

Soil Erosion Bottles

Level: Grades 3-6

Overview

This experiment shows how unprotected soil can be washed away by rain, causing damage to the environment, and it also reveals how the vegetation dependent on soil to survive can help protect it.



In this experiment, water running through bare soil erodes (takes away) some of the soil – that’s why the cup on the left is cloudy. A layer of mulch (fallen leaves or other dead plant material) in the middle bottle protects the soil, and the water that runs off is less cloudy. But soil with vegetation roots anchoring it in place is the best protected, and the water running out of that soil is almost clean. A layer of small pebbles also protects the soil, and can run almost clean. What does this mean for salmon in the stream?

This dramatic experiment is easy to do, but you will need to have some patience. Start setting it up at least a week in advance to give the grass time to grow in one of the bottles. When you actually run the experiment, it’s best to do it outside if you can.

Materials:

- 4 plastic cups
- string
- adhesive putty
- grass seeds (or other fast growing seeds)
- potting soil
- small pebbles
- scissors
- watering can
- felt tip pen
- pencil
- Four 2-Litre plastic bottles

Steps:

1. Draw a large rectangle on one bottle with the felt-tip pen. You need to make the hole big enough to put soil and then water into the bottle.
2. Cut along your lines and remove the rectangle shape you drew from the bottle. An adult can help you. Recycle the piece of plastic that you remove.
3. Repeat the previous steps for the other three bottles, so you have four bottles that are just the same. Put two of the bottles aside for now.

4. Put a layer of soil about 1 inch (2.5 cm) deep into one of the bottles. The level of the soil should be just below the lid of the bottle.
5. Sprinkle the grass seeds into the soil, then wash your hands.
6. Using your watering can, pour water over the grass seeds. Use enough to make the soil damp.
7. Leave the bottle in a place where it will get lots of sunlight, and where it won't get too cold. Add a little water each day to stop the soil from drying out. After a week or so, your grass should have grown.
8. Once the grass has grown, you can prepare your other three bottles. Add about the same amount of soil to them as you put in the first bottle.
9. Leave one of the bottles with soil only. In the second bottle, place a layer of mulch on top of the layer of soil. In the third bottle, place a layer of small pebbles. Now wash your hands.
10. Now you need to make four mini buckets. Near the top of each plastic cup, make two small holes opposite each other using the sharp end of the pencil. Put some adhesive putty underneath, before making the hole, to protect the table.
11. Cut three lengths of string, each about 8 in (20 cm). Thread one end of a piece of string through one of the holes in the cup and tie a knot in it so it will not back through. Do the same in the hole on the other side to make a handle.
12. Make string handles for your other three cups. You should check that they are strong enough to hold the cups when they are full of water.
13. Hang your buckets from the neck of your bottles. You are now ready to perform the experiment. It might get messy, so be sure to do this part outside. Remove your bottle lids, then slowly pour water over each of the four bottles. The water will start to trickle through the soil into the buckets.

Questions for Students

1. Can you explain how the stream is protected by vegetation?
2. What happens when there are heavy rains and there is no vegetation planted along the stream?

How it Works

Roots are crucial to a plant's survival. The roots grow down into the soil and absorb water into tubes that extend right up into the stem and leaves of the plant, above ground. Each grass plant has roots of many different sizes – from tiny fibrous roots up to bigger ones almost as big as the stem. The fibrous roots push out in all directions in the soil, not just downward. The result is a complicated web of roots that holds the soil firmly in place. That's why the water runs out almost completely clear from the bottle with the grass growing in it.

If it is left unprotected, soil can be swept away during heavy rains, taking the nutrients that plants need to grow with it. As this image taken from space shows, soil runs off into rivers and can be harmful to salmon, and other fish and wildlife living there. Planting grass and trees along riverbanks can prevent soil erosion because they hold onto the soil, keeping rivers cleaner. Farmers can protect the soil they need for their crops with animals with a layer of mulch (dead leaves) or the roots of plants.

Source: "Smithsonian Maker Lab Outdoors: 25 Super Cool Projects" by Jack Challoner