2 Investigating Groundwater

INVESTIGATION

As you learned in the previous activity, one factor that might influence where nuclear waste can be stored deep underground is the amount of rainfall in an area. Why? Because precipitation that falls on land may fall or flow into lakes, rivers, or oceans, but a lot of this water will pass through the soil and into the underlying rocks below Earth's surface. Water that goes beneath Earth's surface is called **groundwater.**

In this activity, you will explore how water enters and flows underground through earth materials. This information might be helpful as you consider where to store nuclear waste.

Hydrologists preparing equipment to take groundwater samples below Earth's surface

GUIDING QUESTION

How does water interact with earth materials?

MATERIALS

For each group of four students

- 1 clear plastic cup (9-ounce) of clay
- 1 clear plastic cup (9-ounce) of sand
- 1 clear plastic cup (9-ounce) of water
- paper towels

For each pair of students

- 1 plastic spoon
- 2 graduated cups (30-mL)
- 1 magnifying lens
- 1 SEPUP tray
- 2 tube holders for SEPUP tray
- 2 clear plastic tubes with a hole in the middle of the closed end
- stopwatch or view of wall clock

For each student

- 1 Student Sheet 1.1, "Considering Where to Store Nuclear Waste"

SAFETY

Be careful when handling the clay material. Do not inhale the clay dust or place the clay dust near your eyes. Wash your hands after completing the activity.

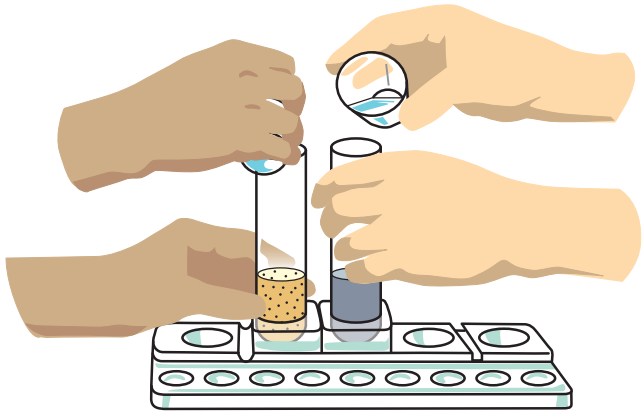
PROCEDURE

1. In your science notebook, make a data table like the one below. Make the spaces big enough to include drawings of the earth materials.

Observations of Clay and Sand

Tube containing	*Observations before adding water*	*Observations after adding water*

2. Examine the samples of clay and sand using the magnifying lens. Record your description of the size and shape of the particles for each sample in your data table.
3. Fill one of the graduated cups to the 30-mL mark with clay using the plastic spoon.
4. Carefully pour the clay into one of the clear plastic tubes. Hold your finger over the small hole in the bottom of the tube as you pour.
5. Fill the other graduated cup to the 30-mL mark with sand using the plastic spoon.
6. Carefully pour the sand into the other clear plastic tube. Hold your finger over the hole in the bottom as you pour.
7. Place the bottom of the tube of sand in a tube holder. Place the tube and tube holder with the open end up over the large cup B in the SEPUP tray. Place the bottom of the tube of clay in the other tube holder. Place the tube and tube holder with the open end up over the large cup C in the SEPUP tray.
8. Add 15 mL of water to each of the graduated cups.
9. Note the time (or start the stopwatch) as you and your partner simultaneously add water to each tube as shown below. Make sure to pour the water slowly and carefully.



10. For the next 5 minutes (min), observe what happens to the water in each tube. Record your observations in the final column of your data table.

11. Discuss the similarities and differences in your observations for clay and sand before and after adding the water.
12. Follow your teacher's directions for cleanup.

ANALYSIS

1. **Sediments** are parts of rocks, shells, and dead organisms that have been worn down into small pieces, mostly by the effects of water. The earth materials you used in the activity—sand and clay—are sediments. Sediments settle on top of each other. The layers they form are pressed and glued together. Over long periods of time, these layers of hardened sediment form **sedimentary rock.**
   a. What do you think happens when water flows from Earth's surface into a shale rock layer, which is made of clay sediments?
   b. What do you think happens when water flows from Earth's surface into a sandstone rock layer, which is made of sand sediments?
2. An **aquifer** is a rock layer that allows groundwater to flow through it. An **aquitard** is a rock layer that restricts the flow of groundwater.
   a. Draw a diagram to show how you would use the materials from this activity (clay, sand, water, and a plastic tube) to build a model of an aquifer.
   b. How would your placement of the earth materials in the tube allow water to flow and collect in an aquifer?
   c. Which earth material would be considered an aquitard?
3. The world's aquifers store much more freshwater underground than is stored in all the lakes and rivers on Earth's surface. Aquifers are sources of drinking water for many people. Add the consideration "location of aquifers" in a new row on Student Sheet 1.1, "Considering Where to Store Nuclear Waste." In the second column, write the recommended action you would take in regard to this consideration. Explain why you recommend taking this action when deciding where to store nuclear waste.

EXTENSION 1

Use the earth materials, water, and a plastic tube to build the model of an aquifer you drew in Analysis item 2. Describe what you did and what happened.