Assignment Discovery Online Curriculum

Lesson title:
Freshwater Habitats

Grade level:
6-8

Subject area:
Life Science: Ecology

Duration:
Two to three class periods

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

Procedure:
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.

Adaptation for older students:
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?

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 Reading:

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:

Grade Level:
6-8
Subject Area:
Science
Standard:
Understands relationships among organisms and their physical environment.
Benchmark:
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.
Benchmark:
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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DiscoverySchool.com
http://www.discoveryschool.com

Classroom Activity Sheet:
Determining the Health of Freshwater Habitats

Name: _____

Freshwater Habitat Data Sheet

Use this data sheet to record the observations you make while studying a freshwater habitat. Record your data accurately.

1. Record initial habitat observations.

What do you see?

What do you hear?

2. Record physical factors of the freshwater habitat.

	Deep	**Shallow**	**Other**
Describe the bottom. (sand, mud, gravel, rocks)			
Water temperature			
Water depth (m or cm)			
Current velocity (meters/second)			
pH			

Classroom Activity Sheet:
Determining the Health of Freshwater Habitats

Name: _____

Freshwater Habitat Data Sheet

Use this data sheet to record the observations you make while studying a freshwater habitat. Record your data accurately.

3. Use the Identification Sheet to record stream organisms in the freshwater habitat.

Type (name)	How many?	Identifying Characteristic

Identification Sheet:
Determining the Health of Freshwater Habitats

Name: _____

Identifying Macroinvertebrates

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	
	Sowbug	

Good Water Quality

These macroinvertebrates cannot survive in polluted freshwater habitats:

Mayfly larvae: I am _ inch to 1 inch long. I have brown leathery gills on both sides of my lower body. I have six legs with hooked tips, antennae, and two (sometimes three!) hairlike tails. Sometimes my tails are webbed together.

Stonefly larvae: I am _ inch to 1-_ inches long. I have six legs with hooked tips, antennae, and two hairlike tails. I do not have gills on the lower half of my body.

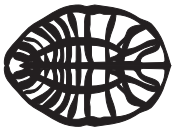
Caddisfly larvae: I am as long as 1 inch. I have six hooked legs on the upper portion of my body, and two hooks at the back end. I might be found in a stick, rock, or leaf case with my head poking out. I sometimes have fluffy gill tufts on the lower half of my body.

Identification Sheet:
Determining the Health of Freshwater Habitats

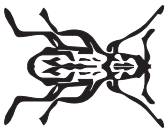
Name: _____

Identifying Macroinvertebrates

Dobsonfly larvae: I am _ inch to 4 inches long. I am dark colored. I have six legs and large, pinching jaws. I have eight "feelers" on the lower half of my body, with paired cottonlike gill tufts along my underside. I have short antennae, two tails, and two small hooks on my bottom!



Water penny: I am _ inch long with a flat, saucer-shaped body. I have a raised bump on one side of my body, and six tiny legs on the other. Some people refer to me as an *immature* beetle.



Riffle beetle: I am _ inch long. I have an oval body covered with tiny hairs. I have six legs and antennae and I walk s-l-o-w-l-y underwater. I do not swim on the surface of the water.

Fair Water Quality

These macroinvertebrates can tolerate fair water quality:

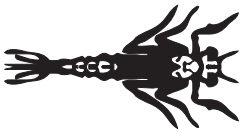
Crayfish: I can grow as long as 6 inches. I have two large claws, eight legs, and many say that I resemble a small lobster.

Scud: I am _ inch long. My body is higher than it is wide. I can be white or gray. I swim sideways and sometimes resemble a small shrimp.

Dragonfly nymph: I am _ inch to 2 inches long. I have large eyes, six hooked legs, and a wide oval or round abdomen.

Crane fly larvae: I am _ inch to 2 inches long. I am milky green colored or light brown. I am pleasantly plump, almost caterpillar-like, and have a segmented body. I have four fingerlike lobes at the back end of my body.

Clam: A clam I am. I am a bivalve mollusk. My body is tucked within two shells joined by a hinge.



Damselfly larvae: I am _ inch to 1 inch long. I have no gills on the lower half of my body. I have three, broad, oar-shaped tails positioned like a tripod. I have six, thin, hooked legs and large, large eyes. I am the damselfly.

Identification Sheet:
Determining the Health of Freshwater Habitats

Name: _____

Identifying Macroinvertebrates

Sow bug: I am _ inch to _ inch long. My body is wider than it is high. I am gray with an oblong body. I have more than six legs and long antennae.

Poor Water Quality

These macroinvertebrates can survive in unhealthy freshwater environments.

Aquatic worms*:* I am _ inch to 2 inches long. I have a very tiny, thin, wormlike body.

Leech*:* I am _ inch to 2 inches long, brown, and terribly slimy. I have suction pads near my head. You might want to check and make sure that I am not attached to your leg when you leave the water.

Pouch snail*:* My shell opens to the left; it cannot seal tightly shut when a predator finds me. Since I breathe air, I like to crawl out of the water.

Midge fly larvae: I am up to _ inch in length. I have a dark head and a wormlike, segmented body. I have two tiny legs on each side.

Blackfly larvae: I am up to _ inch long, and one end of my body is wider than the other. My head is black with a suction pad on one side of it.