Freshwater Habitat: A Water Quality Study

Grade Level: Upper Elementary – Middle School

Purpose: 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 Water Canyon, or another freshwater habitat, to determine its health based on the presence of specific organisms.

Objectives: The student will be able to identify the specific organisms in a freshwater habitat that determines the quality of that habitat. The student will be able identify how an organism's behavior and adaptations relate to its habitat. The student will also be able to state that freshwater habitats have different characteristics depending on whether water is still or moving. The student will be able to determine the water quality of a freshwater water source.

Nevada Department of Education State Standards:
Organisms and Their Environment (Life Science Unifying Concept C) A variety of ecosystems and communities exist on Earth. Ecosystems are dynamic interactions of organisms and their environment. Ecosystems have distinct characteristics and components that allow certain organisms to thrive. Change in one or more components can affect the entire ecosystem.

Diversity of Life (Life Science Unifying Concept D) Evidence suggests that living things change over periods of time. These changes can be attributed to genetic and/or environmental influences. This process of change over time is called biological evolution. The diversity of life on Earth is classified using objective characteristics. Scientific classification uses a hierarchy of groups and subgroups based on similarities that reflect evolutionary relationships.

Materials:
*Many of the following materials are located in the Water Canyon Field Trip Kit
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 Sheets: Macroinvertebrates
Copies of the Classroom Activity Sheet: Freshwater Habitat Data
Copies of the Take-Home Activity Sheet: Freshwater Habitat Data

Anticipatory Set: 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. Brainstorm with students a list of possible freshwater habitats closest to your school. After you have discussed the various water sources nearby, lead the discussion to the creek at Water Canyon. Ask students to describe the plant and animal life that they would expect to find there. Is there anything around that freshwater habitat that could influence the life found there, such as mines, manicured lawns (which may contain chemicals), campsites, 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?

Developing the Lesson: 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 Water Canyon and determine its health based on the presence of specific organisms. If you are unable to go to Water Canyon and decide to use a puddle or a drainage ditch instead, 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.

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.

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 coli form that pollute freshwater.

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 bottom dwellers.

Share with students the list of organisms below and the quality of water their presence indicates. The larva 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**
Alderfly larvae	Crayfish	Aquatic worms
Stonefly larvae	Caddisfly larvae	Leech
Water Snipefly larvae	Dragonfly nymph	Pouch, Orb and Gilled snails
Dobsonfly larvae (Hellgrammite)	Cranefly larvae	Midge fly larvae
Trout	Clam/Mussel	Blackfly larvae
	Damselfly larvae	Amphipod
	Water Penny larvae	Non-Red Midge larvae/ Bloodworm Midge larvae
	Riffle beetle Catfish	Carp

Divide students into teams of three or four. Provide each student with a copy of the Identification Sheet: 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.

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.

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. 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. 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. 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. 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.

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.

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 Water Canyon 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 Water Canyon. 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 water in Water Canyon. Use a map to trace the area that carries the freshwater away. Hypothesize the path a water molecule could take from Water Canyon to the Humboldt Sink.

3. Discuss whether Water Canyon 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?

4. 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.

Conclusion: Review the findings of the field study at Water Canyon. Have a class discussion about these findings. As a class or with a partner, answer the discussion questions listed above. Conclude the lesson by discussing the following: The amount of freshwater on Earth, and in Nevada especially, is limited. Discuss how we use freshwater in our daily lives. Could you measure the exact amount? Are we conscious of the amount of water we use? Brainstorm a list of suggestions to conserve freshwater effectively. Practice them in your own lives.

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:
Compare and Contrast- Take a trip to the Humboldt River and conduct a similar field study to the one conducted at Water Canyon. Compare and contrast the findings from Water Canyon to the Humboldt River. What was similar in your findings? What was different? Which body of freshwater is healthier? Why? What can be done to protect/improve the water quality of the Humboldt River?

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:
Biodiversity
Definition: A variety of living organisms in a given area.

Habitat
Definition: The place in which an organism lives.

Larvae
Definition: The earliest stage of life that various animals undergo before metamorphosis.

Larvae
Definition: The earliest stage of life that various animals undergo before metamorphosis.

Macroinvertebrate
Definition: An animal without a backbone living in one stage of its life cycle, usually the nymph or larval stage.

Nymph
Definition: The larval form of certain insects resembling the adult form, but smaller and lacking fully developed wings.

Riffle
Definition: A stretch of choppy water.

Source: Adapted from a lesson by Mary C. Cahill, middle school science coordinator, Potomac School, McLean, Virginia.

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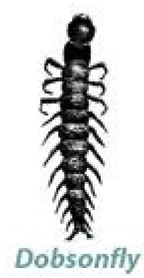
MACROINVERTEBRATES:

Aquatic macroinvertebrates and effects of organic pollution on these communities

The pollution tolerances of the various macroinvertebrates included in the biotic index are based upon the macroinvertebrates' tolerance to dissolved oxygen concentrations in water. Organisms are separated into four categories of pollution tolerance: **sensitive**, **semi-sensitive**, **semi-tolerant**, and **tolerant** to pollution. It is expected that in a stream with good water quality, that macroinvertebrates that are both sensitive to and tolerant to pollution will be found. No particular group or types of organisms will dominate the macroinvertebrate population of the stream. With increased organic pollution (from nutrients found in fertilizers, sewage, and other sources) dissolved oxygen levels within the stream are expected to fluctuate more extremely and fewer pollution sensitive organisms will be found. Macroinvertebrates that can tolerate lower oxygen levels will become more prevalent. As organic pollution continues to increase, some pollution tolerant macroinvertebrates will become dominant and will be able to support large populations within the stream, while pollution sensitive or semi-sensitive organisms will be unable to survive. A shift in macroinvertebrates' food sources is expected with changes in amount of organic pollution in a stream. In clean streams, food sources are usually from within the natural stream system, including leaf litter from trees in the riparian corridor of the stream. In more organically-polluted streams, food might be supplied by other than natural sources, such as nutrients input as fertilizers through runoff or from faulty, un-maintained or satiated septic systems. Increased nutrients will also stimulate plant and algal growth within a stream, offering yet another food source for macroinvertebrates in polluted streams.



GROUP 1

sensitive to pollution

DOBSONFLY

Dobsonfly larvae (Order Megaloptera) are often called hellgrammites. They are commonly found in oxygen-rich water, and obtain oxygen through their skin. The filaments that are found along their sides help them to obtain oxygen from the water by increasing their surface area. They are equipped with hooks on the end of their body which help them to hold onto stable objects (such as rocks) in moving water.

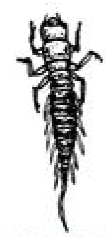
Water Snipefly

WATER SNIPEFLY

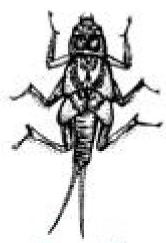
Water Snipefly larvae (Order Diptera) live in clean, fast-flowing water, which is oxygen-rich. Only one genus, Atherix, is found in Wisconsin streams. The larvae live for about one year, then pupate in the soil along stream banks, and emerge as adults in early summer.

ALDERFLY

Alderfly larvae (Order Megaloptera) also have filaments along the sides of their bodies which help them to obtain oxygen from the water in which they live. These macroinvertebrates are carnivores and may live in the water in their larval stage for one to four years before emerging as adults.



Alderfly



Stonefly

STONEFLY

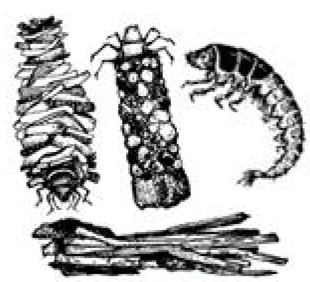
Like other Group 1 organisms, stonefly larvae (Order Plecoptera) are often found in fast-flowing water, to take advantage of the high amounts of dissolved oxygen that are present. Stoneflies breathe through their skin as well as with tufted-gills that are often located at the base of their legs (nearest their bodies). Most times, stoneflies can be distinguished from mayflies by the presence of only two tail filaments (mayflies usually have three).

Group 2

semi-sensitive to pollution

CADDISFLY

Many different types of Caddisfly larvae (Order Trichoptera) live in streams and rivers. Some types build cases, which they carry along with them as protection from predators and their environment. Others spin nets to catch their prey and live in nooks and crannies of rocks and materials along the stream bottom. They obtain their oxygen through their skin, though some have gills to help obtain oxygen.



Caddisfly

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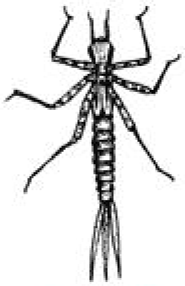
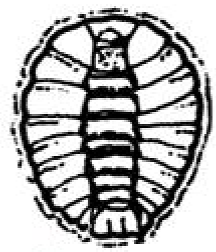


Damselfly

DAMSELFLY
Damselfly larvae (Order Odonata) are found in both flowing and still waters. They move through the water by moving their abdomen and "tails" (called lamellae) back and forth from side to side. They also use the lamellae to aid in breathing. The lamellae make the surface area of their skin larger, which increases the amount of oxygen they get.

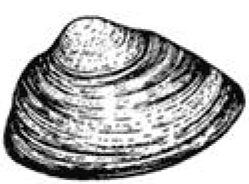
WATER PENNY LARVAE
Water Penny larvae (Order Coleoptera), like Group 1 organisms, rely on moving or fairly-well oxygenated waters for survival. However, rather than being dependent upon food sources from the natural environment, such as leaves, their main food source is algae, which they scrape off rocks. Algal growth can increase when there are more nutrient sources within a stream, and thus these organisms are included in Group 2.



Water Penny

Cranefly

CRANEFLY
Cranefly larvae (Order Diptera) are often found in woody or rotting material and in algae along the bottom of streams. Most usually breathe through openings at the end of their body called spiracles, but in well-oxygenated water can obtain oxygen through their skin. Most species live in the water for a year, emerging as adults in early spring.



Freshwater Mussel

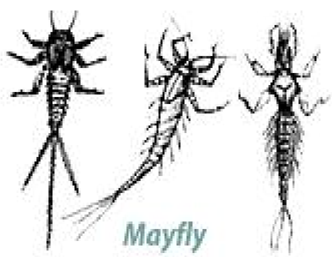
Fingernail Clam

FRESHWATER MUSSEL AND FINGERNAIL CLAM
Freshwater mussels and Fingernail clams (Order Pelecypoda), are filter-feeders; this makes them susceptible to pollution. They can be negatively affected by pollutants that are suspended in the water, which are filtered out as they feed.

RIFFLE BEETLE

Riffle beetles (Order Coleoptera) are somewhat unique among the biotic index organisms, as both juveniles and adults live in the water, while for most organisms included in the index, only the larvae live in the water. Like their name suggests, these beetles are often found in stream's riffles (areas of fairly shallow depth and fast-flowing water), but they can also be found in vegetated areas of slower flow. Larva breathe using gills, while adults use what is called a plastron.

Riffle Beetle



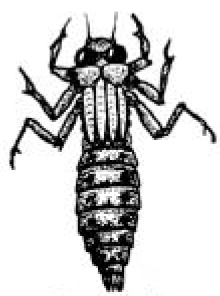
Mayfly

MAYFLY

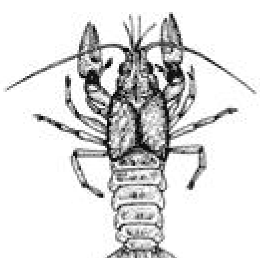
Mayfly larvae (Order Ephemeroptera) can be found in numerous types of habitats within streams. Some, like the flathead mayfly (left), are found on rocks within fast-flowing riffle areas. Others, like the burrowing mayfly (right), are found buried within the substrates. Still other, like the swimming mayfly (middle) are found in less swiftly-moving waters, but which still have adequate dissolved concentrations. They eat detritus or algae within the water and obtain their oxygen through gills found along the sides of their abdomens.

DRAGONFLY

Dragonfly larvae (Order Odonata) can live in streams for less than a year or for up to four years before emerging as adults. They are generally found in slower-flowing water or in lakes or ponds. They might also be found buried several centimeters into the bottom sediments. They breathe by taking water into their bodies at their "tail" end and a process of gas exchange is carried out within a rectal chamber. They can also use the chamber to aid in movement. They take water into the chamber and then expel it to give them a sort of jet-propelled movement.



Dragonfly



Crayfish

CRAYFISH

Crayfish can be found in various aquatic habitats. They primarily eat vegetation, but will also eat animal food if plant material is not present. They require waters with adequate amounts of oxygen, but can withstand waters with less oxygen than others in group 2. They are included in group 2 because they are sensitive to toxic substances that can accumulate in animals of plants that they may eat.

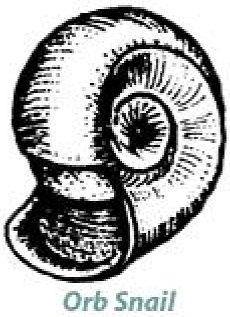
GROUP 3

semi-tolerant for pollution

BLACKFLY

Blackfly larvae (Order Diptera) live in all types of stream habitats. These bowling pin-shaped organisms are found attached to substrate by their back ends. They eat by filtering organic materials from the water with fans that can be outstretched into the water column from their mouth.

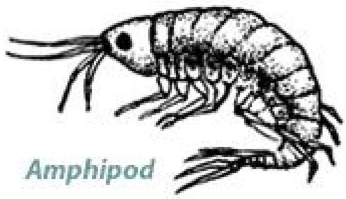
ORB SNAIL



Orb snails (Order Gastropoda) live in a variety of aquatic habitats. They eat primarily decaying plants or algae growing on rocks. These snails obtain their oxygen through a lung that takes up about half of the space within the body cavity. An opening to the lung is found where the mantle (lining inside the shell) and the foot (muscular or fleshy portion of snail upon which it moves) meet. The orb snails also have an additional projection from their foot called a pseudobranch that acts as a gill, offering an additional way for these snails to obtain oxygen. These snails may move to the surface to obtain oxygen for their lung, giving them the ability to live in waters without much dissolved oxygen.

AMPHIPOD

Amphipods, scuds, or side swimmers (Order Amphipoda) are often found in slow-moving waters. They are scavengers, eating primarily decaying plant and animal materials. Since such materials would be readily available in organically polluted waters, their eating habits can help explain why amphipod populations can be large in polluted waters.



NON-RED MIDGE LARVAE

The Non-Red Midge larvae is identical to the Bloodworm Midge larvae except for the Bloodwood Midge larvae's red color. Both the Bloodworm Midge and non-red Midge larvae (Order Diptera) can tolerate fairly low oxygen conditions and feed on a variety of food sources. Different types are herbivores, carnivores, omnivores, and detritivores. Most non-red midge larvae live within the stream for a year or less, and emerge as adults through most of the year (except in the coldest months). There are two families of midges included in this group; they are the biting midges and the lake flies (which do not feed and therefore which do not bite).

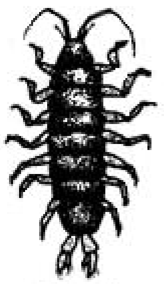
GILLED SNAIL

Gilled snails (Order Gastropoda) also live in a variety of aquatic habitats and, like the orb snails, eat primarily decaying plants or algae growing on rocks. A difference between this snail and the orb snail is that it obtains its oxygen through its gills. These gills offer a large amount of surface area through which oxygen may be obtained.


Gilled Snail

GROUP 4

tolerant to pollution


Isopod

ISOPODS

Isopods or sow bugs (Order Isopoda) are scavengers and they are known to eat a variety of plant and animal material. They are generally found under leaves or other materials in small streams and in some ponds and lakes. They obtain most of their oxygen through the thin "skin" on their legs that are attached to their abdomen.

BLOODWORM MIDGE LARVAE


Bloodworm Midge Larvae

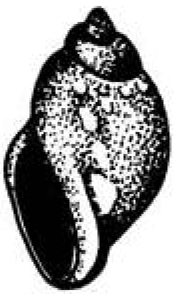
The Bloodworm Midge larvae is identical to the non-red Midge larvae except for the Bloodwood Midge larvae's red color. Both the Bloodworm and non-red Midge larvae (Order Diptera) feed on a variety of food sources and different types are known to be herbivores, carnivores, omnivores, and detritivores. Most Bloodworm Midge larvae live within the stream for a year or less, and emerge as adults through most of the year (except in the coldest months). It's these organisms' red color that allows them to be classified in Group 4, rather than in Group 3 with the other midges. Their red color is due to the fact that they have hemoglobin within them. In humans, it is the hemoglobin within our blood that carries oxygen throughout our bodies. Thus, these organisms have the ability to carry oxygen within their bodies, and thus need to rely less upon dissolved oxygen in the water for their oxygen supply.

TUBIFEX

Tubifex worms are tube builders that eat decaying plant and animal materials, filamentous algae, and diatoms. They live on or in the substrate of various water bodies. Like other Group 4 organisms, they have the ability to withstand low levels of dissolved oxygen in the water, and like the bloodworms, may also have hemoglobin in their bodies to hold and supply them with oxygen. They may also wiggle their bodies in the water to aerate it, thus helping to make more oxygen available to them.


Tubifex

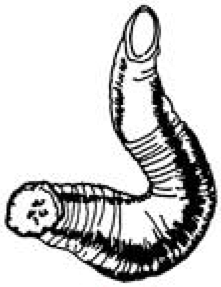
POUCH SNAIL


Pouch Snail

Pouch snails (Order Gastropoda) are similar to orb and gilled snails (Group 3), in that they are found in numerous types of aquatic environments and eat primarily algae and decaying plant materials. Unlike orb and gilled snails, pouch snails have been known to eat decaying animal materials as well. Pouch snails breathe in a similar fashion to orb snails, using a lung to store oxygen. These snails have been reported to live for 48 hours in water without any oxygen. Unlike the orb snails, it is not believed that the pouch snails come to the surface of the water for oxygen either. Instead, scientists believe that these snails can fill their lung with water and obtain oxygen through it as if it were a gill.

LEECHES

Leeches (Class Hirudinea, which has three Orders) are well-known for their interest in sucking blood from warm-blooded organisms, but most types of leeches are scavengers or predators, not blood-suckers. They obtain their oxygen through their skin, and some have been observed using their suckers to hold onto a solid surface and then undulating their body in the water, likely to aid in respiration. Some types of leeches can survive for several days without oxygen, which explains why these organisms are considered tolerant to pollution.


Leech

Water Quality Data Sheet

1. Record your observations of the habitat. What can you hear? What can you see?

2. Using the appropriate instruments, measure the following:

Water Temperature	
Water Depth	
Velocity	
pH	
Phosphates	
Nitrogen	
Other	

3. Select a riffle in which to collect macroinvertebrates. Place a kick seine net or a large net with a small mesh downstream. Hold the net so its bottom rests on the bottom. Disturb the bottom of the stream; pick up rocks and rub the surface of the rocks to dislodge organisms, which will be captured in the net. After a few minutes, carefully raise the net without releasing any organisms. Put them into a collecting bucket. Count and identify the organisms, record this information below, and release them.

Macroinvertebrates			
Group One sensitive to pollution	Group Two semi-sensitive to pollution	Group Three semi-tolerant to pollution	Group Four tolerant to pollution

Analyzing Your Data

To determine the quality of the freshwater habitat (good, fair, or poor), you must calculate the number of organisms found in each category. The presence of good water quality organisms indicates a healthy freshwater environment. The presence of poor water quality organisms indicates a poor freshwater environment.

What is the water quality of Water Canyon? Support your assertion with data.

Hypothesize why the quality of water at Water Canyon is good/fair/poor.

What could happen to change the quality of water at Water Canyon?

Why is it important that Water Canyon maintains a high level of water quality?

What can you do to ensure that Water Canyon has the highest water quality possible?