WATER QUALITY; WHY IS IT SO IMPORTANT?

by Debra Veeder

OBJECTIVES:
Students will be able to describe the relationship between chemical changes in a stream and the reasons these changes take place.

METHOD:
Students will;
1) Measure temperature, **pH**, **dissolved oxygen**, and **turbidity** on a water sample.
2) From the measurement obtained, students will determine the quality of the water.
3) Discuss the factors that would contribute to the water quality readings.

MATERIALS:
World Water Monitoring Day test kits
Sample of stream water
Chart to record results
(Charts for water testing may be found by following the link Tools for Study on this site.)

Grade Level: 3rd + (adjust as needed)
Subject Areas: Science
Duration: One 45 minute session
Group Size: Small groups of 2-4 students
Setting: Indoors
Key Terms: temperature, **pH**, **dissolved oxygen**, **turbidity**, Clean Water Act, **pollution**, action, responsibility

BACKGROUND:

Water is extremely important for human life. We not only use it for drinking, cooking, and washing but also for recreation. Many people like to fish, swim and boat in it. Mississippi has certain water quality standards set forth under the Clean Water Act that specify criteria water bodies should meet for their designated use.

Various forms of pollution can change the chemical make-up of streams and may prevent it from meeting the criteria for its designated use. One way to look at the quality of water in streams is to test four parameters; temperature, pH, dissolved oxygen, and turbidity. These four parameters are tested because of their simplicity and usefulness in screening water for potential problems. They help answer the question "What's in the water?".

Temperature is significant because it affects the amount of **dissolved oxygen** in the water. The amount of oxygen that will dissolve in water increases as temperature decreases. For example, water at 0 degrees Celsius will hold up to 14.6 mg of oxygen per liter, while at 30 degrees Celsius it will hold only up to 7.6 mg/l. Temperature also affects chemical and biochemical reaction rates. As temperature increases, reaction rates speed up.

Symbol "pH" is a numerical expression of the **acidity** or **alkalinity** of a substance. The pH of a water body is important because most **organisms** have a relatively narrow band of pH in which they can live and thrive. When the pH is outside those limits, the organisms cannot survive. The pH is also important because it is a factor in the amount of treatment necessary for water to be used for drinking or for industrial water supply and because the solubility of many other chemicals vary with pH. Photosynthesis, respiration, decomposition, and surrounding geology all affect pH, as do sources of pollution, including atmospheric deposition.

Turbidity, or cloudiness in water, is caused by suspended solid matter, which scatters light passing through the water. Turbidity relates directly to rainfall, **runoff**, and man-made discharges. A hard, fast rain washes a great deal of soil and **organic** matter into the water. The turbid water that results absorbs more heat from the sun than does clear water, so muddy lakes and streams are often warmer than clear ones, but the direct affects of turbidity on the **aquatic** life are more important than the temperature affects. Turbidity reduces the amount of light that penetrates into the water, reducing the light available for **algae** and aquatic weeds to use in **photosynthesis**. High levels of turbidity may coat gill membranes of fish, making it difficult for them to breathe. Finally, the suspended (turbid) material eventually settles to the bottom, where it may cover food supplies for fish and macroinvertebrates and make fish spawning areas unsuitable. If the water is very turbid, it might be the result of soil **erosion**, urban runoff, algae blooms, or bottom sediment disturbances.

Dissolved oxygen gas is important because it is the basis for most aquatic life. The oxygen contained in water molecules can't be used by the life forms in a stream or lake. It is locked in molecularly, and simply isn't available to them. The amount of dissolved oxygen gas is the single most important chemical variable affecting aquatic life.

PROCEDURES:

The World Water Monitoring Day kit is from LaMotte. Contents include; canister (for sampling and storage of the rest of the kit), pH tablets, dissolved oxygen test tablets, small sample tube, 10 ml test tube, thermometers (self-stick), Secchi disk icon (self-stick, to apply to the bottom of the canister), and a chart to read results. Also needed are timing devices/ stopwatches. Prior to using the kits, you need to apply the Secchi disk to the bottom of the canister and apply the thermometers to a plastic tube so that it can be inserted into the canister to read the water temperature. You can also purchase small thermometers that could be used in place of the self-stick ones.

To obtain the **Temperature** you will place the thermometer in the canister for one minute. Once you remove the thermometer from the water, read your temperature immediately. The thermometer that has the blue star will only display a temperature in very cold water. You will most likely use the thermometer with the numbers. You will record the temperature that is highlighted in green. The other colors around it show the range of the water temperature.

The **Dissolved Oxygen** test is prepared in the small tube. The Dissolved Oxygen test measures how much oxygen is available in the water. This test takes about 9 minutes to complete, waiting for the tablets to dissolve and the color to develop. You can record the results as parts per million (ppm) or the test results can be combined with the current temperature to determine the **saturation**.

a) Submerge the small tube into the water sample. Carefully remove the tube from the water sample, keeping the tube full to the top.
b) Drop two dissolved oxygen testabs into the tube. Water will overflow when the tablets are added.
c) Screw the cap on the tube. More water will overflow as the cap is tightened. Make sure no bubbles are present in the sample.
d) Mix by inverting the tube over and over until the tablets have disintegrated. This will take about 4 minutes.
e) Wait 5 minutes for the color to develop.
f) Compare the color of the sample to the Dissolved Oxygen color chart. Record the result as ppm Dissolved Oxygen.

HOW TO DETERMINE % SATURATION: Locate the temperature of the water sample on the % Saturation chart. Locate the Dissolved Oxygen result of the water sample at the top of the chart. The % Saturation of the water sample is where the temperature row and the Dissolved Oxygen column intersect. For example: if the water sample temperature is 16C and the Dissolved Oxygen result is 4 ppm, then the % Saturation is 41.

Dissolved Oxygen

Temperature Degrees Celsius	0 ppm	4 ppm	8 ppm
2	0	29	58
4	0	31	61
6	0	32	64
8	0	34	68
10	0	35	71
12	0	37	74
14	0	39	78
16	0	41	81
18	0	42	84
20	0	44	88
22	0	46	92
24	0	48	95
26	0	49	99
28	0	51	102
30	0	53	106

The **pH** test is prepared in the longer 10ml test tube. There is a short waiting period for the pH tablets to disintegrate until the results can be read.

a) Fill the large test tube to the 10ml line with the water sample.
b) Add one pH wide range test tab.
c) Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.
d) Compare the color of the sample to the pH color chart. Record the result as pH.

Turbidity test is done by comparing the test chart to the view of the Secchi disk icon sticker at the bottom of the canister. Hold the Turbidity chart on the top edge of the canister. Looking down into the canister, compare the appearance of the Secchi disk icon in the canister to the chart. Record the result as Turbidity in JTU.

EXTENSION:

List reasons why the water quality is what it is.
Students could make recommendations on what might be done to improve the water quality.
Research the Clean Water Act.
Research one of the four test parameters and explain what conditions affect its measurements.

EVALUATION:

1) Have students identify what could affect the results for temperature, **pH**, **dissolved oxygen**, and **turbidity**.

2) Have students identify different types of **pollution** that can affect their streams.

3) Have students list reasons it is important to protect our streams and keep the water clean.