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CEDRIC

BEST PRACTICE 3

Communicating soil science

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This document provides guidelines and suggests ideas that have arisen from the implementation of the "Communication & Dissemination" part the CEDRIC Project. The goal is to effectively communicate the hidden world of soil microorganisms to diverse audiences, including students, educators, researchers, and the general public. The document draws inspiration from and summarises innovative outreach strategies, hands-on activities, and exhibit design principles showcased by several scientific communication initiatives such as MikroMondo. The aim is to foster soil literacy, deepen appreciation of soil ecosystems, and inspire engagement with microbial ecology.

1. Understanding the target audience

There are many types of audiences that require distinct approaches, such as:

- **Primary school students:** Engage with simple narratives, sensory experiences, and visual storytelling.
- **Secondary students and undergraduates**: Integrate deeper scientific context, demonstrations, and interactive experiments.
- **Educators and researchers**: Provide frameworks, background resources, and tools that support independent exploration.
- **General public (adults, families)**: Combine storytelling with relatable examples and real-life implications.

Use age-appropriate narratives, balancing scientific accuracy with accessibility is pivotal. For younger audiences, focus on big ideas like "life beneath our feet" and why microbes matter in everyday life. For more advanced learners, include scientific mechanisms, processes like nutrient cycling, and microbial roles in soil health.

2. Core Concepts to Communicate

To build soil literacy effectively, ensure that the following core concepts are integrated into educational materials and activities:

- **The Diversity of soil microorganisms**

Explain that soils are among the most microbially diverse habitats on Earth, hosting countless bacteria, fungi, archaea, and other microscopic life forms. Emphasize that a teaspoon of healthy soil contains more microbes than there are people on the planet.

- **The Diversity of microbial functions in the soil**

Focus on the functional roles of microbes in soil ecosystems, by highlighting their key functions in:

  - Nutrient cycling: By decomposing organic matter, soil microbes release essential nutrients such as carbon, nitrogen, and phosphorus in forms usable by plants, helping maintain soil fertility and support the overall productivity of the ecosystem. These transformations are also the main drivers of the natural carbon and nitrogen cycle, elements closely linked to climate and its change.
  - Plant–microbe interactions: Symbioses such as mycorrhizae improve plant nutrient uptake.
  - Soil Structure and Physical Properties: Microbial activity shapes the physical habitat of soil forming aggregates that improve aeration, water infiltration and retention, root penetration, and resistance to compaction or erosion.
  - Disease suppression and biocontrol: Certain bacteria and fungi produce antibiotics or competitive inhibition that reduce pathogens establishment around plant roots,

- Bioremediation and Detoxification: Soil microbes can transform or neutralize chemical pollutants
- Ecosystem stability and resilience: Soils rich in microbial life are better at performing a larger variety of functions (nutrient cycling, plant growth support, substrate stabilization, etc.) and are better able to withstand stress and recover from extreme events, maintaining healthy and productive ecosystems. It's like having a team with many players who can replace each other when conditions change (drought, floods, extreme temperatures, etc.).

Figure 1: Microbes (fungi) are the principal recyclers in nature, bringing decomposed organic substrates back into the soil: Deadwood and its five decay classes, the last deadwood decayclass represents the first humus form (ligno-form).

- **The connection between Soil Life and Everyday Life**

The relevance of soil microbiology to human well-being is a theme of interest to a broader societal audience, as it focuses on real-world problems and related concerns. These are some examples of themes to be explored to broader audiences:

- Food production and sustainable agriculture.
- Soil's role in ecosystem resilience under climate change.
- Everyday encounters with microbes in food fermentation, composting, and environmental cycles.

3. Strategies for Effective Communication

To achieve effective communication with most young audiences, it is essential to add an interactive dimension to the message. Some examples of activities that deepen understanding through active participation rather than passive observation are provided below:

- **Storytelling and Narrative Design:** Use a 24/7 narrative framework that links soil microbiology to daily life—from breakfast to a walk in nature—to make complex science relatable and engaging. This approach helps audiences see microbes not as abstract concepts but as active contributors to familiar experiences.
- **Multi-Sensory Engagement:** Incorporate elements that stimulate sight, touch, sound, and even smell, where appropriate. Examples include Live demonstrations of microbial activities (e.g., mycorrhizal associations in transparent pot) and interactive models such as Winogradsky columns that visually illustrate microbial stratification and metabolic diversity.
- **Hands-On Activities and Experiments** by providing structured activities that allow participants to experience microbiology as guided microscopy sessions with real soil samples, building simple microbial culture plates to observe fungal and bacterial growth.

Figure 2 Winogradsky columns and windows serve as an excellent tool to convey knowledge about biodiversity, also with hands-on experiments: (left) Europe's largest Winogradsky column; (centre) an example of a Winogradsky window; (right) visitors love to create their own columns.

4. Educational Tools and Resources

Nowadays are available many easy and common ways of communicating and approaching science in an interactive and entertaining way, two main

sections are the module and exhibit design and the digital and virtual tools.

- **Module and Exhibit Design**

Develop modular learning units that can be used in classroom settings or science centres. Each module approaching themes such as deadwood decomposition, microbial biodiversity, or plant–microbe symbiosis should be structured including:

  - Clear learning objectives.
  - A mix of visual, tactile, and inquiry-based elements.
  - Supporting background information for educators.

- **Digital and Virtual Tools**

Leverage technology such as interactive apps, simulations, and virtual tours to enhance accessibility and retention. These tools can complement physical exhibits and offer scalable outreach opportunities.

5. Evaluation and Feedback

Implement mechanisms for evaluating learning outcomes and refining communication strategies:

  - Pre- and post-activity surveys to assess changes in understanding.
  - Feedback stations where participants can express what they learned or found intriguing.
  - Iterative improvement of modules based on participant engagement data.

Continuous evaluation helps ensure that communication efforts remain relevant and impactful.

6. Collaboration and Community Engagement

Engage with a broad range of stakeholders:

  - Schools and educators for curriculum integration.
  - Scientists and researchers to ensure scientific accuracy.
  - Local communities and organizations to tailor programs to regional interests and concerns.

Building partnerships expands reach and fosters a community invested in soil stewardship.

7. Conclusion

Communicating the hidden world of soil microorganisms requires a thoughtful blend of science, storytelling, and interactive engagement. Best practices include tailoring content to diverse audiences, using narratives that connect microbes to daily life, offering hands-on experiences, and continuously evaluating impact. By adopting these strategies, educators and communicators can inspire curiosity, improve soil literacy, and empower people to appreciate the vital roles that soil microbiota play in ecosystems and human well-being.

BOX1: Why so much attention to soil?

Soil is a multifunctional resource, and a broader understanding of its nature and functions creates the right awareness for its proper use and puts appropriate pressure on decision makers to plan and implement effective measures for its protection. Soil performs the following functions: 1. Productive, enabling the production of food, fodder, wood, and other biomass through plant growth, providing nutrients, water, and physical support for roots. 2. Water regulation, storing rainwater, recharging aquifers, reducing surface runoff, and acting as a filter. 3. Climate influence: Soils store large amounts of organic carbon, protecting the regulation of greenhouse gases. 4. Substrate and support for a huge variety of micro- and macro-organisms (microorganisms, insects, earthworms, etc.), essential for natural cycles such as decomposition and nutrient recycling. 5. Provides physical support for infrastructure and

human activities. 6. It provides important raw materials for many sectors. 7. It has a historical and cultural function, preserving traces of the natural and human past.

BOX2: When to organize your "Communication Day"?

Environment Days:

- World Environment Day — **5 June**: The UN's flagship environment outreach day, mobilizing global engagement on climate, pollution, and sustainability.
- World Soil Day — **5 December**: Highlights the importance of healthy soil for food security, biodiversity, ecosystems, and climate regulation.
- World Water Day — **22 March**: Focuses on freshwater ecosystems, water sustainability, and links to food, climate, and human wellbeing
- World Oceans Day — **8 June**: Important for ocean ecosystems and climate pathways.

Biodiversity days:

- International Day for Biological Diversity — **22 May.** A day to increase understanding and awareness of biodiversity issues and actions to protect natural systems.
- World Microbiome Day — **27 June***;* is an annual global awareness day dedicated to celebrating and raising understanding of microbiomes — the vast communities of microorganisms (bacteria, fungi, viruses, etc.) that live in and around humans, animals, plants, soils and ecosystems. These tiny life forms play crucial roles in health, environment, food systems, soil function, nutrient cycling, and climate processes.
- World Wildlife Day — **3 March**: Focuses on wild fauna and flora conservation — highlighting biodiversity conservation globally.
- Earth Day — **22 April**: Massive global environmental awareness day covering climate, biodiversity, ecosystems, and sustainability.
- International Day of Climate Action **— 24 October:** A grassroots climate awareness action day observed globally for mobilizing climate engagement. *(non-UN but widely observed)*

Science Outreach & Education days

SHARPER Night – **late September**: it refers to a major science outreach event of science engagement and discovery. Activities often take place in streets, squares, squares, theatres, museums, labs and online spaces with workshops, talk shows, public experiments, exhibits and more. *(non-UN but widely observed)-*

World Science Day for Peace and Development — **10 November**: one day to highlight the role of science in society, policy, and global sustainable development.

For more information:

- *"Unveiling the hidden world beneath: A showcase of soil microorganisms at MikroMondo"* (Pedobiologia 108, 2025, H. Insam, et al.)
- MikroMondo project (https://www.mikrobalpina.org/it/projektbeschreibung/)