Grade Level: 3-8

Activity Duration:
Warm-up: 10-15 minutes
Part 1: 30 minutes
Part 2: 20 minutes
Part 3: 30 minutes
Wrap-up: 10-50 minutes

Overview:
Warm-Up: Defining Structure & Function
Part 1: Predator & Prey
   Dress-up – Comparing Structures
Part 2: Exploring Fish Structures & Functions
Part 3: Future Fish of the Year 4000 – Form & Function
Wrap-Up

Tool for Understanding the Nature of Science
http://undsci.berkeley.edu/

Tool for understanding the Next Generation Science Standards from Bozeman Science – series of YouTube Videos
http://www.youtube.com/playlist?list=PLUIVwaZQkS2rtZG_L7ho89oFsaYL3kUWq

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 unique structures 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.

Topic: Determining how fish structures function in aquatic environments.

Theme: Structure is related to function

Objectives:
The students will:
1. Identify fish structures in each of the following categories: mouth, body shape, coloration and fins, for two species of fish.
2. Describe how each structure might function to help the fish survive in its habitat.
3. Design a hypothetical fish species with structural adaptations suited for a set of futuristic environmental conditions.

This lesson is adapted from “Fishing: Get in the Habitat! Leader’s Guide, Lesson 2:6 – Adapted for Habitat” with permission from the MN DNR MinnAqua Program. http://tinyurl.com/minnaqua-adapt-habitat
**Next Generation Science Standards**

**Crosscutting Concepts: Structure and Function**
Structure and function are complementary properties. The shape and stability of structures of natural and designed objects are related to their functions(s). The functioning of natural and built systems alike depends on the shapes and relationships of certain key parts as well as on the properties of the materials from which they are made.

**Progression at Grades 3-5**
Students learn that different materials have different substructures, which can sometimes be observed, and substructures have shapes and parts that serve functions.

**Progression at Grades 6-8**
Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.

**Suggested MN Science Standards:**
This lesson may partially or fully address the following standards.

**Grade 5:**
5.4.1.1.1 – Describe how plant and animal structures and their functions provide an advantage for survival in a given natural system.

**Grade 7:**
7.1.1.2.4 – Evaluate explanations proposed by others by examining and comparing evidence, identifying faulty reasoning, and suggesting alternative explanations.
7.4.1.2.1 – Compare and contrast the roles of organisms with the following relationships: predator/prey, parasite/host, and producer/consumer/decomposer.
7.4.4.1.2 – Describe ways that human activities can change the populations and communities in an ecosystem.

**Grade 8:**
8.1.1.2.1- Use logical reasoning and imagination to develop descriptions, explanations, predictions and models based on evidence.

**Environmental Literacy Scope and Sequence**
- 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)
- Social and natural systems can include processes as well as things. (6-8)

For the full Environmental Literacy Scope and Sequence, see: [www.seek.state.mn.us/eemn_c.cfm](http://www.seek.state.mn.us/eemn_c.cfm)
Materials:

Warm-up

- Sheet of drawing paper, one per participant
- Drawing materials for each participant, such as colored pencils, markers, or crayons

Part 1: Adapted for Habitat

- One green, grey or brown shirt with camouflage stripes
- One green, grey or brown shirt with spots or mottled or paisley pattern
- Sturdy crate or box, eight to 20 inches tall and strong enough to hold the weight of a youth standing on top of it (optional, not in kit)
- 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
- Two small backpacks labeled as prey and predator
- Two plastic 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 participants can wear them
- Fish Dress-Up Worksheet, one per student
- One copy of the Fish Dress-Up Worksheet, Instructor Copy
- One copy of the Fish Dress-Up Characteristics sheet

Part 2: Exploring Fish Structures & Functions

- Fish Structures and Functions Sheet
  Student Copy, one per group
- Fish Structures Picture Cards, one set per group
- Fish Structures & Functions Sheet
  Instructor Copy, one copy
- Glue sticks (optional)

Part 3: Future Fish of the Year 4000

- Future Fish of the Year 4000 Sheet, one per participant
  The following is optional:
  - 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 participants
- Crayons or markers
- Scissors
- Stapler or tape
- Crumpled newspaper, for stuffing fish
- Monofilament line, for hanging fish
Vocabulary:

**Adaptation**: A physical characteristic or behavior developed by a plant or animal that makes it better suited to its environment and enables it to survive particular conditions.

**Barbels**: Sensory structures resembling whiskers that contain many nerve endings, some of which are similar to human taste buds. Barbels help fish find food through the senses of taste and touch.

**Biodiversity**: The diversity of life on the planet, which includes genetic diversity, species diversity, and habitat diversity. More specifically, it can be described as the total of all the plants, animals (including humans), fungi, and microorganisms, along with their individual variations and interactions.

**Camouflage**: Coloration and patterns that enable fish and other organisms to blend into their environments, offering protection from predators.

**Caudal fin**: Also called a tail fin, it is located at the back end of the fish and, like a motor, provides the power to propel the fish forward through the water. It also acts as a rudder to assist in steering.

**Cold-blooded/Ectothermic**: Animals, such as fish and amphibians that require the sun’s warmth for heat and have an internal body temperature that varies according to the temperature of their surroundings.

**Community or ecological biodiversity**: The variety of ecological communities or ecosystems that exist.

**Countershading**: Refers to the coloration of an animal that has a light-colored bottom and a dark top.

**Depth perception**: The ability to judge the relative distance of objects and the spatial relationship of objects at different distances.

**Disruptive Coloration**: Coloring, consisting of spots, stripes, or mottled patterns, that blur an animal’s outline and allow it to blend into the background colors and textures of its surroundings.

**Dorsal fin**: The fin located along a fish’s back between its head and tail. It may be a single fin, with or without spines, or consist of two connected or unconnected parts, a sharp-spined part and a soft-rayed part. It provides stability and allows the fish to remain upright in the water.

**Extinction**: Occurs when every member of that species dies.

**Genetic biodiversity**: The range of individual variation within a single species.

**Gill**: The respiratory organ of most aquatic animals that breathe water to obtain oxygen, consisting of a filamentous structure of vascular membranes across which dissolved gases are exchanged.
**Gill rakers:** Bony, finger-like projections which prevent food particles from passing through the gills. They are found on the gill-arch opposite the gill-filaments (red tissues that absorb dissolved oxygen from the water). They vary greatly in number and length and are important for classifying and identifying fishes.

**Habitat:** An area that meets the survival needs of many organisms by providing food, water, cover, and space.

**Ichthyologist:** A scientist who studies fish.

**Lie-in-wait predator:** Northern pike, muskellunge, gar, and other fish exhibiting a particular type of predatory behavior. Instead of cruising around and looking for prey, they lie still on the bottom, mimicking a stick or log, or remain hidden in cover. They capture their unsuspecting prey by surprise, with a sudden burst of speed.

**Mass extinction:** An event where a large number of the earth’s species cease to exist over an unusually short time frame.

**Predator:** An animal that hunts and captures other animals for food.

**Prey:** An animal consumed by a predator.

**Rays:** Fin supports; they’re almost always soft and flexible, and often branched.

**Redd:** A depression created by members of the salmon/trout family; these fish use their tails to fan away finer sediments to create a space in which females deposit and males fertilize their eggs (spawn).

**Roving predator:** Fish that spend much of their time cruising and searching for prey. Rover-predators include bass, many minnows, and trout.

**Spawn:** The process by which fish reproduce. Females release eggs, which are subsequently fertilized by milt (fluid containing sperm) from males.

**Spawning:** Active process of laying and fertilizing eggs.

**Spines:** True fin spines are derived from the soft rays; they’re unjointed and of a single structure, can be sharp and bony.

**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.
Instructor Background Information:

Fish exist in all shapes, sizes, and colors, but they do have some traits in common. All fishes are cold-blooded (ectothermic), 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.

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 27,300 fish species described by scientists and possibly 31,500 species total, most of which are saltwater, or ocean-dwelling.¹

Structure and Function

Fish have adaptations, or specific features and behaviors enabling them to survive in their aquatic habitats. With some exceptions, most fish have fins and a long, streamlined body—or a thin, narrow body—enabling them to swim easily through water. The structure, or shape, of a fish’s body and body parts is often related to their function, or how those parts work. Function also depends on structure. This relationship between structure and function exists in the natural world, but it also pertains to things people invent and construct. A beaver’s flat tail (structure) helps it steer as it swims (function), a duck’s webbed feet (structure) helps it swim (function), the streamlined shape (structure) of a submarine moves easily through water (function), and an umbrella opens to form a wide, rounded surface (structure) that sheds water and protects its user from rain (function).

Fish Adaptations

A wide variety of lakes, rivers, and streams provide a diversity of habitats for Minnesota’s many fish species. There are currently 162 fish species in Minnesota, each possessing special adaptations enabling it to survive in the conditions where it lives. For example,

¹ Ichthyology at the Florida Museum of Natural History Education: Most Commonly Asked Questions webpage. https://www.flmnh.ufl.edu/fish/education/questions/questions.html
some fishes live in deep, open water. Others prefer shallow areas near plants. Some fishes are adapted to the fast-moving currents of streams or rivers, while others are suited to still waters.

Prominent structural adaptations in fish include coloration patterns, body shapes, tail fin shapes and dorsal fin types, mouth features, eyes (large or small, and where they 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.

**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.
Dorsal Fin

A fish’s dorsal fin aids in turning, and serves to keep the fish upright (or prevent it from rolling over) in the water during sudden direction changes. The **dorsal fin** is located along the back (topside) of a fish between its head and tail. Fins consist of a membrane supported by rod-shaped structures called **rays** and **spines**. Rays are soft, flexible fin supports; spines are rays that are stiff and sharp.

Prey fish often have large fins—particularly dorsal fins. A large dorsal fin helps stabilize a short, laterally compressed body, as the fish swims through the water. Spines in the dorsal fin can be used to raise the dorsal fin high enough to make the fish appear larger and less appetizing to a predator. Sharp spines can stick in the mouths and throats of predators. Spines function as a defense against predators as well as a structural component of the fin.

![Fish with large dorsal fin]

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

Small and medium-sized fish, such as those in the sunfish and catfish families, have well-developed spines that protect them from larger predators. However, some very small fish, such as gobies and sculpins, have spines that are as soft and pliable as rays, and minnows have no spines at all. These small fish spend much of their time camouflaged and hiding in tight spaces under logs and rocks.

Predator fish may have large or small dorsal fins, some with spines and some without. The northern pike has a small dorsal fin with no spines that is located close to the caudal (tail) fin. This fin is used to help with locomotion along with stabilization. It is not used for protection like a sunfish, which indicates that this fish is a top-predator and doesn’t need protection like prey fish. The walleye has a large dorsal fin with spines located in the center of the body similar to a sunfish. This indicates that while a walleye is a predator, it is also a prey fish – most likely prey to the northern pike.
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 MNDNR MinnAqua Program Fishing: Get in the Habitat! Leader’s Guide 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.
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.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brook trout</td>
<td><em>Salvelinus fontinalis</em></td>
</tr>
<tr>
<td></td>
<td>(Latin, meaning a little salmon living in springs)</td>
</tr>
<tr>
<td>Lake chub</td>
<td><em>Couesius plumbens</em></td>
</tr>
<tr>
<td></td>
<td>(Named for the ornithologist Elliott Coues and Latin, meaning lead-colored)</td>
</tr>
<tr>
<td>Golden redhorse</td>
<td><em>Moxostoma erythrurum</em></td>
</tr>
<tr>
<td></td>
<td>(Greek, meaning mouth to suck and red-tailed)</td>
</tr>
<tr>
<td>Rock bass</td>
<td><em>Ambloplites rupestris</em></td>
</tr>
<tr>
<td></td>
<td>(Greek, meaning blunt armature and Latin, meaning living among rocks)</td>
</tr>
</tbody>
</table>

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 human 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 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.

**Extinction** occurs when 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.

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 gene 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 MNDNR MinnAqua Program *Fishing: Get in the Habitat! Leader’s Guide Lesson 4:5—Fisheries Management and You.*
Preparation


2. Copy the Fish Dress-Up Worksheet, one per student. May want to print one Instructor copy.


4. Copy the student version of Fish Structures and Functions Sheet, one per group. May want to print one Instructor copy.

5. Copy the Fish Structures Picture Cards, one per group. Recommend each set copied on a different color paper, to keep sets together.

6. Copy the Future Fish in the Year 4000 Sheet, one per student.

7. Gather materials and supplies for creating the year 4000 fish in the Part 3.

Warm-Up: Defining Structure & Function

1. Ask your participants to draw a fish in its habitat and label all of the important structures on the fish and in the habitat. If your participants are struggling you can ask them to consider what they already know about fish from fishing, eating fish, seeing them on TV or at a zoo or an aquarium, etc.

2. Ask participants to describe what a fish does, and list answer on the board.

   Possible answers: swim, hide, eat, chase prey, breathe, and reproduce

3. Tell the group you will be “dressing” two participants to look like a predator and a prey fish. These fish live in a local lake, so consider habitat conditions in your local lake. The group will help dress each fish by directing the teacher to add the structures needed to function in the aquatic environment (listed in step 2) for each fish.


1. Hand out one Fish Dress-Up Worksheet to each participant.

2. As a structure is identified by the group, ask your participants to label the structures on the fish found on the Fish Dress-Up Worksheet during the dress up.

3. Ask two volunteers to come to the front of the group to be dressed up as fish.

4. Ask the group to name one structure found on a fish.
5. Based on which structure the group named, pull out the two examples of the structure from each backpack (one is for the predator and one is for the prey).

6. For each structure, ask the participants in the group to decide how the structure makes it more or less suitable for a prey and predator fish by determining the function of the structure. Help the participants through the process of deciding on an appropriate function for each characteristic. As each body part is added, discuss its structure and function (for swimming, hiding, eating, breathing, etc.), and how it helps the predator or prey fish survive. Use the Fish Dress-Up Characteristics sheet as a guide.

7. Repeat steps 2-4 five times to identify the five structures below (also found on the Fish Dress-Up Characteristics sheet).

Fish Characteristics

A. Body Shape
   - Have the prey fish stand sideways (with one shoulder facing the group) to represent a fish that is laterally compressed.
   - Have the predator fish stand tall on a box or hold his or her hands together above his or her head to become longer (torpedo-shaped).

B. Coloration
   - Give the prey fish a camouflaged a striped shirt to wear. Ask participants what type of coloration the shirt mimics. (Camouflage for blending in and being more difficult to detect in vegetation.)
   - Give the predator fish a mottled/spotted shirt to wear. This coloration helps a predator camouflage with the bottom of a lake or stream to lie in wait for its prey, or approach prey without being noticed.

C. Fins
   - Clip the large, spiky dorsal fin to the shirt near the shoulder blades of the student who is the prey fish. The spikes or points represent sharp spines.
   - Clip the smaller, flimsier dorsal fin, to the bottom of the shirt on the student who is the predator fish.

D. 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 group. 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.

**E. 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 the student’s face—the student can hold the narrow end of the funnel up to their mouth.

8. Have the participants identify the predator and the prey fish.

9. Compare and contrast the structures of the two dressed-up fish and describe how each structure functions to help the fish survive as a predator or prey fish in a watery environment.

10. Ask the group 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.

11. With the two volunteers still in front of the group, ask the participants 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 (yes), in fast-moving water (no), in the deeper open water (no), or in areas with sandy bottoms (yes).)

12. Have the participants review the original fish drawing they made. They can add to and change their labels and the drawing as needed.

**Part 2: Exploring Fish Structures & Functions**

1. Divide your participants into pairs or groups.

2. Hand out the student copy of the Fish Structures and Functions Sheet to each pair/group of participants.
3. Have the participants match the Fish Structures Picture Cards to the definitions on each sheet. The answers will vary for some of the sheets.

4. The participants may use glue sticks to attach the pictures to the sheets (if using a paper copy, kit copy is laminated with Velcro attachments for reuse).

5. In groups of 4 or 6 have the participants share their findings and discuss any differences they may have between each group.

Part 3: Future Fish of the Year 4000 – Form & Function

We have looked at how fish function in their environment, and what structures allow for survival in current environments. 2000 years ago, earth’s environment was very different. 2000 years from now, changes will continue.

1. Tell the participants that it’s the year 4000. Ask them what changes could possibly occur in the environment over the next 2,000 years. Encourage creativity, and suggest naming both positive and negative environmental changes.

   a. What might lakes and rivers be like in Minnesota in the year 4000?
   b. What might the fish habitat and conditions be like in lakes and rivers?
   c. Consider food sources, weather, water quality, and other factors.
   d. What challenges will the fish face in the changed environment?

2. Tell participants 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 participants.

4. Have participants 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.

   a. What environmental changes do they envision?
   b. What could cause these environmental changes?
   c. What is the fish habitat like?
   d. Will current species of fish adapt to these future environmental changes or become extinct?

5. Define and discuss extinction.
6. Participants may use their imaginations to create fantastical, positive, or negative environmental changes.

7. Participants will design a new fish species that inhabits this lake, river, or stream in the year 4000. Ask participants to keep the following questions in mind as they design their fish in question 2:
   a. Where does your fish live? What is the fish habitat in the lake like? What adaptations help the fish survive the environmental conditions there?
   b. What does your fish eat? What adaptations help it obtain its food? Does anything else eat your fish?
   c. Is your fish a fast or a slow swimmer? How do you know?
   d. Is your fish a predator? How do you know?
   e. How does your fish protect itself?
   f. What other special adaptations does your fish have? Why does it need them?

8. Using the Fish Structures and Functions Sheet as a reference, have students sketch and label the mouth, body shape, coloration, fin location and build, and any other structures on the Future Fish in the Year 4000 Sheet for their newly discovered fish.

9. Optional: When they’re satisfied with their designs, make materials available so that the participants can construct models of their fish.

   Participants 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 participants to use computer graphics to design their fish. Remind them to include adaptations that help the fish to survive in its habitat.

10. After they’ve finished constructing their fish, have participants complete Question 3-5 on the Future Fish of the Year 4000 Sheet. Participants will list the new structures and behaviors exhibited by the fish that they’ve created, and describe the survival functions of each.

11. Remind participants how scientists name a newly-discovered species. Have the participants name their fish and write the name in the space on Question 2 on their 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. Have participants build a model (drawing, graphic design, or 3D) of the fish habitat of their design for year 4000 (from question 1). Ask participants to write a description of how that habitat suits the characteristics of the fish they developed.

2. 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.

3. Have participants exchange their habitat descriptions for the water body in the year 4000. 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.

Extensions:

1. After doing the dress-up activity in Part 1, demonstrate the same concepts for the group 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 participants created in Activity 2. Participants 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. Have participants design an aquatic ecosystem that includes microhabitats suitable conditions for all of the fish they created. The ecosystem could be constructed on a classroom or hallway bulletin board. Have participants each place their fish on the bulletin board in the appropriate habitat in the aquatic ecosystem.

4. 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 participants speculate on the habits and habitat of each fish by examining its coloration, fins, body shape, and mouth.

5. Investigate various Minnesota lake- and river- habitats and identify the types of fish that live in those habitats. Ask participants to discuss and explain how those fish are suited or adapted for conditions in the habitat. Have participants write a “Guide to Fishing in Minnesota: Where to Find Different Types of Fish” based on their discussion.
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!

   a. Discuss the features of the fish and how the features help the fish survive where they live.
   b. Omit the Future Fish in the Year 4000 activity and instead do the following:

      i. Make 20 copies of illustrations of six different types of fish.
      ii. Cut each fish into four parts: head, upper body and dorsal fin, lower body with pelvic and anal fins, and tail parts.
      iii. Have each student or pair of participants select one of each these fish part types. Ask the participants to create a fish from these parts by gluing them together to form a new fish on a blank sheet of paper.
      iv. 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.
      v. Provide crayons or markers for coloring the fish. The participants can draw in habitat.
      vi. 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.
      vii. Have participants write down (or dictate for an adult to write) a name for their new fish species.
      viii. 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 participants:

   a. If you could be a fish, what kind of fish would you be?
   b. Have participants, either individually or in pairs, design a fish on large sheets of white butcher paper (approximately three feet square).
   c. Pass out two sets of large paper to each student or group.
   d. Draw both sides of the fish, one side on one sheet of paper, and the other side on the second piece of paper.
   e. Color the fish.
   f. Cut out these two sides of the fish.
   g. Staple or tape the two sides together and stuff the fish with crumpled pieces of newspaper.
   h. Have participants name the fish they created.
i. Ask each student to tell the group about the features they provided for their fish and explain how the features help the fish to survive in its habitat.

j. Attach clear monofilament line to the fish and hang them from the ceiling in the classroom.

Brought to you by Great Lakes Aquarium and MN DNR MinnAqua Program, funded in part by the US Sport Fish Restoration Fund.
Fish Dress-Up Worksheet
Fish Dress-Up Characteristics Sheet

Dress up two volunteers as your group names different structures found on fish. Describe each structure and it’s function as you give them to each volunteer to dress up.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
<th>Tool/Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body shape</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laterally compressed</td>
<td>Swims through plants easily</td>
<td>Volunteer stands sideways (one shoulder facing the class)</td>
</tr>
<tr>
<td>Torpedo-shaped</td>
<td>Swims fast to chase prey, or swims easily in fast-moving water</td>
<td>Volunteer stands on box or puts hands together above their head</td>
</tr>
<tr>
<td><strong>Coloration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Striped, vertical or horizontal</td>
<td>Camouflaged; can hide in vegetation, blending in with vertical plants</td>
<td>Camouflage shirt with striped pattern</td>
</tr>
<tr>
<td>Mottled (spotty) coloration</td>
<td>Camouflaged; Blends in with sand, rocks and gravel</td>
<td>Camouflage shirt with spotted pattern</td>
</tr>
<tr>
<td><strong>Fins</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large, spiny dorsal fin</td>
<td>Fish appears larger; more stability for a short, wide body shape; sharp spines make the fish more difficult to swallow</td>
<td>Large dorsal fin that fits between student’s shoulder blades</td>
</tr>
<tr>
<td>Small rounded dorsal fin,</td>
<td>Swims faster; greater ease of movement in fast currents</td>
<td>Small rounded dorsal fin, clipped at base of student’s shirt</td>
</tr>
<tr>
<td><strong>Eyes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eyes on sides of head</td>
<td>Can see predators coming from many directions; can see all the way around (except directly behind itself)</td>
<td>Ear muffs with eyes on them</td>
</tr>
<tr>
<td>Eyes forward on front of head</td>
<td>Good depth perception helps determine distance to prey</td>
<td>Glasses frames with lenses popped out</td>
</tr>
<tr>
<td><strong>Mouth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small, possibly with elongated lower jaw</td>
<td>Feeds on prey it sees above on surface of water and on plant leaves</td>
<td>Funnel without teeth attached, placed with small end pointing outward</td>
</tr>
<tr>
<td>Large, possibly duckbill-shaped mouth with lots of teeth</td>
<td>Grasps prey that is moving/swimming</td>
<td>Funnel with teeth attached placed with large end facing outward</td>
</tr>
</tbody>
</table>

INSTRUCTOR COPY

Prey Fish

Predator Fish

Form and Function - Science Institute 2014-2015
# Fish Structures and Functions Sheets

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
<th>Minnesota Fish Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body shape</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torpedo-shaped</td>
<td>Swims fast to chase prey, or swims easily in fast-moving water</td>
<td></td>
</tr>
<tr>
<td>Flat-bottom</td>
<td>Hugs the bottom, finds food on bottom</td>
<td></td>
</tr>
<tr>
<td>Laterally compressed</td>
<td>Swims through plants easily</td>
<td></td>
</tr>
<tr>
<td><strong>Scales</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large scales</td>
<td>Provide protection or a defense strategy</td>
<td></td>
</tr>
<tr>
<td>Small scales</td>
<td>More streamlined; allows for less drag, greater maneuverability, and speed</td>
<td></td>
</tr>
<tr>
<td>No scales</td>
<td>Allows for greater maneuverability in fast-moving water; allows catfish skin to have taste buds to sense or taste food in murky water</td>
<td></td>
</tr>
</tbody>
</table>
## Fish Structures and Functions Sheets

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
<th>Minnesota Fish Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dorsal and Caudal (Tail) Fins</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large dorsal fin with sharp spines</td>
<td>Fish appears larger; more stability for a short, wide body shape; sharp spines make the fish more difficult to swallow</td>
<td></td>
</tr>
<tr>
<td>Small dorsal fin</td>
<td>Swims faster; greater ease of movement in fast currents</td>
<td></td>
</tr>
<tr>
<td>Deeply-forked tail fin</td>
<td>Produces less drag; fast swimmer</td>
<td></td>
</tr>
<tr>
<td>Rounded tail fin</td>
<td>Effective acceleration and maneuvering ability; inefficient for prolonged continuous swimming</td>
<td></td>
</tr>
</tbody>
</table>
## Fish Structures and Functions Sheets

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
<th>Minnesota Fish Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eyes forward on front of head</td>
<td>Good depth perception helps determine distance to prey</td>
<td></td>
</tr>
<tr>
<td>Eyes on sides of head</td>
<td>Can see predators coming from many directions; can see all the way around (except directly behind itself)</td>
<td></td>
</tr>
<tr>
<td>Small eyes</td>
<td>Murky, dark, deep-water fish or bottom feeder. (Doesn’t depend on sight to find food.)</td>
<td></td>
</tr>
<tr>
<td>Large eyes</td>
<td>Depends on sight to locate food. Large eyes take in more light.</td>
<td></td>
</tr>
</tbody>
</table>
# Fish Structures and Functions Sheets

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
<th>Minnesota Fish Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mouth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sucker-shaped mouth</td>
<td>Feeds on small plants and animals; sucks or “vacuums” food from the bottom</td>
<td></td>
</tr>
<tr>
<td>Ventral (located under the head)</td>
<td>Feeds at the bottom; “vacuums” or roots around for food from the bottom</td>
<td></td>
</tr>
<tr>
<td>Elongated upper jaw, no teeth</td>
<td>Funnels clouds of plankton toward mouth</td>
<td></td>
</tr>
<tr>
<td>Elongated lower jaw</td>
<td>Feeds on prey it sees above on surface</td>
<td></td>
</tr>
<tr>
<td>Duckbill-shaped mouth or extremely large mouth with strong jaws &amp; teeth</td>
<td>Help it catch/surround, hold, and eat prey</td>
<td></td>
</tr>
<tr>
<td>Barbels (whiskers)</td>
<td>Locates food on bottom; senses or tastes food in murky water</td>
<td></td>
</tr>
<tr>
<td>Structure</td>
<td>Function</td>
<td>Minnesota Fish Examples</td>
</tr>
<tr>
<td>----------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Light-colored underside</td>
<td>Camouflaged; difficult to see from below; blends in with light sky overhead</td>
<td></td>
</tr>
<tr>
<td>Dark topside</td>
<td>Camouflaged; difficult to see from above; blends in with dark lake or river bottom of lake or river underneath</td>
<td></td>
</tr>
<tr>
<td>Vertical stripes</td>
<td>Camouflaged; can hide in vegetation, blending in with vertical plants</td>
<td></td>
</tr>
<tr>
<td>Horizontal stripes</td>
<td>Camouflage breaks up outline of body against horizontal parts of underwater plants, brush piles, and fallen trees</td>
<td></td>
</tr>
<tr>
<td>Mottled coloration</td>
<td>Blends in with rocks and gravel (camouflage)</td>
<td></td>
</tr>
<tr>
<td>Fairly uniform, no bold markings</td>
<td>Swims in open water</td>
<td></td>
</tr>
</tbody>
</table>
Many minnows, yellow perch, walleye, catfish

Bluegill, black crappie, catfish, sturgeon, carp

Muskellunge, perch, smallmouth bass, sunfish

White or striped bass, largemouth bass

Brook trout, northern pike, young sturgeon, northern hog sucker

Gizzard shad, lake whitefish

Sucker, carp, shorthead redhorse

Sturgeon, sucker, carp

Paddlefish

Banded killifish

Northern pike, muskellunge, walleye, gar

Catfish, bullheads, sturgeon, carp
Fish Structures Picture Cards

Trout, Coho salmon, northern pike, muskellunge
Catfish, bullhead, sucker
Bluegill, other sunfish
Trout, northern pike, burbot
Catfish, bullheads, sculpin

Northern pike, muskellunge
Bluegill, other sunfish
Catfish, bullhead, sturgeon
Walleye, sauger, yellow perch, bass

Bass, bluegill, yellow perch
Trout, northern pike, muskellunge
Channel catfish
Yellow bullhead
Carp, sunfish, sucker
<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
<th>Minnesota Fish Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body shape</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torpedo-shaped</td>
<td>Swims fast to chase prey, or swims easily in fast-moving water</td>
<td>Trout, Coho salmon, northern pike, muskellunge</td>
</tr>
<tr>
<td>Flat-bottom</td>
<td>Hugs the bottom, finds food on bottom</td>
<td>Catfish, bullhead, sucker</td>
</tr>
<tr>
<td>Laterally compressed</td>
<td>Swims through plants easily</td>
<td>Bluegill, other sunfish</td>
</tr>
<tr>
<td><strong>Scales</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large scales</td>
<td>Provide protection or a defense strategy</td>
<td>Carp, sunfish, sucker</td>
</tr>
<tr>
<td>Small scales</td>
<td>More streamlined; allows for less drag, greater maneuverability, and speed</td>
<td>Trout, northern pike, burbot</td>
</tr>
<tr>
<td>No scales</td>
<td>Allows for greater maneuverability in fast-moving water; allows catfish skin to have taste buds to sense or taste food in murky water</td>
<td>Catfish, bullheads, sculpin</td>
</tr>
</tbody>
</table>
### Fish Structures and Functions Sheets

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
<th>Minnesota Fish Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dorsal and Caudal (Tail) Fins</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large dorsal fin with sharp spines</td>
<td>Fish appears larger; more stability for a short, wide body shape; sharp spines make the fish more difficult to swallow</td>
<td>Bass, bluegill, yellow perch</td>
</tr>
<tr>
<td>Small dorsal fin</td>
<td>Swims faster; greater ease of movement in fast currents</td>
<td>Trout, northern pike, muskellunge</td>
</tr>
<tr>
<td>Deeply-forked tail fin</td>
<td>Produces less drag; fast swimmer</td>
<td>Channel catfish</td>
</tr>
<tr>
<td>Rounded tail fin</td>
<td>Effective acceleration and maneuvering ability; inefficient for prolonged continuous swimming</td>
<td>Yellow bullhead</td>
</tr>
<tr>
<td>Structure</td>
<td>Function</td>
<td>Minnesota Fish Examples</td>
</tr>
<tr>
<td>----------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Eyes forward on front of head</td>
<td>Good depth perception helps determine distance to prey</td>
<td>Northern pike, muskellunge</td>
</tr>
<tr>
<td>Eyes on sides of head</td>
<td>Can see predators coming from many directions; can see all the way around (except directly behind itself)</td>
<td>Bluegill, other sunfish</td>
</tr>
<tr>
<td>Small eyes</td>
<td>Murky, dark, deep-water fish or bottom feeder. (Doesn’t depend on sight to find food.)</td>
<td>Catfish, bullhead, sturgeon</td>
</tr>
<tr>
<td>Large eyes</td>
<td>Depends on sight to locate food. Large eyes take in more light.</td>
<td>Walleye, sauger, yellow perch, bass</td>
</tr>
</tbody>
</table>
# Fish Structures and Functions Sheets

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
<th>Minnesota Fish Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mouth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sucker-shaped mouth</td>
<td>Feeds on small plants and animals; sucks or “vacuums” food from the bottom</td>
<td>Sucker, carp, shorthead redhorse</td>
</tr>
<tr>
<td>Ventral (located under the head)</td>
<td>Feeds at the bottom; “vacuums” or roots around for food from the bottom</td>
<td>Sturgeon, sucker, carp</td>
</tr>
<tr>
<td>Elongated upper jaw, no teeth</td>
<td>Funnels clouds of plankton toward mouth</td>
<td>Paddlefish</td>
</tr>
<tr>
<td>Elongated lower jaw</td>
<td>Feeds on prey it sees above on surface</td>
<td>Banded killifish</td>
</tr>
<tr>
<td>Duckbill-shaped mouth or extremely large mouth with strong jaws &amp; teeth</td>
<td>Help it catch/surround, hold, and eat prey</td>
<td>Northern pike, muskellunge, walleye, gar</td>
</tr>
<tr>
<td>Barbels (whiskers)</td>
<td>Locates food on bottom; senses or tastes food in murky water</td>
<td>Catfish, bullheads, sturgeon, carp</td>
</tr>
<tr>
<td>Structure</td>
<td>Function</td>
<td>Minnesota Fish Examples</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------</td>
</tr>
<tr>
<td>Light-colored underside</td>
<td>Camouflaged; difficult to see from below; blends in with light sky overhead</td>
<td>Many minnows, yellow perch, walleye, catfish</td>
</tr>
<tr>
<td>Dark topside</td>
<td>Camouflaged; difficult to see from above; blends in with dark lake or river bottom of lake or river underneath</td>
<td>Bluegill, black crappie, catfish, sturgeon, carp</td>
</tr>
<tr>
<td>Vertical stripes</td>
<td>Camouflaged; can hide in vegetation, blending in with vertical plants</td>
<td>Muskellunge, perch, smallmouth bass, sunfish</td>
</tr>
<tr>
<td>Horizontal stripes</td>
<td>Camouflage breaks up outline of body against horizontal parts of underwater plants, brush piles, and fallen trees</td>
<td>White or striped bass, largemouth bass</td>
</tr>
<tr>
<td>Mottled coloration</td>
<td>Blends in with rocks and gravel (camouflage)</td>
<td>Brook trout, northern pike, young sturgeon, northern hog sucker</td>
</tr>
<tr>
<td>Fairly uniform, no bold markings</td>
<td>Swims in open water</td>
<td>Gizzard shad, lake whitefish</td>
</tr>
</tbody>
</table>
1. Describe what you think the habitat of a nearby lake or river might be like in the year 4000.

2. Make a detailed sketch of your new fish in its habitat. **Label** important structures.

**Things to consider:**
- Temperature
- Water Viscosity (how thick or thin)
- Light Exposure
- Space
- Food
- Shelter
- Respiration
3. What food does your new fish eat? Describe which structures help it find and eat its food? How do the structures function?

__________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________

4. Is your fish a predator or a prey species? Support your position by describing the structures that help your fish function as a predator or prey.

__________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________

5. Is your fish a fast swimmer or a slow swimmer in the year 4000 environment? Describe how the structures of your fish function to help your fish be a fast or slow swimmer.

__________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________