Lesson 4: What Makes Water Healthy?

Activity: Students make observations and measurements of several water samples. This activity helps students think about different ways to determine water quality.

Grade level: 4-8
Subjects: Science, social studies
Setting: Classroom
Duration: 50 minutes or more
Key terms: Benthic, pH, Secchi disk, Sediment, Turbidity, Water clarity, Water quality

Photo: D. Brenner

Objectives

After participating in this activity, students will:

- Develop their own criteria for the quality of water
- Understand that there is more to water quality than "meets the eye"
- Engage in a few water quality tests used by scientists
- Explain how water quality in both groundwater and surface systems is impacted by land use decisions
- Classify solutions as acidic or basic, given their pH
- Classify substances by their chemical properties (flammability, pH, acid-base indicators)
- Use tools and equipment appropriate to scientific investigations
- Manipulate simple tools that aid observation and data collection
- Make accurate measurements with appropriate units
- Identify the need for evidence in making scientific decisions
- Use data/samples as evidence to separate fact from opinion

Summary

Water quality is one of the most important factors in a healthy ecosystem. Clean water supports a diversity of plants and wildlife. In turn, our actions on land affect the quality of our water. Pollutants, excessive nutrients from fertilizers, and **sediment** frequently get carried into local lakes and rivers via run-off from urban areas or agricultural fields. By observing and evaluating several water samples, students begin to consider the factors that influence water quality.

Background

Scientists measure a variety of properties to determine water quality. These include temperature, acidity (pH), dissolved solids (specific conductance), particulate matter (turbidity), dissolved oxygen, hardness and suspended sediment. Each reveals something different about the health of a water body.

The result of a single measurement, however, is actually less important than monitoring changes over time. For example, if you measure the pH of the creek behind your house and find that it is 5.5, you might think it is acidic. But a pH of 5.5 might be "normal" for that creek. If the pH or the turbidity of your creek begins to change, however, something may be happening (probably upstream) that is affecting water quality. Taking routine measurements at scheduled intervals allows you to monitor overall changes in water quality.

The following water properties are important in determining water quality:

- **Temperature:** Water temperature is important to fish and aquatic plants. Temperature can affect the level of oxygen, as well as the ability of organisms to resist certain pollutants.
- **Acidity — pH:** The measurement of pH is a measure of the amount of hydrogen ions (H+) present in a substance such as water. Knowing the amount of hydrogen in a substance allows us to judge whether it is acidic, neutral, or basic.
- **Dissolved Oxygen:** A small amount of oxygen, about ten molecules of oxygen per million molecules of water, is dissolved in water. Fish and microscopic organisms need dissolved oxygen to survive.
- **Turbidity:** Turbidity makes the water cloudy or opaque. Turbidity is the amount of particulate matter (such as clay, silt, plankton, or microscopic organisms) suspended in water.
- **Specific conductance:** Specific conductance measures the capacity of water to conduct an electrical current. It depends on the amount of dissolved solids, such as salt, in the water.
- **Hardness:** The amount of dissolved calcium and magnesium in water determines its "hardness." Water hardness varies throughout the United States.
- **Suspended sediment:** Suspended sediment is the amount of soil circulating in water. The amount depends in part on the speed of the water flow. Fast-flowing water can pick up and hold, or suspend, more soil than calm water.

Materials and Preparation

- 5 clear glass jars or clear soda bottles with lids
- Instant coffee and/or cocoa, salt, hydrochloric acid, isopropyl alcohol, and food coloring (to make a purple color)
- Local river or pond water
- *Water Quality Worksheet*
- Water quality testing kits that can be used to measure oxygen and pH

Note: See *Water Quality Worksheet* and other materials at the end of this lesson (supplemental materials).

Advance Preparation

Create water quality jars. Fill the 5 jars with water. (Jar 5 will be filled with the river water.)

- Jar 1 -Add enough coffee grounds and cocoa powder until the water has a good "dirty" look. Label the jar 1.
- Jar 2- Add food coloring so that the water appears clear purple. Label the jar 2.

- Jar 3- Add a trace of hydrochloric acid. The HCl solution should be clear and colorless. Label the jar 3.
- Jar 4- Add a few tablespoons of kosher table salt. The salt will dissolve in the water, resulting in a clear colorless solution. Label the jar 4.
- Jar 5- Fill a jar or bottle with water from your local river. Label the jar 5.

Procedure

1. In small groups, have students examine the water sample jars. You may choose to have students record their observations on the Water Quality Worksheet or in their notebooks.
2. Ask groups of students to work together to determine which of the water samples they would be willing to use for such things as fishing, swimming, boating or drinking.
3. After students have observed all the jars, have them share their consensus and rationale for their decisions regarding water use. Prompt students to provide evidence for their decisions. (You may also choose to record the class data in a chart.)
4. Using this shared experience, facilitate a discussion that leads to an agreed upon definition of "water quality."
5. Have students brainstorm answers to the following questions: What is meant by quality? What is water quality? How can we determine water quality? Why is water quality important to us and to other animals? How did we determine water quality for the bottles? Are these methods trustworthy? How else could we measure water quality? How might scientists measure water quality?
6. Introduce the concepts of dissolved oxygen and pH. Explain what numerical values for each are necessary for life. Explain that scientists use these numerical values to measure water quality.
7. Use one of the water samples from before to demonstrate how each test is conducted.
8. Allow groups of students to measure oxygen and pH for the other water samples. Summarize the results on the board. Discuss the results from a scientist's perspective. Which sample has the highest quality based on this data?
9. Discuss whether these results are consistent with the determinations made just by looking at the water.
10. Explain that water quality is a complex concept and there are many other variables that scientists use to measure it. Explain that you can't tell true water quality just by looking at it.

Adaptations

Provide students with articles from newspapers that refer to the water quality of local rivers. Choose articles that address living organisms in the water or human uses of the water. Describe how members of the community talk about their river or what actions they're taking to prevent or reduce water quality problems.

Source

Used with permission: Center for Highly Interactive Classrooms, Curricula and Computing in Education (Hi-ce), University of Michigan School of Education.

Assessment & Standards

See separate document: FLOW_Assessment_GLCE.pdf

FLOW Feedback

Please take 10 minutes to provide us with your feedback.
Go to: http://www.miseagrant.umich.edu/flow/flow-feedback.html

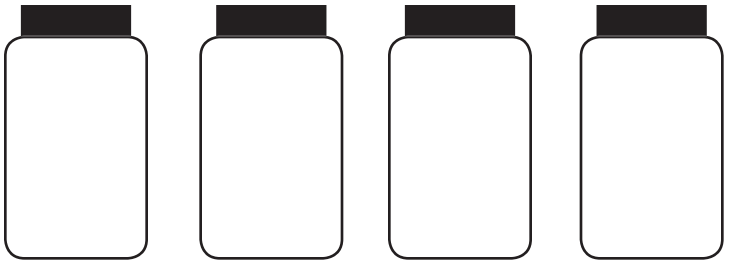
Supplemental Materials, FLOW Unit 2

Lesson 4 - What Makes Water Healthy, Documents:

- Water Quality Worksheet

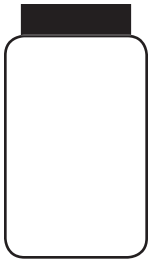
DIRECTIONS:

Look at jars 1-4 that your teacher has provided. Would you use the water in each of those jars to fish? Swim? Boat? Drink? Record your answers on the back of this sheet. Provide reasons for your answers.



Jar 1 Jar 2 Jar 3 Jar 4

Look at jar 5. Would you use the water in that jar to fish? Swim? Boat? Drink?



Jar 5

1. How did we determine water quality for the bottles? Was it an adequate method?

2. How else could we measure water quality?

3. If we were walking along a river, lake or stream, how could we determine its quality?