Analyzing Soil Types

SUBJECT: Science

GRADES: 4

ACTIVITY SUMMARY: Students will compare the properties of different soil types including texture, particle size, and the amount of time it takes for water to move through the different soil types.

DURATION: Approximately two 60-minute periods

OBJECTIVES:
Students will be able to:

1. Compare differences in various soil types.
2. Observe how water travels through soil and becomes groundwater.
3. Analyze how filtration rates change with different soil types.

TEKS ADDRESSED:

4th grade:
1A-demonstrate safe practices and the use of safety equipment as described in the Texas Safety Standards during classroom and outdoor investigations.
2B-collect and record data by observing and measuring using the metric system, and using descriptive words and numerals such as labeled drawings, writing and concept maps.
2D-analyze data and interpret patterns to construct reasonable explanations from data that can be observed and measured.
2E-perform repeated investigations to increase the reliability of results.
2F-communicate valid oral and written results supported by data.
4A-collect, record and analyze information using tools including…hand lenses, graduated cylinders, and timing devices including clocks and stopwatches.
7A-examine properties of soils, including color and texture, capacity to retain water, and ability to support growth of plants.

NATIONAL SCIENCE STANDARDS:

Content Standard D: Earth and Space Science
Grades K-4
Properties of Earth Materials

- Soils have properties of color and texture, capacity to retain water, and the ability to support the growth of many kinds of plants, including those in our food supply.

MATERIALS REQUIRED: (per group)
4 large paper/plastic cups; 2 cups each of gravel, sand, topsoil, clay soil; shallow pan, food coloring, magnifying lens, quart jar of water, stopwatch, container of extra water or access to sink, measuring cup, graduated cylinder

BACKGROUND:
The rate that water moves through soil is important to plant growth. If water moves through soil too fast, it drains away before plants can use it. If seepage into the soil is too slow, water will run off down the hill before it has time to soak in, adding to erosion and leaving some plants without water. Soil seepage is largely determined by the texture or size of the soil particles since there is a relationship between the size of the soil particles and their ability to retain water. Sand does not hold water very well and therefore has a high filtration rate. Clay holds water very well and therefore has a slower filtration rate.

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Original lesson found at www.nps.gov/wica. This version modified by Natural Bridge Caverns.

PROCEDURE:

1. Discuss what types of earth materials make up the natural world. Discuss various rock and soil types (examples include sand, silt, clay, loam, gravel, limestone, sandstone, and granite).
2. Students should examine each soil type. They should rub a pinch between their fingers. What do they feel like? What do they smell like? Students should examine each soil type with a hand lens. Which has the largest particle size? Which has the smallest? Students should record their observations for each soil type in Data Table 1 on the handout.
3. Have students hypothesize about which soil type would hold more water between the particles. Have them predict which of the soil types would be the fastest and slowest for the water to travel through.
4. Punch 4 small holes in each of the plastic cups and fill each cup with one type of soil material.
5. Place about 4 drops of food coloring in the quart jar of water. Place ½ cup of colored water into the measuring cup.
6. Have one student get ready with a stopwatch to time the procedure. Hold one of the cups over the pan and pour ¼ cup of the colored water into the cup. Time how long it takes the first colored water to reach the pan (the pan represents the water table) and record the results in Data Table 2.
7. Measure the amount of water that collected in the pan using a graduated cylinder. Record this information in Data Table 3. Obtain a new sample of the same soil type and repeat this step once more for trial 2. Average the results for trials 1 and 2.
8. Repeat step 6 and 7 for all soil types.
9. Have students fill in the remaining column in Data Table 1 (ability to retain water) based on their observations in steps 6-7. Students can classify the ability to retain water as poor, fair, or excellent. Students should take into account both the amount of water retained and the time it took for the water to move through the soil sample.

Name: _____

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Background Information:
The rate that water moves through soil is important to plant growth. If water moves through soil too fast, it drains away before plants can use it. If seepage into the soil is too slow, water will run off down the hill before it has time to soak in, adding to erosion and leaving some plants without water. Soil seepage is largely determined by the texture or size of the soil particles since there is a relationship between the size of the soil particles and their ability to retain water. In this activity, you will analyze this relationship.

Procedure:

1. Examine each soil type. Rub a pinch between your fingers. What does the soil feel like? What does the soil smell like? Which has the largest particle size? Which has the smallest? Record your observations for each type in Data Table 1. Don't worry about the column labeled "Ability to retain water" for now. You will fill that in later.
2. Hypothesize about which soil type would hold more water between the particles. Predict which of the soil types will be the fastest and slowest for the water to travel through.
    - Which soil type would hold more water between the particles? _____
    - Which soil type would water travel through the fastest? _____
    - Which soil type would water travel through the slowest? _____
3. Punch 4 small holes in each of the cups and fill each with one type of soil material.
4. Place about 4 drops of food coloring in a quart jar of water. Place ½ cup of colored water into the measuring cup.
5. One member of the group will need to be ready with the stopwatch to time the procedure. Hold one of the cups over the pan and pour ¼ cup of the colored water into the soil. Time how long it takes the first colored water to reach the pan (the pan represents the water table) and record the results in Data Table 2.
6. Measure the amount of water that collected in the pan using a graduated cylinder. Record this information in Data Table 3. Obtain a new sample of the same soil type and repeat this step once more for trial 2. Average the results for trials 1 and 2.
7. Repeat steps 5 and 6 for all soil types.
8. Taking into account both the amount of water retained and the time it took for the water to move through the sample, rate the ability of each soil type to retain water as poor, fair, or excellent. Fill in the remaining column in Data Table 1.
9. Answer the analysis questions.

Data Table 1

Soil Type	Relative particle size	Texture	Ability to retain water
Gravel			
Sand			
Clay			
Topsoil			

Data Table 2

Soil Type	Time (sec) Trial 1	Time (sec) Trial 2	Average
Gravel			
Sand			
Topsoil			
Clay soil			

Data Table 3

Soil Type	Amount of water (mL) Trial 1	Amount of water (mL) Trial 2	Average
Gravel			
Sand			
Topsoil			
Clay soil			

EVALUATION: Students can be evaluated through their answers to the Analysis Questions.

Analysis Questions

1. Which soil type took the longest for water to flow through?

2. Which type of soil returned the most water to the pan? Why do you think that is?

3. What would happen to the amount of time it took the water to reach the water table if it were to come across a cave?

4. Do you think that the soil layers could clean the water? If so, how?

5. Which soil type would be the most efficient at cleaning water?

6. What events at the surface could cause the water to need to be cleaned?