



## Investigation 2:

# Separating Soil by Settling



### Key Question

Before you begin, first think about this key question.

**How can soil be separated?**

### Materials Needed

For this investigation your group will need:

- 2 clear-plastic 300 mL (10 oz.) cups (if your school has tall 1-liter graduated cylinders, they would be even better than plastic cups)
- soil sample from your local area
- 250 mL (8 oz.) cup of water
- stopwatch or watch with second hand
- plastic drinking straw



### Investigate

1. By making observations, you are going to investigate how soil materials fall through air and through water.

Place two clear plastic cups side by side on a table.



2. If some of the soil is stuck together in lumps, gently break up the lumps with your fingers before starting the investigation.

Crouch down so that you can see the cups from the side.

Have one person very gently pour about 60 mL (1/4 cup) of soil into one of the plastic cups.

Observe how the soil materials fall through the air inside the cup.

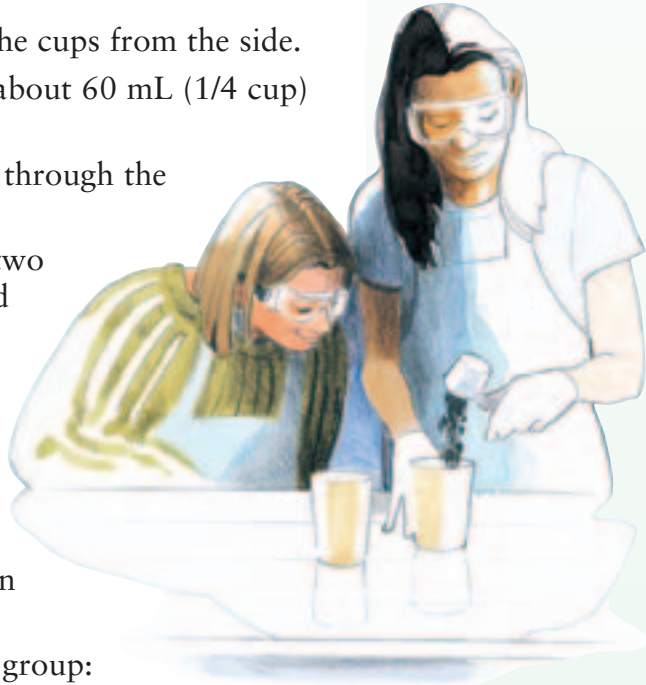
Repeat the pouring and observing two more times. Take turns pouring and observing.

- a) Record all the observations you can make about how soil falls through air. It may be useful to make a drawing to show your observations.
- b) Describe how the soil looks when it reaches the bottom of the cup.

3. Discuss this question in your small group: What would happen to the soil if it were poured into water instead of air? Why is that?

Based on what you already know, make a prediction.

- a) Write down your prediction.
  - b) Write down the reason for your prediction.
4. Fill the second plastic cup 3/4 full of water. When the water is still, gently pour about 60 mL (1/4 cup) of the soil into the cup and observe. Repeat your observations two more times, starting each time with a fresh cup and clear water.
    - a) What happens when the soil meets the water?
    - b) What happens to the soil as it passes through the water?
    - c) What happens when the soil reaches the bottom of the cup?



## Inquiry

### Making Predictions

*Making a prediction is not just guessing. Predictions are made based on all the information and evidence you already have. When making your prediction, you need to be clear about the reasoning that supports it. That is why giving the reason for your prediction is very important.*



## INVESTIGATING SOIL



### Inquiry

#### The Importance of Evidence

The word **evidence** may be familiar to you in criminal investigations. However, evidence is also important in science. In science, valid conclusions depend on evidence that can be trusted. Others should be able to do the same experiment and come up with the same evidence.



Clean up any spills immediately.



5. Look at the prediction you made and the reason you gave for your prediction.

If something different happened from what you expected, discuss what the reasons might be.

- a) How accurate was your prediction?
  - b) Did anything happen that you were not expecting? If so, what?
  - c) Does your reason make good sense?
  - d) If necessary, rewrite your reason to include any new information or ideas you have. Base your explanation on the evidence you have.
6. Allow your water and soil mixture to settle for 5 minutes. Make observations every minute during this time.
    - a) Record everything you observe. An example of a data table is given below. You can change it to suit your needs.

Time (minutes)	Observations
After 1	
After 2	
After 3	
After 4	
After 5	

7. Stir your soil and water mixture with the drinking straw, then let it settle.

Observe what is happening to the soil particles in the water. Note if all particles are behaving in the same way.

- a) Record your observations.
- b) How can you explain what you observe?



8. In your small group, discuss what you think will happen to this mixture if you allow it to settle for a much longer time.  
Based on what you see happening now, predict what the soil inside the cup will look like in 24 hours.
  - a) Write down your prediction.
  - b) Write down the reason for your prediction.
9. Label your cup in a way that you can identify it among others.  
Find a safe place to store your water and soil mixture undisturbed for the next 24 hours.
10. After 24 hours examine your soil and water mixture carefully.  
Observe how it has changed.
  - a) How many kinds of materials can you now observe in the soil?
  - b) What do you think these are?
  - c) How do you think you could find out what the different materials are?
  - d) How accurate was your prediction?
11. Design a good way to show your findings to others. Share your findings with the class.  
Record your information in a way that you can add more to it later. The following shows one way to record your findings:



Be sure to mark your cups so others know what is in them.

What is Found in Soil	
Finding	Evidence
Soil is composed of many things.	We found stones, bits of...

**As You Read . . .****Think about:**

- 1. What makes objects fall toward the center of the Earth?**
- 2. Why do large, heavy objects fall faster than small, light ones?**

**Digging Deeper****Gravity and Friction**

The Earth's gravity pulls all things toward the center of the Earth. The soil materials fell to the bottom of the cup because of the pull of gravity. You know from experience that the speed of a falling object depends on the weight and the size of the object. A bowling ball falls much faster than an air-filled balloon. They are about the same size but the bowling ball is much heavier. A marble falls more slowly than a bowling ball. They are both made of the same type of material, but the bowling ball is much larger, and therefore much heavier. This probably seems very natural to you. However, it is not that simple to explain why. If you dropped those objects on the Moon, they would all fall at the same speed! The difference has to do with a force that



keeps one object from moving against another object. This force is called friction. In this investigation the friction was between the air or water and the falling particles. There is no air on the Moon, so there would be no friction to hold back falling objects.

The soil in your sample probably was made up of differently sized particles. They may have been as large as sand grains or pebbles, or as small as fine mineral particles. The larger particles tended to fall faster, so they reached the bottom of the cup first. It took a long time, however, for the dust to settle in the air and for the muddy water to become clear again. Also, it took longer for the particles to settle in water than in air. That is because the friction is greater in water than in air.



## Review and Reflect

### Review

1. Can you answer the key question after completing this investigation? Explain how you were able to separate soil.
2. What kinds of materials did you find in your soil sample?
3. What is the difference between the way soil particles fall through water and through air?
4. Name two or more things that you learned about soil in this investigation.

### Reflect

5. Do you think all soil is the same everywhere?  
If not, why not?
6. Would you expect all types of soil to behave in the same way when poured in air and water? If not, why not?
7. What additional questions about soil came up during this investigation that you could investigate?

### Thinking about the Earth System

8. In which part of the Earth system is each of the following located?
  - a) soil
  - b) air
  - c) water
9. What evidence did you find in this investigation that would connect soil to the biosphere?
10. Write all the connections that you discovered in this investigation to connect soil to the geosphere, hydrosphere, atmosphere, and biosphere. You can record this information on your *Earth System Connection* sheet.

### Thinking about Scientific Inquiry

11. How is evidence used in science?
12. How can making a prediction be useful in your investigations?
13. Why is it important to give the reason for your prediction?