

Chapter 2. Measuring a Physical Contaminant

Lesson 4. Turbidity

Overview: Contaminants that can affect the quality of or usefulness of water for various uses can be categorized as either chemical, physical or biological. Generally, the most troublesome physical contaminant is sediment: silt, sand, organic debris. As you will see, not only does the presence of sediment affect the drinking quality of water, it can affect other uses of water. To understand and appreciate the significance of physical contaminant such as sediment, we need to know not only how to define and measure it, but also how to prevent it and how to clean up water affected by it. The ideas taught in this lesson should give you a better understanding of sediment as a contaminant.

Purpose: The purpose of this lesson/activity is to introduce students to the idea of physical contaminants in water, help them understand the significance of such contaminants, teach them how to measure or quantify sediment, and illustrate how to deal with sediment.

Ideas Taught:

- A term commonly used to refer to the amount of physical material in a water supply is called turbidity. One way to measure turbidity is by measuring the effect turbidity or sediment has on visibility in the water or light penetration. We can measure turbidity with a simple instrument called a secci disc.

Note: This is a good activity for the students to participate in a contest format. If you decide to do the activity as a contest, you will need to break the class into groups of two or three students each and have the following supplies for each team:

Materials Needed:

- Three to five quart mason jars each completely wrapped in black construction paper, except the opening in the jar. No light can get into the jar from the sides or bottom.
- Fill one jar completely with clear water and the other four filled with four different water samples, each with a different intensity of dark color. The dark color is made by mixing various combinations of blue, green, and red food coloring. If you want each team to have identical samples, you should mix four batches of water, each with a different color of darkness and then fill each

team's jars the same. The object is to get a series of three to five jars with increasing intensity of darkness (simulating turbidity) - from clear to completely black (most turbid).

- A large envelope containing the following materials: an unsharpened pencil with eraser, thumb tack, 12-18-inch piece of cotton string, six-inch or 15-centimeter paper ruler with graduations, common pin, a waxed cardboard or styrofoam coffee cup, a couple lids from styrofoam coffee cups, and index card.
- Transparent tape
- Masking tape
- Scissors
- Stapler
- Waterproof markers in red, black, blue

Procedure:

1. ___ Before class assemble a secci disc:
2. ___ Cut a circle about two inches in diameter from a plastic coffee cup lid.
3. ___ Mark the four quadrants on the disc and color the opposite quadrants black with a waterproof marker.
4. ___ Place a thumb tack through the center of the disc, colored side up and push the thumb tack into the eraser end of the pencil.
5. ___ Take the paper ruler, wrap it around the pencil with the smallest numbers at the erasure end and extending up the pencil. Tape the paper ruler in place. The secci disc is finished.
6. ___ To use the disc, slowly immerse it in a jar, disc at the bottom. Continuing immersing progressively deeper until you can no longer see the black & white pattern.
7. ___ Measure the depth at the point where you can no longer see the disc.
8. ___ By doing this with each jar, you have a comparative scale of turbidity (the depth to which you can see). This is the commonly accepted method for measuring turbidity.
9. ___ Put the 3-5 mason jars with different water samples out for the students. If the students will be in groups, each group should have a set of jars.

10. ____ When class begins, briefly review with the class the ideas about physical contaminants and turbidity that you have already covered. The key point to emphasize here is that turbidity can affect water quality, particularly concerning light penetration and temperature.
11. ____ Explain to the students that the objective of this exercise is to design, build, test and use a type of instrument for measuring turbidity.
12. ____ Give the students 15 minutes to design, construct, test, and use some instrument for measuring the turbidity of each of the water samples in front of them. Their assignment is to arrive at a numeric value for each sample and rate the samples from least to most turbid. Do not show them your secci disc yet!
13. ____ Generally, the students have trouble getting started on this exercise. Occasionally, someone picks up on it right away. If you make it a contest and tell all the students to keep their work to themselves, they will come up with some creative ideas. If they are having trouble, provide some hints and thought provoking questions, such as "What is turbidity and what does it affect?" (Answer: light penetration) "how can we measure to get an idea of light penetration?" (Answer: depth of vision).
14. ____ At the end of the time period, either have the winning team show off their invention, which should be some derivative of the secci disc that you built in advance of the class. Show the students the secci disc you have built. Show them how it works and have each team build one and measure the turbidity of each of the samples.

Lesson Learned: Turbidity is the result of physical material being added to the water. The most frequent cause of turbidity is suspended soil particles that have entered the water as a result of erosion, soil disturbance, or stream bank scouring. Land use practices adjacent to water systems can affect the turbidity of surface water. Ground water is generally free of turbidity because of the protective and filtering layer that the soil plays.

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.