

Soil Texture and Water Percolation

Grade Level

3 - 5

Purpose

Students determine the water holding and draining capacities of different soils and investigate how organic matter affects the amount of water soil will hold. Grades 3-5

Estimated Time

Two 30-minute activities

Materials Needed

- Funnels (2-liter bottles cut in half, 1 per group)
- Coffee filters (cupcake-shaped, 4 per group)
- 2 cups each of 4–5 different dry soil samples (use a variety of textures from sandy to clayey)
 - A Soil Samples Kit (<https://agclassroomstore.com/soil-samples-soil-texture/>) is available for purchase from agclassroomstore.com.
- Measuring cups
- Water
- Stopwatches or a clock with a second hand
- Comparison Graph (https://cdn.agclassroom.org/media/uploads/2016/02/25/comparison_graph.pdf) activity sheet
- 4–5 cups of potting soil

Vocabulary

humus: thoroughly decomposed organic matter

organic matter: a soil component derived from the decay of once-living organisms like plants and animals

pores: the spaces between soil particles and between soil aggregates; pores can be filled with air or water

soil structure: the arrangement of soil particles into aggregates, which contain solids and pore space

Background Agricultural Connections

Sand, silt, and clay particles make up the inorganic, mineral component of soil. Sand particles are the largest and can be seen with the naked eye. Sand has a coarse feel and allows water to move through very quickly. Silt particles are too small to see with the naked eye. They are often found in places that have flooded and dried out again. Clay particles are the smallest, fitting together so closely that it is difficult for water to flow through.

The best soil for plants allows water to move through slowly so that some is held in the soil for plants to use. Water moves too quickly through sand, meaning that plant roots can dry out rapidly. Water moves very slowly through clay, but clay can hold water so tightly that plants can't get to it. Soil that is good for plants has a mixture of sand, silt, and clay particles, as well as **organic matter**. Organic matter, also known as **humus**, acts like a sponge to help the soil capture water. Organic matter is formed by the decomposition of dead plants and animals or plant and animal waste.

Organic matter helps sand, silt, and clay particles stick together, forming good **soil structure**. Hundreds of soil particles are glued together by organic matter into groups called aggregates. Aggregation of soil particles creates pore space, making it easier for water, air, and plant roots to move through the soil. A soil with lots of organic matter will be crumbly. The thoroughly decomposed organic matter in a crumbly soil can absorb lots of water. On a dry weight basis, **humus** has a water-holding capacity of several hundred percent.

While water is absorbed by organic matter and held in the small **pores** within aggregates, the large pores in between aggregates allow water to move quickly through the soil. Well-managed soils that are high in organic matter tend to be more porous, allowing them to rapidly absorb rain and snowmelt (if the soil is not frozen). This reduces erosion. Of course, when the soil is saturated by a long period of rainfall, any additional water then runs off. But until the soil is saturated, it will store up water and let it go gradually.

Crops use lots of water. Summers are dry in the western United States, and most crops will not grow without irrigation. Sometimes irrigation water is scarce and farmers have to take turns, irrigating only at their assigned times. In the eastern United States it rains throughout the summer, so many crops are grown without irrigation. But farmers can't control the rain. Sometimes it may not rain for several days, or it may rain so hard that the soil gets completely saturated. Organic matter helps soil store more water, prevents erosion, and produces better crops.

Engage

1. Ask students to think about what happens when it rains. Where does the water go? Where do puddles form first?
2. Allow students time to think about why some areas have puddles after a rainstorm while in other areas water drains quickly away.

Explore and Explain

Activity 1: Mark, Get Set, Go

1. Prepare the funnels made from 2-liter bottles as shown in the picture (make a mark $5\frac{1}{2}$ inches up from the bottom of each bottle, cut each bottle in half at the mark, invert the bottle tops, and nestle the tops into the bottoms).
2. Divide the class into four or five groups, depending on how many soil samples you have. Provide each group with a funnel and bottom, 2 coffee filters, 1 cup of a soil sample, a measuring cup, and water. Make sure each group has a different type of soil sample.
3. Instruct students to place one coffee filter into the funnel and then add 1 cup of soil into the filter. Cover the sample with another filter. This will ensure even coverage and avoid splashing.
4. Designate one person in each group as a time keeper and another as the water pourer. When the time keeper says “go,” the water pourer should pour 1 cup of water into the funnel.
5. Time should be kept until most of the water has gone through the soil sample. Some samples will drain quite quickly, while others could take 30 minutes or more. Proceed with Activity 2 while keeping an eye on the samples and waiting for them all to finish draining.
6. Compare the time it took for water to percolate through each sample. Add the data to the Comparison Graph (https://cdn.agclassroom.org/media/uploads/2016/02/25/comparison_graph.pdf) activity sheet.
7. Pour out and measure the water that percolated through each sample. Record this on the activity sheet as well.



Activity 2: Adding Organic Matter

1. Instruct the students to return to their groups and empty out their funnels. Starting with new, dry soil will ensure consistent, representative results.
2. Proceed to duplicate the experiment with one change: after placing a new, dry coffee filter into the funnel, add $\frac{1}{2}$ cup of dry soil into the filter and $\frac{1}{2}$ cup of potting soil (to increase organic matter; most potting soils are largely made up of organic

matter). One student should mix in the organic matter with his or her finger, being careful not to puncture the filter. Cover the sample with another new filter.

3. Duplicate steps 4 through 7 in Activity 1. Be sure to record the data on the Comparison Graph activity sheet.
4. Discuss the background material and ask students to identify which sample had the most sand and which had the most clay. Add this evaluation to the graph.

Evaluate

After conducting these activities, review and summarize the following key concepts:

- The mineral component of soil is composed of sand, silt, or clay particles.
- Some soils drain very quickly, and others drain very slowly.
- Soil drainage and water percolation is determined by the texture of soils.
- Adding organic matter to soil improves soil quality.

Acknowledgements

Activities 1 and 2 adapted from USDA Soil Conservation Service publication Soil and Water Conservation Activities by Albert B. Foster and Adrian C. Fox.

Recommended Companion Resources

- Compost by Gosh! (<https://www.miagclassroom.org/matrix/resource/188/>)
- Diary of a Worm (<https://www.miagclassroom.org/matrix/resource/190/>)
- Dig In: Hands-On Soil Investigations (<https://www.miagclassroom.org/matrix/resource/677/>)
- Dirt: Secrets in the Soil (DVD) (<https://www.miagclassroom.org/matrix/resource/379/>)
- Dirt: The Scoop on Soil (<https://www.miagclassroom.org/matrix/resource/181/>)
- Farming in a Glove (<https://www.miagclassroom.org/matrix/resource/196/>)
- Gardening in a Box (<https://www.miagclassroom.org/matrix/resource/1182/>)
- Learn How To Compost (<https://www.miagclassroom.org/matrix/resource/249/>)
- Mountains of Jokes About Rocks, Minerals, and Soil (<https://www.miagclassroom.org/matrix/resource/513/>)
- Nutrients for Life eLessons (<https://www.miagclassroom.org/matrix/resource/1036/>)
- Rocks and Soil (<https://www.miagclassroom.org/matrix/resource/515/>)
- SOIL Reader (<https://www.miagclassroom.org/matrix/resource/397/>)
- Sand and Soil: Earth's Building Blocks (<https://www.miagclassroom.org/matrix/resource/182/>)
- Sandpaper Texturing Kit (<https://www.miagclassroom.org/matrix/resource/805/>)
- Soil Health Education Resources (<https://www.miagclassroom.org/matrix/resource/908/>)
- Soil Samples (Soil Texture) (<https://www.miagclassroom.org/matrix/resource/84/>)
- Soil Science Society of America (<https://www.miagclassroom.org/matrix/resource/500/>)

- Soil Science Videos (<https://www.miagclassroom.org/matrix/resource/470/>)
- Soil! Get the Inside Scoop (<https://www.miagclassroom.org/matrix/resource/510/>)
- The USGS Water Science School
(<https://www.miagclassroom.org/matrix/resource/734/>)
- Topsoil Tour (<https://www.miagclassroom.org/matrix/resource/808/>)
- Under Your Feet: Soil, Sand and Everything Underground
(<https://www.miagclassroom.org/matrix/resource/1217/>)
- You Wouldn't Want to Live Without Dirt!
(<https://www.miagclassroom.org/matrix/resource/658/>)

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