

Chapter 4. The Erosion Process

Lesson 1. Soil Erosion

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 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. Finally, 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 demonstrate that erosion is a physical process.

Ideas Taught: The ideas taught in this activity are:

- Surface erosion is a physical process. It depends on several factors including type and size of soil particles, rate of water application, slope, and the water content of the soil.
- Different soil materials can adsorb and hold water differently. These different capacities change the effects of erosion and contaminant.

Materials Needed:

- A plastic silverware tray with four individualized compartments. (Note: If you cannot find a compartmentalized silverware tray, use four trays, each about 1 1/2" wide, 1" deep, and 12-14" long and glued together, side by side. Another option is to place three plastic, aluminum foil, or

cardboard dividers lengthwise into a 9" x 13" cake pan. Tape the dividers in place on the bottom and ends.)

- Four different soil materials samples. You will need enough of each to fill each compartment with 1/4-1/2" of the top of the tray or pan; the soil materials should be as follows: pea gravel (from hardware store, garden section, or pet store), clean sand, loam or potting soil, and fine silt or clay material.
- One 50 ml graduated cylinder
- Several plastic cups (8 oz.)
- Red or blue food coloring
- Several sheets of plain white paper
- Colored pencils or felt-tip markers
- Water supply
- Small block of wood (2-3" thick); book or eraser will work

Procedure:

1. _____ Before you start this activity, place the dividers in the cake pan or put the individual silverware compartments together, so that you have four compartments, side by side. Drill a hole 1/4" in diameter in the bottom of each compartment to allow water drainage. When you finish, you should have four compartments, each with a hole at the same end. Fill each compartment to the same level with samples.

2. _____ On each of three sheets of paper, draw a picture of four trays. Note the material in each. Mark the top of the paper "top." Mark one sheet in the upper right corner "10 ml," mark the second sheet "20 ml," and mark the third sheet "50 ml."

3. _____ Place the eraser or block of wood under the end of the trays opposite the holes in the bottom. Extend the trays so that the holes are beyond the end of the table. Place a plastic cup under each hole to catch any water that might run out of the holes.

4. _____ Add two to three drops of food coloring 1" below the top of each tray, in the center of the soil material (at twelve o'clock position). Be sure to add the same amount of food coloring to each soil material. Add 10 ml of water to each soil material, directly on top of the food coloring dot.

Observe what happens. Make notes of these three processes on the paper marked "10 ml":

- a. The pattern of water and dye movement in each of the four soil materials. (Draw the pattern for each soil material on separate

- paper.) Use different colored pencils to distinguish between the pattern of dye movement and water movement (wetting).
- b. The extent to which any soil movement or erosion occurred because of adding the 10 ml of water to each soil material. Use a darker pencil to note on your picture any soil erosion.
 - c. The amount of color of any water that might have drained out of the bottom holes in the trays. If any water drained out of the holes, measure these amounts. Record them below the pictures of the water and dye movement patterns.
5. _____ Repeat this entire process. Use the same trays and add 20 ml of water this time. First, add two or three more drops of food coloring in the same location. Be sure to add the same amount of food coloring to each soil material. Now add 20 ml of water to each soil material, directly on top of the food coloring dot. Observe what happens this time (*remember that you are now seeing the effect of a cumulative 30 ml of water*). Make the observations of the three processes. Draw the pictures. Note the outflow on the "20 ml" sheet.
6. _____ Repeat the entire process, this time adding 50 ml of water and making your notes on the sheet marked "50 ml."
7. _____ When you are finished, compare the pictures and results. Discuss with the class the processes observed, the effect of soil material type and water volume on contaminant movement, water storage, water movement and soil erosion.

Lesson learned: What you should have seen is that some soils hold onto water and contaminants very tightly, up to a point. Then the entire soil fails and erosion becomes a significant factor in contaminant movement. Erosion itself becomes a contaminant. Other soil materials, such as coarse sand or gravel do not hold water or contaminants very well, but they do resist the forces of erosion very strongly. In natural systems or locations where we want to prevent erosion and contaminant movement, the right combinations of soil materials serve our purposes: coarse materials for protection and stability, and fine materials for water and contaminant adsorption and retention.

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.