What's in the Water? - Stream Side Science

Summary

In this exercise, students will observe and list abiotic factors in an aquatic system and measure four of them (pH, dissolved oxygen, turbidity and temperature).

Time Frame

2 class periods of 45 minutes each

Materials

- pH test kits *
- Dissolved oxygen kits *
- Turbidity tubes *
- Field thermometers *
- Pencils
- Bucket
- Copies of the student worksheet (pdf)
- Copies of the chemical sampling instruction sheets (pdf)
- Waste bottles (e.g., empty pop bottles)
- Clip boards 15

* For information on equipment for loan or for purchase, contact USU Water Quality Extension at (435) 797-2580 or www.extension.usu.edu/waterquality

Background for Teachers

Purpose

To observe and list abiotic factors in specific ecosystems.

Background

For background information:

- The Teacher Resource pages (pdf)
  provided with this activity give additional information about each factor, including how that factor may vary at different locations, during different times, and some suggested discussion questions.
- The Chemical Properties (pdf)
  section of the Utah Stream Team Manual defines each factor and discusses how the factor changes due to natural and human influences, why the factor is important in aquatic ecosystems, how to take a sample and how to interpret the results.

Intended Learning Outcomes

- Use Science Process and Thinking Skills
  - Observe objects, events and patterns and record both qualitative and quantitative information.
  - Use comparisons to help understand observations and phenomena.
  - Evaluate, sort, and sequence data according to given criteria.
  - Select and use appropriate technological instruments to collect and analyze data.
  - Plan and conduct experiments in which students may:
    - Identify a problem.
    - Formulate research questions and hypotheses.
    - Predict results of investigations based upon prior data.
    - Identify variables and describe the relationships between them.

Plan procedures to control independent variables.
Collect data on the dependent variable(s).
Select the appropriate format (e.g., graph, chart, diagram) and use it to summarize the data obtained.
Analyze data, check it for accuracy and construct reasonable conclusions.
Prepare written and oral reports of investigations.

Distinguish between factual statements and inferences.
Use mathematics as a precise method for showing relationships.
Form alternative hypotheses to explain a problem.

Manifest Scientific Attitudes and Interests

Raise questions about objects, events and processes that can be answered through scientific investigation.
Maintain an open and questioning mind toward ideas and alternative points of view.

Demonstrate Understanding of Science Concepts, Principles and Systems

Know and explain science information specified for the subject being studied.
Apply principles and concepts of science to explain various phenomena.

Communicate Effectively Using Science Language and Reasoning

Provide relevant data to support their inferences and conclusions.
Use precise scientific language in oral and written communication.
Use proper English in oral and written reports.
Use mathematical language and reasoning to communicate information.

Demonstrate Awareness of Social and Historical Aspects of Science

Give instances of how technological advances have influenced the progress of science and how science has influenced advances in technology.
Understand the cumulative nature of scientific knowledge.

Demonstrate Understanding of the Nature of Science

Science is a way of knowing that is used by many people, not just scientists.
Understand that science investigations use a variety of methods and do not always use the same set of procedures; understand that there is not just one "scientific method."
Science findings are based upon evidence.
Understand that science conclusions are tentative and therefore never final.
Understandings based upon these conclusions are subject to revision in light of new evidence.
Understand that various disciplines of science are interrelated and share common rules of evidence to explain phenomena in the natural world.
Understand that scientific inquiry is characterized by a common set of values that include logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results and honest and ethical reporting of findings. These values function as criteria in distinguishing between science and non-science.

Instructional Procedures

Classroom Activity:

Ask students to list all the abiotic factors they can think of in an aquatic system *(e.g., solar radiation, physical structure of the stream or lake, surrounding landscape, weather, and the properties of water itself).*
Tell them they will be testing four of these factors that relate specifically to the water -- pH, dissolved oxygen (DO), turbidity and temperature.
Define each of these factors. Talk about why these factors are important in an aquatic ecosystem, what can naturally influence these factors, and what humans can do to influence

these factors.

Explain to the students that they will be going out to a stream (or other water body) to measure pH, DO, turbidity and temperature. Sampling instruction sheets are found at the end of this lesson. You may want to review the actual testing procedures before going into the field.

Field Activity:

Set up a station for each factor (pH, DO, turbidity and temperature).

At each station, provide:

- Sampling instruction sheets (if possible, laminate these!)
- Waste bottles
- The appropriate testing kit
- Sample bottles if you are not near the stream

Divide the students into four groups. Provide each group with clipboards, pencils, and worksheets. Explain to the students that each group will start at a different station, and rotate so they will measure all the factors.

Have the students fill out the site observations section of the student worksheet before beginning their measurements. Have them follow the instructions for measuring each factor found on the sampling instruction sheets.

Have the students record their results on the student worksheet. You can choose to have one record keeper per group, or have each student record all the information.

Applying the Data:

Have the students compile and graph the data to demonstrate a particular pattern. For example:

- Create a time series graph to show changes in one factor over time.
- Create a graph comparing the results from different water sources.
- Create a graph comparing the results from different teams.
- Create a graph that shows sample statistics (e.g., the mean and standard deviation or range of different student measurements).
- Create a graph that shows the relationship between different factors (e.g., samples at different times or from different sources).

See sample graphs below and on the following page.

Further Discussion:

(See additional discussion questions relating to each measurement in the Teacher Resource pages.)

1. Why would previous weather conditions be of interest when looking at stream conditions?
   Often it can take hours or days for the runoff from a storm or snowmelt to reach the water and travel down the river. Therefore, previous weather may be as important as today's weather in explaining your results.
2. How do you think the abiotic factors you observed at the site may have affected your measurements?
   - *Hot weather may result in extra snowmelt upstream and increase flows. Sunny weather may increase photosynthesis at your site, and therefore increase dissolved oxygen and pH levels. Higher flows from storms or snowmelt may increase the turbidity in your stream.*
   - *Soils in the watershed will affect the chemical composition of the runoff that reaches the stream. Topography (the steepness of the land) will determine whether the stream is steep and fast or slow and wide, which will affect dissolved oxygen and temperature.*
   - *Vegetation along the stream provides shade and protects the banks from erosion.*
   - *Land uses along the stream and in the watershed will determine what type of pollutants may enter the stream (e.g., sediment from agriculture or logging, metals and oils from roads, or fertilizers from golf courses).*

3. Discuss variability in the data, or discuss why the measurements may be variable.
   There is always natural variability in ecosystems (see the discussion question above). When we take measurements, we also introduce some variability due to differences in observers (eye sight, experience) and limitations of the equipment.
4. Discuss why the results might change under the following conditions.
   (See the Resource pages that follow about each parameter to help guide this discussion.)
   - seasons
   - from year to year
   - throughout the day

Extensions

Use other water sources to compare results.
Sample the same station on multiple dates to compare results.
Take measurements on "modified samples" -- see the Utah Stream Team Manual Chemical Properties Section (pdf) for more information.

Bibliography

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Additional resources can be found on the USU Stream Side Science 9th Grade Curriculum web page.

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