LOESS

LITERACY BOOST THROUGH AN OPERATIONAL EDUCATIONAL ECOSYSTEM OF SOCIETAL ACTORS ON SOIL HEALTH

Blueprint

Exemplary Materials

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1. Exemplary Materials

The examples below are intended to support teachers in designing teaching units that focus on soil health education using the 5E framework as additional to the blueprint developed within D3.2 of the LOESS project. These examples were collected within the Communities of Practice of the LOESS consortium. Without the engagement of the Community of Practice members and the project partners, this collection of examples would not have been possible. The materials have the potential to be adapted to specific age groups.

1.1 "The Earth's arable surface" workshop developed by The Nature School

Topic	**"The Earth's arable surface" workshop developed by The Nature School**	
Phase	**Source**	**Explanation**
Engage	https://loess-project.eu/case-studie/the-earths-arable-surface-workshop-developed-by-the-nature-school/	The workshop begins with the teacher gathering the pupils to form a circle outdoors. Using a long rope of about 10 meters, the teacher asks them to grab the rope and form a circle that they put down on the ground together. When the string is on the ground, the teacher explains that the circle represents the Earth's surface. The pupils are asked to think about the composition of the Earth's surface and are informed that water constitutes about ¾.
Explore		Then the teacher explains that the circle can also be a pie chart and divides ¾ of it using 2 pieces of shorter rope and places a jar of water in this part. Then the pupils are asked to think further about what forms the final quarter of the Earth's surface. The teacher divides the remaining ¼ into two parts using a short rope. In one part, which is 1/8 of the earth's surface, there are mountains, glaciers and other barren land which is marked with a large stone. Three quarters of the remaining eighth is too dry or wet to use for food production, and is therefore marked with an empty jar. The remaining part, which is 1/32, about 3%, – is arable land which is marked using a bowl of soil. This represents approximately 1.8 ha/person, 18,000 m2. The exercise provides them with a tangible understanding of the limited space available for food production.
Explain		Then the pupils are tasked to discuss a number of questions in pairs: • What do you think when you see that there is such a small area that can be cultivated? • What feelings do you get when you see how little space there is actually available to grow food on? • How should we use this part of the earth wisely?

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		• How can we use the school playground or allotment that we have access to, knowing this? After discussing in pairs they are asked to present in front of the whole group and the teacher is providing feedback.
Extend		The next activity is to find out what local soil looks like. The pupils are divided into pairs and given petri dishes and spoons to collect different soil samples. The pairs collect samples from a few places and then come back and use a loupe magnification device to see what they can find in the soil. Meanwhile, the teacher asks probing questions to make them reflect further. For example, whether they can smell something from the soil? Do the soil samples look the same? How does the soil feel between their fingers? - Can they detect any organisms or traces of organisms in the soil? What happens if they pour soil into a glass of water? This provides the pupils with sensual experiences of the soil and helps them to make a connection with nature in their everyday environment. In the final lesson the pupils are tasked to collect leaves from the park and add them to the school's growing boxes in the school playground to demonstrate the process of soil formation through the decomposition of organic matter. During this lesson, pupils learn that leaves provide food for the microorganisms in the soil.
Evaluate		As a final step, the teacher does a round where all students say what they learned and the group jointly reflects on the learnings.

1.2 Anthropogenic Climate Change by Edu4Clima

Topic	**Anthropogenic Climate Change - Edu4Clima**	
Phase	**Source**	**Explanation**
Engage	https://edu4clima.gr/program-5/	This Program is based on experiential-exploratory learning and aims on the one hand to present the basic concepts that define anthropogenic climate change (including soil degradation) and on the other hand to present the research project carried out at the Finokalia station and related to the composition of the atmosphere and soil pollution, of the driving force of climate change, which we are experiencing after the industrial revolution.
Explore	The Research, Innovation and Dissemination Hub	The Hub is hosted in the old Primary schools of the settlements of Finokalia and Nofalia in the area of Ano Merabello of the Municipality of Agios Nikolaos which

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	in Finokalia aims to transfer the knowledge produced by research on climate change and air pollution at the University of Crete spearheaded by the research station of the Laboratory of Environmental Chemical Processes to the primary and secondary schools.	together with the research station are integrated into a single destination for education and awareness in issues related to climate change, sustainable development and sustainability. School visits and the EDU4clima training program take place in these areas.
Explain	The program is based on simple experiments-demonstrations, where phenomena such as the ability of carbon dioxide to bind infrared radiation, the effect of the melting of ice on the level and salinity of the sea, the basic principles of circulation of water in the oceans, the increase in acidity in the oceans and the effect this has on living organisms, the effects of soil erosion and degradation.	
Extend	Evaluate climate data and analyze the earth's energy balance reflecting climate change (eg, What does climate change mean?). Understand the effects of climate	Especially for students, an additional goal is to be able to process real experimental results from measurements at the Finokalia station, so that they can step into the role of the researcher and be led to conclusions, see the researcher's work up close and learn about other new professions related to climate change that may be their future profession.

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	change, from local to global, on environmental, biological, soil and social systems (eg, Why does climate change matter?). Compare climate change mitigation and adaptation strategies (macroeconomic and microeconomic) based on current environmental, economic, political and ethical implications (eg, What can we do?).	
Evaluate	The Program is appropriately structured to be interactive and experiential and requires active student participation, including short interactive presentations and films and the use of an online assessment tool after each unit as well as out-of-classroom activities.	Real-time assessment will be made for the understanding of the concepts presented and emphasis will be placed on the points where the students show low indicators of understanding or where they themselves require further clarification.

1.3 Biodiversity in different soils

Topic	**Biodiversity in different soils**	
Phase	**Source/Material**	**Explanation**
Engage	https://www.soundingsoil.ch/zuhoeren/	Students should listen to soil sounds in different environments and reflect on the question: Who do you think is making these sounds? This activity helps educators gauge students' prior knowledge about soil animals and life beneath the surface. Their ideas should be collected, for example, on

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		a whiteboard or flipchart, to facilitate discussion and further exploration.
Explore	Ideally, every group of students should receive their own three jars of soil. A determination key, stereoscopic magnifier and a worksheet to take minutes are helpful for this task.	Students get presented three jars of soil, each from a different area with the task to compare the soil samples and present their findings.
Explain	Students are supported by information cards on soil (health) and should prepare a small presentation.	The educator can support this process by raising questions to draw a bigger picture: What is healthy soil and how does it look like? Introduce key concepts such as soil composition, nutrients, biodiversity, and the role of microorganisms. Connect their observations to real-world applications like farming and ecosystem health. Let the students explain what a healthy soil looks like and what attributes it has.
Extend/ Elaborate	Students are provided with information about the three soil types from the earlier stage and should create a poster.	A group of four students will receive one of the soil samples and additional information about its characteristics. The task is to elaborate on the question: “Which animals are living in this soil – How do they contribute to the characteristics of this soil type?" Based on their findings they should create a poster and present their findings.
Evaluate	Prepare and define learning outcomes and students should be observed closely to be able to give high-quality feedback. Students can be asked to develop an action plan to improve the soil biodiversity in their community.	Monitor the development of skills. For a formative feedback collect products and analyse them.

1.4 Training project on outdoor education in public schools

Topic	**Training project on outdoor education in public schools**	
Phase	**Source**	**Explanation**

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Engage	https://www.istitutocomprensivosattaspanodeamicis.edu.it/index.php/l-istituto/la-scuola/scuola-dell-infanzia https://www.associazionepuntidivista.it/la-scuola-degli-elfi/ https://web.unica.it/unica/it/news_notizie_s1.page?contentId=NTZ102011	*La Scuola degli Elfi,* in collaboration with the Association *Punti di Vista* and the University of Cagliari, is focused on outdoor education and support for the educational community. Recently, the children of the school have 'adopted' a section of the University's Botanical Garden: they have studied it, prepared the soil, and planted seeds. The project captures preschoolers' interest by bringing them to the Botanical Garden where they can connect classroom learning with real-world applications. Children are excited to adopt their own garden section and take responsibility for plants they usually only see on their dinner tables.
Explore	Plant growth and soil are actively explored by the children through questions, predictions, and simple hypotheses about plant and soil needs. Observations are documented with drawings and photographs, then shared in peer discussions.	During monthly visits, the preschoolers question how plants grow, make predictions about what will happen to their seedlings, and formulate simple hypotheses about plant needs and about soil. They carefully record observations through drawings and photographs, eagerly discussing their discoveries with peers as they work alongside gardeners in all phases of planting.
Explain	Observations are shared by the children about soil preparation and planting techniques. Soil texture, moisture, and its importance for plant growth are explored hands-on. Simple botanical concepts are introduced through tactile experiences.	During circle time in the garden, the preschoolers discuss their findings using their emerging vocabulary, sharing their excited observations about soil preparation and planting techniques. Teachers and Botanical Garden staff guide these sessions, providing opportunities for the young learners to share discoveries about local horticultural species and soil properties. Through concrete examples and hands-on demonstrations appropriate for early childhood, the children engage directly with the soil, learning about its texture, moisture, and importance for plant growth. Staff and teachers help them articulate connections between their soil exploration activities and new knowledge, making simple botanical concepts accessible and meaningful for this age group through tactile experiences.
Elaborate	Connections between garden activities and broader concepts are made by the children. Watering plants is	The preschoolers begin to make connections between garden activities and broader concepts. They relate watering plants to the rain cycle and harvesting vegetables to mealtime at home and school. These connections help

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	linked to the rain cycle, and harvesting vegetables is related to mealtime at home and school.	them transfer knowledge to new contexts, like understanding why plants in different locations.
Evaluate	New knowledge about plant cultivation and soil is expressed by the children through educational posters and drawings.	Through developmentally appropriate group discussions and reflection, the children express their new knowledge about plant cultivation using simple language and drawings. They identify challenging aspects and discuss how they overcame these difficulties. The preschoolers reflect on their collaborative efforts, recognizing individual contributions and developing appreciation for teamwork in maintaining their garden plot. This reflective process reinforces both their emerging gardening and soil skills and important social-emotional development.

1.5 Counting Earthworms

Topic	**Activity: Counting Worms – Citizen Science Available at Soil Scientist - Airfield Estate**	
Phase	**Source**	**Explanation**
Engage	https://www.airfield.ie/world-of-soil/soil-scientist/ Airfield: *Let's do an experiment!* intro, worm facts	Sparks curiosity by introducing earthworms' importance in soil health and ecosystem services, especially with fact from the infographic that 100 earthworms can process 840 kg/ha of organic matter per year! They also increase water holding capacity of the soil which reduces flooding risk even on well drained sandy soils. Encourages thinking about soil biodiversity and climate resilience.
Explore	Steps of the experiment	Dig a hole- pour mustard water- place and wash earthworms in the tub à identify types of earthworms. Promotes inquiry-based, hands-on learning.
Explain	Worm ID chart and classification activity	This activity shows students how to classify worms into different categories such as adult or immature and different ecological groups. It leads to improved understanding of soil biodiversity and organism functions in the soil.
Extend	Recording habitat data (plant cover, fertiliser use, site type)	Through this activity, students' capacity to relate worm presence to environmental variables is extended which fosters broader ecological thinking.
Evaluate	Submission of results and analysis prompts	Evaluation is through data reporting using an online form and requires participants to make judgements on soil texture and the types of worms identified using the criteria provided. The form includes an option to request feedback on how to improve the health of their soil based on their

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		data. This provides feedback on their data reporting task.

1.6 Soil Your Pants – Citizen Science

Topic	Soil Your Pants – Citizen Science	
Phase	**Source**	**Explanation**
Engage	"Let's find out how healthy our soil is!" intro in experiment sheet available at https://www.airfield.ie/world-of-soil/soil-scientist/	This activity engages students with the unconventional concept of burying underpants or other cotton clothing. It leads them to the deeper ideas of soil microbial activity and decomposition through its use and assessment.
Explore	Instructions for burial of underpants and observation	Students dig a 5 cm deep hole, bury the pants and then dig them up after 2 months to assess the microbial activity in that soil. It is a hands-on and a long-term activity.
Explain	Post-burial observation and analysis	This activity shows students how to compare decomposition results with soil health indicators. Students record findings and connect observations to biological activity. It explains about types of soil and makes them aware of inputs to the soil which could be beneficial or harmful.
Extend	Soil type assessment and reflection on biological activity	This activity of soil texture testing extends to real-world soil management and sustainability issues.
Evaluate	Photo documentation, breakdown scoring, and result submission	Evaluation of soil health is done using visual scales and data is shared using an online form. The form includes an option to request feedback on how to improve the health of their soil based on their data. This provides feedback on their data reporting task.

1.7 An Choill Bheag (Tiny Forest) – Soil Testing When Planning for a Woodland

Topic	Activity: An Choill Bheag (Tiny Forest) – Soil Testing When Planning for a Woodland Outdoor Classroom An Choill Bheag – LEAF	
Phase	**Source**	**Explanation**
Engage	Introduction to An Choill Bheag. One minute video on tree planting in other schools and resource on How we Benefit from a School	This activity introduces the students to the concept of creating a small, dense, biodiverse native woodland habitat on school grounds and the resulting benefits. This provides the context to encourage students to find out about the soil in their school environment using simple resources when planning for a small woodland outdoor classroom.

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	Woodland	
Explore	Soil testing worksheet; AnCB-WS1-Soil-Testing.pdf	In this activity, exploration of soil pH and of soil type in the school grounds takes place. Students collect soil samples and check the pH using a coloured indicator and perform the soil jam jar test to measure layers of sand, silt and clay.
Explain	Soil testing worksheet; AnCB-WS1-Soil-Testing.pdf	Students learn how to interpret and explain the results – are the areas sampled acidic, neutral or alkaline and what type of soil is at each sampling site.
Extend	Worksheet on Biodiversity Audit	Students extend their exploration of the soil at their location by performing a biodiversity audit.
Evaluate	Worksheet on Planning for the Small Woodland	Students evaluate the soil test and biodiversity audit results to identify where to locate a small woodland. They reflect on their findings to prepare a plan in small groups for their woodland outdoor classroom and submit these for consideration.

1.8 Composting and Healthy Soil

Topic	**Composting and Healthy Soil**	
Phase	**Source**	**Explanation**
Engage	https://www.zivazahrada.sk/produkt/kurz-kompostovania-a-zdravej-pody/	The course "Composting and Healthy Soil" offers practical knowledge on building and maintaining healthy soil in gardens, fields, meadows, and forests. It is designed for a broad audience, including farmers, composting professionals, municipal workers, gardeners, landscape managers, architects, urban planners, ecologists, and anyone interested in circular economy and regenerative land care. Participants will learn about soil ecosystems, composting methods, and the role of soil microbiology, combining theory with hands-on practice and personalized guidance.
Explore		Explore the living world beneath your feet—from gardens and fields to meadows and forests. This course invites participants to discover how soil ecosystems function, how composting supports biodiversity, and how healthy soil connects to plants, animals, and human well-being. Through a blend of online learning, hands-on workshops, and personalized consultations, you'll explore practical tools and regenerative approaches to soil care. Designed for farmers, gardeners, municipal workers, ecologists, and anyone passionate about circular and sustainable land use.

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Explain		This course explains how to build and maintain healthy soil through composting and regenerative practices. It guides participants through the science of soil ecosystems, nutrient cycles, and the role of microorganisms in supporting plant and environmental health. The program is divided into three parts: an online training that builds theoretical knowledge, a hands-on workshop for practical composting skills, and a personalized consultation to apply what you've learned in your own garden, farm, or community. It is designed for anyone interested in sustainable land care — from farmers and gardeners to municipal workers and ecologists.
Extend		This course extends your understanding of soil health and composting beyond the basics. It offers a deep dive into the biology of living soil, nutrient cycles, and the role of compost in supporting resilient ecosystems. Through structured online lessons, practical workshops, and personalised consultations, participants expand their skills in assessing soil and compost quality, managing composting processes, and applying regenerative practices in real-world settings. Whether you're a farmer, gardener, municipal worker, or environmental planner, this course helps you extend your impact by integrating sustainable soil care into your work.
Evaluate		This course helps participants evaluate soil health and compost quality using both scientific and practical methods. Through online lessons, hands-on workshops, and individual consultations, learners gain tools to assess soil structure, microbial activity, nutrient cycles, and compost maturity. Regular tests, interactive discussions, and real-life case studies support the evaluation of knowledge and skills throughout the course. By the end, participants are equipped to critically evaluate and improve soil and compost systems in their own gardens, farms, or communities.

1.9 Green-Blue Schoolyards

Topic	**Green-Blue Schoolyards**	
Phase	**Source**	**Explanation**
Engage	https://www.groenblauweschoolpleinen.nl/ https://www.ivn.nl/	Green-Blue Schoolyards (Groenblauwe Schoolpleinen in Dutch) is a joint initiative between the province of South Holland and the Delfland Water Board. A green-blue schoolyard blends green (garden) and blue (water) spaces. It offers an outdoor space for playing as well as education.

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	NatureWise Foundation	Schools frquently adopt and take inspiration for educatinal modules from organisations such as NatureWise Foundation and IVN Natuur educatie Most of these lesson packages include educational approaches to foster engagement with natural elements including soil. For instance, in the course 'nature education (Natuureducatie in Dutch) students engage and explore various natural elements using all their senses.
Explore		Activities in the lesson packages encourage student-led learning, where they can test ideas and engage in real-world problem-solving for instance by critically thinking over and investigating local problems related to including water, climate change, and soil. For examples, the IVN Outdoor Lessons and Nature Assignments for Primary Education facilitate exploration of biodiversity and ecological interactions through hands-on activities.
Explain		In most lessons, an educator (usually a school teacher or a professional) explains the facts and observations made during the activities. Students can consolidate their learning through reflection, discussion, and guided feedback from teachers. The approaches to these vary across the lessons and range includin presentations, or storytelling based on their outdoor experiences to help students articulate their findings.
Extend		Under the 'Tiny Forest Rangers' program, by IVN, students participate in planting Tiny Forests and become 'Tiny Forest Rangers.' Where they are responsible for monitoring the growth of the forest, guiding visitors, and utilizing the area as an outdoor classroom. By taking on the role of rangers, students apply their knowledge and experience in real-world settings, and develop a sense of ownership and thus feeling motivated to engage in environmental stewardship.
Evaluate		Most lessons provide formative assessment tools and resources which often includes observations on student's observations, discussions, etc. Teachers can use structured assignments to gauge students' conceptual understanding for instance on water flow, soil properties, and biodiversity. Summative assessment often includes projects where students design and present sustainable schoolyard

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		solutions, demonstrating their learning and ability to apply concepts.

1.10 L'espoli del sòl (Soil's plunder)

Topic	**L'espoli del sòl (Soil's plunder)*** ***The authors of this project have been members of EduglobalSTEM and teachers at INS Escola Feixes***	
Phase	**Source: L'espoli del sòl**	**Explanation**
Engage	• Initial questions. • Rising food pricing news. • What are we made of?	Students are asked some initial questions to connect with their conception of soil and its main elements. We start wondering about the chemical components of food and soil, their rising prices and then they are prompted to think on what chemical elements are we made of.
Explore	• Follow the atom. • Soil horizons. • Soil puzzle pieces.	Students get to explore the biogeochemical cycles of the main elements and compounds found in our body, our food and our soils: H_2O, C, N, P and K by following the atoms. To do that, they use an online game in order to explore the cycles' reservoirs and quantify their processes. After that, they conclude all the elements go through the soil at some point and therefore start exploring the different horizons of soil through a puzzle representation of soil and field trip to gather samples. These samples will be analyzed in the high school lab.
Explain	• Soil horizons. • Soil analysis. • Soil texture. • Soil origin and structure. • Soil chemistry. • Lab analysis results. • Individual lab report. • Agriculture case-studies. • What have I learned?	Students need to explain some properties about the vertical structure of soil, the chemical and physical properties of the soil's upper layer, and finally learn how to model and resolve 2nd degree equations related to agriculture case-studies: • **Soil's structure and formation**: Each group needs to describe the soil's horizon, how it is created and how it is destroyed in front of the class, with the help of the soil puzzle pieces. • **Chemical and physical properties**: Students analyze the soil's samples in the lab. With the help of the project's site and the teachers explanations they have to study the soil's texture, origin, density and chemical properties (CEC, OM, CO_2, NO_3, and pH).

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		Each student must fill a lab report where they contrast their initial hypothesis with the results from their investigation. • **Agriculture case-studies**: Teachers present 3 case-studies for the students to model and resolve. Each individual student has to create their own portfolio to explain how to resolve each type of 2nd degree equation. All of these explanations need to be recorded in their on-line portfolio (What have I learned?).
Extend / Elaborate	• Fueling conflicts. • Orography study.	After explaining the soil's properties and formation, students should be able to assess a soil's fertility. We extend this idea by explaining the need for artificial fertilizers in order to feed the whole human population. However, this need breeds conflicts worldwide. Students are then presented with some social conflicts related to each of the elements and compounds studied initially and must answer several questions to help them understand the conflicts, relate them to what they already know, form an opinion and structure all of these new ideas. Moreover, in order to apply what they've learned about the 2nd degree equations and apply their explanations from the portfolio to a real case, students must model a part of the orography from the field trip using the GeoGebra app.
Evaluate	• Activity tracker. • Final product: A trip to sustainability.	Finally, students must synthesize everything they've learned and connect all of these ideas in a Google maps, as part of their final product. We present them with several alternatives to the need for artificial fertilizers and other issues related to the current agricultural and food system. Each group must explain how one of the sustainable solutions or alternatives is related to the biogeochemical cycles, the soil's properties and the social conflicts studied in front of the class with the help of their Google maps presentation. Their speeches are evaluated and qualified alongside other written activities and productions made throughout the project. All of these activities are given feedback and can be tracked in the project's activity tracker.

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1.11 WEATHERING & EROSION

Topic	WEATHERING & EROSION	
Phase	**Source**	**Explanation**
Engage	https://www.generationgenius.com/weathering-erosion-and-deposition-for-kids/ **AIM** Students will explore the science of weathering and erosion to understand how Earth's surface changes. They will discover what happens during weathering, and the different ways this material is moved through erosion. **DURATION** One to two 45-minute classroom periods. **MATERIALS** • Science notebooks • Pencils *Station 1* • Sugar cubes • Plastic tray • Plastic bag (Ziploc) *Station 2* • Watering can • Potting soil or sand • Clear basin *Station 3* • Coarse sand paper • Limestone, calcite, or other soft stone	Show students a picture of a tree growing through a rock. Ask students to describe what they see in the image. Focus the discussion on the actual crack formed from the plant growing. Ask students to think of other places they have seen cracks in Earth's surface. Examples include potholes in the road or cracks on the sidewalk. Explain that there are many different natural processes in our environment that change the surface of Earth. A process known as weathering causes these changes. Mention that even humans cause weathering and erosion. For example, each time we dig soil, or just walk along the ground, we are slowly changing Earth's surface.

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Explore	Divide students into three groups. Allow the groups to rotate through each station, using their science notebooks to record their observations. STATION 1: PHYSICAL WEATHERING Have students model the process of physical weathering using sugar cubes. Place a tray on the table and put six sugar cubes in a plastic bag. Put this plastic bag containing the sugar cubes on the tray. Have students press down on the sugar cubes so that they crush apart. Encourage students to discuss and make note of what they observe. STATION 2: WATER EROSION AND DEPOSITION Take a clear basin and fill one side of the basin with a steep slope of soil. Have students take a watering can and pour water over the steep slope. They should see water and soil falling down the slope. They should also see evidence of deposition based on where the soil settles	Explain to students that they will be exploring the process of weathering and erosion. They will examine different causes of weathering and some different types of erosion. They will also recognize that weather events like rain, snow, and wind are not the only factors that contribute to weathering and erosion.

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	on the other side of the basin. STATION 3: WIND EROSION Place a rock on the table with coarse sandpaper. Have students sand the rock for a few minutes to demonstrate wind erosion with sand. Make sure a new rock is provided for each group as well as a fresh piece of sandpaper.	
Explain	After students complete all stations facilitate a classroom discussion about the differences between weathering and erosion.	Reiterate that for weathering, weather is not the only contributing factor. Human activities, plants, and other factors can also cause weathering. Review the different types of erosion and features of each. Explain that Station 1 provided a visual of what happens to soft pieces of rock during weathering. Station 2 demonstrated what happens during water erosion, and Station 3 showed what happens when the wind blows particles such as sand against rock over a period of time. **Watch the video as a class then facilitate a class discussion** Weathering & Erosion Video For Kids | 3rd, 4th & 5th Grade
Extend		Students can use the DIY Activity to model what happens during weathering, erosion, and deposition just like Zoe did. They should be able to describe the causes of each process, and be able to recognize at what step each process is occurring within their model demonstration.
Evaluate		Continue the discussion about the differences between weathering and erosion in the context of how they change Earth's surface over time. Use the stations completed in the Explore section of this activity to facilitate this discussion, as students were able to visualize key differences between the processes of weathering and erosion. Ask students to list examples of things they may have seen in nature that could have been caused by either weathering or erosion. For example, students can say they saw weeds growing through cracks or saw a large pothole in the ground. Have students state whether their example could have been

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		caused by weathering or erosion. Provide time for students to explain why they believe this to be true.

1.12 The WormEx II - Experiment

Topic	The WormEx II CBPR experiment	
Phase	**Source**	**Explanation**
Engage	https://iris.unibs.it/handle/11379/581865	Aiming at contributing to disseminate the importance of healthy soils for the society and at highlighting their hydrological functions, we designed the WormEx II experiment, an educational experiment and a citizen-based participatory research performed in high-school classes, in view of attracting students' attention on the hydrological role played by macropores, through the observation of some aspects of earthworm digging activity.
Explore		The core of the experiment consists in replicating Charles and Horace Darwin's famous observations on the sinking of stones. We reproduced a couple of wormstones (inspired by that positioned by Horace Darwin at Down House), and we positioned them in the garden of the Liceo Copernico high-school in Brescia in March 2022. Since then many sinking measurements were performed with the participation of high-school and university students, teachers and faculty staff. Students meet Charles and Horace Darwin's original works on the matter. They go in depth with the text analysis, recognizing both Charles' rigorous epistemological approach based on ample data collection and Horace's attitude at designing an experiment to obtain good quality data. Contextually they deal with the scientific importance of patient practice and long lasting data collection.
Explain		Students have various meetings in class to discuss a first interpretation of the measured data, and following lectures with university staff to effectively calculate soil hydrological properties from the infiltration tests performed in the field.
Extend		We periodically organize discussion sessions between the high school students and one university student who worked on the data to obtain his bachelor degree in sustainable agricultural systems.
Evaluate		Some students have reported about this activity in the talk organized to obtain their high school degree, and also in following meetings of the LOESS CoP.

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1.13 Soil Surfaces

Topic	Soil Surfaces	
Phase	**Source**	**Explanation**
Engage	https://www.umwelt-im-unterricht.de/unterrichtsvorschlaege/was-passiert-unter-unseren-fuessen	The students describe the condition of the soil along their way to school. They are asked to observe what they see when they look down while walking and to describe the different surface types they encounter along the way. Their observations are collected and recorded in a mind map that is visible to the entire class.
Explore	To support their work, the students are given a magnifying glass and a worksheet that includes the task description and also a table for recording and comparing their observations.	As part of an excursion, the students analyze the condition of soil surfaces at various locations. These may include the schoolyard, the school garden, a meadow, etc. The students describe the appearance of the different surfaces, their composition, the animals and plants present, how the soil is used, how humans influence the soil, and where the water flows when it rains. The different sites are then compared with one another. Soil samples may also be collected, and experiments can be conducted.
Explain	The students use their recorded observations to present their findings.	The students present their findings in a group discussion. The results are recorded on the (smart-)board.
Extend	An illustration showing the functions of soil is provided, along with optional support to help with labeling the illustration.	The teacher presents an illustration of the functions of soil. Using the results recorded on the board or smartboard, the students work together to explore the importance of soil as a habitat and water reservoir, as well as the consequences of soil sealing. They explain which types of soil are important for animals, plants, and humans, on which soils water can seep through, what happens to soil that is built upon or sealed by humans, and what measures can be taken to reduce the impact of development/sealing. More advanced students can create their own posters based on the example of the illustration.
Evaluate	Learning outcomes can be predefined, and targeted feedback can be provided during the discussion. Specific reflection questions can also be prepared in advance.	Exchange and discussion allow for the assessment of comprehension difficulties. This can be further supported through targeted reflection questions.

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1.14 Secrets of the Soil: Journey of Discovery

Topic	Secrets of the Soil: Journey of Discovery	
Phase	**Source: LOESS Integrated Learning Scenario from a Turkish Teacher**	**Explanation:**
Engage	The teacher asks the following question to attract the students' attention: *Is the soil, which we touch unknowingly at every moment of our lives, which we live on and which is the source of our food, really just a surface, or is there a much larger world hidden underneath?* A brainstorming activity will be organized after the answers received from the students. The teacher asks questions to activate the students' prior knowledge and to focus on what information they are trying to learn. Some of the brainstorming questions the teacher may suggest are: ● Have you ever had a handful of soil in your hand and how did you feel? ● What is soil made of? ● Why is soil important? ● Why do living things need soil?	Lesson 1 (20 minutes) **'The Importance of Soil'** This learning scenario will help students do research, solve problems and think critically. Brainstorming and discussion

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	● Is soil only brown, what other colors can it have? ● Do you have any questions about soil? To further increase students' curiosity, a video will be shown. This activity will pave the way for students to make discoveries about soil.	
Explore	Students are asked to create a mind map based on the information they have obtained from the videos they have watched. They will develop their knowledge of soil by exchanging ideas with the mind maps they will create collaboratively. For the next lesson, students are asked to bring different types of soil from different regions. They are encouraged to bring some soil from forested and green areas, while the other part is from arid and urbanized areas.	Lesson 1 (20 minutes) **'The Importance of Soil'** Discussion and preparation for the next lesson
	Students visually analyze soil samples taken from different environments (garden, forest, urban area) and observe the living organisms, plant roots, and stones in them. The teacher asks questions so that students can make observations,	Lesson 2 (20 minutes) **Healthy Soils and Living Things on Plants**

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	especially regarding the colors, smells, and wetness or dryness of the soil. Students use their own eyes, then their magnifying glasses, to examine soil samples in class. Students observe and record in their notebooks or use an online tool like Canva to record the color, texture, and presence of visible organisms (e.g., earthworms, insects, plant roots) in their samples.	
Explain	The teacher shows students some pre-prepared visuals of living organisms in the soil and explains how the physical appearance and texture of soil can be related to the health of the soil and the environment in which it has been collected. The teacher shows a video of the long-term growth of plants.	Lesson 2 (20 minutes)
Extend	1) In this stage, bean seeds are planted in the soil types brought by the students (lively, healthy, nutrient-rich soil brought from the forest area and dry, sandy soil brought from the industrialized region). Sufficient watering is done. Containers are placed in a sunny place. Regular watering will	Lesson 3 (30 minutes)

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	continue. Students observe the development of the seeds they have planted in transparent containers every 5 days and take notes. They measure plant heights with rulers. They make observations by taking into account the water holding capacity of the channels in healthy soil. 2) After the plant growth experiment, students observe that plants in healthy soil have sufficient ventilation channels and high water holding capacity. Teacher emphasizes the soil around them and makes connections to how to use the lands they live in sustainably. 3) Students discuss and compare plant growth in healthy and unhealthy soils. The role of nutrients and biota in healthy soils in plant growth will be summarized and the lesson will conclude.	

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Evaluate	A brainstorming session was conducted to learn and activate the students' prior knowledge. Some questions were asked: ● Have you ever held a handful of soil in your hand and how did you feel? ● What is soil made of? ● Why is soil important? ● Why do living things need soil? ● Is soil only brown, what other colors can it have? ● Do you have any questions about the soil? The teacher created a checklist to assess students' prior knowledge and participation in the lesson. See Appendix-1	**Initial Assessment**
	The teacher can use the observation table and weekly observation log table to document and evaluate the observations of the students in the 2nd lesson. See Appendix-2 - Soil Types Observation Table	**Formative evaluation**
	A 10-question exam may be used for the final assessment. See Appendix-5 – Final assessment.	**Final assessment**

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