The Salmon Times

December *Number 3*

Salmon Demonstration Spawns Some Fishy Questions

The busiest time around a salmon hatchery is in late fall when the adult salmon are spawned. If you visit the hatchery at this time of year you may be lucky enough to see how the hatchery workers collect the eggs from the females (hens) and the milt or sperm from the males (bucks). Students who visit the Nashua National Fish Hatchery in the fall always amaze the hatchery staff with an amazing variety of "egg-cellent" questions. Here are a few of the most common questions:

Does squeezing the eggs from the female hurt the fish?

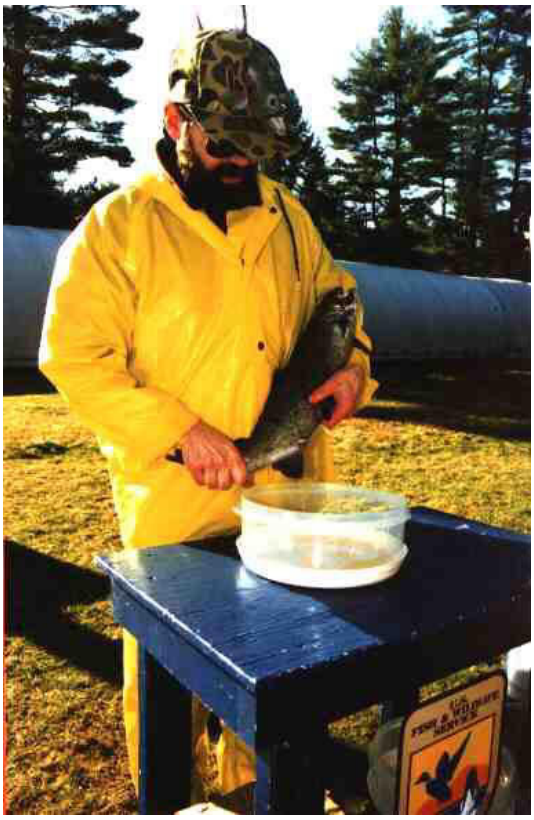
The eggs aren't really squeezed from the fish. A little gentle pressure exerted by both hands helps to guide the eggs out of the fish. This procedure doesn't harm the salmon in any way.

How do you tell the difference between a male and female salmon?

Except during the spawning season, male and female salmon look identical. As the spawning season approaches, males begin to develop a hook on their lower jaw. This hook, called a kype, is made from cartilage. Following spawning the kype gradually disappears.

How many eggs can a salmon produce? How many survive?

As a rule of thumb, a female produces 700 to 800 eggs per pound of body weight. A ten pound hen will lay about 7500 eggs. In the wild, predators and other factors greatly reduce this number. 50 salmon may reach the smolt stage and migrate to sea. Perhaps only two adult fish will return to the river two to three years later. As you can see, there is a good reason why salmon lay so many eggs!



A U.S. Fish and Wildlife Service employee spawns a female adult Atlantic salmon.

How big do Atlantic salmon get? How long do they live?

Salmon may reach a size of 25 to 30 pounds. There are stories of salmon weighing as much as 100 pounds. Now that's a big fish! In the wild, salmon can reach the ripe old age of seven or eight.

What do you feed Atlantic salmon at the hatchery?

Atlantic salmon are predators. This means that they eat other animals. At a hatchery it would be pretty expensive and time consuming to feed the salmon live animals like herring and shrimp. Instead, the hatchery buys fish food that is specially made just for Atlantic salmon. It contains fish meat and oil (like herring), grain, and a variety of vitamins and minerals.

Ecosystems:

Wildlife Communities in Action!

In the last issue of *The Salmon Times* you learned about habitats, places where plants and animals live. To fully understand how these plants and animals go about their daily lives within their habitats, we need to talk about something called and ecosystem. An ecosystem includes all the living organisms (plants and animals), and non-living things in a particular environment. The non-living things include soil, rocks, and water. When looking at an ecosystem we are really interested in the relationships and interractions between living organisms and their environment.

There are usually several different types of ecosystems in a watershed. Because they live in water, fish live in aquatic ecosystems. Lakes, rivers, ponds, and streams are all examples of aquatic ecosystems. Terrestrial ecosystems describe communities of plants and animals on dry land. As you have already learned, wetland ecosystems are home to an amazing variety of wildlife. Ecosystems are linked together by water and animals. Water may flow through a number of ecosystems on its way "from the mountains to the sea." An animal may make its home in one ecosystem and find its food in another.

All living things, both plants and animals, need food or energy to survive. Energy enters an ecosystem in two ways. Green plants use water and the sun's energy to make their own food through a process called photosynthesis. Because of this ability plants are called producers. Energy may also enter an ecosystem in the form of dead plant and animal material. For example, a leaf falls off a tree into a stream. The leaf is then consumed by small organisms called decomposers, primarily bacteria and fungi. Animals do not have the ability to make their own food and instead must eat other plants and animals. They are called consumers. Animals that eat other animals are called predators.

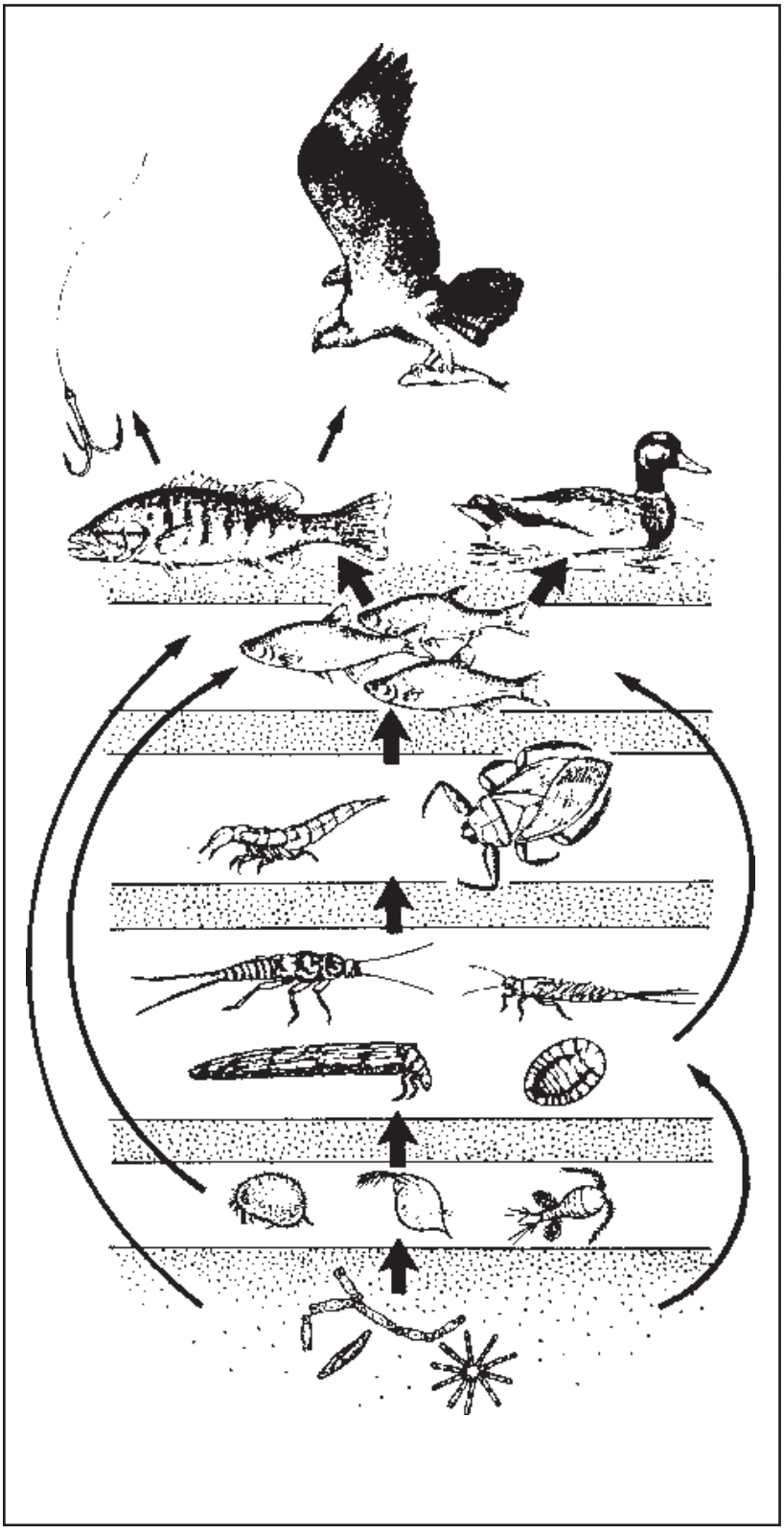
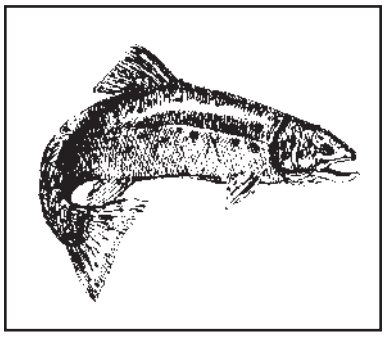


Illustration from Pond and Stream Safari, Cornell Cooperative Extension

This illustration shows how energy moves from one organism to the next in a typical food chain.



A food chain describes how energy is transferred from one organism to the next in an ecosystem. For example, a plant is eaten by an insect. The insect is then eaten by a frog, which in turn is consumed by a snake. If you were to catch and eat the snake (yuck!) you would become a part of this food chain. When a plant or animal dies, decomposers break them down into nutrients. The nutrients enter the soil, providing food for future plants to grow. So you can see how this energy cycle repeats itself over and over again.

There are many different food chains in an ecosystem. In fact, individual animal species may belong to a number of food chains. In one food chain a salmon may eat a crayfish. If that same salmon later eats an aquatic insect it would then belong to at least two food chains. Get it? All of these different food chains combine to form a food web. A food web describes the many complex food relationships that exist between plants and animals within an ecosystem. Every plant and animal plays an important role in the web.

The health of an ecosystem is often determined by the variety of different plants and animals found there. Biodiversity is a measure of the number of different species present in an ecosystem. Generally, the greater the diversity of plants and animals, the healthier the ecosystem. What do you think would happen to an ecosystem if a species were to go extinct? Do you think the disappearance of Atlantic salmon from many of New England's rivers had an effect on those aquatic ecosystems?

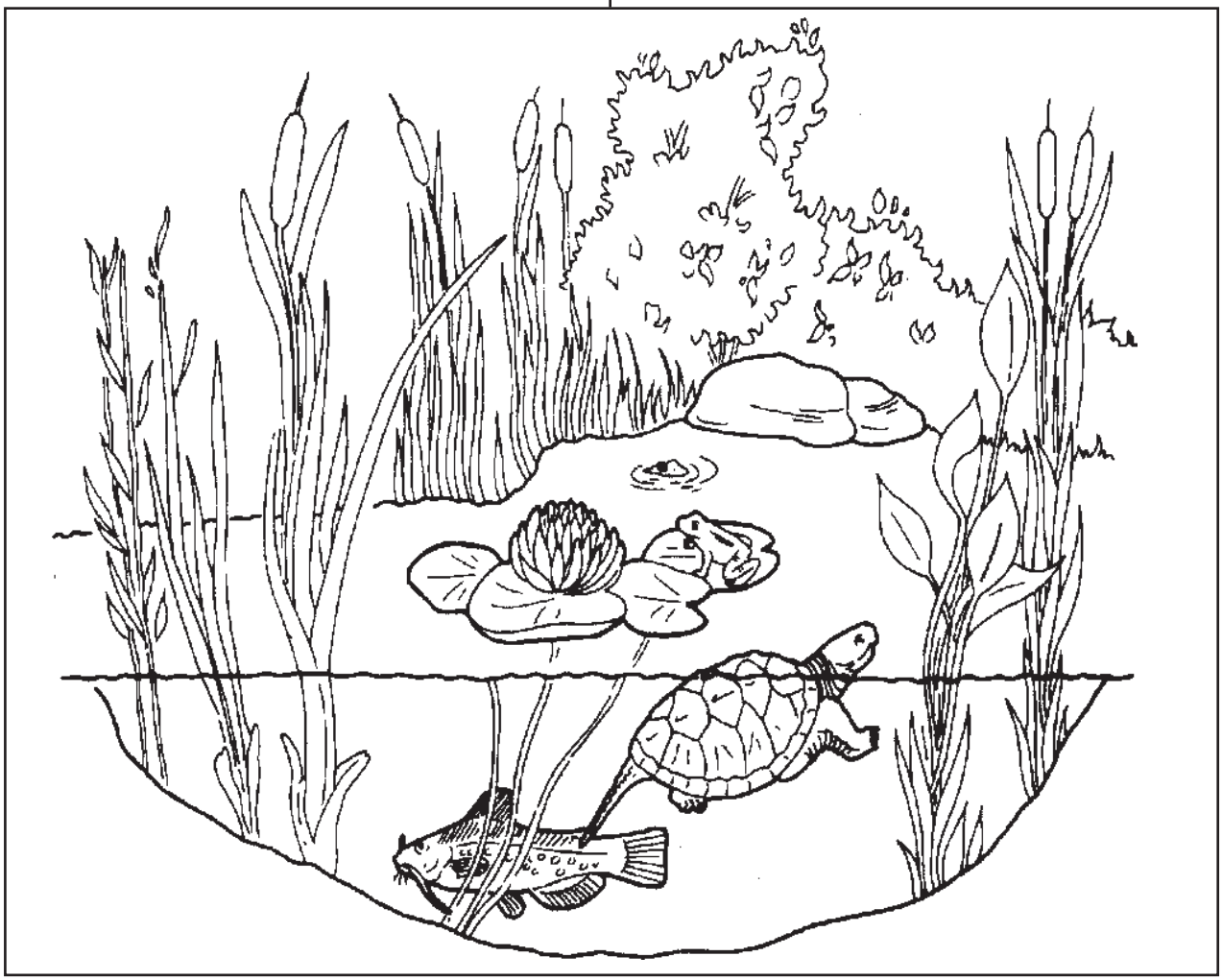
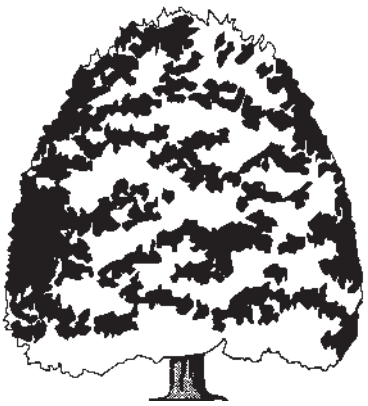


Illustration from Living in Water, National Aquarium in Baltimore

When looking at ecosystems, we aare really interested in looking at the relationships and interactions between living creatures and their environment. Non-living physical features such as rocks, soil, and water are important parts of an ecosystem.

Making a living in:

The Stream Scene



One of the most important aquatic ecosystems, at least from the viewpoint of an Atlantic salmon, is a stream - for this is where salmon are born and, later, reproduce. Streams are active places brimming with life.

As with all ecosystems, the physical surroundings of a stream determine what forms of plant and animal life can live there. Streams can be places of great and immediate change. Spring floods, resulting from melting snow and excessive rains, can challenge all but the hardiest of organisms. Low flows in late summer can mean loss of aquatic habitat and high water temperatures. Some streams have even been known to dry up during extended periods of drought. Now that is a tough environment!

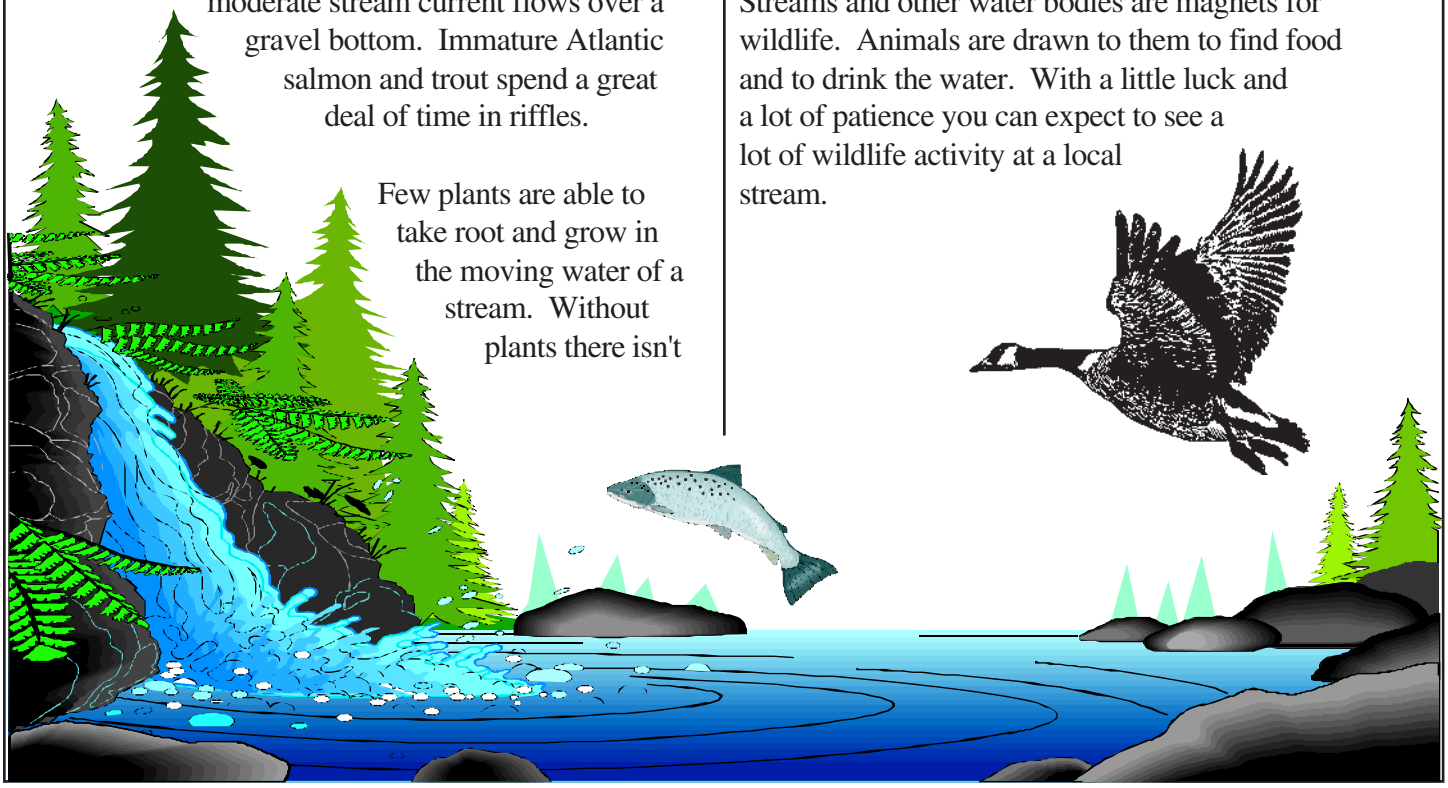
Within a stream there are areas that favor the presence of certain wildlife species over others. Rapids are areas with large boulders and fast moving water. Very few animals live in rapids. Many streams have areas where the water is deeper, the current is slower, and the bottom is more muddy or sandy. Flat water is generally where you will find the greatest diversity of plant and animal life. Riffles are areas where a moderate stream current flows over a gravel bottom. Immature Atlantic salmon and trout spend a great deal of time in riffles.

Few plants are able to take root and grow in the moving water of a stream. Without plants there isn't any photosynthesis to produce energy or food for the stream community. So where does the energy for a stream ecosystem come from?

Trees and other land plants are the source of most of the energy that enters a stream. Leaves, twigs - even terrestrial insects - fall into the water. Strong winds and surface runoff assist in delivering these materials to the stream. Decomposers break down the material, called detritus, releasing nutrients back into the energy cycle.

Trees and other plants that border a stream ecosystem play other important roles. Plant roots reduce steam bank erosion, cutting down on the amount of soil that is washed into a stream. The shade provided by trees keeps water temperatures cooler during the hot days of summer. This is important for cold water fish like trout and salmon. As you can see, there is much interaction between terrestrial and aquatic ecosystems.

Streams and other water bodies are magnets for wildlife. Animals are drawn to them to find food and to drink the water. With a little luck and a lot of patience you can expect to see a lot of wildlife activity at a local stream.



Aquatic Insects:

The World of the Small Down Under...

Most people are familiar with the larger animals that are commonly found in or near a stream - fish, frogs, snakes, raccoons, otter, and great blue heron - to name a few. But those animals are not always around when you are. On the other hand, you are almost guaranteed to find aquatic insects in any stream you visit. These small creatures provide a window into the fascinating and complex world of an aquatic ecosystem..

Did you know that most of the insects flying around in the air began life underwater? It's true. In fact, insects outnumber most other forms of animal life in an aquatic ecosystem. That's a good thing because aquatic insects are an extremely important part of the food web. They are the food for many larger animals including fish, frogs, and birds. Without aquatic insects ecosystems would look much different.

larva *adult*

Crane Fly

Aquatic insects are invertebrates. Unlike fish, people, and birds, invertebrates lack a backbone. Instead of a spine or backbone invertebrates may have a hardened body, like a beetle, or a shell, like a snail or mussel. Some invertebrates have soft bodies, like earthworms. Spiders and crayfish are other types of invertebrates that be found in or around a stream. Invertebrates come in an amazing variety of shapes and sizes.

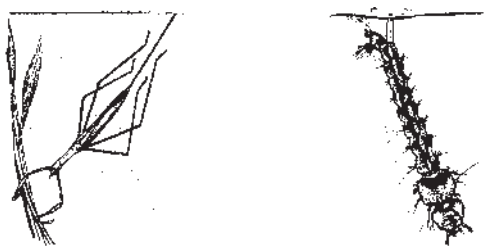
The life of an aquatic insect begins when the parent lays eggs in the water. Immature aquatic insects become adults after going through metamorphosis, a process which can radically change the insect's appearance.

nymph *adult*

Mayfly

A caterpillar goes through metamorphosis to become a butterfly. Immature aquatic insects are called either larvae or nymphs. A nymph looks somewhat like the adult stage of the insect. Larvae look very different from the adult. Following metamorphosis many species of adult insects remain in the water, spending their entire lives there. Many others leave the aquatic environment and become terrestrial or land-based. Mosquitos, dragonflies, and black flies are three common insects that are born underwater.

As with all forms of life in a stream, aquatic insects have developed certain unique adaptations that allow them to breathe, move, find food, and otherwise survive. All insects need oxygen to live. Like fish, some insect species get oxygen from water. Others breath air just like people. What is fascinating is *how* some of these creatures do this. Water scorpions and giant water bugs have breathing tubes that reach to the surface of the water. The diving beetle actually carries a bubble of air as it swims underwater. Pretty cool, huh?!



water scorpion *mosquito larva*

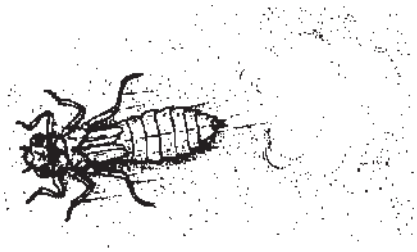
Some aquatic insects breath through tubes that reach up to the water's surface.

Illustrations from Pond and Stream Safari, Cornell Cooperative Extension

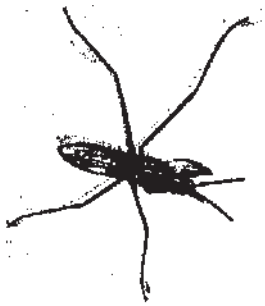
Water boatmen swim through the water using their long hairy eggs like the oars in a boat.

Different insect species eat different types of food. Herbivores eat nothing but plants. Algae, the "slippery green stuff" that grows on rocks at the bottom of streams, is a favorite food of many herbivores. Predators eat other animals. Predatory aquatic insects eat other insects, fish, and even small frogs. Omnivores feed on plants *and* animals. Scavengers eat dead plant and animal matter.

Aquatic insects move around in the water in a variety of ways. Some simply crawl along the rocks and mud on the stream bottom. Dragonfly nymphs move around by forcing water out through their abdomen, just like a jet engine. Water boatmen use their long hairy legs to paddle through the water, much like a rowboat. The waxy surface of the water strider's legs allow them to "skate" across the surface of the water. Insects lacking the ability to move themselves through the water simply drift along with the current.



A dragonfly nymph moves through the water by expelling water from its abdoman - just like a jet engine.



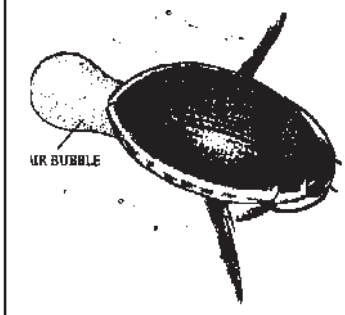
Water striders can actually "walk on water" due to a waxy substance that coats their legs.

Camouflage is an adaptation that provides protection from predators. The body color and pattern of many aquatic insects allows them to blend in with their surroundings. If a predator can't see them, it won't eat them! Camouflage is an important adaptation for many stream creatures, including Atlantic salmon. Salmon even have the ability to change color to match their background.

Giant water bugs are predatory insects that occasionally feed on small fish and frogs. Their bites can really hurt!

Aquatic insects can reveal a great deal about the health of a stream, pond, river, or lake. Some species are very sensitive to water quality. They are particularly sensitive to the amount of oxygen in the water. A healthy stream generally has a large variety of aquatic insect species. Only the hardiest of insects can survive in a polluted aquatic environment.

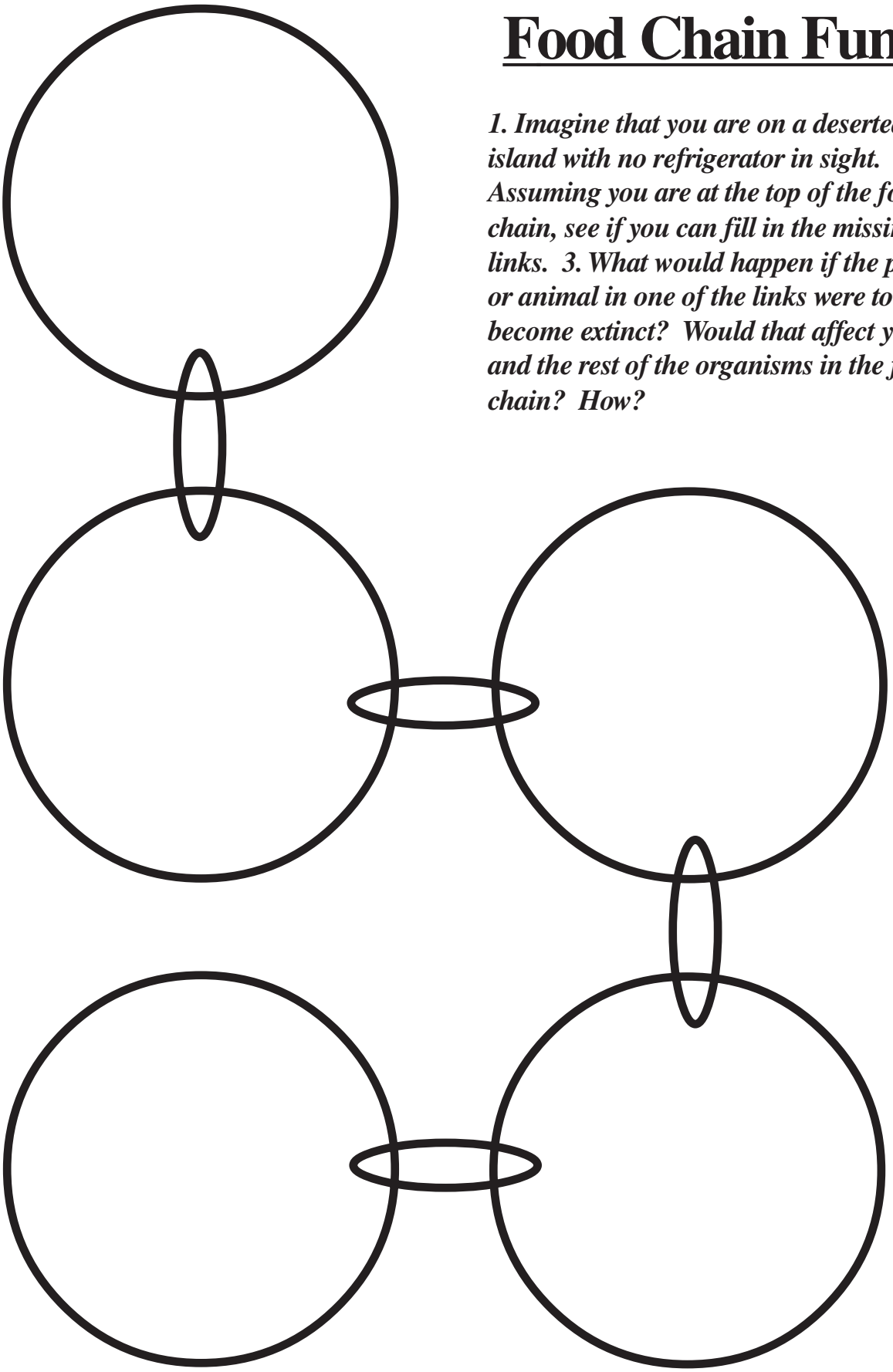
Water quality monitoring is a popular environmental conservation activity. One aspect of testing for water quality generally involves determining the variety and number of aquatic insects and other invertebrates in a body of water. If you have been wondering about the health of a nearby water body you might begin to get some answers by doing a survey of the insects that live there. Perhaps this is something you can do with your class. It can be a lot of fun!



To breathe, a diving beetle carries a bubble of air underwater.

Food Chain Fun

1. Imagine that you are on a deserted island with no refrigerator in sight. 2. Assuming you are at the top of the food chain, see if you can fill in the missing links. 3. What would happen if the plant or animal in one of the links were to become extinct? Would that affect you and the rest of the organisms in the food chain? How?



The Puzzler

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ECOSYSTEM
AQUATIC
TERRESTRIAL
PREDATOR
NUTRIENTS
ENERGY
SPECIES
FOOD CHAIN
BIODIVERSITY
DROUGHT
RAPIDS
RIFFLE
DETRITUS
EROSION
LARVAE
NYMPH
ADAPTATIONS
INVERTEBRATE
CONSERVATION
SURVEY