

FISH MORPHOLOGY

OVERVIEW	Students study the parts of a fish to develop the understanding that the shape, form and structure of a fish's parts influence its lifestyle and behavior.
OBJECTIVES	Following completion of this lesson, the students will be able to: <ul style="list-style-type: none">• Identify the various parts of a fish;• Describe the concept of fish morphology;• Relate shape, form and structure of a fish's parts to function;• Draw inferences about where and how fish might live based on its morphology
GRADE LEVELS	3 rd -12 th grades
NJCC STANDARDS	Science Indicators: 5.1: End of Grade 4: A-1, A-2; 5.3: End of Grade 4: A-2, B-2; 5.5: End of Grade 2: A-1, A-2, B-1; End of Grade 4: A-1, A-3, B-1, B-2, End of Grade 6: B-1, End of Grade 8: A-2, B-2; 5.7: End of Grade 2: A-1, A-2, End of Grade 4: A-2; 5.10: End of Grade 2: A-1, End of Grade 6: A-1 Mathematics Indicators: 4.5: C6, C2, E2, C3, C4; 4.2: 2A1, 4A1, 4A3, 2A3, 6A3, 8B2, 2A2, 4A2, 2B1, 2B2, 6A4, 6A3; 4.3: 2A1, 2A4, 4A1, 4A5, 2B1, 4B1, 4C1, 5C3, 5E2, 12B1, 6B1, 8B1; 4.4: 5A2, 2C1, 4C1 Visual Arts Indicators: 1.3: 1; 1.6: 1, 4
MATERIALS	<ul style="list-style-type: none">• Rubber fish models (can be purchased from NASCO 1-800-558-9595) or several different kinds of whole frozen fish that demonstrate different shapes (flounder, skate or ray, an eel, a perch, sea bass, angel fish, tuna, or mackerel) obtained from your local fish market or supermarket. Once obtained, fish can also be frozen and reused,• Tempera paint; Paint brushes (1 1/2 - 2 1/2" brushes seem to work best);• Colored markers; Newsprint paper, or other kind of craft paper;• Newspaper; Fish anatomy diagram and fish morphology chart (included in this lesson plan).
PROCEDURES	Review fish anatomy and explain that all fish have the same basic body parts; however those parts may look different. Have students hypothesize why different body parts are shaped differently. Introduce the concept of fish morphology or how the form and shape of a fish and its parts influence function. Students will spend approximately 10-30 minutes doing Gyotaku, the ancient Japanese art of fish printing using rubber models or real fish. If real fish are used, wash, blot dry and, if frozen, thaw slightly before printing. Lay fish flat on top of newspaper. Brush a <u>thin</u> layer of paint on the exposed side of the fish.

The best prints result from the least amount of paint while still attaining full coverage. Carefully lay a sheet of paper on top of the painted fish, and gently press paper down onto all parts of the fish to help pick up details. Slowly lift the paper to reveal the print and place aside to dry. Often a fresh coat of paint is not necessary before the next print. Have students label the external anatomy of the fish and use the fish morphology charts to label the body shape of their fish and the fish's tail on their prints. Next have students compare and contrast the morphology of their fish to the prints that were made from other species of fish. Have students write a paragraph about their fish's possible behavior and habitat based on its shape and anatomy.

BACKGROUND

Fish shape and anatomy helps us discover information about how a fish moves, where and how the fish lives, and how it has adapted to its environment. By studying the morphology of living things, humans have learned how to better design machines such as submarines, torpedoes, airplanes and automobiles. Body shape, mouth location and size, tail shape and color all give indication of how fish live and function. For example, we know by the shape and color of a flounder that it lives on the sea bed floor and swims like a flying bird. Because its top is brown, it blends in with the ocean floor. Since both eyes are on the same side of its head, it indicates that the flounder lives on or near the bottom

Body shape is a good indicator of how a fish moves and where it lives. Fish that are flat or **depressiform** like a skate or flounder flap their fins up and down to swim through the water in the same way a bird flaps its wings. They normally live on the bottom of the sea floor. Meanwhile, fish that are long and skinny or **filiform**, like an eel, slither through the water like a snake. Fish that are streamlined and have an oval or **fusiform** cross-section like a tuna or striped bass are fast swimmers and usually live in open water. A **compressiform** shape like that of angelfish looks thin when viewed from the front. This body shape is well designed for making quick turns and quick bursts of speed over short distances. Compressiform fish commonly live where there are many places to take refuge such as ponds, lakes, or coral reefs, or they school together in shallow open waters.

The shape of a fish's tail indicates how the fish moves and lives as well. A rounded tail or a **truncated** tail like that of a killifish or minnow is good for maneuverability and short bursts of speed. This kind of tail is commonly found on fish in coastal embayments. A forked tail like that of a striped bass is good for maneuverability and speed over longer distances. **Lunate** or crescent shaped tails like those found on a swordfish are not good for maneuvering but allow for great speed over long distances and are usually found on fish that live in the open ocean.

The size and location of the mouth tells us a lot about where a fish finds its food, what food it eats, and where it may live. Fish with a large mouth generally eat large pieces of food; an exception is the whale shark that filters small pieces of food through its large mouth. Fish with a small mouth generally eat small items of food such as plankton. If the mouth is oriented upwards, it is a surface feeder, or it feeds on prey above it, like a stargazer or stonefish. If the mouth is located in the middle front of the head, like a tuna, we can assume that the fish feeds on prey directly in front of it. If the mouth is oriented downwards, it is a

bottom feeder, like a catfish. Some fish have elongated tube-like mouths to reach into crevices, like a butterfly fish, or to “slurp” up food like a seahorse.

Color Patterns help determine where a fish may be found and how it escapes predators. Fish that are **camouflaged** can blend in to match surroundings to hide from predators; a good example of a **camouflaged** fish is a flounder, which can also change colors to blend in. Another color pattern is called **disruptive coloration**. This is when a fish has spots, stripes, or patches of color to break up and diffuse the fish’s actual outline. Many coral reef fish have **disruptive coloration**.

Counter-shading is when a fish such as an anchovy or tuna has a dark back and lighter belly. This enables these fish to hide in the open ocean to hide from predators that might be looking down or up at them as the sunlight penetrates the water column. Many fish use **warning coloration** or bright colors to warn other fish of the presence of venomous spines or some other defensive mechanism. Fish may also use an **advertising pattern** or color to attract a mate, defend its territories, or promote the idea that it can clean other fish. There may also be different forms of **mimicry** in fish such as false eye spots to confuse predators into attacking the wrong end of the fish. The Stonefish or Sargassum fish mimic other objects of no interest to enemies. Finally there are fish that mimic another species of fish. A fierce Blenny mimics a helpful cleaner, while the Snake-eel mimics a dangerous poisonous sea snake.

Also see “Fish Morphology” chart included in this lesson plan.

VOCABULARY

Advertising Pattern- A pattern or coloration that signals that the fish may have something wanted by other fish.

Anatomy - The separation of the parts of an organism in order to ascertain their position, relationship, structure and function.

Camouflage- Colors and patterns that help an object blend in with surroundings.

Compressiform- Flat from side to side looks tall and thin when viewed from the front.

Depressiform- Shaped flat like a pancake.

Disruptive Coloration- Colors that help an object break up and distract from its true form.

Filiform- Long, skinny tube shape.

Fusiform- streamlined oval shape.

Lunate- Crescent or quarter-moon shape.

Mimicry- Coloration or shape of an object that imitates something it is not.

Morphology - The study of structure or form and overall shape.

Truncate- A short, square or slightly rounded shape.

Warning Coloration- Bright colors that caution they possess great danger.

EXTENSIONS

See NJMSC Lesson Plan “Build-a-Fish”
See Student worksheet “Fish Morphology” included in this lesson plan.

REFERENCES

Bond, C.E. 1979. Biology of Fishes. Saunders College Publishing, Philadelphia. Pp. 11-32.

Robins, C.R., G.C. Ray and J. Douglass. 1986. The Peterson Field Guide Series - A Field Guide to Atlantic Coast Fishes of North America. Houghton Mifflin Company, Boston. Pp. 10-11.

Thurman, H.V. 1990. Essentials of Oceanography (3rd ed.). Merrill Publishing Company, Columbus. Pp. 286-287.

Internet Resources:

<http://www.aqua.org/animals.html>









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Fish Morphology: Fish Shapes

BODY SHAPE

Crosssection	Fish	Shape	Locomotion
	 Tuna	Fusiform	Fast-swimming in open water.
	 Tautog	Compressiform	Quick speed for short distances.
	 Skate	Depressiform	Swims like a flying bird.
	 Pipefish	Filiform	Slithers through the water like a snake.

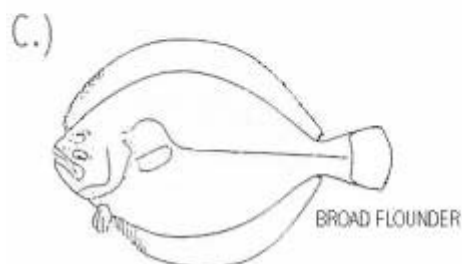
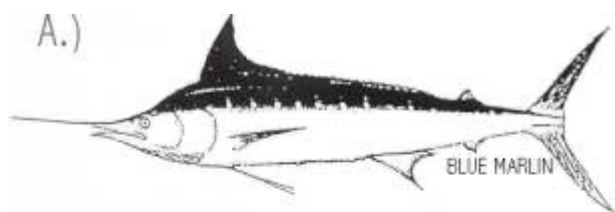
CAUDAL FIN SHAPE

Shape	Function
Rounded 	Large amount of surface area allows for effective acceleration and maneuvering, but creates drag causing fish to tire easily.
Truncate 	Effective acceleration and maneuvering. Not as much drag as a rounded shape.
Emarginate 	Effective acceleration and maneuvering. Not as much drag as a rounded shape or truncate shape.
Forked 	Good acceleration and maneuvering. Less surface area means less drag.
Lunate 	Rigid fin with less surface area means less drag and great acceleration, but decreased maneuvering.

Fish Morphology: Student Activity 1

Study the chart (below) of different fish body shapes and tail shapes. The shape of a fish can tell how the fish moves through the water. Answer the following questions selecting fish from the pictures above. Tell what about each fish causes you to select each answer.

1. Which of the fish above swims the fastest in open water?
2. Which fish can make sharp turns?
3. Which fish can not make sharp turns?
4. Which fish is a great sprinter but not fit for a long distance marathon?
5. Which fish swims like a flying bird?
6. Which fish slithers through the water like a snake?
7. Which fish lives on the sea floor?





Fish Morphology: Student Activity 1-Answers

- 1) A. Its shape is fusiform and it has a lunate tail. There is less drag on the fish, so it can swim faster over longer distances.

- 2) B. Rounded tail is best for maneuvering.

- 3) A. Lunate tail is worst for maneuvering.

- 4) B. The large surface area of the rounded tail is great for propulsion but creates the greatest drag so the fish tires easily.

- 5) C. It has a depressiform shape.

- 6) D. It has a filiform shape.

- 7) C. It is depressiform, and both eyes are on the same side of its head.



Fish Morphology: Student Activity 2

Study the fish anatomy diagram (Class Osteichthyes), and answer the following questions.

1. What part of the fish is used to propel through the water?
2. Which fins give the fish stability and keep it from rolling over?
3. Which fins are used as the fish's 'brakes'?
4. Which fins help the fish move backwards and up and down in the water?
5. Which fin helps the fish steer?
6. Which part of the fish protects the gills?
7. Why is it that fish swimming together in a school never run into each other?



Fish Morphology: Student Activity 2-Answers

1. The caudal fin.
2. The dorsal fins and anal fin.
3. The pectoral fin and pelvic fin.
4. The pectoral fin and pelvic fin.
5. The caudal fin.
6. The operculum.
7. The lateral line allows the fish to sense changes in the pressure of the surrounding water and alert them to movement such as another fish turning.