

The Oyster: A Not-So-Typical Mollusc

Lab Activity: Dissection of a Bivalve *Middle School Version*

Lesson by Kevin Goff

SETTING THE STAGE

The earliest animals on Earth (sponges) had irregular body shapes. Later, many animals developed **radial symmetry**, with a body shaped like a merry-go-round. Animals with these body plans usually sit still on the seafloor – like sponges, coral, and sea anemone. Others just drift along on ocean currents – like jellyfish. These animals do not actively forage for food. Instead, they wait for food to come to them. Their body shape lets them get food from any direction.

But eventually, some worm-like animals evolved **bilateral symmetry** [“bye-LAT-eral”]. Their bodies have two sides that are mirror images of each other: left versus right. This body plan is an adaptation for **directional movement**. To understand why, imagine a car with monster truck tires on one side and little red wagon wheels on the other. It would go in circles! Having identical left and right sides lets an animal track in a straight line.

VIDEOS TO WATCH

To see how a bilateral, cephalized body lets an animal actively seek food, watch these *Shape of Life* clips:

- Flatworm Animation: Body Plan (under “Animation”; 2.5 min)
- Flatworm: An Invasive Flatworm Hunts Earthworms (under “Behavior”; 2.5 min)

In time, those first bilateral, cephalized, worm-like animals branched into new animal groups. These include most of the animals we see today: penguins and porcupines, scorpions and squid, ants and alligators, bullfrogs and bull sharks, and so on. The fossil record shows that some of the earliest bilateral animals were **molluscs**. Molluscs have soft bodies, but often grow a hard shell on their backs. The first molluscs were simple snails with a shell shaped like a dome or umbrella. But in time, they evolved into a spectacular variety of new forms, each adapted for a different

VIDEOS TO WATCH

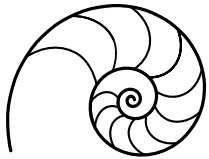
For dazzling displays of animals able to capture food from any direction, watch these clips on the *Shape of Life* (under “Behavior”):

- Sponges: Filter Feeding Made Visible (2.5 min)
- Cnidarians: Anemone Catches Goby (2.5 min)

VIDEOS TO WATCH

Get familiar with the basic mollusc body plan – and how it permits directional movement – by watching these *Shape of Life* clips:

- Mollusc Animation: Abalone (under “Animation”; 1.5 min)
- Molluscs: Pycnopia Chases Abalone (under “Behavior”; 2.5 min)



Shape of Life

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lifestyle. One group of early molluscs became **bivalves**, with TWO shells joined by a hinge. Modern bivalves include clams, oysters, scallops, and mussels.

In today's lab we'll dissect the oyster. As you'll see, the oyster is an oddball, quite different from its cephalized, bilateral ancestors. But as you study it, keep in mind that it descended from a crawling, grazing snail with an umbrella on its back!

LAB ACTIVITY

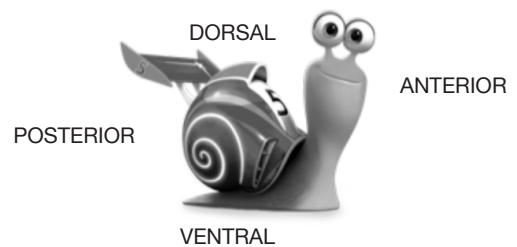
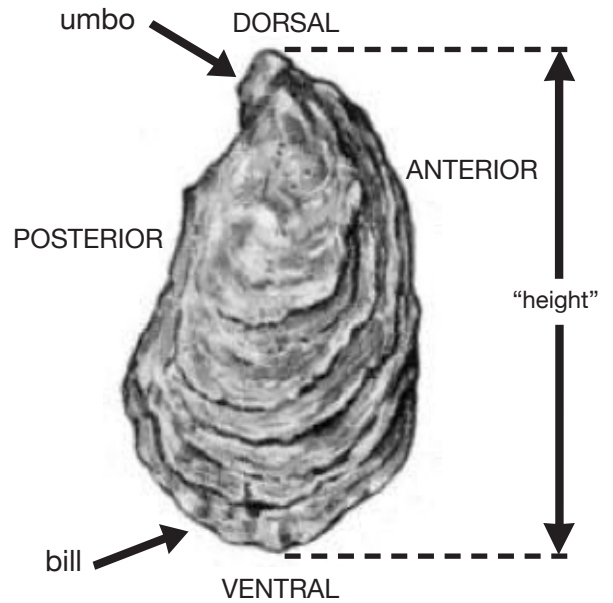
Foundation, Floor, and Roof

Line a dissecting tray with paper towels and get a fresh oyster and dissecting tools.

ALERT! You **MUST** situate your specimen correctly in your tray, as shown in the diagram. If you don't do this, when you get inside everything will be backwards from your diagrams! Oysters come in many shapes. No two oysters look exactly alike. But most have a narrow end called the **umbo** and a wide end called the **bill**. Turn your oyster so that the umbo points away from you, like in the picture.

An oyster has TWO shells, called **valves**. It rests with the bowl-shaped valve underneath and the flatter valve facing the sky. One is the floor, the other the roof. But remember that the animal inside descended from a bilateral snail. ***If you stand your oyster on end, can you see a left side and a right side – the imperfect remains of bilateral symmetry?***

Now compare the oyster and snail pictured above. Both animals also have the same four body surfaces: **dorsal** (its back), **ventral** (its belly), **anterior** (its head), and **posterior** (its tush). ***On the diagram, mark where you think the oyster's mouth and anus will be once we get inside.***



(Images: Rainer Zenz and Icon Archive)

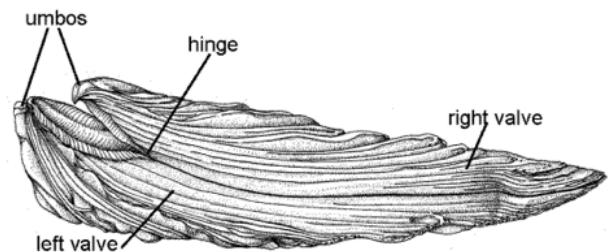
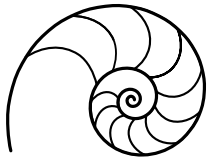


Image: Richard Fox's Invertebrate Anatomy Online (originally in Galtsoff 1964)



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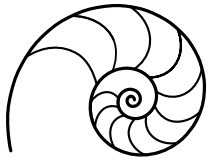
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Doors and Windows

An oyster sure doesn't look like a snail on the outside. To appreciate the family resemblance, you'll have to look under the hood. In life, the two valves were joined by a tough-yet-flexible **hinge ligament**, which works like a door hinge. Your teacher broke the hinge ligament when opening your oyster, but you can find its remains near the umbo. Your teacher also sliced through the strong **adductor muscle** ["uh-DUCK-ter"]. This clamps the oyster shut. Lift the lid and find the tough adductor amidst the softer tissues (see diagram below). Also look for the purplish scar on the upper valve, where the adductor was attached. When this muscle relaxes, the oyster springs open – just a crack – to let water flow in and out. *What two things does this water contain, necessary for survival?*

When an oyster is threatened, its adductor muscles clamp the two shells together. The oyster is an **intertidal** species. It often cements itself to a hard surface (usually another oyster!) where the tides constantly rise and fall. *Think! What events in the intertidal zone might provoke an oyster to slam shut and seal up for a while? Try to think of at least three:*



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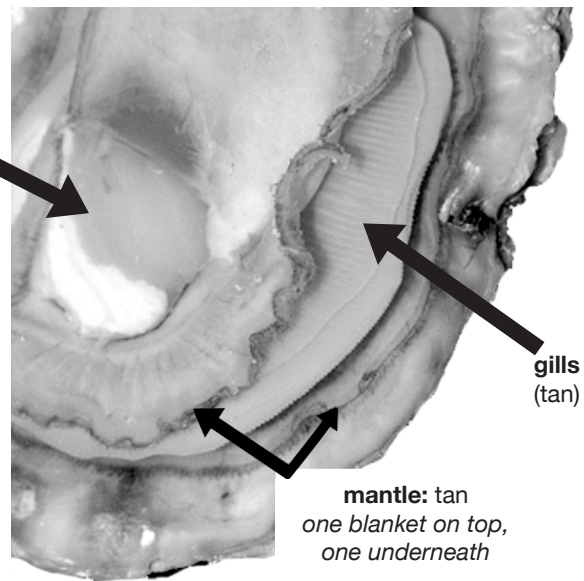
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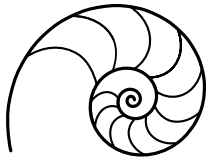
Sheetrock and Interior Trim

Remove the upper valve. The entire body is wrapped in a flimsy blanket of tissue called the **mantle**. The mantle may be tattered on top, damaged when the oyster was opened. But probe UNDER the body, and you'll see it's still intact, snug against the shell. Though soft and flimsy, the mantle is very important for defense: It creates the **shell**! It does this in two stages: First, tiny glands lay down a web of protein fibers. Next, the glands release a calcium paste onto the web, and it hardens like plaster. Feel the inner surface of the upper valve. *Why do you suppose the oyster makes its shell so smooth on the inside?*



Oyster on the half shell
(Image: MD Sea Grant)





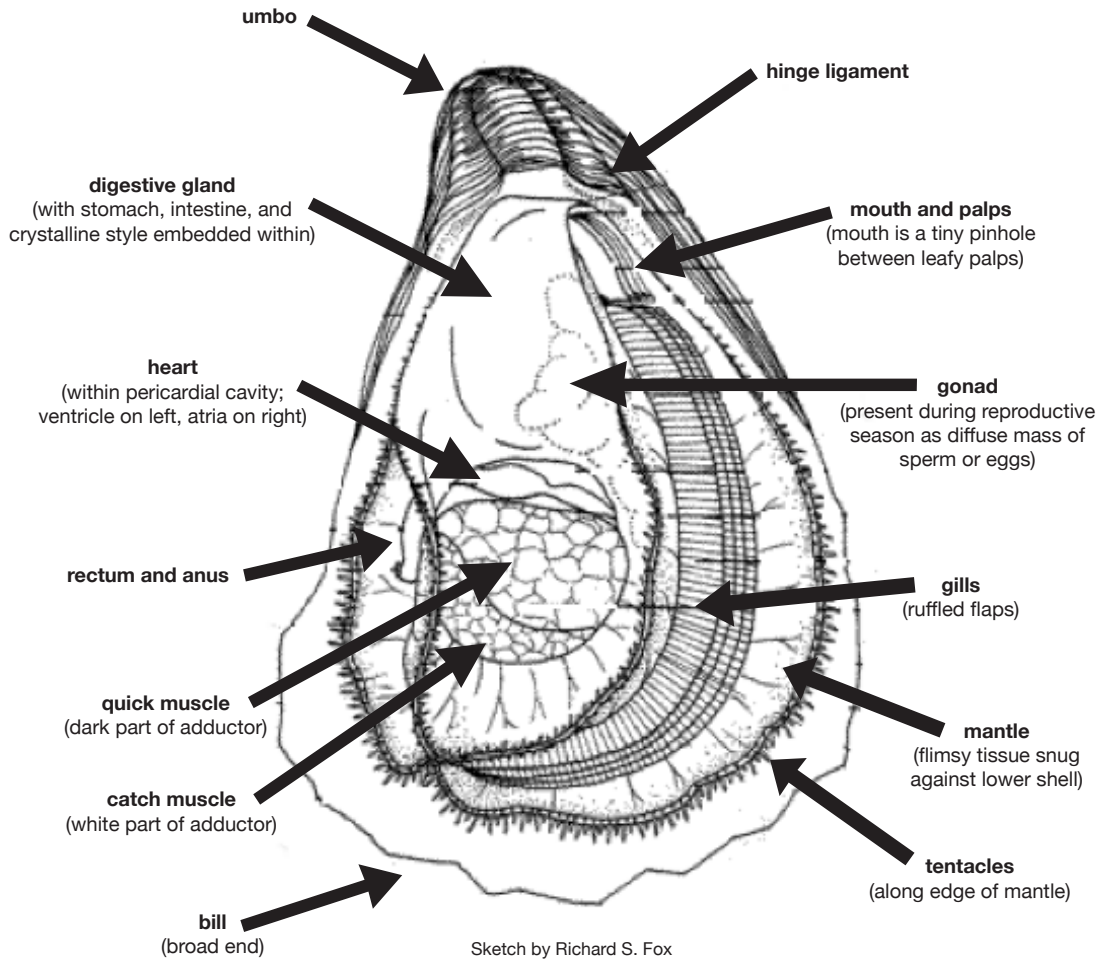
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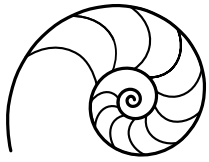
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Plumbing and Air Conditioning

For a better view of internal features, trim away the blanket of mantle atop the body. Lift it with fingers or forceps, and remove it with scissors or scalpel.



Find the four flap-like **gills** in the **mantle cavity**. The mussel circulates seawater over these gills. These absorb oxygen into the bloodstream. Study them under a magnifying glass or binocular scope. *Describe their texture. How do you think this helps increase the amount of oxygen absorbed?*



Shape of Life

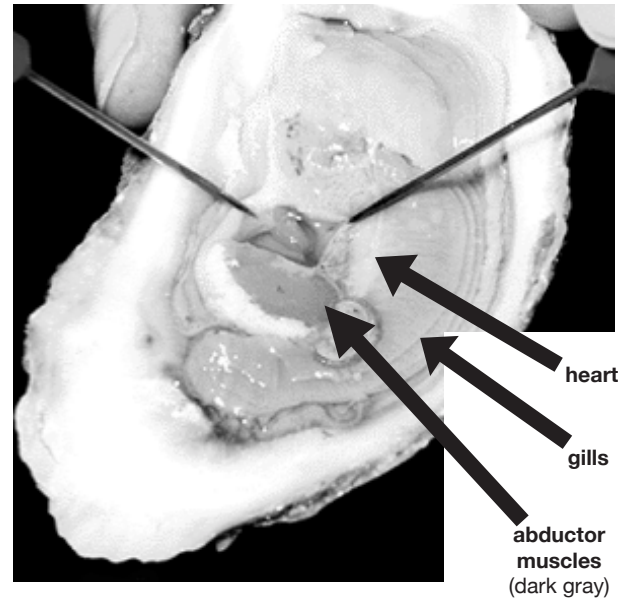
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The **heart** has a room of its own, called the **pericardial cavity** [“PAIR-i-CARD-ee-al”]. Find it just above the adductor. This little room might be covered with a ceiling of tissue. If so, open it with scissors. If your oyster is fresh – hence still alive – you might see its heart slowly swell and relax! A gentle squeeze with forceps might cause it to contract in response.

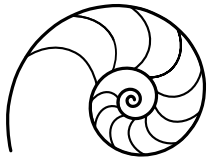
The tiny heart receives oxygen-rich blood from the gills, then pumps it to the rest of the body. The blood is colorless – not red – because it isn’t iron-based like ours. Iron-based blood can carry more oxygen. We also have arteries for delivering blood to our tissues. But in bivalves, blood just soaks weakly through spongy spaces in their tissues. This is a lot less effective at delivering oxygen than our own arteries and iron-based blood. *Why do you think oysters can get by with such an inefficient oxygen-delivery system?*



(Image: MD Sea Grant)

If your oysters are fresh, your teacher might put a piece of gill in a well slide, to view under a compound microscope on low or medium power (not high). Look for “shimmering” on the edge and in the channels. Those are fluttering cilia. Your teacher may also add microscopic yeast cells near the gill. If so, these will look like tiny ping pong balls being swept in and through the gill’s channels.

In most underwater animals, gills are for respiration: taking oxygen from the water. But in bivalves, the gills evolved another very important function: they collect food! Bivalves are **filter feeders** that sift microscopic organisms from the water (algae and bacteria). They coat their gills with sticky **mucus** [“MYOO-kiss”], which traps food.



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The gills are also carpeted with thousands of **cilia** [“silly-uh”], microscopic hairs that whisk back and forth like fluttering eyelashes. These sweep food up to the leaf-like **palps**, which you can find at the dorsal end of the gills. Between them is a pinhole **mouth** (hard to see). *What do you think is the function of these leafy “lips”?* (Helpful hint: they aren’t for kissing.)

Next, food moves into the **stomach**, buried within the greenish-brown **digestive gland**. You can slice into this region with your scalpel, but the stomach is hard to distinguish. Whatever the oyster can’t digest passes through the **intestine** and out the **anus**. Look for these structures on the left side of the adductor.

Notice that oysters are HEADLESS! Remember, their snail-like ancestors DID have heads. That is, they were **cephalized**. The fossil record shows that these early snails were abundant in the ocean 550 million years ago, at a time when many new predators were arriving on the scene. For safety, some snails began digging into the seafloor. Fossils show that in one line of snails, the dome-shaped, umbrella-like shell evolved a crease along its dorsal edge. This probably enabled them to flap their shells to wriggle into the seafloor. Fossils also show that their bodies gradually became wedge-shaped for easier digging. They spent less and less time crawling around and foraging for food, and some evolved the ability to filter-feed instead. And in time, their heads vanished – just like modern bivalves today! Many – like oysters and scallops – also lost their perfect bilateral symmetry. *Why was the bivalve body able to evolve into a headless, less symmetrical form? (Hint: What was the original function of a cephalized, bilateral body?)*
