



Soil Percolation: Where Does the Rain Go? - Teacher Guide

Setting the Stage

This demonstration or activity provides an opportunity for students to conduct an experiment that reinforces one component of the water cycle. It can also be used as a review or a segue to a unit on landforms in that any water that does not infiltrate can then act as an erosive force on the landscape.



Soil Horizon. Photo credit: kisforkateatkins

Lesson Overview

- *Part 1 – Engagement (15 minutes) Water movement in the water cycle*

Students review the water cycle and are challenged to consider what happens to precipitation when it hits the surface.

- *Part 2 – Exploration (30 minutes) Water movement through Earth materials*

Students collect and analyze data to model the movement of water through different Earth materials.



Instructional Overview	
Grade Level	Upper Elementary (grades 3-5)
Instructional Time	45 minutes (<i>total time needed</i>)
NGSS Standards Alignment	Building proficiency towards the following: 4-ESS2 and 5-ESS2 Earth's Systems
Driving Question(s)	• What happens to water/precipitation when it strikes the Earth's surface? • What are the implications of the speed at which water infiltrates the Earth's surface?
Learning Goals	• Students will connect the flow of water in the water cycle to the types of Earth materials. • Students will be able to collect and analyze data that model a component of the water cycle and apply their results to the effects of the water cycle on the Earth's surface.
Materials	Materials for each group of 4 students: ☐ 3 plastic cups with holes poked into the bottom (cups should be big enough to hold 1 cup of material) ☐ 1 plastic cup without holes ☐ 1 cup of potting soil ☐ 1 cup of clay (bone meal but any finely textured material will do) ☐ 1 cup of sand (play sand will do) ☐ 1 cup measuring cup or graduated cylinder ☐ Water ☐ Paper towels ☐ Stop watch ☐ Data table <i>Note: If this is performed as a teacher demonstration, one set of the above materials is all that is required.</i>
Material Preparation	☐ Poke holes in the bottom of the plastic cups in advance. An awl or a pocket knife is ideal, but any sharp object with a relatively fine point will work. ☐ Test what amount of water to use for your experiment. The exact amount will depend upon what you use for your clay/potting soil/sand. The



	amount of water should percolate all the way down to the paper towel under the cups with soil in them without profusely spilling out of the bottom (roughly an 1/8 cup of water). Safety Information: The clay material is very fine and could be an irritant if inhaled. The instructor should fill the cups with clay for the students.
Vocabulary	<u>Infiltration</u> is the process of water going from being on top of the ground (soil) to getting into the ground (soil). <u>Percolation</u> is the process of water moving deeper into the soil. <u>Runoff</u> is any precipitation that does not move through Earth materials (soil) after it hits the Earth's surface.

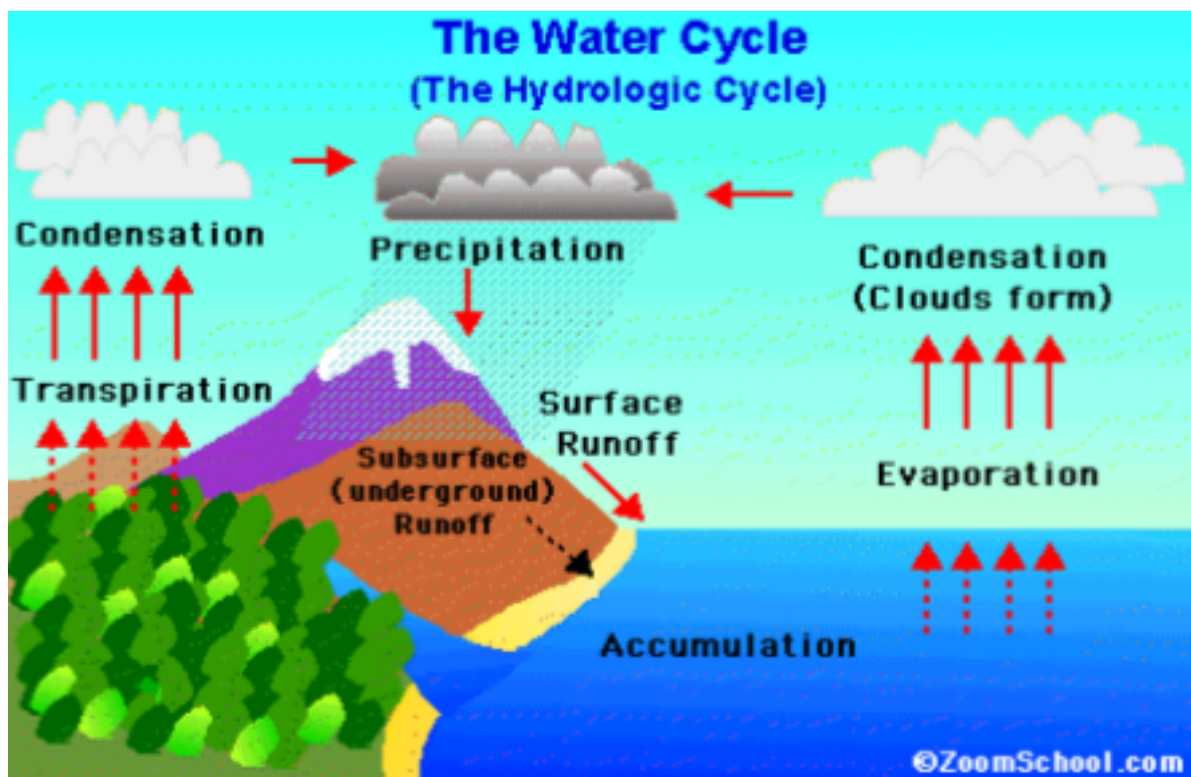


Background Information for the Teacher:

- Infiltration and percolation is generally a function of the size of the particles that make up the soil. Soil particle sizes can be thought of as on a continuum between clay (the smallest particles) and sand (the largest).
- Small particles pack more closely together, and therefore the space between particles is smaller. This slows down the rate at which water can infiltrate and percolate. Sand, with its larger size, has more space between particles and the water will move more quickly through it.
- Play sand, which can be used in this lab, actually contains a high proportion of smaller particles that would not be considered “sand” by an ecologist. Water, therefore, is slower to move through the play sand than it would through sand out in a natural setting.
- Potting soil, which can be used as a third medium through which the water percolates, contains high amounts of large organic matter bits. Because of this, water moves through it quickly.
- Compaction is the process by which soil is packed down. This happens when people walk repeatedly on an unpaved path (note that puddles form here more readily than on untrodden patches). Cows also do this in areas where they graze. Compaction will happen regardless of the size of the soil particles (clay or sand or anywhere in between).
- The amount of water that infiltrates and percolates has a direct impact on:
 - the amount of erosion in an area (lower infiltration means more water moving over the surface, which can then erode landscapes), and
 - the amount of water available to plants. Plants, of course, take up the water they need through their roots. If water does not infiltrate or percolate down to where the plants’ roots are, the plant cannot get to that water or use it.

Part 1 (Engage) Water movement in the water cycle (15 minutes)

Show students a picture of the water cycle and ask them to describe to a partner what happens to a drop of water as it travels through the water cycle. Ask one or two students to share their ideas. Challenge them to think about a drop that hits the surface near their home. If possible, take students outside and pour water on various surfaces while asking them to make observations of where the water is traveling to when it hits the ground. Ask them why there is a variation in what happens to the water on these different surfaces. They may mention that one surface is “hard” and another surface is “soft.” Tell them that they will have a chance to compare the movement of water on different surfaces.





Part 2 (Explore) Water movement through materials (30 minutes)

Note: This may be done as a demonstration or a student investigation.

Tell the students that they are going to investigate the movement of water in three materials to see if the kind of soil affects how water can travel through the material. They will test three (3) types of soil:

- Potting Soil
- Clay
- Sand

Show the students the three soil types. Ask them to formulate hypotheses that also include why they think so (e.g., “Which one will the water move the fastest/slowest through?”).

Have them construct a data table that looks like this:

	Clay	Potting Soil	Sand
Time (seconds)			



Ask students what they would do to test the materials so that they can compare the results later. Write all their ideas in a place where the class can see their ideas, and then, as a class, identify a set of steps that ensures that they can compare the data for the amount of time it takes for water to flow through the material. Here is a set of steps that they might use in small groups.

- Decide upon an amount of each soil type to be added to cups with holes in the bottom.
- This can be 1 cup as measured or up to a marking on the cups, provided all cups are the same. Identify (or have them identify) that we are controlling a variable (amount of soil) by doing this.
- Tell the students they are to fill cups with holes in the bottom with the agreed upon amount with sand; repeat this for potting soil.
- Place soil cups on top of a paper towel to absorb the water once it has percolated all the way through.
- They should then fill 1 plastic cup without holes in the bottom with $\frac{1}{8}$ C of water (or the amount of water you determined from your preparation).
- One student should practice using the stopwatch, and once that student is ready, another student should pour the water over one of the soil cups, carefully recording how long it takes the water to get from initial contact with the soil to the bottom of the cup and to the paper towel. Note: the clay can take a long time and may never reach the bottom. If a group starts with the clay, allow them to start on another soil type after they've waited on the clay for a while.
- Record their data in their data table.



After each group has collected their data, have them post their data on a class data table that may look like the one below. There should be one row for each team.

Time (seconds) for water to flow through the material

	Sand	Potting Soil	Clay
Group 1			
Group 2			
Group 3			
Group 4			
Average Time (sec)			

Once all have collected and recorded their data on the class data table, analyze the data together.

- Ask students why they may use the average data when comparing the different materials.
- Lead a discussion on the speed at which water moves through the materials while asking students to focus on the implications for the water cycle.
- Ask them what happens to the precipitation that falls on a surface that has a lot of clay. This is a good time to ensure they can use the terms infiltration, percolation, and runoff. Show them pictures (or ask them to find pictures) of erosion caused by runoff (a water cycle term).

To wrap this activity up, students should add what they learned from this investigation into their notebooks. They should incorporate the terms infiltration and runoff into their explanations.

If time remains, consider having students run the investigation again by varying a component of the investigation. However, ensure they have a reason to run the investigation. For example, they may be curious about how water flows through mixtures of the materials.