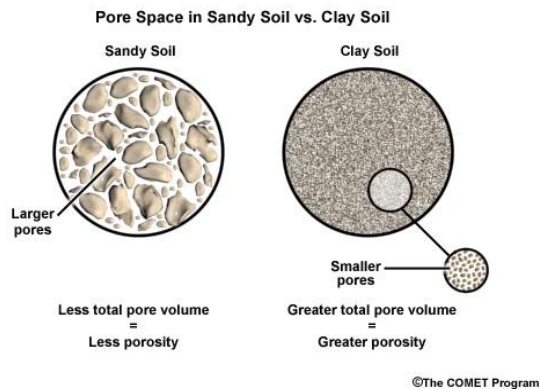


### Background

In this investigation, students further explore soil properties, particularly the relationship between particle size and percolation. They also are introduced to the word, *loam*. This investigation provides valuable information if your class is planning a natural stormwater solution, particularly a rain garden. It will help students understand why an area with clay soil drains poorly and would be inappropriate for a rain garden unless the soil is replaced. Understanding how and why different soils have different water-retention or percolation properties can also help students grasp the importance of using native plants that are suited for specific soils and drainage conditions.



### Standards:

#### Next Generation Science

**Standards:** MS-ESS3-3, HS-ESS3-2, HS-ESS3-3, HS-ESS3-4.

**Skills Exercised:** the scientific method; data collection; math (averaging, determining rates); critical thinking (drawing conclusions from data); teamwork; communication skills; experiment set-up.

**Grades:** 9-12; can be adjusted by teachers for lower grades and different skill levels.

**Time:** 60-90 minutes, if each team does 3 samples, the experiments, follow-up group summarization and clean-up.

### Teacher Instructions

This investigation is designed to be done by teams of 4-5 students and to include a class follow-up period for sharing and discussing the results. Teachers should review the *Student Soils Percolation* handout, which includes:

- The Lab Procedure
- Percolation Test Chart that guides predictions and observations
- Class Data Table
- Post-Lab Discussion Questions

Depending upon the time available, the teacher will decide whether each team will do one or all of the soil samples, and whether they will prepare the lab materials or just do the procedure. (*Instructions on lab setup are provided on a separate page, so that it can be done by the students, if desired.*) It is important that students understand that consistency in their methods is important and that each soil be tested by three teams or 3 times by each team for more reliable results.

It is recommended that teachers perform this lab ahead of time and make any necessary adjustments for their student populations.

Before the Lab, the teacher assigns teams and reviews the student instructions with the students. Each team will have “jobs” (Reader, Timer, Measurer, Pourer, Data Recorder). Demonstrating the lab to is effective. Students might need help in positioning the clay so that it does not leak on the bottle edges.

Students should complete the Pre-Lab predictions by answering the **A** lettered questions in the shaded areas of the **Percolation Test Chart**. As the students perform the experiment, they will complete the **B**-lettered questions.

After the experiment, the class completes a **Class Data Table**. The students average their results and determine the rate of percolation (ml/sec). If there are outliers in their data, they should discuss possible reasons. The completed table provides the basis for answering the **Post-Lab Discussion Questions in the student worksheet**, which can be done as a class, in teams, or individually.

#### Materials for Entire Class:

- Empty clear 2-liter soda bottles cut as described (one bottle per soil sample)
- Soil samples: dry sand, moist clay, dried loam, dried school soil
  - The clay needs to be moist to be handled; if teachers want the soil samples to be the same (having less variables), moist samples can be used.
  - The results will differ if lumpy loam or school soil is used, because there are usually larger pores between aggregates. For this inquiry, it is best to break up the lumps.
  - Students could compare these variables within one soil sample, as a further investigation.
- Small mesh window screen
- Containers to hold dry and wet soil samples, one for each soil type
- Containers or baggies to hold used soil samples, one for each soil type
- Timers (1 per group)
- Measuring cups or beakers (1 per group)
- Water (500 mL per test)

#### Materials for each team of 4-5 students:

- Water
- 1 Timer
- 1 Measuring cup or beaker
- 1 clear 2-liter bottle top for *each* soil sample
- 1 clear 2-liter bottle bottom or similar container for *each* soil sample
- 1 piece of window screen for *each* soil sample
- Soil samples: sand, clay, school soil, and loam or silt, if available.
- Container for bottle tops holding wet soil

#### Clean Up:

1. Put used water in a bucket and dump outside, not in the sink.
2. Collect the used soil samples in specified containers, one for each soil type. They can be left out to dry and be reused. Mold will grow, if they are stored wet. The clay needs to be sealed in air-tight containers or bags after excess water has been removed.

### Additional Resources:

**Grades 10-12:** [Water Movement in Soil](#), USDA Natural Resources Conservation Service. Best seen after the presentation and investigation. Provides more detail on soil texture, water movement factors, land-use connections; graphics demonstrate water movement.

<https://www.youtube.com/watch?v=vmo0FRAVgkM&feature=youtu.be>

**Lab Preparation:**

1. Empty, rinse, and remove labels from bottles.
2. Cut the window screen into 5x5 inch circles (**Figure 1**).
3. Cut the 2-liter bottles approximately 6 inches from the bottom of the container (**Figure 2**).
4. The top of the bottle will be inverted into the bottom of the bottle. The window screen will be placed into the top of the bottle, covering the opening. *Note: the window screen needs to be placed tightly so that the soil will not fall through.* (**Figure 3**).

