Activity 32: The Percolation Rate of a Soil

Maine Geological Survey

Objectives:

To show how particle size and soil texture control water flow through a soil.

Time:

Demonstration: start in a given class period, follow up the next day. Activity: two days unless you have a soil percolation column for each student; clean-up for 10-15 minutes the day after all tests have been run.

Background:

Infiltration (the rate at which water enters a soil) and percolation (the rate at which water moves through a soil) are key factors in determining the value of a soil as a crop soil. These two factors influence the formation of natural wildlife habitats, and the nature and speed of flooding in a given area. Additionally they need to be considered in decisions affecting the conservation of water supplies.

As the particle size of a soil becomes smaller, the collective surface area of the particles becomes greater. Water moves more slowly through the material due to both hydrostatic adsorption onto the surfaces of particles and the decreasing size of the pores through which the water flows. Many clay-rich soils percolate very little water, leaving it on the surface to evaporate. This can be a serious problem in areas where septic systems and leach fields must be constructed. Clay-rich soils tend to send more water into runoff channels and thus transfer more rainfall into streams and rivers than

the more sandy soils. Thus areas with clay-rich soils flood more easily than areas with sandy soils.

Materials:

Each pair of students will need:

- At least one soil percolation column (The 4-foot plastic tubes sold as fluorescent light bulb protectors work well. Available at hardware stores.)
- A sample of soil from each student's garden or lawn
- 250 ml beaker, 600 ml beaker, and 50 ml graduated cylinder
- A ring stand and single jaw spring buret clamp
- Access to calculators, water, pens, and notebooks

Demonstration materials - using the three separated soil fractions, sand, silt, and clay, (from Activity #31, Determining a Soil's Textural Classification) set up three demonstration tubes in a prior class period. Place 300 ml of each one of the soil fractions in a different tube and have three students add 400 ml of water, simultaneously, to each tube. Place beakers beneath the three tube spouts and release spout clamps. Compare the rates of percolation at the end of the period or the next day.

Procedure:

Have each student pair measure out 250 ml of one of their soil samples and place the soil in a percolation column. Do NOT compact the soil. Clamp the column securely to the ring stand and place the assembly on the floor. Add 400 ml of water to the column and place the column back on the counter. Place the collection beaker under the spigot and remove the small clamp from the spigot. Have students record the starting time, the volume recovered, and the stopping time for the sample. The stopping time is when no more water has dripped out of the spigot in a three minute time interval. Depending upon the soil type, it may take many hours, even overnight, for any appreciable amount of water to travel through the soil. Some soils may need to be checked at the end of the day, and even the next day. Have students clean out the tubes and repeat the procedure for the student sample not tested in the first trial. Rinse the mud and water into a five

gallon plastic bucket and discard outside. This material can cause problems in sink drains and pipes. Have students perform the calculations and answer the questions.

Follow-Up:

Have a registered soil scientist speak to the group on percolation tests and rates; have this person describe the reasons behind leach field construction and some of the modern technology and products involved.

Have students add the percolation rate for their soil to the list of facts that they are developing about their soil sample. Use this list as a basis for an oral report to the class or as an essay question on a test.

References:

Activity developed by Duane Leavitt.

Name_____

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Student Sheet

Purpose:

To determine the rate at which water passes through your soil sample. This rate is called the percolation rate and is important in farming, gardening, and leach field construction.

Materials:

You will need at least one soil percolation column, two columns if you and your partner are going to test each of your soil samples simultaneously. You will also need a soil sample from your garden, a 250 ml beaker, a 650 ml beaker, a 50 ml graduated cylinder, a ringstand, a single jaw spring buret clamp, water, pens, calculator, and notebook.

PROCEDURE:

Measure 250 ml of your soil and place it in the percolation column. **DO NOT** compact the soil in the column. Clamp the column to the ring stand using the buret clamp and place this assembly on the floor. Using the 650 ml beaker, add 400 ml of water to the percolation column. Place the assembly on the counter and align the plastic spout so that it drains into the 600 ml beaker. Record the time in Table 1.

Let the water drain through your soil into the collection beaker. After a three minute interval without dripping, assume that percolation has ceased and record the time.

Using the 50 ml graduated cylinder, determine the exact amount of water that has passed through the soil. Record this volume.

Start Time	Stop Time	Volume of Water Recovered (ml)

CALCULATIONS: (SHOW YOUR WORK!!!)

1. Stopping time - Starting time = Duration (minutes)

2. Duration (minutes) / 60 minutes/hour = Duration (hours)

3. Volume recovered (ml) / 3785 ml/gallon = Volume recovered (gallons)

4. Volume recovered (gallons) / Duration (hours) = Gallons/hour

5. Obtain all the percolation rates for the samples tested by your class and find the following - fastest rate, slowest rate, and average rate. Record these.

   Fastest percolation rate: _____

   Average percolation rate: _____

   Slowest percolation rate: _____

Dispose of the materials in the percolation column as directed by your teacher; **DO NOT LOSE THE SMALL PIECE OF WIRE SCREEN THAT FITS INTO THE PLASTIC SPOUT**. Clean and dry the column before it is used again.

Questions:

1. What type(s) of soil did the students with the fastest rate of percolation have?

2. What type(s) of soils did the students with the slowest rate of percolation have?

3. Describe and explain the relationship between percolation rate and soil based on the data in questions #1 and #2 above.

4. How does the average rate value compare to the extremes?

5. On a macroscopic scale, how would you increase the rate of a poorly draining soil? How would you decrease the rate of a too rapidly draining soil? Refer to soil textures.