

Soil/Water Challenge

Overview

In this one-day activity, students apply what they know about soil components to design a soil column that allows water to move through it at a specified rate.

North Carolina Essential Science Standards

- 6.E.2.4 Conclude that the good health of humans requires: monitoring the lithosphere, maintaining soil quality and stewardship.

Background

Particles of rocks, minerals, and organic matter make up soil. The sizes of rock and mineral particles in a soil determine many of its characteristics. Rock particles more than 2 mm across are gravel. Rock particles from 2.0-0.05 mm across are sand. Particles 0.05-0.002 mm across are silt. Clay particles are smaller than 0.002 mm across. Larger particles have more space between them, and allow water to pass through more easily. Small particles such as silt and clay, with less space between them, hold water. The rate that water passes through soil depends on the balance of large and small spaces in that soil.

Materials

Materials for the whole class

- * several buckets or dishpans into which students can dump water as they experiment with different soil mixtures and clean tubes.

Materials for groups of 4 (students will work in pairs)

- gravel, sand, and clay and a scoop for each
- plastic tubes (tubes will need to be cleaned out and reused for all classes)
- 9 oz cup of water
- 2 droppers
- 2 timers
- 2 hand lenses
- 2 rulers
- 2 pieces of paper*

Materials for individual students

- *science notebooks

*Materials supplied by teacher

Preparation

1. Prepare the soil components, scoops, and cups of water for distribution.
2. Have 3 tubes ready for demonstration, one each of gravel, sand, and clay. Be sure the tubes are filled 3 inches deep (the surface of the soil should be 3

inches from the bottom of the tube). Have a dropper full of water and a timer ready.

3. Set up several stations with dishpans or buckets into which students can dump water as they experiment with different soil mixtures and clean tubes.
4. Before this activity, ask students to read text about soil and soil components.

Procedure

1. Set up teams of 4 at a table, made up of 2 pairs. Pairs are to work together and share gravel, sand, and clay. Also give out scoops for each material, hand lenses, a cup of water, droppers, rulers, and timers.
2. Ask students to place a small amount of each soil component on a piece of paper and observe it with a hand lens. Also ask students to touch each component. Have students describe in writing each of the three soil components, including what it feels like.
3. Ask what happens to water that falls on the ground when it rains. Students will generate many different answers. If one includes water running into the soil, ask where the water goes in the soil. Try to bring out the idea that there would have to be spaces in the soil for the water to go into.
4. Hold up a tube of gravel and ask what will happen to the water when you squeeze a dropper full into the tube. Ask them how long they think it will take for the water to reach the bottom of the tube.
5. Squeeze the water into the tube of gravel for all to see. Discuss results and ask for predictions of what would happen with sand or clay in the tube.
6. Repeat the same procedure with sand and clay and compare results among the 3 substances.
7. **Challenge:** Each pair of students will receive all 3 soil components and a tube. Their challenge is to manipulate the soil mixture in the tube so that water reaches the bottom exactly 30 seconds after it is placed at the top of the tube. The tube must be filled to 3 inches from the bottom. Time begins when the first drop of water hits the soil and ends when the first drop of water reaches the bottom of the tube. Students may:
 - use any soil component or combination of soil components in the tube,
 - use any amount of water, a little or a lot, but they must drop it in with the dropper,
 - apply the water from the dropper however quickly or slowly they want.
8. Explain that each pair must record each trial in their notebooks with
 - an accurate description of the soil components in the tube,
 - a description of how they added the water,

- the time it took the water from the time they added it until it reached the bottom.
9. When students succeed, challenge them to repeat their results.
 10. Have students clean and rinse all tubes for reuse. Tubes with clay that are too difficult to clean may be discarded. Extra tubes included in the kit are to replace clay tubes that might be discarded. Do not flush gravel, sand, or clay down the drain.

Reflection/Discussion

- A farmer is considering buying land to grow corn. If rain immediately sinks below the surface of this land, the roots of his corn will be dry a few hours after the rain falls. On the other hand, if rain pools at the surface, the roots remain wet and rot. Discuss with the class: what mixture of soil types is the farmer looking for?
- Land far from towns cannot be served by a town's sewer system. To build homes there, people use a system that treats sewage in a tank. The system then disperses wastewater just below the surface of the ground. If the soil is the right type, water sinks into the earth. If it is the wrong type, water rises to the top in rainy weather, causing a health hazard. Discuss with the class: what mixture of soil types should a homebuilder look for?