Who Lives in the Water? - Stream Side Science

Summary

In this exercise, students will collect and observe macroinvertebrates in an aquatic system. They will record and summarize their findings.

Time Frame

1 class periods of 70 minutes each

Materials

- Kick nets*
- Bucket
- Plastic pans*
- Pencils
- Transfer pipettes*
- Clipboards
- Magnifying glasses*
- Plastic petri dishes*
- Copies of student worksheet (pdf)
- Waders
- Macroinvertebrate keys and photos (pdf)
- Copies of macroinvertebrate sampling instructions (pdf)

If you wish to preserve samples:

- Ethanol or isopropyl alcohol (70% alcohol, 30% water)
- Small glass vials*

* 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 investigate the diversity in a specific area through observation and charting.

Background

For background information see the macroinvertebrate section (pdf) of the Utah Stream Team Manual for information about macroinvertebrates and natural and human influence on macroinvertebrate populations.

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.
Develop and use classification systems.

Manifest Scientific Attitudes and Interests

Raise questions about objects, events and processes that can be answered through scientific investigation.

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.
Solve problems by applying science principles and procedures.

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 reference sources to obtain information and cite the sources.
Use mathematical language and reasoning to communicate information.

Demonstrate Awareness of Social and Historical Aspects of Science

Cite examples of how science affects human life.
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.
Recognize contributions to science knowledge that have been made by both women and men.

Demonstrate Understanding of the Nature of Science

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.

Instructional Procedures

Classroom Activity:

Tell your students this activity will focus on the diversity of macroinvertebrates found in an aquatic ecosystem.

Ask the students to define the word aquatic macroinvertebrate. (*An organism that is large enough to see with the naked eye, and has no backbone.*)

Ask the students to define the term diversity. (*The number of different species found in an area.*)

Have students compare two different stream types (e.g., a small fast moving stream versus a large slow stream.) Ask students what adaptations organisms would need to allow them to live in each environment. Why would the adaptations differ? (*Examples include: external conditions such as climate; the degree to which a system is isolated from other areas; different types of physical habitats; condition of the water, including chemical conditions, temperature, clarity, velocity, depth, food availability, and presence of predators*).

Review common macroinvertebrates found in your area with the students. Be sure they are familiar with the keys they will be using in the field. If you would like a larger, laminated version

of the key provided in the Teacher Resource pages, please contact USU Water Quality Extension at (435) 797-2580.

Review instructions for sampling and processing macroinvertebrates with your students before they go into the field.

Field Activity:

Set up stations for sampling macroinvertebrates (if possible set up enough stations to have about five students at each). These areas should be easily accessible and should represent different conditions, such as different substrates (pebble, cobble, or silt), different flow conditions (running water or still backwater), or areas with leaf and woody debris.

Each station should include:

- Sampling instruction sheets (it helps to laminate these!)
- Waders
- Kick net
- Plastic pan
- Transfer pipettes
- Magnifying glasses
- Petri dishes
- Macroinvertebrate keys

Remind the student to observe the behaviors and adaptations of the macroinvertebrates. How do they move? How do they eat? Are they adapted for one area over another?

Demonstrate with two students how to safely collect samples with a kick net.

Divide the students into groups. Provide each group with clipboards, pencils, and student worksheets. Each group will sample at a different station.

At each station, the students will put the samples into plastic pans and sort them with transfer pipettes and petri dishes.

Have the students follow the instructions for sampling and sorting macroinvertebrates on the macroinvertebrate sampling sheet.

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

You may want to preserve some macroinvertebrates to keep in the classroom. To do this, place the macroinvertebrate into a glass vial or collection bottle and fill with 70% alcohol and 30% water.

Applying the Data:

Have the students calculate the diversity for each area they sampled. The simplest method is a simple count of number of different types of each organism in each sample. See the Further Discussion section below for other thoughts on diversity calculations.

Have students present data in tables or graphs (see example below).

Compare results from different sites

Further Discussion:

1. What habitats had the greatest diversity? What habitats had the lowest diversity? Why?

   More diverse aquatic habitats provide more niches or microhabitats that specialized organisms may inhabit. Therefore, cobble bottomed streams may have more types of organisms living in them than a silt bottomed backwater. Keep in mind, however, that many other factors may affect the diversity you observe. The absence or presence of predators can greatly affect diversity and food availability may restrict certain types of organisms. In addition, many aquatic organisms are susceptible to water pollutants or even to increases in water temperature. In these situations, so-called "pollution tolerant" species may be all you will see. Refer to the Missing

Macroinvertebrates lesson plan for more specifics on pollution tolerance.

2. How might water pollution affect the diversity you observed?
   Typically, in polluted water, many sensitive species will disappear. Often these systems will still have a high abundance of organisms, and may even have higher total abundance of organisms than "pristine" systems, but the number of different types of species is greatly reduced.
3. How do adaptations of the insects allow them to inhabit different niches in an aquatic ecosystem?
   The organisms you collect display an array of adaptations to their unique environment. For example, most organisms you collect in fast moving water either have clawed feet for holding on, have a very streamlined body, or may have some means of attaching to the rocks. Organisms found in soft silt in quiet waters may experience low oxygen conditions. You may find "blood worms," which are dipteran fly larvae. The red color is from hemoglobin, which helps these organisms trap oxygen when there isn't much around.
4. Would you expect to find similar degrees of diversity and similar adaptations to similar habitats in other parts of the world?
   Probably, all else being equal, you might expect the same level of diversity in similar situations. The level of diversity is one ecological measure that scientists use worldwide to compare systems.
5. Would you expect to find the exact same species (types) of organisms?
   The actual species present would probably be very different, and would reflect the evolutionary history of that particular continent or region.
6. What is the best way to express diversity in an ecosystem?
   There are many different diversity indices (a numeric value representing diversity). The simplest diversity index is simply the number of species found at a site. Other more complicated diversity indices weight the index according to the number of individuals found for each species. For example, a class collects two samples with 10 species each. However, Sample 1 had 91 individuals of one species and only 1 individual of each other species while sample 2 had 10 individuals of each species. Are these equally diverse?

Extensions

Use other water sources or other locations along a single river or stream to compare results (see the activity Wetland versus Stream Macroinvertebrates).
Sample the same stations on multiple dates to compare results.
Research factors that would contribute to a decline in the diversity of macroinvertebrates (refer back to the activity What's in the Water? and/ or see the activity Missing Macroinvertebrates).

Bibliography

Lesson plan authors: Andree Walker and Nancy Mesner (Utah State University Water Quality Extension)
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Additional resources can be found on the USU Stream Side Science 9th Grade Curriculum web page.

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