

Chapter 4. The Erosion Process

Lesson 3. The effects of erosion on channel systems.

Overview: The intended use of water, along with the presence of physical, chemical and biological agents, determines water quality. The most common contaminant requiring treatment is sediment. Sediment is soil and other fine materials that affect the color, appearance or clarity of water. Treatment for sediment is filtration. Indirectly, sediment also causes the biological contamination of water. Many microorganisms find shelter or protection within small soil aggregates. Therefore, the microorganisms are often safe from treatment. Sediment entering water often carries microorganisms and chemicals.

Sediment originates from a variety of sources including runoff from agricultural land, runoff from highways and road construction sites, and runoff from urban construction sites. Flooding causes sediment through scouring stream banks and bottoms. Bank and bottom disturbance due to recreation also produce sediment. The best way to reduce the effect of sediment in water systems is to reduce it or to reduce the source - erosion. During this lesson, we will look at the erosion process and its effect on water quality.

Purpose: The purpose of this lesson is to examine the erosion process from soil surfaces. We will also observe soil and chemical movement associated with erosion. In this activity, we will consider the effect of erosion on stream and river channels, and on lake shorelines.

Materials needed: (If you are working in teams, you will need the following materials for each team.)

- Three different soil material samples - you should have about a pound of each of the following: pea gravel, fine sand, and a fine soil material such as silt or loam (potting soil will work). (Note: If you can get clean, washed, white sand, the demonstration is much more visual; however, it is not essential.)
- A flat cookie sheet with several holes drilled or a slot cut in one end or in the center (at what would be the six o'clock position). Water runs off the sheet in one spot when it is placed on a slope.
- Toothpicks, Popsicle sticks, twigs, small branches, some stones 1-2" in diameter.
- Masking tape
- Bucket or jar full of water

- Bucket to catch runoff water
- Piece of plastic, rubber, or tygon tubing (1/4" or so in diameter) for siphoning water from the bucket onto the cookie sheet
- Red, blue, or green food coloring
- Small block of wood to put under one end of the cookie sheet

Procedure:

1. _____ Using a cookie sheet and soil materials, you are going to make a simple flood plain. When you finish, the upper end (upslope position) of the cookie sheet will be the end without the holes. The lower end (down slope position) will be the end with the holes. The bucket of water will be your river water supply. Use the plastic tube to siphon a small, steady stream of water out of the bucket. If you wish, you can fit a piece of plastic, rubber or tygon tubing into the bottom of a 2-liter plastic pop bottle. Connect several bottles by a siphon network to provide a constant source of water. You can change the flow rate by using a hose clamp or clothespin on the tubing, and raising or lowering the level of your bucket above the cookie sheet. The higher up you go, the greater the flow rate.
2. _____ To create your floodplain, lay the cookie sheet flat on a table. Spread a band of sand (4-5 inches wide and 1/2" deep) down the full length. If you wish, place some pea gravel in the center as a rock island. You can use some pea gravel to create gravel bars, bends in your river channel. You can also use some fine material to create a peninsula from one edge of the cookie sheet to the center or across your sand channel. Use the sticks, toothpicks and other materials the same way - be creative with your landscape. Now fill the edges of the cookie sheet with a layer of the finer material. You can reverse this design if you wish, placing the fine materials in the center and the coarser materials on the sides.
3. _____ Place your landscape on a slight angle, with the upper end about an inch to 1 1/2" higher in elevation than the lower end of the cookie sheet with a layer of finer material. You can reverse this design if you wish, placing the fine materials in the center and the coarser materials on the sides.
4. _____ Place your landscape on a slight angle, with the upper end about an inch to 1 1/2" higher in elevation than the lower end of the cookie sheet. Extend the lower end (where the holes are) just off the edge of the table, with a bucket under the holes to catch the water. Now set up the water reservoir at an elevation above the upper end of the cookie sheet. Change the incoming flow volume and rate by raising or lowering the reservoir, or by opening or closing the delivery tube.
5. _____ Begin by running a small, low volume, steady stream of water from the reservoir directly onto the cookie sheet, at the top center position (twelve o'clock position). Observe what happens. You will see the beginning of formation of a stream channel and you will see how a river corridor forms. If you place a stick,

toothpick, rock, different soil material, or another barrier in front of the stream of water, you will see a change in the river channel. Be careful not to flood out your system too soon.

6. _____ Observe the flow channel. When there is a stable system operating, apply a drop of food coloring to the soil at the edge of your stream channel. Do not place the drop in the channel. Watch what happens. Pay attention to the encroaching erosion process, the pick-up of the food coloring, and the flow pattern of the food coloring in the channel. The food coloring is quickly dispersed. It also travels a long distance in a short time.

7. _____ Now, place a drop of food coloring in the soil several inches away from the stream channel. Observe what happens to this drop. Unless the soil is wet and there is water movement, the food coloring will remain where it was applied. Discuss the process of stream channel movement and water within streams. When a contaminant enters a stream corridor, it mixes quickly and travels great distances in a short time.

8. _____ The discussion with this activity is almost limitless. Assign each team with creation of a different landscape. Watch the effects of diversions on stream corridor development. Observe what happens when moving water systems dissect different soils. These stream and channel erosion processes apply to highway embankments, plowed fields, flooded stream corridors and shorelines.

Lesson learned: Stream bank and channel erosion depends on the soil material, stream bank protection, and the rate and volume of water moving along the stream channel. Stream bank and channel erosion can cause widespread contamination in a short period.

The lesson above was adapted from "*What is Water Quality? A Resource Guide for 4-H Leaders and Teachers*," 80 pages of activities and experiments related to water quality. (\$5.00) Order from the Montana 4-H Program at Montana State University-Bozeman. Phone 406-994-3501.