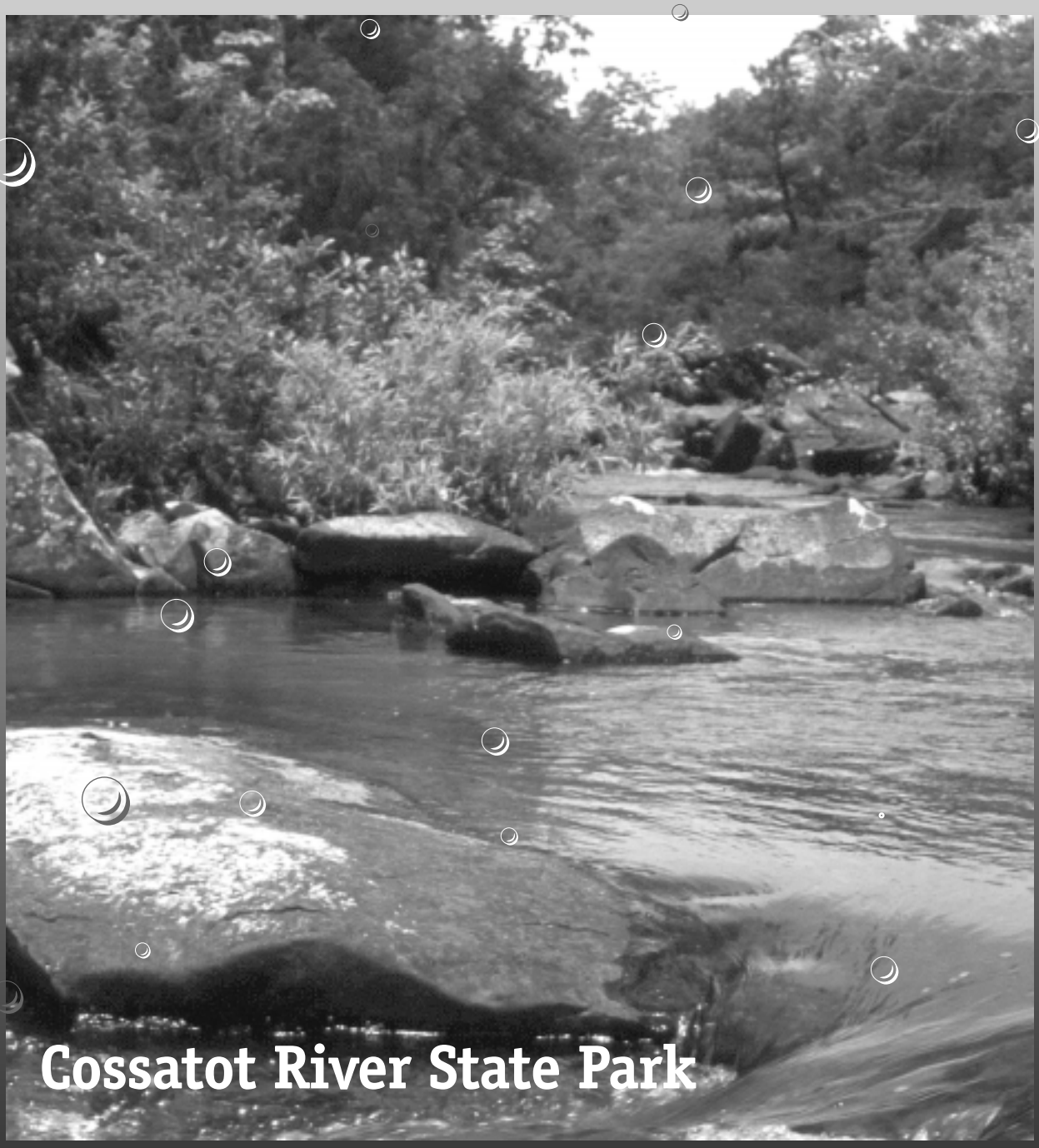

Watershed/Stream Study Guide and Activity Book

Cossatot River State Park

Watershed/Stream Study Guide and Activity Book

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Contents

Introduction

The *Cossatot River State Park Watershed/Stream Study Guide and Activity Book* is primarily designed to educate school children about watersheds and stream ecology with emphasis on the Cossatot River. This study guide is divided into four sections. Section 1 (watersheds & stream ecology) deals with what a watershed is and with basic ecology of a stream. Section 2 (macroinvertebrate profiles) deals with the common macroinvertebrates that can be found in the Cossatot River. Section 3 (activities) has puzzles and other fun activities. Section 4 is a glossary. Throughout the study guide are words in **bold** print. These words are in the glossary.

To reserve programs for your class or group, contact the park.

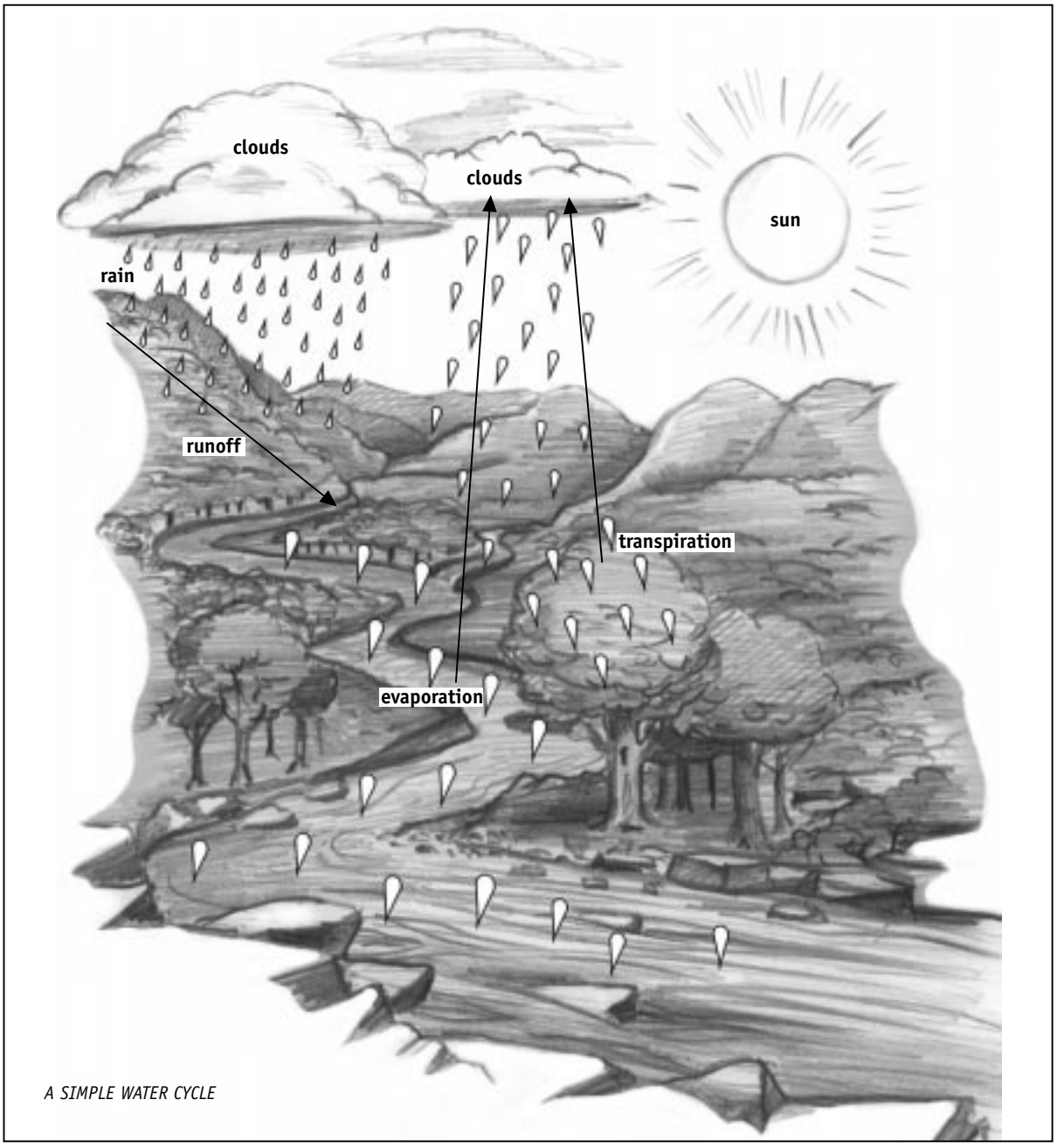
For more information contact:
Cossatot River State Park
960 Hwy 4 East
Wickes, AR 71973
(870) 385-2201
e-mail: cossatot@arkansas.com

SECTION 1
Watersheds and Stream Ecology

The Water Cycle

Water is constantly moving on the earth. It moves from streams and rivers to lakes and oceans. From these bodies of water, it moves to the air. From air it moves to land, streams and other bodies of water. How does it do this?

Energy, from the sun in the form of heat, warms water and causes it to become a gas called water vapor. This process is called **evaporation**. Another way water gets into the air is through plants. Plants get water from the soil through their roots and send it to the leaves.



A SIMPLE WATER CYCLE

The leaves release the water into the air as water vapor. This process is called **transpiration**. The water vapor rises in the air and cools, forming clouds. When the clouds are cool enough, the water vapor becomes water drops or ice crystals and fall to the ground as rain or snow. Once on the ground, some of the rain and snow (after it has melted) will seep into the soil. This water may be used by plants, and some may **evaporate**. Some of the rain and melted snow will flow off the land surface forming **runoff**. The runoff will flow into streams and the streams will flow into other bodies of water. The cycle then starts all over again.

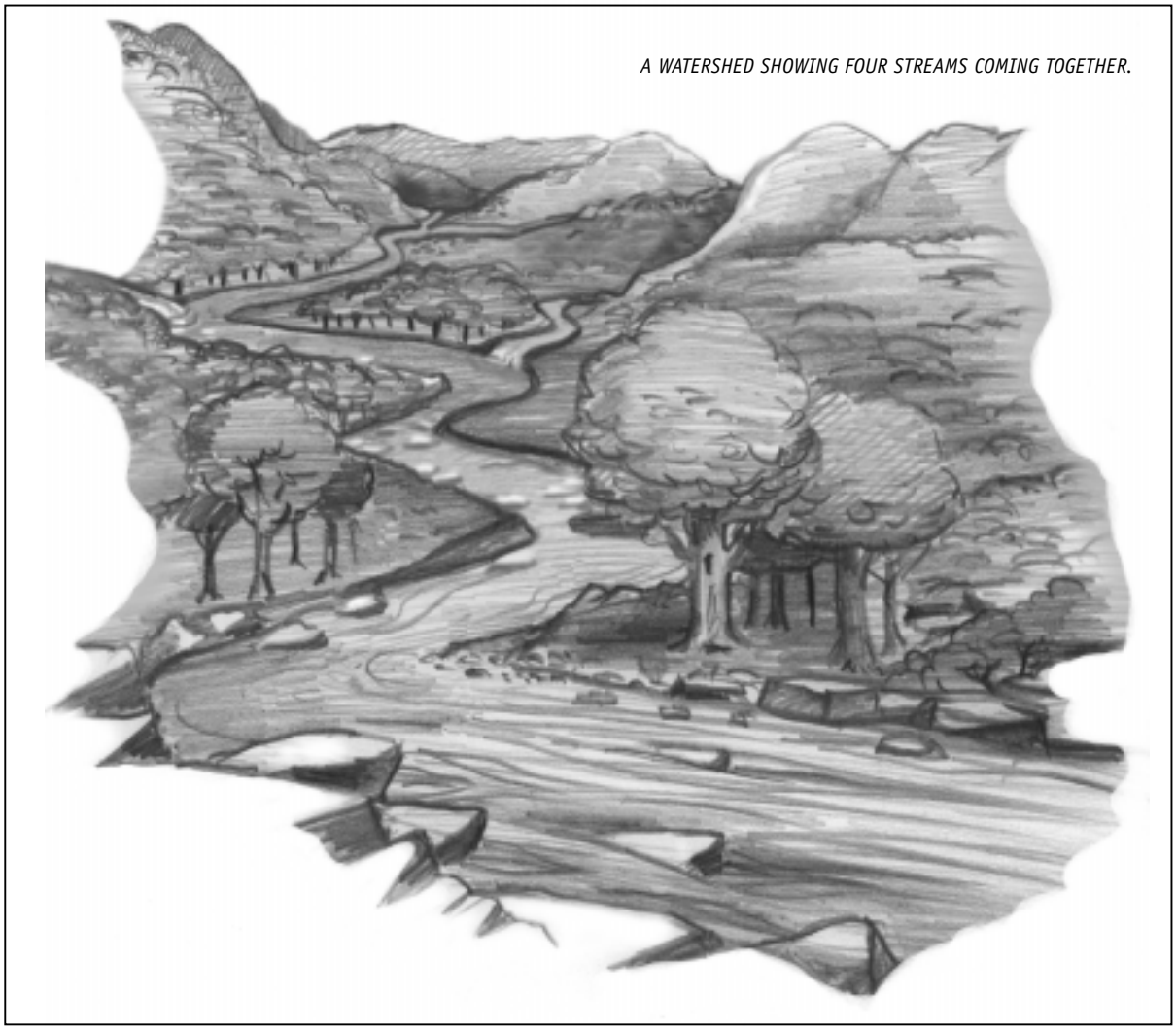
What is a Watershed?

When it rains, the water flows off the land and into small streams. The small streams flow into rivers. This is a **watershed**. In other words, a **watershed** is the area of land that catches rain and drains it into a stream, or river. The more it rains, the more water flows into a stream or river.

A **watershed** can be as small as a few acres or it can be hundreds of square miles in size. A large **watershed** consisting of hundreds of streams or rivers can be divided into smaller **watersheds** as small as one stream. What separates **watersheds** are ridges of higher land. No matter where someone lives, they live in a **watershed**.

Every stream is the product of its **watershed**. A stream is made up of water which flows into it from the land above it. This is also called runoff. If the land is abused, such as soil erosion occurs or pollutants are spilled, the stream receiving the runoff is **degraded**. Each one of us is linked to a stream. How we use the land affects the health of the stream.

Each **watershed** has its own runoff patterns, which are dependent upon the types of plants and trees and the natural slope of the land. The size of the Cossatot River **watershed** north of US 278 (Hwy 4) is about 277 square miles.



A WATERSHED SHOWING FOUR STREAMS COMING TOGETHER.

Looking at the map of the Cossatot River watershed, answer the following questions:

1. Is your school in the Cossatot River watershed?
   ☐ Yes ☐ No
2. Do you live in the Cossatot River watershed?
   ☐ Yes ☐ No
3. If not, do you know what watershed you live in?
   ☐ Yes ☐ No
4. Could rain falling in Mena affect the water level of the Cossatot River?
   ☐ Yes ☐ No
5. Could rain falling in Wickes affect the water level of the Cossatot River?
   ☐ Yes ☐ No

MAP OF THE COSSATOT RIVER WATERSHED ABOVE U.S. HIGHWAY 278 (FORMERLY HIGHWAY 4)

What is a Riparian Zone?

A **riparian zone** is the area of land, with trees and other plants, next to a stream. This area experiences regular flooding. The trees and other plants in the **riparian zone** are very important. They help clean water from runoff by filtering eroded soil and excess nutrients. During floods, they slow the flow of the water, which reduces erosion and filters soil that has washed into the stream. The roots also hold stream banks together. Leaves and other plant parts which fall into the river become a very important part of the stream's food web.

THE RIPARIAN ZONE ALONG A STREAM.

In the upper Cossatot large aquatic plants (such as lily pads & pond weed) are virtually absent, because of swift water velocity during high flows. The river has very little canopy cover due to the rocky stream banks and force of the water. The very rocky stream banks make it difficult enough for trees to grow, but the action of flooding (breaking and uprooting trees) prevent most trees from getting very tall. This lack of a canopy lets the sunlight reach the river resulting in very warm water, during the summer, which lowers the amount of dissolved oxygen (the oxygen available to aquatic animals). Opposite some of the steep rocky banks are small flat areas where flood waters spread out, slow down, and river carried soil is deposited (left behind). These areas are characterized by deep rich soil and are called alluvial terraces. In these areas some trees do grow large enough to create some canopy over the river.

The Stream Ecosystem

The place where plants and animals live is called a habitat, and the group of plants and animals that live there is called a **community**.

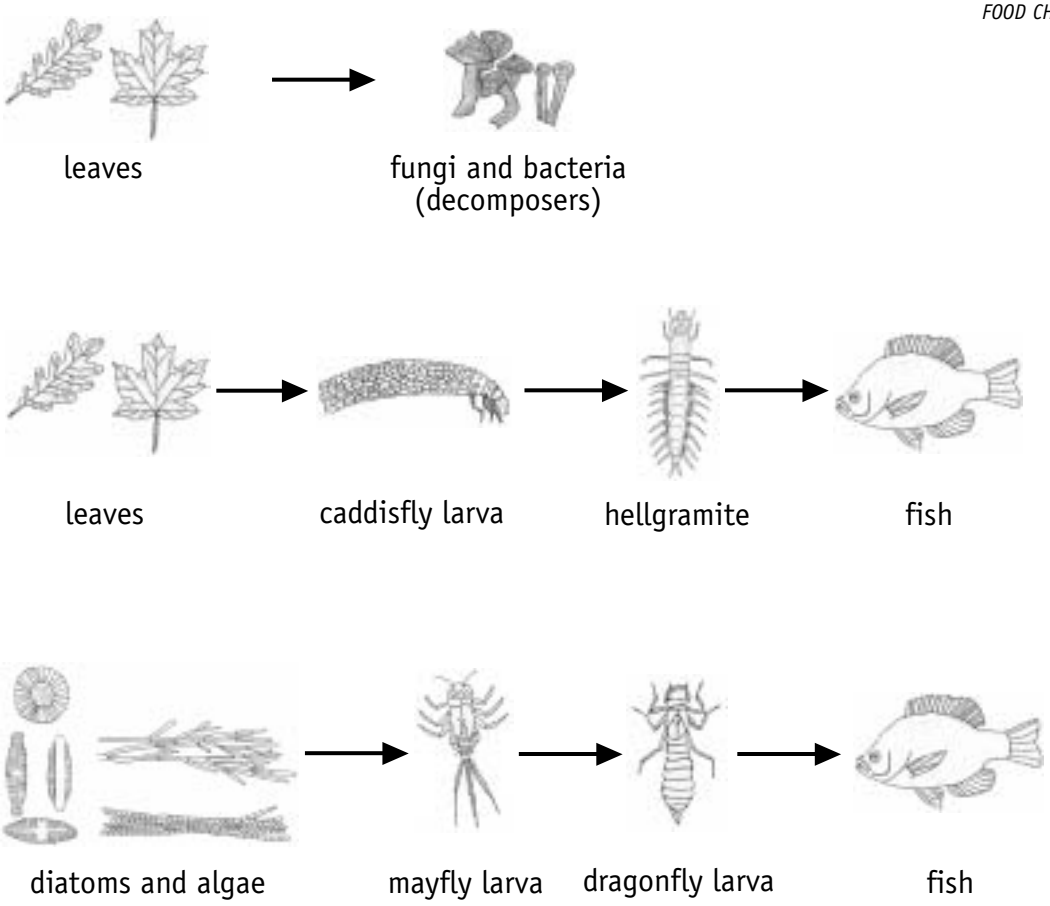
Plants and animals of a community, interacting with each other and with the air, soil, water, sunlight, and climate, in a way that allows the community to exist year after year, form an **ecosystem**.

Plants and animals of an ecosystem are linked together by their feeding relationships. Plants are called **producers** because they use the sun's energy to produce food. This food, such as leaves and other plant parts, provides the energy animals need to live. This energy is passed through the community in a **food chain**. In a food chain producers are eaten by **primary consumers**. Primary consumers are eaten by **secondary consumers**. The animals which eat secondary consumers are called **tertiary consumers**. Each food chain also contains **decomposers**. These are bacteria, fungi, and some types of insects that break down dead plant and animal parts into nutrients, which are then used by plants.

Every ecosystem contains many food chains, which are linked together forming a complex **food web**. Look at the illustrations on the next two pages. They are linked together because animals do not eat just one thing, but many different things and so play different roles in a number of food chains. Different ecosystems are also linked together. Animals from one ecosystem will eat plants and animals from another ecosystem. In this way, all ecosystems are linked together.

In the Cossatot River most of the food from producers is from leaves and plant parts washing into the river, algae, and to a lesser extent aquatic plants. This sup-

FOOD CHAINS



Three simple food chains; the arrows point to the organism doing the eating.

ports the food web directly (the primary consumers) and indirectly (the secondary & tertiary consumers and the decomposers).

There are many living things in a stream ecosystem. Some are called macroinvertebrates. Macro means they are large enough to see and invertebrate means they do not have a backbone. Some common examples are worms, snails, mussels, insects, and crayfish.

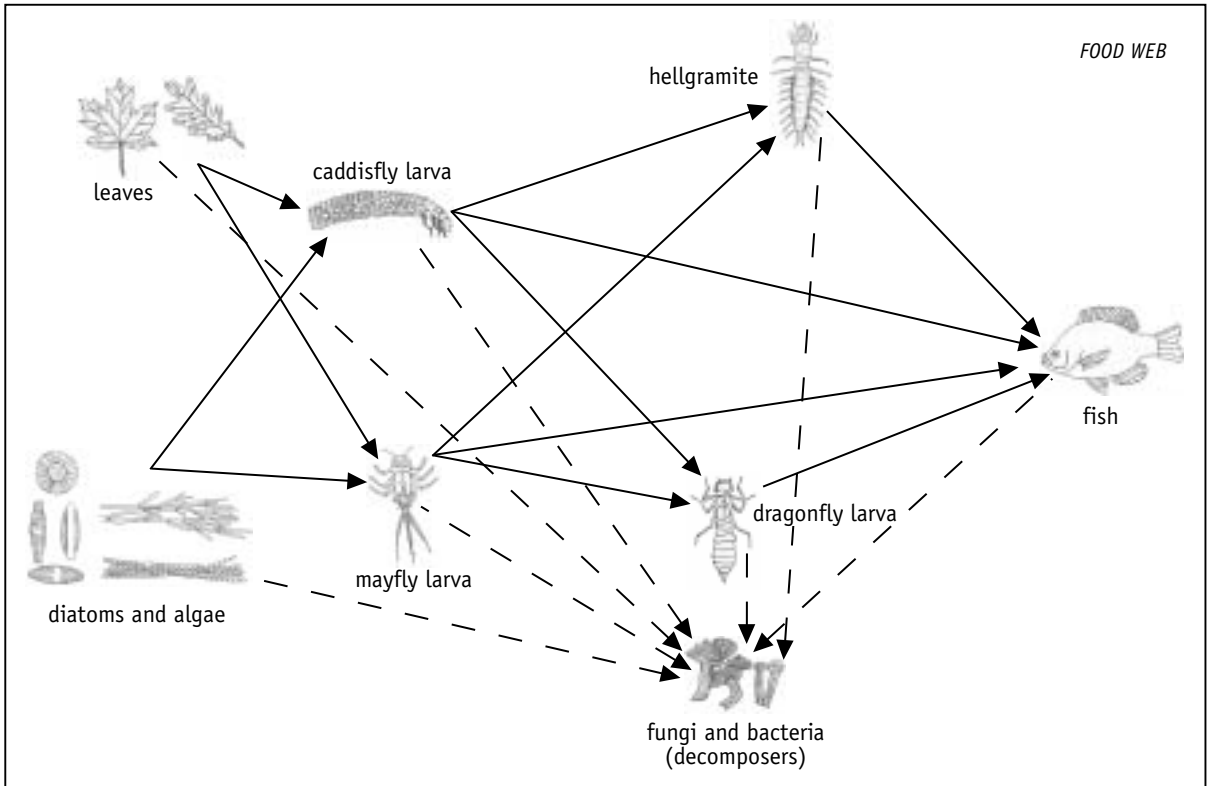
Aquatic animals are placed in one of four feeding groups based on how they get their food. These feeding groups are shredders, scrapers, collectors, and predators.

1. **Shredders**. These macroinvertebrates feed by shredding, or cutting into pieces, leaves and other plant parts. Examples include some stoneflies and caddisflies. They are also primary consumers. While feeding, small pieces break off and drift in the water. They also produce waste, which drifts in the water.

2. **Scrapers or Grazors**. Scrapers, such as snails and water pennies, feed primarily by scraping algae and microscopic organisms called diatoms off of rocks and other objects. Occasionally they feed on larger aquatic plants. They are sometimes called grazors because they graze on algae like a cow grazes on grass. When they feed, pieces of algae and other plant material break off and drift in the water along with their wastes. They are also primary consumers.

3. **Collectors**. These macroinvertebrates, such as mussels and mayfly larva, "collect" their food by filtering the water or by gathering it off the **substrate**. They collect the fragments and wastes produced by shredders, scrapers, and predators. They also collect algae, microbes, and other organic particles. This group could be considered primary consumers (eat algae), secondary consumers (eat microbes) and decomposers (eat food fragments and waste of the other groups).

4. **Predators**. Predators (which include fish and hellgrammites) feed on shredders, collectors, scrapers, and even other predators. While eating, pieces of the prey break off and float away, along with the predators wastes. This group includes secondary and tertiary consumers.



A simple stream food web using the previous three simple food chains; the solid arrows point to the organism doing the eating; the dashed arrows indicate decomposers at work after the organism has died.

Macroinvertebrates as Indicators

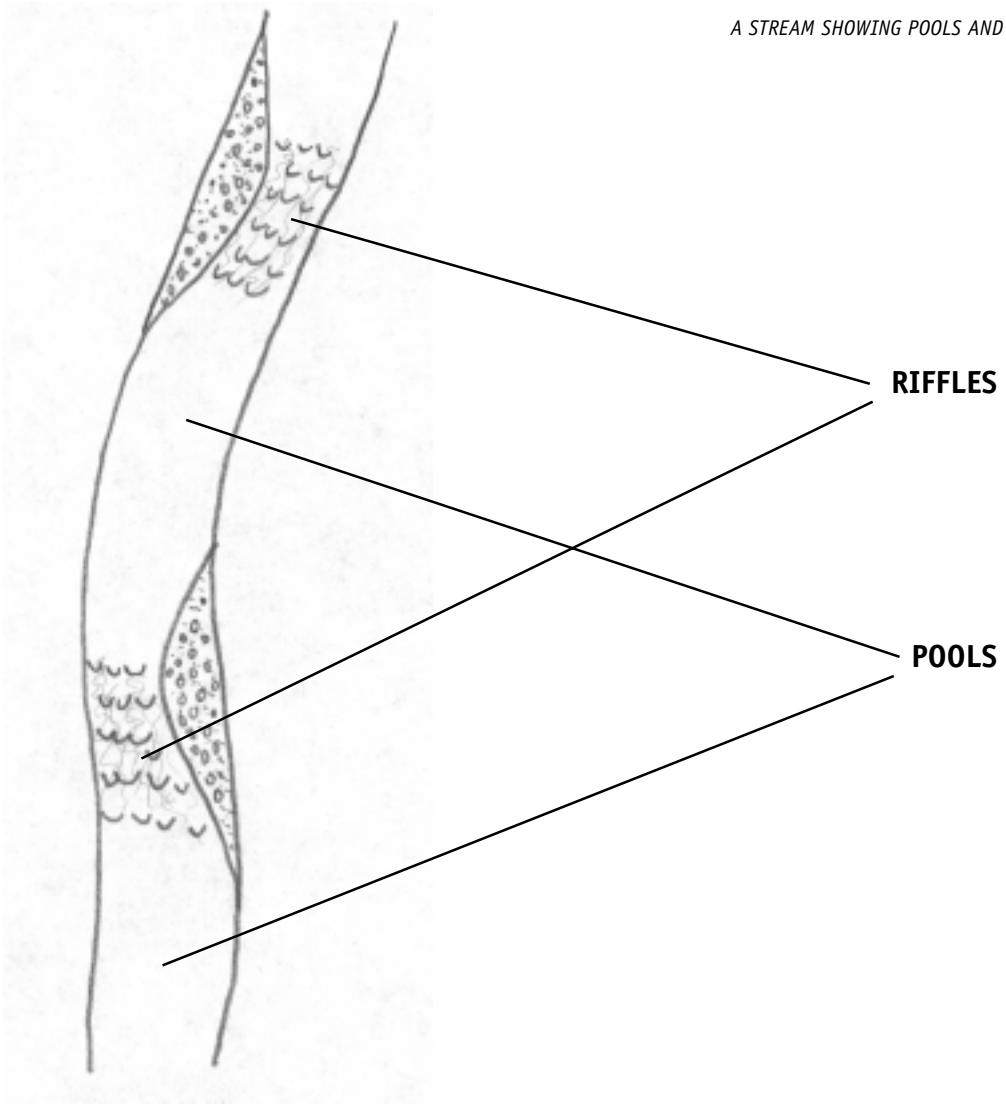
Macroinvertebrates are important as food to all the creatures living in the water. Many can be used as **indicator species**. This means they can tell whether or not a river is polluted or impared.

In rivers, some macroinvertebrates live attached to rocks and plants in places called **riffles**. Riffles are areas where the water is shallow and flowing fast over rocks. These macroinvertebrates are indicators of good water quality. They are sensitive to pollution. The moving water gives them food and oxygen. If the water is polluted, there is less food and oxygen for them and they die. Examples of these macroinvertebrates are caddisfly larva, gilled snails, mayfly larva, riffle beetle larva, stonefly larva, and water pennies.

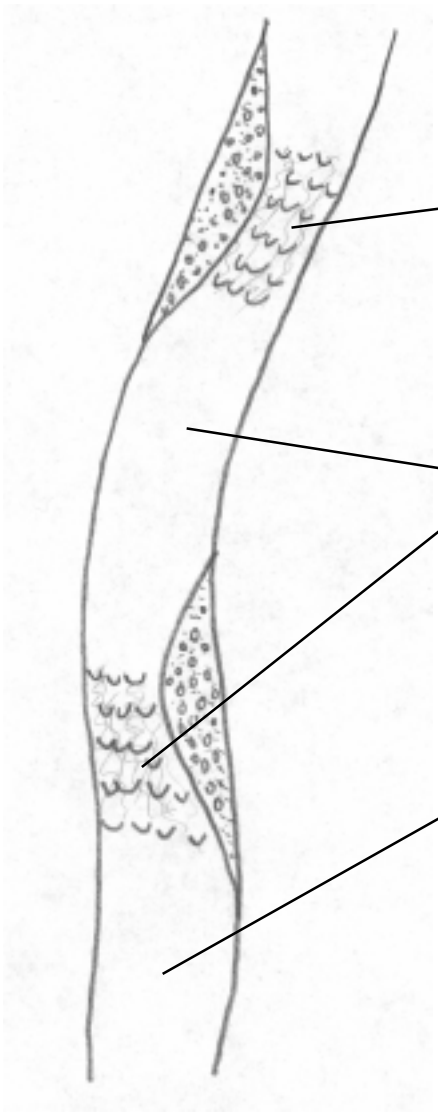
Some macroinvertebrates are indicators of polluted water. They can live in polluted water and in non-polluted water, but they can be found in large numbers in polluted water. These macroinvertebrates are most often found in pools or slow moving areas of a stream. Examples include aquatic worms, leeches, lunged snails, midge fly larvae, and rat-tailed maggots

If the river has mostly pollution sensitive macroinvertebrate species in it, that is a good indication that the water is clean and of high quality. If there are mostly macroinvertebrates that are not sensitive to pollution in the river, that is an indication that the water is polluted and only those types of species can survive.

A STREAM SHOWING POOLS AND RIFFLES



Name the areas of the stream below. Name five macroinvertebrates that live in each area. Can you name any macroinvertebrates that live on the surface of the water? (Hint: look in the macroinvertebrate profiles section.)



_____

_____

THESE LIVE IN POOLS:

1. _____

2. _____

3. _____

4. _____

5. _____

THESE LIVE IN RIFFLES:

1. _____

2. _____

3. _____

4. _____

5. _____

THESE LIVE ON THE SURFACE:

1. _____

2. _____

3. _____

4. _____

5. _____

Living in a Fast Stream

To live in fast moving water, such as riffles, you have to have some way to keep the water from carrying you downstream. The macroinvertebrates living in riffles have some interesting ways to avoid being carried downstream. Many have a flattened body. With a flattened body there is less force from the water hitting it and they can live under and between rocks to avoid the current. A smooth body also allows water to go past with reduced force. Many macroinvertebrates have suckers or claws on their legs they use to cling to rocks and other objects. Some use stones or grains of sand to anchor themselves down and others use sticky threads to stick to rocks.

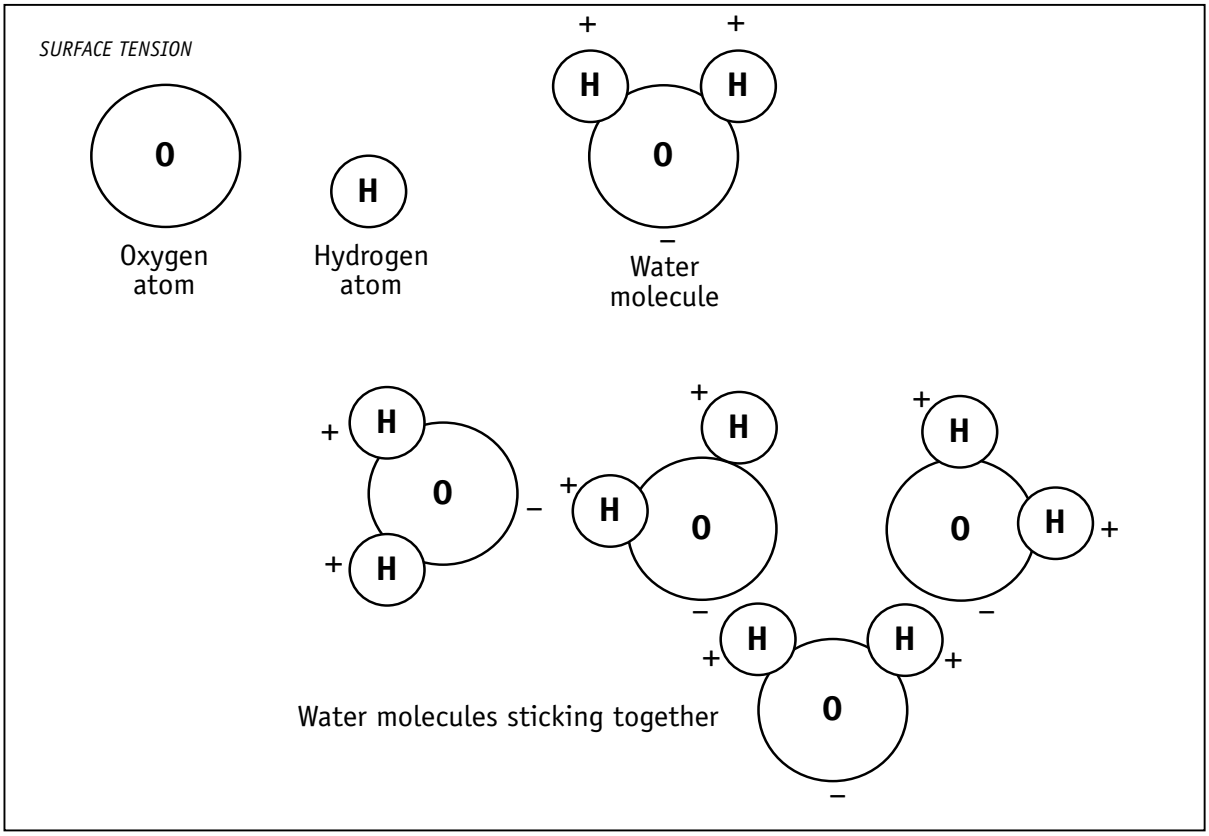
The behavior of macroinvertebrates also helps them avoid being carried downstream. By staying under and between rocks, they avoid the current. Some can be found on the downstream side of rocks on the streambed. There is very little current on this side of the rock.

What is Surface Tension?

The chemical description for water is H2O. This means that in one water molecule, there are two atoms of hydrogen attached to one atom of oxygen. The hydrogen atoms are attached to one side of the oxygen atom. This results in the water molecule having a positive charge on this side. On the other side of the water molecule there is a negative charge. Opposite electrical charges attract. This results in the negative side of one water molecule being attracted to the positive side of another water molecule. This attraction results in water clumping or sticking together.

On the surface of water, water molecules hold on to each other very strongly, because there are no water molecules pulling on them from the air above. Because these water molecules hold on to each other so strongly, they form an invisible skin called “surface tension”.

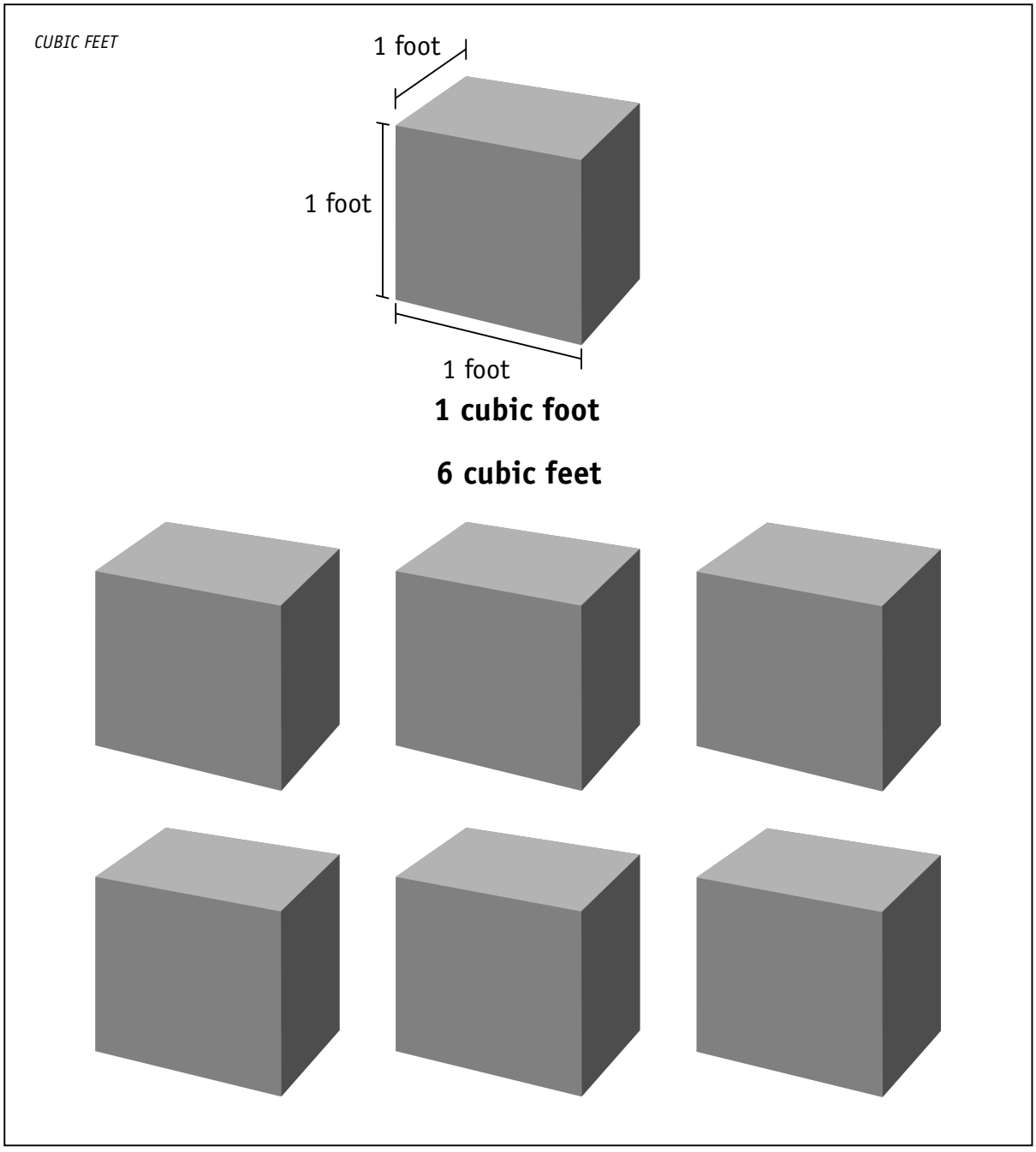
Surface tension is the reason a water strider and other insects can run across water and not sink. Because of surface tension, you can make a paper clip or a needle float on water. Fill a bowl with water. Place the paper clip or needle on the teeth or prongs of a fork. Slowly and gently lower the fork into the bowl of water. The paper clip or needle will float off the fork and you will be able to see the “dents” in the water they make.



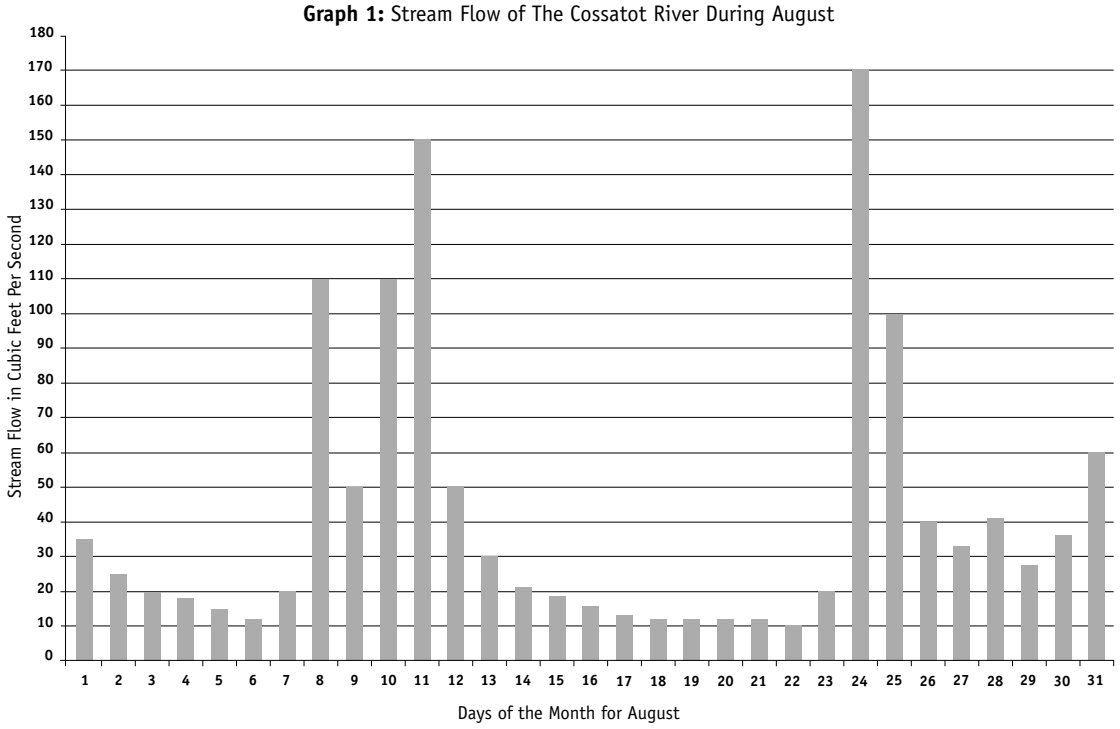
What is Cubic Feet per Second?

The following pages have graphs on the stream flow of the Cossatot River. Stream flow is measured in cubic feet per second. What is "cubic feet per second"? Image a box that is one foot high, one foot wide, and one foot long. This is one cubic foot. Now image the box is full of water. This is one cubic foot of water. Now image 300 of these boxes full of water moving past you in one second. This is 300 cubic feet per second. Image 1500 of these boxes full of water moving past you in one second. This is 1500 cubic feet per second. A cubic foot of water weighs 62.4 pounds. If the stream flow is 100 cubic feet per second, then 6240 pounds of water just flowed by in one second. Water is heavy. This is why it is dangerous to be in a stream when it is high or flooding. The water can easily knock you off your feet and carry you downstream.

How much does 750 cubic feet of water weigh?_____



Graph 1: Stream Flow of The Cossatot River During August



Look at Graph 1, above.

(1) a. Which day had the highest stream flow? _____

b. What was the stream flow for that day? _____

(2) a. Which day had the second highest stream flow? _____

b. What was the stream flow for that day? _____

(3) a. Which day had the lowest stream flow? _____

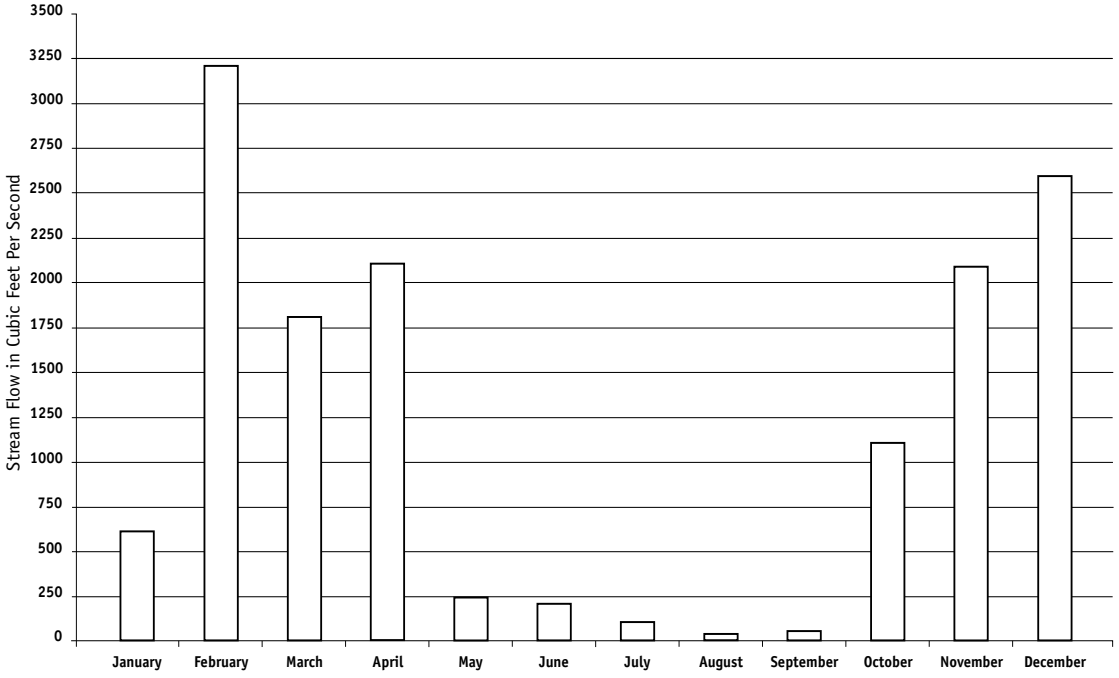
b. What was the stream flow for that day? _____

(4) What was the stream flow for August 9 ? _____

(5) What was the stream flow for August 8? _____

(6) What causes the stream flow to increase? _____
(Hint: read the page on watersheds)

Graph 2: Stream Flow of The Cossatot River at Highway 246 During a One-Year Period



Look at Graph 2, above.

Color in the four seasons (spring, summer, fall, winter) on the graph. Suggestion: use blue for winter, yellow for spring, green for summer, and red for fall.

(1) Which month had the highest stream flow? _____

(2) Which season had the highest stream flow? _____

(3) Which season had the lowest stream flow? _____

(4) Is there a relation between stream flow and the amount of rain that falls? _____
(Hint: read the page on watersheds)

(5) Which season had the most rain? _____

(6) Which season had the least rain? _____

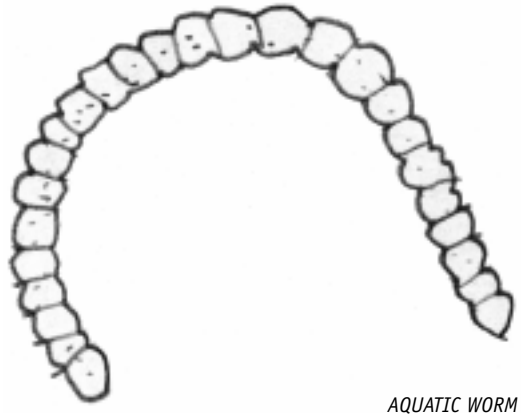
SECTION 2 Macroinvertebrate Profiles

Aquatic Worms

Aquatic worms may be red, tan, black, or brown and grow up to five inches long. They look like thin earthworms and move by stretching and pulling their body in a worm like fashion.

Aquatic worms are not sensitive to pollution. Their blood contains the red blood pigment **hemoglobin**, which makes it easier to use the oxygen in the water. This allows them to live in areas with very little oxygen in the water, such as areas with large amounts of decaying leaves. Hemoglobin is why your blood is red. They are also found in floating masses of algae, or sediments on the stream bottom in slow moving or still areas of the stream (pools). Large numbers of the aquatic worms indicates a high level of pollution, such as animal waste or sewage.

They are **decomposers** and can be put in the **collector** feeding group.

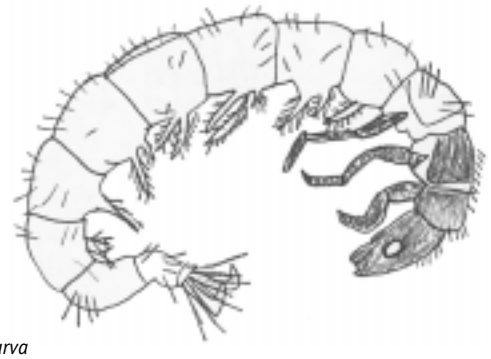


AQUATIC WORM

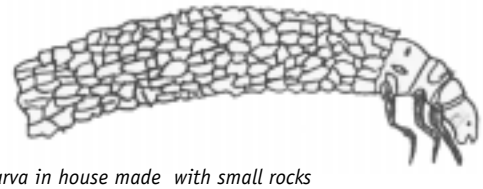
Caddisfly

Caddisfly **larvae** are very sensitive to pollution and are an indicator of high water quality. Living in **riffles** or **currents**, they are up to 1/2 inch in length and have gills on the underside of their body or at the end. Some eat algae or other plants and make their houses by gluing together small rocks, sand, twigs, or leaves. They are in the **shredder** or **scraper** feeding group. Other caddisfly **larvae** build tent like houses by spinning a web to trap food by filtering flowing water and are in the **collector** feeding group. They are an important food source. Adults live for about a month.

CADDISFLY



larva



larva in house made with small rocks

larva in a tent-like house

adult

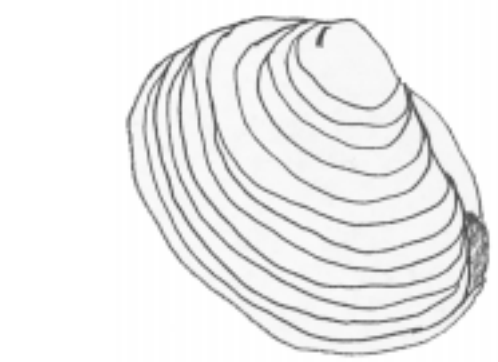
Clams & Mussels

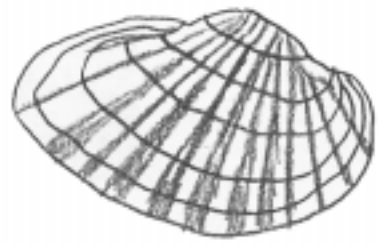
Native mussels can live for years and are somewhat sensitive to pollution. They eat by pulling water inside their shells and filtering it to remove bits and pieces of food. This puts them in the collector feeding group.

Native mussels are somewhat flat, oblong in shape, and lopsided. The highest point on the shell is closer to one end. The larvae of native mussels are parasitic. They live off the gills of fish and depend on fish to spread them throughout the river. When the larvae reach the right size, they drop off the fish's gills and fall to the bottom of the stream.

The asiatic clam is not a native species. It came from asia and is more tolerant to pollution than the native mussels. They also eat by filtering the water. Asiatic clams are smaller (1 inch), symmetrical, and more round than native mussels. The highest point on the shell is equal distant from both ends. The larvae of asiatic clams are not parasitic. They can move from one stream to another by attaching to the feet of birds, the surface of boats, or drifting downstream.

ASIATIC CLAM





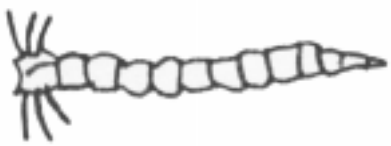
NATIVE MUSSEL

Cranefly

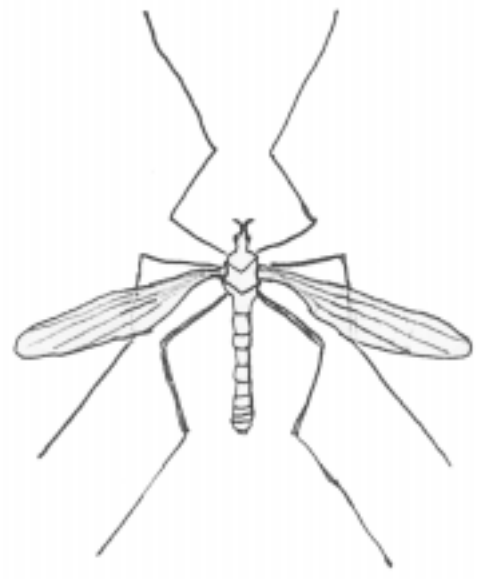
The cranefly larva is somewhat sensitive to pollution. It has a round squishy fat body with no legs and can be up to four inches long. It can be milky, light-brown, gray, or greenish in color. The head is usually pulled in, so the front appears round. Its back end has several finger-like structures, which are thrust through the water's surface for breathing. It feeds on decaying plant material (a **decomposer**) and can be put in the collector feeding group. The adult looks like a giant mosquito, however they do not bite. Most adults do not eat and are short lived.

CRANEFLY

larva



larva

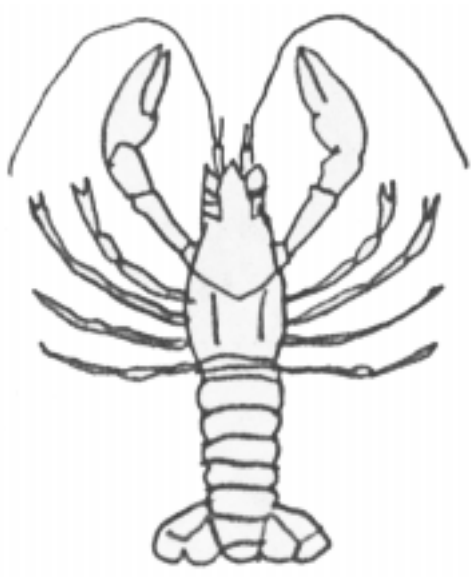


adult

Crayfish

Crayfish are somewhat sensitive to pollution. They can live for several years and grow by shedding their shells. A process called molting. They must hide while their new shell hardens to protect their soft bodies. Most often they found hiding under rocks during the day and come out to eat at night. Being generalists in their eating habits, they eat anything they find or catch (dead or alive). They can be placed in the scraper, collector, and predator feeding groups.

CRAYFISH



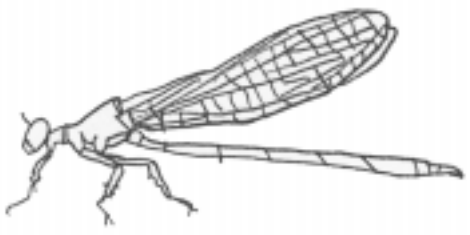
Damselfly

Most damselfly larvae are somewhat sensitive to pollution. They are predators and use a large scoop-like lower lip to catch their prey. Their bodies are narrow and have three oar-shaped fan-like gills on the tail. It takes one to four years for the larvae to develop into an adults. Adult damselflies are generally smaller and more slender than adult dragonflies. Most adults perch with wings pressed together over their backs. Adults feed on other insects they catch while flying. Mosquitoes make up a large part of the adults' diet.

The Ebony Jewelwing damselfly is found in small forested streams and is an indicator of high water quality. It has a dark metallic green body with black wings.

DAMSELFLY

larva



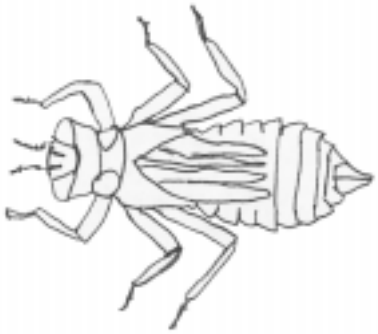
adult

Dragonfly

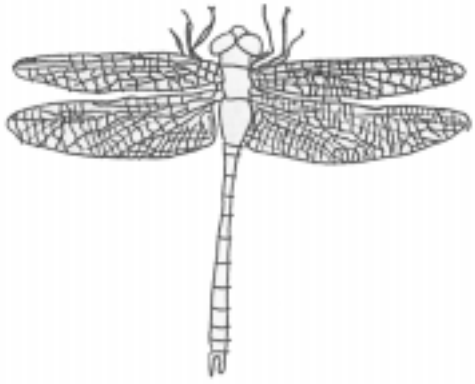
Dragonfly larvae are somewhat sensitive to pollution. They are predators and use a large scoop-like lower lip to catch their prey. The bodies of dragonfly larvae are somewhat short and fat and have a fat pointed tail. It takes from one to four years for the larvae to become adults. Adult dragonflies are generally larger and fatter than adult damselflies. Most adults perch with the wings straight out to the sides. Adults feed on other insects they catch while flying.

DRAGONFLY

larva



larva



adult

Gilled Snails

The gilled snail is very sensitive to water pollution and is an indicator of high water quality. It has gills for breathing and gets its oxygen from the water. It is called a grazer or scraper because it eats by grazing or scraping algae off rocks and plants. Inside a hard, spiral shaped shell is a soft body. A plate like door protects the opening of the shell and can be closed quickly. If you hold the shell with its tip pointing up and the opening facing you, the opening will be on the right side. The shell is made of calcium carbonate.

The gilled snail can be found on rocks in the stream current. Amazingly, it can also be found crawling on rocks in very fast water (riffles). Its smooth shell and cone like shape reduces the force of the water hitting it, and so it can crawl on the rocks and not get washed away.

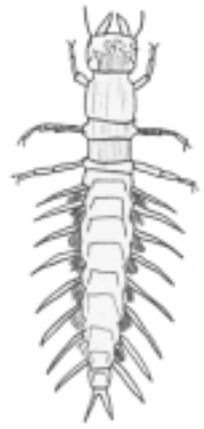
GILLED SNAILS

Hellgrammite and Dobsonfly

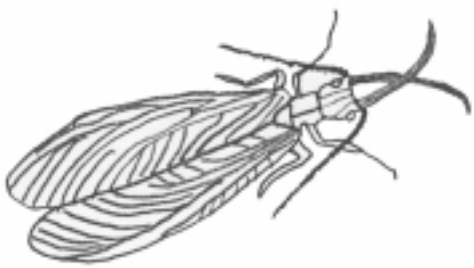
The hellgrammite is very sensitive to water pollution. It is an indicator of high water quality. Growing up to 4 inches long, it is a predator, which means it eats other insects and aquatic life. It is the larva of the dobsonfly, a land insect. It takes one to four years for a hellgrammite to become a dobsonfly. The dobsonfly only lives for a few days.

The dobsonfly lays its eggs with a protective cover on top of leaves, which are directly above water. This protective cover is white and looks like bird droppings on the leaves. When the eggs hatch, the hellgrammites drop into the water.

HELLGRAMMITE AND DOBSONFLY



Hellgrammite (Dobsonfly larva)

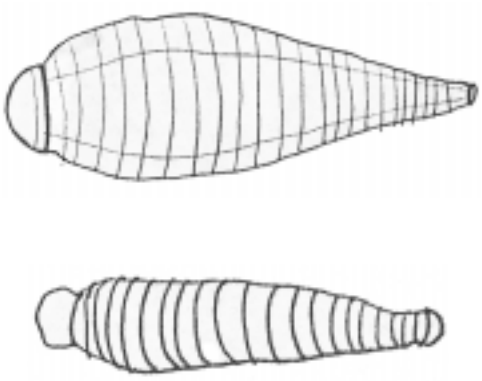


Dobsonfly (adult)

Leech

Leeches are not sensitive to pollution. It has a worm-like flattened body. Most are scavengers (eat dead things) or feed on other invertebrates. This put them in the collector or predator feeding group. Only a few are parasitic on people. Leeches that attach to people are usually found in slow moving or still areas of the stream (pools). They have suckers at both ends which are used for feeding, attachment, and movement.

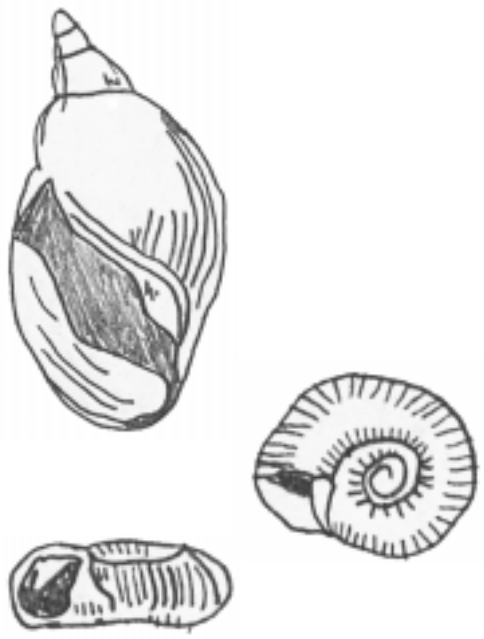
LEECHES



Lunged Snail

The Lunged Snail is not sensitive to water pollution. To breathe, it comes to the water's surface to get air and stores the air in its shell cavity. It can live in water which has little or no oxygen in it and is usually found in slow moving or still areas of the river. It can be a grazer (eats algae) or a decomposer, which eats dead and decaying things. This would put it in the scraper or collector feeding group. Inside the hard shell, which can be spiral or flattened in shaped, is a soft body. It does not have a plate-like door covering the shell opening. If you hold the shell with its tip pointing up and the opening facing you, the opening will be on the left side. The shell is made of calcium carbonate.

LUNGED SNAILS

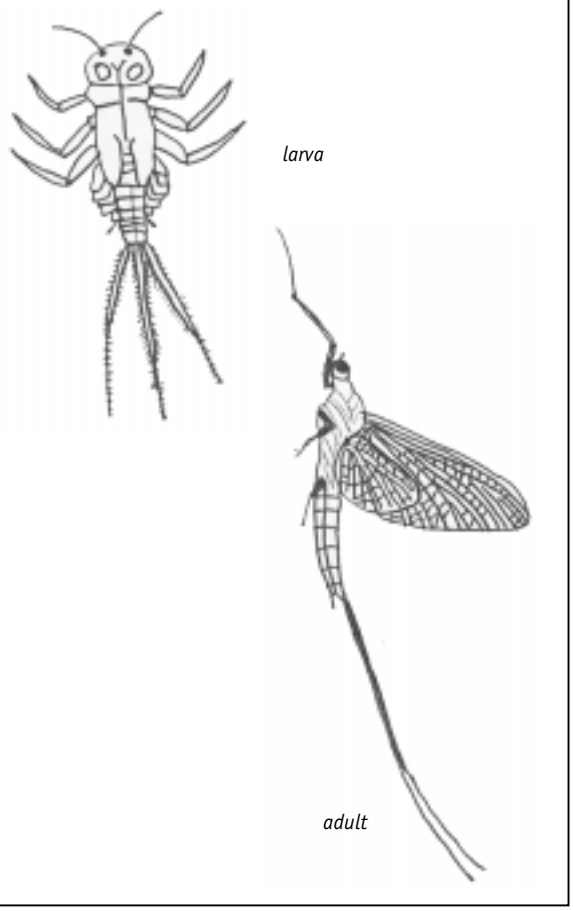


Mayfly

The mayfly larva is very sensitive to water pollution and is an indicator of high water quality. It has feathery gills along the side of its body that it uses to get oxygen from the water. It lives on rock surfaces in riffles. The mayfly larva can do this, because it has a flat body, which reduces the force of the water on it, it has a claw on each leg to grip rocks, and it often stays on the downstream side of the rock where there is less current. Some are collectors, that is they get food by filtering water or collecting it off the surface, and some are grazers, that is they eat algae by grazing it like a cow.

It can take up to two years for the larva to become an adult. When they do become adults, large numbers of adults may emerge from the stream at the same time. Adults do not eat and only live from 2 hours to 3 days.

MAYFLY

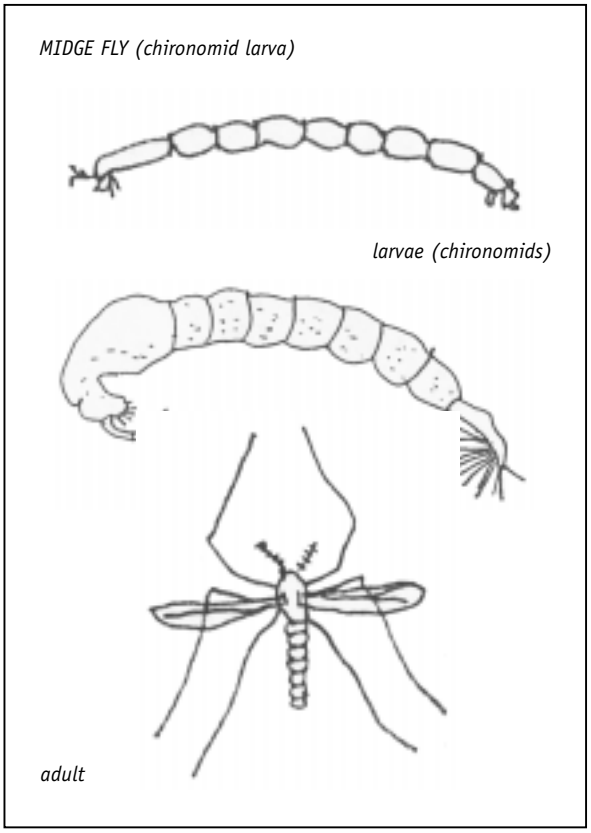


Midge Fly (chironomid larva)

Midge Fly larvae are not sensitive to pollution. They are also called chironomids and can be red, yellowish, greenish, or whitish in color. The red ones are called bloodworms. The red color is caused by the red blood pigment hemoglobin. Hemoglobin makes it easier to use the oxygen in the water. This allows them to live in areas with very little oxygen in the water, such as areas with large amounts of decaying leaves or sediments on the stream bottom in slow moving or still areas of the stream. Hemoglobin is the reason your blood is red. They can be found in all, but the most polluted aquatic conditions. Presence in large numbers may indicate pollution, such as animal waste. They are decomposers and can be put in the collector feeding group.

They grow up to 1/2 inch long and have a distinct, often dark head. There is one pair of tiny legs below the head and one pair on the back end. A thin dark line can be seen inside the body. This is the digestive tract. They live in tubes made of sand, silt, or debris cemented together with a sticky secretion. Chironomids are an important food of fish.

Adults (midge flies) look like mosquitoes, but do not have the needle like mouth of a mosquito.

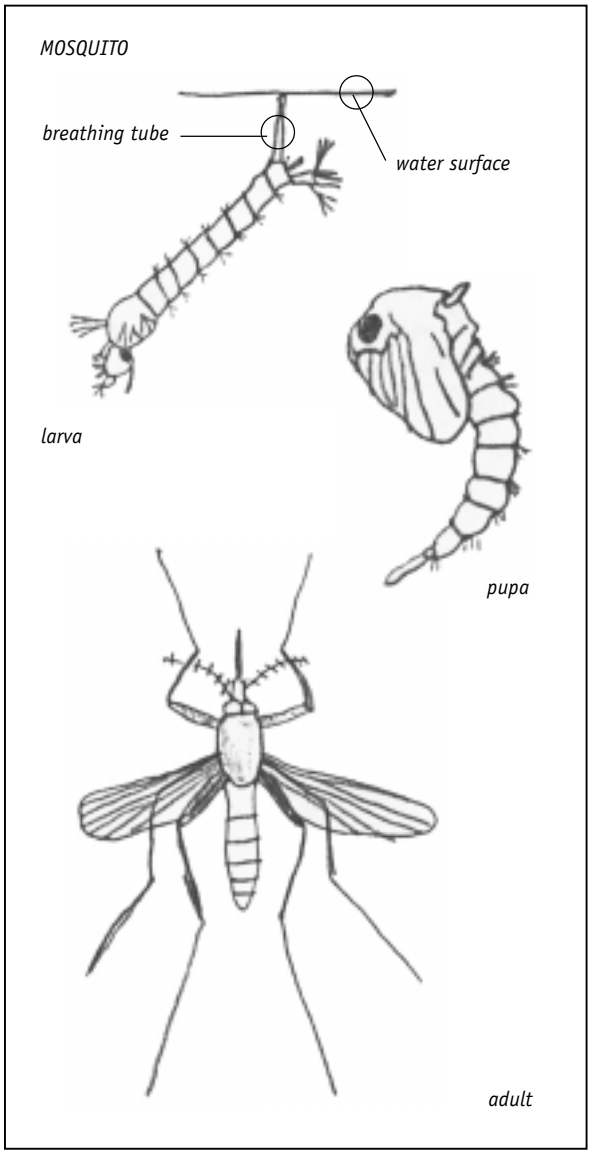


Mosquito

Mosquito larvae are often called wiggle-tails because of their wiggling movement in water. Larvae breathe at the surface and can be found anywhere there is standing water or still areas of a stream. Many have a breathing tube on their rear end and can be seen at the surface sticking it out of the water. Most larvae feed on organic debris, such as decaying leaves, although a few are predators. They are in the collector or predator feeding group.

A pupa is a stage the mosquito larva goes through before becoming an adult.

Adult males do not bite. It is the adult females that bite and are serious pest. Some can transmit disease. They are a food source for many insects, fish, and birds.



Planaria

The planaria is very sensitive to water pollution and is an indicator of high water quality. It is a flatworm and can be mistaken for a leech. Found on the bottom of rocks or on leaf litter, it eats small aquatic organisms, living or dead. This puts it in the collector or predator feeding group. It has a soft, cigar-shaped, flat body, up to 3/4 inches long, which is dull gray to black in color. It may or may not have a distinct head, and this head may be arrow shaped with eye spots. These eyespots are not true eyes, but they can detect light.

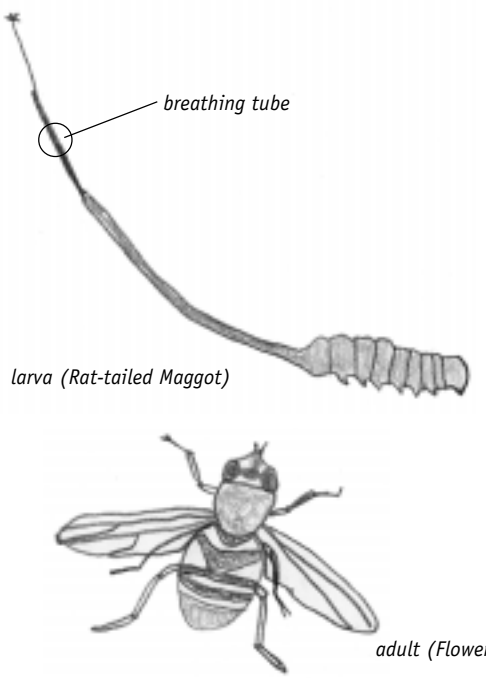
PLANARIAN

Rat-tailed Maggot

Rat-tailed maggots are not sensitive to pollution. They live in slow moving or still areas of the river, in areas with decomposing material such as leaves and twigs. Some can be found in tree holes. They eat the decomposing material and other tiny organisms. They can be put in the collector feeding group. It is easy to recognize them by their very long breathing tube, which looks like a long tail. To breathe, they stick this breathing tube out of the water. Because they obtain their oxygen from the air, they frequently inhabit areas with very little oxygen in the water. Large numbers of the Rat-tailed maggots indicates a high level of pollution, such as animal waste or sewage.

Rat-tailed maggots are the larvae of flower flies, or drone flies. Flower flies feed on nectar from flowers and are pollinators.

RAT-TAILED MAGGOT



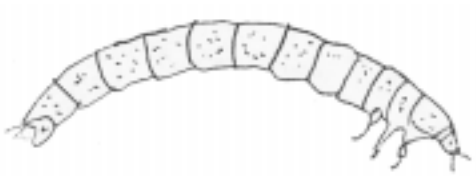
Riffle Beetle

The riffle beetle larva is somewhat sensitive to pollution. Its body is long, hard, stiff, and is up to 3/4 inch long. On the upper middle section of the body, there are six long jointed legs. Its back end has two tiny hooks and short hairs which are sometimes hard to see.

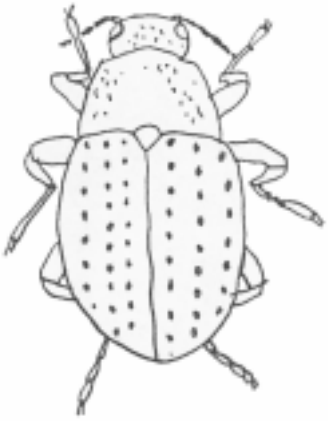
The riffle beetle adult is very sensitive to pollution and is an indicator of high water quality. The adults are better indicators of pollution than larva, because they have been subjected to the conditions of the water quality over a longer period. Usually, adults and larvae live in riffle areas of the stream. They do not swim on the surface, but walk slowly under the water on plants or rocks. Their stout legs and large claws allow them to grip effectively. It has a small oval body about 1/4 inch long and one pair of antennae.

Adults and larva eat algae.

RIFFLE BEETLE



larva



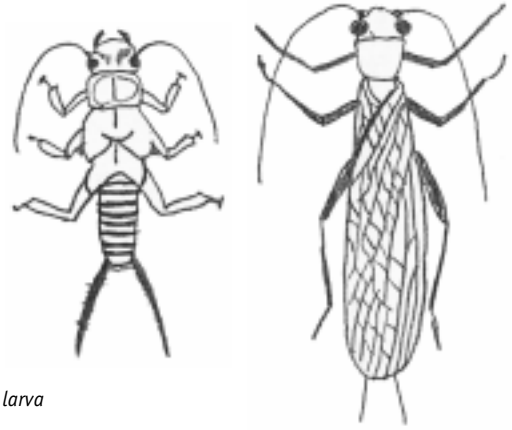
adult

Stonefly

Stonefly larvae are very sensitive to water pollution and are indicators of high water quality. They are found in clean streams with high levels of oxygen in the water. Some eat plants, while others eat fungi and bacteria from rotting leaves and some are predators. This puts them in the shredder, collector or predator feeding group. They have two long antennae and two hair-like tails. On the middle section of body, there are six jointed legs. Each leg has two hooks on the end, which are used to grip rocks. Gills are often located on or behind each leg. It lives on rock surfaces in fast currents and riffles. Stonefly larvae can do this, because it has a flat body, which reduces the force of the water on it, the legs have hooks to grip rocks, and it often stays on the downstream side of the rock where there is less current.

Most adults are poor fliers and only come out at night.

STONEFLY



larva

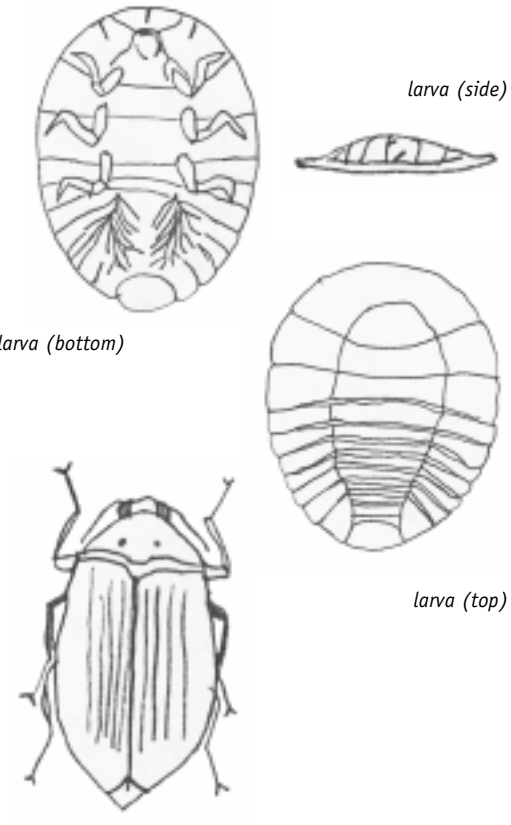
adult

Water Penny

The water penny is very sensitive to pollution and is an indicator of high water quality. It can be found on rocks in the stream current and in riffles. The water penny can do this, because it has a round flat body, which reduces the force of the water on it, it has claws on each of its six legs to grip rocks, and it often stays on the downstream side of the rock where there is less current. The water penny can be brown, black, or tan in color. Its round flat body with a plate like covering looks like a tiny round leaf. When it is attached to a rock, it is difficult to remove. It eats algae and is in the scraper feeding group.

It is the larva of a beetle, which lives in or near the water. Adults do not live very long.

WATER PENNY



Water Strider

Water striders look like small spiders, which skate across the water. However, they are not spiders. Spiders have eight legs and water striders have six legs. They have hair on the ends of their legs which does not break the surface tension of water (see the section on surface tension for an explanation). The hair prevents them from sinking. Water striders are predators and eat small insects that fall onto the water's surface. They locate the small insects by feeling the vibrations the insects produce on the surface of the water. Some have wings and can fly. They can be found in slow moving or still areas of the river.

WATER STRIDER

Whirligig Beetle

The larvae of whirligig beetles are somewhat sensitive to pollution. They are predators and catch their food with pincher-like mouth parts. The body is long and slender and has six legs with claws near its head. Past the legs, it has feather like gills on the sides of its body.

Adult whirligig beetles live in slow moving or still areas of the river. They are somewhat flattened and rapidly whirl and gyrate on the surface of the water. Paddle-shaped swimming legs allow them to swim as they do. They have divided eyes: the lower part sees what is going on under the water and the upper part sees what is happening on or above the water surface. The adults eat live or dead insects floating on the surface of the water.

WHIRLIGIG BEETLE

larva *adult*

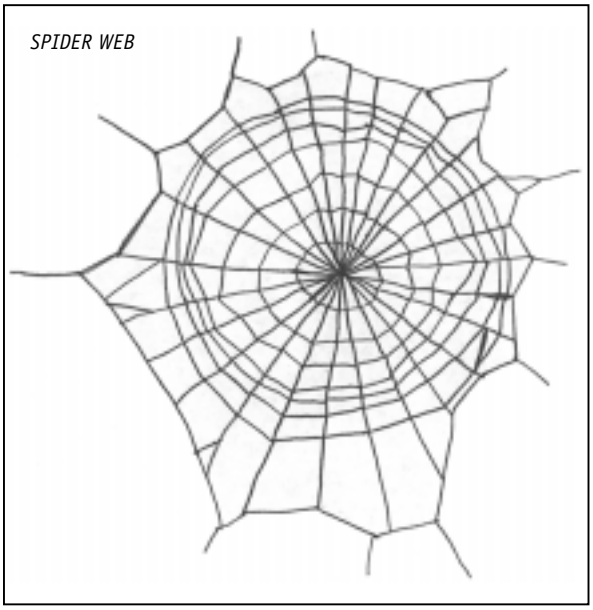
What is Biodiversity?

Biological diversity or more commonly called biodiversity is simply the different kinds of plants, animals, and other living organisms. These different kinds of plants, animals, and other living organisms are different species. For example, a corn field has low biodiversity because most of the plants in this area are one kind of plant, "corn", and with one kind of plant there would not be a lot of different animals. However, a forest has high biodiversity, because there are many different kinds of plants, animals, and other living organisms here.

The Cossatot River has high biodiversity. The "Macroinvertebrate Profiles" section only talked about 21 different kinds of macroinvertebrates. There are many more different kinds of macroinvertebrates, fish, other animals, plants, and other organisms in the Cossatot River.

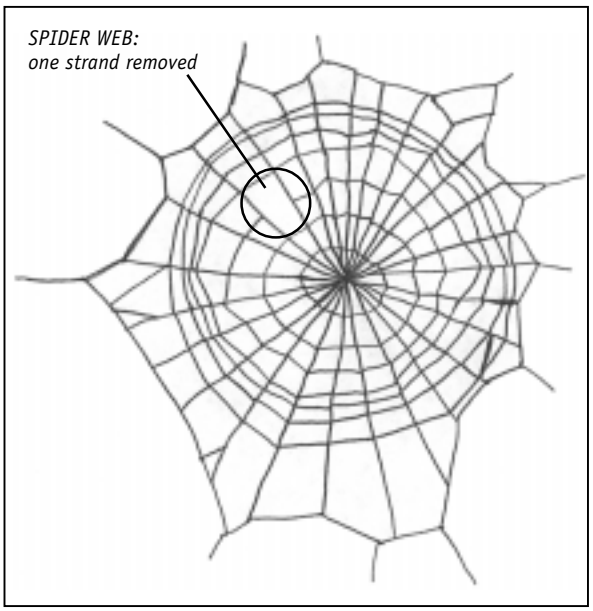
But what good is biodiversity? For an ecosystem to be healthy, it is generally thought that it needs to have high biodiversity. Many of the macroinvertebrates mentioned in this workbook appear to do the same thing in the stream ecosystem. For example, water pennies and many mayfly and caddisfly larvae eat algae and may be eaten by fish. If a natural disaster such as disease, drought, or cold temperature were to kill all of the mayflies, there would still be water pennies and caddis fly larvae to eat algae and become food for fish. The more different kinds of organisms there are that do similar things in an ecosystem, the easier it is for an ecosystem to work or recover from a natural disaster.

SPIDER WEB

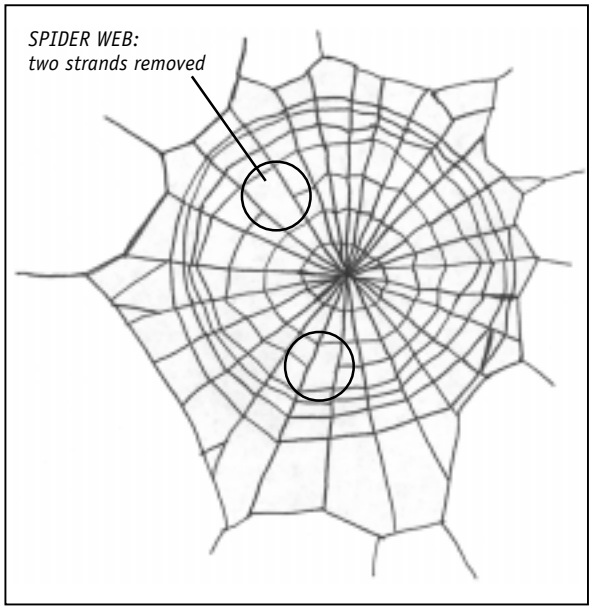


How an ecosystem works, the food web and how organisms interact with each other and their environment, can be pictured like a spider web. All of the strands of the spider web represent the different organisms and their interactions. (Remember the drawing of the food web?)

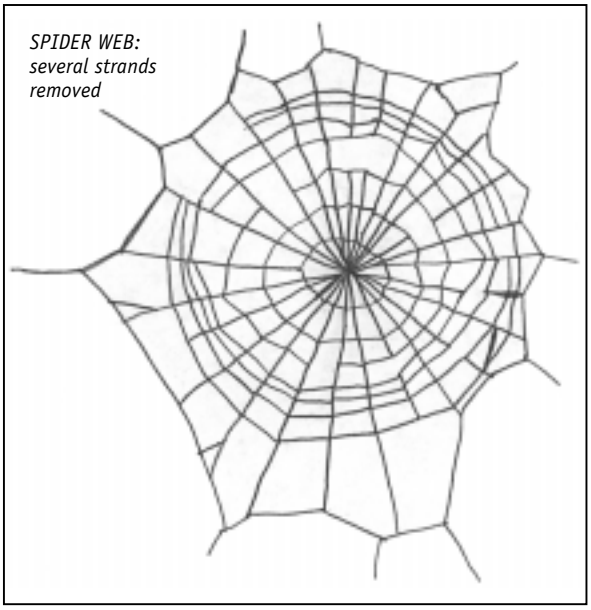
You can remove one strand and the spider web will still work.



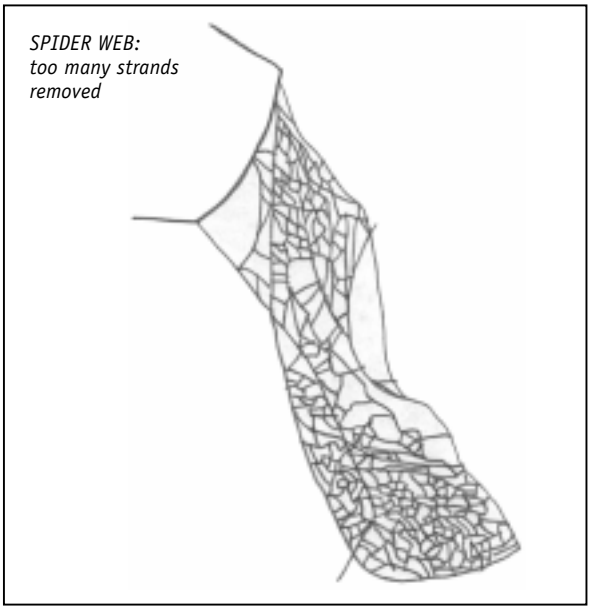
You can remove two strands and the spider web will still work.



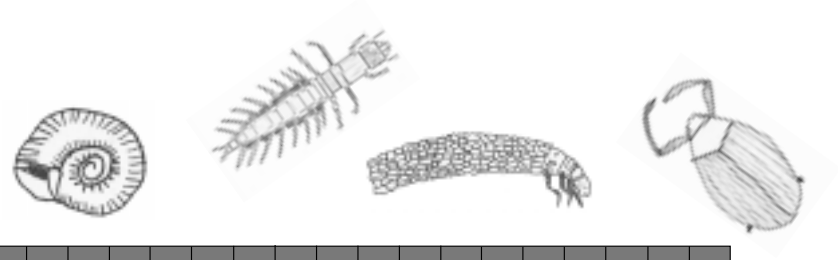
You can remove several strands and the spider web will still work.



But, if you remove too many strands from the spider web, it will fall apart and no longer work. The same is true for an ecosystem. You can remove 1, 2, or even several species, but the more you remove, the more difficult it is for an ecosystem to work. If you remove too many, then the ecosystem will not work at all.



SECTION 3 Activities



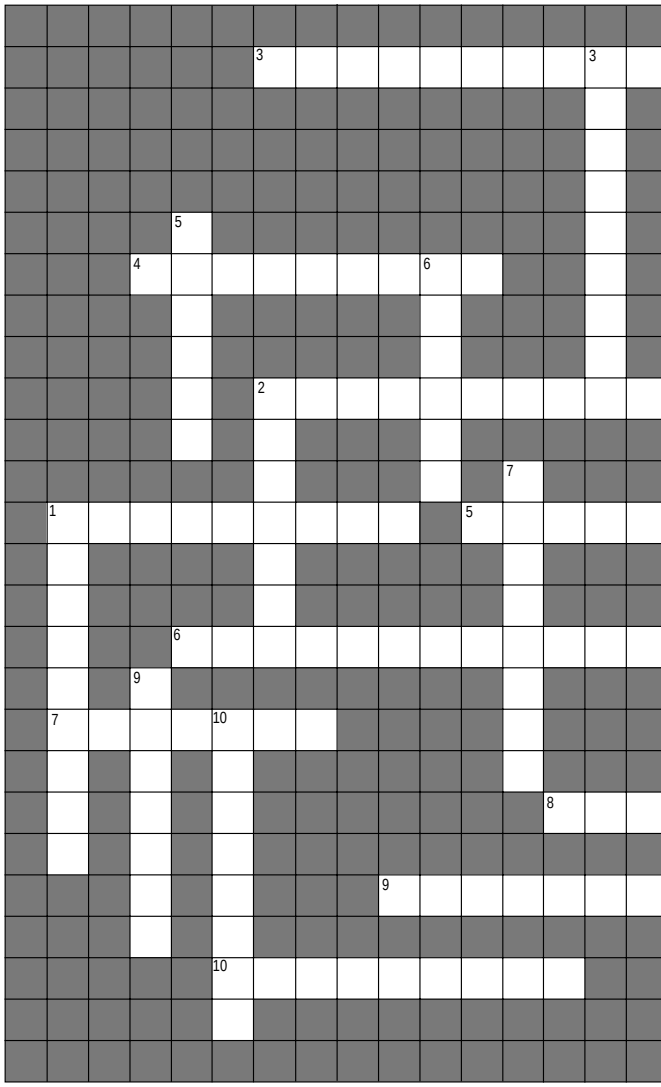
Crossword Puzzle

Across

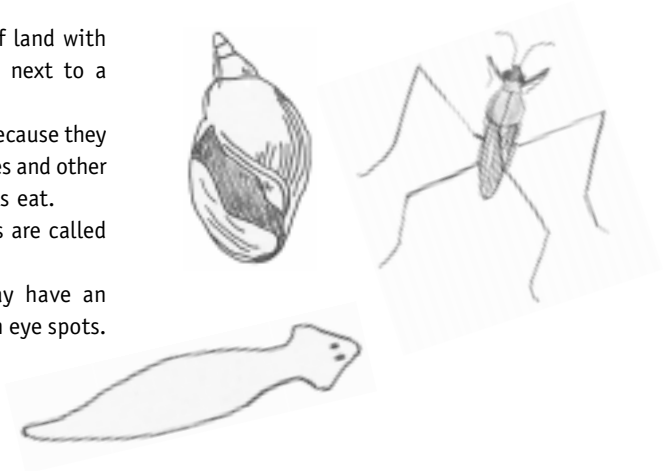
1. These adult beetles are somewhat flattened and rapidly whirl and gyrate on the surface of the water.
2. The larva of a dobsonfly.
3. Something that breaks down dead plant and animal parts into nutrients.
4. Most make their houses by gluing together small rocks, sand, twigs, or leaves.
5. This type of snail is very sensitive to water pollution and gets its oxygen from the water.
6. They look like small spiders, which skate across the water. (Hint: 2 words separated by a hyphen in the puzzle)
7. It eats algae and diatoms by scraping them off of rocks and other objects.
8. Some are parasitic on people. It has a worm-like flattened body.
9. It eats anything it can catch such as shredders, collectors, and scrapers.
10. Some macroinvertebrates can tell whether or not a river is polluted. They are called _____ species.

Down

1. The area of land that catches rain and drains it into a stream.
2. The place where plants and animals live.
3. Plants and animals of a community, interacting with each other and with the air, soil, water, sunlight, and climate, in a way that allows the community to exist year after year, form an _____.
4. The group of plants and animals that live in a habitat is called a _____.
5. The larva is an indicator of high water quality. The adults do not eat and live from 2 hours to 3 days.
6. This snail is not sensitive to water pollution. To breathe, it comes to the water's surface to get air.



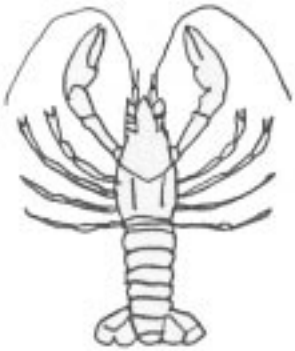
7. This zone is the area of land with trees and other plants next to a stream.
8. Plants are called this, because they make food, such as leaves and other plant parts that animals eat.
9. Animals that eat plants are called this kind of consumer.
10. A flat worm which may have an arrow-shaped head with eye spots.



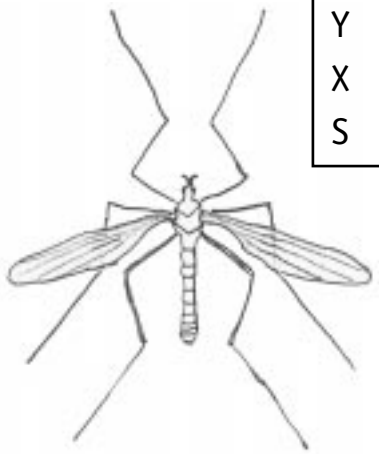
Cossatot Word Search

Words can go across, up, down, diagonal or backwards.

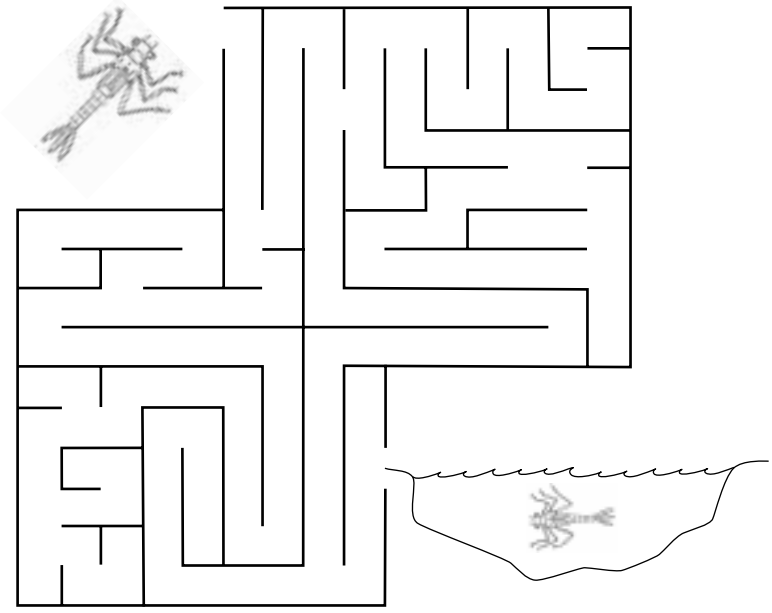
COLLECTOR
CRANEFLY
DECOMPOSER
HABITAT
RIFFLE
SHREDDER
WATERSHED
COMMUNITY
CRAYFISH
DOBSONFLY
MOSQUITO
RIPARIANZONE
STONEFLY
COSSATOT
DAMSELFLY
ECOSYSTEM
MUSSEL
RUNOFF
WATERPENNY



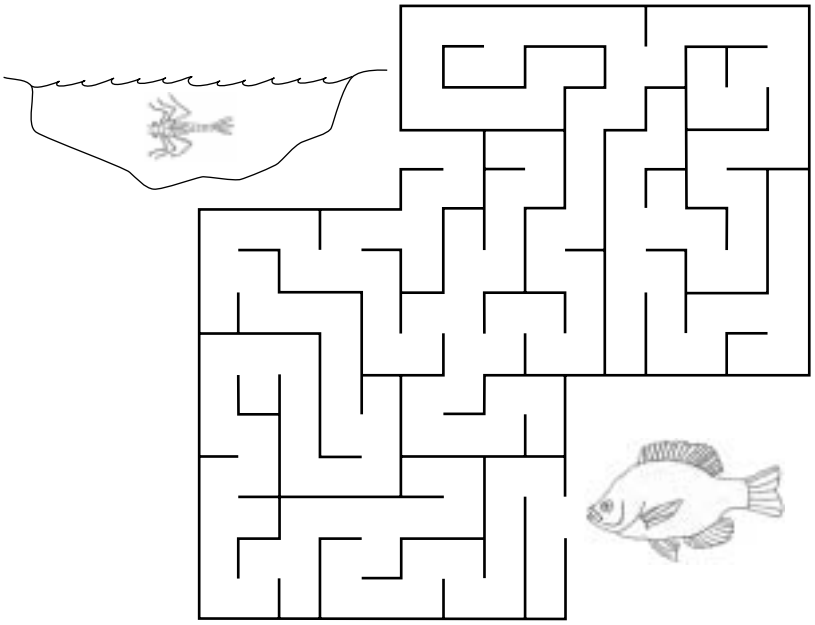
U	D	F	E	L	X	E	D	D	U	Z	S	W	C	I
E	C	N	X	U	L	B	E	X	S	C	A	G	R	U
P	C	R	Y	F	X	H	C	T	T	T	C	Y	A	Z
R	C	O	F	L	S	C	O	K	E	G	O	K	N	O
E	I	I	S	R	F	N	M	R	T	W	S	Y	E	T
L	R	P	E	Y	E	N	P	K	M	U	S	I	F	I
J	E	T	A	F	S	E	O	S	E	E	A	R	L	U
B	A	S	L	R	N	T	S	S	D	N	T	O	Y	Q
W	N	Y	S	N	I	O	E	J	B	P	O	T	Z	S
X	I	G	Y	U	S	A	R	M	X	O	T	C	F	O
B	V	C	O	M	M	U	N	I	T	Y	D	E	F	M
H	S	I	F	Y	A	R	C	Z	X	V	V	L	O	D
Y	L	F	L	E	S	M	A	D	O	H	S	L	N	G
X	H	T	A	T	I	B	A	H	I	N	Y	O	U	V
S	H	R	E	D	D	E	R	U	C	D	E	C	R	T



Help the damselfly find its way home to water.



Help the fish find something to eat.



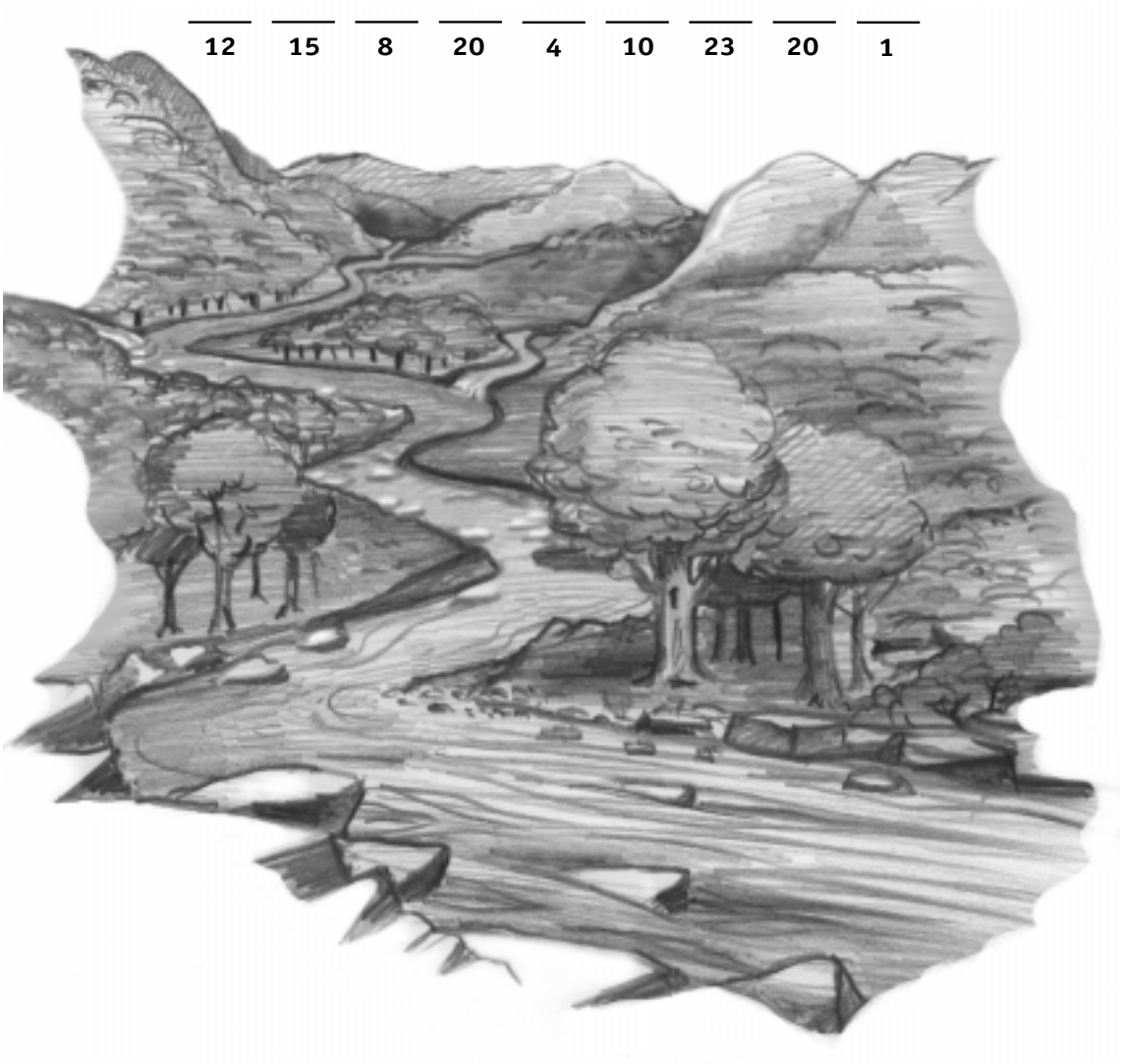
Decode the Secret Message

To decode the secret message, place the corresponding letter in each numbered blank.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
15	9	16	1	20	26	19	23	6	18	22	7	11	2	5	14	25	4	10	8	13	21	12	24	17	3

12	20		15	7	7		7	6	21	20		6	2		15										

12	15	8	20	4	10	23	20	1



Double Puzzle

Unscramble each of the clue words.
Copy the letters in the numbered cells to other cells with the same number.

CEHLE ☐☐☐☐☐
8 7

FIFLER ☐☐☐☐☐☐
4

DOFO ☐☐☐☐
9

RAETW ☐☐☐☐☐
1 3

VIERR ☐☐☐☐☐
5

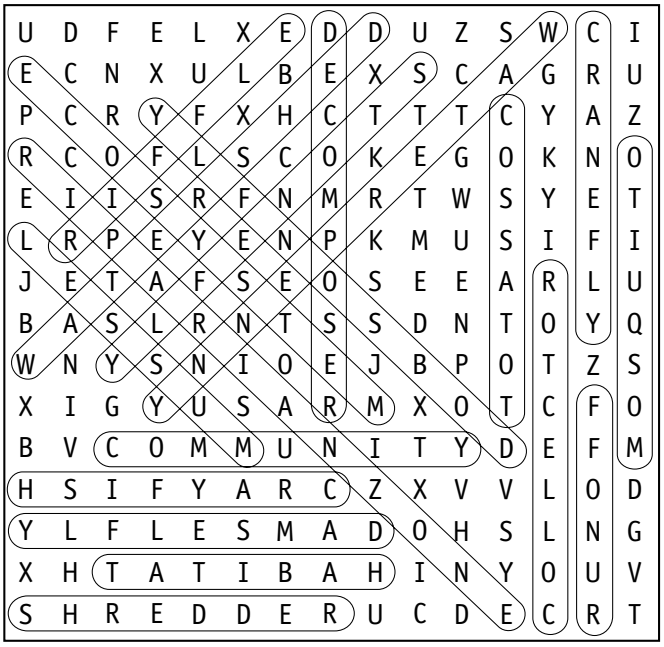
LIGSL ☐☐☐☐☐
6

NIRA ☐☐☐☐
2

1	2	3	4	5	6	7	8	9

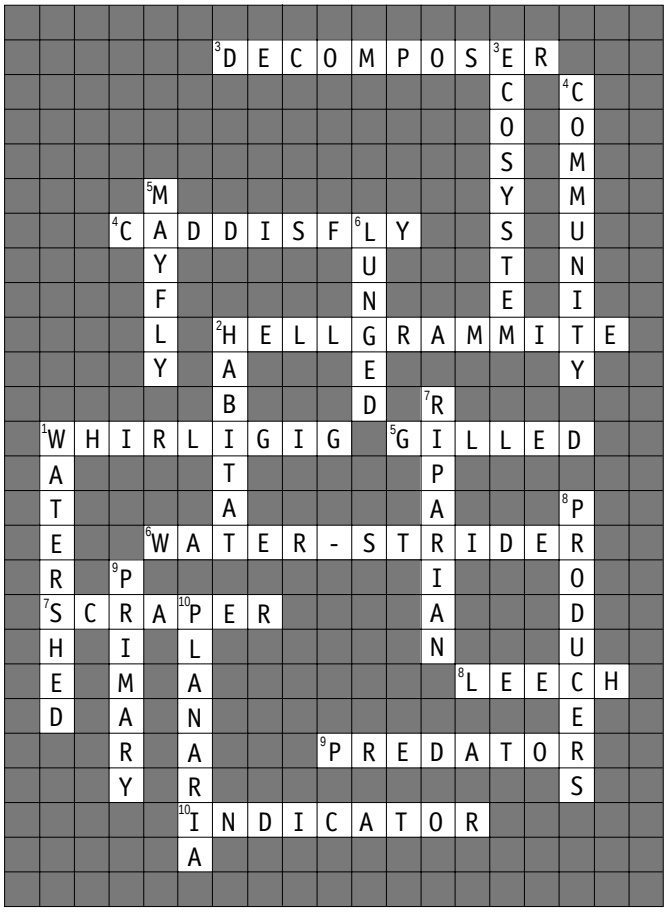
Word List: RIVER, WATER, RIFFLE, LEECH, RAIN, FOOD, GILLS

Puzzle Answers



Cossatot Word Search

Crossword Puzzle



SECTION 4
Glossary

alluvial terrace–A flat, raised area along a stream or river where the water leaves behind soil and rotting material, such as leaves, during a flood

aquatic organism–Any living thing that lives in water

biodiversity or biological diversity–The different kinds of plants, animals, and other living organisms

calcium carbonate–A hard substance that makes up bones, shells, chalk, and limestone, and is used in making concrete

collectors–Macroinvertebrates that get food by filtering the water or by collecting it off the bottom of the stream; this group could be considered primary consumers (eat algae), secondary consumers (eat microbes), and decomposers (eat food fragments and waste of the other groups).

community–The group of plants and animals that live in a habitat

current–The force of flowing water

decomposers–Bacteria, fungi, and some types of invertebrates that break down dead plant and animal parts into nutrients, which are then used by plants

decomposing material–Something that is rotting; decomposers are breaking down dead plant and animal parts.

degrade–To lower the quality or health of something

diatom–A microscopic algae

digestive tract–The parts of a body that digests food

dissolved oxygen–The oxygen in water that aquatic animals can use to breathe; this oxygen gets into the water from oxygen in the air mixing and dissolving into the water.

ecosystem–(a) Plants and animals of a community, interacting with each other and with the air, soil, water, sunlight, and climate, in a way that allows the community to exist year after year; (b) A system of interactions between living organisms and their environment

evaporate or evaporation–A process where a liquid, such as water, turns into a vapor

food chain–The way food (or energy) goes through a community; producers are eaten by primary consumers; primary consumers are eaten by secondary consumers; secondary consumers are eaten by tertiary consumers. An example is: a weed is eaten by a grasshopper; the grasshopper is eaten by a praying mantis; the praying mantis is eaten by a bird.

food web–A complex linking of many food chains in an ecosystem

grazors–See scrapers

gyrate–To move in a spiral motion

habitat–The place where plants and animals live

hemoglobin–An iron-containing substance which helps blood carry oxygen and is red in color

indicator species–Organisms which show by their absence or presence the quality or health of a habitat, such as a stream

invertebrate–An animal which does not have a backbone; this includes those that can be seen and those that are microscopic

larva–The immature or young stage of an animal's life

larvae–plural of larva

leaf litter–An accumulation of fallen leaves on the ground or on the bottom of a stream

lopsided–Something that is unbalanced (or one side is larger than the other)

macroinvertebrate–An animal which can be seen and that does not have a backbone; some common examples are worms, snails, mussels, insects, and crayfish.

metallic–something that has a shiny, glittery, metallic look

microbe–A microscopic organism

microscopic–Can only be seen by using a microscope

molting–A process where an invertebrate, such as a crayfish, sheds its shell or covering

oblong–A somewhat rectangular shape with rounded edges

organic debris–Parts or pieces of anything that came from something alive and is now rotting

organism–Any living thing

parasitic or parasite–An animal that lives by eating some part of another animal without killing it; examples include ticks, leeches, and tapeworms.

pollinator–Any living thing that moves pollen from one flower to another flower; wind and water can also do this, and are pollinators for some plants.

predator–An animal (such as a macroinvertebrate or fish) that catches and eats other animals

prey–The animal (such as a macroinvertebrate) that is caught and eaten by a predator

primary consumer–Any living thing that eats plants

producer–Any living thing, such as a plant, that produces its own food

pupa–A stage in the life of some insects during which the larva changes into an adult

riffle–A shallow area of a stream which flows quickly over rocks

riparian zone–The area of land and plants along a stream or river which experiences regular flooding

runoff–The water from rain or melted snow that flows over land and into a stream

scavenger–An animal that will eat another animal that is already dead

scrapers–Macroinvertebrates which eat by scraping algae and microscopic organisms called diatoms off of rocks and other objects; they are sometimes called grazors; this group is composed of primary consumers.

secondary consumers–Any living thing that eats primary consumers

sediments–Soil which has washed into a stream and has settled to the bottom in slow-flowing areas

shredders–Macroinvertebrates which eat by shredding, or cutting into pieces, leaves and other plant parts; they are also primary consumers.

species–A group of organisms that resemble each other very closely

streambed–(a)The surface of the area on which the stream usually flows; (b)The surface at the bottom of a stream

substrate–The material which forms the streambed, such as rocks, sand, or mud, and on which many aquatic organisms live

surface tension–The condition on the surface of water where the water molecules stick together and form a skin-like layer

symmetrical–Both sides are the same (or balanced)

tertiary consumers–Any living thing that eats secondary consumers

transpiration–The release of water vapor into the air by plants

watershed–The land drained by a river and all of the smaller streams that run into it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