

Form and Function

Grade Level(s): 6th – 8th
Time: 35-45 minutes
Group Size: 20-30 students
Use: In Class

NYS Learning Standards Core Curriculum MST

Living Environment: Standard 4

Students will: understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

- *Key Idea 1:* Living things are both similar to and different from each other and nonliving things.
- *Key Idea 3:* Individual organisms and species change over time.

Summary

Students will be introduced to a few freshwater or saltwater fish species of New York State. They will learn a variety of fish body parts and their functions; and that fish, as well as other animals, can adapt or change over time to better survive in their environment.

Objectives

The lesson objectives are to introduce students to the adaptations of several local fish species, and for them to be able to discuss and describe the external anatomy of a fish and the function of specific anatomical features.

After this presentation, students will be able to:

- Identify 1-3 fish that inhabit saltwater and freshwater.
- Describe 3-5 external anatomical features of a fish.
- Explain how adaptations help fish survive.
- Compare and contrast adaptations of different fish species.

Materials

- Fish Anatomy reference sheet
- Fish Parts reference sheet
- Survival of the Fish worksheet
- Fish models/pictures

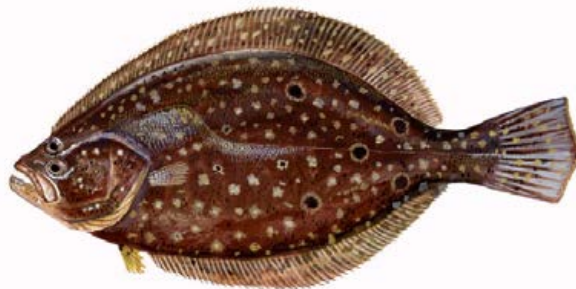


Illustration by Duane Raver

Vocabulary

- **External Anatomy** - The outside body parts.
- **Caudal/Tail Fin** - Fin on end of fish; used to propel the fish.
- **Dorsal Fin** – Backside (top) fin on a fish; used for balance and protection.
- **Pectoral Fin** – Side (“chest”) fins on a fish; used for balance and steering.
- **Anal Fin** - Last bottom fin on a fish located near the anal opening; used for balancing and steering.
- **Pelvic Fin** – Paired bottom or belly fins on a fish; used in balance and steering.
- **Gills** - Organ a fish uses to obtain oxygen from the water.
- **Operculum** - Flexible bony plate that covers the gills.
- **Lateral Line** - Organ a fish uses to “feel” low vibrations; tiny microscopic pores.
- **Nares** - Organ a fish uses to smell; similar to nostrils but not used for breathing.
- **Scales** - Protective cover on a fish; similar to skin.
- **Slime** - Covers scales; layer protects from bacteria, parasites, etc.
- **Vertebrate** - Organism with a backbone.
- **Superior Mouth** - A mouth that opens upward (usually surface feeders).
- **Inferior Mouth** - A mouth that opens downward (usually bottom feeders).
- **Terminal Mouth** - A mouth located at anterior end of fish’s body (mid water feeder).
- **Camouflage** – The ability to blend in with the background or habitat.
- **Adaptation** - The adjustment or change in behavior or body to become better suited for survival in a particular environment.

Vocabulary words will show up once in **bold**

Background

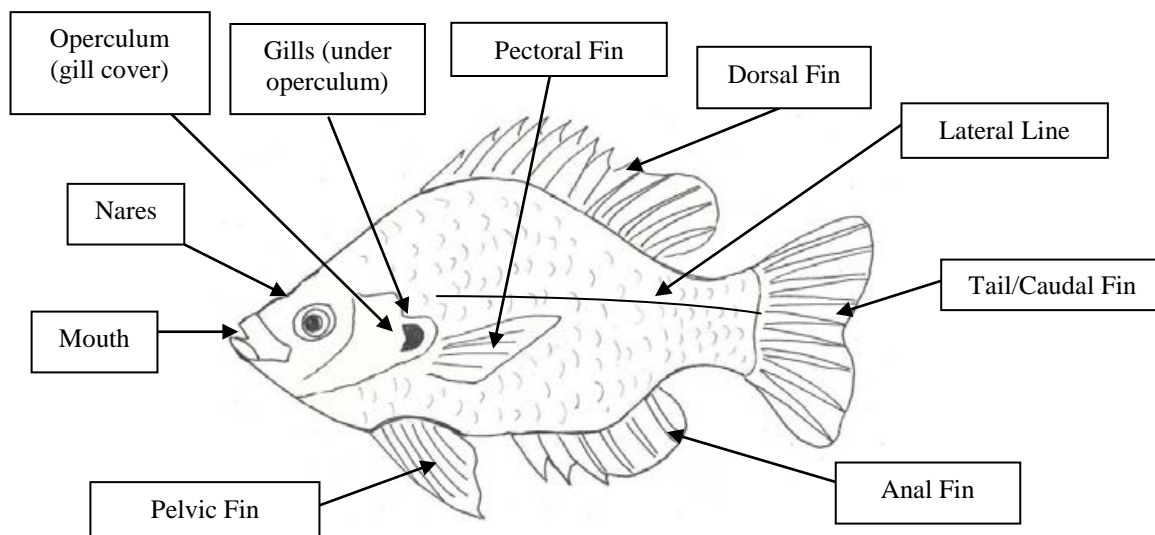
Over time, animals have adapted or changed in order to better survive in their environment. Although different fish species have different appearances, the function of their outside body parts (external anatomical features) is similar. Also, the outside body parts of fish can tell us a lot about a species: where it lives in the water, how it finds food, and how it protects itself from predators.

External Anatomy

Common external anatomical features of fish include: dorsal fin, anal fin, caudal fin, pectoral fins, ventral fins, gills, lateral line, nares, mouth, scales, and body shape.

Fins

All fish have external appendages called fins. Like human limbs, fins provide fish with the ability to balance, steer, propel, and protect itself. Fins are either single, along the centerline of the fish such as the dorsal fin, anal fin, and tail fin; or paired, like the pectoral fins and pelvic fins. The **pectoral fins** also help fish balance, and at times move backwards. The top fin or **dorsal fin** is used for balancing but its main function is usually protection, having sharp spines within the fin. The **pelvic fins** and **anal fin** are located on the bottom or belly of fish and help with steering as well as balance. The tail fin, also called the **caudal fin**, helps propel a fish forward. In some “torpedo-shaped” fish like the pike, the anal and dorsal fins are further back toward the caudal fin, therefore aiding in bursts of speed for fast swimming predators!. Fish like tuna have more “forked-shaped” tails, aiding these fish to be more endurance and long-distance swimmers.



Gills

Located on either side of the “head” area, **gills** remove oxygen taken from the water. A fish “breathes” by opening its mouth to take in water. The water is then forced through the gill chambers, over feather-like gill filaments that absorb oxygen from the water and remove carbon dioxide from the fish’s blood. The water then flows out through the gill slits. Some fish have spines located on the **operculum** (harder protective covering of the gill) as a defense mechanism to protect them from predators.

Lateral Line

Running down the length of a fish’s body is the **lateral line**. This organ is used to feel vibrations in the water. The lateral line is made up of a series of microscopic holes located just under the scales of a fish.

Nares

All fish can smell. Located on a fish’s snout are paired holes, or **nares**, used for detecting odors in the water. Some fish, like catfish and eels, have a heightened sense of smell. The nares are made up of many capsules, each containing numerous chemical receptors. Water flows through the nares as the fish swims or while they are facing into a current. Behind the nares, in a

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chamber, are sensors (chemical receptors) that detect chemicals that are dissolved in the water. Once an odor is detected, the nerves send signals to the fish's brain that interpret the smells. These smells might attract the fish or keep it at bay depending on whether the fish interprets the smell to represent food or danger.

Eyes

Almost all fish have eyes that have an adjustable lens that moves back and forth to focus, sort of like a camera lens would function. Fish usually have one eye on each side of the head to help them focus and zero in on prey. Eyes can warn when a predator is near, or can detect the slightest movement of small prey. Some fish can even see in color. Studies have found that Pacific salmon and rainbow trout have color vision that is similar to a human's.

Scales and Slime

Most fish have scales covering the length of their body. **Scales** protect fish from injury, much like skin on the human body. The colors, shapes, and patterns of scales can help a fish **camouflage** with its surroundings. On top of these scales is a mucus coating known as slime. **Slime** protects fish from bacteria and parasites in the water. Anglers should be careful not to remove the slime layer when handling a fish. Using bare, wet hands is the best way to handle fish.

Body Shape

A fish's body shape can tell you a lot about its behavior. So can the shape and size of certain external features. For example, the body shape can indicate where that fish lives in the water column, and what type of swimmer it is. A "torpedo" shaped body can indicate a faster swimmer or a rounder shaped body most likely is a slower swimmer. And flatfishes, like flounder, live on the sea bottom.



Tail Shape

A fish's tail shape can tell you about its swimming abilities. For example, a deeply forked tail usually indicates a fast swimmer like a tuna or bluefish, whereas a more rounded tail means the fish is good at turning like a trout or sunfish.

Mouth

The mouth parts of a fish will vary in size and may or may not contain teeth, depending on what that fish eats. The flounder's large, sharp teeth grasp prey as the flounder lunges out for food. A largemouth bass on the other hand, has teeth more like sandpaper. It gulps its prey whole, so sharp teeth are not necessary. The location of the mouth on a fish's body can also give us a clue as to what may be the fish's diet. A **superior mouth**, a mouth pointing upward, means the fish will usually eat food located above it. A fish with an **inferior mouth**, a mouth pointing downward, will usually eat food located below it.; A **terminal mouth**, a mouth typical of most fish, is at the end of the head and usually indicates a mid-water column feeder.

Form, Function, and Adaptations

Although fish species can look very different from one another due to various adaptations, their body parts serve similar functions. Here are a few examples:

Flounder

Flounder are a group of flat-lying saltwater fish that live on the sea floor near the coast. When hatched though, flounder look like most other fish, swimming upright in a vertical position. Around 3 weeks to 3 months into its life, one eye begins to move over toward the other side of its head! This amazing adaptation allows adult flounder to lie flat on the bottom so it can wait unseen for their prey to swim by. Flounder also have many sharp teeth which allow it to snatch smaller fish that swim above it. Although this group of flatfish looks different than most “vertical swimming” fish, the fins still have the same functions.



Illustration by Duane Raver

Largemouth Bass

Largemouth bass live near the bottom of freshwater lakes, ponds, and streams. Their greenish brown coloring blends well with the surrounding aquatic vegetation and tree stumps. This camouflage protects them from predators. When swimming through the water, their white bellies also help to camouflage them with the sky above. The teeth of a largemouth bass are brush-like with a texture of sandpaper. Their teeth are suited for gripping, not tearing, and to swallow prey whole. Adult largemouth bass can easily consume smaller fish, frogs, and even baby ducks in one big gulp! Although the mouth parts of largemouth bass are different than many other freshwater predators, they serve the same function, to consume food.



Illustration by Duane Raver

Sea Robin

Having several adaptations to protect against predators, the sea robin is an interesting looking fish. They are a bottom dwelling fish with very large pectoral fins. These large pectoral fins make the sea robin look much larger to passing predators. As an additional defense against predators, sea robins have a very sharp dorsal fin and spines on its gill covers. Sea robins can also make a barking or croaking sound that scare off predators. No kidding! Although the sea robin physically looks different than most other species, its fins still help to balance its body, steer through the water, and protect it against predators. Because of its odd external characteristics, many humans consider the sea robin to be a trash fish, not suitable to eat, yet in fact it is fine for human consumption.



Illustration by Nim Lee

Relationship to Fishing

Knowing what a fish eats, where it lives, and how it defends itself can help us to target a species when fishing. Depending on where a fish lives in the water changes how and where anglers fish for that species. For example, black sea bass prefer to live in and around structures, such as underwater rocks, dock pilings, reefs, or shipwrecks. Anglers targeting black sea bass will fish around these structures, and often go offshore to find large reefs or wrecks. Catfish have a heightened sense of smell and lack good vision. By knowing what the catfish eats, anglers can better target them by using baits with a strong odor.



Main Activity

Introduction

1. The instructor will begin the program by introducing themselves.
2. Introduce today's lesson and activity(s). Describe to the students that they will be learning about:
 - a. Local fish species and identification
 - b. External anatomy of some local fish
 - c. Adaptations of certain fish species
 - d. Creating their own species of fish in an activity

Local Fish Species & External Anatomical Features

1. State that fish may look different from one another but their external anatomical features serve similar functions.
2. Using the lesson's Vocabulary Words, describe and discuss external anatomical features of several local fish species using fish mounts or laminated photos.
3. Discuss differences on the mouth shape, body shape, and tail shape of each fish.
4. Tell the students that understanding the external anatomical features of certain species will help with using certain fishing techniques, i.e. bottom dwellers, fast swimmers, etc.
5. Go over safety rules for handling fish, and important information (described below):
 - Slime layer = protection. To handle fish, use wet hands, no rag or shirt.
 - Dorsal fin with spines = protection. Slide hand over dorsal fin to flatten spines.
 - Gills = breathing. Do not hold by the gills, as damage may occur.
 - Teeth = eating/protection. Do not hold by the mouth, sharp teeth can injure.
 - Body shape = where it lives. Indicates where to fish (water bottom, middle, top).
 - What fish eats = what to use as bait.

Adaptation

1. Introduce the word “**adaptation**”. Describe that organisms adapt or change in order to better survive in an environment.
2. Adaptations can be acquired over dozens to thousands of years. Ask students to use this concept of adapting in relation to organisms. Can they name a few animals (or plants) that have “adapted” to its environment or habitat?
3. State that by simply knowing the adaptations or external anatomical features of a fish, it can help us to determine “how” and “where” to fish for them.
4. Give a few examples of certain species and ask the students where they would fish in order to catch them.

Examples:

Flounder - lives on bottom, so use sinkers to get bait down to bottom

Bluefish - lives in top-middle of the water column, so use bobber to keep bait afloat

Largemouth Bass - camouflaged to live in weeds, so use a “weedless-rigged” bait

Wrap Up

Review

Have students name and/or describe:

- 1-3 fish specific to varying local environments
- 3-5 external anatomical features of a fish
- How the body form of a fish influences its function
- Adaptations of different fish species & how they benefit and promote survival of the that fish species

Questions for Discussion

Q: Can you name three species of fish we discussed?

A: Flounder, bluefish, largemouth bass, pumpkinseed sunfish, etc.

Q: What unique adaptation do flounder (fluke) have that allows them to lie flat on the ocean floor?

A: Both eyes on one side of its head.

Q: Where do sea robins live in the water column (top, middle, or bottom)?

A: Bottom.

Q: What does a bluefish eat?

A: Smaller fish such as, herring, anchovies, shrimp, croakers, krill, crabs, squid, and marine worms.

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Q: If a fish has a forked tail, is it a fast or slow swimmer?

A: Fast.

Q: Why do some fish have a spiny dorsal fin?

A: For protection from predators.

Q: What are the large pectoral fins of a sea robin used for?

A: Protection – when pectoral fins are spread out, they look much bigger.

Q: If a fish has an inferior mouth, where does it get its food?

A: On the bottom (ocean, bay, river etc).

Q: What type of habitat does a largemouth bass prefer?

A: Weedy or log filled ponds and streams, to camouflage in weeds or shadows.

Q: What does a bluegill sunfish eat?

A: Tiny fish, fish eggs, aquatic insects, small worms, and crayfish.

Worksheet Activity (see Worksheet at end of Lesson)

Students will be told to use the information they just learned, along with the information on the worksheet *Survival of the Fish* and the *Fish Body Parts* reference sheet (that will be handed out) to create their own fish to best survive their new chosen environment. After handing out the worksheets, the instructor can read the directions aloud or have the students volunteer to read. After reading, the instructor will point out the boxed space on page 2 of the worksheet for drawing their own fish. Students will be given 10-12 minutes to complete the whole worksheet.

Students will be told to use a mouth shape, a body shape, and a tail shape from the *Fish Body Parts* reference sheet. Students can be creative with the other fin shapes and defense mechanisms of their fish if they choose. During this time the instructor can walk around to help guide the students in their fish creation.

Helpful tips: Start with answering the questions under “Task” before drawing their fish.

Remember:

1. First select an environment – Ice Age or Meltdown, then...
2. Decide what your fish will eat (influences mouth type it will have)
3. Decide where your fish will live (influences body type it will have)
4. Decide how your fish will move (influences tail-fin type it will have)
5. Decide how your fish will protect itself (e.g. camouflage, speed, shape, size, etc.)
6. Also have them answer the boxes on page 2 which will help to give their fish form.

If time allows, after students have created their fish, the instructor may have a few students share their creations and tell why their fish has certain adaptations.

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Related Materials

“Fish anatomy”

http://en.wikipedia.org/wiki/Fish_anatomy - semi-detailed description of external anatomy and internal systems, with diagrams and references.

Web Resources

NYS DEC’s Freshwater Fish site provides information on a variety of species, with over ten series on fish including: true bass, common minnows, common prey fish, sunfish, and trout.

“Marine Fish,” NYS Department of Environmental Conservation, 2012. 25 October 2012.
<http://www.dec.ny.gov/animals/69149.html> - description of "diadramous" fish that use both saltwater and freshwater habitats during their life cycle. Springboard to several fish species.

“Freshwater Fish,” NYS Department of Environmental Conservation. 2012. 25 October 2012.
<http://www.dec.ny.gov/animals/269.html> - springboard to three websites on New York’s freshwater fish, with detailed information on a dozen species; a fish atlas of habitat and range; and a photo gallery.

“Fisheries Biology and Management” Maryland Department of Natural Resources (MDNR). 10 October 2008
<http://www.dnr.state.md.us/education/envirothon/FISH%20ANATOMY.pdf> – descriptions of fish anatomy, organ functions, how fish swim, and otoliths.

“Do Fish See in Color?” Ask a Scientist. Cornell Center for Materials Research. 5 December 2001. 18 February 2009
<http://www.ccmr.cornell.edu/education/ask/index.html?qid=295> – Response from a scientist regarding fish vision; a question & answer site.

“Fish Anatomy.” Florida Fish and Wildlife Conservation Commission. 25 October 2012.
<http://myfwc.com/fishing/freshwater/fishing-tips/anatomy/> - description of external and internal anatomy, organ and body part functions.

Worksheet

SURVIVAL OF THE FISH

Background

The Earth has gone through some changes. It is your job to adapt a fish to live and survive in a new environment.

Task

Pick 1 of the environments below. To help your fish adapt, you need to consider the following:

- **what** your fish is going to eat
- **where** it is going to live
- **how** it is going to defend itself
- **how** it is going to move about in its new environment

Environments

Please select 1 of the following

ICE AGE

The Earth has just emerged from an Ice Age and it is dark and cold. The ocean floor is very mountainous. Because of the cold, dark conditions, only a few plants grow in the shallow water. Other marine animals on this planet include swimming crabs, large nocturnal sharks, giant squids, small dark colored fish, and a variety of aquatic insects. Polar bears have survived and enjoy eating the small dark colored fish.

MELTDOWN

The Earth has just emerged from a Meltdown. The climate is tropical, wet and hot. Most of the ocean is covered by large kelp forests. Spiny algae grows thickly on the ocean floor. The spines of this plant are poisonous, and any animal which touches it is sure to die. Marine animals include sea snakes, three varieties of jellyfish, silver-bluefish, bottom clams, crabs that hide in the kelp forests, and dolphins. The tropical birds have survived and live on a diet of silver-blue fish and sea snakes.

Environment Chosen: _____

Completion

You will have about 10-12 minutes to complete your task.

Think about what your fish needs to do to survive in the environment you chose!

What adaptations will your fish undergo to survive in its new environment?

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SURVIVAL OF THE FISH

.....

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Pick 1 of the environments below. To help your fish adapt, you need to consider **what** your fish is going to eat, **where** it is going to live, **how** it is going to defend itself and **how** it is going to move about in its new environment.

Environments:

Please select 1 of the following:

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Completion:

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Earth Chosen:

What adaptations will your fish undergo to survive in its new environment?

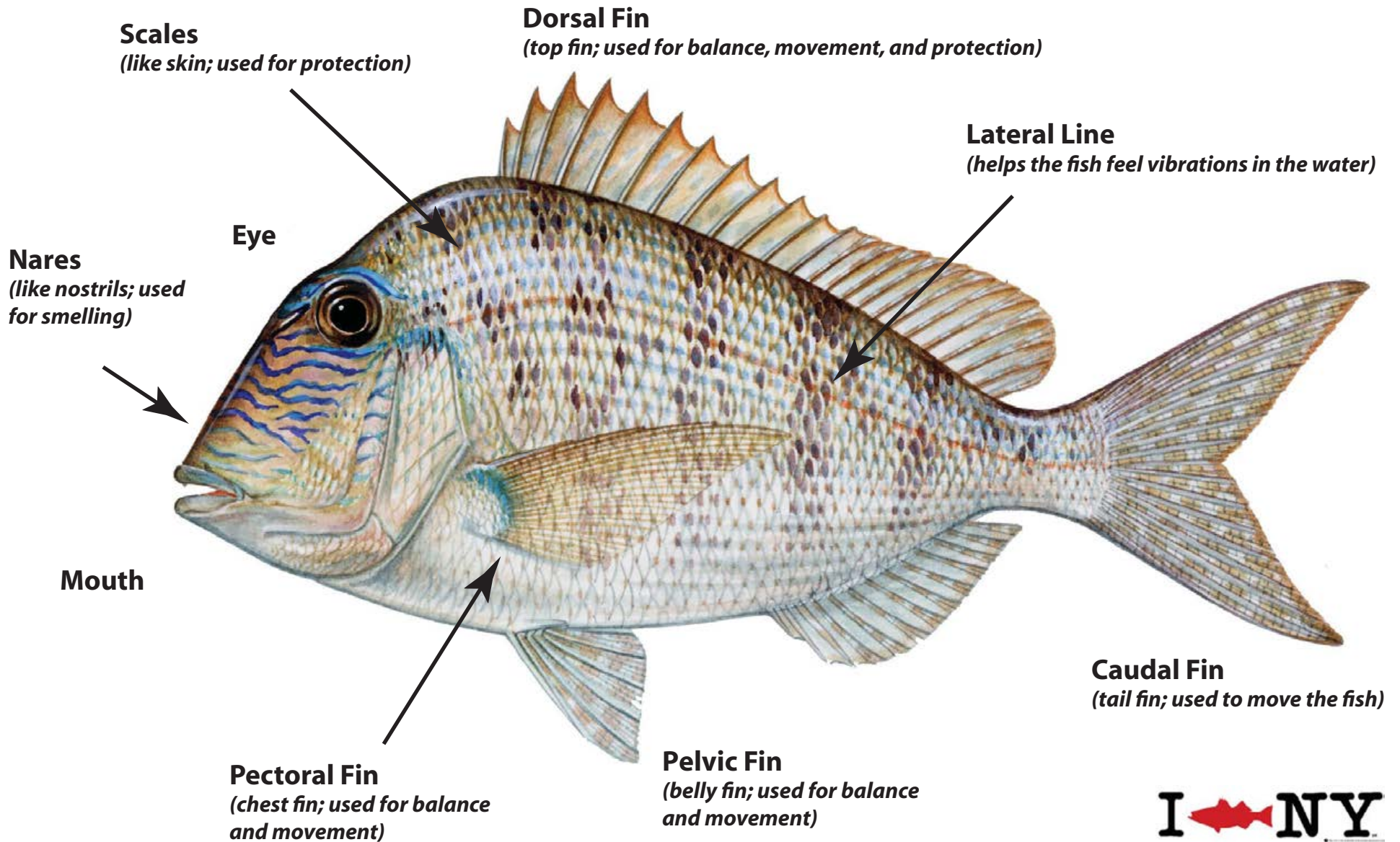
Based on the Earth you chose, **describe** how your fish will adapt its:

Body shape:	Eyes (number, vision type, etc.):
Fins (number, shape, function, etc.): <i>Dorsal-</i> <i>Ventral-</i> <i>Pectoral-</i> <i>Caudal/tail-</i>	Predator/prey relationship: <i>Predators:</i> <i>Prey:</i>
Habitat (top, middle, bottom of water):	Defense mechanisms:
Mouth (shape, teeth present, etc.):	Color:

How does your fish look after its new adaptations?

Based on the adaptations you chose, **create** your fish:

External Anatomy of a Bony Fish

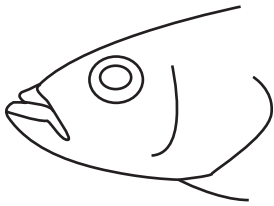


Examples: Body Part Shapes of Fish

Artwork by Nim Lee and Sarah Bruner

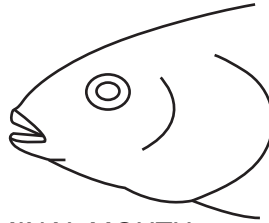


MOUTH SHAPES



SUPERIOR MOUTH

- Eats food above it
- May eat at the water's surface



TERMINAL MOUTH

- Eats food in front of it



INFERIOR MOUTH

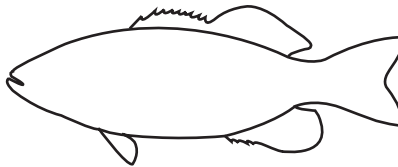
- Eats food below it
- May eat off of the bottom

BODY SHAPES



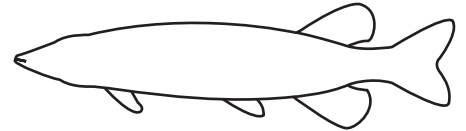
OVATE BODY

- Slow swimmer
- Difficult for predators to swallow



FUSIFORM BODY

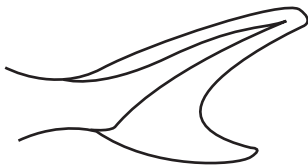
- High speed swimmers



ELONGATE

- Hides in rocks and weeds

CAUDAL / TAIL FIN SHAPES



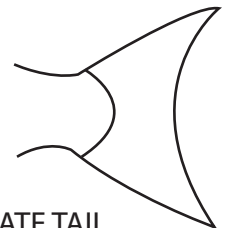
HETEROCERCAL TAIL

- Fast swimmer
- Constantly moving



FORKED TAIL

- Fast swimmer



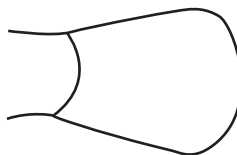
LUNATE TAIL

- Long distance swimmer



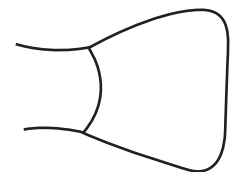
POINTED TAIL

- Slow swimmer
- Bottom wriggler



ROUNDED TAIL

- Good at turning
- Fast for short distances



TRUNCATE TAIL

- Good at turning
- Slower swimmer

EXTERNAL ANATOMY WORD FIND

Find and circle the body parts of fish.

Dorsal fin is the top or backside fin used for balance and protection.

Anal fin is the last bottom fin used in balancing and steering.

Caudal fin is another name for the tail fin used for moving forward.

Pectoral fins are located on the chest.

Ventral fins are the bottom or belly fins used for balancing and steering.

Gills are used to obtain oxygen from water.

Lateral line runs along the body and feels vibrations.

Nares are used for smelling, but not breathing.

Scales cover the entire body and protect fish.

Slime layer is slippery and protects fish from bacteria and parasites.



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