

# Soil Particle Layering

## OBJECTIVES

Students discover that soil is made up of different-sized particles by shaking soil samples in water and allowing the particles to settle out.

### The students

- ▶ collect and observe a sample of soil
- ▶ observe that air is present in soil
- ▶ create soil layering within a soil sample
- ▶ classify soil particles according to size

## SCHEDULE

**Session I** About 40 minutes

**Session II** About 30 minutes, 1 day after Session I

## VOCABULARY

clay	organic matter
coarse	particle
fine	sand
mineral particles	silt

## MATERIALS

### For each student

- 1 Activity Sheet 2

### For each team of two

- 1 magnifier
- 1 spoon, plastic
- 1 tray, plastic
- 1 tube, plastic, closed-end, with cap

### For the class

- newspaper\*
- 1 roll tape, masking
- 1 trowel
- water, tap\*

\*provided by the teacher

## PREPARATION

### Session I

- 1 Select one site on the school grounds for collecting soil, and obtain permission to dig a hole there during the activity.
- 2 Each team of two will need a plastic spoon, a closed-end plastic tube with a cap, a magnifier, a plastic tray, a sheet of newspaper, a strip of masking tape, and access to tap water.

### Session II

- 1 Make a copy of Activity Sheet 2 for each student.
- 2 Each team of two will need their tube from Session I and a magnifier.

## BACKGROUND INFORMATION

Soil contains many **mineral particles**, including **sand**, **silt**, and **clay**. Sand particles are classified as the largest, or **coarsest**, particles; the smallest, or **finest**, are classified as clay. Soil particles between sand and clay in size are classified as silt. In addition to these mineral particles, soil also contains dead and decaying plant and animal material, or **organic matter**. Soil is also teeming with life, and is home to many small animals and microorganisms.

In order to identify the different particles that make up a soil sample, the soil must be separated into its constituent parts. This can be difficult to do using a magnifier and a pair of tweezers. An easier method is to shake a sample of soil in a tube of water and allow it to settle out. The coarsest particles fall to the bottom of the tube first, followed by the medium-sized particles, and so on. The organic matter typically floats at the water's surface. Some of the organic matter becomes waterlogged and settles on the top layer.

Left for a period of time, the settling particles will form layers in the tube, each layer consisting mainly of one particle size. By examining the tubes, students are able to estimate the proportions of the different particles that make up their sample.

## ▼ Activity Sheet 2

### Soil Particle Layering

Draw the particle layers in your tube.  
Then label the layers.  
Use as many of these words as you need.

clay    organic matter    pebbles    sand    silt

Drawings and labels will vary with soil samples.



## Guiding the Activity

### Session I

- 1 Invite students to think back to their previous observations of soil. Remind them that soil is made up of many different things. Ask, **What do you think you would find if you separated all the things that make up soil?**

Tell students that in this activity they will examine soil more closely than they did in the previous activity.

- 2 Give each team of two a plastic tray.

Take students outside to the collection site. Bring the trowel and have students bring their trays.

Using the trowel, dig a fairly deep hole. Fill each tray. Be sure to take soil from both the top and the bottom of the hole as well as the middle.

### Additional Information

*Accept all ideas at this time. Students may mention rocks, twigs, sand, or animals.*

**Note:** To save time, you could use soil samples collected in Activity 1.

*The hole should be about 20 cm (8 in.) deep. This will ensure a variety of particles in each team's sample.*

## Guiding the Activity

- 3 Back in the classroom, give each team of two a sheet of newspaper and a magnifier. Have them spread the newspaper out over their desk or table.

Tell the students to spread out the samples on their trays and closely examine the soil by feeling it and looking at it with their magnifiers.

Write the words *mineral particles* on the board. Tell students that a **particle** is a small amount or piece of something. Explain that soil is made up of many particles. Some of these are **mineral particles**, small parts of weathered rocks. Ask students, **Are all the particles of soil the same size?**

Ask, **How do the soil particles feel?**

- 4 Ask, **Do you see anything in the soil that might once have been part of a plant?**

Write the term *organic matter* on the board. Explain that the term **organic matter** refers to anything that was once alive, such as leaves, twigs, and parts of animals and plants.

Ask, **Does your soil sample contain organic matter?**

Ask, **Do you see any animals, such as worms or insects, either alive or dead?**

- 5 Give each team of two a plastic spoon, a plastic tube with a cap, and a strip of masking tape. Instruct students to use the tape to label their tubes with their names.

Tell each team to put 10 spoonfuls of soil from their tray into the tube. Then direct the teams to fill the tubes about half full with water. Tell the students to closely observe the water.

Ask, **What do you see?**

Ask, **Where do the air bubbles come from?**

## Additional Information

*Students may say that they are. Lead them to see that they are not.*

*Some particles of the soil will probably feel sandy or gritty, and some will probably feel smooth.*

*The amount of organic matter present in soil varies. In some areas there is a great amount of it, and in other locations there is very little.*

*If students saw part of a plant or an animal, that would constitute organic matter.*

*If the soil is moist, some animals may be present.*

*Students should see air bubbles rising.*

*Students may suggest that they come from the soil.*

## Guiding the Activity

Explain to students that air is present in the little spaces in the soil. As the water fills these spaces, it replaces the air, and the air rises and forms bubbles. Tell students that the air is important to animals that live in the soil.

- 6 Tell students to put the caps on the tubes and hold on to them tightly. Instruct them to hold the tubes upright, and shake them twenty times.

Have students turn the tubes upside down, continue to hold the lids in place, and again shake 20 times. While the students are shaking their tubes ask, **Are the soil materials in the tube moving with the water?**

After students have stopped shaking their tubes ask, **Are the materials in the tube still moving?**

Ask, **What do you think will happen in the tube if we left it to sit undisturbed overnight?**

Have the students place their tubes in an undisturbed place overnight.

Have students discard the remaining soil and wash off the trays, spoons, and trowel. Have them return the materials to the kit.

## Session II

- 7 Have each team retrieve their tube of soil. Ask, **What do you observe?**

Explain that the heavier particles settle to the bottom quicker than the lighter particles. (See Figure 2-1.)

Give each team a magnifier. Instruct students to closely observe the material that settled to the bottom. Ask, **What do you notice?**

Remind students that soil is made up of

## Additional Information

*Caution students not to shake too hard, or the lids may come off.*

*yes*

*Yes, but the larger particles are beginning to sink.*

*Accept all predictions. Students may say that all the particles will settle to the bottom.*

*The water is partially clear, while most of the material has settled to the bottom. There may also be a layer of material floating on the surface of the water. The particles that cause the cloudiness in the water for several days are the lightest particles, called clay.*

*Students should be able to see layers.*

## Guiding the Activity

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particles of different sizes. Explain that when you dig up soil from the ground, the particles are usually mixed together. Shaking a soil sample in a tube with water and allowing the soil to settle to the bottom—as the students have done—creates layers that clearly show the amounts of different-sized particles.

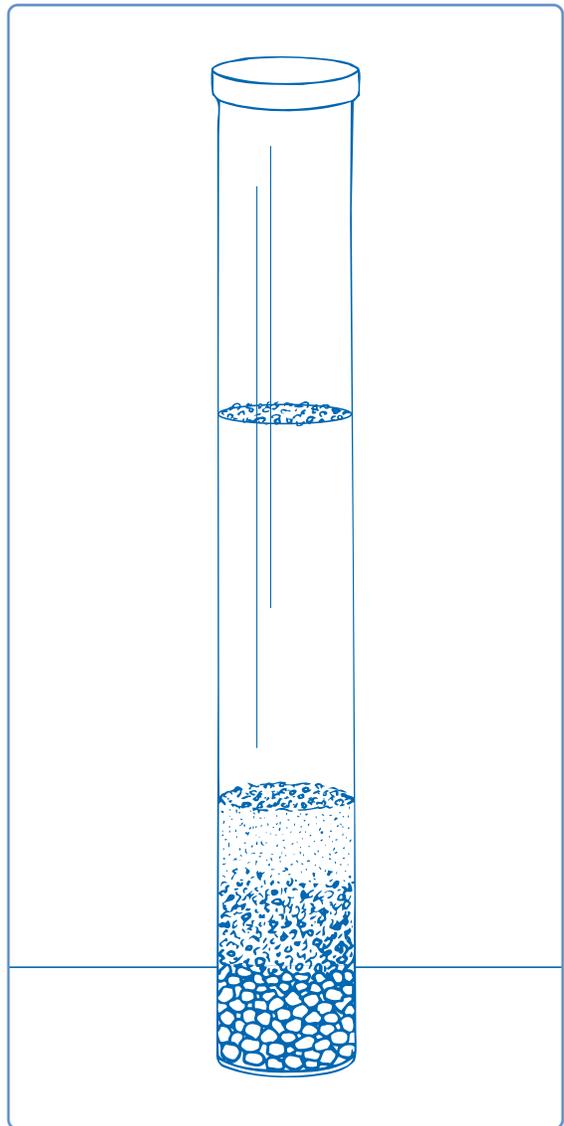
Explain to students that soil scientists can tell a lot about the soil from doing a test such as this. If the particles are one-third clay, one-third sand, and one-third organic matter, the soil is very good for growing plants. If the soil has too much sand, the scientist will recommend that clay and organic matter (such as leaves or mulch) be added.

Write the words *coarse* and *fine* on the board. Ask students, **What do these words mean?**

Ask, **Where in your tube do you see the coarsest particles?**

Ask, **Where do you see the finest particles?**

## Additional Information



▲ *Figure 2-1. Tube showing layers of soil.*

*Students may know that something **coarse** is made up of large particles of material while something **fine** is made up of small particles of material.*

*Students should see the coarsest particles in the material at the bottom.*

*in the top layer of material that settled in the tube*

## Guiding the Activity

Explain to students that coarse particles in the soil fall to the bottom first because they are the heaviest. Tell students that although small pebbles are sometimes present, the coarsest particles in soil are usually particles of **sand**. Write *sand* on the board.

Ask, **What do you think settles last? Why?**

Write the word *clay* on the board. Explain to students that the finest particles found in any soil anywhere are particles of **clay**.

Write the word *silt* on the board. Explain to students that particles of **silt** are finer than sand, but coarser than clay. Ask, **Where are the silt particles in your tubes?**

## Additional Information

*Students should infer that the finest particles settle last because they are the lightest.*

*Point out these particles in the students' tubes as forming the top layer of the settled material.*

*They form the middle layer of the settled material.*

*Some students may have material floating on the top of the water.*

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Have students look at the top of the water. Ask, **What do you see?**

Tell students that the material at the top is organic matter.

Give each student a copy of **Activity Sheet 2**. Have the students draw in the layers that they observe in their tubes and label them.

Tell students that they will learn more about all the materials in soil in later activities.

## REINFORCEMENT

If there is a construction site or another place near the school where several feet of earth have been cut away, take the students to see it. Have them collect samples of the soil at different levels, place them in settling tubes, and compare the particles that make them up.

## CLEANUP

Collect and save the students' tubes of soil and activity sheets for use again in Activity 3. Return the magnifiers to the kit.

## SCIENCE AT HOME

Encourage students to repeat the activity at home on a soil sample from their yards or other nearby location. With a parent's supervision, they can collect and observe a sample. Using any tall, narrow, clear container, they can create soil layering. Remind students to add water and shake the container to mix the soil and water. Then they should leave their setups undisturbed overnight. Invite students to describe the process to their families and to share their results with the class.

## Connections

### Science Challenge

Do the following activity after students have finished using the tube with settled layers of soil particles from this activity as a basis of comparison with the two other settled samples in Activity 3. Tell each team to gently drain the water out of the tube. Give each team a small, disposable aluminum baking pan, and tell students to empty the soil into the pan by tapping the tube gently as they move it in a line so the separated layers stay separated as much as possible. Tell students to remove the organic matter from the pan and then spread out the particles in each separated layer. Have students leave their pans in a sunny location until the soil is thoroughly dry, which may take two or three days. (If you have access to an oven, you could dry the soil by baking the pans at 500°F for about 30 minutes. Make sure the pans are completely cooled before returning them to the teams. *Safety Note:* The soil will cool more slowly than the pans, so check to make sure it has cooled completely.) Guide the teams to examine their samples. Tell them to first stand back away from the pan and decide what overall color the soil is, then examine the particles more closely. Are all the particles the same color, or are they different colors? Then have students use a magnifier to examine the particles in each layer. What shape are the particles—round? flat? pointed? Do they have sharp edges or smooth edges? Encourage students to draw close-up views of “typical” particles in each layer.

### Science Extension

When you discussed students’ ideas for separating the different-size particles in soil (see Science Challenge in Activity 1), if they did not suggest sifting soil with different-sized screens, briefly describe the method and ask them whether they think it would work. Give each team a cupful of soil, three empty containers, and two sifters—one with a wide-mesh screen and the other with a fine-

mesh screen. Have students sift the soil with the wide-mesh sifter, set aside the material that did not pass through that sifter, and then use the fine-mesh sifter to resift the remaining soil. Pebbles and other large particles that do not pass through the wide-mesh screen should be considered coarse soil. Soil that passes through the wide-mesh screen but not through the fine-mesh screen is medium soil. Soil that passes through the fine-mesh screen is fine soil. Let students examine the particles in each sample of sifted soil with a magnifier.

### Science and Math

With older or more capable students, have each team use a postage scale, kitchen scale, or other small scale to weigh the three samples of soil—coarse, medium, and fine—that they separated with a sifter in the Science Extension above. Tell students to record the weight of each sample. Then help students construct a simple bar graph comparing the weights of the three separated samples, with the vertical axis labeled *Weight* and the bars labeled *Coarse Soil*, *Medium Soil*, and *Fine Soil*.

### Science and Language Arts

Use the procedure described for Science and Language Arts in Activity 1 with the word *clay*, separating the consonant blend and the long vowel: *cl ay*. Have students list as many words as they can think of that begin with the blend *cl* and words that have the long *a* sound in them. You may want to review beforehand the various spellings of the long *a* sound—*ay* or *ey* at the end of words and *a*, *ae*, and *ai* within words. As a greater challenge, ask students to list words that rhyme with *clay* and then write a brief poem using as many of the words as they can.