Lesson One: Seeing Soil

Overview:
Throughout the world, millions of people depend on subsistence agriculture for food. Many of them live in areas with non-productive, eroded soils. Even in good farming areas, loss of topsoil threatens food production. Thus, educating people about the importance of soil is an important part of Heifer International's mission of promoting sustainable agriculture.

Soil provides some of the most basic needs for life on earth, including food for plants, animals, and humans. In this lesson, students perform science observations in the classroom to learn about differences in soil.

National Standards Addressed:
- Develop abilities necessary to do scientific inquiry.
- Develop an understanding of organisms and environments.
- Develop an understanding of properties of earth materials.

Materials:
- *What is Soil?*
- *Lab Report*
- Soil samples (have students bring some to class)
- Potting soil
- Magnifying lenses
- Lidded jars
- Water
- White paper plates
- Two flower pots

Lesson Procedure:
1. Ask the students what they ate today. Where did the food come from? All the students should be able to trace their food back to plants and soil. By discussing this, students should understand why soil is important to humans.

2. Have students take notes while you read *What is Soil?* List some important characteristics of soil such as:

   - It takes hundreds of years to form just one inch of soil.
   - There are many different types of soils with different colors and textures.
   - Healthy soil needs water and organic material (humus).
   - Humus is the decomposing plant and animal matter in soil.
   - Soils are one of the main factors to determine what plants and animals can survive in a particular environment.

3. How much soil is there? Do the following demonstration:

   Take an apple and explain to the students that the apple represents the earth. Notice the apple's skin, hugging and protecting the surface. Water covers approximately 75% of the surface. Right away, cut the apple in quarters. Toss three quarters (75%) away. The three quarters (75%) you just removed represents how much of the earth is covered with water — oceans, lakes, rivers and streams.

   What is left (25%) represents the dry land. 50% of that dry land is desert, polar, or mountainous regions where it is too hot, too cold or too high to be productive. So cut that dry land quarter in half and toss one piece away. Only 12.5 % of the original is left. 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. Cut away 40% of what you have left.

   You now have approximately 10% of the apple. Peel the skin from the tiny remaining sliver. Hold up the piece of apple skin and explain that this part of the whole apple represents the soil that humans depend on for the world's food supply. Humans depend heavily on soil, so we need to take care of the little soil we have.

   Food growth competes with all other needs — housing, cities, schools, hospitals, shopping centers, land fills, etc., and sometimes, it doesn't win.

   (From The Natural Resources Conservation Service, by way of: the Soil Science Education Home Page, http://LTPwww.gsfc.nasa.gov/globe/index.htm.)

4. Have students examine the complexity of soil. Ask them to bring in about one or two cups of soil from their gardens, yards, fields, or a local playground. Provide some samples of potting soil as well. In this way, you will have a variety of soils that vary in color and texture. Be sure to include some soil samples with small twigs or bits of broken leaves in it. Point out that this material from living things will decompose and become part of the soil, called "humus."

   Place soil samples in baggies so that each pair of students will have several samples to examine.

5. Pair the students up and direct them to do the following observation:

   a. Partner A closes his or her eyes, feels the soil sample, and describes how the soil feels. Terms might include soft, scratchy, rough, smooth. Partner B writes down the words with the available pencil and paper.

   b. Partner A looks at the soil and describes the color using as precise words as possible. Vocabulary might be chocolate, caramel colored, silver gray etc.

   c. Partners switch roles using a different soil sample. Partners discuss the differences in texture and color of their samples.

   d. Partners spread soil samples on paper plate to facilitate careful examination with magnifying lens. Look for different particles that make up the soil samples. Record observations on paper.

e. Each pair of students should label a jar with their names. Add soil to the jar to one third full. Add water to the jar until it is almost full. Tighten the lid on the jar and shake the jar for 15 seconds. Return the jar to central location to sit overnight.

   The next day observe the jar using the magnifying lens to inspect each part more clearly. Record observations.

   Soil particles are classified by size. From smallest to largest the particles are:
   1. Clay
   2. Silt
   3. Sand

   Draw the layers of different particles and label them. The larger particles will settle toward the bottom of the jar. If the bottom layer of soil in your jar is coarse, then it is sandy soil. If it is made of fine particles, then the soil is mostly clay or silt soil.

Soils can be either clay soils, sandy soils, or somewhere in-between. Explain that the best kind of soil for growing crops that humans eat is soil that has a good mixture of both clay, sand, and organic matter (humus). Soil needs organic matter (such as compost) to grow healthy plants.

Do the following experiment comparing a random soil sample and soil with compost mixed in to see how healthy soils help plants grow better:

a. Distribute the *Lab Report* worksheet. Fill out the first question, "What are we trying to find out?" as a class. The answer will be something like, "Does soil with compost make seeds grow faster?" The rest of the questions can either be filled out independently or as a class.

b. Take soil from your backyard or park (do not take soil from a garden). Squeeze the soil into a ball. If it keeps its shape, it has a high clay content. If it falls apart, it has a high sand content.

c. Take two flower pots and fill one with soil from the park or other unfertilized source. Fill the other flower pot with potting soil (the potting soil should already have compost mixed in it). Label the pots according to the soil.

d. Plant several seeds of the same type in each pot. Place in sunlight and water regularly.

e. As a class, periodically record the growth of the plants, and compare.

f. The plants in the potting soil should grow better than the others, since the compost adds nutrients to help plants grow.

HANDOUT: What is Soil?

Soil is like a layer of skin covering the Earth. Although there are rocks and dust on other planets, there is no soil. This is because soil needs air, water, and living creatures.

To make soil, you need to use wind, rain, and freezing and thawing temperatures to break rocks down into small particles. Add air and water. When plants and animals die and start to decay, the nutrients in their bodies are mixed into the soil (this is called *humus*). After hundreds of years, this mixture will become rich, productive soil. Living organisms such as bacteria and earthworms live in the soil and recycle nutrients to keep the soil healthy.

Without soil, it would be difficult for humans to live on Earth. Plants need soil to grow in and get nutrients from. Animals need plants to eat. Without plants and other animals, it would be hard for humans to survive. In addition, soil absorbs water when it rains to help prevent flooding. It also acts as a filter against pollutants in the water we drink.

The kind of soil in your neighborhood depends on the kind of rocks and the kind of plants and animals that went into making the soil, as well as the general temperature and rainfall in your area. In places where there are not many plants, there may not be much humus in the soil. In places where there is too much rain, many of the nutrients are washed right out of the soil. Since there are so many different kinds materials and climates that go into creating soil, there are many different kinds of soil. If you look at a variety of soils, you will see that they have very different colors, textures, and even smells!

Good soil needs food and water. Soil needs to constantly absorb the right amount of water and organic material or else it will lose nutrients, leaving barren deserts where no food can be grown. It is important for humans to take care of their soil because without it, we may not be able to survive.

HANDOUT: Lab Report

1. SCIENTIFIC QUESTION - What are you trying to find out?

2. HYPOTHESIS - What do you think will happen?

3. EQUIPMENT - What do you need to do this experiment?

4. PROCEDURE - What steps are there in your experiment?

5. RESULTS - What happened in your experiment?

6. CONCLUSIONS - Why do you think this happened?