Why Do We Study Soil?

Purpose

To introduce students to the importance of soil and why it needs to be studied

Overview

In the first activity, students generate a list of why soils are important. In the second activity, students are asked to describe the five factors that form a unique soil profile and to explore these concepts. In the third activity, students are shown a demonstration of how much soil there is on Earth that is available for human use.

Student Outcomes

Students will understand the importance of soil science.

Students will be able to provide reasons for studying soil.

Students will understand how soil properties are determined by the five soil forming factors.

Students will appreciate the relative amounts of usable soil that exist on Earth.

Science Concepts

Earth and Space Sciences

- Earth materials are solid rocks, soil, water, biota, and the gases of the atmosphere.
- Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants.
- The surface of Earth changes.
- Soils are often found in layers, with each having a different chemical composition and texture.
- Soils consist of minerals (less than 2 mm), organic material, air and water.
- Water circulates through soil changing the properties of both the soil and the water.

Physical Sciences

- Objects have observable properties.

Life Sciences

- Organisms can only survive in environments where their needs are met.
- Earth has many different environments that support different combinations of organisms.
- All populations living together and the physical factors with which they interact constitute an ecosystem.

Scientific Inquiry Abilities

- Identify answerable questions.
- Design and conduct an investigation.
- Use appropriate tools and techniques including mathematics to gather, analyze, and interpret data.
- Develop descriptions and explanations, predictions and models using evidence.
- Communicate procedures and explanations.

Time

One or two class periods (depending on level of exploration for second activity)

Level

All

Materials and Tools

- Apple and small knife (or diagrams or overhead materials of apple activity)
- Soil medicine examples (e.g. diarrhea medicine, antibacterial gel or cream, facial masks)
- Soil art examples (e.g. mud cloth, sand painting, pottery)
- Soil building material examples (e.g. red brick, photos of adobe and Earthship houses)
- Makeup (e.g. foundation, blush)
- Soil samples (if available, especially soils that match the colors or textures of the medicine, art, building material, or makeup examples)
- Plant
- Soil story example (e.g. Maryland Flood Plain Soil)

Prerequisites

None

Why are soils important?

Soils exist as natural ecosystems on the surface of Earth made up of macro and microorganisms, minerals, organic matter, air, and water. Soils are living systems that provide many of the most fundamental functions needed for life. Important functions of soil include:

- Providing the fertile medium in which we grow our food and fiber
- Producing and storing gases such as CO_2
- Storing heat and water
- Providing a home for billions of plants, animals and microorganisms
- Filtering water and wastes
- Providing the source material for construction, medicine, art, makeup, etc.
- Decomposing wastes
- Providing a snapshot of geologic, climatic, biological, and human history

Soil forms very slowly and comprises only about 10 or 11% of Earth's surface. So, it is important to study this essential natural resource and understand how it should be used and conserved properly.

What To Do and How To Do It

Activity One: Why are soils important?

1. Collect as many materials and tools as possible from list in Materials and Tools section of gray box.
2. Ask the class "Why are soils important?" and "Why do you think it is important to study soils?"
3. Record their answers on a blackboard or somewhere that all students can read the responses.
4. As students give answers that relate to the collected materials, bring out those materials and show them to the class. For example, if a student says that we use soil as art, have a clay pot available for viewing. If students run out of ideas about the uses of soils, ask them about soil as art (and bring out the African mud cloth [Bogolanfini] or a picture of one) or soil as medicine (for diarrhea, antibacterial gel, examples of people eating soil for digestive problems, etc.) Also bring out soil samples that resemble these materials for comparison.
5. Lead the discussion to the many possible reasons why it is important to study soil (see above).

Activity Two: Are soils all the same?

1. Show students photographs from the *Soil Investigation Introduction* section titled *Soils Around the World.* Have students check the World Wide Web (e.g. soils.usda.gov or soils.gsfc.nasa.gov), library, and other sources for other photographs of soil profiles. Also, look for color drawings or photographs of soil properties by GLOBE students on the GLOBE Web site (try going to the data access page, then to *GLOBE Sites* and then to *Soil Profiles*).
2. Ask students why one soil profile looks different from another? What are some of the factors that would make a soil look the way it does? Help guide their responses by reading the *Five Soil Forming Factors* (parent materials, climate, topography, biota, and time) in the GLOBE *Soil Investigation Introduction.*
3. Have the students identify the 5 soil forming factors at their school and ask how they might differ at other locations, within the neighborhood, or around the world.
4. Discuss the concept that every soil tells a different story based on the properties that have formed it because of the 5 soil forming factors. As an example, use the following Maryland Flood Plain Soil photograph and story.

   This soil profile is from a creek bed in College Park, Maryland, USA in the Chesapeake Bay watershed. When the soil scientists were studying this profile, they noticed that there was a black layer right in the middle of the profile. When the scientists looked at this layer with a hand lens (small magnifying glass) they could see that the black color was due to many tiny bits of charcoal and ash. Using different kinds of tests, they learned that this material was deposited about 300 - 350 years ago.

Figure-SO-WH-1: College Park, Maryland

Where would charcoal and ash have come from about 300-350 years ago? What was going on in the Chesapeake Bay region at about that time?

Settlers coming to this region for the first time were burning the forests to make room for farms. The residue from those forest fires flowed down into the rivers and creeks and eventually some of it was deposited in this creek bed and became part of this soil profile. The soil above this layer was created after the ash and charcoal were deposited by flooding of the river and the addition of sediments eroded from the local area on top of the charcoal layer. In soils, the youngest materials are found at the top of the profile. After the sediments were deposited by the flooding water, soil processes took over to form structure, color, and other soil properties that we can see and measure.

The scientists also noticed that in the horizon below the charcoal and ash layer, there were clam and oyster shells (as well as some pebbles rounded by washing down the river during flood events). With careful testing, they learned that the objects in this horizon were deposited here about 400 - 450 years ago.

What was going on in the Chesapeake Bay about 400 - 450 years ago?

The indigenous people who lived in this area before the settlers came would come to the Bay for their holiday feasts and they would celebrate and eat lots of clams and oysters. What we see here was what was left behind. These shells eventually flowed down into this creek bed and became part of the soil profile.

The last part of the story takes us to the beginning. The lowest two horizons in this profile are of an earlier soil that was buried under the river sediments of the newer soil. The buried soil shows structure, colors and other features that indicate it is many thousands of years old and was in a swampy area before the river changed its course and began to bury it.

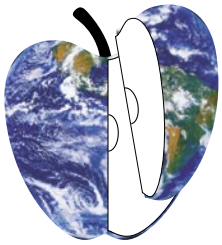
This is an example of how a soil can be a record of the history of the area around it and can tell us its story. Other stories are available on the Soil Science Education Web page (soils.gsfc.nasa.gov) under the "Every Soil Tells a Story" feature.

5. Ask students to try to come up with "stories" about how other soils may have formed and the properties that they have.
6. Introduce the concept of diversity in soil which states that because every soil is different, each one can only be used in a certain way. For example, which kind of soils would be best for growing crops (flat, fertile, moist, deep, etc.)? Which soils would be best for building a pond or reservoir (clay with massive structure, high density, low porosity, flat or depressed area on the landscape, etc.)? Which would be best for filtering wastes (high surface area, lots of organisms, not too cold or wet, etc.)? Have the students think of other land uses and what kinds of soil properties would be best for those uses too cold or wet, etc.)? Have the students think of other land uses and what kinds of soil properties would be best for those uses.

*Activity Three: How much soil is there on Earth?**

1. Take an apple and a small knife, or use the graphics below to conduct the following demonstration:

2. Teacher says: "Pretend that this apple is the planet Earth, round, beautiful, and full of good things. Notice its skin, hugging and protecting the surface."
3. Teacher asks and discusses:
   a. "How much of the surface of the earth is covered by water?"
   b. Answer: Water covers approximately 75% of the surface.
   Action: Cut the apple in quarters. Toss three quarters (75%) away.



4. Teacher says: "The three quarters (75%) that was just removed represents how much of the earth is covered with water - oceans, lakes, rivers, streams. What is left (25%) represents the dry land. Fifty percent of that dry land is desert, polar, or mountainous regions where it is too hot, too cold or too high to be productive".
   Action: Cut the "dry land" quarter in half and toss one piece away.

5. Teacher says: "When 50% of the dry land is removed, this is what is left (12.5% of the original). Of that 12.5%, 40% is severely limited by terrain, fertility or excessive rainfall. It is too rocky, steep, shallow, poor or too wet to support food production."
   Action: Cut that 40% portion away.

6. Teacher says: "What is left is approximately 10% of the apple.
   Action: Peel the skin from the tiny remaining sliver.

7. Teacher says: "The remaining 10% (approximately), a very small fragment of the land area, represents the soil we depend on for the world's food supply. This fragment competes with all other needs - housing, cities, schools, hospitals, shopping centers, land fills, etc., and, sometimes, it does not win."
   Action: Discuss with students some ways in which they could be more mindful of the soil and the way soils are being used at their homes or in their town. For example, discuss the idea of composting to recycle wastes and help make the soil rich in organic matter, and about keeping soil covered with vegetation so that it will not erode away or become compacted.

* *How Much Soil Is There? Learning Activity* courtesy of: The Natural Resources Conservation Service, U.S. Department of Agriculture

(This material can be downloaded from soils.gsfc.nasa.gov.)