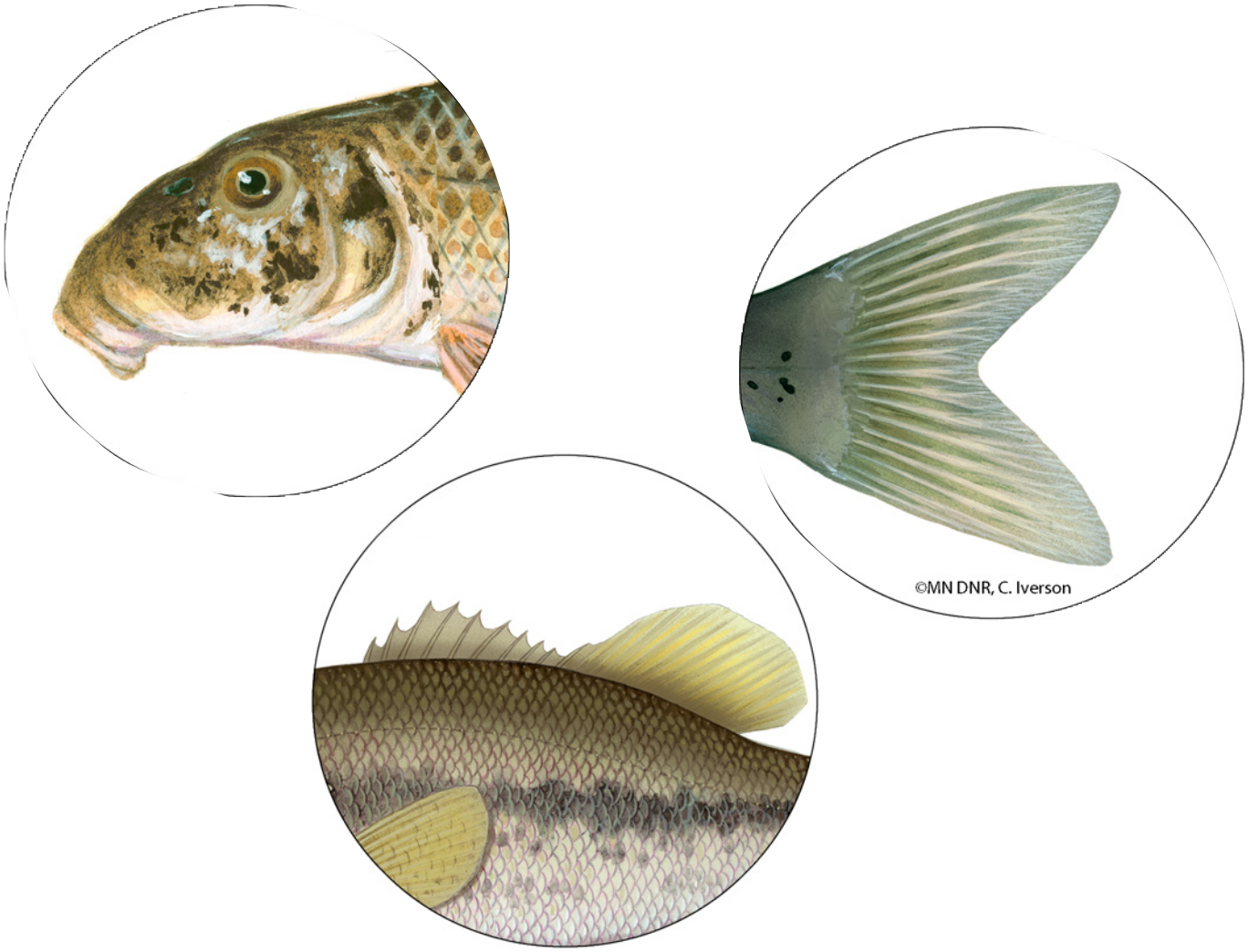
Adapted for Habitat

The physical features and behaviors of fish enable their survival.



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Please note: Academic Standards are updated regularly and our alignments will be updated on the DNR Academic Standards Website at: www.mndnr.gov/education/teachers/edstandards_intro.html

Adapted for Habitat

Minnesota Academic Standards

◒ Lesson *introduces* this Benchmark.
◒ Lesson *partially* addresses this Benchmark.
◒ Lesson *fully* addresses this Benchmark.

Language Arts

Grade 3
I. Reading and Literature
B. Vocabulary Expansion:
Benchmark 1—The student will acquire, understand and use new vocabulary through explicit instruction and independent reading. ◒
II. Writing
A. Types of Writing:
Benchmark 1—The student will write in a variety of modes to express meaning, ◒ including:
a. descriptive
b. narrative
c. informative
d. friendly letter
e. poetic
III. Speaking, Listening, and Viewing
A. Speaking and Listening:
Benchmark 1—The student will participate in and follow agreed-upon rules for conversations and formal discussions in large and small groups. ◒
Benchmark 2—The student will demonstrate active listening and comprehension. ◒
Benchmark 3—The student will follow multi-step oral directions. ◒
Benchmark 4—The student will give oral presentations to different audiences for different purposes. ◒

Grade 4
I. Reading and Literature
B. Vocabulary Expansion:
Benchmark 1—The student will acquire, understand and use new vocabulary through explicit instruction and independent reading. ◒
II. Writing
A. Types of Writing:
Benchmark 1—The student will write in a variety of styles to express meaning, ◒ including:
a. descriptive
b. narrative
c. informative
d. friendly letter
e. poetic
f. persuasive
g. thank you note
III. Speaking, Listening, and Viewing
A. Speaking and Listening:
Benchmark 1—The student will participate in and follow agreed-upon rules for conversation and discussions in large and small groups. ◒
Benchmark 2—The student will demonstrate active listening and comprehension. ◒
Benchmark 3—The student will give oral presentations to different audiences for different purposes. ◒

Grade 5
I. Reading and Literature
B. Vocabulary Expansion:
Benchmark 1—The student will acquire, understand and use new vocabulary through explicit instruction and independent reading. ◒
II.Writing
A. Types of Writing:
Benchmark 1—The student will write in a variety of modes to express meaning, ◒
including:
a. descriptive
b. narrative
c. informative
d. formal letter
e. poetry
f. persuasive
g. thank you notes
h. reports

III. Speaking, Listening, and Viewing
A. Speaking and Listening:
Benchmark 1—The student will participate in and follow agreed-upon rules for conversation and formal discussions in large and small groups.
Benchmark 2—The student will demonstrate active listening and comprehension.
Benchmark 4—The student will give oral presentations to various audiences for different purposes.

Science

Grade 3
IV. Life Science
B. Diversity of Organisms:
Benchmark 1—The student will describe the structures that serve different functions in growth, survival and reproduction for plants and animals.
IV. Life Science
C. Interdependence of Life:
Benchmark 1—The student will know that organisms interact with one another in various ways besides providing food.

Grade 4
IV. Life Science
B. Diversity of Organisms:
Benchmark 1—The student will classify plants and animals according to their physical characteristics.
Benchmark 2—The student will learn that the characteristics used for grouping depend on the purpose of the grouping.

Grade 5
I. History and Nature of Science
C. Scientific Enterprise:
Benchmark 1—The student will describe different kinds of work done in science and technology.
IV. Life Science
E. Biological Populations Change Over Time:
Benchmark 2—The student will recognize that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival.

Environmental Literacy Scope and Sequence

Benchmarks

- Social and natural systems are made of parts. (PreK-2)
- Social and natural systems may not continue to function if some of their parts are missing. (PreK-2)
- When the parts of social and natural systems are put together, they can do things they couldn't do by themselves. (PreK-2)
- In social and natural systems that consist of many parts, the parts usually influence one another. (3-5)
- Social and natural systems may not function as well if parts are missing, damaged, mismatched or misconnected. (3-5)

For the full Environmental Literacy Scope and Sequence, see:
www.seek.state.mn.us/eemn_c.cfm

Chapter 2 • Lesson 6

Adapted for Habitat

Grade Level: 3-5
Duration: Part 1: 30 minutes
Part 2: 50 minutes
Group Size: any
Subject Areas: Expressive Arts, Science
Academic Skills: construction, drawing, generalizing, invention, modeling, presentation skills, public speaking, recognition, simulation, visualization, writing
Setting: indoor or outdoor gathering space with tables
Vocabulary: adaptation, biodiversity, camouflage, depth perception, disruptive coloration, dorsal fin, extinction, habitat, ichthyologist, predator, prey, redd, spawn
Internet Search Words: fish adaptations, fish features

Instructor's Background Information

Fish exist in all shapes, sizes, and colors, but they do have some traits in common. All fishes are cold-blooded vertebrates, for example. And all fishes have gills for absorbing oxygen from water and fins to help them maneuver underwater. Most fish species have scales that protect their bodies.

Although most fish share some characteristics, there are thousands of different species of fish in the world, and each has unique features that have developed over time, becoming progressively refined in response to changes in environmental conditions. As the biological adaptation of a species evolves over many hundreds or thousands of years, that species becomes better and better suited to its habitat. An **adaptation** is a physical characteristic or behavior of a plant or animal that suits it to its environment and enables it to better survive particular conditions. Adapted features are inherited, or passed genetically from generation to generation. Adaptations happen slowly over time. Adaptations also include behaviors that help an organism to be more successful in its environment.

Summary

Fish exist in a variety of sizes, shapes and colors. Unique characteristics called adaptations help them survive in their watery environments. In Part 1, two student volunteers "dress" in the adaptations of predator and prey fish. In Part 2, the class decides what a local lake or river environment might be like in the year 4000. Each student then designs a fish with adaptations suited to this habitat of the future.

Student Objectives

The students will:

1. Identify fish adaptations in each of the following categories: mouth, body shape, coloration, reproduction, and fins, for at least three different species of fish.
2. Describe how each adaptation might help the fish survive in its habitat.
3. Design a hypothetical fish species with adaptations suited for a set of futuristic environmental conditions.
4. Explain that adaptations are features, characteristics, and behaviors that help organisms survive conditions in the habitats where they live.

Materials

Warm-up
- **Fish Identification Cards from Lesson 2:5—Diving Into Diversity**, four sets
- Large hat
- Sheet of drawing paper, one per student
- Drawing materials for each student, such as colored pencils, markers, or crayons

Part 1: Adapted for Habitat
- Two name tags marked "predator" and "prey"
- Shirt with camouflage pattern or stripes
- Drab-colored shirt
- Sturdy crate or box, eight to 20 inches tall and strong enough to hold the weight of a student standing on top of it (optional)
- One pair of earmuffs or a headband with large paper eyes taped or otherwise attached to either side
- Large eyeglass frames (such as plastic sunglasses with the lenses popped out)
- Three beanbags or foam balls
- Backpack, with a large spiky dorsal fin attached (fin can be cardboard)
- Backpack, with a small flimsy dorsal fin attached (can be paper or fabric)
- Two paper funnels (one should be large, with forward-protruding paper teeth taped to the inside of its wide end; the other should be smaller, without teeth)
- Two twelve-inch lengths of quarter-inch elastic, for attaching to funnels so students can wear them

continued

Because fish are one of the oldest groups of animals, they've had time to become one of the most diverse animal groups. Only insects exhibit a greater diversity of species. About half of the earth's known species are insects (200,000 species). There are approximately 18,000 fish species, most of which are saltwater, or ocean-dwelling.

Fish Adaptations

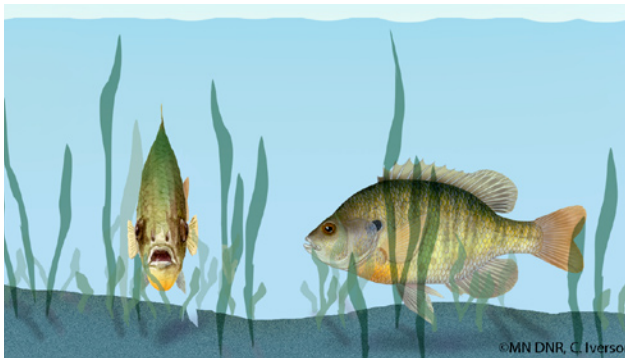
A wide variety of lakes, rivers, and streams provide a diversity of habitats for Minnesota's many fish species. There are currently 160 fish species in Minnesota, each possessing special adaptations enabling it to survive in the conditions where it lives. For example, some fish live in deep, open water. Others prefer shallow areas near plants. Some fish are adapted to the fast-moving currents of streams or rivers. Others are suited to still waters.

Prominent adaptations include coloration patterns, body shapes, tail fin shapes and dorsal fin types, mouth features, eye (large or small, and where thay are placed on the head), and reproductive habits. If conditions change dramatically, for example, if an algae bloom results in a decrease in dissolved oxygen levels in a lake, a fish species suited to waters with high oxygen levels may no longer be suited for survival in the altered environment. **Ichthyologists** (scientists who study fish) continue to learn more about the adaptations of fish and how human activities impact aquatic environments and fish populations.

Body Shape

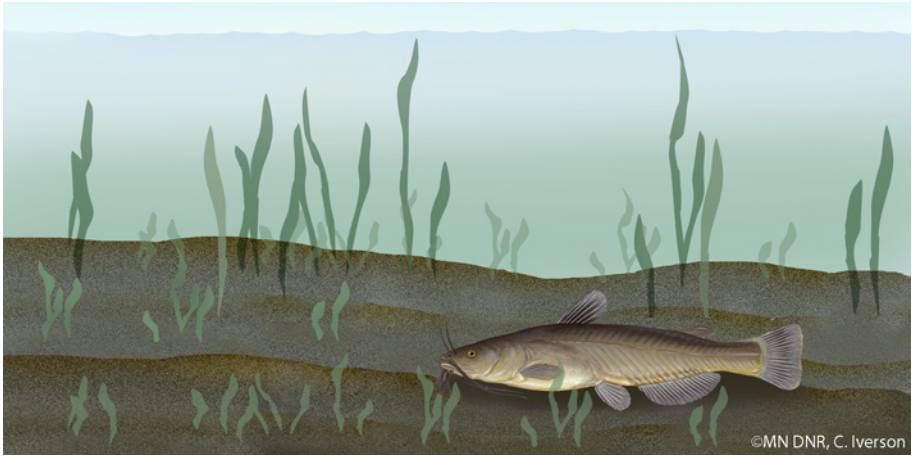
Fish have various body shapes, including flat or laterally compressed bodies, flat-bottomed bodies, and long, torpedo-shaped bodies.

Prey fish (fish eaten by other fish) often have bodies that are laterally compressed, or flat from side to side. This shape allows them to easily fit and maneuver in areas with many aquatic plants. In vegetation, these fish can find cover and hide from **predators** (fish that eat other fish). A sunfish is an example of a prey fish. These fish are also known as panfish because their shape fits a frying pan. Sunfish are small fish with small mouths suited for eating tiny things (like insects) that they find as they swim in areas of aquatic vegetation.



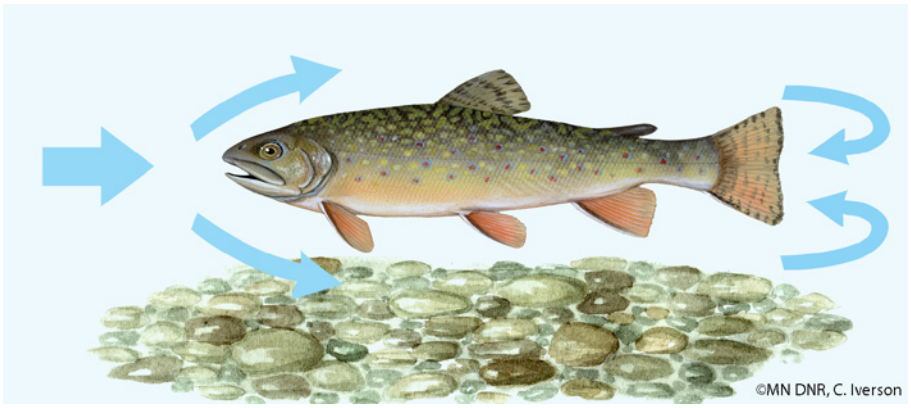
Because its shape is laterally compressed, a bluegill maneuvers easily in a cover of vegetation.

Flat-bottomed fish "hug" or travel along the bottom of a lake, river, or stream as they search for food.



Bullheads are bottom-feeders with flat undersides.

Some prey fish and many predator fish are torpedo-shaped. This streamlined shape enables the fish to swim quickly, with less drag in the water. Examples of torpedo-shaped fish include trout, salmon, northern pike, gar, and muskellunge.



A torpedo-shaped trout swims against the current. (Arrows show direction of current.)

Some fish are long and narrow, or ribbon-shaped, like snakes. Burbot, lamprey, and the American eel are ribbon-shaped fish. This shape enables them to swim very fast, maneuver currents, and fit into crevasses and holes in the rocks or sunken logs that afford cover and protection from other predators.

A ribbon-shaped burbot.

Materials (continued)

- Two handfuls of paper confetti, or the small paper circles from a hole punch
- Broom and dustpan for sweeping up the confetti scattered during the activity
- Small bowl
- **Fish Adaptations and Advantages Sheet**, one per student

Part 2: Future Fish of the Year 4000

- **Future Fish of the Year 4000 Sheet**, one per student
- **Fish Adaptations Sheet**, one per group
- Crayons, colored pencils, or markers
- Construction paper
- Selection of art and craft materials such as scissors, glue, construction paper, modeling clay, and paint
- Pencils and pens

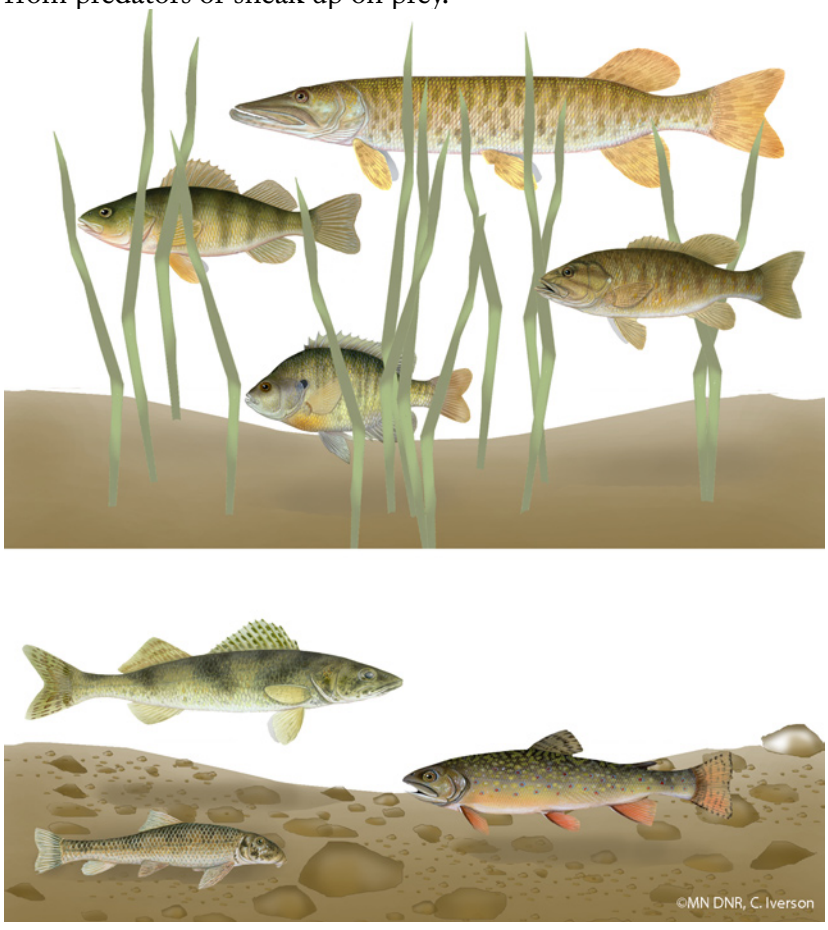
K-2 Option

- Sheets of white butcher paper (approximately three feet square), two per student or pair of students
- Crayons or markers
- Scissors
- Stapler or tape
- Crumpled newspaper, for stuffing fish
- Monofilament line, for hanging fish

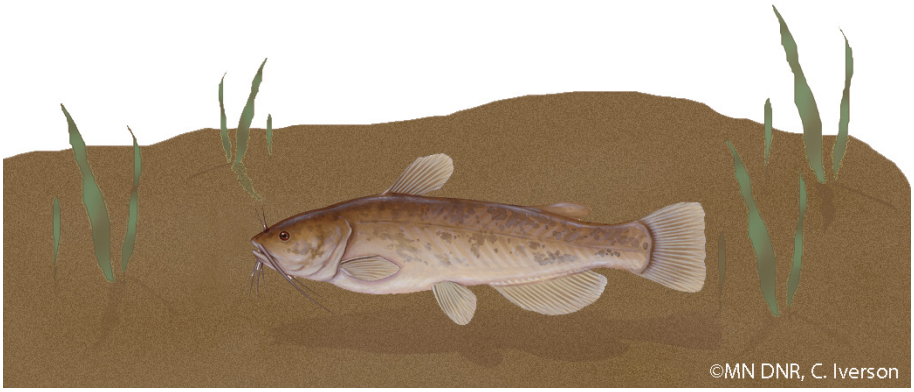
Coloration

Fish have many different colors and patterns. Each species is unique, and patterns and colors help a fish identify potential mates and others of its own species. Color and pattern are also survival tools, enabling fish to fool other fish by masquerading as something best avoided. A fish can distinguish predators from prey, and it recognizes the fish with which it can safely travel in schools. Colors and patterns are significant adaptations that help fish survive in other ways, too.

Coloration that helps fish blend into environments and prevent detection is called **camouflage**. An animal with **disruptive coloration** is marked with spots, stripes, mottling, or other patterns that break up its outline and help it blend into its background. Vertical stripes camouflage fish in backgrounds containing plants. Fish with vertical stripes include yellow perch, bluegills, smallmouth bass, and muskellunge. Fish marked with specks or dots merge with backgrounds containing air bubbles as would occur in riffles and rapids in a river. Specks or dots also camouflage fish in areas where small rocks or pebbles are the background. Brook trout have spotted patterns; sauger and northern hogsucker are examples of fish with mottled patterns. The drab coloration of some species, such as brown bullheads, helps them blend into murky, muddy, or dark backgrounds on pond bottoms. Camouflaged fish can more easily hide from predators or sneak up on prey.



Disruptive coloration like stripes, spots, and specks helps fish blend into their surroundings.

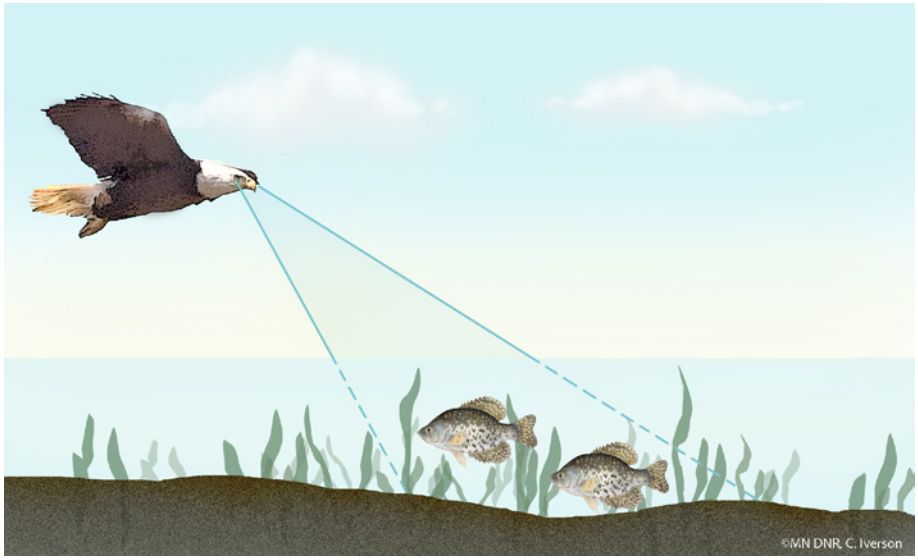


Drab coloration also blends fish into their surroundings.

There are occasions when a fish can benefit from drawing attention to itself. Some fish have bold, dramatic patterns that distract predators from recognizing them as lunch. For example, a bowfin (dogfish) has a large dark spot, a false eyespot, on its tail. The eyespot really looks like an eye, which confuses predators, causing them to target the prey's tail instead of its head. Some fish, such as rainbow darters, display bright colors only during the **spawning** (egg laying) season, to attract mates.

Notice the eyespot on the bowfin's tail.

Sunlight falls on a fish's environment from above. In these conditions, a light-colored bottom and a dark top (**countershading**) hides a fish from predators. Most minnows, perch, and walleye have light-colored undersides or bellies that make it hard for predators to see them from below because they blend in with the lighter sky. Fish with dark-colored upper sides include bluegills and crappies. Predators, such as eagles and osprey, have a difficult time seeing fish with dark upper-sides from their vantage above the water, because the fish blend in with the darker colors of lake or river bottoms.



A black crappie displays countershading—the eagle has a difficult time seeing it from overhead.

When threatened, sunfish display their large dorsal fin to look larger.

Dorsal and Caudal (Tail) Fins

Prey fish often have large fins—particularly dorsal fins. The **dorsal fin** is located along the back (topside) of a fish between its head and tail. A large dorsal fin helps stabilize a short, laterally compressed body, as the fish swims through the water. A large, flared dorsal fin also helps a small fish look bigger and more threatening, as illustrated by the sunfish. The dorsal fin of a sunfish also has sharp spines that can stick in a predator's throat, making the sunfish more difficult to swallow. Spines function as a defense against predators as well as a structural component of the fin.

The **caudal fin**, or tail fin, is located at the end of the fish and provides power that propels the fish forward, like a motor. It also acts like a rudder to assist in steering. Caudal fins have varied shapes, such as forked, rounded, heart-shaped, and square.

The shapes of caudal fins tend to correspond to the cruising speed of fishes. **Roving predators** (fish that spend much of their time cruising and searching for prey) require speed or continuous movement, and they typically have forked tails. A forked tail produces less drag in the water than a rounded or squared tail, enhancing speed. When a roving predator, such as a channel catfish, locates a potential meal, quick flicks of its forked tail provide a sudden burst of speed, enabling it to overtake and capture its prey. **Lie-in-wait predators** also capture their prey with a sudden burst of speed, but instead of cruising around looking for prey, they remain still, mimicking a stick or log. The longnose gar is an example of a lie-in-wait predator. They lie still, under cover, and wait for unsuspecting prey to swim by. They then dart out to ambush it. Some lie-in-wait predators have torpedo-shaped bodies with rounded caudal (tail) fins. Others have forked tails like roving predators. The dorsal and anal fins are usually located toward the back of the long

body, close to the large caudal fin. Just as a motor provides power in the back of a boat, dorsal and anal fins lying close to the tail concentrate power at the back of a fish. These fins all work together to propel the fish forward with a burst of power as unsuspecting prey ventures near the camouflaged predator that has patiently awaited its approach.

The northern pike is a predator whose dorsal fin is located near its tail.

Sometimes smaller fins are beneficial. Prey species, such as minnows, and many stream or predator fish, such as brook trout, have small fins. These allow fish to swim in swift river currents without much resistance, hide from large predators in small crevices and holes, and swim quickly in currents as they chase prey. (See **Lesson 2:2—Fins: Form and Function** for more information on fin adaptations.)

Mouths

The feeding behavior of fish can be discerned by the shape, size, and location of their mouths. Prey fish have small mouths suited to eating plankton, small plants, and insects. Predator fish have large mouths that enable them to eat other fish. Predators often have a mouthful of sharp teeth to help them catch and hold their prey. Fish mouths might point up for snatching insects from the surface of the water, straight ahead to reach food in front of the fish, or point down to find food on the bottom. (See the **Fish Adaptations Sheet** in this lesson for illustrations.)

Examples of Fish Mouths

Suckers and carp have soft-lipped, sucker-shaped mouths that point downward for sucking small plants and animals from the bottom. Sturgeon also have mouths—as well as sensory barbels, or whiskers—positioned underneath their snouts. They eat snails, clams, crayfish, and immature insects from the bottom.

Paddlefish have an elongated upper jaw that resembles a canoe paddle. The upper jaw protrudes beyond the lower jaw. Paddlefish swim with their mouths wide open, eating mostly plankton filtered from the water with screen-like structures (gill rakers) located at the backs of their throats. Their paddles, covered with sensory receptors, locate and guide the food (clouds of plankton) into their mouths.

The mouths of banded killifish point upward. With their elongated lower jaws, they feed on prey (floating insects) that they see above them on or near the water's surface.

The large, duckbill-shaped mouths of northern pike and muskellunge allow these large predator fish to easily grasp sizeable prey. Numerous—and extremely sharp—teeth allow them to catch and securely hold their prey. The diet of the adults consists mostly of fish, but they eat just about anything they can catch, including frogs, mice, crayfish, muskrats, and ducklings. Northern pike and muskellunge can eat fish as long as one-third to half their own length!

The relatively large jaws of the largemouth bass allow it to "inhale" smaller prey, sucking it in with water. Largemouth bass, as well as the garfish, grab large prey. They can turn it around in their mouths to swallow it head-first, so that the spiny dorsal fins of some prey species don't catch in their mouths. Like northern pike, a largemouth bass can consume prey nearly half its own length and it, too, eats almost anything it can catch, including other fish, frogs, crayfish, and insects.

Eyes
The eyes of a prey fish are located on either side of its head. The fish can see all around, but not directly above or directly behind itself. Fish with eyes on the opposite sides of their heads don't have very good **depth perception—**they can't easily determine distances between themselves and other objects.

Many predator fish have eyes located further forward on their heads. Having both eyes focused in the same direction provides better depth perception, enabling them to catch prey.

The eyes of a northern pike face forward; a bluegill's eyes are on the sides of its head.

Reproductive Behaviors
Most fish lay eggs instead of giving birth to live young. Different species of fish demonstrate a variety of **spawning** or breeding behaviors.

Nesting—Males in the sunfish family use their tails to sweep sediment and create bowl-shaped nests on lake or stream bottoms. The females supervise the nest building and choose and mate with the males who build the best nests and have the brightest coloration and patterns. After fertilizing the eggs, the males guard the nests and protect the eggs from predators. They also keep the nest free of debris and oxygenate the eggs by fanning their tail over them.

Fish in the salmon family dig depressions for their nests, which are known as **redds**. While the male wards off other males, the female does most of the digging by using her tail to fan away finer sediments. She

then lays eggs in the redd. The male fertilizes the eggs by releasing milt over them, and buries them to hide them from predators.

Catfish find protected areas, such as hollow logs or holes in banks, in which they deposit eggs and guard them and the newly-hatched young.

Broadcast Spawning—Some fish, such as yellow perch or some minnow species, lay their eggs in a mass or string of jelly to be left alone hanging on a plant or an old log. Some fish even "glue" their eggs—one at a time—to aquatic plants. Other fish, such as freshwater drum, release their eggs into the open water, where they must fend for themselves. Yellow perch, northern pike, and carp randomly disperse their eggs near vegetation. The eggs have a sticky coat or covering. As they fall through the water, the eggs stick to vegetation, where they remain secure until they hatch.

Naming Fish

To distinguish one organism from another, scientists give each species a unique scientific name consisting of two words. The first word is the name of the genus. The second word is the species name for the organism. Scientific names are usually Latin or Greek. Scientific names often describe adaptations, such as physical features, physiological functions, behaviors, genetic makeup, or evolutionary history. Sometimes the name of the person who discovered the organism becomes a part of its scientific name.

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Common Name	Scientific Name
Brook trout	*Salvelinus fontinalis* (Latin, meaning a little salmon living in springs)
Lake chub	*Couesius plumbens* (Named for the ornithologist Elliott Coues and Latin, meaning lead-colored)
Golden redhorse	*Moxostoma erythurum* (Greek, meaning mouth to suck and red-tailed)
Rock bass	*Ambloplites rupestris* (Greek, meaning blunt armature and Latin, meaning living among rocks)

What Causes Conditions to Change in Aquatic Environments?

Changes in an environment can occur naturally. Some environmental changes are seasonal or cyclical; some changes can be permanent. Natural events cause drought, temperature changes, disease, and flooding. Environmental changes are also caused by people's activities.

If conditions in an aquatic habitat change quickly, fish might do one of several things. They might migrate to an alternate habitat until conditions return to a tolerable state. Or they may be able to tolerate

Extinction occurs when a species as a whole can't adapt to changes in the environment and every member of that species dies. Extinction can occur gradually over generations as one species evolves into something else, or a species can become extinct when all organisms of that type die suddenly or relatively quickly. The term **mass extinction** describes an event where a large number of the earth's species cease to exist over an unusually short time frame.

the change and continue unhindered in their typical habitats. They might also change their activity levels, adjust in other ways, or die. If conditions are severe enough, or last long enough, the species may become **extinct**.

If environmental conditions change suddenly in a lake or river, the fish species with the most specialized adaptations may have the greatest difficulty tolerating change. They may not be able to survive. The fish with the most generalized adaptations—those that provide options to enable them to survive in the new conditions—are the most likely to survive.

Maintaining Aquatic Biodiversity

Biodiversity, or variety of life, usually refers to the total number of species inhabiting a given environment. Types of biological diversity include:

- community or ecological biodiversity: the variety of ecological communities or ecosystems that exist
- genetic biodiversity: the range of individual variation within a single species
- species biodiversity: this most common usage of the word includes different types of species—from bacteria to sturgeon and phytoplankton to Norway pines—that exist in a certain location

Biodiversity is important to people, too. We depend upon it for our very existence. Every ecosystem and every species of plant and animal has a unique place in the functioning of the earth's web of life or life support system. Interacting in the delicately balanced systems of the natural environment, the different species function to cycle oxygen, water, and nutrients and provide food for all life on the planet, including human life. The biggest threat to biodiversity today is loss of habitat. The rate at which we consume natural resources is increasing, which also poses a serious threat to biodiversity.

In most cases, a species needs many generations to adapt to changes in the environment, but people are changing the landscape faster, more dramatically, and in more ways than ever. Sustainable management of all Minnesota's land and water habitats is essential for the conservation of our aquatic biological diversity. Understanding the effects of land-use practices on aquatic habitats is increasingly important in guiding resource management, conservation, and restoration strategies. The individual daily decisions that people make about their consumption and use of resources are important decisions and do make a difference, either negative or positive, on our resources. For more information on how individuals can conserve Minnesota's aquatic habitats and biodiversity, see **Lesson 4:5—Fisheries Management and You.**

Procedure

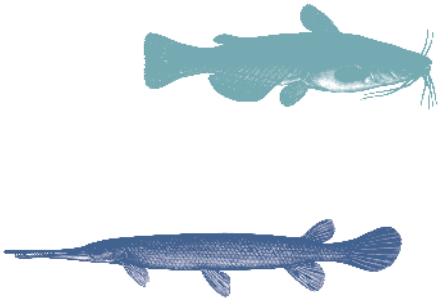
Preparation

1. Copy and make four sets of **Fish Identification Cards** from **Lesson 2:5—Diving Into Diversity**
2. Collect and assemble the props for the dress-up activity.
3. Copy the **Fish Adaptations Sheet**, one per student.
4. Copy the **Adaptations and Advantages Sheet**, one per student.
5. Copy the **Future Fish in the Year 4000 Sheet**, one per student.
6. Gather materials and supplies for creating the year 4000 fish in Part 2.

Activity

Warm-up

1. Ask the students to define adaptation. Tell students that they will revisit this definition, so it will be helpful to write down any ideas they may have about what the word means.
2. Conduct a class discussion on features and behaviors that people have to help them survive in our habitat. As a part of the discussion, ask the students to identify different kinds of features or behaviors another animal might have to help it survive similar conditions. Examples: Which features help humans eat their food? (Hands with fingers and thumbs to hold food and utensils; teeth for chewing and biting.) Which features help certain animals eat their food? (Some, like cougars, have sharp teeth; frogs have long sticky tongues; hummingbirds have long beaks to reach nectar; bears have strong claws to lift and turn rocks over to find grubs.)
3. Tell students that all of the things they've listed are called adaptations. Write this definition for adaptation on the whiteboard or projection device: adaptation—a feature or behavior that helps an organism survive in its environment (a characteristic that helps a plant or animal survive the conditions where it lives).
4. Write the categories of types of adaptation on the whiteboard or projection device, including the following: body shape, color, body parts (such as fins and scales), mouth, eyes, and behaviors.
5. Put one set of **Fish Identification Cards** from **Lesson 2:5—Diving Into Diversity** into a large hat. Pass the hat around to students. One at a time, have each student draw a fish identification picture from the hat. As each student draws a picture from the hat, ask the student to figure out an adaptation that the fish has, and to decide which category to put it in. Have the student tape the card on the whiteboard under one of the category headings. (Note that a card may fit under more than one heading.) Ask the student to choose a prominent adaptation type illustrated in the drawing and place it under the corresponding heading. If the student thinks the card could go under more than one heading, use additional cards of that fish from the other sets of **Fish Identification Cards** and place one under each adaptation heading the student identifies for that fish.



6 Wrap up with a discussion describing how fish (like all organisms, including people) have different characteristics called adaptations, and discuss why having various adaptations is helpful. Ask students to compare their original definition of adaptation with the new definition on the whiteboard or overhead.

Lesson
Part 1: Adapted for Habitat

1 Ask two student volunteers to come to the front of the class. Wonder aloud with them: What type of adaptations do different types of fish have? (Explain that the answer depends on where the fish live, and what they do to survive the conditions there.)

Give each volunteer a nametag labeled "prey" or "predator"

2 Tell the class you will be "dressing" the students with fish adaptations. These fish live in a local lake, so consider habitat conditions in your local lake. One student will dress in predator adaptations. The other student will dress in adaptations suited to a prey fish.

3 For each body part or characteristic presented, ask the students in the class to decide which type of adaptation might be suitable for a predator fish, and then, what type of characteristic would be suitable for a prey species. Help the students through the process of deciding on an appropriate adaptation. As each body part is added, discuss its benefits, and how it helps the predator or prey fish survive.

In the following steps, as you hold up each prop you may wish to ask the class if they can guess which fish characteristic or adaptation it represents. Or you may wish to explain an adaptation and ask students to decide what type of prop could represent that feature—then present the prop you've provided.

You may refer to the **Fish Adaptations Sheet** for this part of the lesson, but don't give copies of this to the class until after the dress-up is completed and the class has decided where (or in what type of habitat) each of the two dress-up species lives.

Fish Characteristics
Body Shape

- Have the prey fish stand sideways (with one side facing the class) to represent a fish that is laterally compressed.
- Have the predator fish stand tall on a box to become longer (torpedo-shaped).

Coloration

- Give the prey fish a camouflaged hunting shirt or a striped shirt to wear. Ask students what type of coloration the shirt mimics. (Camouflage for blending in and being more difficult to detect in vegetation.)
- Give the predator fish a drab-colored shirt to wear. This inconspicuous coloration helps a predator lie in wait for its prey, or approach prey without being noticed.

Fins

- Give the prey fish the backpack with the large, spiky dorsal fin attached to it. The spikes or points represent sharp spines.
- Give the predator fish a backpack with the smaller, flimsier dorsal fin attached to it.

Eyes

- Give the predator fish a pair of glasses to wear to emphasize the eyes located more towards the front of the face. Toss some beanbags to the student to try to catch, to illustrate a predator fish's depth perception (having both eyes focused on the beanbag).
- Give the prey fish volunteer a pair of earmuffs with eyes on them. The student should be standing sideways so one earmuff eye faces the class. Now ask the volunteer to cover or close one eye, to simulate the depth perception of a prey fish (being able to focus one eye in a particular direction). Toss the beanbags again. It should be more difficult for this student to catch the beanbag with one eye closed than it was for the other student (the predator fish), who had both eyes open. The prey fish will have trouble judging the location and distance of the beanbag.

Mouth

- Use a length of elastic to place a small funnel over the prey fish student's face (and under the nose) with the small end pointed outward.
- Place the large funnel (with the paper teeth) protruding outward over the predator fish student's face. The wide, open end should face outward from over the student's face—the student can hold the narrow end of the funnel up to their mouth.

Reproduction (Behavior)

- Hand the prey fish a handful of paper confetti (fish eggs) to carefully put into the small bowl placed on the floor behind them. The bowl represents the nest or redd that the male sweeps out on the lake or stream bottom. Tell the class that the female carefully lays the eggs in the nest. Afterward, the male guards the nest to keep predators away until the eggs hatch.
- Hand the predator fish a handful of paper confetti to scatter around the immediate area. These scattered eggs have a sticky coating that helps them stick to plants in the water. Fish that scatter their eggs and leave them wherever they fall are free to pursue prey.

4 Briefly review with the class the adaptations you have given each fish. Give each student a **Fish Adaptations Sheet**. With the two volunteers still in front of the class, ask the students if they can figure out where, or in what type of habitat of the local water body, each fish lives. (In the vegetated areas of the lake or stream, in fast-moving water, in the deeper open water, or in areas with sandy bottoms.)

5 Have the students compare and contrast the adaptations of the two dressed-up fish and describe how each characteristic helps the fish survive as a predator or prey fish in a watery environment.

Vision: One eye or two? Try this demonstration with the class. If you look at an object with just one eye instead of both eyes, depth perception is affected. This can be demonstrated by holding a finger up in front of your right eye. Hold that finger about six inches away from your right eye and keep it there. Close your left eye only. Look at the finger with your right eye and then, keeping your finger where it is, close your right eye and look at the finger with only your left eye. When you look at the finger with only your right eye, it will appear closer than when you look at it with only your left eye open, or even when looking at it with both eyes open.

6 Ask the class to name the two fish they have created. They can use names of real fish or they can make up species names that reflect the adaptations that the fish have, such as spiky-finned pancake fish, fast-water fly eater, or big-mouth prey chaser.
7 Ask students to complete the **Adaptations and Advantages Sheet.**

Part 2: Future Fish of the Year 4000

1 Tell the students that it's the year 4000. Ask them what changes could possibly occur in the environment over the next 2,000 years. What might lakes and rivers be like in Minnesota in the year 4000? What might the fish habitat and conditions be like in lakes and rivers? Encourage creativity, and suggest naming both positive and negative environmental changes. Consider food sources, weather, water quality, and other factors. What challenges will the fish face in the changed environment?
2 Tell students that they are ichthyologists (scientists who study fish) in the year 4000. A new fish is discovered in the local lake and the resident ichthyologist is notified. It's your job to study the fish, discover and describe its habitat, adaptations or features, behaviors, diet, defense mechanisms, and lifestyle. You must also give it a name. (Scientific names typically use words that describe features or behaviors of the organisms; sometimes an organism is named for the person who first discovered it.)
3 Hand out the **Future Fish in the Year 4000 Sheet** to students. Have students complete Question 1 by writing a paragraph describing the local lake, river, or stream in the year 4000. Or, you might ask them to illustrate the local water body by drawing or using a computer graphics program. What environmental changes do they envision? What could cause these environmental changes? What is the fish habitat like? Will current species of fish adapt to these future environmental changes or become extinct? Define and discuss extinction. Students may use their imaginations to create fantastical, positive, or negative environmental changes.
4 Complete Question 2 on the **Future Fish in the Year 4000 Sheet**. Students will design a new fish species that inhabits this lake, river, or stream in the year 4000. First, have students draw a small sketch of their fish to work out the details of their design before creating their fish. Ask students to keep the following questions in mind as they design their fish:
   - Where does your fish live? What is the fish habitat in the lake like? What adaptations help the fish survive the environmental conditions there?
   - What does your fish eat? What adaptations help it obtain its food? Does anything else eat your fish?
   - Is your fish a fast or a slow swimmer? How do you know?
   - Is your fish a predator? How do you know?
   - How does your fish protect itself?
   - What other special adaptations does your fish have? Why does it need them?

5 When they're satisfied with their designs, make materials available so that the students can construct models of their fish. Students can use various media and art forms to create their fish, depending on what you have available, such as various markers, crayons, colored pencils, construction paper, tag board, modeling clay, cardboard paper towel rolls, and paint. Or, ask the students to use computer graphics to design their fish. Remind them to include adaptations that help the fish to survive in its habitat.

6 After they've finished constructing their fish, have students complete Question 3 on the **Future Fish of the Year 4000 Sheet**. Students will list the adaptations exhibited by the fish that they've created, and describe the survival advantages of each.

7 Remind students how scientists name a newly-discovered species. Have the students name their fish and write the name in Question 4 on the **Future Fish of the Year 4000 Sheet**. Remind them to create a name that refers to the adaptations, behaviors, or features of the fish (and possibly the name of its discoverer).

Wrap-up

1 Ask each student to use his or her **Future Fish of the Year 4000 Sheet** to share with the class the habitat conditions they decided upon for the lake or river in the year 4000. Show the model of the new fish species that was found in the lake, describe its adaptations, and explain how the adaptations help the fish to survive in its habitat.

2 Ask the class to discuss why adaptations are useful for fish. Discuss how the various fish the students created fit into different **niches**, or fill different roles, in an ecosystem. Can students determine why biodiversity, or a variety of species, is important in an ecosystem? Have students research the word biodiversity, and locate and list three benefits of biodiversity. Compare the lists and count the number of benefits the class identified.

3 Have students design an aquatic ecosystem that includes micro-habitats suitable conditions for all of the fish they created. The ecosystem could be constructed on a classroom or hallway bulletin board. Have students each place their fish on the bulletin board in the appropriate habitat in the aquatic ecosystem.

Assessment Options

1 Evaluate the **Fish Adaptations and Advantages Sheet**. Students should have named three fish adaptations in each of the following categories: mouth, shape, coloration, reproduction, and fins, and described an advantage for each adaptation.

2 Evaluate student reports about the habitat conditions they decided upon for the lake or river in the year 4000 based upon descriptions of the habitat, the adaptations of the future fish, and the explanations for how those adaptations help the fish survive in its habitat.

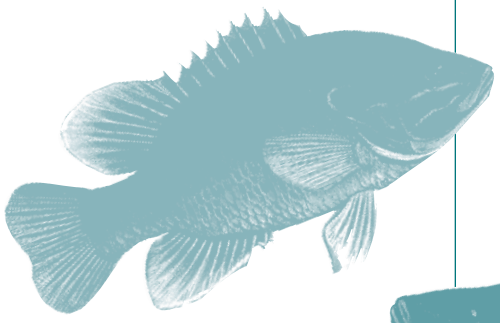
Review the Adapted for Habitat activity from Part 1 and the adaptations of the predator and prey fish. Students may use the **Fish Adaptations Sheet** as a guide. They should include adaptations from the following categories in their designs: coloration, body shape, eyes, fins, mouth, and reproductive behavior.

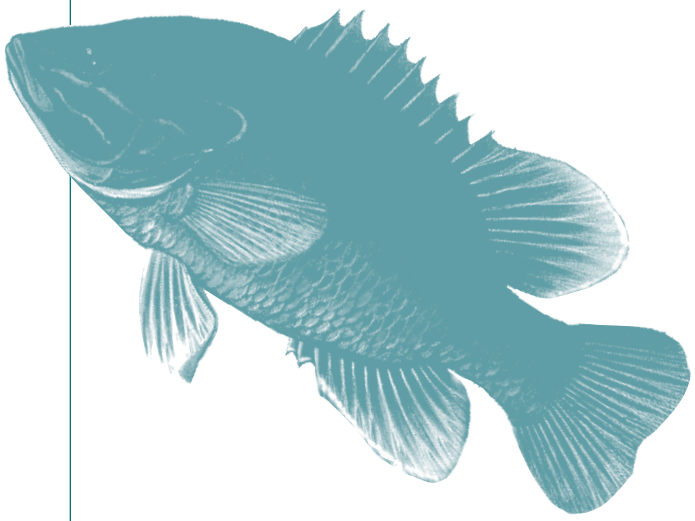
3 Have students exchange their habitat descriptions for the water body in the year 4000 with one another. Ask them to decide if the fish they created would be able to survive in this new habitat and explain why or why not. Create a new fish adapted to the conditions described for this habitat.

4 Have students create other aquatic organisms that live in the same lake with their year 4000 fish. If these other organisms prey on the fish they created, what adaptations would they need to obtain their food? If they're prey species, which adaptations would protect them from being eaten by the fish they created?

5 Have students build a model of a fish habitat for a fish species of their choosing. Ask students to write a description of the habitat and include how that habitat suits the characteristics of the fish they chose. Assign each student a partner and have the partners explain their habitat models to each other and describe how their habitat suits the characteristics of the fish for which they created the habitat.

6 Assessment options include the Checklist and Rubric on the following pages.





Adapted for Habitat Checklist

Possible Points	Points Earned Student	Points Earned Instructor	
5	_____	_____	Student identifies at least five features of fish that are adaptations.
2	_____	_____	Student defines *adaptation*.
4	_____	_____	Student names three adaptations and describes the advantage of each adaptation in helping the fish survive in the habitat where it lives.
4	_____	_____	Student designs a predator fish with four adaptations that help it to survive in the habitat where it lives.
4	_____	_____	Student designs a prey fish with four adaptations that help it to survive in the habitat where it lives.
2	_____	_____	Student determines possible habitat conditions of a local lake in the year 4000; can explain why habitat conditions might be as described in the year 4000.
4	_____	_____	Student creates a fish with four adaptations suited to help the fish survive in the local habitat as described for the year 4000.
2	_____	_____	Student names a fish in a way that reflects its adaptations or the name of the scientist who discovers it.
Total Points			
27	_____	_____	**Score** _____

Checklists are tools for students and instructors. Checklists involve students in managing their own learning. They help students understand and set learning goals before the lesson begins, and help them monitor their progress during the lesson, ensuring that they meet learning goals and objectives by the end of the lesson. Students can also use checklists to discover areas that may need improvement. Checklists help instructors monitor each student's progress throughout the lesson, facilitating appropriate adjustment of instruction to ensure learning by the end of the lesson. The instructor may wish to have students add several of their own learning goals to the checklist to personalize it, and to accommodate varied learning needs and styles.

Grade

25-27 points = A
Excellent. Work is above expectations.

21-24 points = B
Good. Work meets expectations.

16-20 points = C
Work is generally good. Some areas are better developed than others.

12-15 points = D
Work does not meet expectations; it's not clear that student understands objectives.

0-11 points = F
Work is unacceptable.

Adapted for Habitat Scoring Rubric

Adaptation Criteria	4 Excellent	3 Good	2 Fair	1 Poor	0 Unacceptable
Recognizing adaptations	Identifies at least five features, such as type of mouth, fins, coloration, reproduction style, as adaptations and explains that adaptations are physical features or behaviors that help an organism survive in its habitat.	Identifies four features, such as type of mouth, fins, coloration, reproduction style, as adaptations and explains that adaptations are physical features or behaviors that help an organism survive in its habitat.	Identifies three features, such as type of mouth, fins, coloration, reproduction style, as adaptations and explains that adaptations are physical features or behaviors that help an organism survive in its habitat.	Recognizes that fish features are called adaptations, but can't correctly explain that adaptations are physical features or behaviors that help an organism survive in its habitat.	Doesn't recognize that the word adaptations refers to body parts, features, characteristics, or behaviors.
Functions of adaptations	Names three adaptations and describes the advantage of each in helping the fish survive in its habitat.	Names two adaptations and describes the advantage of both.	Names one adaptation and describes the advantage of one adaptation.	Names one adaptation, but not the advantage of that adaptation.	Can't describe how adaptations help an organism survive in its habitat.
Predator vs. prey	Designs two fish (a predator and a prey species) with four adaptations that help each fish survive in its habitat.	Designs two fish (a predator and a prey species) with three adaptations that help each fish survive in its habitat.	Designs either a predator or a prey fish species with two adaptations that help it survive in its habitat.	Designs a fish (neither a predator or a prey species) with two adaptations that help it survive in its habitat.	Can't identify adaptations of predator or prey species; can't describe how how the adaptations exhibited in their design help the fish survive conditions in its habitat.
Meeting future habitat challenges	Determines possible habitat conditions of a local lake in the year 4000; explains why habitat conditions might be as described in the year 4000. Creates a fish with four adaptations that help the fish survive in that habitat. Names fish in a way that reflects its adaptations or the name of the scientist who discovers it.	Determines possible habitat conditions of a local lake in the year 4000; creates a fish with three adaptations that help the fish survive in that habitat. Names fish, but in a way that doesn't reflect its adaptations or the name of the scientist who discovers it.	Determines possible habitat conditions of a local lake in the year 4000; creates a fish with two adaptations that help the fish survive in that habitat. Names fish, but in a way that doesn't reflect its adaptations or the name of the scientist who discovers it.	Determines possible habitat conditions of a local lake in the year 4000; creates a fish with one adaptation that helps the fish survive in that habitat. Doesn't name fish.	Creates fish, but doesn't connect fish features to habitat conditions. Can't provide reasons that explain the aquatic habitat conditions they envisioned for the year 4000.

Score _____ (Calculate score by dividing total points by number of criteria.)

Diving Deeper

Extensions

1. After doing the dress-up activity in Part 1, demonstrate the same concepts for the class comparing the adaptations of two real fish: a predator, such as northern pike, walleye, or muskellunge, contrasted with a prey fish such as a sunfish or perch.
2. Create a hallway or classroom exhibit of the fish the students created in Part 2. Students can create a lake or stream scene on the wall and tape their fish into it, like a mural. The completed **Future Fish of the Year 4000 Sheets**, with habitat and adaptation descriptions can be displayed next to the fish.
3. Look at photos of fish. (Fish photos can be obtained on the Internet, from angling magazines, or printed on 8.5" x 11" paper from the *MinnAqua Leader's Guide* CD.) Have students speculate on the habits and habitat of each fish by examining its coloration, fins, body shape, and mouth.
4. Investigate various Minnesota lake and river habitats and identify the types of fish that live in those habitats. Ask students to discuss and explain how those fish are suited or adapted for conditions in the habitat. Have students write a "Guide to Fishing in Minnesota: Where to Find Different Types of Fish" based on their discussion.

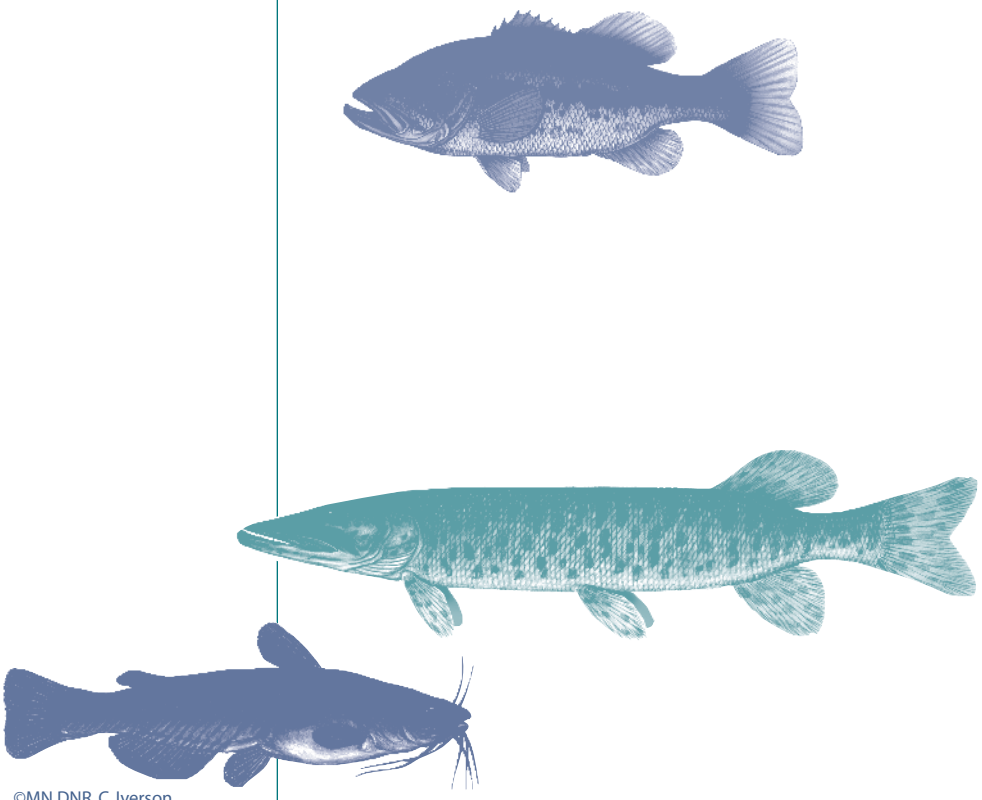
For the Small Fry

K-2 Option

1. If you do the Adapted for Habitat dress-up activity, make sure you have enough time for every student to dress up as a predator or prey fish—every student will want to be involved! Discuss the features of the fish and how the features help the fish survive where they live. Omit use of the term adaptation. Omit the Future Fish in the Year 4000 activity and instead do the following: Make 20 copies of illustrations of six different types of fish. Cut each fish into four parts: head, upper body and dorsal fin, lower body with pelvic and anal fins, and tail parts. Have each student or pair of students select one of each these fish part types. Ask the students to create a fish from these parts by gluing them together to form a new fish on a blank sheet of paper. They should be thinking about what kind of traits their fish may need to survive in its habitat, for example, a big mouth and a long body. Provide crayons or markers for coloring the fish. The students can draw in habitat. Explain that the name of a plant or animal often describes something about that organism. For example, a violet is a purple flower, or a catfish has whiskers. Have students write down (or dictate for an adult to write) a name for their new fish species. Then ask them to describe the type of habitat in which it lives and what it eats, based on the features of their fish.

2 Read the book *Fish Faces,* by Linda Bylander. The book can be obtained from the Minnesota DNR MinnAqua Program.

3 After the dress-up activity, ask students: If you could be a fish, what kind of fish would you be? Have students, either individually or in pairs, design a fish on large sheets of white butcher paper (approximately three feet square). Pass out two sets of large paper to each student or group. Draw both sides of the fish, one side on one sheet of paper, and the other side on the second piece of paper. Color the fish. Cut out these two sides of the fish. Staple or tape the two sides together and stuff the fish with crumpled pieces of newspaper. Have students name the fish they created. Ask each student to tell the class about the features they provided for their fish and explain how the features help the fish to survive in its habitat. Attach clear monofilament line to the fish and hang them from the ceiling in the classroom.



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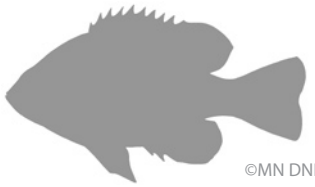
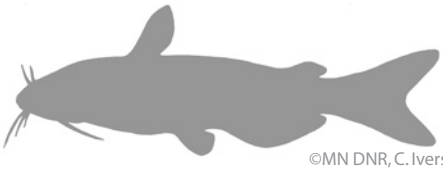
Fish Adaptations Sheet

Adaptation	Survival Benefit	Minnesota Fish
Body shape		
Laterally compressed	Swims through plants easily	 ©MN DNR, C. Iverson Bluegill, other sunfish
Torpedo-shaped	Swims fast to chase prey, or swims easily in fast-moving water	 ©MN DNR, C. Iverson Trout, Coho salmon, northern pike, muskellunge
Flat-bottom	Hugs the bottom, finds food on bottom	 ©MN DNR, C. Iverson Catfish, bullhead, sucker
Coloration		
Horizontal stripes	Camouflage breaks up outline of body against horizontal parts of underwater plants, brush piles, and fallen trees	 White or striped bass, largemouth bass
Vertical stripes	Camouflaged; can hide in vegetation, blending in with vertical plants	 Muskellunge, perch, smallmouth bass, sunfish

continued

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Fish Adaptations Sheet

Adaptation	Survival Benefit	Minnesota Fish
Coloration (continued)		
Mottled coloration	Blends in with rocks and gravel (camouflage)	 ©MN DNR, C. Iverson Brook trout, northern pike, young sturgeon, northern hog sucker
Dark topside	Camouflaged; difficult to see from above; blends in with dark lake or river bottom of lake or river underneath	 ©MN DNR, C. Iverson Bluegill, black crappie, catfish, sturgeon, carp
Light-colored underside	Camouflaged; difficult to see from below; blends in with light sky overhead	 ©MN DNR, C. Iverson Many minnows, yellow perch, walleye, catfish
Fairly uniform, no bold markings	Swims in open water	 ©MN DNR, C. Iverson Gizzard shad, lake whitefish
Fins		
Large dorsal fin with sharp spines	Fish appears larger; more stability for a short, wide body shape; sharp spines make the fish more difficult to swallow	 ©MN DNR, C. Iverson Bass, bluegill, yellow perch

continued

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Fish Adaptations Sheet

Adaptation	Survival Benefit	Minnesota Fish
Fins (continued)		
Small dorsal fin	Swims faster; greater ease of movement in fast currents	 ©MN DNR, C. Iverson Trout, northern pike, muskellunge
Deeply-forked tail fin	Produces less drag; fast swimmer	 Channel catfish
Rounded tail fin	Effective acceleration and maneuvering ability; inefficient for prolonged continuous swimming	 Yellow bullhead
Mouth		
Ventral (located under the head)	Feeds at the bottom; "vacuums" or roots around for food from the bottom	 Sturgeon, sucker, carp
Extended upper jaw	Funnels clouds of plankton toward mouth	 Paddlefish

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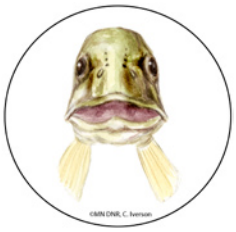
Fish Adaptations Sheet

Adaptation	Survival Benefit	Minnesota Fish
Mouth (continued)		
Protruding lower jaw/ mouth points upwards	Feeds on prey it sees above on surface	 Banded killifish
Duckbill-shaped mouth	Grasps prey	 Northern pike, muskellunge
Barbels (whiskers)	Locates food on bottom; senses or tastes food in murky water	 Catfish, bullheads, sturgeon, carp
Extremely large mouth	Surrounds prey	Largemouth bass
Strong jaws and teeth	Help it catch, hold, and eat prey	Walleye, northern pike, muskellunge, gar
No teeth	Eats plankton (tiny organisms floating in water)	Paddlefish
Eyes		
Eyes forward on front of head	Good depth perception helps determine distance to prey	 Northern pike, muskellunge

continued

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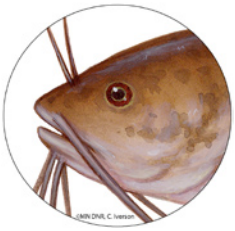
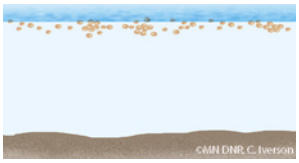
Fish Adaptations Sheet

Adaptation	Survival Benefit	Minnesota Fish
Eyes (continued)		
Eyes on sides of head	Can see predators coming from many directions; can see all the way around (except directly behind itself)	 Bluegill, other sunfish
Small eyes	Murky, dark, deep-water fish or bottom feeder. (Doesn't depend on sight to find food.)	 Catfish, bullhead, sturgeon
Large eyes	Depends on sight to locate food. Large eyes take in more light.	 Walleye, sauger, yellow perch, bass
Reproductive Behavior		
Broadcast spawning and eggs float	Some eggs will survive because large numbers are produced and released	 White bass, freshwater drum
Eggs released in rocks or gravel on bottom	Cover and protection from waves, currents and predators	 Walleye

continued

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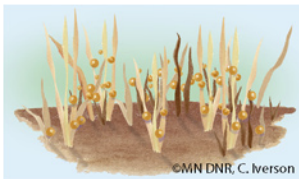
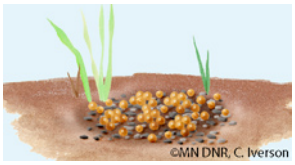
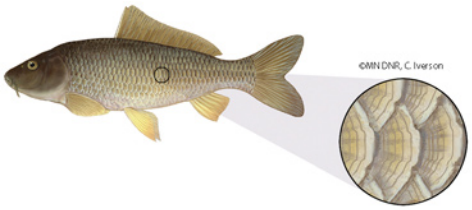
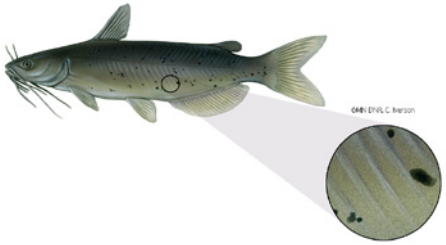
Fish Adaptations Sheet

Adaptation	Survival Benefit	Minnesota Fish
Reproductive Behavior (continued)		
Attaching eggs to vegetation	Eggs don't float away or get carried away in currents, cover and protection, suspended above muddy bottom	 Yellow perch, northern pike, carp
Fish sweep out depression on bottom (nest or redd) with tails	Nests protected by adults Redds protect eggs from currents in gravel depressions	 Nests: green sunfish, smallmouth bass, creek chub Redds: brook trout, salmon
Scales		
Large scales	Provide protection or a defense strategy	 Carp, sunfish, sucker
Small scales	More streamlined; allows for less drag, greater maneuverability, and speed	 Trout, northern pike, burbot
No scales	Allows for greater maneuverability in fast-moving water; allows catfish skin to have taste buds to sense or taste food in murky water	 Catfish, bullheads, sculpin

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Name _____ Date _____

Fish Adaptations and Advantages Sheet

	Adaptation Name three fish adaptations (features or traits).	**Survival Benefit** Describe the advantage of each adaptation—how does it help the fish survive in the conditions where it lives?
Mouth	*Example: strong jaws and teeth to catch, hold, and eat prey*	*Example: to catch, hold, and eat prey*
	1.	
	2.	
	3.	
Body shape	Adaptation	Advantage
	1.	
	2.	
	3.	

continued

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Name _____ Date _____

Fish Adaptations and Advantages Sheet (continued)

	Adaptation Name three fish adaptations (features or traits).	**Survival Benefit** Describe the advantage of each adaptation—how does it help the fish survive in the conditions where it lives?
Coloration	Adaptation	Advantage
	1.	
	2.	
	3.	
Reproduction	Adaptation	Advantage
	1.	
	2.	
	3.	

	Adaptation Name three fish adaptations (features or traits).	**Survival Benefit** Describe the advantage of each adaptation—how does it help the fish survive in the conditions where it lives?
Fins	Adaptation	Advantage
	1.	
	2.	
	3.	

continued

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Name _____ Date _____

Future Fish of the Year 4000 Sheet (continued)

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Name _____ Date _____

Future Fish of the Year 4000 Sheet

1. Describe what you think the habitat of a nearby lake or river might be like in the year 4000.

_____

_____

_____

_____

_____

_____

_____

2. Make a simple sketch of your new fish.

continued

What food does your new fish eat? Which adaptations help it find and eat its food?

Is your fish a predator or a prey species? How can you tell?

Is your fish a fast swimmer or a slow swimmer? How do you know?