NATIONAL GEOGRAPHIC
Activity*develop*

Preserving Soils

How can fertile soil be protected?

Overview

Students explore a map showing cropland density around the world. They discover how soil is formed and explore how plants get nutrients from topsoil. Finally, they use computational models to explore how wind, water, and plants affect soil quality.

For the complete activity with media resources, visit:
http://education.nationalgeographic.org/activity/preserving-soils/

Directions

1. Spark students' thinking about preserving soils.

Tell students that plants get most of their nutrients through their roots, which grow in soil. Ask:

- *How can the soil be worn away?* (Soil can be eroded by wind and by water.)
- *What do you think can prevent soil erosion?* (Answers will vary. To prevent erosion, you have to protect the soil from wind and water. This can be done by covering it with plants or rocks. Holding the soil together by covering it and preventing flooding events will prevent soil loss.)

2. Discuss the role of uncertainty in the scientific process.

Tell students that science is a process of learning how the world works and that scientists do not know the “right” answers when they start to investigate a question. Students can see examples of scientists' uncertainty in forecasting crop yields. Show the **Projection of Maize Crop Yields in France** image from the media carousel above. (Download the image from the media carousel above by clicking on the down arrow in the lower right corner of the image window.) Tell students that these graphs in this image show the projection of maize crop yields in France over this time period—the average daily precipitation, number of hot days, and yield of maize. The gray line shows the predictions for crop yield based on technological improvements. The pink shading shows the expected yield based on temperature and precipitation influences. The red lines outside the pink shading show the total uncertainty. Ask:

- *Does the technology trend (gray line) accurately predict crop yields?* (No, the technology trend does not adequately predict crop yields. This is because crop yields are dependent on temperature and precipitation as well as technological improvements.)

- *Why do you think the crop models still have uncertainty even after accounting for precipitation and temperature differences year to year?* (Student answers will vary. The crop yield could be affected by a pest infestation.)

Tell students they will be asked questions about the certainty of their predictions and that they should think about what scientific data is available as they assess their certainty with their answers. Encourage students to discuss the scientific evidence with each other to better assess their level of certainty with their predictions.

3. Introduce the concept of stocks and flows in a system.

Tell students that materials flow into and out of systems. The flow of the materials over time can change and can be influenced by many different factors and interacting parts.

Scientists think about how one part of the system can affect other parts of the system. Give students a simple example of a stock and flow in a system, as described in the scenario below.

There is a bathtub with water flowing in from the faucet and water leaving through the drain. Ask:

- *When the drain is plugged, what happens to the level of water in the bathtub?* (The water level will increase because the outflow of water is stopped, but water keeps coming in from the faucet.)
- *When the faucet is turned off, what happens to the level of water in the bathtub?* (The water level will decrease because the inflow of water is stopped, but the water keeps leaving through the drain.)
- *How can the level of water in the bathtub be kept at the same level?* (The water in the bathtub can be kept at the same level by making the inflow equal to the outflow. Then the water that comes in through the faucet will be offset by the water that leaves through the drain.)

Tell students they will be following the flow of materials, in this case the amount of topsoil and nutrients, through a system. Let students know they will be exploring some environmental and human factors that contribute to changes in the quality of soil in the modeled system.

4. Introduce and discuss the use of computational models.

Introduce the concept of computational models and give students an example of a computational model they may have seen, such as forecasting the weather. Project the **NOAA Weather Forecast Model**, which provides a good example of a computational model. Tell students that scientists use weather models to predict future conditions based on current information about the energy and moisture in the atmosphere. There are many different types of models. Scientists can use soil models to predict the movement and quality of soil in a region. Let students know that they will be using models of soil movement and quality.

5. Have students launch the Preserving Soils interactive.

Provide students with the link to the Preserving Soils interactive. Divide students into groups of two or three, with two being the ideal grouping to allow groups to share a computer workstation. Tell students they will be working through a series of pages of questions related to the data in the interactive. Ask students to work through the interactive in their groups, discussing and responding to questions as they go.

Tell students that this is Activity 2 of the **Can We Feed the Growing Population?** lesson.

6. Discuss the issues.

After students have completed the activity, bring the groups back together and lead a discussion focusing on these questions:

- *Why do plants' roots grow extensively in the topsoil?* (The topsoil has the most nutrients. Plants get nutrients through their roots. The topsoil is the best place to get the nutrients.)
- *How did you use the model (***Model 2: Landscapes With Plants***) to prevent erosion on a hillside?* (Plants reduced the erosion rate on the slope. This is because the plants' roots hold the topsoil together, preventing it from eroding.)
- *How does erosion affect plant growth?* (Erosion will cause plants to not grow as well. If the soil erodes, the nutrients go with it. If the soil doesn't have enough nutrients, the plants won't grow well. If the plants won't grow well, then more soil will erode because there are few roots to hold the soil together.)

Tip

If you would like to save student data for grading online, register your class for free at the High-Adventure Science portal page.

Tip

This activity is part of a sequence of activities in the Can We Feed the Growing Population? lesson. The activities work best if used in sequence.

Modification

This activity may be used individually or in groups of two or three students. It may also be modified for a whole-class format. If using as a whole-class activity, use an LCD projector or interactive whiteboard to project the activity. Turn embedded questions into class discussions. Uncertainty items allow for classroom debates over the evidence.

Informal Assessment

1. Check students' comprehension by asking them the following questions:

- What natural processes can result in soil erosion?
- What natural process can prevent or minimize soil erosion?
- Is erosion more likely on a slope or on a flat area? Why?
- How does erosion affect plant growth?

2. Use the answer key to check students' answers on embedded assessments.

Objectives

Subjects & Disciplines

Science

- Earth science
- General science

Learning Objectives

Students will:

- describe how plants prevent or minimize erosion
- describe the relationship between slope and erosion rates
- describe the characteristics of topsoil (soil layer from which plants derive nutrients)
- describe why a plant's growth could be affected by erosion

Teaching Approach

- Learning-for-use

Teaching Methods

- Discussions
- Multimedia instruction
- Self-paced learning
- Visual instruction
- Writing

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
    - Information, Media, and Technology Skills
        - Information, Communications, and Technology Literacy
    - Learning and Innovation Skills
        - Critical Thinking and Problem Solving
- 21st Century Themes
    - Global Awareness
- Critical Thinking Skills
    - Analyzing
    - Evaluating
    - Understanding

National Standards, Principles, and Practices

National Science Education Standards

• **(5-8) Standard A-1:**
Abilities necessary to do scientific inquiry
• **(5-8) Standard D-1:**
Structure of the earth system
• **(5-8) Standard F-1:**
Personal health
• **(5-8) Standard F-4:**
Risks and benefits
• **(9-12) Standard A-1:**
Abilities necessary to do scientific inquiry
• **(9-12) Standard A-2:**
Understandings about scientific inquiry
• **(9-12) Standard C-5:**
Matter, energy, and organization in living systems
• **(9-12) Standard F-1:**
Personal and community health
• **(9-12) Standard F-2:**
Population growth
• **(9-12) Standard F-4:**
Environmental quality
• **(9-12) Standard F-5:**
Natural and human-induced hazards

Common Core State Standards for English Language Arts & Literacy

• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.6-8.3
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.11-12.3

• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.11-12.1
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Craft and Structure, RST.9-10.4
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.9-10.3
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.9-10.1
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Craft and Structure, RST.6-8.4
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Key Ideas and Details, RST.6-8.1
• **Reading Standards for Literacy in Science and Technical Subjects 6-12:**
Craft and Structure, RST.11-12.4

ISTE Standards for Students (ISTE Standards*S)

• **Standard 3:**
Research and Information Fluency
• **Standard 4:**
Critical Thinking, Problem Solving, and Decision Making

Next Generation Science Standards

• **Crosscutting Concept 1:**
Patterns
• **Crosscutting Concept 2:**
Cause and effect: Mechanism and prediction
• **Crosscutting Concept 3:**
Scale, proportion, and quantity
• **Crosscutting Concept 4:**
Systems and system models
• **Crosscutting Concept 5:**
Energy and matter: Flows, cycles, and conservation
• **Crosscutting Concept 7:**
Stability and change
• **Science and Engineering Practice 1:**
Asking questions and defining problems
• **Science and Engineering Practice 2:**
Developing and using models
• **Science and Engineering Practice 3:**
Planning and carrying out investigations
• **Science and Engineering Practice 4:**
Analyzing and interpreting data
• **Science and Engineering Practice 5:**

Using mathematics and computational thinking
• **Science and Engineering Practice 6:**
Constructing explanations and designing solutions
• **Science and Engineering Practice 7:**
Engaging in argument from evidence
• **Science and Engineering Practice 8:**
Obtaining, evaluating, and communicating information

Preparation

What You'll Need

Required Technology

- Internet Access: Required
- Tech Setup: 1 computer per learner, 1 computer per small group, Interactive whiteboard, Projector

Physical Space

- Classroom
- Computer lab
- Media Center/Library

Grouping

- Heterogeneous grouping
- Homogeneous grouping
- Large-group instruction
- Small-group instruction

Resources Provided: Websites

- NOAA Weather Forecast Model

Resources Provided: Handouts & Worksheets

- Answer Key - Preserving Soils

Resources Provided: Interactives

- Preserving Soils Interactive

Resources Provided: Images

- Projection of Maize Crop Yields in France

Background & Vocabulary

Background Information

Agricultural land is productive because of its fertile soils. It takes many years to make a fertile soil. Soil is made as rocks are weathered into smaller particles. The mineral content of a soil is related to the rocks that were broken down to form it. As the rocks start to break down, plants' roots can take hold in the cracks and further break down the rocks.

Additionally, as the plants die and decay, they add organic matter to the soil. A high-quality soil has a large amount of organic matter, which is found mainly in the topsoil (the top 12 inches of soil). Plants' roots obtain nutrients from the topsoil. The topsoil is very high in organic matter, water, and nutrients.

Topsoil can be quickly eroded through the actions of wind and water. If the soil is not held together, it can literally blow away on the wind, as happened in large areas of the U.S. Midwest during the Dust Bowl era. Similarly, loose soil can be washed away by flooding events.

Good land management practices can prevent or minimize the amount of erosion from a parcel of land. Part of a good land management practice involves making sure the soil is always held together. One way to do this is to keep the land continually planted; the plants' roots will hold the soil together and prevent it from blowing or washing away.

Prior Knowledge

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Recommended Prior Activities

- Using the Land

Vocabulary

Term	Part of Speech	Definition
arable	*adjective*	land able to produce crops.
erosion	*noun*	act in which earth is worn away, often by water, wind, or ice.
model, computational	*noun*	a mathematical model that requires extensive computational resources to study the behavior of a complex system by computer simulation.
organic	*adjective*	composed of living or once-living material.
system	*noun*	collection of items or organisms that are linked and related, functioning as a whole.
terrain	*noun*	topographic features of an area.
topsoil	*noun*	the most valuable, upper layer of soil, where most nutrients are found.

For Further Exploration

Reference

- National Geographic Encyclopedic Entry: rural area
- National Geographic Encyclopedic Entry: urban area
- National Geographic Encyclopedic Entry: agriculture
- National Geographic Encyclopedic Entry: fertility
- National Geographic Encyclopedic Entry: humus

Funder

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Partner