Where Does the Water Go?

Part I - Permeability

Objectives

1. The student will observe that different types of soils vary in their ability to hold water.
2. The student will determine how water holding capacity influences plant growth.

Grade Level	1-3	4-6
TEKS:	S- 1.10B; 2.10A,B; 3.11B	S- 4.11A

TAKS:	GRADE	OBJECTIVES
Reading:	3, 4, 5, 6	1, 4
Writing:	4	1, 2, 3, 4, 5, 6
Science:	5	1, 2, 3, 4
Math:	4	1, 2, 3, 4

Assessment Summary:

Materials:

1. Sample of each of the following; Clay soil, sand, potting soil. (Assistance can be obtained from local Natural Resources Conservation Service office, extension agent or high school ag science teacher.)
2. Newspaper
3. Three clear plastic cups with holes in the bottom (use small nail or small drill).
4. Three pint or quart jars
5. Soil Permeability worksheet
6. Water
7. Measuring cup
8. Paper towels
9. Stop watch or watch with second hand

Assessment:

Teacher observation, completion of chart, and discussion appropriate to grade level.

Background Information:

Where Does the Water Go? Part I
Permeability

Rate of water movement through the soil, or permeability, is important. If water moves through soil too fast, it drains away before plants can use it. On the other hand, if movement is too slow, water will run off downhill before it has time to soak into the soil, thus leaving plants without any water again.

Although many factors are taken into consideration, soil permeability is usually determined by soil texture (the size of soil particles). Soil requires both water and oxygen (air) to support strong plant growth. Water and oxygen are found in the pore spaces between soil particles. The ideal soil is a combination of sand, silt and clay. Sand provides fast drainage and good aeration (high permeability), but does not hold water very well. Clay is good for its water holding ability, but dangerously low in supplying air to the soil (low permeability). As water fills the spaces between soil particles, it drives out air. In soils with a high proportion of clay, water remains a long time in the pore spaces and the roots are deprived of oxygen for many hours. With some plants, this temporary lack of oxygen is very damaging. Thus it is easy to drown plants in a clay soil.

Soil particles attract water molecules. This allows water to move in all directions in the soil, even upward, against the force of gravity. This movement is called capillary action.

Capillary action is important to plant growth because it makes water available to the plant roots even after the top of the soil has dried after a rain.

After a rain gravity pulls the water downward, often past the depth plant roots have grown. The soil particles attract water molecules and pull them upward so that water is available to be used by the plant roots. The size of soil particles determines how quickly, and how far water will be pulled upward. In sandy soils, which have larger particles and larger pore spaces, capillary action will be rapid, but water will not move as far. In soils with smaller particles and smaller pores spaces, movement of water will be slower, but will be pulled higher than in sandy soils. This is one reason sandy soils dry out quickly. Plants grown in sandy soils need water more regularly than those grown in clay or loamy soils.

Where Does the Water Go?

Permeability

Lesson Plan

1. Introduce new vocabulary:

Grades 1-3	Grades 4-6
Drain	Permeability
Particles	Aeration
Oxygen	Capillary action

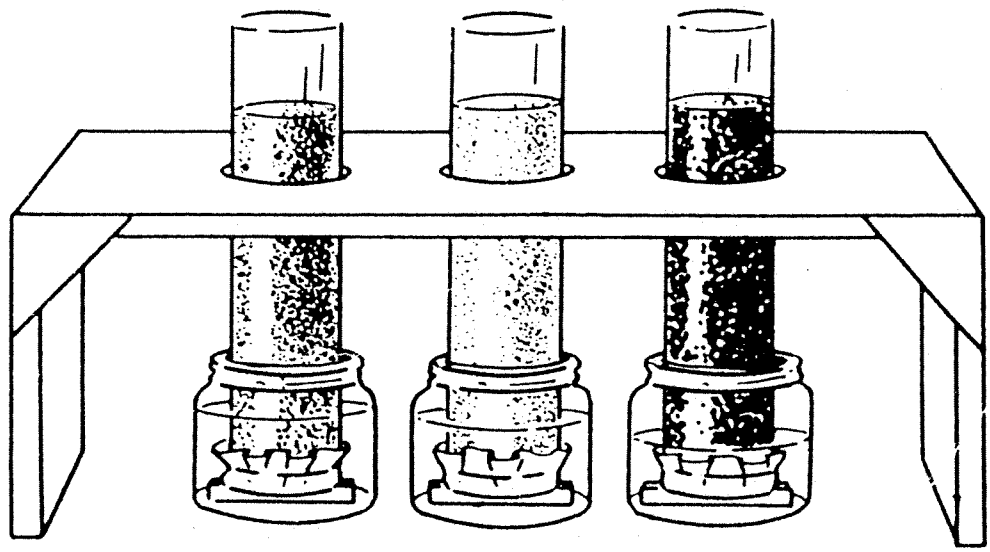
2. Spread each sample of soil (clay, sand, loam) separately on a newspaper and leave them until all feel dry to the touch. Two or three days should be long enough if you stir the soil occasionally. Sift the soil samples to be used in class.
3. With a hot nail, or small electric drill make five small holes in the bottom of each plastic cup.
4. Cut a circle of paper towel to fit the bottom to each cup. Put these inside the cups to keep the soil from dropping through the holes.
5. Fill each cup one-third full of soil. Pack clay soil in one, sandy soil in the second, and potting soil in the third.
6. Place the cups over the open canning jars.
7. Using a measuring cup, pour ½ cup of water over the soil in each cup. Using a stop watch or second hand measure the time it takes for water to run out the bottom of the cup. Use additional measured amounts of water if needed. Record the information on the chart.
8. Discuss the permeability results with the students, using the questions found after the chart.

Additional Activity – Capillary Action:

Water also moves upward through the soil. This is called capillary action. Demonstrate this in the following way.

1. Cut the bottom out of a plastic cup and cover the opening with cloth, using a rubber band to hold it on.
2. Fill the cup 3/4 full of dry soil.
3. Fill a pie pan or similar container with water.
4. Hold the cup so that the cloth covered end is just under the water.
5. Observe how moisture moves upward through the soil.

6. Ask the students which is stronger: gravity or capillary action? (Capillary action is stronger because the water moves upward against the force of gravity.)
7. Explain that capillary action is important because in dry weather plant roots must be able to pull water upward when the soil above the roots drys out.
8. Test different types of soil for capillary action: try pure sand, and other soils the students bring in.
9. In which type of soil does water move upward most rapidly?
10. In which soil does water move the highest?
11. Where else is capillary action important? (In the human body. Our bodies contain capillaries, or small blood vessels, that move blood upward, against the flow of gravity.)
12. Have students research and write a descriptive paper about capillary action and its importance.



Capillary Action Demonstration

Soil Permeability

Record how quickly water moves through different soils.

	Clay Soil	Sandy Soil	Potting Soil
Seconds before water begins to drip			
Seconds before water stops dripping			
Quantity of water that came through			

Discuss your results by answering the following questions.

2. Which soil did the water enter most quickly?

3. Which soil did the water pass through most rapidly? Most slowly?

4. Which soil held the most water?

5. What do you think would happen to plants growing in each soil in a very dry summer? In a wet summer?

6. Which soil would you want to plant a crop in? Why?

7. Which soil would you not want to plant a crop in? Why?

8. Which soil would you not want to have your crop planted during a drought?