WATER INFILTRATION – Teacher's Guide

DESCRIPTION:

Students collect data on infiltration rate (the rate that water soaks into the ground) and hypothesize about the relationship between infiltration rate, soil composition, soil compaction, and vegetation found at the site.

GRADE LEVEL(S):

8th

OBJECTIVES: Students will:

- Record and graph infiltration rates
- Draw conclusions about infiltration

NEXT GENERATION SCIENCE STANDARDS:

This activity supports the following Performance Expectation:

MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Analyzing and Interpreting Data	ESS2.C The Roles of Water in Earth's Surface Processes	Cause and Effect

COMMON CORE STATE STANDARDS:

English Language Arts

RST.6-8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Mathematics

MP.2. Reason abstractly and quantitatively.

8.EE.5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.

MATERIALS:

- Water Infiltration Student Handout [1 per group]
- Washcloth [1 per group]
- 100 ml graduated cylinder [1 per group]
- Water bottle [1 per group]
- Permanent marker [1 per group]
- Metal cylinder [1 per group]
- Ruler [1 per group]
- Stopwatch or timer [1 per group]

- Colored pencils [1 set per group]

BACKGROUND:

Infiltration rate is the rate that water moves into and through the soil; it is sometimes referred to as the percolation rate. A high infiltration rate will allow water to move *into* the soil quickly, but it will also quickly move through it. Sand and gravel, with larger pore spaces between particles, allow water to pass through quickly. Clay, with much smaller pore spaces, has a slower infiltration rate. Infiltration rates are also slow in compacted soils because pore space is decreased. When water does not soak into the soil quickly, it creates surface runoff and/or puddles (exposing it to rapid evaporation in the desert sun). Infiltration rates have significant effects on plant survival and growth.

TIPS FOR ENTIRE CLASS PARTICIPATION:

- Break students into six groups.
  - Two groups will run the experiment at location #1.
  - Two groups will run the experiment at location #2.
  - Two groups will run the experiment at location #3.

PROCEDURES:

1) Explain the background, as needed, to the class.

2) Have students hypothesize which three locations might have different water infiltration rates (e.g., in the base path of the baseball field, in a flower bed near the building, and in an unused dirt area). Two groups will conduct the experiment at each of these three locations. Make sure the setups at each location are at least 1m from each other.

3) Pass out student handout packets and have students write down their own hypothesis about which area they believe will have the fastest, medium, and slowest infiltration rates.

4) Have students place a washcloth on the spot to be measured. Slowly pour 750 ml of water onto the cloth and make sure water does not run out from the sides. This may take several minutes. This step pre-wets the soil and makes it easier to push the coffee can into the ground.

5) Mark a line at 3cm from one end of the metal cylinder. After the water has all soaked in (i.e., it is not glistening anymore), remove the washcloth and carefully push the metal cylinder into the soil 3 cm. Push directly down on the cylinder, not at an angle, as this can cause cracks in the soil that the water can flow through. Sometimes a slight twisting motion helps while doing this.

6) Fill a graduated cylinder with 100 ml of water.

7) The timer will tell the observers when to pour the 100 ml of water into the can as their teammate starts the stopwatch. The water should be poured in slowly to keep from eroding a hole under the side of the can. The observers will watch the water as it infiltrates into the soil. When the soil surface is no longer glistening, the observers will tell the timer to stop the stopwatch.

8) Students should record the number of seconds needed for all of the water to infiltrate into the soil on the "My Observations of Water Infiltration Data Sheet" (Fig. 1).

9) Have students work with their classmates to fill in the "Class Average Table" (Fig. 1) with all of the infiltration times. Calculate the average infiltration time for each of the three locations.

10) Divide 100 ml of water by the average number of seconds needed for the infiltration. This is the Infiltration Speed (in milliliters per second).

11) Graph the infiltration speed at each site on the "Water Infiltration Graph" (Fig. 2).

My Observations of Water Infiltration Data Sheet

Date: September 13, 2005 Time: 10:15 am

Location: Flower bed in front of school

Infiltration Time: 24 seconds

Class Average Table

Location	1st group's infiltration time (seconds)	2nd group's infiltration time (seconds)	Average infiltration time (seconds)	Infiltration speed (100 ml / average infiltration time)
Flower bed in front of school	21	24	22.5	4.4 ml/second
Under swing at west end of swing set	78	78	78	1.3 ml/second
South side of flag pole	33	35	34	2.9 ml/second

Figure 1. Example My Observations of Water Infiltration Data Sheet

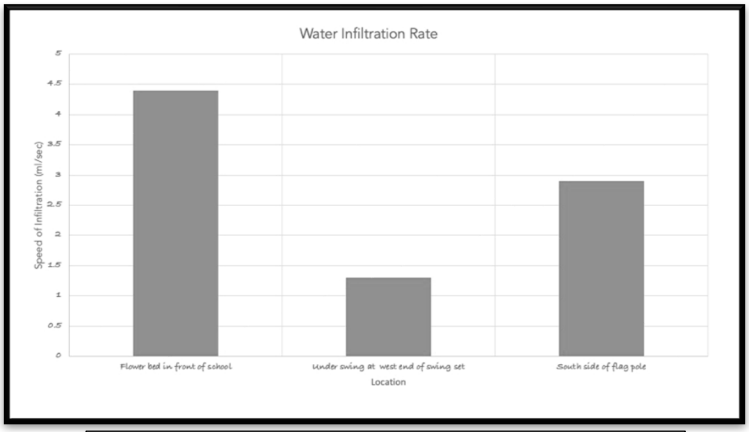


Figure 2. Example Graph of Water Infiltration Rate

CONCLUSIONS:

Allow students to draw conclusions from the graphs. Students should answer the following:

- How does the infiltration rate vary in different areas of the schoolyard?
- Does the soil type affect infiltration rates?
- How might the water infiltration rate affect the kinds of plants that can grow in each area?
- Are there other explanations for your data? What other factors might affect infiltration rates?