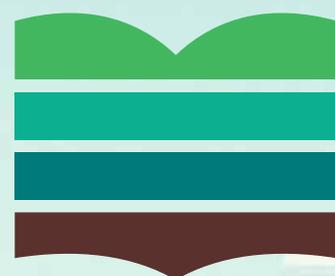


LOESS Soil Atlas

A toolbox for
educators,
researchers, and
engaged citizens



LOESS

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



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1. Introduction

Welcome to the Soil Atlas of the LOESS Project – Literacy boost through an Operational Educational Ecosystem of Societal actors on Soil health.

Healthy soils are the foundation of all life: they provide us with food, purify water, offer habitats for biodiversity, and play a vital role in stabilizing our climate and landscapes. Yet, estimates suggest that 60 to 70% of soils in Europe are already degraded.

The LOESS Project addresses this challenge by strengthening soil literacy at all levels of education and society. It develops a wide range of teaching and learning materials as well as other tools and materials to integrate the topic of soil health into schools, universities, adult education, and the wider public.

This Soil Atlas provides a comprehensive overview of all materials developed within LOESS – including the Student Module, Glossary, Crowdmapping tool, AR application, Blueprint, Online Module for Lecturers, Desk Research Results, Case Studies, the CERL Workshop, the MOOC, the Learning Scenarios and Best Practices.

It serves both as a reference and as a source of inspiration to explore and apply these diverse tools within your own educational or professional context. The materials are designed for a wide range of audiences – from students and teachers to researchers, practitioners, and citizens – ensuring that everyone can find something useful and inspiring.

We invite you to explore the materials, find inspiration, and get involved – because protecting and caring for our soils is something we can only achieve together.

Let's take care of our soils, our lives, and our planet.

2. How to use the Atlas

The LOESS Soil Atlas is structured to provide easy access to all materials developed within the project, addressing different educational levels and target groups. Each section offers resources, examples, and tools that support soil literacy in formal and informal learning contexts. Case studies are included at the end for each educational level, providing concrete examples from practice and supporting transfer to different learning contexts. NOTE: Please note that some of the materials can be used in more than one educational level. The table below provides an overview of which materials are most applicable for each educational level.

LEVEL	AUDIENCE	MATERIALS
Primary	Primary teachers	<ul style="list-style-type: none"> • MOOC – Soil education: an integrated STEM approach – online course • Case studies of soil health education practices
Secondary	Teachers (11–18 years)	<ul style="list-style-type: none"> • Learning scenarios for schools – lesson plans • MOOC – Soil education: an integrated STEM approach – online course • Glossary of soil-related terms • Crowdmapping tool for soil health • AR application on Soil • Case studies of soil health education practices
Higher Education	University lecturers & students	<ul style="list-style-type: none"> • Soil, Society, and Sustainability: A Modular Teaching Framework for Higher Education • Educational Course for Biology and Environmental Education Teacher Students • Module for Lecturers on Community Based Research and Learning • Training Workshop: From soil problem to research question • Blueprint for integrating soil health education into teaching • Glossary of soil-related terms • European Voices on Soil Health Podcast • Crowdmapping tool for soil health • AR application on Soil • Case studies of soil health education practices
Vocational & Adult Education	VET trainers, adult educators	<ul style="list-style-type: none"> • Module for Lecturers on Community Based Research and Learning • Training Workshop: From soil problem to research question • Blueprint for integrating soil health education into teaching • MOOC – Soil education: an integrated STEM approach – online course • Glossary of soil-related terms • European Voices on Soil Health Podcast • Crowdmapping tool for soil health • AR application on Soil • Case studies of soil health education practices
General Education / Public	All audiences	<ul style="list-style-type: none"> • Glossary of soil-related terms • European Voices on Soil Health Podcast • Crowdmapping tool for soil health • AR application on Soil • Case studies of soil health education practices

3. Materials

The materials were developed in European cooperation by the project partners within the LOESS project.

3.1 BACKGROUND AND RESEARCH

LOESS Project – Literacy boost through an Operational Educational Ecosystem of Societal actors on Soil health – launched in 2023 as part of the EU Horizon “A Soil Deal for Europe” mission and funded by EU Horizon, the LOESS Project works to enhance understanding of soil-related knowledge among educators, policymakers, and various societal actors. By assessing existing knowledge levels across different stakeholder groups, the project identifies gaps and opportunities for innovation in teaching and learning formats.

LOESS co-creates educational tools and pilot programs that bring together scientific research, policy insights, and local cultural knowledge. These include MOOCs, learning scenarios, a dedicated AR application, and a crowdmapping tool. The project emphasizes hands-on engagement, collaboration, and practical application, turning knowledge into informed decision-making.

Through these efforts, LOESS fosters dialogue between diverse actors and supports

initiatives that translate soil literacy into tangible actions. By equipping communities and institutions with tailored resources, the project encourages creative and evidence-based solutions for sustainable soil management.

MORE INFORMATION:

<https://loess-project.eu/>

3.1.1 RESEARCH STUDY

The LOESS research study focused on assessing the current state of, and identifying future wishes for, soil (health) education across Europe at different educational levels—primary, secondary, vocational, tertiary, and among the general public. The study employed a triangulated methodology combining desk research, focus groups, and interviews across 15 European countries. Key findings across all levels and countries include:

- **Limited presence** of the term “soil health” within existing education across Europe.
- An emphasis on **knowledge acquisition** as the dominant focus of soil (health) education. The wished form of soil (health) education envisions more experiential, **doing-based learning activities** (e.g. soil monitoring) and opportunities for cultivating values and ways of being (e.g. reflective and caring attitudes toward soil conservation), rather than relying solely on traditional, lecture-based knowledge transfer.
- A strong aspiration emerged for shifting away from predominantly indoor learning environments (e.g. classrooms) toward **outdoor and experiential settings** (e.g. gardens, forests), enabling more immersive and sensory learning experiences centered on soil (health), and fostering more **emancipatory and participatory educational processes**.
- A shared wish was expressed to move beyond the dominant mechanistic paradigm—which focuses on understanding individual soil components and processes—toward a more **ecological paradigm** that acknowledges the complex interconnections between soil (health), ecosystems, and humans.
- Current collaborations in soil (health) education usually involve a limited range of disciplines or stakeholders, mainly teachers and students. There is a wish to

broaden these **collaborations** by including societal actors (e.g., farmers, policymakers) and diverse perspectives, creating learning contexts that reflect real-world situations.

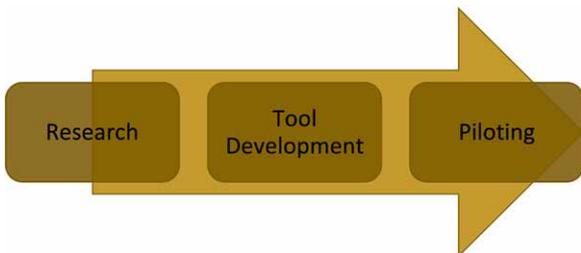
Further information can be found in this report: https://loess-project.eu/wp-content/uploads/2024/10/Deliverable-2.2_Report-on-awareness-needs-and-vision-for-soil-education_with_disclaimer.pdf

As part of the research activities, the project partners identified and analysed examples of best practices in soil (health) education across Europe, including educational programs, initiatives, and courses. This work resulted in a collection of case studies, which is available on the project website (<https://loess-project.eu/case-studies/>).

The case studies showcase innovative approaches to soil (health) education that reflect the wished characteristics identified in the study. They feature examples of outdoor and experiential learning, activities that foster practical skills and caring ways of being, as well as systems-oriented, collaborative and community-engaged initiatives grounded in participatory and emancipatory learning processes.

These case studies offer inspiration and practical guidance for educators and institutions aiming to design soil (health) education programs that respond to the wishes identified in this research. The collection of case studies available on the website can be filtered by educational level, learning setting, type of learning activity, and country (see screenshots below).

3.1.2 DEVELOPMENT OF THE MATERIALS



The educational materials presented in this Soil Atlas were developed based on the findings of the research study intro-

duced in the previous chapter. Building on the jointly identified needs and evidence, the development of the materials was coordinated by selected project partners who assumed lead responsibility for different components of the work. Once the materials were completed, they were tested within the consortium in various educational and regional contexts. This Atlas provides an overview of the materials developed so far.

3.2 LEARNING SCENARIOS FOR SCHOOLS – LESSON PLANS

The LOESS learning scenarios are comprehensive, classroom-ready lesson plans for secondary school educators working with learners aged 11–18. They integrate scientific, technological, engineering, and social perspectives to help students understand soil as a living system. Each scenario offers clear objectives, hands-on and digital activities, and links to the UN Sustaina-

ble Development Goals (SDGs). Available in 13 languages, they can be adapted to different subjects and curricula and used as stand-alone lessons or within larger projects connecting local soil issues to global sustainability themes. All scenarios can be downloaded from <https://loess-project.eu/learning-scenarios/>.

3.2.1 SOIL DETECTIVES

TITLE: Soil Detectives

FORMAT: Learning Scenario

TARGET AUDIENCE: 14 to 16 year-old students.

SUBJECTS COVERED: Biology, Geography, Geology

AUTHORS: Ana Belén Yuste Martínez & Javier Calamardo Murat

DESCRIPTION: This learning scenario analyses different soil properties (moisture, organic matter content and nutrient retention) and invites students to use the acquired knowledge to analyse fertility and sustainable practices developed in the local community. Similarly, it combines practical analysis in the laboratory with theoretical content on the importance of soil and invites students to capture all the results



Photo: © University of Vechta, Caroline Schmidt.

obtained in a Geographic Information System (GIS) that maps the area. Finally, the content learned will be presented in a dedicated song, promoting creativity and the responsible use of artificial intelligence.

LEARNING OBJECTIVES:

- Learn how to look for useful information online.
- Engage students in multidisciplinary activities.
- Represent information in Geographic Information Systems (GIS).
- Enrich students' vocabulary with words relevant to soil education.

- Develop critical thinking and work collaboratively to conduct soil analysis.
- Raise awareness of threats to soil fertility and learn to assess soil health.

LINK: <https://loess-project.eu/learning-scenarios/>

3.2.2 THE LIFE BENEATH OUR FEET

TITLE: The Life Beneath Our Feet

FORMAT: Learning Scenario

TARGET AUDIENCE: 11 to 16 year-old students.

SUBJECTS COVERED: Biology, Chemistry, Mathematics, Physics

AUTHORS: Bosiljko Đerek & Tina Copot

DESCRIPTION: In this activity, students investigate the health and composition of soil across different environments – such as gardens, forests, and urban areas. By examining the biological components of soil and applying mathematical methods to analyse their findings, students gain a deeper understanding of how soil properties vary and how they influence the broader ecosystem balance.

Building on their observations, students will identify factors affecting soil health and propose practical solutions to improve it in a specific area. This interdisciplinary scenario combines biology,



mathematics, and environmental science, promoting inquiry-based learning and real-world problem solving.

The activity directly supports several United Nations Sustainable Development Goals (SDGs), including Goal 2 – Zero Hunger, Goal 3 – Good Health and Well-being, and Goal 15 – Life on Land. By understanding soil systems and the processes that sustain them, students become more aware of how healthy soils contribute to food security, human health, and biodiversity—key foundations for a sustainable future.

LEARNING OBJECTIVES:

- Use online resources to gather information about soil conservation practices and soil health indicators, evaluating the credibility of such sources.

- Represent soil related information in various ways, including mathematical data representation (graphs, charts) and creative presentations (visual storytelling).
- Critically assess the factors affecting soil health in different environments and propose evidence-based solutions to improve it.
- Work collaboratively on projects, fostering teamwork, communication, and shared responsibility for learning outcomes.

LINK: <https://loess-project.eu/learning-scenarios/>

3.2.3 SOS – SAVE OUR SOILS

TITLE: SOS! Save Our Soils!

FORMAT: Learning Scenario

TARGET AUDIENCE: 15 to 18 year-old students.

SUBJECTS COVERED: Biology, Geography

AUTHORS: Emma Abbate & Vittoria Buccigrossi

DESCRIPTION: This learning scenario engages students in understanding soil health through interactive, hands-on activities that examine soil properties and their role in ecosystems and society. Students investigate soil types, conduct experiments in a virtual lab, and analyse soil degradation using digital tools, culminating in a presentation challenge. The plan integrates web research and practical tasks to build skills in data analysis, interpretation, and persuasive communication. Flexible and adaptable to various curricula, it emphasises ecology, biodiversity,



sustainability, physical geography, and human-environment interaction. Familiarity with satellite imagery, graphs, and GIS resources is recommended to maximise learning outcomes.

In addition, this learning activity addresses competencies in scientific inquiry, environmental stewardship, and sustainable development, and it is designed to be flexible and replicable, matching the proficiency levels of average high school students. Additionally, it aligns with Sustainable Development Goals (SDGs): SDG 13 (Climate Action), and SDG 15 (Life on Land), by promoting awareness and action towards soil health and environmental conservation.

LEARNING OBJECTIVES:

- Recognize the commonest patterns of soil types across Europe.
- Acquire knowledge that cartographic representations of soil can be employed to guide decisions regarding land stewardship.
- Develop scientific observation and data recording skills.
- Conduct experiments to observe how different light conditions affect plant growth and health and interpret the results.
- Integrate concepts from Geography and Biology to gain a holistic understanding of soil health and its environmental impact.

LINK: <https://loess-project.eu/learning-scenarios/>

3.2.4 EXPLORING SOIL: A LEARNING ACROSS STEM

TITLE: Exploring soil: A Learning across STEM

FORMAT: Learning Scenario

TARGET AUDIENCE: 11 to 13 year-old students.

SUBJECTS COVERED: Biology, Chemistry, Mathematics, Physics

AUTHORS: Sarika Chawla & Nikita Poirier

DESCRIPTION: In this series of lessons, students will explore the importance of soil by integrating concepts from biology, chemistry, physics, and math. They will examine soil composition, learn how organisms contribute to soil health, and measure soil properties like pH and moisture. Using math, students will analyse data on soil erosion and nutrient content. Physics will help explain water retention and filtration. Hands-on experiments and real-world applications will enhance their understand-

ing of soil’s critical role in ecosystems, agriculture, and sustainability, fostering interdisciplinary learning and environmental awareness.

In addition, this learning scenario develops students’ competences in scientific inquiry, data analysis, and critical thinking. Through studies of biodiversity, nutrient cycles, and human-environment interactions, students enhance their understanding of ecosystem sustainability. They will also gain skills in measuring and analysing real-world data, conducting field studies, and using digital tools for documentation, connecting local and global environmental issues to Sustainable Development Goals (SDGs).

LEARNING OBJECTIVES:

- Understand the relationship between soil health and food production.
- Explore methods to enhance soil quality and sustainability.
- Learn to visually communicate information about soil ecosystems.

- Discover how technology can improve soil management practices.
- Recognize the importance of microorganisms in soil health.
- Identify strategies to prevent soil erosion and contamination.
- Appreciate the role of soil in supporting sustainable agriculture.
- Use digital tools to assess and monitor soil properties.
- Encourage critical thinking about soil conservation efforts.

LINK: <https://loess-project.eu/learning-scenarios/>

3.2.5 NEW SOILUTION: THE CLUES BENEATH OUR FEET

TITLE: New SOILution: The clues beneath our feet

FORMAT: Learning Scenario

TARGET AUDIENCE: 15- to 18-year-old students

SUBJECTS COVERED: Biology, Chemistry, Geology, Geography, Humanities

AUTHORS: Valentina Cesari & Irene Somà

DESCRIPTION: This learning scenario explores soil as a vital yet non-renewable resource, essential for life, food production and cultural heritage. Students will examine “soil solutions”, focusing on the role of soil in nutrient cycling and environmental interactions. Through paleo-stratigraphy, they will analyse soil layers to uncover past civilizations and its role in preserving cultural heritage. The scenario contrasts traditional farming with innovative soilless methods like hydroponics, emphasizing the importance of soil restoration. By combining ancient practices with modern technology, students will gain insight into sustainable food production, soil conservation and

urban farming’s impact on biodiversity and mitigating soil consumption effects.

LEARNING OBJECTIVES:

- Identify and describe different soil types and layers in chronological order, gaining basic knowledge of archaeological stratigraphy.
- Reflect on how soil properties affect the preservation of artefacts and human remains.
- Explain soil’s role in plant growth and describe how physical and chemical parameters influence both natural and soilless farming systems.
- Recognize the impacts of soil sealing and propose innovative, sustainable solutions for proximity farming and soil preservation.
- Apply hands-on methods for testing soil parameters, develop scientific observation and data recording skills, and connect insights from Humanities, Earth Sciences, Chemistry, and Biology to understand soil’s central role in sustainability.

LINK: <https://loess-project.eu/learning-scenarios/>

3.2.6 SOIL HEALTH: WHAT IS THIS ALL ABOUT AND WHY IS IT A TIMELESS AND INFINITE MUST?

TITLE: Soil Health: What is this all about and why is it a timeless and infinite must?

FORMAT: Learning Scenario

TARGET AUDIENCE: 16 to 17 year-old students

SUBJECTS COVERED: Biology, Chemistry, Geography, Geology, Philosophy

AUTHOR: Eirini Anastasiadou

DESCRIPTION: In this learning scenario, students explore soil composition and the role of organisms in maintaining soil health. They measure key properties such as pH and moisture and examine how these factors influence ecosystems and agriculture.

Through indoor and outdoor activities, hands-on experiments, and real-world applications, students engage with soil- and sustainability-related challenges, deepening their understanding of soil's vital role in supporting life. The scenario follows the 5E Instructional Model to guide learning from exploration to reflection and application.

LEARNING OBJECTIVES:

- Identify and describe soil layers, composition, and main substrates essential for life.
- Explain soil's role in supporting plant growth, ecosystems, and its significance since ancient times.
- Understand soil's relevance for sustainability, including food security, biodiversity, clean water, and the SDGs.
- Address real-world soil challenges, use online resources for research, and connect learning to sustainability contexts.
- Collaborate effectively, think critically, show empathy for environmental issues, and visually present findings about soil ecosystems.

LINK: <https://loess-project.eu/learning-scenarios/>



Photos: © University of Vechta, Caroline Schmidt.

3.2.7 DIGGING DEEPER: EXPLORING THE VITAL ROLE OF SOIL IN LOCAL ECOSYSTEMS

TITLE: Digging Deeper: Exploring the vital role of Soil in local ecosystems

FORMAT: Learning Scenario

TARGET AUDIENCE: 10 to 12 year-old students.

SUBJECTS COVERED: Biology, Mathematics, Geography, ICT and Civic engagement

AUTHORS: Anita Šimac

DESCRIPTION: In this learning scenario, students will explore the importance of healthy soil and its role in supporting local ecosystems such as parks and beaches. Students will investigate different types of soil, examine soil biodiversity, and analyse the effects of pollution and human activity on soil health. This project integrates science, mathe-

tics, geography, and environmental education, promoting hands-on learning and engagement with the local community.

LEARNING OBJECTIVES:

- Understand the importance of soil health for ecosystems.
- Investigate the different types of soil found in parks and beaches.
- Analyse the relationship between soil quality, biodiversity, and environmental sustainability.
- Collect soil samples, analyse their properties, and map soil types.
- Raise awareness about the impact of pollution and urban development on soil quality.

LINK: <https://loess-project.eu/learning-scenarios/>



Photo: © University of Vechta, Caroline Schmidt.

3.3 HIGHER EDUCATION

This section provides resources developed specifically for universities and higher education institutions. They support both teaching and research by connecting soil science with sustainability, pedagogy, and civic engagement. The materials include modules, workshops, and courses that promote ex-

periential and interdisciplinary learning, encouraging future educators, researchers, and community partners to work together on soil literacy and action. Each tool can be adapted to different academic contexts and teaching styles.

3.3.1 SOIL, SOCIETY, AND SUSTAINABILITY: A MODULAR TEACHING FRAMEWORK FOR HIGHER EDUCATION

TITLE: Soil, Society, and Sustainability: A Modular Teaching Framework for Higher Education

FORMAT: University module

TARGET AUDIENCE: University students/lecturers

DESCRIPTION: This module equips lecturers with theoretical foundations and practical tools to integrate soil education into teaching for sustainability. It includes four flexible sessions that can be combined or used independently. Basic knowledge of soil functions and threats can be acquired through self-study.

The module blends field-based experience, core soil science, and interactive, game-based learning to provide a holistic introduction to soils. Participants explore soils as living ecosystems, learn about their functions, threats, and protection, and work with digital and hands-on tools to analyse soil health. They also engage with educational



Photo: © University of Vechta, Caroline Schmidt.

methods that promote systems thinking, active learning, and ethical reflection. Overall, the module strengthens both subject knowledge and pedagogical skills, enabling educators to link soil topics with sustainability, community action, and real-world problem-solving.

LEARNING OBJECTIVES:

- Understand key soil functions, relevance, threats, and regional aspects.

- Use soil-related tools and ESD methods in teaching.
- Collaborate with external partners and engage communities in soil activities.
- Develop and evaluate educational materials and approaches.
- Apply critical, systemic, and solution-oriented thinking to real-world projects.

LINK: <https://loess-project.eu/training-module/>

3.3.2 EDUCATIONAL COURSE FOR BIOLOGY AND ENVIRONMENTAL EDUCATION TEACHER STUDENTS

TITLE: Educational Course for Biology and Environmental Education Teacher Students

FORMAT: Student course

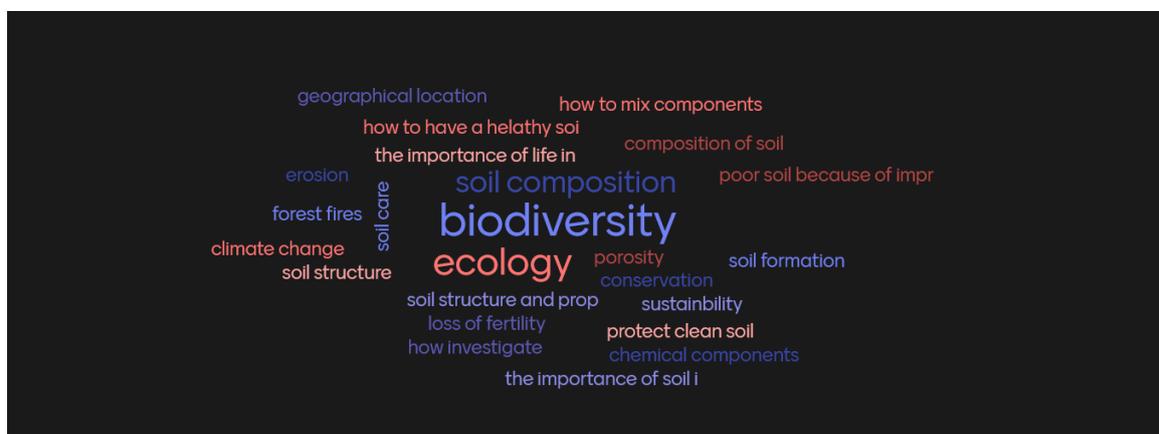
TARGET AUDIENCE: Teacher students

DESCRIPTION: Soil health as a stand-alone topic remains clearly underrepresented in European curricula. To address this gap an educational course on soil health education specifically designed for pre-service biology and environmental education teachers has been developed.

The course is aimed at future educa-

tors and can be integrated into existing teacher training programs or offered as an independent module. It comprises four sessions of 90 minutes each, during which participants explore how to design and implement effective teaching sessions on soil health. Upon completion, participants are expected to be able to develop their own teaching scenarios grounded in pedagogical theory and best practices in science education.

The course package includes a detailed module description and a set of PowerPoint slides, enabling interested educators to implement the module independently with their students.



Picture: Screenshot taken during a MOOC, where parts of the educational course were presented.
© Universität Innsbruck, Institut für Fachdidaktik.

LEARNING OBJECTIVES:

- Students can explain the importance of soil health for education and the environment.
- Students can independently plan and design teaching units on soil health.

- Students can apply educational concepts and best practices from the modules in their own teaching.

LINK: <https://loess-project.eu/educational-course/>

3.3.3 ONLINE MODULE FOR LECTURERS ON COMMUNITY-BASED RESEARCH AND LEARNING

TITLE: CERL Module for Lecturers

FORMAT: Flipped classroom workshop (online)

TARGET AUDIENCE: Lecturers

DESCRIPTION: The Online Module for Lecturers is conceptualized as a flipped classroom workshop comprising four sessions of 60 minutes each. The module is designed to support educators in re-envisioning their teaching practices through reflective and participatory approaches.

The workshop combines theoretical input on Community Engaged Research and Learning (CERL) with interactive activities for sharing experiences and collaboratively deepening understanding. Emphasis is placed on integrating soil health examples across disciplines, and participants design a CERL project to implement in their own teaching.

Participants are expected to develop and apply their own CERL-based projects within their disciplinary contexts.

LEARNING OBJECTIVES:

- Evaluate relevant sources on CERL, and particularly on embedding CERL methodology into the higher education curriculum.
- Identify and evaluate pedagogies, methods and opportunities for integrating soil (health) education and awareness into CERL projects.
- Design and plan the implementation of a CERL project within a module or course that fosters meaningful and respectful stakeholder engagement, aligns with student learning outcomes, and integrates opportunities for learner reflection.
- Apply common principles of science communication and ethical consideration when working collaboratively with community members.
- Demonstrate the ability to critically reflect on the learning content and their professional experiences and to further integrate feedback.

LINK: <https://loess-project.eu/cerl-module-for-lecturers/>

3.3.4 TRAINING WORKSHOP: FROM SOIL PROBLEM TO RESEARCH QUESTION

TITLE: Working with partners:
developing a research question from a
real-world soil problem

FORMAT: Community Engaged
Research and Learning Workshop

TARGET AUDIENCE: University
students and lecturers

DESCRIPTION: This interactive workshop introduces participants to the process of turning real-world community soil health problems into clear, researchable questions. Through the use of a case study and facilitated dialogue between participants, we explore simple principles of partnership working and collaborative enquiry. By the end, participants will have practised shaping a community issue into a focused research question they can apply in their own teaching or projects. The session ends with a short collective summary to capture key insights and next steps.

LEARNING OBJECTIVES:

- Identify what you already know and what you want to learn about creating research questions from community problems.
- Recognize basic principles of working well with community partners.
- Explain the difference between a broad problem and a focused research question.
- Practice turning a community-identified soil-health issue (or crowd-mapped issue) into a researchable question.
- Reflect on how this approach could fit into your own teaching or context.

LINK: <https://loess-project.eu/training-workshop/>



loess-project.eu



SESSION PLAN

1. Welcome, task outline and setting learning objectives (10 mins)
2. Context and background (10 mins)
3. Working in groups – addressing a research question (40 mins)
4. Feeding back and plenary discussion (30 mins)
5. Summarising (20 mins)
6. Reflecting on process (10 mins)



3.4 VOCATIONAL AND ADULT EDUCATION

The resources in this section are designed for professional educators, trainers, and adult learners who wish to integrate soil health into lifelong and vocational learning. They include teaching blueprints and a Massive Open Online Course (MOOC) that

offers flexible, self-paced study. These materials emphasize practical application, reflection, and real-world learning. They help educators strengthen links between education, employment, and sustainable land use practices.

3.4.1 BLUEPRINT FOR INTEGRATING SOIL HEALTH EDUCATION INTO TEACHING

TITLE: Blueprint for integrating soil health education into teaching

FORMAT: Handbook/Blueprint

TARGET AUDIENCE: Educators (diverse)

DESCRIPTION: The Blueprint for Exemplary Sustainable Practices is designed as a handbook for educators interested in integrating soil health education into their teaching. Focusing on the description of a well-tested pedagogical foundation, the blueprint provides examples for different phases of an educational process following the 5E Model developed by Bybee and colleagues (Bybee et al., 2006).

The blueprint aims to support educators who wish to implement interactive and inquiry-based teaching in their classrooms. It was developed through an iterative process, with researchers from the LOESS consortium providing continuous feedback. The final version includes a detailed description of



Photo: © Innsbruck University, Lucas Weinberg.

the five interrelated phases that guide teachers in designing motivational and learning-intensive programs that not only engage students physically but also promote deep learning: Engage, Explore, Explain, Extend, and Evaluate.

LEARNING OBJECTIVES:

- Users can identify practical examples of sustainable soil management from the provided activities.
- Users can apply knowledge from the material to suggest improvements for soil management in real-world contexts.
- Users can adapt teaching strategies to promote inquiry-based learning about soils.

LINK: <https://loess-project.eu/blue-print-biology-course/>

3.4.2 MOOC – SOIL EDUCATION: AN INTEGRATED STEM APPROACH

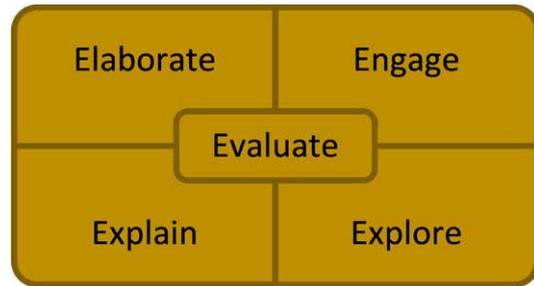
TITLE: Soil education: an integrated STEM approach

FORMAT: Asynchronous online course

TARGET AUDIENCE: STEM teachers and non-formal STEM educators

DESCRIPTION: This Massive Open On-line Course (MOOC) explores the critical role of soil health and soil education in shaping a sustainable future. It supports educators in integrating soil-related topics into STEM teaching to create meaningful, engaging, and interdisciplinary learning experiences. Participants gain insights into using soil health as a lens to address real-world sustainability challenges, adopt innovative pedagogies, and promote integrated teaching approaches.

The course introduces the Biological Science Curriculum Study (BSCS) 5E Instructional Model, a proven framework for fostering student engagement and deep learning. Through practical examples, it demonstrates how to make teaching more interactive, inquiry-based, and student-centred.



Own illustration based on Bybee 2006.

By connecting soil health to the United Nations Sustainable Development Goals (SDGs) and relevant EU policies, the MOOC helps teachers link global issues to students’ daily lives, encouraging critical thinking, sustainability awareness, and action-oriented learning.

LEARNING OBJECTIVES:

- Explain what soil is, why soil health is important for humankind, and how to teach these topics in an engaging and interdisciplinary way.
- Understand and apply the BSCS 5E Instructional Model in STEM teaching.

- Integrate economic, societal, ethical, biological, and chemical dimensions of soil health into their lessons.
- Design a learning scenario on soil health ready for classroom or non-formal education use.

LINK: <https://loess-project.eu/mooc-soil-education-an-integrated-stem-approach/>

3.5 GENERAL EDUCATION

This section’s tools make soil literacy accessible to all, from students and teachers to communities and policymakers. They help bridge science and society by making soil

health visible, understandable, and relevant to everyday life. The resources are suitable for formal education, informal learning, exhibitions, and public awareness campaigns.

3.5.1 GLOSSARY OF SOIL-RELATED TERMS

TITLE: Glossary of soil-related terms

FORMAT: Glossary/Dictionary on soil-terms

TARGET AUDIENCE: General public, Secondary, Higher, and Vocational and Adult Education

DESCRIPTION: The Glossary is available in 9 different languages. It provides a structured and accessible compilation of key terms used throughout the Soil Atlas. It is designed to support a clear understanding of soil-related concepts for users with varying levels of prior knowledge, including educators, students, practitioners, and stakeholders in land management. The resource brings together terminology from soil

science, ecology, agriculture, and environmental policy, ensuring consistent use of definitions across the project’s materials.

Each entry provides a concise explanation of key terms and their relevance to soil systems and ecological processes. The glossary covers core concepts—from soil structure and nutrient dynamics to degradation, climate impacts, and sustainable land use. As a practical reference, it helps readers quickly clarify unfamiliar vocabulary, strengthens soil literacy, and supports the project’s goal of making soil knowledge accessible and applicable across diverse educational and professional contexts.

LEARNING OBJECTIVES:

- Learners can understand and explain key terms from the LOESS glossary.
- Learners can recognize connections between core concepts of sustainable soil management.

- Learners can reflect on human impacts on soil and apply glossary concepts to real-life soil and land management practices.

LINK: <https://loess-project.eu/glossary-list-of-terms/>

3.5.2 EUROPEAN VOICES ON SOIL HEALTH PODCAST

TITLE: European Voices on Soil Health – Why should we care about it?

FORMAT: Podcast

TARGET AUDIENCE: General public, Secondary, Higher, Vocational and Adult Education

DESCRIPTION: European Voices on Soil Health is a key communication and educational component of the European LOESS project. The podcast aims to strengthen public and professional understanding of soil health, raise awareness, and highlight the importance of soils for environmental sustainability, agriculture, and climate resilience.

Each episode is dedicated to a different participating country. Episodes feature one with a professional from research, practice, or policy who discusses national challenges, local initiatives, and innovative solutions, and one with students involved in LOESS educational activities who share their learning experiences, perspectives, and messages for a broader audience.

This dual format combines expert knowledge with the views of young people, showcasing the diverse under-



standings, experiences, and priorities related to soil health across Europe.

In addition, the podcast serves as a complementary educational tool within LOESS: it supports training, encourages interregional exchange, and provides a platform for sharing good practices and project outcomes. In this way, European Voices on Soil Health contributes to building a well-informed and engaged society committed to the sustainable management of soils in Europe.

LEARNING OBJECTIVES:

- Learners understand the importance of healthy soils and the ecological, social, and economic impacts of soil management.
- Learners can experience real-life stories to see how human actions affect soil and natural resources.

- Learners can reflect on different perspectives by engaging with specialists’ insights and cross-country examples.

LINK: <https://loess-project.eu/podcast/>

3.5.3 CROWDMAPPING TOOL FOR SOIL HEALTH

TITLE: LOESS Soils Map

FORMAT: Crowdmapping-tool (App & Website)

TARGET AUDIENCE: General public, Secondary, Higher, and Vocational and Adult Education

DESCRIPTION: The LOESS Crowdmapping tool is available in 14 different languages. The tool allows individuals and communities to actively contribute data on soil conditions across Europe. Through a user-friendly mobile app and web interface, participants can submit observations on soil erosion, moisture, pH, and other parameters in their local areas.

This collaborative platform builds a shared database that supports both scientific research and decision-making: the collected information helps researchers assess soil degradation trends and provides policy makers with on-the-ground data to inform land management strategies. Designed to be inclusive, the tool is accessible to non-specialists – anyone can contribute via a simple survey form and intuitive

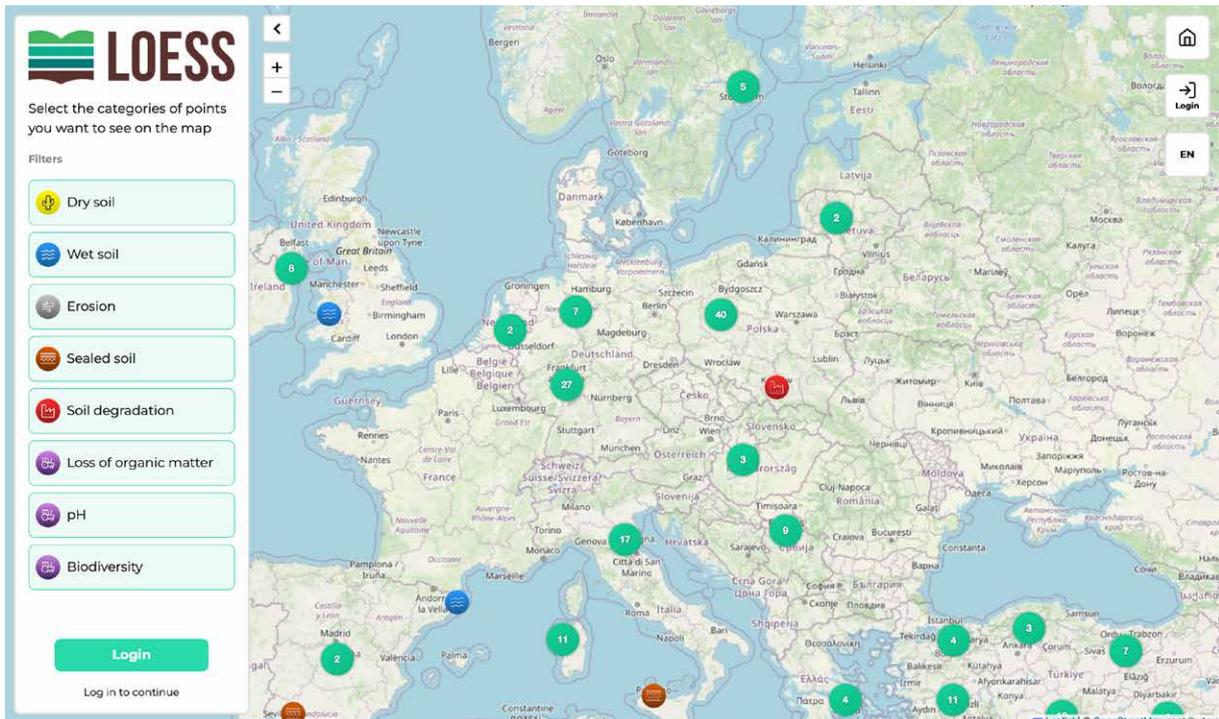
map interface. By engaging citizens in data collection, the project taps into distributed local knowledge and strengthens soil literacy through active participation.

Ultimately, this tool underpins LOESS’s mission to build an operational educational ecosystem: by combining community engagement and digital technology, it enables a participatory, data-driven approach to understanding and protecting soil health.

LEARNING OBJECTIVES:

- Learners can use the LOESS crowdmapping tool to record local soil conditions.
- Learners can interpret mapped soil data to identify soil health issues.
- Learners understand community-based data for research and decisions.
- Learners can analyse spatial patterns and suggest actions to improve soil health.

LINK: <https://loess-project.eu/crowdmapping-tool/>



TRY OUT THE TOOL:



Android



Apple

3.5.4 AR-APPLICATION ON SOIL

TITLE: LOESS Soil App

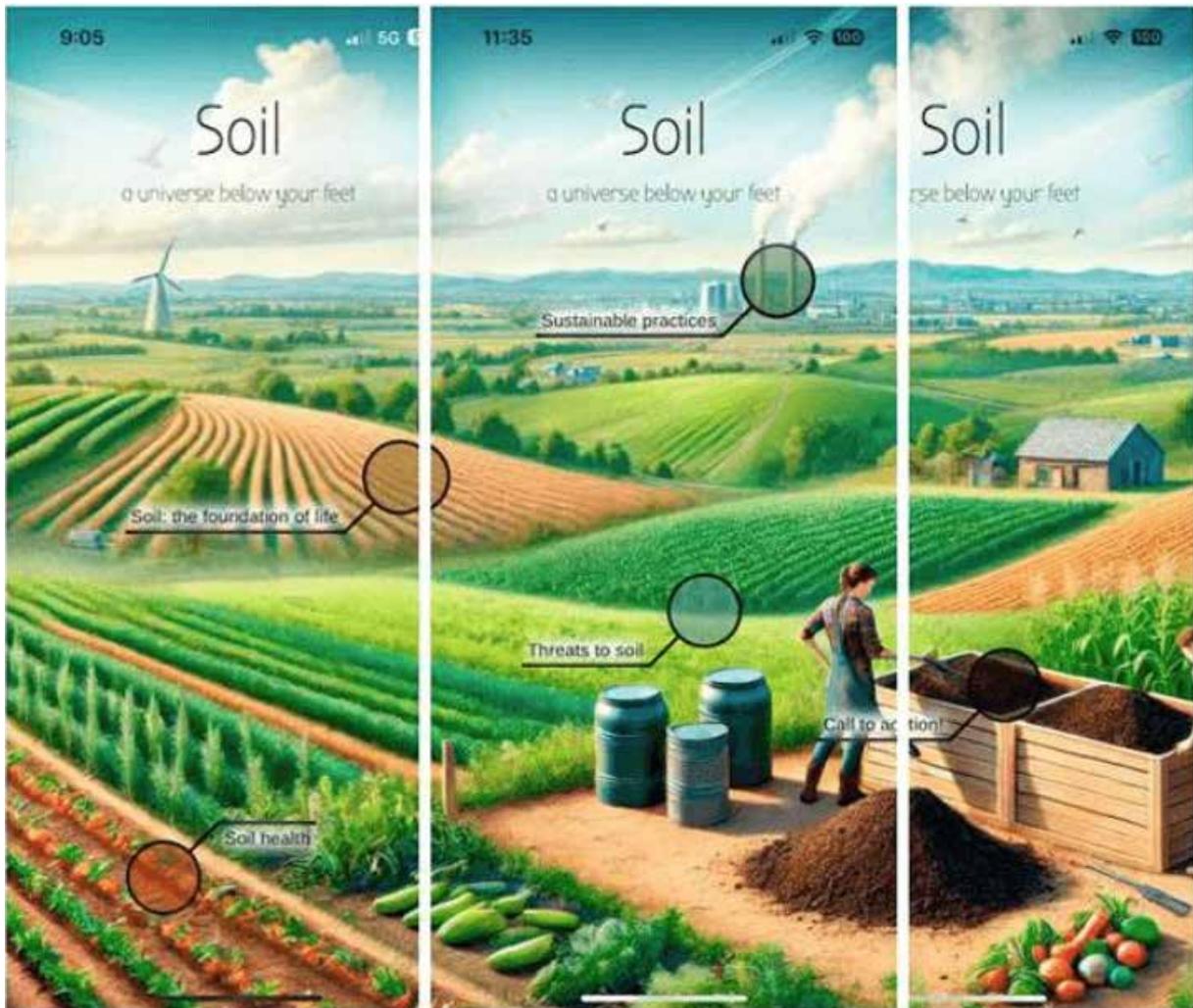
FORMAT: App (Android + Apple)

TARGET AUDIENCE: General public, Secondary, Higher, and Vocational and Adult Education

DESCRIPTION: The LOESS AR-App allows individuals and communities to explore soil health through interactive,

augmented reality experiences. Using a user-friendly mobile app, participants can view and interact with 3D models of soil organisms, engage with educational stories, and complete quizzes and mini-games that illustrate key soil concepts.

This immersive platform combines education and engagement: users gain hands-on understanding of soil biodiversity, structure, and ecosystem



functions, while building awareness of soil degradation and sustainable land management. The app is designed to be accessible to non-specialists – anyone can explore its content through intuitive AR interactions and simple game-based learning.

By integrating augmented reality, interactive storytelling, and quizzes, the project taps into active learning and strengthens soil literacy across age groups. Ultimately, this app supports LOESS’s mission to build an operational educational ecosystem: by combin-

ing innovative digital technology and community engagement, it enables a participatory, interactive approach to understanding and protecting soil health.

LEARNING OBJECTIVES:

- Learners can visualize soil processes and functions through the app experiences.
- Learners can explore and understand key soil topics through the AR application.

- Learners can apply their knowledge from the AR application through interactive games and quizzes.

LINK: <https://loess-project.eu/ar-app/>

TRY OUT THE APP:



Android



Apple

3.6 CASE STUDIES OF SOIL HEALTH EDUCATION PRACTICES

In the following chapters we present a selection of case studies from over 60 examples across 15 European countries collected through the LOESS project. They show how soil education is applied in schools, universities, public spaces, farms and community organisations, using approaches such as outdoor activities, classroom experiments,

citizen science, games, cultural events and digital tools. The full collection is available at <https://loess-project.eu/case-studies/> and can be filtered by education level, learning setting, activity type and country, offering practical inspiration and ideas adaptable to other regions and learning environments.

3.6.1 PRIMARY SCHOOL

Example 1

TITLE: Green-Blue Schoolyards

FORMAT: Outdoor/interactive schoolyard transformation

TARGET AUDIENCE: Primary students

DESCRIPTION: This initiative transforms traditional asphalt schoolyards into welcoming, biodiverse outdoor learning and play areas by introducing greenery (trees, shrubs, grass) and blue-infrastructure elements (rain-water retention, permeable surfaces) to improve student well-being, reduce heat/iso-



Photo: © Thierry Schut

lation, and enhance ecological functioning. It engages pupils in the design process and links school-ground improvements to broader climate-adaptation and urban-nature goals.

LEARNING OBJECTIVES:

- Recognize how transforming built school-grounds into green-blue infrastructure improves micro-climate, biodiversity and student comfort.
- Understand the role of interactive, nature-rich outdoor spaces as learning environments and their benefits for health and social inclusion.
- Develop awareness of how school-site design can contribute to sustainability, storm-water management and urban resilience.
- Encourage collaborative design and community engagement in school-yard redevelopment, linking pupils, educators and local authorities.

FURTHER INFORMATION:

<https://loess-project.eu/case-studie/green-blue-schoolyards/>

Example 2

TITLE: Soil Discovery Trail

FORMAT: Outdoor nature trail with interactive stations

TARGET AUDIENCE: Primary & secondary school students, general public

DESCRIPTION: Located near Regensburg (Germany), the trail features 19 display boards (some with audio stations) and is freely accessible to the public. Guided tours for school groups can also be booked. The trail is designed to raise awareness of soil processes in landscapes, fields and forests, and encourages hands-on engagement via puzzle stations, natural objects and outdoor classroom settings.

LEARNING OBJECTIVES:

- Develop appreciation for fertile soils and their dynamic nature through sensory, outdoor learning.



Photo: © Leibnitz-Universität Hannover.

- Understand the processes within soils (biological, chemical, physical) and how they are influenced by land use and environment.
- Engage with interactive tasks that illustrate closed ecological cycles, human impact and soil-ecosystem interconnections.
- Equip teachers and students with tools (task sheets, interactive stations) to integrate soil education into outdoor learning.

FURTHER INFORMATION:

<https://loess-project.eu/case-studies/soil-discovery-trail/>

Example 3

TITLE: Irish Schools Sustainability Network (ISSN)

FORMAT: Network of teachers and students; indoor & outdoor activities; workshops, films and community engagement (Ireland)

TARGET AUDIENCE: Primary and secondary school students and educators across Ireland

DESCRIPTION: The ISSN was established in 2021 to create a community of teachers and students committed to climate and ecological literacy in schools. They provide a range of free resources and programmes – including monthly online meet-ups, CPD workshops for teachers, a “Soil – Don’t treat me like dirt!” unit, student-led videos (“5 Minutes of Sustainability”), and campaigns like “Plant a Planet”.

LEARNING OBJECTIVES:

- Empower students and teachers to engage in climate action and biodiversity initiatives.
- Provide accessible tools and programmes for embedding sustainability and soil health into school life.



Photo: © Irish Schools Sustainability Network

- Develop partnerships and networks that transform education from passive learning towards active ecological citizenship.

FURTHER INFORMATION:

<https://loess-project.eu/case-studie/irish-schools-sustainability-network/>

3.6.2 SECONDARY SCHOOL

Example 1

TITLE: Dirty Matters: The Soil Game

FORMAT: Cooperative board game

TARGET AUDIENCE: Secondary students

DESCRIPTION: ‘Dirty Matters’ is an educational board game developed by the British Society of Soil Science to raise awareness of soil health and its role in tackling global sustainability challenges such as climate change, hunger, and water pollution.

As “soil guardians,” 2–6 players work together through six rounds to feed the world, keep waters clean, and combat climate change using the power of soil.

Designed for ages 8 and above, the game uses a fun and engaging format to teach soil properties and demonstrate how improving soil health supports the UN Sustainable Development Goals.

LEARNING OBJECTIVES:

- Understand the multiple functions of soil, including water retention, nutrient cycling, carbon storage, and biodiversity.
- Explore how agricultural management practices influence soil quality and environmental processes.

- Recognize the connections between soil health and the UN Sustainable Development Goals.
- Develop teamwork, decision-making, and reflective thinking skills related to soil and environmental issues.

FURTHER INFORMATION:

<https://loess-project.eu/case-studie/dirty-matters-the-soil-game/>

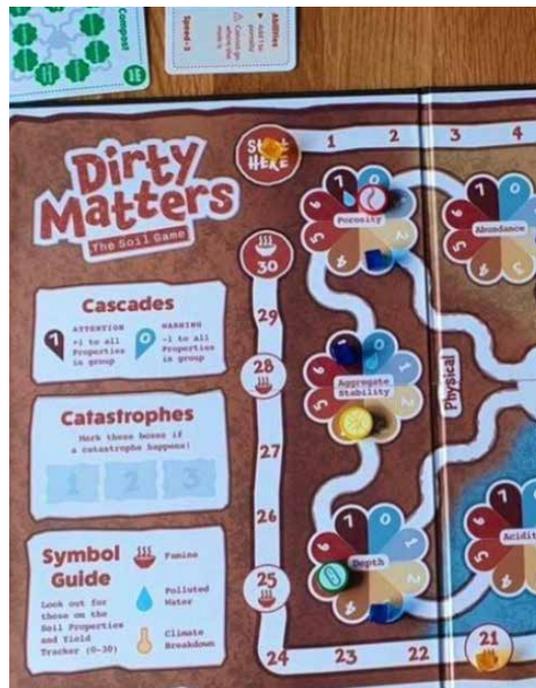


Photo: © <https://soils.org.uk/dirtymatters/>

Example 2

TITLE: Soil Protection School Experiments

FORMAT: Classroom and outdoor school experiments

TARGET AUDIENCE: School pupils (primary & secondary)

DESCRIPTION: This initiative encourages students to conduct simple soil protection experiments to explore how soils function, how they degrade, and how protective practices can mitigate damage. The experiments might include measuring soil erosion under varying conditions, testing soil compaction effects, exploring organic matter addition, and observing how changes in land-use impact soil health. Through guided investigation and reflection, learners gain direct insight into soil-ecosystem processes and the human-induced risks to soil.

LEARNING OBJECTIVES:

- Understand the basic processes of soil degradation (erosion, compaction, loss of organic matter) and how they affect soil health.
- Develop the ability to design, carry out and interpret hands-on experiments that illustrate soil protection measures.
- Appreciate the role of soil in ecosystem services (water filtration, nutrient cycling, biodiversity support) and how protective practices safeguard these services.
- Foster awareness of human-environment interactions and encourage proactive behaviour in soil stewardship and sustainable land use.

FURTHER INFORMATION:

<https://loess-project.eu/case-studies/soil-protection-school-experiments/>



Photo: © University of Vechta, Caroline Schmidt.

3.6.3 HIGHER EDUCATION

Example 1

TITLE: SoilSphere – Connecting University College Dublin soil researchers

FORMAT: Networking project with indoor and outdoor events, presentations, campus and research farm tours

TARGET AUDIENCE: Soil researchers University College Dublin; students and early career researchers interested in soil science

DESCRIPTION: SoilSphere is a strategic initiative by the UCD Earth Institute that fosters collaboration among soil scientists from multiple disciplines. It provides networking opportunities, facilitates knowledge and resource sharing, supports the development of research consortia, and promotes careers in soil science. Activities include campus soil walks, research presentations, funding workshops, and research farm tours, both indoors and outdoors.

LEARNING OBJECTIVES:

- Participants can connect and collaborate with soil researchers from diverse disciplines.
- Participants can access and utilize information on funding and research opportunities in soil science.
- Participants can understand and communicate the importance of soil health in research and policy contexts.
- Participants can explore and engage with practical soil research through campus and field activities.
- Participants can reflect on interdisciplinary approaches and develop strategies for future collaborative projects.

FURTHER INFORMATION: <https://loess-project.eu/case-studies/soilsphere-connecting-university-college-dublin-soil-researchers/>



Photo: © SoilSphere UCD.

Example 2

TITLE: Student Challenge “Make all soils healthy again!”

FORMAT: Challenge / competition

TARGET AUDIENCE: University students

DESCRIPTION: University students were invited to develop proposals addressing three key questions: (1) How can soil health be effectively measured? (2) How can land users and policymakers utilise soil-health information? (3) How can soil health be communicated to a wider audience? The challenge aimed to actively involve students, harness their innovative ideas and generate concrete proposals to influence the EU Mission Board’s agenda for soil health.

LEARNING OBJECTIVES:

- To define and quantify soil health in a way that links to the United Nations Sustainable Development Goals (SDGs).
- To develop strategies and tools for land-management, policy and stakeholder use of soil-health data.
- To design effective communication approaches for raising public awareness of soil health and its importance.
- To encourage interdisciplinary collaboration, innovation and real-world societal impact by engaging students in a challenge that bridges academia, industry and policy.

FURTHER INFORMATION: <https://loess-project.eu/case-studie/student-challenge-make-all-soils-healthy-again/>



Photo: © Wageningen University and Research.

3.6.4 VOCATIONAL AND ADULT EDUCATION

Example 1

TITLE: Soil Revitalization Project in a Traditional Apple and Pear Orchard

FORMAT: Demonstration project

TARGET AUDIENCE: Agricultural students in VET, professionals in soil health and sustainable fruit production, and those interested in traditional orchards

DESCRIPTION: Students at Escola Agraria d'Alfarràs (Spain) revitalized soils in a traditional orchard of local apple and pear varieties. By adding organic matter, beneficial microbes, and promoting biodiversity, the project improved soil fertility, reduced chemical inputs, enhanced water efficiency, and increased fruit quality. Soil health is monitored using bioindicators and soil analysis.

LEARNING OBJECTIVES:

- Learn to assess and monitor soil fertility in a real orchard setting.
- Understand how organic amendments and biodiversity enhance soil health and plant growth.
- Gain insight into sustainable orchard management and traditional fruit varieties.
- Develop skills to use soil revitalization projects for education and knowledge transfer.

FURTHER INFORMATION: <https://loess-project.eu/case-studie/soil-revitalization-project-in-a-traditional-apple-and-pear-orchard/>



Photo: © Gamta mieste.

Example 2

TITLE: Vocational School EPAL at the American Farm School

FORMAT: Vocational education programme in a school farm context

TARGET AUDIENCE: Vocational students, agricultural trainees, educators in vocational agriculture and soil/land-use sectors

DESCRIPTION: The American Farm School (Greece) combines theory and hands-on practice on its educational farm. Students in the EPAL vocational track are engaged in real-world agricultural production, project work, and sustainable land-use practices.

LEARNING OBJECTIVES:

- Acquire practical skills and knowledge in agriculture, soil management and sustainable farming practices.
- Understand the integration of vocational education with real farm production and resource stewardship.
- Develop competencies to apply soil-friendly, regenerative agricultural techniques in a vocational context.
- Enable students to transfer what they learn into productive, environmentally responsible land-use occupations.

FURTHER INFORMATION: <https://loess-project.eu/case-studie/the-vocational-school-epal-of-the-american-farm-school/>



Photo: © American Farm School website.

3.6.5 GENERAL EDUCATION

Example 1

TITLE: Geoderma – The Living Skin of Planet Earth

FORMAT: Educational documentary film

TARGET AUDIENCE: General public

DESCRIPTION: This short film, presented by soil biologist Ladislav Miko, explores the nature, functions and importance of soil for all living organisms. It includes close-up footage of soil organisms (worms, fungi, microbes) and landscapes, showing how soil supports life on Earth.

LEARNING OBJECTIVES:

- Understand the role of soil as a vital resource and foundational element for ecosystems.
- Identify and appreciate the biodiversity present in soil— including fauna, flora and microorganisms.
- Recognise how human activities impact soil health and what that means for life on Earth.
- Develop greater awareness of soil conservation and sustainable land-use practices.

FURTHER INFORMATION: <https://loess-project.eu/case-studie/documentary-geoderma-the-living-skin-of-planet-earth/>

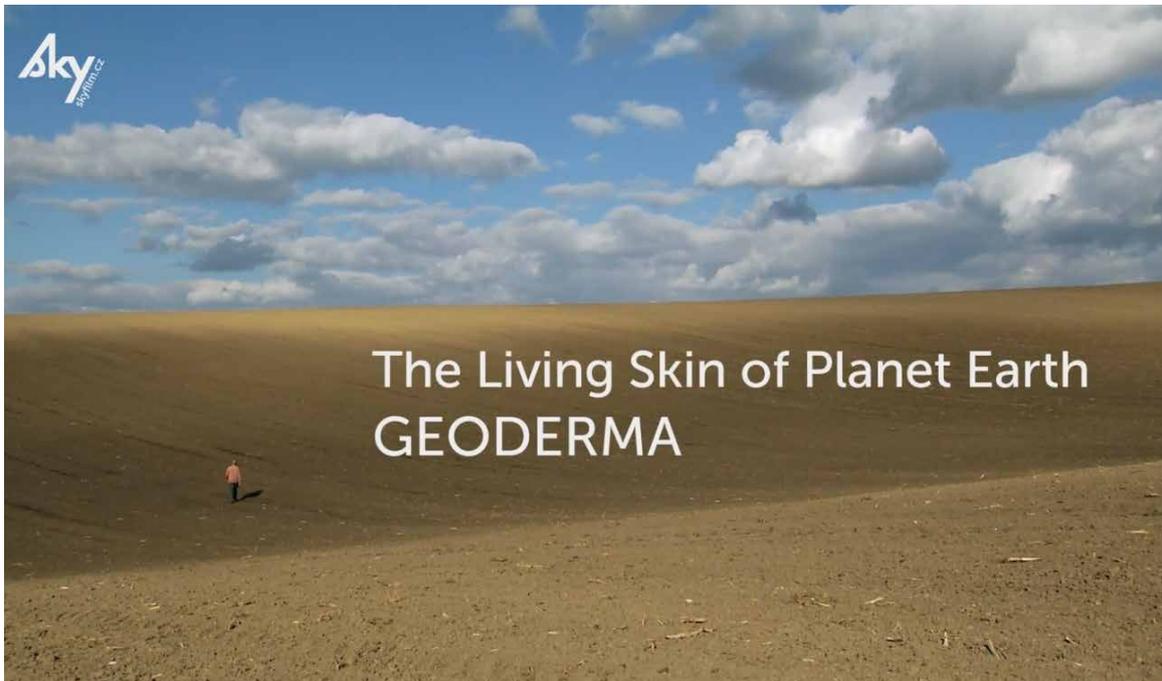


Photo: © SKYFILM <https://www.youtube.com/watch?v=IC1Dem7cbHI>

Example 2

TITLE: The Thin Skin of the Earth – Our Soils

FORMAT: Touring exhibition

TARGET AUDIENCE: General public

DESCRIPTION: This travelling exhibition explores the hidden living world beneath our feet – soil biodiversity, its ecosystem functions, formation, diversity, threats, and how human activity affects it. Visitors enter immersive, interactive exhibits (3D models, VR, multimedia) where they “shrink” to the size of a soil organism and explore chambers on soil life, soil types, scientific research and soil risks.

LEARNING OBJECTIVES:

- Understand that soil is alive and contains complex ecosystems of organisms and processes.
- Learn about soil types, formation, diversity and how soils support plant life, water, nutrients and climate.
- Recognize threats to soil (sealing, compaction, erosion, loss of biodiversity) and their consequences for humans and the environment.
- Gain insights into how soil research works and what individuals or society can do to protect and sustainably manage soil.

FURTHER INFORMATION: <https://loess-project.eu/case-studie/touring-exhibition-the-thin-skin-of-earth-our-soils/>



Photo: © Sachsenhits VRmedia Niesky (Screenshot)
<https://my.matterport.com/show/?m=f42uyKowgXf&sr=-.54,1.24&ss=92>

4. Final Words

This Soil Atlas brings together a range of educational materials designed to make the topic of soil more accessible within learning contexts. It does not aim to provide comprehensive knowledge about soils itself, but rather to support educators in finding suitable approaches, resources, and perspectives for their teaching practice.

Throughout this work, one central idea has guided the selection and structure of the materials: soil is not only an environmental topic but also an educational one. It connects natural, social, and ethical dimensions and therefore offers valuable entry points for interdisciplinary and transformative learning.

Education professionals play a key role in shaping how future generations perceive and relate to the living world. By integrating soil-related themes into education, we can help learners understand interconnections between human activity and natural systems and encourage reflection on sustainability as a shared responsibility.

The Soil Atlas is intended as an open and evolving resource – an invitation to experiment, adapt, and expand. It provides inspiration and structure for educational practice, but its true potential unfolds in classrooms, workshops, and field experiences where ideas become lived learning.



Map showing the locations of all LOESS project partners.

LINKS AND DOWNLOADS

CONTACT:

loess@wilabonn.de

PROJECT WEBSITE

<https://loess-project.eu/>

DESK RESEARCH: Report on awareness, needs and vision for soil education

https://loess-project.eu/wp-content/uploads/2024/10/Deliverable-2.2_Report-on-awareness-needs-and-vision-for-soil-education_with_disclaimer.pdf

LEARNING SCENARIOS

<https://loess-project.eu/learning-scenarios/>

STUDENT MODULE

<https://loess-project.eu/training-module/>

EDUCATIONAL COURSE FOR BIOLOGY AND ENVIRONMENTAL EDUCATION TEACHER STUDENTS

<https://loess-project.eu/educational-course/>

ONLINE MODULE FOR LECTURERS

<https://loess-project.eu/cerl-module-for-lecturers/>

TRAINING WORKSHOP – FROM A PROBLEM TO A RESEARCH QUESTION

<https://loess-project.eu/training-workshop/>

BLUEPRINT

<https://loess-project.eu/blueprint-biology-course/>

MASSIVE OPEN ONLINE COURSE

<https://loess-project.eu/mooc-soil-education-an-integrated-stem-approach/>

GLOSSARY

<https://loess-project.eu/glossary-list-of-terms/>

PODCAST

<https://loess-project.eu/podcast/>

CROWDMAPPING TOOL

<https://loess-project.eu/crowdmapping-tool/>

AR-APPLICATION

<https://loess-project.eu/ar-app/>

CASE STUDIES

<https://loess-project.eu/case-studies/>



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