Agriculture in the Classroom
UtahStateUniversity
COOPERATIVE EXTENSION

Perkin' Through the Pores

Slip Slidin' Away

Purpose
Students will be able to determine the water holding and draining capacities of different soils and will investigate how organic matter increases the amount of water soil will hold.

Time: 3, 30-minute activities

Grade Level: Elementary

Materials
- ❑ Comparison Graph attachment
- ❑ 4 cups of four or five different dry soil samples (make sure one is quite sandy and another quite clayey; samples are available for purchase through Utah Agriculture in the Classroom: http://bit.ly/soilsamples)
- ❑ 5 cups of potting soil
- ❑ Funnels (2-liter bottles cut in half)
- ❑ Coffee filters (cupcake shape)
- ❑ Water
- ❑ Measuring cups
- ❑ Stopwatches or a clock with a second hand

Vocabulary
humus: thoroughly decomposed organic matter

organic matter: products derived from living organisms, like plants and animals

Background

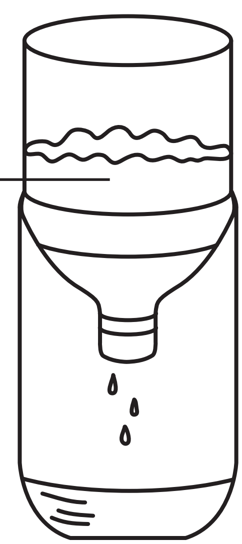
Sand, silt, and clay are inorganic materials. Sand is made up of larger particles which can be seen with the naked eye. It has a coarse feel and allows water to move through very quickly. Silt particles are too small to see with the naked eye. Silt is often found in places that have flooded and dried out again. Clay is made up of very tiny particles. The particles fit together so closely that it is difficult for water to flow through.

The best kind of soil for plants allows water to move through slowly enough so that some of it stays in the soil for the plants to use. Water moves too quickly through sand. It moves very slowly through clay, but clay holds the water so tightly that plants can't get to it. Soil that is good for plants has a mixture of sand, silt, clay, and organic material, or humus. Humus acts like a sponge to help the soil capture water. Humus is formed when plants and animals die.

When organic matter is used up, soil packs together in clods. A cloddy soil has fewer air spaces. A soil with more organic matter will be crumbly. Not only does a crumbly soil take in water faster than a cloddy one, it holds more. The thoroughly decomposed organic matter in a crumbly soil can absorb lots of water. On a dry weight basis, this humus has a water-holding capacity of several hundred percent and acts like a sponge. In addition to the water held by the organic matter, water held in the pores between the soil particles and between the soil granules is greater. Hundreds of very fine soil particles are glued together by the organic matter into soil granules.

This increased water-holding capacity of soils high in organic matter makes a big difference in the intake of water. These well-managed soils can absorb most of the rain and snowmelt (if the soil is not frozen). This means there will be less erosion. Streams will run clear. 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.

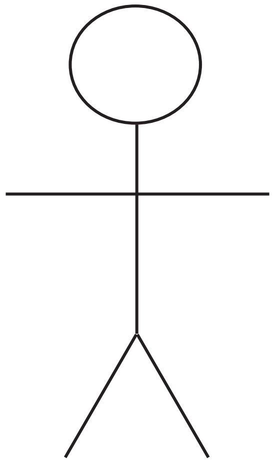
Crops use lots of water. Vegetables use an average of 2 acre-feet, or 650,000 gallons an acre. Cotton takes 800,000 gallons an acre. An acre of alfalfa needs over a million gallons. To produce one ear of corn takes over a barrel of water. Organic matter helps soil store more water, prevents erosion, and produces better crops.



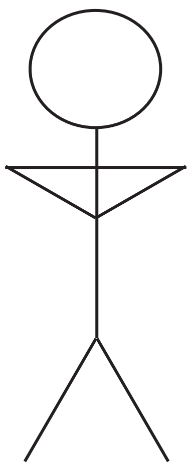
Activity Procedures

Activity 1 - Mark, Get Set, Go

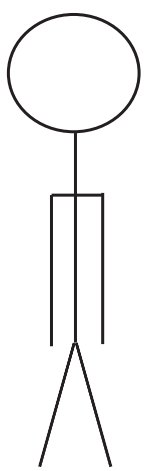
1. Prepare the 2-liter bottle funnels as shown in the picture to the right. Place the bottle on a table and measuring up from the table surface, place a mark at 5-1/2 inches. This is where you should cut the bottle in half.
2. Divide the class into four or five groups, depending on how many soil samples you have. Provide each group with a funnel and bottom (made from a 2 liter bottle), two coffee filters, 1 cup of one of the soil samples, a measuring cup and water.



Sand



Silt



Clay

3. 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. One person in each group needs to be designated as the time keeper, another as the water pourer. When the time keeper says go, the water pourer should pour 2 cups of water into the funnel.
5. Time should be kept until most of the water has gone through the soil sample. Some will go through quite quickly while other could take 30 minutes or more. Proceed with Activity 3 during this waiting period while keeping an eye on the samples.
6. Compare the time it took for water to percolate through each sample. Add the data to the Comparison Graph.
7. Pour out and measure the water that percolated through the sample. Record this on the graph.

Activity 2 - Adding Organic Matter

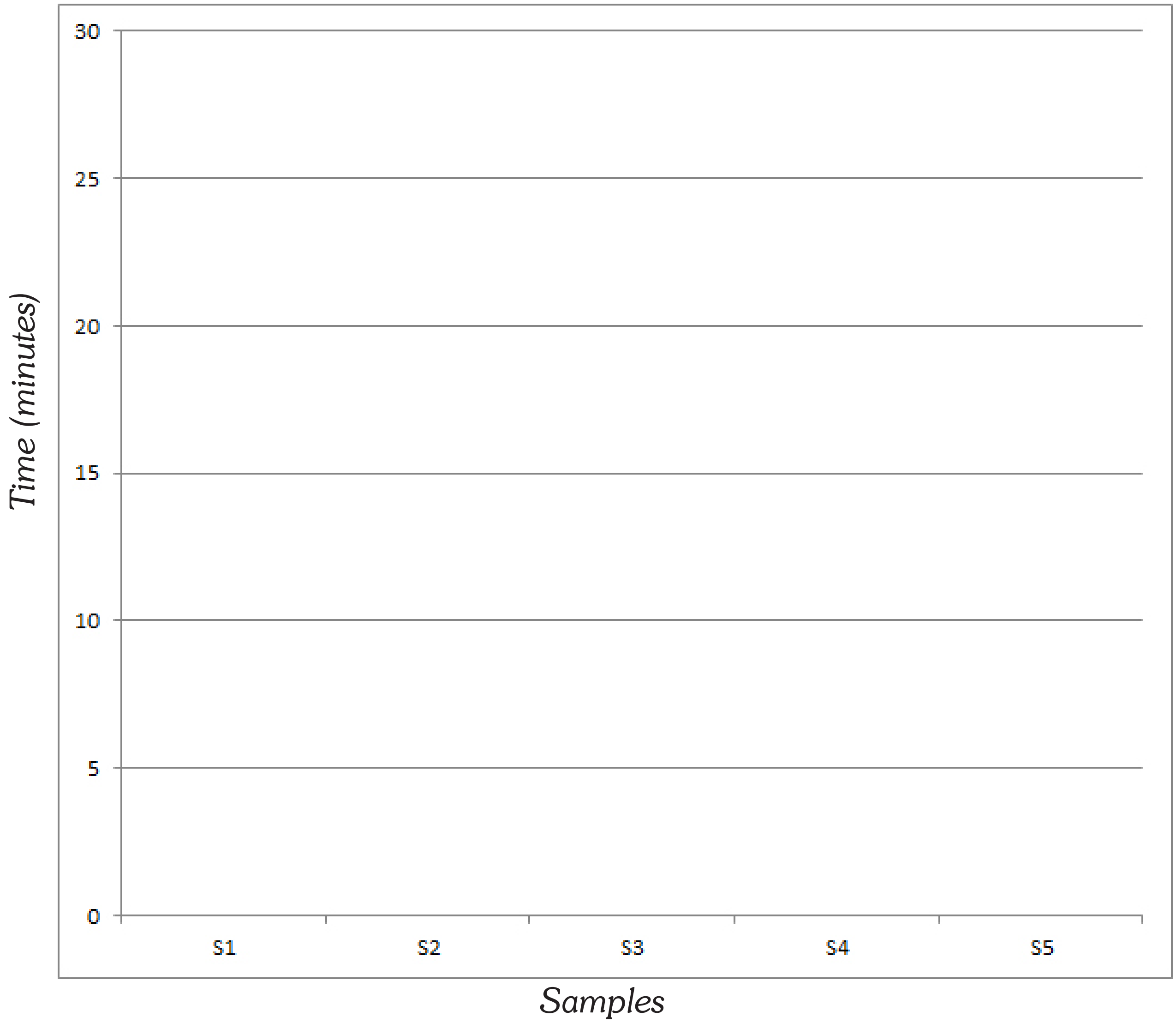
1. Students should return to their groups and empty out their funnels. (Starting with new, dry soil will ensure consistent and scientific results.) Procede to duplicate the experiment: place a new, dry coffee filter into the funnel and then add 1 cup of dry soil into the filter. Cover the sample with another new filter.
2. This time, add one cup of potting soil, to increase the organic matter, to each filter. One student should mix in the organic matter with his or her finger, being careful not to puncture the filters.
3. Duplicate steps 4 through 7 in Activity 1. Be sure to record the data on the Comparison Graph.
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 Comparison Graph.

Activity 3 - Pick a Path

5. Divide the class into four groups. Assign each group one of the following titles: water, sand, silt, and clay. Explain to students that there are three soil particle sizes; sand is the largest, followed by silt, and the smallest is clay.
6. Soil particles should position their arms like the examples in the drawing to the left.
7. Group the sand particles together so that each particle is touching another (finger tip to finger tip). Now tell students in the water group to try and run through the sand group (under their arms). They should be able to run through will little difficulty.
8. Repeat the above step for silt and clay. Silt particles should be touching elbows, and clay particles should be touching shoulders. Discuss the results.
9. Mix up the sand, silt and clay particles (students) to make a loam. Ask the water group to run through.

10. Discuss the following questions:
    - In the “Pick a Path” game which group did the water have a more difficulty running through?
    - Which types of soils hold more moisture?
    - Does the amount of organic matter effect the water holding capacity of soil?
    - Looking at the Comparison Chart which soil had the most sand? Which had the most clay?
    - Can you figure out the water holding capacity of the soil?
    - Why is it important to know how water percolated through the soil? Who can use that information?

Perkin' Through the Pores - Comparison Graph



What was the amount of water collected after percolation in each sample?

______ S1 ______ S2 ______ S3 ______ S4 ______ S5

Which samples do you think had the most sand? ________________

Which sample had the most clay? ________________

Which sample had the most organic matter? ________________

(*Hint: Compare the amount of water collected, the speed of percolation, and the visual evidence.*)