

Soil Water

Main Concept

When water touches the soil it either enters the soil or it runs off the top. If water enters the soil, the process is called infiltration, but if the water flows over the surface, it is called runoff. Soils that are less disturbed generally have more continuous pore spaces. Therefore, water infiltrates better in less disturbed soils than disturbed ones.

EDUCATIONAL GOALS

- Demonstrate that water infiltrates better in less disturbed soils.
- Demonstrate that more water runs off of soils that are more disturbed.
- Understand the importance of infiltration and how it can help provide water for plants to grow and prevent flooding.

Demonstration is suitable for Kindergarten through College. Activity is suitable for 5th - 8th Grade.

Materials & Preparation

- 2 pans of soil from two different management areas. (for example a field that has not been tilled in many years (no-till), a field that has been tilled every year, a lawn, a pasture, a forest, or a construction site.
- 2 plastic cups with holes in them to simulate rainfall
- 2 racks to hold the plastic cups above the soil
- 2 containers to capture runoff from the two pans
- 2 pieces of screen
- 2 metal racks or stiff screens to separate the soil pans from glass pans
- 2 glass pans to capture water that infiltrates through the soil
- 2 plastic cups
- 1 tack
- 1 measuring cup to measure the amount of water that passes through the soil.

Background Information

Water easily enters soils that have large holes to the surface. Many holes in the soil are made by worms and other critters in search of food or shelter in the soil. Undisturbed soils consisting of leaf litter, dead plant matter, and other organic components provide food for worms, thereby increasing the worms' productivity. Certain fungi create a soil glue called glomalin which helps hold the worm holes open. Soils that have been disturbed generally lack the soil glues necessary to hold the particles together. As a result, when it rains the soil particles fall apart into a mud which forms a crust on the surface and plugs the holes. Water does not infiltrate as easily through the crust, so much of the rainfall runs off.

Explanation

Soil from a lawn, an orchard, or a field that has not been tilled for several years will have many larger pores meaning that water will infiltrate in these soils more easily than in disturbed soils. If soils are collected in a pan with no bottom, that pan can be fitted with a screen and rack system atop a glass pan. The glass pan is used to capture the water that has infiltrated through the soil. It is possible to measure the water in the glass pans for comparison against the water collected from beneath disturbed soils. If there is any runoff from the less disturbed soils, it will generally be clear.

As simulated rainfall is added to the soil from a continuously tilled field, a construction site, or from several inches below the surface, the soil will generally fall apart into individual soil particles and form a mud slurry. This mud will seal the surface of the soil and most of the water will run off the surface of the soil. The soil particles in the runoff water will make the water cloudy. When these particles settle out of the water, a layer of mud will form on the bottom of the containers used to catch the runoff.

The best way to gather the samples is with a set of metal cutters about 3-1/2" x 8" x 3-1/2". These cutters can be pushed into the ground and pulled back out with a clawed hammer. The cutter with the sample inside is then set on a screen and rack that keeps the soil from falling out. Simulated rainfall can be applied to the top of the sample using a plastic cup with holes punched in the bottom using a common thumb tack. The soil trays can be tipped slightly by placing them on a cutting board that is held up on one side by bottle caps.



Answers to Student Handout

1. Answers will vary. If the samples were taken from one area that was less disturbed than another, more water should infiltrate into the sample from a less-disturbed area, and more water should runoff of the soil from the more-disturbed area.

2. Answers will vary. The runoff water should be clearer from soils that have a protective cover over them (plant parts) or were disturbed less and contain more soil glues.

3. Answers will vary. A soil that is both disturbed and has more silt and clay in it will generally result in cloudy water that will take a while to clear.

4. The less disturbed the soil, the more stable the soil will be. The more stable soil will have more pores in it because the particles will not fall apart easily or fill the holes.

5. The soil that holds together the best is the soil that can resist erosion the best.

Further Investigations

Compare samples from several different management areas.

Allow the soils to dry for several days and run the experiment again. Do you get the same results?

Take the soils out of the pans, mix them up and put them in the pans again. Do the soils act the same after they have been disturbed?

Add residue (plant parts) to the surface of each pan. Does the presence of plant parts help the infiltration?

Name: _____

Student Procedures:

1. Ask your teacher about the source of the soil samples and record the information here.

What type of soil is in each tray?	
Tray 1	Tray 2

2. Add water to each soil by way of the rainfall simulator. Add about 1/3 cup at a time to each of the two soils.
3. Record your observations after each addition of water.
4. Use the measuring cup to measure how much runoff came from each tray.
5. At the end of the experiment, measure the volume of water that went through the soil and into the glass tray underneath.

Observations after the rain water was added to each tray.	
Tray 1	Tray 2

Questions:

1. Did both soil samples react the same way to the addition of water? _____

2. Was the runoff water more clear in one jar or the other?

3. If the water became cloudy, did it become clear again? How long did it take to become clear again?

4. Which soil would have more pores in it after a rain storm?

5. Which soil is more apt to resist erosion during a rain storm?
