Aquatic Organisms and Their Habitats

Objectives:

Students will understand the following:

1. The presence of specific organisms in a freshwater habitat determines the quality of that habitat.
2. An organism's behavior and adaptations relate to its habitat.
3. Freshwater habitats have different characteristics depending on whether water is still or moving.

Materials:

The class will need the following:

1. Various field guides of pond life or freshwater life
2. Collecting nets such as small fish nets, long-handled dip nets, kick seine nets
3. Collecting buckets, preferably white, so that it is easier to see collected organisms
4. pH paper
5. Thermometers, preferably those that do not contain mercury
6. Meter sticks or tape measures Fish floats or any object that will float on water (even a leaf)
7. Stop watches or watches with a second hand
8. Magnifying glasses or bug boxes to help identification
9. Old shoes or boots
10. Copies of the Identification Sheet: Identifying Macroinvertebrates
11. Copies of the Classroom Activity Sheet: Freshwater Habitat Data
12. Copies of the Take-Home Activity Sheet: Freshwater Habitat Data

Procedures

1. Discuss with students the characteristics of freshwater habitats. Explain that scientists consider water to be a freshwater source if it has a salinity (saltwater content) of less than .005%. Freshwater habitats can be ponds, lakes, bogs, rivers, streams, creeks, marshes, and swamps. Even a puddle or a drainage ditch can be a source of freshwater. A reservoir is an example of an artificial freshwater resource.
2. Brainstorm with students a list of possible freshwater habitats closest to your school. After you have determined which freshwater habitat is closest, ask students to describe the plant and animal life that they would expect to find there. Is there anything around the freshwater habitat that could influence the life found there, such as farms, manicured lawns (which may contain chemicals), asphalt, trees, or other bodies of freshwater? Ask students to hypothesize about the health of the habitat and its diversity of life. Would they consider it healthy or unhealthy? Why?
3. Explain to students that they can learn about the health of a freshwater habitat by studying the organisms living within it. Scientists have determined that certain

organisms can tolerate a polluted freshwater environment, while others can only live in a healthy freshwater environment. In this activity, students will visit a freshwater habitat and determine its health based on the presence of specific organisms.

4. If the closest freshwater habitat to your school is a puddle or a drainage ditch, adjust the data collection in this lesson as necessary. For instance, if the habitat does not have flowing water, as in a pond, lake, or puddle, students cannot test the water velocity. However, a number of organisms can be found living in puddles and ditches.
5. Introduce the word *macroinvertebrate* to the class. Explain that a macroinvertebrate is an animal without a backbone living in one stage of its life cycle, usually the nymph or larval stage. Macroinvertebrates can spend a few years living in this stage in a freshwater habitat and can be seen without a microscope. Many macroinvertebrates are benthic organisms, or bottom dwellers.
6. Explain that scientists look at the number and type of organisms present in a freshwater habitat to determine its health. The water quality of a freshwater habitat is *good* when it is rich in oxygen and capable of supporting a variety of organisms. Water quality is *fair* when it contains less oxygen and low concentrations of pollutants, and *poor* water quality habitats suffer from high levels of pollutants. Some organisms can only be found in healthy freshwater habitats with good water quality, while others can tolerate fair water quality, but are unable to survive in a poor water quality habitat. And some organisms are able to live just about anywhere.
7. Clarify for students that a pollutant is something introduced to an environment that is not native to it: for example, warm water introduced to a stream is called a thermal pollutant and can harm the organisms adapted to live in the cool water, environmental pollutants taint freshwater habitats, and human and animal waste products contain bacteria such as fecal coliform that pollute freshwater.
8. Share with students the list of organisms below and the quality of water their presence indicates. The larvae of a stonefly, for example, is a macroinvertebrate that is very sensitive to chemical and physical changes in water, and its presence indicates good water quality. Clams and crayfish are able to survive in fair water quality areas, but not in poor water quality areas. Blackfly larvae and leeches can be found in any type of water, and their presence alone suggests a poorer quality of water.

Good Water Quality	**Fair Water Quality**	**Poor Water Quality**
Mayfly larvae	Crayfish	Aquatic worms
Stonefly larvae	Scud	Leech
Caddisfly larvae	Dragonfly nymph	Pouch snail
Dobsonfly larvae (Hellgrammite)	Cranefly larvae	Midge fly larvae
Water penny	Clam	Blackfly larvae

Riffle beetle	Damselfly larvae	Carp
Trout	Sow bug	
	Catfish	

9. Divide students into teams of three or four. Provide each student with a copy of the Identification Sheet: Identifying Macroinvertebrates and the Classroom Activity Sheet: Freshwater Habitat Data. Review these sheets with the class. The identification sheet will be used to distinguish and classify organisms found during the field study. The activity sheet will be used to record their findings. Explain to students that they will study two specific parts of the freshwater habitat—shallow and deep areas. For example, in a stream the shallow water should reach no higher than a student's ankle, and the deep water should reach no higher than the knee. In a pond or puddle (depending on its size), the shallow areas exist along the edges, and the deeper areas are in the center.
10. Review the safety precautions to follow during fieldwork:
    - Wear old boots that will keep feet dry.
    - Remember wet surfaces, such as rocks with algae, are slippery.
    - Be sure of the depth before stepping further into the water.
    - Handle organisms gently and return them to the habitat alive.
    - Be aware that some organisms can bite or pinch.
    - Never drink the water.
11. Have each team gather collecting equipment and choose a place to work in the habitat. First have each student quietly stand or sit and observe the habitat. What can they hear? What can they see? Have them observe the water's edge and surface, and look through the water to the bottom of the habitat. Encourage students to use these observations as they choose an area to complete their habitat study. Have the students record their initial observations on their data sheet.
12. Have students first measure the water temperature with a thermometer. Using a meter stick, they will record the depth. Next, students should determine the velocity of the flowing water by measuring the distance a float travels downstream in a 10-second time period. Students can measure the pH of the water with a pH kit, pH paper, or pH probe. Test for phosphates, nitrogen, and other chemicals using kits obtained from science supply catalogs if there is time and interest. Students should record all data on their data sheets.
13. If students choose a stream, have them find an area that has riffles in which to collect macroinvertebrates. A riffle area is where water passes quickly over a barrier or structure in the stream, creating a slight disturbance in the water's surface. This disturbance increases the oxygen content in the water.
14. Students should place a kick seine net or a large net with a small mesh downstream. Hold the net so its bottom rests on the bottom of the stream to prevent organisms from being washed downstream underneath the net.

15. Students *should* disturb the bottom of the stream; they should pick up rocks and rub the surface of the rocks to dislodge organisms, which will be captured in the net. After a few minutes, students will carefully raise the net without releasing any organisms. They will gently put them into a collecting bucket. Students should identify and count the organisms, record their information on the data sheet, and release them.
16. In still water, students will use various nets to capture organisms. They must carefully sift through mud or sand in the net when looking for macroinvertebrates. Collect all organisms in buckets and identify and count those captured. Record the data on the data sheet.
17. For homework pass out copies of the Take-Home Activity Sheet: Analyze Your Data and review the questions with students. Explain that to determine the quality of the freshwater habitat (good, fair, or poor), students must calculate how many organisms they find in each category. The presence of good water quality organisms indicates a healthy freshwater environment. If students find an equal number of poor and fair water quality organisms, have them hypothesize how the habitat can be improved to sustain good water quality organisms.

Adaptations

Ask students to study a number of different sites in the local freshwater habitat and compare their data for each site. Have them make detailed observations of the surrounding area to hypothesize what affects the health of the stream. If possible, have students visit the stream during different seasons and compare the data obtained for each season. Further research could be done regarding how the land is used around the habitat. Are lawns or fields adjacent to the freshwater habitat? Are land areas chemically treated? What effects do these areas have on the habitat?

Discussion Questions

1. Compare and contrast the areas in the freshwater habitat. Which area had the greatest diversity of life? Which had the highest population? Why were some areas more diverse than others?
2. Locate the source of the freshwater habitat studied. Use a map to trace the area that brings freshwater to the habitat or the area that carries the freshwater away. Hypothesize the path a water molecule could take from the freshwater study site to the nearest ocean.
3. Saltwater and freshwater mix in bays and estuaries. Organisms such as shrimp, crab, and oysters have adapted to live successfully in these habitats. What special adaptations must they have that allow them to live in such a habitat?
4. Discuss whether the freshwater habitat studied would be considered healthy or unhealthy. What organisms indicated this? Are there any threats to the water quality there? Are measures being taken to maintain the quality of the habitat? What could be done to improve the health of the habitat?

5. The amount of freshwater on Earth is limited. Discuss how you use freshwater daily. Could you measure the exact amount? Make a number of suggestions to conserve freshwater effectively.
6. Explain at least one predator-prey relationship in the freshwater habitat studied. Hypothesize what would happen if one of the organisms disappeared from the habitat.

Evaluation

Use the following three-point rubric to evaluate students' work during this lesson:

- **Three points:**works exceptionally well in the field and completes data sheet accurately with detailed observations; answers the questions completely and shares observations with the class; demonstrates a clear understanding of the fieldwork
- **Two points:** works somewhat carefully in the field and completes data sheet, but answers lack detailed observations; completes most of the questions and demonstrates a general understanding of the fieldwork
- **One point:** not engaged in fieldwork and partially completes the data sheet; answers some of the questions, but does not demonstrate an understanding of the work

Extensions

Field Guide
Have the class create a field guide for the organisms found in the freshwater habitat. Include sketches of the organisms and a detailed description of their sizes, shapes, and body parts, as well as a general description of the habitat. Include a map of the range where the organisms live. Assemble the field guide pages to use as reference for studying organisms throughout the year.

Food Web
Create a bulletin board or poster with pictures and descriptions of the organisms identified around the freshwater habitat. Use string to show which organisms prey on each other. Consider what would happen if an organism disappeared from the habitat.

Habitat Story
Write a story about the freshwater habitat. How did it form? What will it look like 100 years from now? Students could choose to tell the story from the perspective of a habitat organism.

Suggested Readings

Our Poisoned Waters
Edward F. Dolan. Cobblehill Books, 1997.
In a clear and reasoned discussion, this book explains in detail how the limited fresh

water on the planet is threatened through pollution and overuse–and what you can do about it. An extensive bibliography provides additional reading.

Water: The Drop of Life
Peter Swanson. NorthWord Press, 2001.
Written as a companion to the PBS series of the same name, this book explores water on a global scale. Beautiful color photographs augment the chapters describing the importance of water in our daily lives and how water is endangered by pollution, waste, and overuse. A list of companion Internet sites for each chapter follows the text.

Vocabulary

benthic
Definition: Organisms living in the bottom of water habitat.
Context: Many macroinvertebrates are considered **benthic** dwellers because they are found on the bottom of freshwater habitats.

biodiversity
Definition: A variety of living organisms in a given area.
Context: The health of a freshwater habitat is determined by the **biodiversity** of the organisms living in it.

habitat
Definition: The place in which an organism lives.
Context: Organisms live in a variety of **habitats**, such as forests, meadows, and streams.

larvae
Definition: The earliest stage of life that various animals undergo before metamorphosis.
Context: Fly **larvae** are macroinvertebrates that live in freshwater habitats.

macroinvertebrate
Definition: An animal without a backbone living in one stage of its life cycle, usually the nymph or larval stage.
Context: Scientists determine freshwater habitat health by the quantity and diversity of the **macroinvertebrates** present.

nymph
Definition: The larval form of certain insects resembling the adult form, but smaller and lacking fully developed wings.
Context: Dragonfly **nymphs** are carnivorous macroinvertebrates found in many freshwater habitats.

riffle
Definition: A stretch of choppy water.
Context: Macroinvertebrates thrive in areas where water **riffles** over rocks, exposing the water to increased oxygen.

Academic Standards

This lesson plan may be used to address the academic standards listed below. These standards are drawn from Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education: 2nd Edition and have been provided courtesy of the Mid-continent Research for Education and Learning in Aurora, Colorado.

Grade level: 6-8
Subject area: Science
Standard:
Understands relationships among organisms and their physical environment.
Benchmarks:
Knows factors that affect the number and types of organisms an ecosystem can support (e.g., available resources; abiotic factors such as quantity of light and water, range of temperatures, and soil composition; disease; competition from other organisms within the ecosystem; predation).

Grade level: 6-8
Subject area: Science
Standard:
Understands biological evolution and the diversity of life.
Benchmarks:
Knows ways in which living things can be classified (e.g., taxonomic groups of plants, animals, and fungi; groups based on the details of organisms' internal and external features; groups based on functions served within an ecosystem, such as producers, consumers, and decomposers).

Credit

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