

Chapter 4. The Erosion Process

Lesson 2. Contaminant Movement

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.

Idea Taught: The ideas taught in this activity are:

- Very coarse materials, like rock and gravel do not erode easily. Contaminant by movement of chemicals and contaminants of such soils is much greater than it is in fine materials like silt and clay.

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

- Four different soil material samples. You will need enough of each to fill 3/4 of a 16 oz. plastic pop bottle. The soil materials should be as follows: pea gravel (from a hardware store, garden section or pet store), clean sand, loam or potting soil, and fine silt or clay material.
- Four 10 oz. plastic pop bottles. Cut out the bottoms, so that the bottles are like long funnels when turned upside down.
- Four cotton balls or four squares (2" x 2") of cheesecloth
- One graduated cylinder (50 milliliters)

- Several plastic cups (8 oz.)
- Red or blue food coloring
- Water supply
- Some type of rack or stand. Stand your funnels in four circles of cheesecloth having the same diameter as the pop bottles.

Procedure:

This activity demonstrates the differences in water-holding capacity of different soil materials, the differences in pore sizes and amounts with different soils, and the differences in the chemical trapping ability of different soils. Before you being this demonstration, you first need to make some soil "profiles," or columns of different kinds of soils.

1. _____ Place a cotton ball or balled up piece of cheesecloth in the mouth of each pop bottle. Now carefully lay the hardware cloth inside the pop bottle, over the top of the cotton ball and flat against the mouth (funnel) part of the bottle. Use the hardware cloth to keep the soil from sliding out the mount of the bottle when you fill it up. The cotton ball acts like a filter. Do not pack the cotton ball too tightly. Slowly fill the bottle with one sample. Place a little in the bottom to hold the hardware cloth in place, then gradually fill the rest of the bottle to 1 1/2 inches of the top. Stand the filled bottle in your rack and repeat this procedure for each of the soil materials. When you finish, you should have four funnels or soil columns, each with a different soil material.
2. _____ Place four drops of food coloring directly in the center and on the top of each of the four soul columns. After the food coloring has soaked into the soil, place a cheesecloth circle on top of the soil in each column. Place a plastic cup under each column-funnel to catch any water that might flow through the columns. Measure out 200 ml of water and slowly pour it onto the cheesecloth surface of a column. Repeat this procedure for all four columns.
3. _____ To add a little interest and excitement, tell the class to record the length of time it takes in each case for water to begin flowing from the bottom of the column after it is added at the top. You can also have the class record the length of time water continues flowing from the bottom from the beginning of time when it was added. (This part of this activity is done in much more detail in another lesson, but you can include as much of it as you wish here.)
4. _____ Be sure to have a plastic cup under each column. We have used additional clear, plastic pop bottles for cups, cutting off the mouth of the bottle rather than the bottom. After 10-15 minutes, have the students compare the volume and color of the water that has drained out of each cup. You might also talk about any erosion of the soil material that has occurred, resulting in sediment in the drainage water.

5. _____ Point out the difference in color and intensity of color of the drainage water. Question the students about which soil material held the least amount of water and food coloring. Discuss the difference in amount of water that traveled through each column, through the volume of water applied and the amount of soil the water passed through was the same for each column. What are the reasons for these differences? Explain to the student that food coloring has few chemical or electrical properties that would cause soil particles to hold it. When the soil pores hold the food coloring and it mixes with water, its color intensity changes.
6. _____ Soil and earth material made of large particles (and filtering materials as well) have many large pores, holes, or channels between the particles. Water moves through it easily. In contrast, fine materials have many pores or channels, and most of them are very fine. Because of this physical feature, water moves through the fine soil materials very slowly. Some of it mixes with other water and chemicals before it passes through.
7. _____ There are both advantages and disadvantages associated with different kinds of materials and their respective physical characteristics. If we want to slow the movement process, we can use a fine material or soil or filter. If we want to clean up a contaminated site by flushing it with water, it is generally easier to clean a site with coarse soil. This is true because it does not have many pores or channels where the contaminant can get "hung up."

Lesson Learned: The physical properties of soil, spill site, earth, and filters affect how chemicals, pollutants, and contaminants behave in the environment. When we add the complexity of chemical behavior to physical behavior, contaminant movement can become quite complex.

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.