</u> • Critical thinking • Communication • Teamwork
Estimated duration	3 lesson hours (approximately 150 minutes)
Activity overview	Students investigate air quality around their school using online environmental monitoring platforms and field observations. Working in groups, they compare different locations (school entrance, playground, nearby roads, green areas), analyse air quality indicators and discuss possible causes of pollution. Finally, they prepare recommendations to improve environmental quality within the school community.
Materials and resources	• Tablets or computers • Observation sheets • Maps • Notebook
Digital tools	• IQAir • Windy • Google Maps • Google Sheets • Canva
Implementation procedure	<u>Preparation</u> The teacher introduces the concepts of air pollution, air quality indicators and their impact on human health and the environment. Students discuss possible sources of pollution around their school and formulate initial hypotheses about which locations may present different air quality conditions. <u>Investigation</u> Working in collaborative groups, students identify several observation points around the school (e.g., school entrance, playground, nearby streets and green areas). They collect field

	observations and consult real-time air quality information using online environmental monitoring platforms. Students record and organise the collected data in observation tables. <u>Analysis</u> Students compare the environmental observations with the digital air quality data obtained from online sources. They identify differences between locations, discuss possible causes of pollution, and analyse how traffic, vegetation or weather conditions may influence local air quality. <u>Presentation</u> Each group prepares a short presentation summarising the investigation, presenting the collected evidence and proposing practical recommendations to improve air quality within the school or local community. The activity concludes with a class discussion comparing the different findings and suggested solutions.
Inclusion and adaptation	The activity can be adapted by: ● Mixed-ability groups. ● Printed worksheets when digital access is limited. ● Peer support. ● Flexible participation roles.
Assessment	Assessment may include: ● participation; ● environmental observations; ● interpretation of air quality information; ● teamwork; ● final presentation.
Additional resources	The following resources may support the implementation of the activity: ● IQAir – https://www.iqair.com ● Windy – https://www.windy.com ● European Environment Agency Air Quality – https://www.eea.europa.eu/themes/air

Learning Unit 4: Hands-On Exercise 4

Design a smart sustainable school: A digital STEM innovation challenge

Field	Activity information
Target age group / educational level	11–14 / 15–18
STEM area(s)	Engineering / Mathematics / Science / Technology
Environmental topic / sustainability theme	Energy Efficiency / Sustainable Buildings / Circular Economy / Climate Action
Learning objectives	Students will: • identify sustainability challenges within school environments; • apply STEM knowledge to design innovative solutions; • integrate digital technologies into sustainable school planning; • communicate ideas using digital design tools.
Competences developed	<u>STEM</u> • Engineering design • Mathematical reasoning • Systems thinking <u>Environmental</u> • Sustainable development • Energy efficiency • Resource management <u>Digital</u> • Digital design • Multimedia presentation • Online collaboration <u>Transversal</u> • Creativity • Problem solving • Communication • Teamwork
Estimated duration	4 lesson hours (approximately 180 minutes)

Activity overview	Students work as sustainability consultants challenged to redesign their school as a "Smart Sustainable School". Each team analyses the current school environment and proposes practical improvements related to renewable energy, water conservation, waste management, biodiversity, mobility and digital technologies. The final proposal is presented through digital posters or presentations.
Materials and resources	• Computers • Internet access • Worksheets • School map • Measuring tape (optional)
Digital tools	• Canva • Google Slides • SketchUp Free • Tinkercad • Padlet
Implementation procedure	<u>Preparation</u> The teacher introduces the concepts of sustainable schools, smart technologies and environmental challenges in educational settings. Students discuss the main sustainability issues that may affect their own school, such as energy consumption, waste generation, water use, green spaces and mobility, before defining the objectives of the design challenge. <u>Investigation</u> Working in collaborative groups, students analyse different areas of the school and identify opportunities for environmental improvement. They gather information through direct observation, simple measurements, photographs or discussions with teachers and classmates, focusing on aspects related to sustainability and digital innovation. <u>Design</u> Each group develops its own proposal for a Smart Sustainable School, integrating STEM knowledge and digital technologies. Students design practical solutions such as renewable energy systems, water-saving measures, recycling initiatives, biodiversity areas, smart lighting or digital environmental monitoring tools. The proposal is prepared using digital design and presentation platforms. <u>Presentation</u>

	Each group presents its Smart Sustainable School proposal to the class, explaining the identified challenges, the proposed solutions and their expected environmental impact. Students compare the different projects, discuss their feasibility and collaboratively select the most innovative and sustainable ideas, reflecting on how these solutions could be applied in real educational contexts.
Inclusion and adaptation	The activity can be adapted by: • Collaborative groups. • Flexible task distribution. • Multiple presentation formats. • Visual supports. • Adapted worksheets if required.
Assessment	Assessment may include: • creativity of the proposal; • feasibility of solutions; • STEM integration; • collaboration; • communication skills.
Additional resources	The following resources may support the implementation of the activity: • SketchUp Free – https://app.sketchup.com • Tinkercad – https://www.tinkercad.com • Canva – https://www.canva.com • European Green Schools resources – https://environment.ec.europa.eu

Learning Unit 5: Community Engagement and Project-Based Learning in EBL

Learning Unit 5 focuses on connecting Environment-Based Learning (EBL) with community engagement and project-based learning, encouraging learners to explore environmental challenges beyond the classroom and participate in meaningful local action. The Hands-On Exercises promote collaboration, investigation and shared responsibility through projects linked to the school and wider community. Through activities related to biodiversity, food sustainability, waste and circular economy, and local green spaces, learners develop STEM competences, environmental awareness, teamwork and civic engagement. The activities encourage learners to identify local challenges, collaborate with others and contribute to practical and sustainable solutions.

Learning Unit 5: Hands-On Exercise 1 Biodiversity detectives: exploring local ecosystems through environmental observation

Field	Activity information
Target age group / educational level	11–14 / 15–18
STEM area(s)	Science / Biology / Environmental Science / Interdisciplinary STEM
Environmental topic / sustainability theme	Biodiversity / Nature Conservation / Ecosystem Observation / Environmental Citizenship
Learning objectives	Students will: • identify local plant and animal species through direct observation; • understand the importance of biodiversity for healthy ecosystems; • develop scientific observation and classification skills; • analyse relationships between biodiversity and environmental quality; • promote environmental responsibility through community awareness.

Competences developed	<u>STEM competences</u> ● Scientific observation ● Species classification ● Environmental investigation ● Data collection <u>Environmental competences</u> ● Biodiversity awareness ● Nature conservation ● Ecosystem understanding ● Environmental citizenship <u>Digital competences</u> ● Digital documentation ● Online species identification ● Collaborative digital mapping <u>Transversal competences</u> ● Teamwork ● Critical thinking ● Communication ● Problem solving
Estimated duration	3 lesson periods (approximately 150 minutes)
Activity overview	Students investigate the biodiversity of a nearby natural area, school garden or local park through direct observation and environmental exploration. Working in collaborative groups, they identify plants, insects and birds, document their observations with photographs and field notes, and create a collaborative biodiversity map. The activity encourages students to reflect on the importance of protecting local ecosystems and to propose simple conservation actions that can be implemented within the school or community.
Materials and resources	● Observation worksheets ● Clipboards ● Pencils ● Smartphones or tablets (optional) ● Camera (optional) ● Local field guides
Digital tools	● iNaturalist ● Google My Maps ● Google Lens (optional) ● Padlet ● Canva

Implementation procedure	<u>Preparation</u> The teacher introduces the concepts of biodiversity, ecosystems and environmental observation. Students discuss the importance of local biodiversity and identify different habitats that can be explored within or near the school. <u>Investigation</u> Working in collaborative groups, students explore the selected natural area, identify plant and animal species, take photographs and complete observation sheets. Digital tools may be used to support species identification and record geographical locations. <u>Analysis</u> Students organise the collected information, compare biodiversity observations between different locations and identify factors that may positively or negatively affect local ecosystems. They discuss how biodiversity contributes to healthy environments and community well-being. <u>Presentation</u> Each group prepares a biodiversity map and presents its findings to the class. Students propose simple conservation actions that could improve biodiversity in the school or local community and reflect on their role as environmental citizens.
Inclusion and adaptation	● Mixed-ability collaborative groups. ● Visual identification guides. ● Flexible participation roles. ● Adapted observation routes when necessary. ● Printed worksheets available for students with limited digital access.
Assessment	Assessment may include: ● participation during field investigation; ● quality of environmental observations; ● accuracy of species identification; ● teamwork and collaboration; ● biodiversity map; ● final presentation.
Additional resources	● iNaturalist ● Google My Maps ● European Environment Agency – Biodiversity ● UNESCO – Biodiversity Education

Learning Unit 5: Hands-On Exercise 2

Food miles investigation: From farm to plate

Field	Activity information
Target age group / educational level	11–14 / 15–18
STEM area(s)	Science / Mathematics / Geography / Environmental Science / Interdisciplinary STEM
Environmental topic / sustainability theme	Food Sustainability / Sustainable Consumption / Climate Change / Environmental Citizenship
Learning objectives	Students will: ● investigate the origin of everyday food products; ● calculate the approximate distance travelled by different foods; ● understand the environmental impact of food transport; ● analyse the benefits of local and seasonal products; ● promote responsible food consumption.
Competences developed	<u>STEM competences</u> ● Data collection ● Mathematical calculations ● Geographical analysis ● Environmental investigation <u>Environmental competences</u> ● Sustainable consumption ● Climate awareness ● Food sustainability ● Responsible citizenship <u>Digital competences</u> ● Online research ● Spreadsheet organisation ● Digital infographic design <u>Transversal competences</u> ● Critical thinking ● Teamwork

	• Communication • Decision making
Estimated duration	3 lesson periods (approximately 150 minutes)
Activity overview	Students investigate the journey of common food products from their place of origin to their homes. Working in groups, they identify where different foods come from, estimate the distance travelled, compare transport methods and discuss the environmental impact associated with food distribution. Finally, they design a sustainable shopping basket that prioritises local and seasonal products and communicate their conclusions through a digital infographic.
Materials and resources	• Food packaging • World map • Calculator • Worksheets • Computers or tablets • Internet connection
Digital tools	• Google Maps • Google Sheets • Canva • European Food Information Resource (FoodExplorer) • FAO Food Systems resources
Implementation procedure	<u>Preparation</u> The teacher introduces the concepts of food sustainability, food miles and sustainable consumption. Students discuss where everyday food products come from and how transport affects the environment. <u>Investigation</u> Working in collaborative groups, students examine food labels, identify the country of origin of selected products and calculate the approximate distance travelled using digital mapping tools. They organise the collected information into comparison tables. <u>Analysis</u> Students compare the environmental impact of local and imported products, identify patterns in food distribution and discuss how consumer choices influence sustainability. They reflect on the benefits of supporting local producers and reducing food transport.

	<u>Presentation</u> Each group designs a digital infographic illustrating the journey of selected food products and proposes a sustainable shopping basket based on local and seasonal alternatives. The activity concludes with a class discussion on responsible food consumption and environmental citizenship.
Inclusion and adaptation	The activity can be adapted by: • Mixed-ability collaborative groups. • Simplified calculation tables where needed. • Visual maps and infographics. • Flexible task allocation. • Peer support throughout the activity.
Assessment	Assessment may include: • participation during investigation; • accuracy of food origin research; • quality of data organisation; • environmental reasoning; • infographic design; • final presentation.
Additional resources	The following resources may support the implementation of the activity: • Google Maps • Google Sheets • Canva • FAO – Food Systems • European Food Information Council (EUFIC)

Learning Unit 5: Hands-On Exercise 3

Community waste audit: Investigating waste generation and promoting circular economy

Field	Activity information
Target age group / educational level	11–14 / 15–18

STEM area(s)	Science / Mathematics / Environmental Science / Interdisciplinary STEM
Environmental topic / sustainability theme	Circular Economy / Waste Management / Recycling / Sustainable Consumption
Learning objectives	Students will: ● analyse waste generation within the school environment; ● classify different types of waste; ● collect and interpret environmental data; ● understand the principles of the circular economy; ● develop practical proposals to reduce waste and improve recycling practices.
Competences developed	<u>STEM competences</u> ● Scientific observation ● Data collection ● Data analysis ● Mathematical reasoning <u>Environmental competences</u> ● Waste reduction ● Recycling awareness ● Circular economy principles ● Sustainable behaviour <u>Digital competences</u> ● Data recording ● Spreadsheet management ● Digital presentation <u>Transversal competences</u> ● Teamwork ● Critical thinking ● Problem solving ● Communication
Estimated duration	3–4 lesson periods (approximately 180 minutes)
Activity overview	Students carry out an environmental audit to investigate how waste is generated and managed within their school. Working in collaborative groups, they observe different areas, classify waste, quantify the collected data and identify opportunities for improvement. Based on their findings, students develop practical recommendations to reduce waste generation and promote more sustainable behaviours within the school community.

Materials and resources	● Observation sheets ● Waste classification guide ● Gloves ● Waste bags ● Weighing scale (optional) ● Computers or tablets
Digital tools	● Google Sheets ● Canva ● Padlet ● Google Forms ● Google Maps (optional)
Implementation procedure	<u>Preparation</u> The teacher introduces the concepts of environmental citizenship, community participation and biodiversity conservation. Students discuss the importance of public green spaces and select a nearby location to investigate. <u>Investigation</u> Working in collaborative groups, students visit the selected green space to observe its environmental characteristics. They document biodiversity, accessibility, cleanliness, available facilities and signs of environmental degradation using photographs, field notes and digital mapping tools. <u>Analysis</u> Students analyse the collected information, identify environmental strengths and weaknesses and prioritise possible actions that could improve the selected green space. They discuss how local communities can contribute to protecting and enhancing public natural environments. <u>Presentation</u> Each group prepares a community action proposal including practical recommendations such as planting native species, installing birdhouses or insect hotels, improving waste management or creating awareness campaigns. The proposals are presented to classmates, teachers or local stakeholders to encourage real community engagement.
Inclusion and adaptation	● Collaborative mixed-ability groups. ● Flexible task distribution. ● Adapted observation routes. ● Visual support.

	● Peer mentoring during field activities.
Assessment	Assessment may include: ● participation in fieldwork; ● quality of environmental observations; ● feasibility of improvement proposals; ● teamwork and collaboration; ● community action plan; ● final presentation.
Additional resources	● iNaturalist ● Google My Maps ● European Environment Agency – Nature and Biodiversity ● Canva

Learning Unit 5: Hands-On Exercise 4

**Adopt a green space: A community action project
for Biodiversity and Sustainability**

Field	Activity information
Target age group / educational level	11–14 / 15–18
STEM area(s)	Science / Biology / Environmental Science / Interdisciplinary STEM
Environmental topic / sustainability theme	Biodiversity / Green Spaces / Environmental Citizenship / Community Engagement
Learning objectives	Students will: ● assess the environmental condition of a local green space; ● identify biodiversity and sustainability challenges; ● collaborate with classmates to design improvement proposals; ● strengthen environmental responsibility through community participation; ● understand the value of protecting local natural environments.

Competences developed	<u>STEM competences</u> ● Environmental investigation ● Observation ● Data collection ● Ecological analysis <u>Environmental competences</u> ● Biodiversity conservation ● Environmental stewardship ● Community participation ● Sustainable development <u>Digital competences</u> ● Digital documentation ● Mapping ● Multimedia presentation <u>Transversal competences</u> ● Collaboration ● Leadership ● Creativity ● Communication ● Civic engagement
Estimated duration	4 lesson periods (approximately 180–200 minutes)
Activity overview	Students adopt a nearby green space such as a school garden, local park or community area and investigate its environmental characteristics. Working collaboratively, they identify strengths and challenges related to biodiversity, accessibility, cleanliness and sustainability. Based on their observations, students design realistic improvement proposals and present them to the school or local community, promoting active environmental citizenship.
Materials and resources	● Observation worksheets ● Camera or mobile device ● Measuring tape (optional) ● Clipboards ● Computers ● Internet connection
Digital tools	● Google My Maps ● iNaturalist ● Canva ● Padlet ● Google Slides

Implementation procedure	<u>Preparation</u> The teacher introduces the concepts of environmental citizenship, community participation and biodiversity conservation. Students discuss the importance of public green spaces and select a nearby location to investigate. <u>Investigation</u> Working in collaborative groups, students visit the selected green space to observe its environmental characteristics. They document biodiversity, accessibility, cleanliness, available facilities and signs of environmental degradation using photographs, field notes and digital mapping tools. <u>Analysis</u> Students analyse the collected information, identify environmental strengths and weaknesses and prioritise possible actions that could improve the selected green space. They discuss how local communities can contribute to protecting and enhancing public natural environments. <u>Presentation</u> Each group prepares a community action proposal including practical recommendations such as planting native species, installing birdhouses or insect hotels, improving waste management or creating awareness campaigns. The proposals are presented to encourage real community engagement.
Inclusion and adaptation	The activity can be adapted by: ● Collaborative mixed-ability groups. ● Flexible task distribution. ● Adapted observation routes. ● Visual supports. ● Peer mentoring during field activities.
Assessment	Assessment may include: ● participation in fieldwork; ● quality of environmental observations; ● feasibility of improvement proposals; ● teamwork and community action plan; ● final presentation.
Additional resources	● Google My Maps ● European Environment Agency – Nature and Biodiversity ● Canva

Learning Unit 6: Assessment and Impact Evaluation of EBL in Disadvantaged Contexts

Learning Unit 6 focuses on the practical use of assessment and evaluation within Environment-Based Learning (EBL), helping learners and educators reflect on learning experiences, measure progress and understand the impact of environmental activities. The Hands-On Exercises introduce accessible and participatory approaches to collecting evidence, reflection and evaluation. Through activities involving reflection, observation, connection to nature and evaluation methods, learners develop self-awareness, critical thinking and reflective skills while contributing actively to the assessment process. The activities demonstrate how simple, inclusive and adaptable evaluation approaches can support meaningful EBL experiences, particularly in disadvantaged and diverse educational contexts.

Learning Unit 6: Hands-On Exercise 1 Co-design of an EBL observation checklist

Field	Activity information
Target age group / educational level	11–14 / 15–18
STEM area(s)	Interdisciplinary STEM
Environmental topic / sustainability theme	The checklist itself is topic-independent and is designed to be used alongside any and all existing EBL activities.
Learning objectives	Students will: • Work together to agree simple, clear criteria for what good scientific investigation looks like during an EBL activity. • Use a co-designed, icon-supported checklist to self-assess and peer-assess process skills such as questioning, observing, recording and collaborating.

	● Practise giving and receiving short, specific, low-stakes feedback within a group.
Competences developed	● Self-regulation ● Self-evaluation ● Peer analysis ● Peer feedback ● Metacognitive awareness ● Collaboration ● Teamwork
Estimated duration	30 – 60 minutes. ● This could be based on an “overall” analysis of any and all EBL activities being conducted or it could be focused on developing a checklist for a specific EBL activity.
Activity overview	Before carrying out an EBL activity, the class works together to agree three to five simple ‘look fors’ of good scientific investigation, such as ‘I asked a question’ or ‘I recorded what I saw’, expressed as a short checklist. Students use this checklist to tick off their own progress at agreed points during the activity, while the teacher circulates with a matching observation log to note evidence of engagement, questioning and collaboration. The activity closes with a short circle discussion in which each group identifies one checklist item it managed well and one it will work on next time.
Materials and resources	● Copies of the checklist ● Pens, markers or pencils ● Flipboard, large sheet of paper or whiteboard for the class to co-design the checklist. This could also be done using post-it notes ● A teacher observation log sheet matching the agreed checklist items
Digital tools	None are required. As an alternative to students recording their own data, an online form (i.e. a short google form) could be used instead of or alongside the paper checklists. It is noted however that the learning is probably better supported through students recording their own individual findings using their own checklists to retain access to individual data.

Implementation procedure	<u>Co-design:</u> Work with students towards answering a specific question/ statement - e.g. "What does good scientific investigation look like?". Guide discussion towards three to five concrete, observable items (e.g. asking a question, recording an observation, trying a number of options to identify a solution, etc.) and record these items. <u>Checklist creation:</u> Based on the identified items, work with the group to create a checklist. Try to ensure that all participants have an agreed, shared understanding of what the checklist is asking and what it is for. Add instructions to the checklist based on in-class discussion/ queries. <u>Evaluate EBL activity:</u> Based on a previously-completed EBL activity, or in conjunction with performing an EBL activity, have students reflect on and provide responses to the checklist items. If conducting an EBL activity, it may be useful to identify 2 or 3 agreed "checkpoints" during the activity and ask students to pause briefly during these to reflect on the checklist items. Depending on the group and/ or your own desired level of detail, it may be enough to simply have students respond either "yes" or "no" to the checklist items, or to give them additional detail and description. <u>Reflection:</u> After completing the activity/ checklist have the students work in small groups, students discuss the checklist items they did as part of the process. As an addition/ expansion of this, students could be encouraged to reflect on a checklist item they feel they did well and/ or one they would like to improve upon next time. <u>Improvement:</u> Students could also be asked to consider or shown additional parts of the scientific enquiry process and reflect on how these could have been included in the EBL activity
Inclusion and adaptation	● Checklists should use clear headings and simple sentence starters to support students with language difficulties or barriers to reading/ writing. ● It may be useful to try to focus on this as a formative low-stakes activity, rather than any form of assessment.

	Because students help to write the checklist themselves, they will have greater ownership of the criteria and the activity can feel less like an assessment, which is particularly helpful for students for whom formal assessment has previously been a source of anxiety. • Group composition can be adjusted so that a more confident student supports a less confident peer during the self-assessment step, reflecting a scaffolded, collaborative approach to assessment. • The same checklist structure can be reused across different EBL topics throughout the year, allowing students to track their own progress over time.
Assessment	As mentioned above, this activity is more of a formative activity than any kind of assessment tool. Therefore, the activity focus on engagement and developing process skills, without contributing to a formal grade. It may be useful to ask students to consider where else in their education process they may be able to apply this to in order to encourage greater reflection on and engagement with their learning processes.
Additional resources	A process on "Teacher Feedback to Improve Pupil Learning" is available from the Education Endowment Foundation, which can be useful as a reference for this and similar activities: • https://educationendowmentfoundation.org.uk/education-evidence/evidence-reviews/feedback-approaches

Learning Unit 6: Hands-On Exercise 2

Reflection circles

Field	Activity information
Target age group / educational level	11–14 / 15–18
STEM area(s)	Interdisciplinary STEM

Environmental topic / sustainability theme	The checklist itself is topic-independent and is designed to be used alongside any and all existing EBL activities.
Learning objectives	Students will: ● Reflect, individually and/ or in a small group, on what was done, what was learned, and how the EBL investigation felt. ● Practise structured, low-stakes peer listening and feedback. ● Contribute ideas that help the teacher adjust and improve future EBL lessons.
Competences developed	● Self-evaluation ● Reflective thinking ● Self-awareness ● Peer analysis ● Peer feedback ● Collaboration ● Teamwork
Estimated duration	30 – 60 minutes. ● This could be based on an “overall” analysis of any and all EBL activities being conducted or it could be focused on developing a checklist for a specific EBL activity. It can be run as a follow-up session immediately after an EBL investigation
Activity overview	Immediately after an EBL investigation, students take part in a short, structured reflection circle in groups of four to six. Students are given four simple prompts for discussion - what we did, what we found out, how it felt, and what we would change. Each group records one key reflection on a card for a classroom ‘Reflection Wall’. The teacher follows up with two or three groups in a short, informal conversation to gather richer feedback.
Materials and resources	● Flipboard, large sheet of paper or whiteboard (“reflection wall”) ● Pens, markers or pencils
Digital tools	None are required. A phone or tablet voice recorder could be used to capture spoken reflections from students but this brings concerns around data storage, etc.

Implementation procedure	<u>Set up reflection circles:</u> Arrange students into small groups immediately after the EBL investigation and introduce the four prompts: what we did, what we found out, how it felt, and what we would change. <u>Guided reflection:</u> The teacher models a short sample answer to each prompt, then each group works through all four prompts in turn, with every student contributing at least one response. <u>Reflection Wall:</u> Each group selects one reflection to write or draw on a card and adds it to the Reflection Wall, creating a shared, visible record of the class's thinking. <u>Short follow-up conversation:</u> The teacher speaks briefly with two or three groups, asking open questions such as 'What helped you most during the investigation?' to gather more detailed evaluative evidence. <u>Teacher review:</u> The teacher reviews the Reflection Wall and follow-up notes to identify one specific change to make to the next EBL lesson.
Inclusion and adaptation	The activity can be adapted by: • All four prompts are designed to be answered orally or visually as well as in writing. • A rotating, low-pressure speaking order, rather than always starting with the same student, helps to ensure that quieter students are not consistently put on the spot. • Where appropriate, students can be grouped with a trusted peer to support confidence during the reflection circle.
Assessment	This activity is more of a formative activity than any kind of assessment tool. Therefore, the activity focus on engagement and developing process skills, without contributing to a formal grade. It may be useful to ask students to consider where else in their education process they may be able to apply this to in order to encourage greater reflection on and engagement with their learning processes.

Additional resources	While too advanced to share with students directly, the University of Hull Library has a set of guidelines for reflective writing which may help inform teacher practice/ guidance of students for the activity - https://libguides.hull.ac.uk/reflectivewriting/schon
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Learning Unit 6: Hands-On Exercise 3

Measuring connection using the Inclusion of Nature in Self (INS) scale

Field	Activity information
Target age group / educational level	6–10 / 11–14
STEM area(s)	Science and Mathematics
Environmental topic / sustainability theme	The scale is topic-independent and is designed to be used alongside any and all existing EBL activities.
Learning objectives	Students will: ● Use a simple picture-based scale to record how connected students feel to the natural world, before and after an EBL activity. ● Pool students individual responses into class data and represent the result as a tally and a simple graph. ● Discuss what the data does and does not show, and suggest reasons for any change students can see.
Competences developed	● elf-reflection ● Self-evaluation ● Data literacy ● Data representation ● Interpretation of evidence ● Critical thinking ● Communication
Estimated duration	30 – 60 minutes. It is suggested that this could involved 10 minutes before the activity and 10 - 20 minutes after it, plus 20-30 minutes for the class data work and discussion. The scale

	itself takes under a minute to complete, so it can be attached to an EBL activity of any length.
Activity overview	Students are shown a row of seven pairs of circles, one labelled “me” and one labelled “nature”, which overlap a little more each time. They circle the pair that best matches how connected to nature they feel. The same sheet is completed again after a specific EBL activity, and the class pools both sets of responses as a tally and a bar chart. The class compares the before and after picture and discusses what might explain any difference, including whether a single question can really capture something as broad as a relationship with nature.
Materials and resources	● Printed INS sheets, one per student for each of the two rounds ● Pens or pencils ● Flipchart, whiteboard or large sheet of paper for the class tally and chart ● A simple code or number for each student, so the before and after sheets can be paired without using names
Digital tools	None are required. Online software could replace the paper-based activity, but this would be complex given each student is required to complete their own sheet. Potentially the seven images can be placed in a short online form (e.g. Google Forms) if the class already uses one, and the tally can be charted in a spreadsheet as part of the mathematics work.
Implementation procedure	<u>Warm-up:</u> Before showing the scale, ask the class what the word “nature” means to them and record the answers. This matters, because students in urban areas often picture nature as somewhere far away, and the discussion gives everyone a shared starting point. <u>Baseline:</u> Hand out the sheet and explain that the two circles stand for “me” and “nature”, and that they overlap more as you move to the right. Ask students to circle the one pair that feels right today. Stress that there is no correct answer and that individual sheets will not be shown to anyone. <u>EBL activity:</u>

	Run the EBL activity exactly as planned. Nothing about the activity itself needs to change. <u>Repeat:</u> Give out the same sheet again after the activity, ideally at the same time of day and in the same room, and ask the same question. Students reuse their code so that the two responses can be matched. <u>Class data work:</u> Tally how many students chose each of the seven positions before and after, and draw both as a bar chart. Ask the class what they notice, whether the change is large or small, and what else might explain it besides the activity, the weather, the day, or simply having been asked the question twice.
Inclusion and adaptation	• The scale needs no reading and no writing, so disadvantaged students with low literacy, etc. can all take part on equal terms, without any particular support that marks them out. • Because the instrument is a picture rather than a sentence, it needs no translation and results remain comparable across languages and countries. • The activity could use codes rather than names and report only the class result. Individual scores do not need to be (and perhaps should not be) displayed or compared, and a low score should never be treated as a shortcoming. • Younger students may find overlapping circles abstract. Try a physical version first, with two hoops on the floor that the class moves closer together, before moving to the paper sheet.
Assessment	The scale is not a test and no individual result should contribute to a grade. It is best used as a class-level indicator that the teacher keeps alongside other evidence of the impact of an EBL activity. The mathematics the activity generates, e.g. tallying, identifying the most common response, and drawing and reading a bar chart, etc. can, however, be assessed against other standards or evaluation resources.
Additional resources	The original scale and an illustrated version developed for less abstract thinkers are described here: https://www.mdpi.com/2071-1050/13/4/1761

	A longer companion instrument for ages 8–12, the Connection to Nature Index, is available free from NAAEE and works well alongside the INS scale: https://evaluation.naaee.org/tools/connection-nature-index
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Learning Unit 6: Hands-On Exercise 4

Using the NAAEE eeVAL libraries

Field	Activity information
Target age group / educational level	11–14 / 15–18
STEM area(s)	Interdisciplinary STEM
Environmental topic / sustainability theme	The activity can be applied to an EBL activity the class has already completed, whatever its environmental theme.
Learning objectives	Students will: • Turn a broad question about an EBL activity into one that can actually be answered with evidence. • Compare several established evaluation methods and select one, giving reasons for the choice. • Collect, summarise and present findings honestly, including what the evidence cannot show.
Competences developed	• Evaluative thinking • Research design • Data literacy • Critical thinking • Ethical awareness • Collaboration • Communication
Estimated duration	60 – 90 minutes, split across two sessions, plus whatever time the chosen method needs to gather responses. • It works best shortly after an EBL activity that the class still remembers well.

Activity overview	The class agrees one honest question about an EBL activity it has already carried out, such as whether the activity changed anyone's mind, or whether everybody actually got to take part. Small groups receive short summaries of four to six evaluation methods drawn from the NAAEE eeVAL libraries (survey, interview, observation, photographs, drawings, group discussion, etc.) which have been selected by the teacher and choose the one best suited to the question, explaining why. Each group runs its chosen method with a small number of respondents, then reports back a one-page summary of what it found and what it could not find out.
Materials and resources	• Printed one-page summaries of four to six methods from the eeVAL libraries • Pens or pencils • Flipchart, whiteboard or large sheet of paper for the class tally and chart • Post-it notes • Paper recording sheets matching each of the offered methods • A camera or tablet, only if the photograph method is chosen
Digital tools	None are required. The teacher needs access to the eeVAL website when preparing the method summaries, but students do not. Where devices are available, a short online form could be used for the survey method and a spreadsheet for charting the responses.
Implementation procedure	<u>Present the question:</u> Ask the class what they would like to know about the EBL activity they completed. Record all suggestions, then narrow them to one question specific enough to answer. <u>Method menu:</u> Give each group the printed method summaries and ask them to sort the methods by which would answer the question best, which would take the longest, and which would let the most people take part. <u>Choose and check:</u>

	Each group selects one method and explains the choice to the class. Apply a shared fairness check: could someone who finds reading hard, or who is new to the language, take part in this method <u>Gather:</u> Groups use their method with a small, agreed number of respondents. <u>Report back:</u> Each group presents a one-page summary covering our question, our method, what we found and what we still do not know
Inclusion and adaptation	• Keep at least two non-written methods on the menu, such as photographs, drawings or a dot vote, so that every student can carry out a full evaluation rather than only assist with someone else's. • The eeVAL materials are written for a United States audience, so the summaries should be shortened, translated and reworded into local terms before they are handed out. • Assign clear roles within each group (i.e. who is going to ask, who is going to record, who will keep time, who will present, etc.). • Ensuring anonymity and participation is important. Student respondents should be allowed to decline responses. Students should ensure that no names are recorded, etc.
Assessment	What is assessed here is the reasoning, not the result. A group that chooses its method well, applies it carefully and reports honestly that it found no change has completed the task correctly. The one-page summary works well as a final output, judged on whether the question is answerable, the method fits the question, and the conclusions stay within what the evidence supports.
Additional resources	https://evaluation.naaee.org/resources/methods-library https://evaluation-archive.naaee.org/evaluation-tools/tool-library

5. Final Remarks

The ECOTEACH Hands-On Exercises provide a practical bridge between the project's pedagogical framework and the implementation of Environment-Based STEM learning in real educational contexts. Across the six Learning Units, the activities encourage learners to observe, investigate, experiment, measure, collaborate and apply STEM knowledge to meaningful environmental and sustainability challenges.

The collection is designed as a flexible and adaptable resource rather than a fixed set of lesson plans. Teachers and educators can select and adapt the activities according to their learners, available resources and educational context, while maintaining their main Learning Objectives and inclusive approach.

Together with the other resources of the ECOTEACH Virtual Classroom, the Hands-On Exercises contribute to making Environment-Based STEM education more practical, inclusive, engaging and transferable, particularly for disadvantaged learners and educational contexts.

