Lesson 2. Fish Shape

Lesson Objectives:

- Students will understand that the size and shape of a fish tells many things: what it eats, where it lives, and how it swims
- Students will learn about scales, coloration and camouflage

Vocabulary words: fusiform, ventral, lateral, pectoral fin, pelvic and many more concerning particular body parts.

What is the General Anatomy of a Fish?

Fish are somewhat torpedo-shaped. Having a shape like this makes it easier to glide through the water. This is called a **fusiform** body shape. The body is compressed at the sides and tapers more at the tail than at the head. Each fish has a set of vertebrae and segmented muscles that repeat from head to tail. This group of bones and muscles help the fish to propel itself from side to side as it swims through the water.

A fish has a number of **fins**. A fin is a membrane supported by rays or spines that function in swimming or orientation in the water. One or more dorsal fins may be located along the center of the back. A caudal fin lies at the end of the tail and is the primary organ for generating thrust to move through the water. One or more anal fins are situated on the **ventral** midline near the caudal fin. There are two pairs of **lateral** fins on fish. The first lateral fin is the **pectoral fin**. It is usually found on the body behind the gills. The second lateral fin, the **pelvic fins**, are found on the belly behind the head, and before the **anal fins**.

There is great diversity in the size, shape and details of fishes. Some fish are stringlike, like the eel, or globe-shaped like the puffer or greatly flattened, like the flounder. Some fish lack eyes, and others lack some of the features by which fish are recognized, including gills, fins, and scales. Their appearance is greatly influenced by their environment.

Diagram 2-1. To the right is a Sargassum fish that lives in Sargassum and resembles its surroundings.

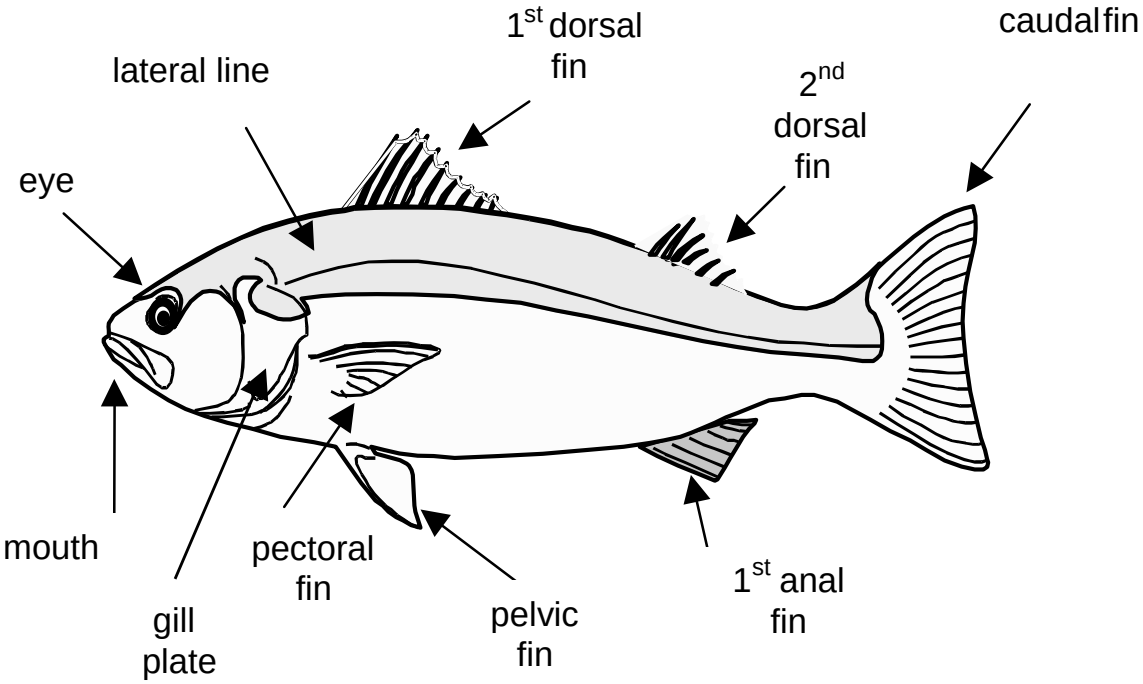


Diagram 2-2. Fin Location

Scales and Skin

Fish need scales to protect their bodies. The bodies of most fish are covered with overlapping rows of scales. In a number of species, the scales have developed into bony plates. In some species, such as the eel, the scales are minute. In others, such as the catfish, they are almost absent. Fishes are sometimes classified according to the shape and characteristics of their scales. In the following chart, scale type, shapes and characteristics are listed.

A thin layer of skin, the **epidermis**, covers the scales. This layer contains the pigment cells that give the fish its color and cells that secrete a slippery mucous layer that covers the entire body. This mucous layer protects the fish from harmful bacteria and toxins that may be present in it's watery habitat. Mucous also helps to protect fish when humans handle them!

Diagram 2-3. Scales and Characteristics.

Scale	Shape	Characteristic	Example	Illustration
ganoid	rhombic	covered with enamel-like layer	gar	
cycloid	almost circular	smooth edges	salmon	
ctenoid	round	serrate or combed edges	perch	
placoid	torpedo-like, pointed ends	sharp, tooth-like	blue shark	

How Does Your Fish Swim?

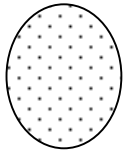
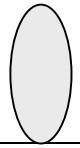
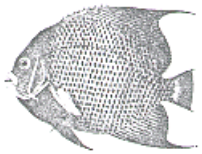
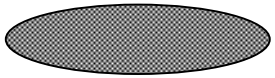
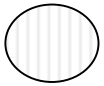
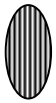
Muscles

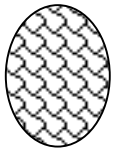
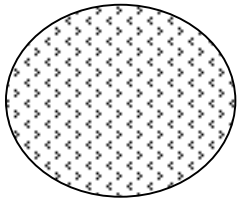
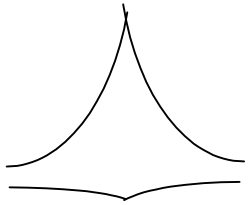
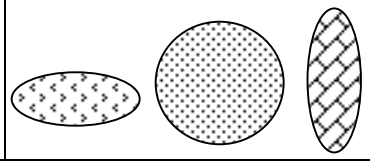
The main muscles in the body of a fish are arranged along the sides of the trunk and the tail. The larger muscles run along the back at either side of the spinal cord, and the smaller ones are located below it. Each muscle group is composed of a series of interlocking segments. In ordinary swimming, the muscles alternate contraction from either side. This contraction moves from the front of the fish to the back. This gives the **caudal fin** a wavelike motion. A few types of fishes, such as the eel, swim by a slithering, **serpentine** (snake-like) motion of their bodies. Certain others, among them the trunkfish, propel themselves by the action of their fins without great body motion.

Body Form

The body form of a fish can give a quick assessment of the fish's way of life. In the diagram on the following pages, the different body shapes, and forms are described. Different shapes allow some fish to be fast or slow, bottom dwellers or live in the **pelagic zone**, and others to survive the extremes of the ocean.

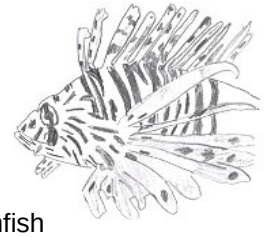
See the following chart for an illustration of the different body forms.

	CROSS-SECTION BODY SHAPE	TYPE	EXAMPLE	FISH	CHARACTERISTICS
A		fusiform		Tuna Jack- Crevelle Salmon	Fast swimming, ultra-streamlined, open water fishes
B		compressed		Angelfish Filefish	Not constantly moving, require bursts of speed, large eyes
C		depressed		Skates, Rays Angel Shark Flounder	Flight-like swimming, may live near or on the bottom.
D		leptocephalii		larval eels, plankton	weak swimmer, ribbon-like, continuous body
E		eel-like (anguilliform)		American Eel	Adults live in fresh-water, spawn at sea, lack pelvic fins, scaleless
F		thread-like (filiform)		Snipe Eel	Long, thin body, moves like a wavy ribbon
G		ribbon-like (taeniform)		Pricklebacks Gunnels	small, elongate, brightly colored, dorsal fin composed of spines

H		arrow-like (sagittiform)		Pikes Gars Needlefish	Arrow-like body shape, elongated fragile beak, surface dwellers
I		combination of shapes (globiform)		Lumpsuckers Frogfish	smooth or warty skin, tadpole shaped body, deep water dwellers, pelvic fins united to form sucker
J		combination of shapes		Boxfish Cowfish Puffers	Body covered with bony armor, small mouth, slow-moving, live in seagrasses and coral reefs
K		combination of shapes		Sea Horse Sea Moth	coiled tail, head bent downward, "armor plating", mouth is trap-doorlike
L		combination of shapes		Bullhead	depressed head, very round body, compressed tail

Why do Fish have Different Colors?

Fishes are among the world's most colorful inhabitants. When fishes are viewed in their normal habitat, color is quite functional in camouflage, disguise, warning to would-be predators and concealment. A disruptive coloration in a fish may cause it to look conspicuous out of its natural environment. The coloration or patterns of fish may reveal information about where it lives. The many patterns, colors, spots, stripes, patches and blotches may seem random or bewildering. Certain patterns of stripes, bars, **ocelli**, and other markings tend to break up the outline of the individual or make it look less prominent. Bright and bold colors often accompany dangerous venom, or bad taste. For example, the Lionfish is very showy, and beautiful. Their beauty matches their venom. They are very dangerous.


Lionfish

Markings

Many fish react to the color of their environment by altering their own hues to match it. Some fish can change their colors when startled, at rest, or to match their surroundings. Others can change stripes to spots for protection. Color changes in a fish may also

happen as a fish ages or grows. Some fish have flaps or irregular outlines, while others have patterns and skin **appendages** that resemble the local vegetation.

A common method of concealment is **countershading**. This is when the coloration is lighter on the belly than on the back. Many species have black, bluish or green backs and silvery bellies. The fish appears one color when seen from below because of how the light is bounced off it.

Activity 2-1. Interview with a Fish

Objective: Students will generalize that fish have a variety of sizes, colors and forms. Students will also grasp that fish characteristics are relative to their environment.

Method: Students will work with each other using interviewing techniques. The students will utilize research and writing methods to develop the history and lifestyle of fish.

Background: The ocean is a vast realm of knowledge and diversity. When people think of the ocean, they think of huge whales, playful dolphins, schools of fish, and beautiful coral reefs. Often, people fail to realize how different each organism really is.

The main purpose of this activity is for students to establish an understanding of fish adaptations and the purposes for the differences in each. Stress to the students that they should try to see the world through the animals' eyes, not give them human characteristics

Procedure:

1. OPTIONAL EXPERIENCE: Invite a local newspaper reporter to talk with your students. Ask him or her to describe what a reporter does, and especially to talk about the techniques of interviewing and writing used.
2. Have the students brainstorm, research, or search on the internet for lists and descriptions of different fish species from different aquatic and marine locations.
3. Work with the students to establish a research, interview and reporting format for their use as reporters. Follow the example below:

   Research
   Each team of students should:
   - Decide which fish to interview
   - Write a list of questions to ask
   - Use reference materials to take notes for appropriate responses

Interview:

- Each team of reporters has now selected an animal.
- The team will first need to gather information about the animal through observation and consulting resource materials.
- One student asks questions while the other student assumes the role of the fish and responds to the questions.
- Questions might include
  - Fin shape
  - Size and length
  - Mouth location and appearance
  - Coloration and appearance
- Have the students change roles.

Use care: Remind the students not to project human attributes to the animal. Stress to the students that they should try to see the world through the eyes of the fish.

Final Report: Each team of students should use its notes and information that they have gathered as the background for writing up the interview with the chosen fish. The write up should be in the form of an informative newspaper article. The article should talk about the fish differs from other fish, its adaptations, its appearance, what it eats and where it lives. The article should convey that the students understand why fish are found in varieties of shapes, sizes and forms.

Variation: Instead of a newspaper article, have the students present the information in front of the other students. This will emphasize public-speaking skills. Or, collaborate all the articles into an environmental mini-newspaper for everyone to read and keep.

Teacher Evaluation of the project: If the articles are read aloud to the other students, or presented to the class in a public speaking forum, initiate discussion with some of the following words that might describe each fish: invertebrate, vertebrate, cartilage, omnivore, herbivore, carnivore, demersal, bioluminescence, colorful, dull, counter-shaded, spotted, lateral line, etc.

Activity 2-2. Animal Poetry

Objective: Individual students or groups of students will recognize that people other than scientists are interested in wildlife, experience the inspirational value—and successfully write a poem. Hopefully, they will understand how people such as artists, writers and photographers also study wildlife for use in their careers.

Method: Students will work alone or in small groups to imagine seeing the ocean through a fish's eyes, and then write poems about their experiences and visions. This activity is designed for every student--or group of students--to create a poem.

Background: Poetry is available for every person to use, write and read. It is a form of expression, using organized words. There are many kinds of poetry. Song and free verse are two kinds, while another is meter and rhyme.

Procedure:

1. Have students envision that they are snorkeling on a coral reef, or in a submersible diving in the depths of the ocean. Ask everyone to pick a fish and think about it for a few minutes. The students should imagine they are the fish living in the marine environment. Begin their thoughts with words such as beauty, water, coral, dark, cold, fins, tails, gills, sunlight, and plants.
2. The students can be guided with a few words such as, "Imagine how long it lives, how does the coral reef look through their eyes, what does its food taste like, what is their favorite thing to do."
3. Have the students write a poem. Remember that the poems are an expression and do not have to rhyme. Some poem types are listed below.
4. VARIATION: Instead of individual poems, do a group poem. Each student contributes one word, and classroom discussion revolves around each student's experience in becoming a fish.

Here are a few examples of poetic forms that might be used.

Haiku. Haiku, originated by the Japanese, has an emphasis on the number of syllables. It consists of three lines, with five, seven and five syllables each. See the following example:

	Syllables
Fish lazily swim	5
In an underwater world.	7
What would one see there?	5

Cinquain. Cinquain is based on syllables-or may be based on number of words-but there are five lines. Each line has a specific purpose and number of syllables or words. These are: 1) the title in two syllables (or words) 2); a description of the title in four syllables (or words); 3) a description of action in six syllables (or words); 4) a description of a feeling in eight syllables (or words); and 5) another word for the title in two syllables (or words). Here are two examples, the first using syllables and the second using words.

Example 1.

Panther

Vital, quiet
Moving swiftly to live
Endangered by human patterns
Near lost

Example 2.

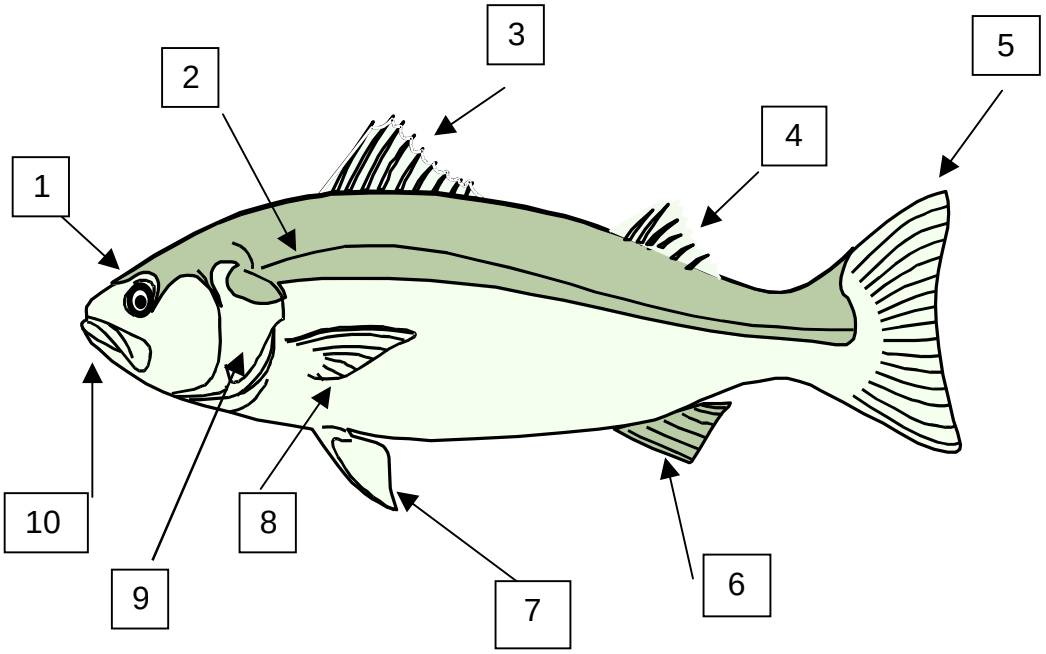
Sea Otter

Mammal of living waters
Swimming, sleeping, eating, diving, basking, playing.
Sensitive indicator of the quality of continuing life
Still here

Additional Variation:
The completed poems may be typed and framed, or displayed with a picture of the fish that it is about, or an ink drawing. Additionally, any of the poems created can be written in the shape of a fish. Put the words in the shape of a fish outline.

Activity 2-3. Label the General Anatomy of the Fish.

Method: The following fish has been labeled with numbers. The structures of the fish are discussed in the General Anatomy section of Unit 3. All answers can be found there. Fill in the spaces below that match the number where the arrow is pointing.

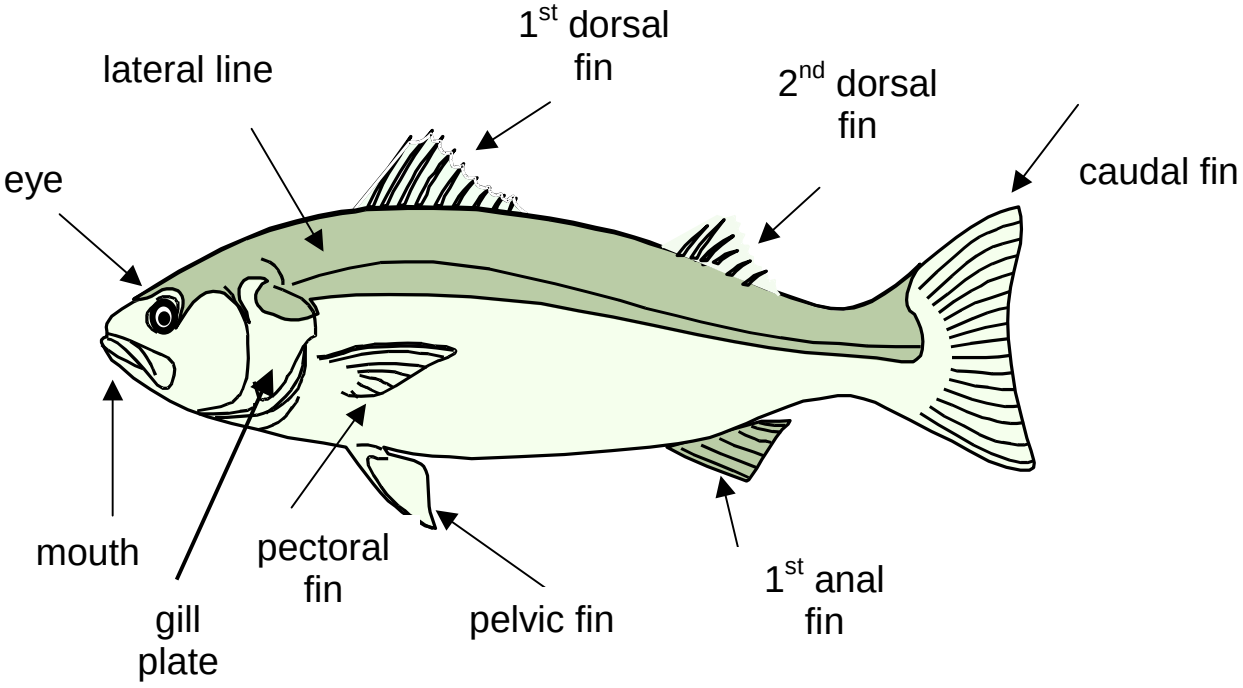


1. _____ 2. _____
3. _____ 4. _____
5. _____ 6. _____
7. _____ 8. _____
9. _____ 10. _____

Are there any parts your fish does or does not have that the fish above does or does not have?

_____ _____
_____ _____

Activity 2-3a. Label a Fish -- Teacher's Key



Student Information Sheet 2.
Fish Anatomy

What does the shape of a fish tell you? Not only does the body shape of a fish tell you a lot, but the shape of the fins, and the mouth location and shape can tell you where the fish lives, the type of food that it might eat, and if it swims fast or slow. Take a look at the following table.

Body Shape

flattened bottom surface	sitting on the bottom
bullet or torpedo shaped	for fast swimming
thin, flat, vertical disc shape	feeds above or below
thin, flat, horizontal disc shape	bottom feeding
hump-backed	stable in moving waters

Look for these vocabulary words when you read about fish shape: **rod, ribbon, compressed, fusiform, compressed and flattened.**

The mouth of a fish can reveal how a fish feeds.

Mouth

large mouth	surrounds prey
little mouth	nibbling on small plants/animals
mouth near top	eating near surface or on prey above
mouth in middle	eating directly ahead
mouth on bottom	eating off the bottom

Look for these vocabulary words when you read about fish: **inferior, subterminal, terminal and superior**.

Tail shapes	Fins
rounded	pectoral
truncate	dorsal
indented or **emarginate**	pelvic
pointed	anal
forked	caudal

Next time a fish comes into sight, identifying what it eats, how it swims, and where it lives might be a little easier!!