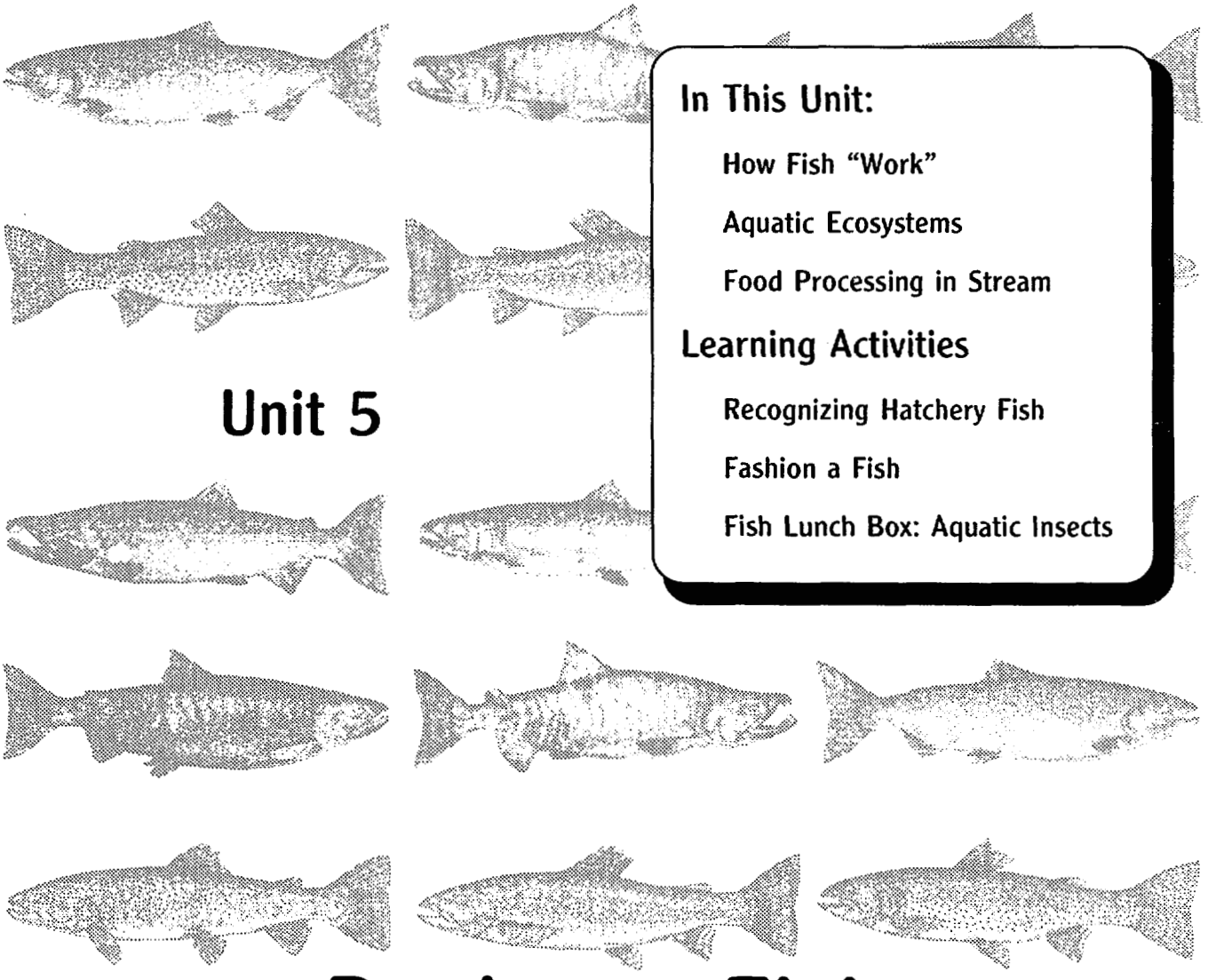


In This Unit:

How Fish "Work"

Aquatic Ecosystems

Food Processing in Stream

Learning Activities

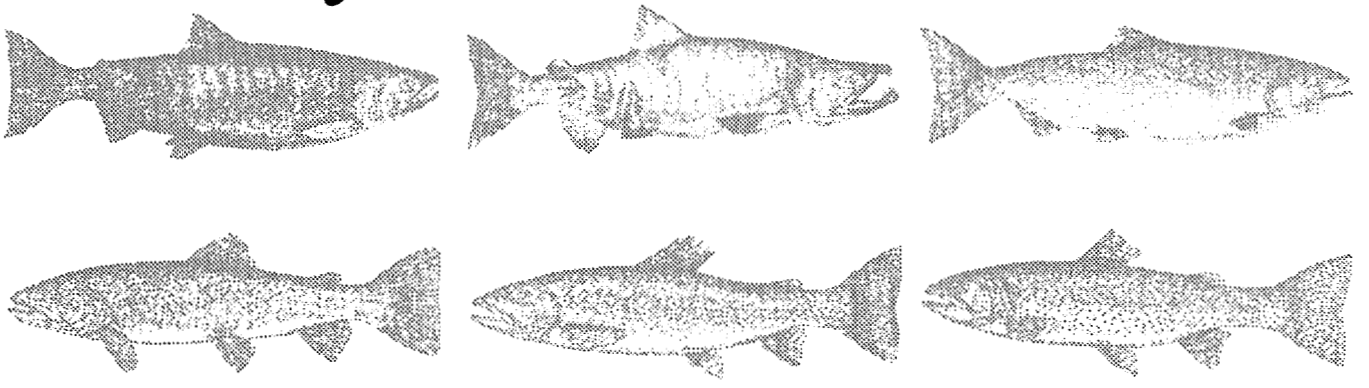
Recognizing Hatchery Fish

Fashion a Fish

Fish Lunch Box: Aquatic Insects

Unit 5

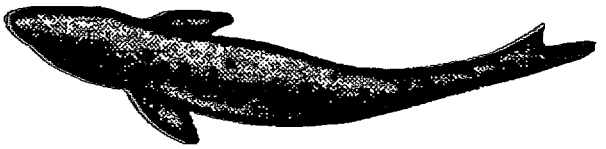
Designer Fish by Mother Nature



How Fish Work

Adapted from Responsible Angling Outdoor Empire Publishing, Inc., Seattle, WA, 1992 (Background information for learning activities "Recognizing Hatchery Fish," p. 167 and "Fashion a Fish," p.171)

sediments in large amounts clog the spaces between gravels. This prevents water from percolating through and causes fish and insect mortality. If pools are filled with sediments, rearing and hiding habitat is reduced or eliminated.



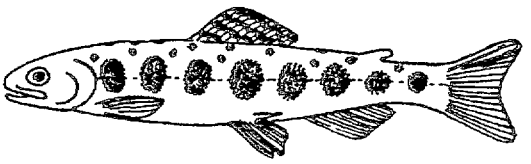
A streamlined shape help fish swim against the current.

Gills

You have something in common with a fish. A fish, just like you, needs oxygen to live. You have lungs that remove oxygen from the air. A fish has gills that remove oxygen from the water. Water flows into the fish through its mouth. It passes over the gills, the gills remove the oxygen, and the water flows out through the gill vents.

Shape

Moving through water is hard work! Many fish are streamlined or flat. This smooth shape allows them to slip through the water using the least amount of energy. The streamlined shape of salmon allows them to force their way up rapidly flowing rivers. The flat shape of a flounder allows it to hide on a sandy or muddy bottom.

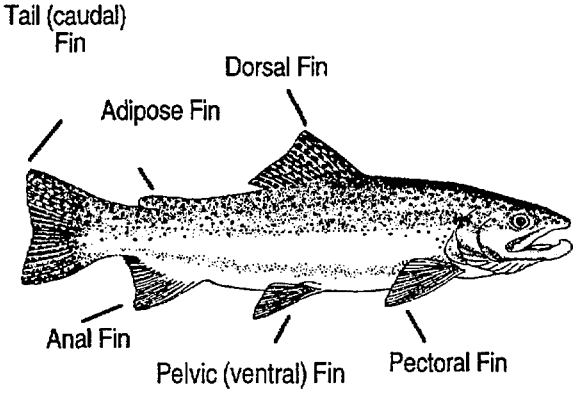


Irregular colorations help disguise fish from predators and potential prey.

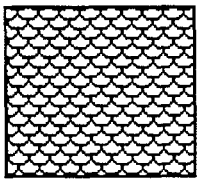
Color

Fish want to go undetected by other fish. If they are predators, they do not want their prey to see them and flee. If they are prey, they don't want the predators to see them! Even at a young age, irregular color patterns make fingerlings harder to see.

Fish are usually darker on their backs and lighter



Fins allow a fish to aim, balance, and move itself through the water.



Most fish are covered with scales for protection

Fins

Fins allow the fish to move, to aim itself, and to balance itself. Fins along the back of a fish (*dorsal fins)* and along the stomach (*pelvic* and *anal fins*) balance the fish and keep it upright. *Pectoral fins,* those that stick out along the sides, help a fish position or aim itself in the water. Pectoral fins can also act as brakes. A fish uses its tail fin (*caudal fin*) to move itself forward through the water. Many fish have another fin called the adipose fin. The adipose fin is located about halfway between the dorsal fin and the tail fin.

Protective *Coverings*

Most fish have scales covering their bodies. Scales protect the fish's body like clothes protect your body. The scales slide over each other, allowing the fish to move and turn.

Some fish don't have scales. These fish have thick, tough skin to protect themselves. Catfish and sharks are examples of fish that do not have scales.

A protective slime coats the body of many fish. Slime helps to protect fish from fungi, diseases and *parasites.*

Sensory Organs

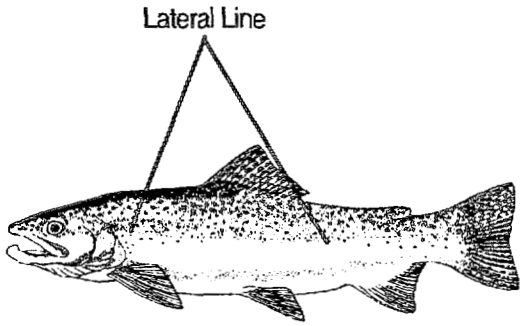
Eyes - Fish have two eyes. Many fish have well developed sight. They can see above, below, and ahead of them at any time. The only area they cannot see is directly behind their tail. Fish can use their eyes independently. One eye may be looking up, while the other is looking ahead and down!

Some fish live in cloudy water, or are only active at night. Vision is not as important to them. Their eyes may be smaller, or less developed. They have learned to rely on other senses to survive.

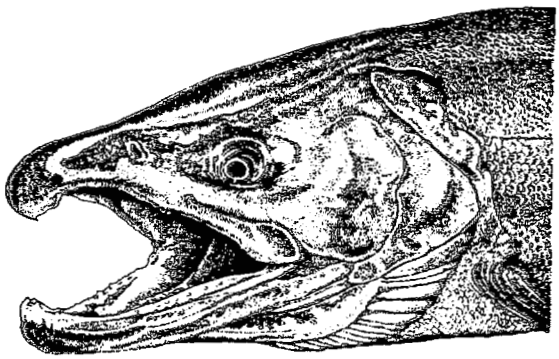
Smell - All fish have nostrils, and most have an extremely keen sense of smell. Smell is particularly well-developed in those fish that have poor vision. Salmon have an extremely strong sense of smell. There is strong evidence that they use this to return to the streams of their birth to spawn.

Hearing - Fish have ears, but they are located inside their bodies. Some fish use these ears for hearing, but they are mostly used for balance. Fish also have a lateral line, located along their sides. This organ senses pressure changes caused by things like the movement of another fish.

Taste - Just like you, fish can taste what they eat. Fish have taste buds in their mouths. Catfish even have taste buds outside of their mouth. They are located in their whiskers (barbels). Catfish can taste their food before they even put it in their mouths!



A lateral line senses changes in pressure around the fish.



Fish can use their eyes independently, looking above, below, and ahead at any one time.

Aquatic Ecosystems

A healthy stream is a highly diversified ecosystem. Its complex food chain ranges from microscopic diatoms and algae to large fish, birds and mammals. The diversity of species, particularly aquatic organisms, and their numbers are important to any stream study for two reasons:

- As indicators of water quality in the stream
- As parts of various food chains, including fish

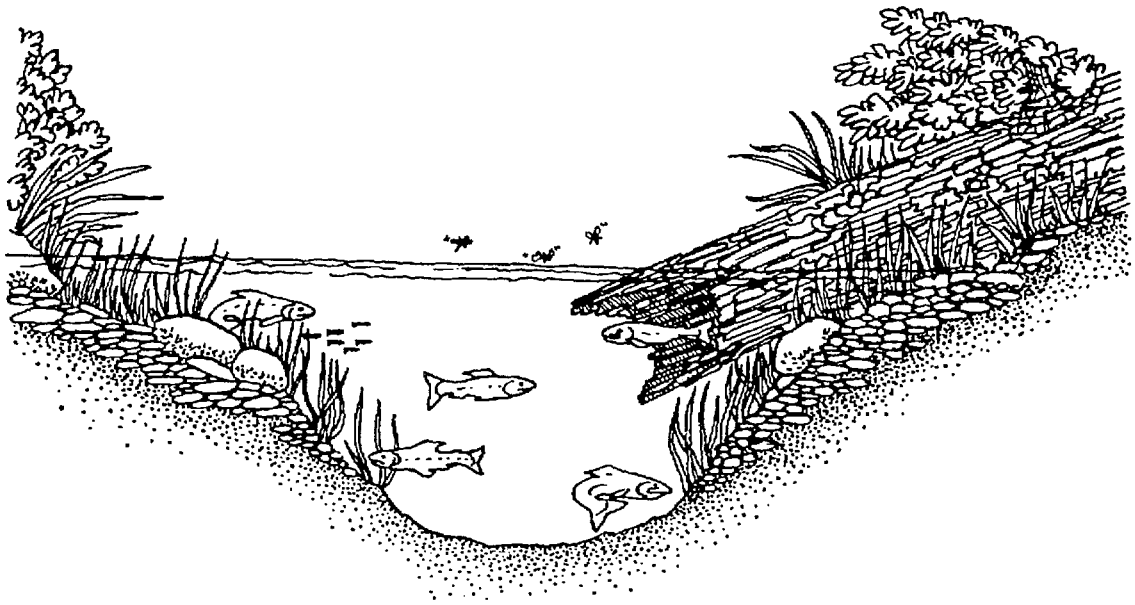
A wide variety of organisms inhabit water. The size and diversity of a population depend on the quality of available water. Fish occupy an important position in the aquatic food chain and obtain their food supply from several sources. The amount of food available in a stream is determined by the characteristics discussed in previous sections. When producers are plentiful, consumers also flourish. Diatoms coating a rock feed primary consumers such as mayflies. They, in turn, feed higher-order consumers like stoneflies and fish.

Overhanging vegetation supplies a variety of terrestrial insects to the menu. Many aquatic insects use streamside vegetation during emergence and adult stages of their life cycle.

Some aquatic insects leave their positions among boulders and gravel in riffles and are carried downstream short distances before reattaching to the stream bottom. When insects are moving in a water column, as drift or during emergence, they are most vulnerable to being eaten.

Benthic (bottom) organisms are found on stones or in mud or vegetation. Because a streambed serves as a place for attachment, most organisms in a fast-moving stream will be benthic.

Organisms in fast water have many specialized methods for obtaining food. To gather food in a water column, they grasp it quickly or filter it from the water while remaining stationary. Others gather food on the bottom. Plankton can be producers or consumers and float or swim freely throughout a stream. Few organisms can live in rapid sections of streams without being swept downstream by the current. Consequently, plankton are abundant in slower waters of large streams and rivers.



Food Processing in Streams

This section is adapted from "Turning Over a Wet Leaf," by Rosanna Mattingly, and used with permission from the Science Teacher, September 1985.

In autumn, forest floors are piled high with leaves, but in spring, the Earth's load is lightened; the leafy carpet has worn thin and seems to disappear with the melting snow. Where have the leaves gone? Those that stay where they fall are decomposed, for the most part, by soil invertebrates and microbes. But many of the "disappearing leaves" are carried down hill slopes into small, heavily canopied forest streams.

Most leaves and other organic materials blown by the wind, washed from the surrounding landscape, or fallen directly from overhanging limbs into watercourses do not get very far. They are trapped by rocks, logs and branches close to where they entered the water. They become part of the food or energy base of the stream.

Some of this material settles out in pools and backwaters. Leaves that get buried will decompose anaerobically. Because anaerobic processes are much slower than aerobic ones, buried leaves remain intact longer. These leaves can be recognized by their black color. Eventually the buried leaves are re-exposed, and decomposition continues aerobically, much as if they had never been buried.

Functional feeding groups

What or who is responsible for all this aerobic decomposition? Leaf litter can be broken down and decomposed slowly by abrasion and microbial action, but streams also harbor invertebrates that help decompose leaves and other organic materials under a variety of conditions. A rich, diverse population of aquatic insects is keyed to the varied quality of this food base.

Although most of us have seen our share of crayfish and snails, other aquatic invertebrates, a bit smaller and often a bit quicker, can easily elude us.

The aquatic invertebrates we are interested in here are inconspicuous aquatic insect larvae and nymphs (immature forms). It is hard to distinguish one species from another at this immature stage, and the nymphs' names are based, in general, on their adult characteristics. So, rather than identify these animals individually, we can group them according to the mode of feeding for which each animal is adapted. What is important is not so much what, but how the animals eat, hence the distinct functional feeding groups.

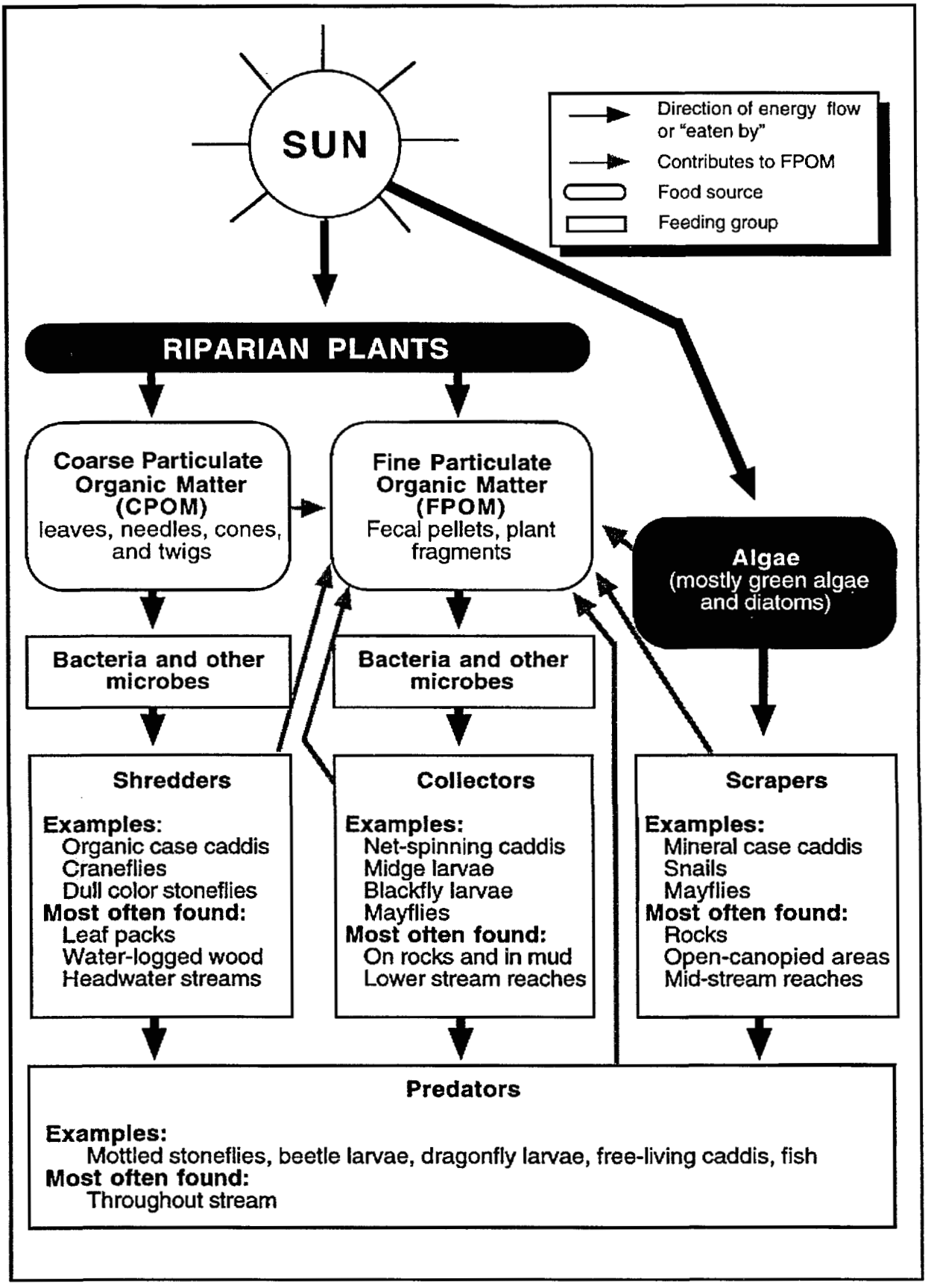
Shredders

Some aquatic invertebrates feed on leaves or other organic material - such as wood, needles and fruit - by biting into them or by cutting or boring through them. These insects are called shredders. Shredders generally reduce whole leaves to masses of small particles, but they often leave the midrib and veins intact. Thus, they "skeletonize" the leaves. Many shredders prefer leaves that have been partially decomposed by microbes; with microbial decomposition, leaves become tender and digestible.

In the Pacific Northwest, litter from many soft-leaved shrubs is quickly colonized by microbes. This microbe conditioning makes leaves into palatable, nourishing invertebrate meals before most other leaves are ready. Though they are somewhat slower to decompose than herbaceous leaves, alder leaves are also a favorite.

Other types of leaves must remain in a stream longer before they become soft enough for the animals to eat, so shredders end up with a "time-release" menu.

By chewing on leaves, shredders expose leaf surfaces and edges to further attack by microbes. Shredders also biochemically alter organic substrates as the material passes through their digestive tracts. So, shredders excrete material usually composed of particles that are smaller and of a different quality than what they ate. Many



Adapted from: Ken Cummins, "From Headwater Streams to Rivers," *American Biology Teacher, May 1977, p. 307*

stonefly and caddisfly larvae are shredders. Caddisflies are especially intriguing because many use the same leaf bits and other organic fragments they eat to construct the cases in which they live.

Collectors

Collectors are animals that feed on particles of organic material less than 1 millimeter in diameter. These particles may not be very wide, but they are a mouthful for most collectors. One major food source for collectors is fecal pellets of other stream organisms. One group of collectors, called filterers, uses nets or mucus-coated fans to filter these small particles from the water. Others, gatherers, eat particles deposited or growing on the bottom of a stream channel.

Collectors eat algae, fragments of plants and animals, dissolved organic matter that has come together (flocculated) to form a particle, bacteria, and inorganic particles such as sand, in addition to the feces of shredders and other animals. Some filterers and gatherers feed, at least for short periods, on particles of little or no nutritional value. Apparently, some appear to pay no attention to what they are eating.

Filter feeders include blackfly larvae-elongate that are bulbous near the bottom end where they attach themselves to stream substrates. Blackfly larvae have fans with which they strain particles from the water column. These fans are coated with a sticky substance that catches small particles that would otherwise pass through their fans.

Freshwater clams feed in a similar manner by passing food over mucous-covered gills that filter out small food particles. Some free-living caddisflies spin nets of various mesh sizes and thereby selectively collect particles of certain sizes. Mayfly nymphs and beetle and fly larvae are particularly abundant gathering collectors.

Collectors are often more abundant than shredders in low-gradient streams where fine particles are not washed away so rapidly. These streams provide pools and other areas where particles can settle out of the water. Fairly large numbers of collectors live all year long, unlike shredders, which are abundant during the fall in most streams.

Scrapers

Scrapers (sometimes called grazers) harvest algae and other materials from rocks and stream surfaces. Diatoms and other algae associated with these surfaces (periphyton) are generally most abundant in spring before leaves develop on overhanging tree limbs and block the sun. Periphyton also flourish in wide streams where the canopy does not stretch across the width. Algae will thrive again in autumn, in part because more light and nutrients reach a stream after leaves fall. Predictably, the abundance of scrapers follows the same pattern.

Scrapers include certain mayfly larvae, some of which are flat. Their flatness lets them stay close to rock surfaces to avoid being swept away by swift currents. Some scrapers have suction disks on their abdomens. With these disks the insects can attach to surfaces and feed in rapidly flowing water where diatoms and other algae grow. Some scraper caddisflies construct their cases with small stones that afford the animals additional protection from the current.

Snails also harvest algae. They use feeding structures called radulae to rasp food from stone surfaces and to rasp at leaf surfaces.

Predators

Those invertebrates and other aquatic organisms, such as fish, that capture live members of other functional groups can be classified as predators. Predators may be among the first animals spotted in a sample collected from a stream because many of these animals, particularly predacious stoneflies, are comparatively active and conspicuously patterned or colored.

Crane fly larvae and odonates (dragonflies and damselflies) differ from stoneflies as predators because they are more nondescript and relatively

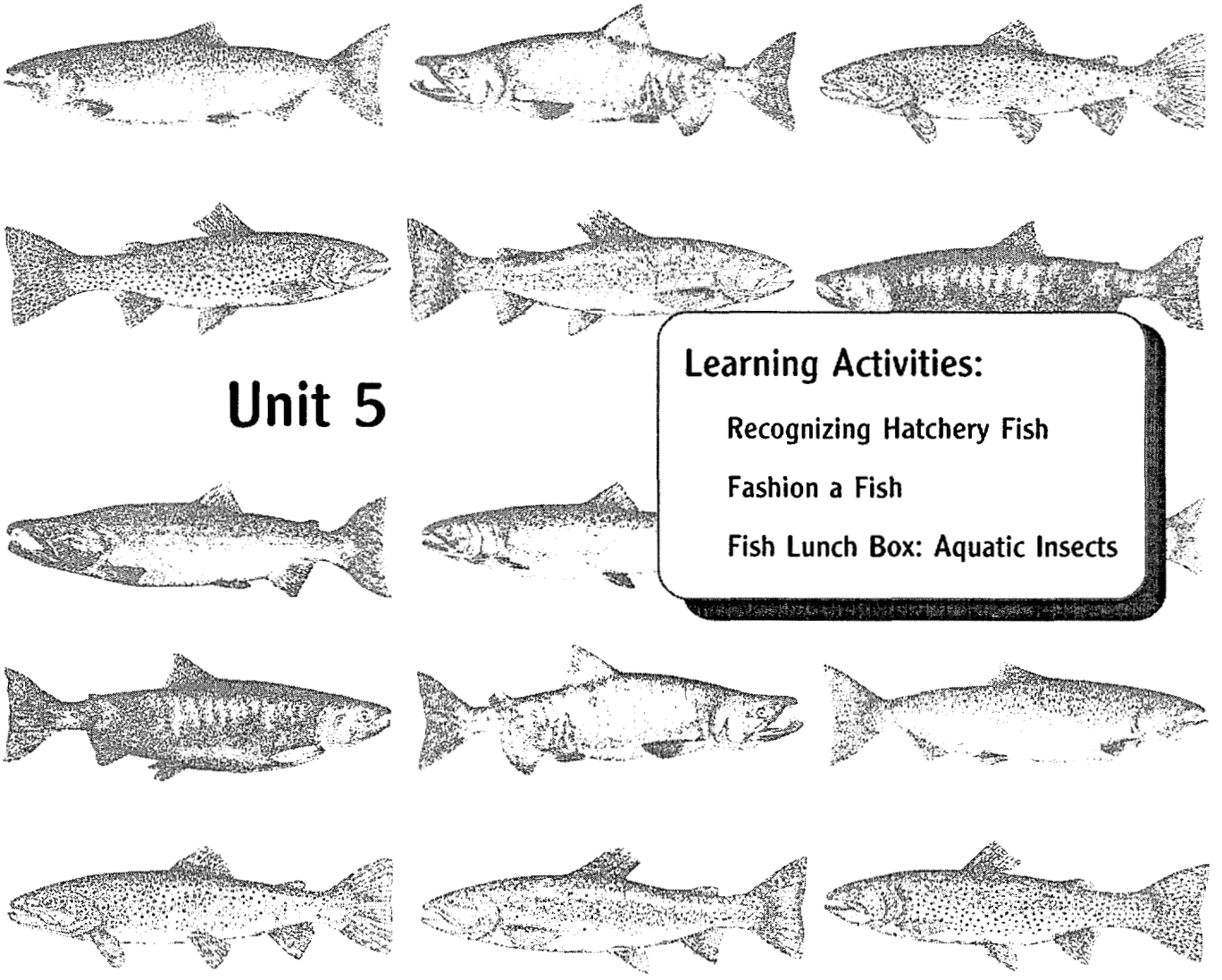
inactive. Odonates often sit still and hidden (some bury themselves in sediment with only their eyes protruding) with their hinged, retractile mouthparts aimed at unsuspecting prey.

Predators can be subdivided into piercers, which suck the body fluids of their prey, or engulfers, which ingest their prey whole.

Diversity and Adaptability

In streams, organic materials are produced, received, stored and decomposed. A large flood one year can introduce material from a flood plain. A fairly mild discharge another year can promote storage. Even nearby streams sometimes differ remarkably in gradient and riparian vegetation. The kinds and amounts of invertebrates vary along with each stream's characteristics. But the similarity between the types of invertebrates the world over is striking.

Dividing stream invertebrates into shredders, collectors, scrapers and predators is artificial, because some of these immature forms fit into more than one category. For example, scrapers may eat a lot of detritus while they graze algae. However, they may not grow as well or may pupate at a smaller size in areas where relatively less algae is available. Collectors may eat algae, bacteria, animals and sand. Some collectors also shred leaves, and some shredders can survive on fine particles when leaves are not available. But these distinctions are valuable. By looking at the feeding habits of these young invertebrates, you can begin to sort out different roles these animals play in the ecology of watersheds.



Unit 5

Learning Activities:

- Recognizing Hatchery Fish
- Fashion a Fish
- Fish Lunch Box: Aquatic Insects

Designer Fish by Mother Nature

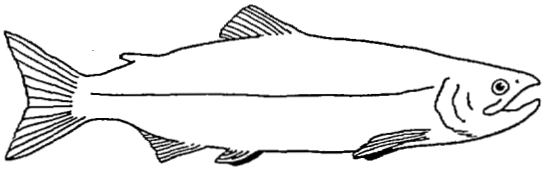
Unit 5

Recognizing Hatchery Fish

Drawings from
Salmonid Enhancement Program
Government of Canada
Fisheries and Oceans
Vancouver, British Columbia, Canada.

Key Concepts:

- Fish are propelled through the water by the use of their fins and body movements.
- Hatchery fry can be identified by noting the patterns of par marks and spots.



Teaching Information

The drawing of a typical salmonid below can help students learn to identify salmonid fins. Fins in fish are always of two kinds: paired, which includes the pectoral and pelvic fins; and unpaired, which includes the dorsal, caudal (tail), adipose and anal fins. You can use the drawing as an overhead for class discussion, either with the fins named or unnamed. Or you can duplicate the drawing in the same context, allowing students to write in the fin name.

If you have fish of any type in the classroom, you could let students observe them and try to determine how each fin is used by the fish to move. Fish swim mainly by lateral movements of the tail and caudal fin, while the paired fins are held closely against the body and the other unpaired fins are spread out to keep the fish in a vertical position. This is a good way for students to learn the names of the fins.

The identification chart for salmonid fry can also be used as an overhead, or a handout for the hatchery visit. You may want to have older students construct a dichotomous key for the fry; again, a good way to learn the differences in the various fish.

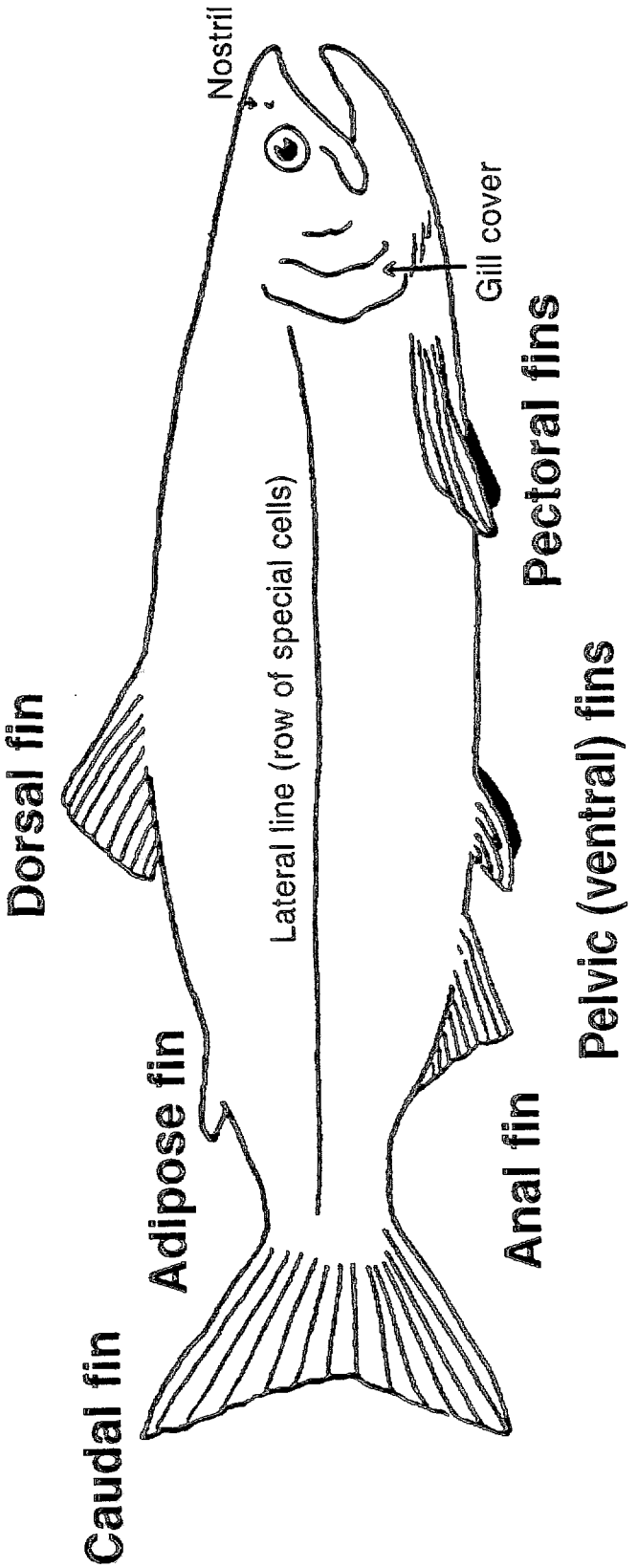
Materials

- Chart: The Exterior Anatomy of a Salmon
- Juvenile Fish ID Key

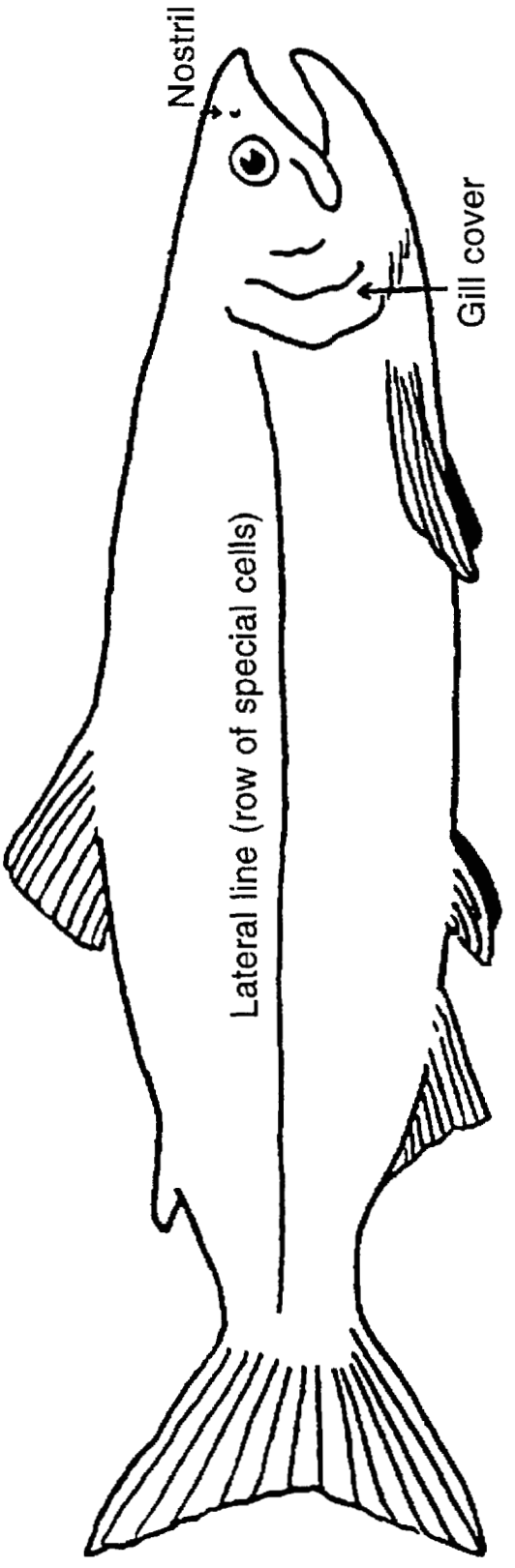
Key Words

interspaces, lateral line, maxillary, parr marks, rays

The Exterior Anatomy of a Salmon

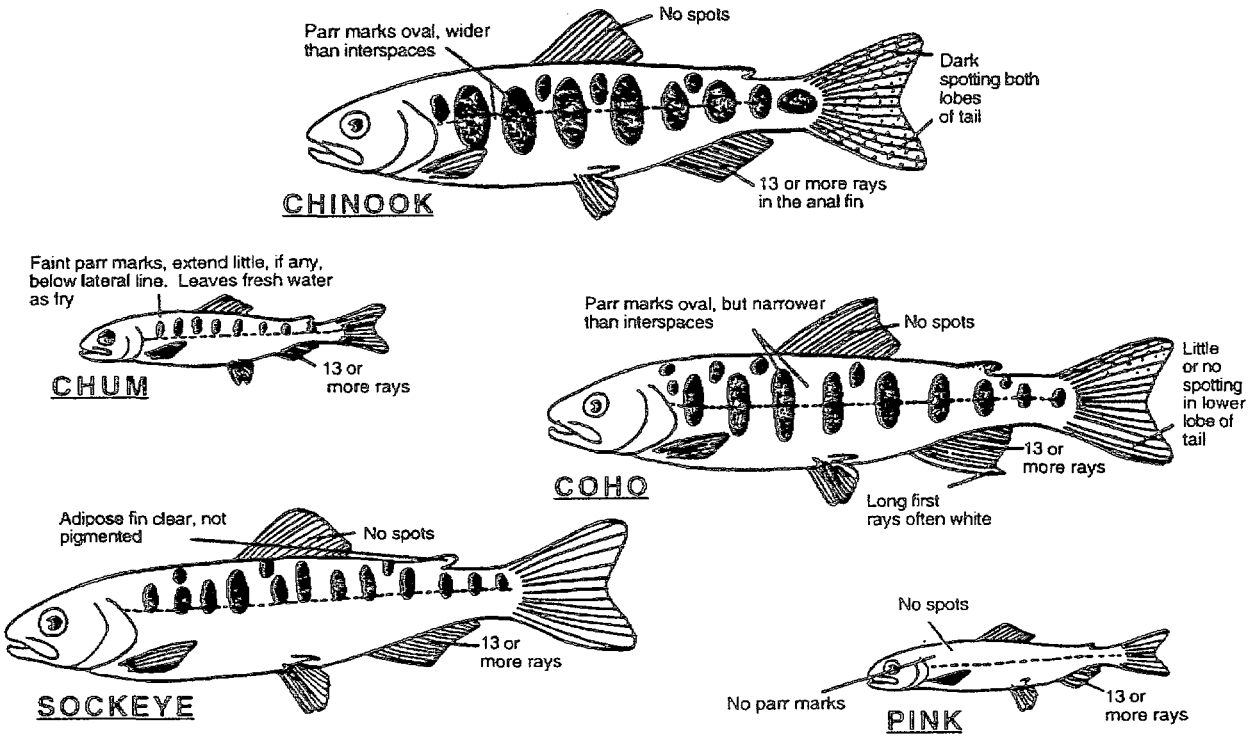


The Exterior Anatomy of a Salmon

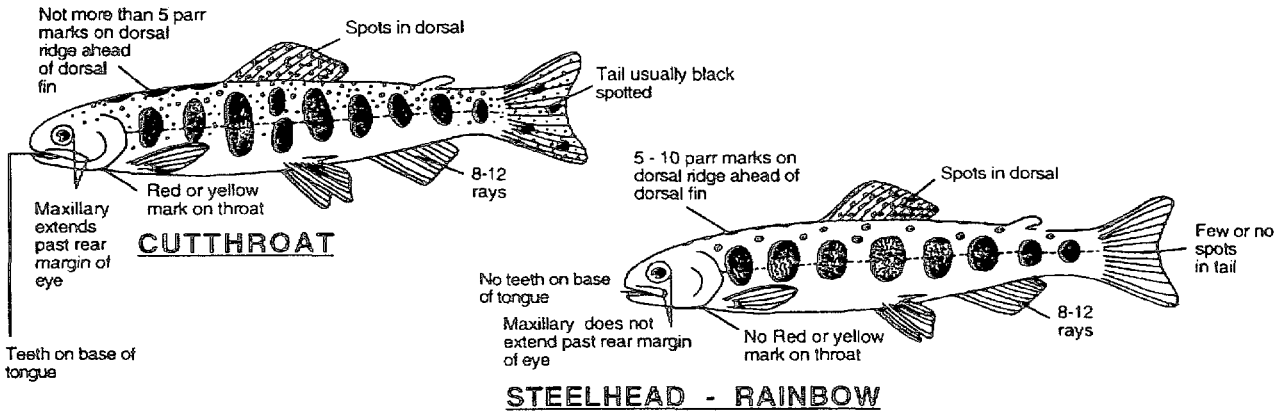


Identification Features of Juveniles

PACIFIC SALMON
(GENUS ONCORHYNCUS)



TROUT
(GENUS ONCORHYNCUS)



Unit 5

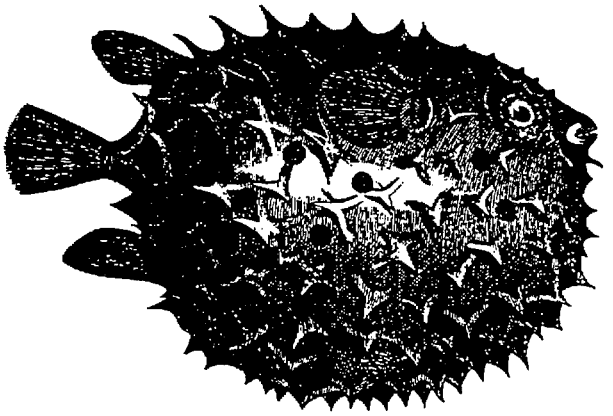
Fashion a Fish

This activity was adapted from:

Project WILD - Aquatic
Western Regional Environmental Education Council;
U.S. Fish and Wildlife Service, Sport Fish Restoration Program
1983, 1985, 1992

For more information contact Information and Education:
Washington Department of Fish and Wildlife
600 Capital Way N
Olympia WA 98501-1091

Key Concepts:



FOR YOUNGER STUDENTS

- Fish can be classified according to body shape and coloration

FOR OLDER STUDENTS

- Fish have adaptations that enable them to survive in their habitats.

Teaching Information

Aquatic animals are the product of countless adaptations over long periods of time. These adaptations, for the most part, are features that increase the animals' likelihood of surviving in their habitat. When a habitat changes, either slowly or catastrophically, the species of animals with adaptations that allow them many options are the ones most likely to survive. Some species have adapted to such a narrow range of habitat conditions that they are extremely vulnerable to change. They are over-specialized and are usually more susceptible than other animals to death or extinction if their environment changes in some way.

In this activity, the students design a kind of fish. They choose the adaptations that their fish will have. Each choice they make would actually take countless years to develop. As these adaptations become part of the fish's design, the fish becomes better suited to the habitat in which it lives. Because of the variety of conditions within each habitat, many different fish can live together and flourish. Some adaptations of fish are shown in the table that follows. The major purpose of this activity is for students to investigate the concept of adaptation in fish.

1. Assign students to find a picture or make a drawing of a kind of animal that has a

special adaptation - for example, long necks on giraffes for reaching high vegetation to eat, large eyes set into feathered cones in the heads of owls to gather light for night hunting.

2. Conduct a class discussion on the value of different kinds of adaptations to animals. As a part of the discussion, ask the students to identify different kinds of adaptations in humans.

3. Pool all of the students' pictures or drawings of adaptations. Categorize them into the following groups:

   - protective coloration and camouflage
   - body shape/ form
   - mouth type/ feeding behavior/ reproduction behavior
   - other (one or more categories the students establish, in addition to the four above that will be needed for the rest of the activity)

Note for teachers of younger students: The first three steps are optional for younger students. The remaining steps need only include the adaptation card for body shape and coloration; reproduction and mouth cards are optional for younger students.

4. Divide the adaptation cards into five groups of four cards each, one each of coloration, mouth type, body shape, and reproduction.

5. Pass one complete set of cards to each group of students. There might be five groups, with four to six students in each group. If the class size is larger than about 30 students, make additional sets of adaptation cards.

6. Ask the students to "fashion a fish" from the characteristics of the cards in the set they receive. Each group should:

   - create an art form that represents their fish
   - name the fish
   - describe and draw the habitat for their fish

7. Ask each group to report to the rest of the class about the attributes of the fish they have designed, including identifying and describing its adaptations. Ask the students to describe how this kind of fish is adapted for survival.

8. FOR OLDER STUDENTS: Ask the students to make inferences about the importance of adaptions in fish and other animals.

Materials

five cards for each adaptation from the masters provided: mouth, body shapes, coloration, reproduction

art materials: paper

(Note: Body shape and coloration are the only cards needed for younger students.)

Extensions

1. Take an adaptation card from any category and find real fish with that adaptation!

Note: A collection of books about fish is useful.. Do not be as concerned about reading level as much as profuse illustrations.

2. Look at examples of actual fish. Describe the fish's "lifestyle" and speculate on its habitat by examining its coloration, body shape and mouth.

Key Words

adaptation, catastrophe, extinction, habitat, reproduction

Evaluation

FOR YOUNGER STUDENTS

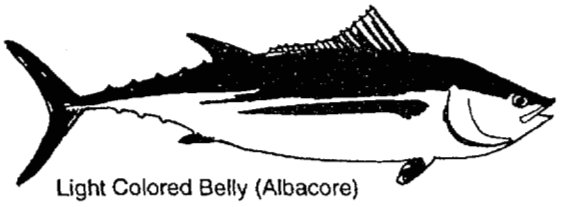
Circle the fish with vertical stripes, the one that can best hide in plants. Circle the fish with the horizontal, flat shape. Circle the fish that would be difficult to see from above. (Use the masters provided to give the students drawings of fish.)

FOR OLDER STUDENTS

Name two fish adaptations in each of the following categories: mouth, shape, coloration, reproduction. Then describe the advantages of each of these adaptation to the survival of the fish in their habitats.

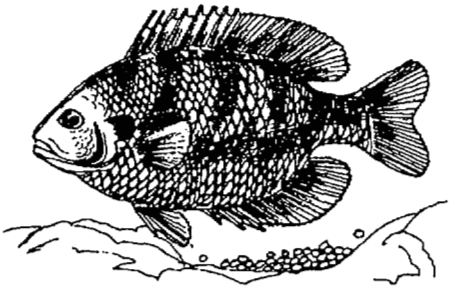
Invent an animal that would be adapted to live on your school grounds. Consider mouth, shape, coloration, reproduction, food, shelter, and their characteristics. Draw and describe your animal.

Adaptation	Advantage	Examples
Mouth		
Sucker shaped mouth	Feeds on very small plants and animals	Sucker, carp
Elongate upper jaw	Feeds on prey it looks down on	Spoonbill, sturgeon
Elongate lower jaw	Feeds on prey it sees above	Barracuda, snook
Duck bill jaws	Grasps prey	Muskellunge, pike
Extremely large jaws	Surrounds prey	Bass, grouper
Body Shape		
Torpedo shape	Fast moving	Trout, salmon, tuna
Flat bellied	Bottom feeder	Catfish, sucker
Vertical disk	Feeds above or below	Butterfish, bluegill
Horizontal disk	Bottom dweller	Flounder, halibut
Hump backed	Stable in fast moving water	Sockeye salmon, chub, razorback sucker, coho salmon
Coloration		
Light colored belly	Predators have difficulty seeing it from below	Most minnow, perch, tuna, mackerel
Dark upperside	Predators have difficulty seeing it from above	Bluegill, crappie, barracuda, flounder
Vertical stripes	Can hide in vegetation	Muskellunge, pickerel, bluegill
Horizontal stripes	Can hide in vegetation	Yellow and white bass, snook
Mottled coloration	Can hide in rocks and on bottom	Trout, grouper, rockbass, hogsucker
Reproduction		
eggsdeposited in bottom	Hidden from predators	Trout, salmon, most minnows
eggs deposited in nests	Protected by adults	Bass, stickelback
floating eggs	Dispersed in high numbers	Striped bass
eggs attached to vegetation	Stable until hatching	Perch, northern pike, muskellunge, carp
live bearers	High survival rates	Guppies



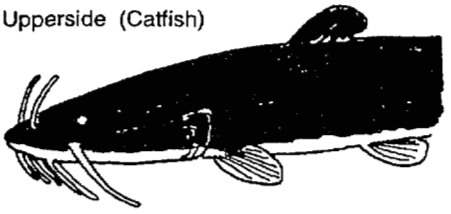
Coloration

Eggs Deposited in Nests (Blue Gill)

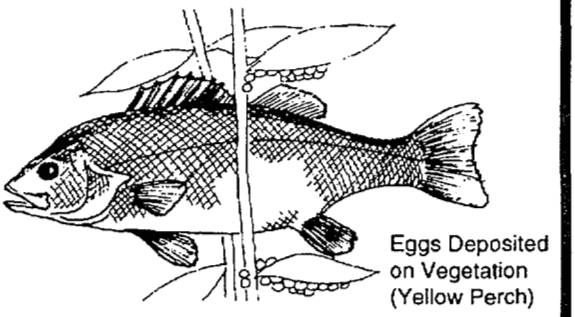


Reproduction

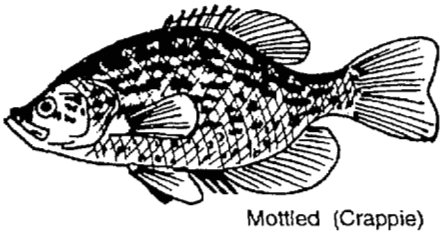
Dark Upperside (Catfish)



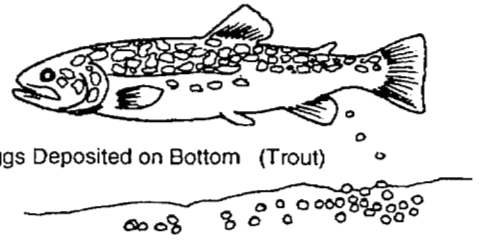
Coloration



Reproduction



Coloration



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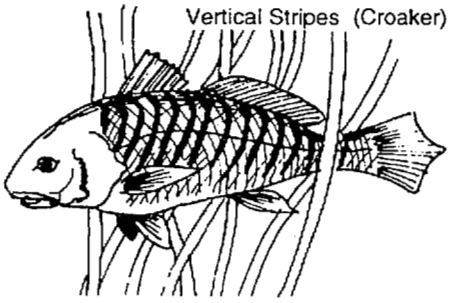
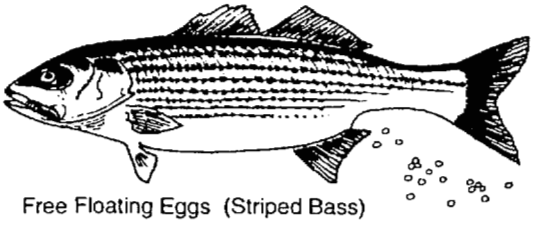
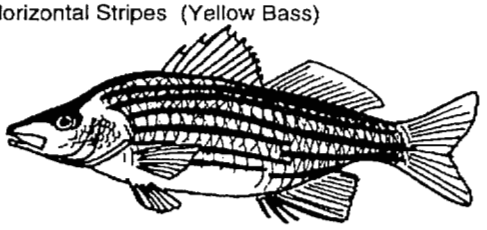


Coloration



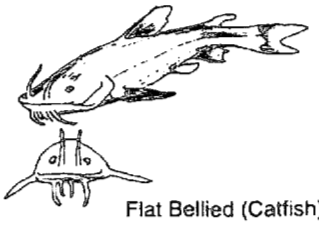
Reproduction

Horizontal Stripes (Yellow Bass)



Coloration

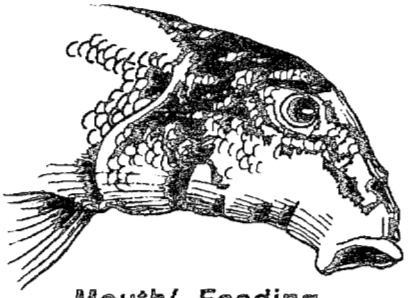
Reproduction



Flat Bellied (Catfish)

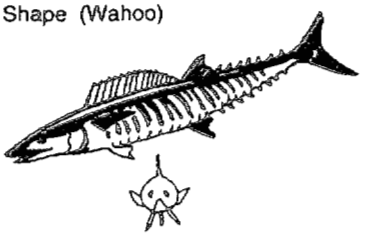
Shape

Sucker Shaped Jaw (Sucker)



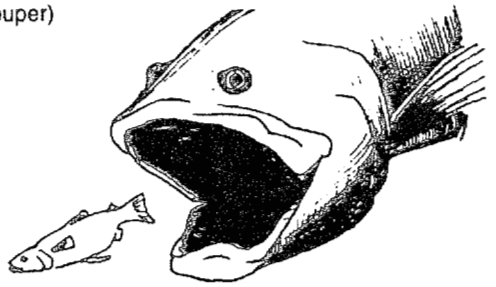
Mouth/ Feeding

Torpedo Shape (Wahoo)



Shape

Extremely Large Jaws (Grouper)

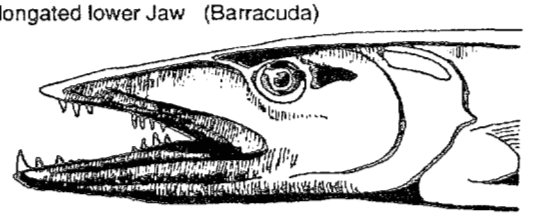


Mouth/ Feeding

Horizontal Disc (Halibut)

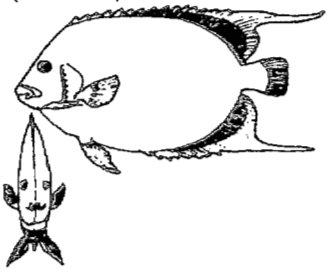
Shape

Elongated lower Jaw (Barracuda)



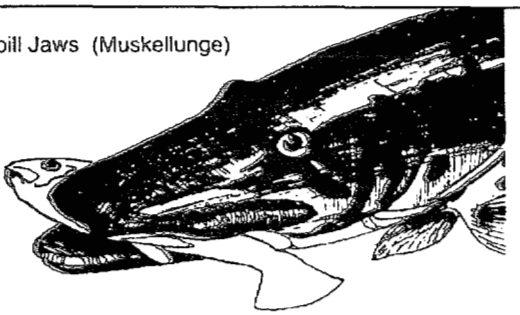
Mouth/ Feeding

Vertical Disc (Butterfish)



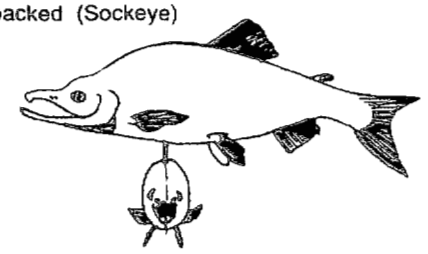
Shape

Duckbill Jaws (Muskellunge)



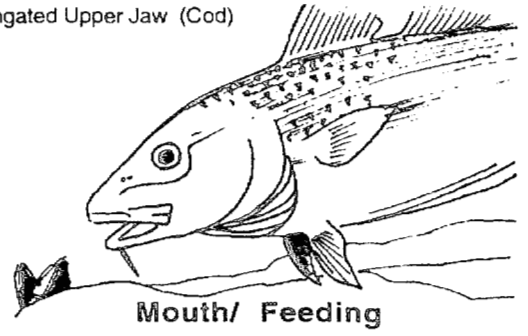
Mouth/ Feeding

Humpbacked (Sockeye)



Shape

Elongated Upper Jaw (Cod)



Mouth/ Feeding

Unit 5

Fish Lunch Box: Aquatic Insects

Key Concepts:

- some insects live most of their lives in streams and other fresh water
- aquatic insects are one of the primary food sources of fish in natural environments
- aquatic insects play various roles in the stream ecosystem

Teaching Information

Your students will learn much about what kind of foods fish are fed in hatcheries during your visit, but what about fish in streams and other natural settings? Much of the diet of salmonids is made up of aquatic insects, such as stoneflies, caddisflies and mayflies. These insects spend almost all of their lives in fresh water, emerging into the air only to reproduce. A study of these insects is one of those "magic" activities that seems to work for students of all ages.

Such a study can be done in most streams, ditches, ponds, swamps and lakes near your classroom. Most hatcheries have streams on or next to their grounds, and hatchery staff may be able to help make an aquatic insect study part of your hatchery visit.

Dividing students into small groups works well for this activity. Each group could explore different stream habitats, such as ripples, pools, leaf litter, rocks, sand, etc., and compare what they found.

One caution about studying stream insects: stream rocks are usually very slippery. Very small streams no larger than a few feet in width are best; side channels of larger streams work also. Students should have rubber soled shoes and expect to get at least wet feet.

Materials (for each group of students)

- fine mesh net (D-ring net or smaller aquarium net), 1-2
- white plastic or enamel pan, 1-2
- eye droppers, 3-4
- small artist paint brushes, 2-3
- tweezers, 2-3
- plastic ice cube trays, 2

Fish Lunch Box: Aquatic Insects

You will learn what fish eat for lunch at the fish hatchery during your visit. But what about lunch for wild fish and fish that leave the hatchery? What fish eat depends on the size of the fish, but much of the time salmon and trout have AQUATIC INSECTS for lunch (breakfast and dinner too!).

Aquatic insects are insects that spend most of their lives in water. Gazing into the cold water of a stream, things look pretty still and lifeless. But take a closer look. Skeletons of leaves with only the main ribs remaining are evidence of the work of some of the aquatic insects. Leaves and wood fall into the stream, are eaten by insects, and the energy that was in the leaves and wood end up in the insects. Some of the insects also get energy from plants that grow in the water. Then fish eat the insects and they get energy!

Most aquatic insects spend almost their entire lives in water. They change their form, grow wings and emerge from the water only during spring or summer to mate.

Explore a stream during your hatchery visit or near your school. Collect a handful of leaf litter, rocks, or pebbles and sand from the stream. Or kick up bottom material from under rocks and let the current carry the material from under the rocks into a fine mesh net. Place the material you have collected in a light colored container partly filled with stream water. You will soon see many aquatic insects crawling on the bottom of the container or swimming in the water in the pan.

Using eye droppers, paint brushes or tweezers, move the insects from the pan into an ice cube tray partially filled with stream water. Sort the insects by placing similar looking insects together in the individual ice cube containers. Then use the key below to investigate what kind of insects you have discovered. Aquatic insects can be divided into the following groups according to how they feed:

SHREDDERS - feed on leaves or wood that fall into streams. Eats the softer plant material, leaving the leaf skeletons.

COLLECTORS - feed on fine material in streams. Some filter the water for their food (filtering collectors), while others burrow in the stream bottom, feeding as they

go (gathering collectors).

SCRAPERS - feed by scraping the surface of rocks and logs, removing simple plants called algae.

PREDATORS - feed on insects, and other invertebrate animals.

What kinds of insects did you find? What percentage are scrapers? Shredders? Compare your results with another stream or from the same stream at a different time of year.

Use the Aquatic Insect Guide to identify the insects and place them into broad categories. Additional information can be obtained from the references below.

For Further Reading:

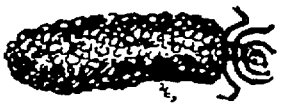
An Introduction to the Aquatic Insects of North America (3rd ed.) by Richard W. Merritt and Kenneth W. Cummins, Kendall/ Hunt Pub. Co., Dubuque, IA. 1978.

A Guide to the Study of Freshwater Ecology (5th ed.) by James G. Needham and Paul R. Needham, Holden-Day, Inc., Oakland, CA. 1962.

Aquatic Insect Guide

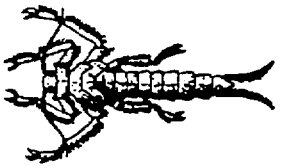
Builds a portable "house" or case to live in ..... Caddisfly

- If case is made of material that was once living (wood leaves, etc.) ..... Shredder
- If case is made of mineral material (rocks, sand grains) ..... Scraper



Has two tail* ..... Stonefly

- If dark and uniformly colored ..... Shredder
- If large and brightly colored ..... Predator



Has three tails (sometimes two)* ..... Mayfly

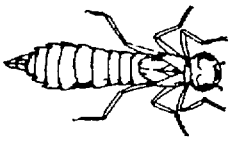
- If flat and egg-shaped ..... Scraper
- If cigar-shaped and round ..... Collector/Gatherer

Worm-like ..... Cranefly, Blackfly or Midge

- If cigar-shaped and round ..... Gathering Collector (Midge)
- If very large and in leaf litter ..... Shredder (Cranefly)
- Other worm-like insects ..... Filtering Collector (Blackfly)

Free-living, 3 pairs of legs ..... Odonates/Beetles

- If large, with gills at end of abdomen ..... Predator (Damselfly, Dragonfly)
- If no gills, usually tough outer covering, jaws often easy to see ..... Beetles
- Dark Brown; tough outer covering ..... Gathering Collector (Riffle Beetle)
- Color varied; abdomen soft-bodied ..... Predator



*For two-tailed insects, mayflies have gills (feathery-looking structures) along the abdomen (part of body behind legs) area while stoneflies do not.