5 Soil Composition

Chris knew that his class had watered the plants in the school garden and that they hadn't survived. He wondered if previous classes had watered their plants. Students in his class found a science notebook showing the watering schedule of two classes from the year before. They had watered the garden regularly, but their plants hadn't grown either. Chris thought there was enough air and sunlight in the garden. He decided it was time to find out more about soil.

What is the composition of soil?

READING

When reading, answer the Stopping to Think questions in your mind. They can help you find out whether you understand the main ideas.

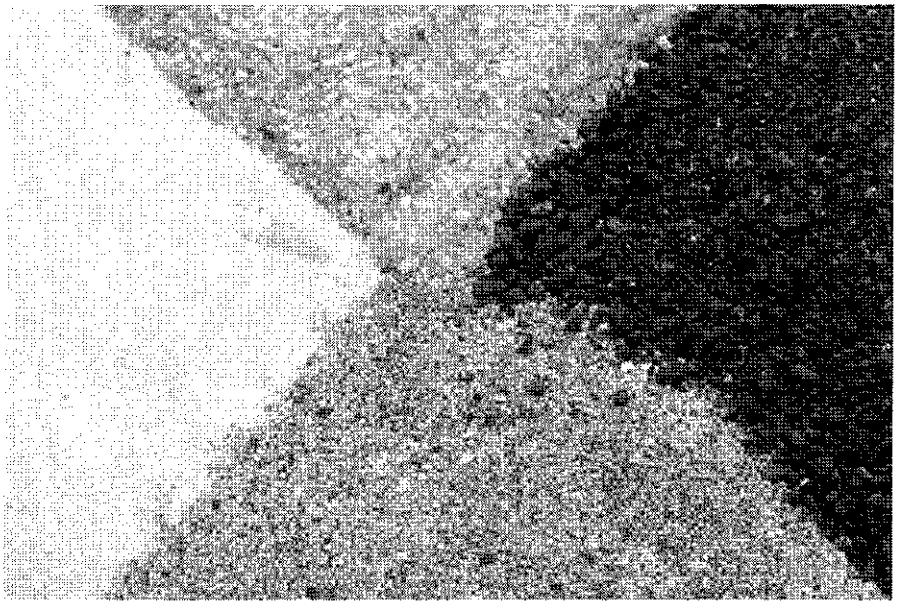
Weathered Rocks in Soil

All soil may seem alike, but soils in different places are different. One thing that all soils have in common is that they are mixtures of many things. Tiny pieces of rock are found in most soils. How do rocks become so tiny? Over time, rocks crack, crumble, and are broken apart by water and wind. Drops of water on a rock may repeatedly freeze and melt, causing the rock to crack. Water may react with some of the chemicals in a rock and cause part of the rock to wear away. Rocks sometimes fall from higher places, breaking as they fall and roll. All of this wearing down of rocks by natural forces is called **weathering.**

STOPPING TO THINK 1

The paragraph above describes three examples of rock weathering. Think of another example. Need help? Consider the different ways that water moves over the surface of the earth.

Scientists have names for the different-sized rocks found in soil. **Sand** is the word used for the largest pieces of rock in soil. Compared to rocks, sand is still very small, with the largest piece being less than 1/5 of a centimeter! Individual pieces of sand, or *grains*, are easily visible, but they are not as big as small pebbles.



Four different kinds of sand show a variety of grain sizes and compositions.

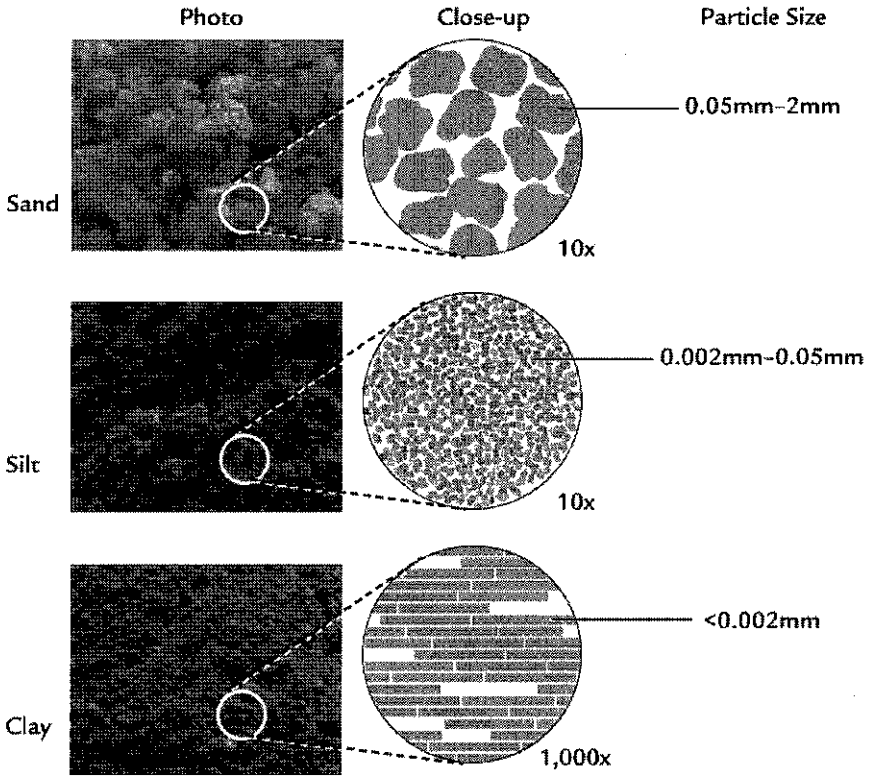
Pieces of rock that are smaller than sand are called **silt** and **clay.** Pieces of clay are so small they cannot be seen without a microscope. Pieces of silt are smaller than sand, but bigger than clay. You can compare the relative sizes of these rock pieces in Figure 1, "Comparing Rock Pieces" on the next page. Together, sand, silt, and clay are the main components of soil.

Soil from different places contains different amounts of sand, silt, and clay. For example, the soil from a desert may have a lot of sand in it. Soil scientists can often tell which part of the world a soil sample is from, based on the amount and type of sand, silt, and clay in the sample.

STOPPING TO THINK 2

A student examines some soil. She notices a small rocky piece that measures 1 millimeter (mm) across. Is this particle likely to be a rock, sand, silt, or clay? How do you know? Use Figure 1 on the next page to help you decide.

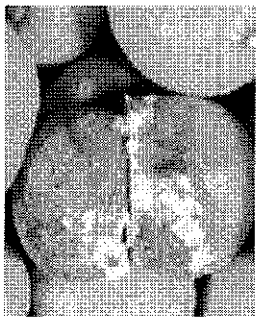
FIGURE 1: COMPARING PARTICLE SIZES IN SOIL



Organic Matter in Soil

Have you ever watched what happens to a very ripe piece of fruit that has been forgotten? It begins to change color, becomes soft, and starts to smell. It is **decomposing** (dee-kum-POZ-ing), or breaking down. If left outside on the ground, it will decay further until it is no longer recognizable as fruit.

Soil contains a lot of decomposed material. Fruit may fall to the ground and decompose to the point that it becomes part of the soil. The same thing happens to animal waste and to dead plants and animals that are not eaten by other animals. Decomposing plants and animals, including insects, leaves, and flowers, contribute to the **organic** (or-GAN-ik) **matter** in soil. The word "organic" refers to material from living organisms.



Bacteria and mold are decomposing these lemons.

As time passes, bacteria and other microorganisms help break down organic material into smaller and smaller particles that may look like dark brown clumps in the soil. Eventually, organic matter breaks down into basic chemicals. These chemicals, called **nutrients** (NEW-tree-unts), can dissolve in water and be absorbed by plant roots. The word *nutrient* comes from the Latin root *nutr-*, which means "to feed." Plants use nutrients produced from decomposing organic matter to grow. Organic matter is an important part of soil.

STOPPING TO THINK 3

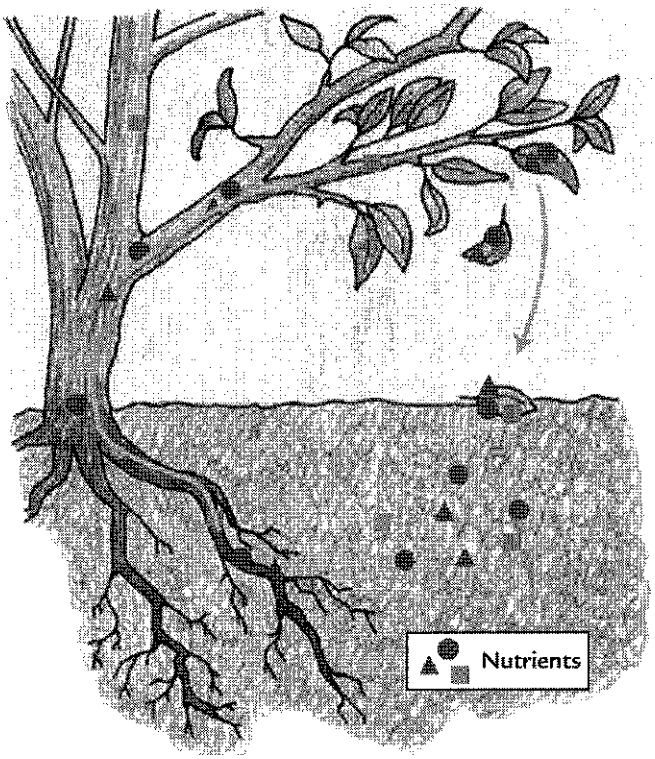
Why is it important for plants to grow in soil containing organic matter?

There can be different amounts of organic matter in the soil. In areas where many plants and animals live, grow, and die, there is more organic matter in the soil. Plants remove nutrients from the soil, but eventually they also give them back, as shown in Figure 2 below. When a plant dies, it may fall to the ground and decompose, adding to the organic matter (and the amount of nutrients) in the soil. This cycle of organisms living and dying helps enrich the soil with organic matter.

STOPPING TO THINK 4

How can a dead plant help another plant live?

FIGURE 2:
THE CYCLE OF
NUTRIENTS



Soil Layers

Topsoil is the soil in the uppermost layer of soil on the surface of the earth. It is the soil layer that you normally see, although it is only one of many layers. Each layer above bedrock has different characteristics. The different characteristics of each soil layer and bedrock are described below.

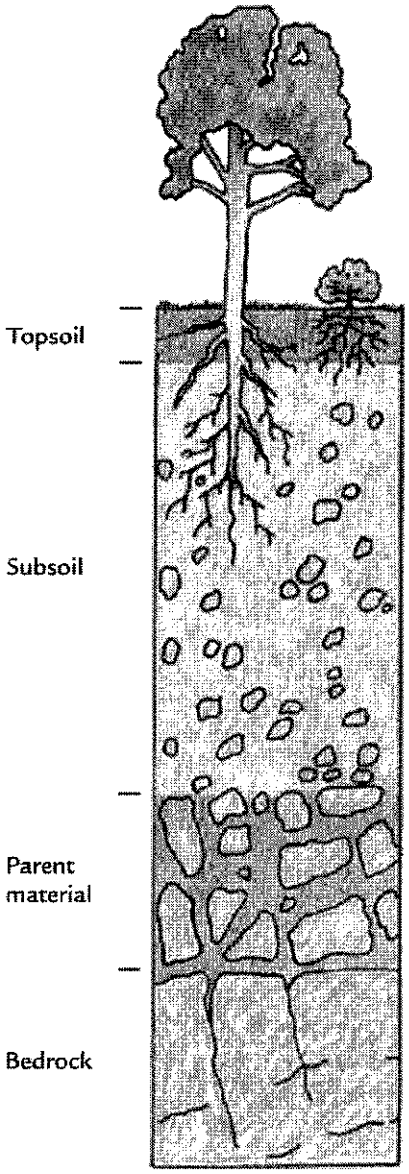


FIGURE 3:
CHARACTERISTICS OF SOIL LAYERS AND BEDROCK

TOPSOIL is a combination of rock, sand, silt, clay, organic matter, air, and water. Plants grow roots in this layer, which is rich with biological activity. Topsoil is about 20 centimeters deep, but it may be thinner or thicker depending on the location.

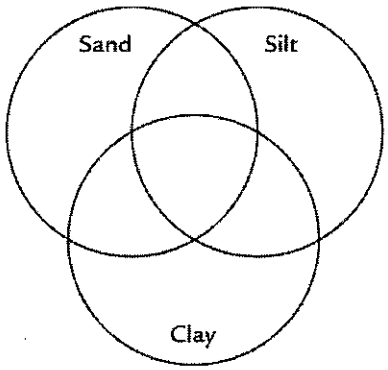
SUBSOIL contains some of the chemicals found in the topsoil as water drips from the soil above and washes these nutrients down. There is not much organic material in this layer.

PARENT MATERIAL is made up of slightly broken-up bedrock. Plant roots usually do not penetrate into this layer. Very little organic matter is found here.

BEDROCK is hard rock that lies beneath all the soil layers.

ANALYSIS

1. Create a larger version of the Venn diagram shown below. Record the characteristics of sand, silt, and clay in the circle with that label. In the spaces that overlap, record common features.



2. A dead leaf falls from a tree to the ground. If left undisturbed, what will happen to it?

3. Earthworms help organic matter decompose. In what soil layer do earthworms live? Explain your answer.

4. Look at your data on Student Sheet 4.1, "Soil Column Observations," from the last activity.

   a. Compare your data with what you now know about soil. Label sections of the soil column with words that you learned in this activity.
   Hint: Every section will not get a label.

   b. Which soil layer(s) did Soils A and B come from?

   c. Which soil, A or B, do you think is a better soil for gardening? Support your answer with evidence.

5. Look at your answer to Analysis Question 4 of Activity 3, "Observing Soil."

   a. Revise your answer to the question: *What is soil?* Write as complete a description as you can.

   b. Explain how your definition has changed since you began this unit.

6. What could be wrong with the soil in the school garden? Make a list of your ideas.

EXTENSION

Observe the decomposition of a piece of fruit. Find an appropriate place on the ground outside to place an old banana, avocado, or apple. (Remember that decomposing fruit may attract insects or small animals that help in the decomposition process.) Mark the area as a science experiment. Make observations every day for a few weeks and record your findings in your science notebook.