Mud in the Water

Objective

Students will learn about soil erosion and water pollution by building a demonstration model from pop bottles and observing the movement of materials representing pollutants from soil into water.

Background

Thousands of years ago, people began to farm because they found they could produce more food that way than they could by hunting and gathering. Over the years, people discovered that some farming practices were harmful to the land. Cutting down the trees, clearing away vegetation and letting animals overgraze left topsoil unprotected so winds and water could erode it away. The runoff water washed topsoil and rocks into streams and rivers, causing sedimentation. The buildup of sediment at the bottom of a stream or river creates a muddy bottom. This extra mud changes the living environment for many fish and wildlife and can restrict water flow. Runoff nutrients and fertilizers carried with the soil can cause rapid algae and weed growth that may harm fish and other aquatic organisms.

Early farmers learned from their mistakes and developed better farming methods. They learned to farm on the contour and build terraces—ridges of soil built across the slope to slow the runoff of water.

When European settlers came to the New World, they were overwhelmed by what seemed like endless resources—acres and acres of rich soil never before used for farming. Many farmers abandoned the methods their ancestors had developed for protecting the land. When one field began to produce poor crops, the farmer would simply abandon it and move deeper into the wilderness.

As more people moved in, they began farming sloping lands that washed away easily and sandy soils that blew away. In the early 20th Century, farmers began plowing up the native grasses of the Southern Plains to plant wheat. Since that land had never before been plowed, farmers had no way of knowing that their hard work would set off what we now know as the Dust Bowl. A severe drought dried up the exposed soil. With no grass roots to hold the sandy soil in place, it simply blew away with the strong summer winds.

Once farmers saw what had happened, they began thinking of different farming methods they could use that would protect the soil. One method involved using chemicals on weeds instead of turning the soil with a plow. This method, called no-till farming, keeps vegetation in place while allowing farmers to produce the food people need.

Oklahoma Academic Standards

GRADE 5

Earth's Systems: ESS2-1. Earth and Human Activity: ESS3-1

GRADE 6

Ecosystems: LS2-4,5. Earth and Human Activity: ESS3-3

GRADE 8

Earth's Systems: ESS2-2. Earth and Human Activity: ESS3-4

Materials

- four 2-liter plastic soda bottles
- 1 bottle cap
- permanent marker
- topsoil
- sand
- mulch or sod
- water
- measuring cups
- razor knife
- scissors
- push pin or ice pick

Vocabulary

erode—wearing away material from the earth's surface by natural processes

contour—following the natural lines of uneven terrain to limit erosion of topsoil

no-till farming—method of farming in which plowing is avoided by applying chemicals to eliminate weeds

runoff—rainfall not absorbed by soil

sedimentation—the buildup of material at the bottom of a stream or river

terrace—ridges of soil built across the slope to slow the runoff of water

Ag in Your Community

Invite someone from your local soil conservation office to talk to your class about soil conservation methods used locally to protect the soil.

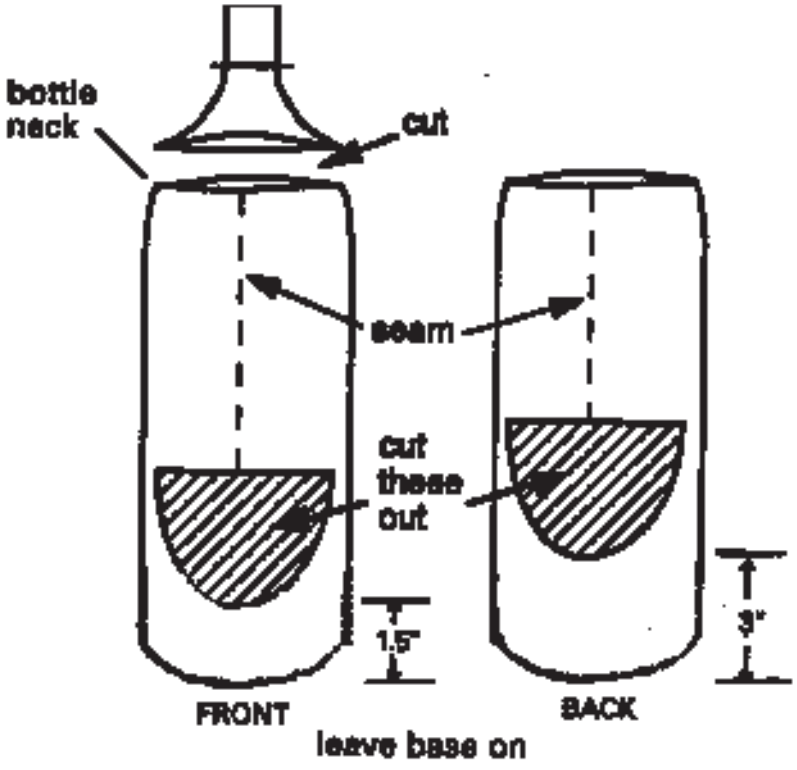
Procedure

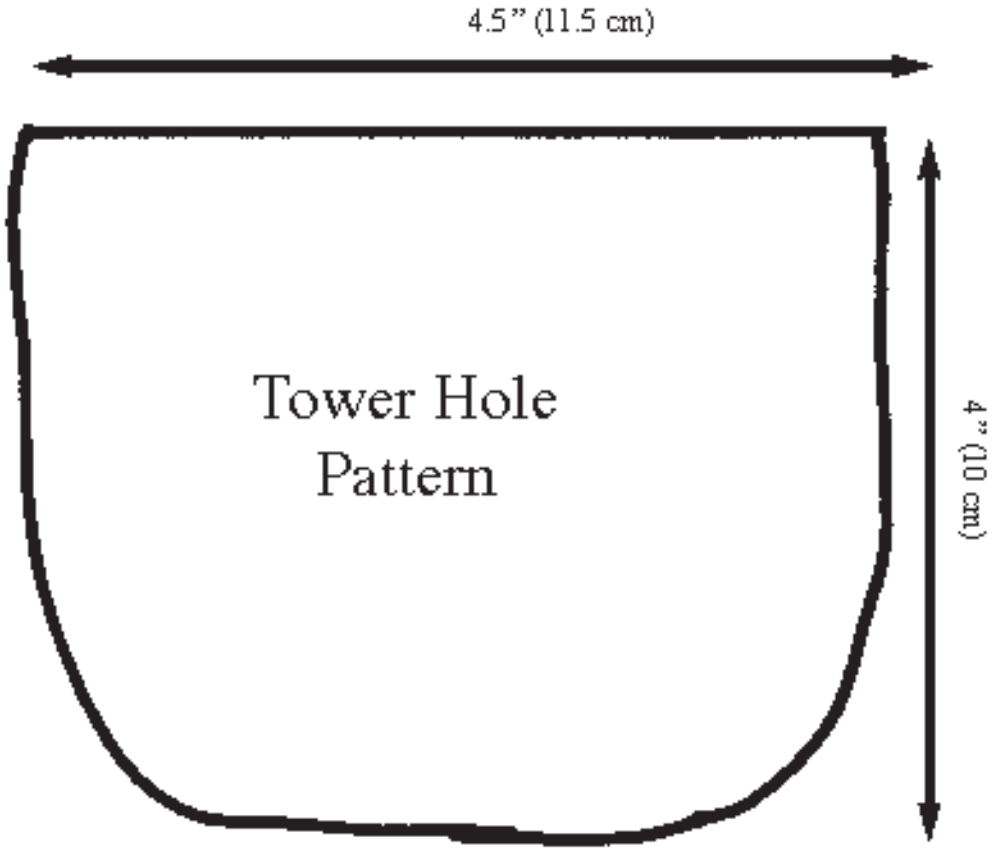
1. Build an erosion model ahead of time for demonstration purposes, using the instructions included with this lesson.
2. Read and discuss background and vocabulary.
   —Write the word "erosion" on the chalkboard.
   —Students will discuss the definition of the term.
   —What causes erosion?
   —What problems can erosion cause?
   —Where have students seen examples of erosion in your community?
   —How can erosion be avoided?
3. Show students the erosion model you have built ahead of time.
   —Follow the instructions to demonstrate the effect of erosion on the soil and on the water.
   —Repeat the demonstration, using soil with some kind of mulch mixed in.
   —Students will note the difference in the clarity of the catch water.
   —To show how fertilizers and pesticides reach our groundwater and drinking water, add food coloring to the soil tray.
4. Ask each student to bring one 2-liter plastic bottle to class.
   —Divide the class into groups of four.
   —Provide each group with a copy of the instructions for constructing the erosion model.
   —Each group will conduct one of the experiments suggested in the instructions.
   —Students will keep records so they can report observations to the class.
5. Students will locate examples of erosion in your community and photograph them.
   —As a class or in groups, students will discuss what might have caused the erosion in the photos.
   —Students will discuss what steps might be taken to prevent further erosion.
   —What might happen to the surrounding buildings, etc., if the erosion is not controlled?
6. Students will plant different kinds of seed in the soil trays of their erosion models.
   —When the seeds have sprouted and the soil in the trays is covered with vegetation, students will test the different plants for their ability to hold the soil and protect the water.

Erosion Model

BOTTLE 1: THE SUPPORT TOWER

1. Cut out the tower pattern on the back page.
2. Cut the top off the bottle with a knife or scissors. (See diagram 1.)
3. Choose a front and back on the tower, and mark these locations with a marker or pen at the base of the bottle.
4. Measure 1 1/2 inches (4cm) up from the "front" mark on the bottle. Make another mark.
5. Take the tower pattern and trace it on the front side of the bottle. The rounded edge or bottom of the pattern should be on the 1 1/2 inch mark. See diagram 1.
6. Turn the bottle around to the back mark.
7. Measure three inches (7.5 cm) up from the mark on the back of the bottle.
8. Using the tower pattern, trace it onto the back side of the bottle. The rounded edge of the pattern should be on the 3-inch mark. See diagram 1.
9. Cut out the front and back holes.



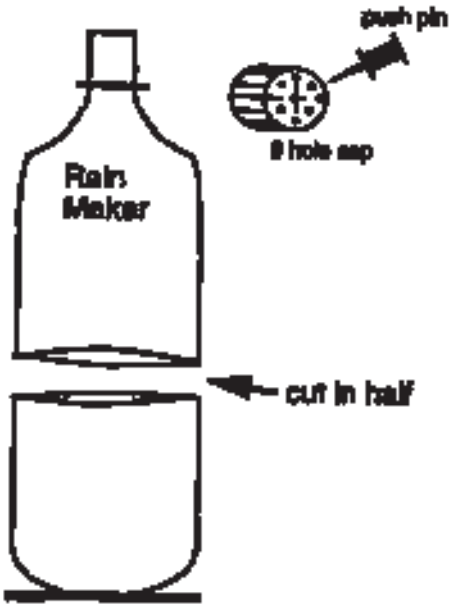


BOTTLES 2 AND 3: SOIL TRAY (You need at least two of these.)

1. Use a permanent marker to draw a line (baseline) around the base of the bottle about 2 inches from the bottom of the bottle.
2. Lay the bottle on its side.
3. Find the seams that run the length of the bottle. You can use these seams as a guide.
4. Use the marker to draw a line along each seam from the baseline to the neck of the bottle.
5. At the neck of the bottle, draw a line from one seam line to the other seam line.
6. Cut along lines, and remove the side of the soil tray. The soil tray is ready to be filled with soil.
7. Repeat steps 1-7 for the second soil tray.

FILLING THE SOIL TRAY

1. With the bottle on its side, Fill one bottle with about 1/2 inch of sand. This is the subsoil. Level the subsoil and gently press it down to make it firm.
2. Put 1/4 inch of moist topsoil over the sand. remove or break up any soil clumps. The layers of soil should be easy to see through the side of the bottle.
3. Repeat steps 1 and 2 for the second soil tray.
4. In the second tray, press mulch (grass clippings, newspaper, wood chips) into the moist topsoil so most of the surface is covered. You may also use a piece of sod from your yard or plant alfalfa, ryegrass, lettuce, radish or some other fast-growing seed in the tray.
5. Sprinkle about 1/2 a bottle cap full of glitter evenly over the surface of both trays. The glitter represents some kind of fertilizer or pollution.



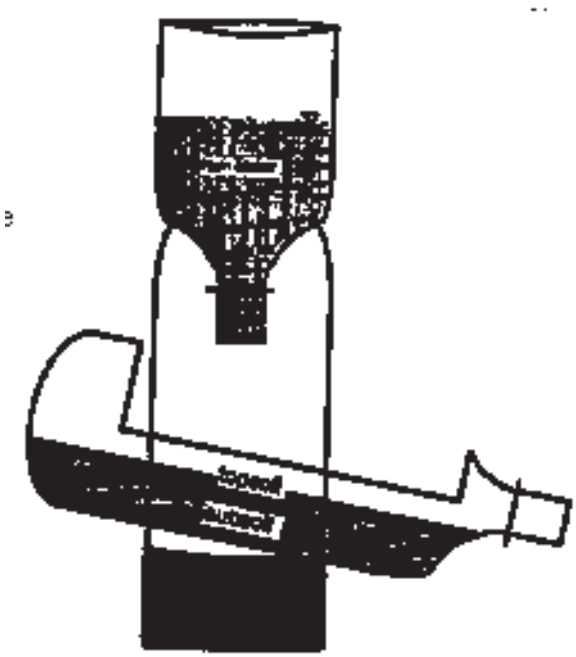
BOTTLE 4: RAIN MAKER

1. Cut the next bottle in half to form a funnel and a water container. See diagram at left.
2. The funnel or top portion is the rain maker.
3. Poke holes in the bottle cap by using a push pin or ice pick. Make nine holes with the push pin.
4. Screw the cap tightly on the rain maker, and fill the rain maker about halfway with water to test whether all holes are free-flowing. If the water is only dribbling out, enlarge the holes by wiggling the push pin back and forth a bit more.
5. The bottom half of the bottle can be used to hold the water added to the rain maker.

Oklahoma Ag in the Classroom is a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education.

PUTTING THE MODEL TOGETHER

1. Pour sand into the tower (Bottle 1) to make it stable.
2. Push the bare soil tray through the holes in the tower. The neck of the soil tray should be lower than the base of the soil tray. (See diagram at right.)
3. Place the model on an empty coffee can, block of wood or some other platform so the mouth (bottle cap end) of the soil tray is high enough to place a measuring cup beneath it.
4. Insert the empty rain maker into the top of the tower.



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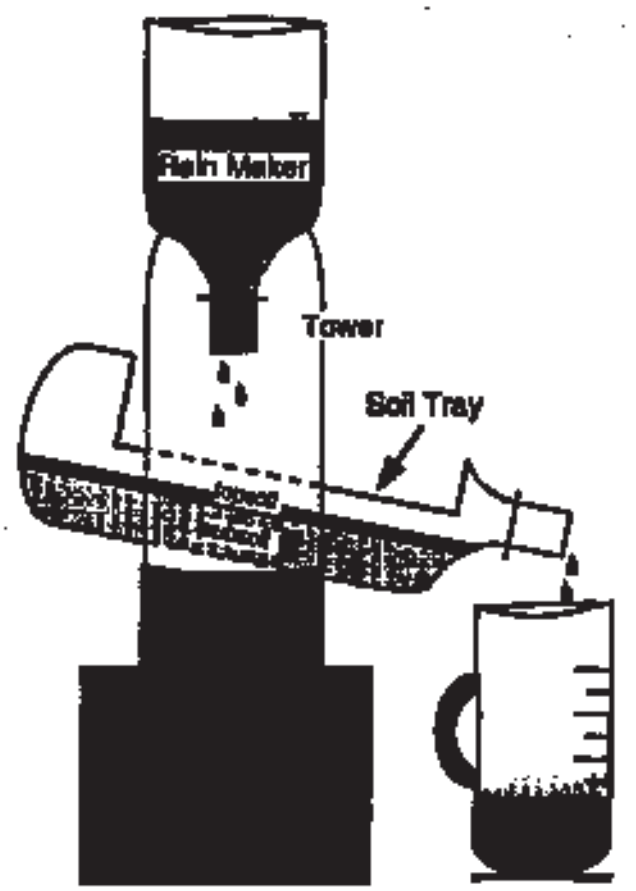
How to Do the Demonstration



1. Use a two-cup measuring cup to collect runoff. Make sure you use the same size collection container when comparing runoff between demonstrations.
2. Pour water into two separate containers so each container has two cups of water This water will be added to the rain maker. Place the measuring cup below the soil tray to collect runoff. (See diagram at left.)
3. Dump the water from one container into the rain maker.
4. Observe the amount of glitter and soil being "eroded" into the measuring cup.
5. When all of the runoff water has flowed into the measuring cup, set it aside. You will need to use it to compare runoff with the next soil tray.
6. Remove the first soil tray from the tower and replace it with the second soil tray (mulch tray).
7. Repeat demonstration steps 2-4, but this time use the mulch tray and the second container of water.
8. Compare the results. Which measuring cup has the most water? The most Glitter? Was the mulch helpful in reducing the amount of runoff? erosion? Was the topsoil washed away directly beneath the rain maker? Look at the collection containers and think of them as a stream or river. How would the glitter affect water quality and aquatic life?

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