Water Quality Testing Station

Virginia Science SOLs

6.1, 6.5, 6.7, LS.1, LS.4, LS.7 and LS.11

Key Concepts

the basic needs of organisms in order to carry out life processes, the health of ecosystems, the importance of protecting and maintaining water resources, water quality monitoring, and using field equipment

Setting

riparian trail adjacent to North Anna River (north side of Route 30) and the wetlands outlet (south side of Route 30)

Summary

Students will measure the pH, DO (dissolved oxygen) and the temperature of a local stream to determine if conditions are optimal for supporting aquatic life.

Learning Objectives

The students will:

1. practice collecting, recording and analyzing data in the field with water quality testing equipment.
2. determine if the water quality supports aquatic life.
3. discuss and hypothesize what impacts might be affecting the water quality.
4. explain why water quality is important to aquatic life.

Background Information

Students will arrive in groups of approximately 25 with adult chaperones. Brief summaries of the following information on water quality parameters should be provided during the course of the 30 minute station.

pH

The measure of how acidic or basic any liquid is pH. The pH scale ranges from 0-14 with 0 being most acidic and 14 being most basic. Neutral is 7. For water to support aquatic life it should test between 6.5 and 8.5. Sream pH level is primarily determined by the bedrock and soils of the channel.

However acid deposition, either wet such as acid rain or dry such as acidic gases and particles moved by the wind, can make water too acidic for aquatic life. Runoff containing a variety of cleaning products such a laundry detergent or bleach can cause the water to be too basic to support aquatic life. Runoff carrying fertilizers can also affect the pH. Depending upon the fertilizer it can either be too acidic or too basic.

People need to be particularly careful as to what can be carried away by runoff which ends up in streams, rivers, bays and eventually the ocean.

DO (dissolved oxygen)

The measure of how many molecules of oxygen are in the water is called DO. Many forms of aquatic life are dependent upon oxygen just as humans are. We get our oxygen from the air, but these organisms pull the dissolved oxygen out of the water. If there is too little oxygen, these organisms can't breathe and die.

Background , continued

Many factors can affect the amount of DO in the water. Moving water has higher levels of DO than still or stagnant water. The type of organisms present in water (plant, bacteria, fungi) affects the DO concentration. Oxygen is more easily dissolved into water with low levels of dissolved or suspended solids. Water with high amounts of nutrients (from runoff carrying fertilizers) can produce algae in large quantities. When these algae die, bacteria decompose them and use up oxygen. This process is called eutrophication and can lead to massive fish kills. The colder the water, the more oxygen can be dissolved in the water.

Temperature

Temperature can affect the organisms that live in water in several ways:

- the amount of oxygen that can be dissolved in the water
- the temperature of the organisms within the water and their activity, rate of growth and reproduction
- the rate of photosynthesis by plants in the water

Most organisms that live in water will have the same temperature within their bodies as the temperature of the water that surrounds them. Aquatic organisms have a very narrow range of temperatures in which they can survive, grow and reproduce. If the water becomes too hot or too cold, the organisms are unable to breathe, grow and reproduce as they should.

Human activity such as cutting down trees that shade a river or stream, deposition of sediment from erosion caused by development, or dumping hot water that has cooled equipment in a power plant can adversely affect the lives of aquatic organisms.

Materials

- La Motte "World Water Monitoring Day" kit (per small group of approximately five students) which should include:
  - A temperature strip (in °C)
  - Small glass vial with cap
  - Plastic "test tube" with cap
  - DO TesTabs in foil packets
  - pH wide range TesTabs in foil packets
  - color chart with DO and pH
  - A portable dry erase board and marker may be used to record data for the entire group (optional)
- If the kits have been used multiple times, water thermometers may be preferable to the strips
- 1 student data card per team (from journal)
- pH paper (i.e. pool supply type) for comparison purposes
- water quality test probeware if available for comparison purposes
- laminated sheets showing pH and DO levels of common aquatic organisms

Procedure

1. In advance of the first session, determine with the field day coordinator where the water samples are to be taken and how they are to be stored. Weather and other conditions may affect whether students can be safely involved in this process or not.

2. Explain to the group that they will be performing 3 different water quality tests within their small group: pH, DO and temperature. Ask the students if anyone can explain what pH measures and why it's important to aquatic life. Next ask if anyone can explain what DO is and why it's important to aquatic life. They will all be familiar with temperature so simply ask if temperature is important to aquatic life and why or why not.

3. Based on their answers to the questions in step 2, briefly discuss what each test measures and how pH, DO and temperature affect aquatic life.

4. Discuss where and how today's water samples were (or will be) taken and how this may influence the results. For example, if the container with the water sample has not been kept full and cool it may cause the dissolved oxygen reading to be lower than it may have been otherwise.

5. Before dismissing the groups to perform the tests, ask the students if they have used the kits before and if they need a brief review of the procedures. Remind them that the instruction booklets provide the directions as well.

6. Explain to the adult chaperones that the five students can be divided up to perform the test as follows: two for DO, two for pH and one student for temperature. Typically, the DO takes the longest, so the pH and temperature students can begin answering the questions on the data card, when they have completed their tests. They can also be assigned to take pH readings with pH strips for comparison purposes.

   Instructions for performing the tests are:

   Measuring DO

   - Choose 2 students to measure DO.
   - One student will submerge the small glass vial in the water sample. The vial should be filled completely and removed carefully, keeping it full to the top.
   - The other student will drop 2 DO TesTabs into the vial. (Some water will overflow when the tabs are dropped in.) Screw the cap on the vial. More water may overflow as the cap is tightened. Make sure no bubbles are present in the sample.
   - The TesTabs should be dissolved by inverting the vial over and over. This may take about 4 minutes.
   - Wait 5 more minutes for the color to develop.
   - Compare the color of the sample to the DO color chart.
   - Have students record the results (0ppm, 4ppm or 8ppm).
   - To find the percentage of saturation use the chart on page 16 of the booklet in the World Water Monitoring Day kit. (The temperature of the water will have to have been taken to find the percentage of saturation.)
   - Have students record the percent saturation.

   Measuring pH

   - Choose 2 students to measure pH.
   - One student can fill the test tube to the 10mL line with the water sample.
   - The second student can add one pH wide range TesTab to the water sample.
   - Cap the test tube and invert repeatedly until the TesTab has disintegrated. Bits of material may remain in the sample.
   - Compare the color of the sample to the pH color chart.
   - Record the results.

   Measuring Temperature

   - Use a water thermometer to take the temperature of a water sample

Procedure, continued

Debriefing Activity:

7. When it looks as though the majority of the small groups have completed their tasks, call them back together and discuss the overall results of the tests.

DO Results

This kit is a simple screening test and will only give a poor (0ppm), fair (4ppm), or good (8ppm) rating for the amount of DO. Based on the test do the students think that the DO level is appropriate for supporting aquatic life? If not, what might be affecting the DO level? Note that different aquatic organisms have varying toleratance levels to changes in DO and pH.

pH Results

The pH should be a 6, 7, or 8 on the color chart to be optimal for aquatic life. Based on the test do the students think the pH level is appropriate for supporting aquatic life? If not, is the water too acidic or too basic? How might the water have gotten this way?

Temperature Results

In general does the temperature seems exceedingly hot or cold for this time of year and place? Are there any signs of drainage into the stream that might be affecting the temperature?

If the station leader or the teacher who are visiting that day have access to electronic probe ware, additional readings can be taken for comparison.

Extension activity (if time left in rotation)

How do everyday products that get into runoff affect the pH of water?

Materials: 5 10-mL test tubes, 5 pH wide range TesTabs, 5 eye droppers or pipettes, small amounts of Mr. Clean, All, lime pellets, antibacterial hand soap, and ice melt (potassium chlorides & sodium chloride)

- Fill 5 test tubes (one for each group) with 10mL of the water sample. The students can do themselves if time. If not, prepare while they're doing the other tests
- In test tube 1 add three drops of Mr. Clean; in test tube 2 add three drops of All; in test tube 3 add three "pellets" of pelletized lime; in test tube 4 add three drops of antibacterial soap; in test tube 4 add three drops of ice melt.
- Add a pH wide range TesTab to each test tube, cap, and invert repeatedly until tab is disintegrated.
- Compare each test tube to the pH color chart.

Did the products affect the pH of the water? How? Did the water become more acidic or more basic?

How might these products get into runoff?

Resources

World Water Monitoring Day homepage at www.worldwatermonitoringday.org

For an extensive list of water quality data resources, visit the main resource link of the on-line curriculum.

Team member names

Student Water Quality Testing Data Card

pH, Dissolved Oxygen (DO) and Temperature

Temperature: _____ °C

In general does the temperature seems exceedingly hot or cold for this time of year and place? If so, what might be causing the temperature change?

DO: _____ ppm _____ % of saturation

Is the level of DO appropriate for supporting aquatic life? If not, what might be affecting the level of DO?

pH: _____

Is the pH of the water in the appropriate range for aquatic life? If not, is the water too acidic or too basic? Is there any evidence of what might be changing the pH?

Based on the results of the three tests do you think this is a healthy stream that adequately supports aquatic life? Why or why not?

How can we protect streams and rivers so they have appropriate levels of DO, pH and temperatures?

Why is it important to protect streams and rivers?