Chemically Testing for Water Quality

Lesson focus: water quality testing

Lesson objectives:

- Follow complex directions to complete chemical water tests to include ph, dissolved oxygen, phosphate, nitrate, alkalinity, or settable solids
- Record gathered data in field notebook, including observations and results of chemical testing
- Construct a data chart and graph to depict the results of the chemical testing
- Write a report using collected data to make conclusions on water quality at the sample site and factors affecting the quality at that site.
- Analyze and compare collected data in order to assess the overall quality of the body of water

Enduring Understanding:

- Humans impact the water quality in a watershed.
- All living things need good water quality for their survival.

Georgia Performance Standards:

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

a. Exhibit the above traits in their own scientific activities.
b. Recognize that different explanations often can be given for the same evidence.
c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

a. Follow correct procedures for use of scientific apparatus.
b. Demonstrate appropriate technique in all laboratory situations.
c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSh3. Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.
b. Develop procedures for solving scientific problems.
c. Collect, organize and record appropriate data.
d. Graphically compare and analyze data points and/or summary statistics.
e. Develop reasonable conclusions based on data collected.
f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

a. Develop and use systematic procedures for recording and organizing information.
b. Use technology to produce tables and graphs.

c. Use technology to develop, test, and revise experimental or mathematical models.

SCSh6. Students will communicate scientific investigations and information clearly.

a. Write clear, coherent laboratory reports related to scientific investigations.
b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.
c. Use data as evidence to support scientific arguments and claims in written or oral presentations.
d. Participate in group discussions of scientific investigation and current scientific issues.

SCSh9. Students will enhance reading in all curriculum areas by:

a. Reading in all curriculum areas
- Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.

c. Building vocabulary knowledge
- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
- Explore understanding of new words found in subject area texts.

d. Establishing context
- Explore life experiences related to subject area content.
- Discuss in both writing and speaking how certain words are subject area related.
- Determine strategies for finding content and contextual meaning for unknown words.

SEV4. Students will understand and describe availability, allocation and conservation of energy and other resources

d. Describe the relationship of energy consumption and the living standards of societies.
f. Describe the need for informed decision making of resource utilization. (*I.e.* energy and water usage allocation, conservation, food and land, and long-term depletion)

SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.

c. Explain how human activities affect global and local sustainability.
d. Describe the actual and potential effects of habitat destruction, erosion, and depletion of soil fertility associated with human activities.
e. Describe the effects and potential implications of pollution and resource depletion on the environment at the local and global levels (*e.g.* air and water pollution, solid waste disposal, depletion of the stratospheric ozone, global warming, and land uses).

Grade level: High School

Materials:

- LaMotte chemical test kits for: temperature, dissolved oxygen, pH, Hach chemical test kits for: nitrate, phosphate, alkalinity
- Copies of chemical test instructions from the Adopt-a-Stream website (http://www.georgiaadoptastream.org/) – using the website will provide the most current information
- 2 liter water sample
- Waste water bucket
- Protective gloves (non-latex)
- Safety goggles
- Blank notebook to be used as a field notebook for data recording
- Handouts for the slide presentation

Time Needed: 2 weeks, 1 hour each day

Background information:

Water quality is an important part of any aquatic ecosystem. By taking water samples and testing things such as temperature, pH, nutrient levels and dissolved oxygen levels, scientists can monitor the health of these ecosystems. Taking samples regularly over time allows us to monitor creeks, streams, lakes and rivers, and to observe and record any changes in water quality which could have an effect on the ecosystem.

Temperature:
Water temperatures have an effect on which species are able to live in a particular area. Temperatures may also affect animals' feeding and reproduction habits, as well as the water's capacity to hold dissolved oxygen (cold water can dissolve more oxygen than warm water). Temperatures change naturally throughout the day and are also affected both by natural factors such as shade cover and snow melt and by human factors such as industrial discharge and surface runoff.

pH:
pH is a measurement of how acidic or how basic a body of water is. Different species of aquatic life can tolerate different pH ranges; however most species prefer water that is relatively close to neutral pH, or 7.0. Extremes in pH can make water uninhabitable or may affect feeding and reproduction. While there are natural geographical variations in pH due to factors such as soil composition, pH levels may also be affected by human factors such as mining drainage and industrial discharge.

Dissolved Oxygen:
Just as with temperature and pH, different species require different concentrations of oxygen in the water. Oxygen can enter water directly from the atmosphere and is

produced during photosynthesis by plants and algae. It is removed from the water by plants and algae during respiration and by the decay of organic matter. Oxygen concentrations may be affected by water temperature, pressure, and salinity, as well as by the density of fish populations and by plant and algae photosynthesis, respiration, and decay.

Nutrients:
Nutrients such as nitrogen and phosphorous are present in water naturally, from animal waste and decaying organic matter. These nutrients can sometimes build up in water both from natural sources and from human factors, including sewage, fertilizer runoff, detergents, and industrial discharge. This buildup of nutrients is called **eutrophication.** High levels of nutrients may spur the growth of algae and aquatic plants, which can lead to oxygen depletion due to respiration and decay by the plants or algae.

For information on water quality parameters, please see the resources section.

Learning Procedure:

1. Discuss with students (using a power point presentation and hand outs) the purpose of water quality monitoring, possible parameters to test for, acceptable limits for each test, and what it means when the results are outside the acceptable range.
2. Divide the class into groups of 3-4 students.
3. In the lab, review the field instructions on how to conduct each of the six tests on "practice" water. Monitor the student activities.
4. Once everyone is comfortable with the tests, assign one test to each group to conduct stream side. Hand out instructions for that test to each group.
5. Head to the sample site. Either prior to heading out or at the site, be sure to review basic safety procedures with the class.
6. Collect a water sample and perform the chemical tests. Record results.
7. Have students record their observations about the sample site and conditions, making sketches in a field notebook.
8. Group leaders will verbally share their data with the class. Each student should record all the data in his or her field notebook.
9. Repeat steps 7-10 each day for two weeks with each team conducting each of the various tests throughout the test period.
10. Based on the results, each student should construct a data sheet and a graph in EXCEL and write a summary report (including the graph) analyzing the data and making conclusions concerning human impact from non-point source pollution and its effect on the sample site. They should use a line graph to show normal limits compared to test data.

Evaluation:

- Did the students accurately perform each test?
- Did the student keep an accurate data recording in field notebook?
- Did the student submit a report that analyzed the data and drew conclusions about human impact?

Rubric for Evaluation of Reports:

- **Level 1:**
  Field notebook data incomplete or inaccurate. Data sheet and graph incomplete or inaccurate. Summary report does not analyze data or draws incorrect or illogical conclusions about effects of non-point source pollution. Report sloppy and disorganized.
- **Level 2:**
  Field notebook data complete and mostly accurate. Data sheet and graph complete and mostly accurate with some errors or mislabeling. Summary report attempts to draw conclusions from data about effects of non-point source pollution, but with some errors. Report somewhat organized and neat.
- **Level 3:**
  Field notebook complete and accurate with very little error. Data sheet and graph complete and accurate, labeled correctly, with very little error. Line graph used to compare normal limits to test data. Summary report analyzes data with little error and provides logical conclusions about effects of non-point source pollution. Report neat and well-organized.
- **Level 4:**
  Field notebook thoroughly complete and accurate. Data sheet and graph thoroughly complete and accurate and labeled clearly and correctly. Line graph used to compare normal limits to test data. Summary report analyzes data thoroughly and accurately and draws conclusions in a clear and concise manner about effects of non-point source pollution. Report extremely neat and well organized.

Extensions:

1. Chemical testing at sample site may be carried on once a month, continuing to collect data over an extended period. Continue graphing each test date to gain more comparative data.

2. Visit site on the same stream in a different location. Perform testing at the new location and compare data gathered at the first site.

3. Ask students to determine the source of the stream and into what other bodies of water it flows by either physically exploring or by investigating via a road map or on the county's website.

4. Ask students to identify potential sources of pollution and non-point source pollution along the watershed. Remind them that the stream is connected to the entire watershed.

5. Ask students to develop a plan to improve the watershed. For example if there is a farm or industrial complex located within the watershed what filters could be put in place to reduce and better yet eliminate the pollution.

6. Ask students to identify potential sources of pollution in their neighborhoods and even their own households. Ask them to offer ways to reduce or better yet eliminate the sources. For example, run off from streets and lawns may go directly into ditches that do not have adequate grassy banks that buffer and filter pollutants. Students may wish to encourage family members to replace harmful household cleaning products with environmentally safe ones.

7. Ask students to create a model or drawing of an environmentally friendly community with a complete infrastructure of streets, schools, churches, businesses, homes and green spaces.

Resources:

Georgia Adopt-A-Stream Program: www.gaadoptastream.org
- Biological & Chemical Stream Monitoring
- Getting to Know Your Watershed
- Educator's Guide
- You're the Solution to Water Pollution – Poster
- Power Point Presentations: Introduction, Chemical Training

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