Analyzing Soil Types

SUBJECT: Science
GRADE: 4
DURATION: Approximately two 60-minute periods
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.

OBJECTIVES:
Students will be able to:

1. Examine and analyze properties of various soil types.

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.

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 for 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 is 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.

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

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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 without water. plants 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 for 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 is 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. Considering 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			
Top Soil			
Clay Soil			

Data Table 3

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

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?

3. Based on your observations of particle size and texture, why did _____ return the most water to the pan?

4. 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?

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

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

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

8. Were your hypotheses correct? Explain why or why not.

TEKS ADDRESSED:

4th Grade

1(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations

1(B) use scientific practices to plan and conduct descriptive investigations and use engineering practices to design solutions to problems

1(C) demonstrate safe practices and the use of safety equipment during classroom and field investigations as outlined in Texas Education Agency-approved safety standards

1(D) use tools, including hand lenses; metric rulers; Celsius thermometers; calculators; laser pointers; mirrors; digital scales; balances; graduated cylinders; beakers; hot plates; metersticks; magnets; notebooks; timing devices; sieves; materials for building circuits materials to support observation of habitats of organisms such as terrariums, aquariums, and collecting nets; and materials to support digital data collection such as computers, tablets, and cameras, to observe, measure, test, and analyze information

1(E) collect observations and measurements as evidence

1(F) construct appropriate graphic organizers used to collect data, including tables, bar graphs, line graphs, tree maps, concept maps, Venn diagrams, flow charts or sequence maps, and input-output tables that show cause and effect

1(G) develop and use models to represent phenomena, objects, and processes or design a prototype for a solution to a problem

2(A) identify advantages and limitations of models such as their size, scale, properties, and materials

2(B) analyze data by identifying any significant features, patterns, or sources of error

2(C) use mathematical calculations to compare patterns and relationships

3(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats

3(C) listen actively to others' explanations to identify relevant evidence and engage respectfully in scientific discussion

5(A) identify and use patterns to explain scientific phenomena or to design solutions

5(B) identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems

5(C) use scale, proportion, and quantity to describe, compare, or model different systems

10(B) model and describe slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice

11(C) determine the physical properties of rocks that allow Earth's natural resources to be stored there.