

CHAPTER

1

Fish Classification

- Give an overview of the five living classes of fish.



Classification of Fish

There are about 28,000 existing species of fish, and they are placed in five different classes. The classes are commonly referred to as hagfish, lampreys, cartilaginous fish, ray-finned fish, and lobe-finned fish (see the table in the previous lesson).

Hagfish

Hagfish are very primitive **jawless** fish. They retain their notochord throughout life rather than developing a backbone, and they **lack scales and fins- Lacking paired fins means they are not strong swimmers and would struggle being pred**. Hagfish are noted for secreting large amounts of thick, slimy mucus. The mucus makes them slippery, so they can slip out of the jaws of predators.

Lampreys

Like hagfish, **lampreys** also lack scales and are **jawless**, but they **have fins and a partial backbone**. The most striking feature of lampreys is a large round sucker, lined with teeth, that surrounds the mouth (see **Figure 1.1**). Lampreys use their sucker to feed on the blood of other fish species.



FIGURE 1.1

Sucker Mouth of a Lamprey. The mouth of a lamprey is surrounded by a tooth-lined sucker.

Cartilaginous Fish

Cartilaginous fish include sharks, rays, and ratfish (see **Figure 1.2**). In addition to an **endoskeleton composed of cartilage**, these fish have a complete backbone. They also have a relatively large brain. They can solve problems and interact with other members of their species. They are generally predators with keen senses. Cartilaginous fish lack a swim bladder. Instead, they stay afloat by using a pair of muscular fins to push down against the water and create lift.

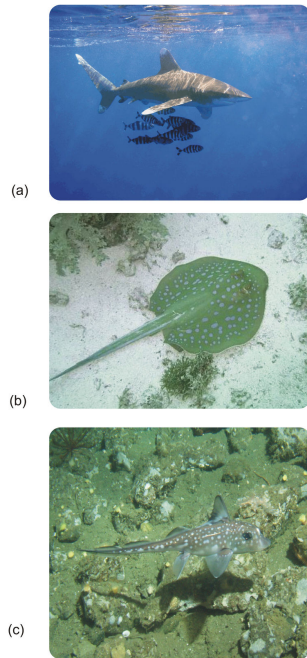
One of the most important traits of cartilaginous fish is their jaws. Jaws allow them to bite food and break it into smaller pieces. This is a big adaptive advantage because it greatly expands the range of food sources they can consume. Jaws also make cartilaginous fish excellent predators. If you've ever seen the film *Jaws*, then you know that jaws make sharks very fierce predators (see also **Figure 1.3**).

Ray-Finned Fish

Ray-finned fish include the majority of living fish species, including goldfish, tuna, salmon, perch, and cod. They have a bony endoskeleton and a swim bladder. Their thin fins consist of webs of skin over flexible bony rays, or spines. The fins lack muscle, so their movements are controlled by muscles in the body wall. You can compare their ray fins with the fleshy fins of lobe-finned fish in **Figure 1.4**.

Lobe-Finned Fish

Lobe-finned fish are currently far fewer in number than ray-finned fish. Their fins, like the one shown in **Figure 1.4**, contain a stump-like appendage of bone and muscle. There are two groups of lobe-finned fish still alive today: coelacanths and lungfish.

**FIGURE 1.2**

Cartilaginous Fish. All of these fish belong to the class of cartilaginous fish with jaws. (a) Oceanic whitetip shark (b) Ray (c) Ratfish

**FIGURE 1.3**

Jaws of a Shark. Sharks have powerful jaws with multiple rows of sharp, saw-like teeth. Most other fish are no match for these powerful predators.

1. **Coelacanth**s are ancient fish with just two living species. They are at risk of extinction because of their very small numbers.
2. r. - You can ignore this one.

Summary

- There are about 28,000 existing species of fish, and they are placed in five classes: hagfish, lampreys, cartilaginous fish, ray-finned bony fish, and lobe-finned bony fish.



FIGURE 1.4

Fins of Bony Fish. The fins of ray-finned and lobe-finned fish are quite different. How is the form of the fins related to their different functions in the two classes of fish? Ray Fin (left), Lobe Fin (right)

Practice

Use these resources to answer the questions that follow. **These are really helpful:**

- <http://www.hippocampus.org/Biology> → Non-Majors Biology → Search: **Fish**
1. Describe the body style of agnathans.
 2. Describe the body covering of cartilaginous fish.
 3. Compare rays to skates.
 4. Compare and contrast ray-finned fish to lobe-finned fish.
 5. What animals evolved from lobe-finned fish?
- <http://www.hippocampus.org/Biology> → Biology for AP* → Search: **Vertebrate Diversity**
1. Describe the main differences between the two groups of jawed fishes living today.

Review

1. Assume that a new species of fish has been discovered deep in the ocean. It has a complete vertebral column made of cartilage. Which class should the new species be placed in? Name one other trait you would expect to find in the new species of fish. Explain your answers.
2. Fish with jaws may be very large. Infer how their jaws may be related to their large body size.

CHAPTER 2 Fish Structure and Function

- Describe structure and function in fish.



What are these geometric shapes?

This is the scales - the skin - of a blue Siamese fighting fish, and they almost look like a piece of art. They also look like they form a smooth, streamlined skin. Why is this important to a fish?

Structure and Function in Fish

Adaptations for Water

Many structures in fish are adaptations for their aquatic lifestyle. Several are described below and shown in **Figure 2.1**.

- **Scales** protect fish from predators and parasites and reduce friction with the water. Multiple, overlapping scales provide a flexible covering that allows fish to move easily while swimming.
- Fish have **gills** that allow them to “breathe” oxygen in water. Water enters the mouth, passes over the gills, and exits the body through a special opening. Gills absorb oxygen from the water as it passes over them.
- Fish have a stream-lined body, **Fusiform**. They are typically long and narrow, which reduces water resistance when they swim.

- Most fish have several fins for swimming. They use some of their fins to propel themselves through the water and others to steer the body as they swim.
- Most fish have a

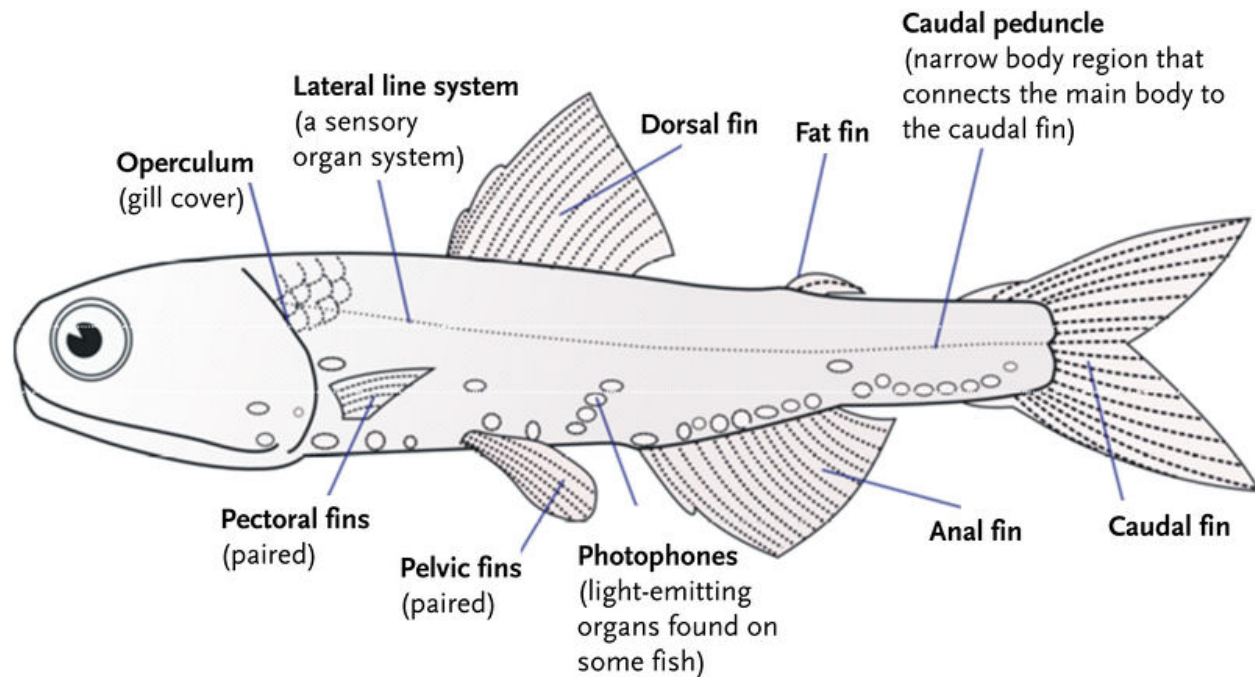


FIGURE 2.1

General Fish Body Plan. A fish has a stream-lined body with gills and fins. (1) operculum (gill cover) (2) lateral line system (a sensory organ system) (3) dorsal fin (4) fat fin (5) caudal peduncle (narrow body region that connects the main body to the caudal fin) (6) caudal fin (7) anal fin (8) photophores (light emitting organs found on some fish) (9) pelvic fins (paired) (10) pectoral fins (paired).

Jaw and Jaw Evolution

Jawed fish use their jaws and teeth to grind up food before passing it to the rest of the digestive tract.

Jaws evolved only once (rather than evolving multiple times in different species through parallel evolution). (ref)

- Jaws evolved from gill arches which are the bony parts between gill slits.
- It is thought that a gill arch in an agnathan became fused to its skull (11).
- The upper part of the gill support became the top jaw and the bottom part of the gill support became the bottom jaw. Embryology points to this and the arrangement of nerves in shark heads and most simple fishes shows that jaws are in line with gill arches.
- While fish had the first bony jaws, they also have some of the most complicated.

The evolution of the jaw is incredibly **important** because it led to fish to be able to ingest a much wider variety of foods and allowed them to be active hunters as opposed to passive filter feeder (1). This led to a wide variety of adaptations in morphology. Fish became more agile to be better predators, they were able to reduce their armor

because they were less vulnerable, and their muscle density was able to decrease because they no longer led such a sluggish lifestyle (10).

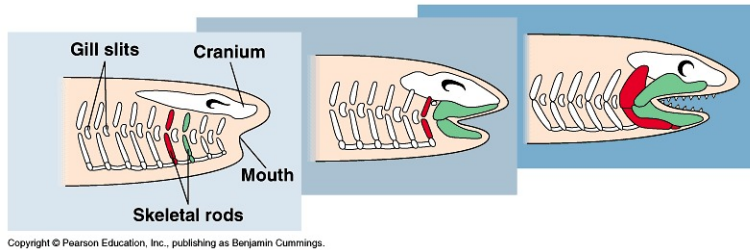


FIGURE 2.2

Summary

- Many structures in fish are adaptations for their aquatic lifestyle. For example, fish have a stream-lined body that reduces water resistance while swimming.
- Fish Jaws evolved from skeletal elements of jawless fish
- Fish have gills for “breathing” oxygen in water and fins for propelling and steering their body through water.

Practice

Use this resource to answer the questions that follow.

- <http://www.hippocampus.org/Biology> → Non-Majors Biology → Search: **Fish**

1. What are general characteristics of fish?
2. Why are fish ectotherms?
3. What features allow sharks to detect their surroundings?
4. What is a swim bladder?
5. Describe the fins of ray-finned fish.

Review

1. What are gills? What purpose do they serve in fish?
2. Describe fish scales, and state their functions.
3. Describe how fish use their muscles to swim.
4. What is a swim bladder? How is it used?
5. List two ways that fish can sense prey animals.