

What's in Soil?

Soil Isn't a Dirty Word

Objectives

Students will be able to list the four components of soil.

Students will be able to estimate the amount of minerals and organic materials in a given soil sample.

Students will be able to demonstrate that soil contains air and water.

Materials

- small plastic bag of loose, crushed, soil for each pair of students
- newspaper
- hand lenses
- tissue paper or thin paper towel (thick school brown paper towels do not work)
- overhead projector
- water
- 2-cup containers: plastic or paper cups, soup cans or beakers.
- 1 cup measuring cups
- Soil Components transparency

Time

Activity 1: 30 minutes
Activity 2: 10 minutes
Activity 3: 20 minutes

Getting Started

Gather materials, make necessary copies, and transparencies. For Activity 3, cut a 6-inch piece of yarn or string and tape one end to the center of the “Soil Pie: Components of the Soil.” The other end should remain loose so that you can move it up or down to show how the percentage of water and air changes depending on climatic conditions.

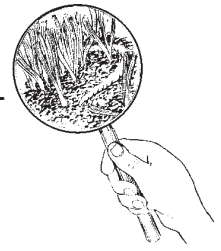
Procedures

Activity 1 - Soil Inventory

1. Divide students into pairs. Give each pair a small plastic bag of soil (students could have brought samples from home, but make sure that it is really soil not a soilless media like some potting mixtures, which is for the most part organic matter). Ask them to dump their sample out onto a newspaper.
2. Using a hand lens, ask each pair of students to write down what they see or feel (moisture) in their sample. You may want to let them know that the small, bead-like, particles they see are called **mineral matter**. Depending on the samples, they should see mineral pieces (little rocklike pieces), organic matter, (leaves, sticks, straw, worms, beetles, etc.), water (moisture, unless the soil is totally dry) and air (which they will probably not mention, because they cannot see it).
3. Show students the “Components of Soil” transparency. All of the items they have inventoried should fit into one of the four soil component categories.

Activity 2 - Soil Moisture

1. Pick one of the soil samples that feels moist or appears to have the most organic matter.
2. Place a paper towel on your overhead. Notice that it blocks out the light. Place a drop of water on the paper towel, some of the light now shines through.
3. Place the moist soil sample on the paper towel and after a few minutes (depending how wet your sample is) dump off the soil. Check to see if the soil left any moisture in the towel by placing it on the lit overhead. Soils do hold moisture.



Activity 3 - Soil Air

1. Ask each student group or pair to place 1 cup of **dry** soil into a 2-cup container.
2. Students should slowly pour 1 cup of water into the soil container until the soil is “saturated” or all the dry soil is “mud.” While they were pouring the water they should notice the “air bubbles” that are rising to the surface.
3. Students should measure the amount of water left and subtract it from 1 cup.
4. Lead students to infer that the amount of water in the soil sample was approximately the amount of air that was displaced. As the students added the water to the sample, they should have seen bubbles, until the sample was saturated.
5. Have students compare the amount of water that they were able to pour into their soil samples. There will be differences depending on the soil texture and organic matter. What is the percentage of air in the soil sample? If they were able to add a 1/4 cup of water, the sample contained 25 percent air.
6. Using the components of the soil transparency, and the movable yarn, explain how air and water amounts change.

Discussion

1. What are the components of soil? (mineral matter, organic matter, water, air)
2. Which two components are the most variable? (water and air) Why?
3. Why do worms come up to the surface after a drenching rain? (to breathe)

Background

Soil is naturally occurring, unconsolidated or loose material at the surface of the earth, which is capable of supporting plant and animal life. In simple terms, soil is comprised of three components: solid, liquid, and gas. The solid phase which accounts for approximately 50 percent of the volume in a typical soil is a mixture of **mineral** and **organic matter** and gives soil its mass. Soil particles fit loosely (depending on the particle size) leaving “empty” pore spaces. The pore spaces are then filled with water (liquid) and air (gas). The water and air in an “average” soil make up the other half of the soil’s volume.

All soils are made up of the four major components; however the portions will vary. The **mineral matter** is derived from the weathering of hard rock at the earth’s surface. An “average” soil is made up of approximately 45 percent mineral content by volume, the amount and size of mineral particles vary.

In an “average” soil, the amount of **organic matter** (living and dead organisms) will range between 1 and 5 percent. Organic matter is mostly composed of dead plant and animal remains. This decay in the upper layer of soil, or topsoil, is the major source of plant nutrients and other organisms. Organic matter is what makes a soil fertile. Soils high in organic matter do not compress as tightly allowing for more air spaces. Organic particles also hold the moisture by absorbing water. Water is held in the small air spaces



between soil particles. Sand does not hold water because there is no organic matter to hold water and because the spaces between particles is large.

Approximately 50 percent of the soil is made of **pore space**. In an “average” soil the pore space is occupied by *25 percent air and 25 percent water*. Of course when it rains or during a drought these percentages change drastically. You can demonstrate this by using the “Components of the Soil” transparency and yarn, as explained in the teacher preparation section. Show how weather patterns affect the air and water percentages. (The yarn, representing the line between the two components is easily moved.) Water and air in the soil is very important to the plants and animals that live in this ecosystem. Water carries the nutrients to the plants. Both water and air are necessary for life and growth processes of plants and animals. Plants and animals breathe. Plants consume carbon dioxide through their roots and animals take in the oxygen.

Vocabulary

mineral matter: small pieces of weathered of rock (parent material), broken down over thousands of years.

organic matter: products derived from living organisms, like plants and animals.

Soil Pie: Components of Soil

