

The Mussel: A Not-So-Typical Mollusc

Middle School Student Edition

Lab Activity: Dissection of a Bivalve

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 that the two sides must be mirror images, 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 two Shape of Life clips:

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

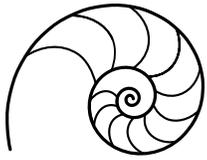
Animals with bilateral symmetry also usually have a distinct **head** at one end, with a **mouth** and **sense organs**. We say they are **cephalized**, meaning “head-having” [“SEFF-alized”]. In contrast, animals with radial symmetry are not cephalized: They have no head, just a mouth in the middle. Being both bilateral and cephalized permits an animal to move in one purposeful direction. They go headfirst, letting their sense organs lead the way, like floodlights through a fog. Such animals can actively seek out the things they need. They can forage for food, track live prey, seek better habitats, or search for a mate.

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 lifestyle. One

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: Pycnopodia Chases Abalone (under “Behavior”; 2.5 min)



Shape of Life

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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 mussel (*Mytilus edulis*). As you'll see, the mussel 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

Floor and Roof

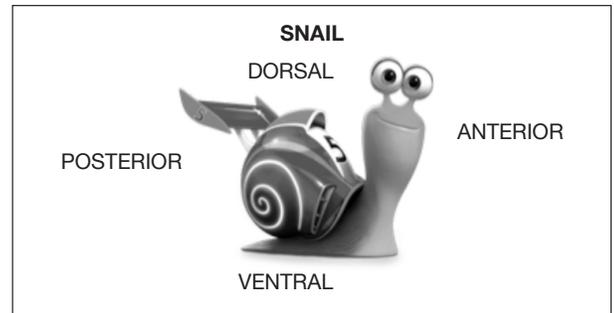
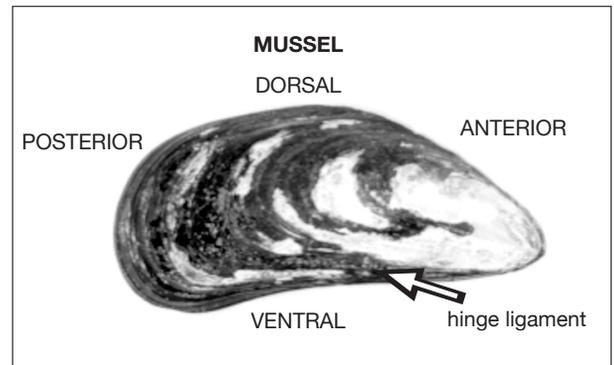
Line a dissecting tray with paper towels and get a mussel and dissecting tools. If your mussel is pickled in preserving fluid, rinse it under a faucet to diminish the odor.

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! The leathery **hinge ligament**, which joins the two shells, should be on the upper right.

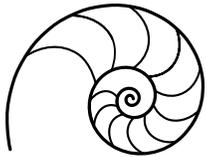
A mussel has TWO shells, called valves. Remember that the animal inside descended from a bilateral snail. ***If you stand your mussel on end, can you see a left side and a right side – the imperfect remains of bilateral symmetry?***

Now compare the mussel and snail pictured above. Note that the mussel has a left and right flank – just like the snail.

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 mussel's mouth and anus will be once we get inside the shell.***



(Images: Rainer Zenz and Icon Archive)



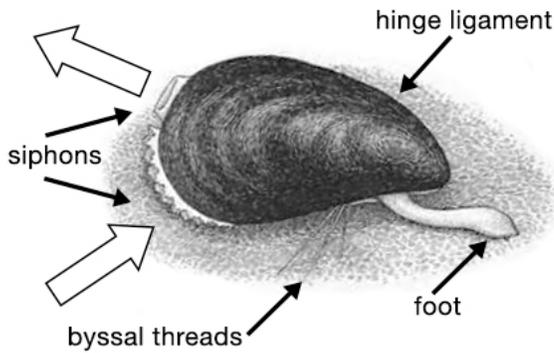
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Doors and Windows



A mussel sure doesn't look like a snail on the outside. To appreciate the family resemblance, you'll have to look under the hood. First, find the tough-yet-flexible hinge ligament, which works like a door hinge. On the opposite side, slip a scalpel between the valves (not too deep!) and twist just enough to open a small crack (not all the way yet!). Peek inside and observe the soft, ruffled fringe of the mantle around the edge. At the posterior end, the mantle has two open windows called siphons. In life, these let water flow in and

out (white arrows). *What two things does this water contain, necessary for survival?*

Now BEFORE opening your mussel all the way, READ ALL FIVE STEPS BELOW. You'll need to cut through the tough **adductor muscles**, but you want to avoid damaging the other soft tissues:

- (1) Study the diagram below to learn the location of the anterior and posterior adductors.

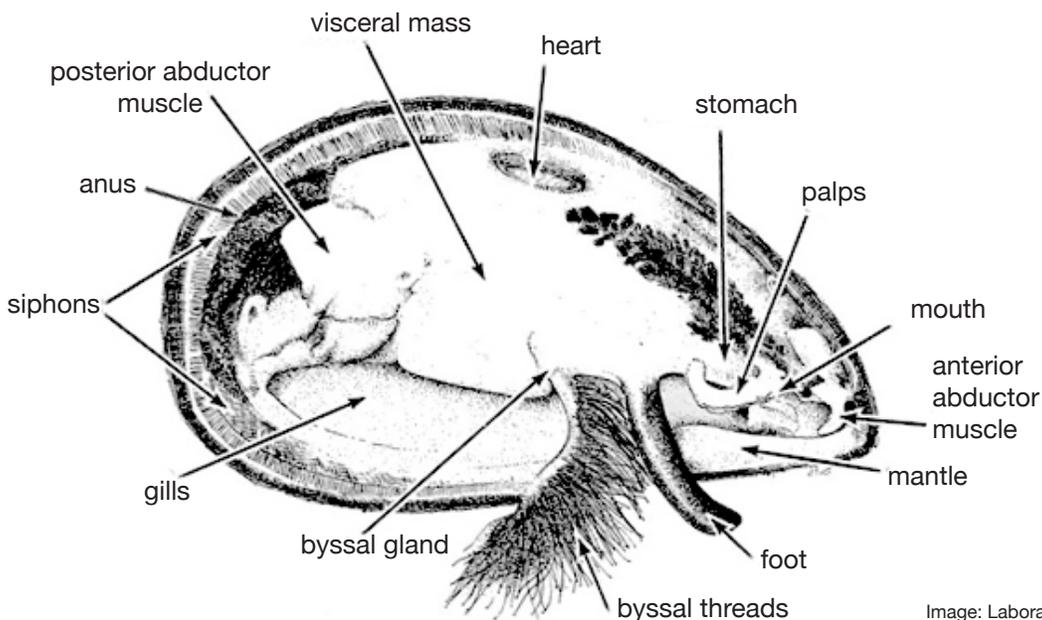
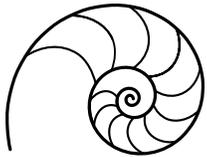


Image: Laboratory and Field Investigations in Marine Biology by Sumich & Dudley, 4th ed.



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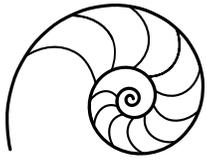
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- (2) Slip your scalpel between the soft mantle and upper valve.
- (3) Gently peel the soft tissue away from the shell.
- (4) With luck, the adductors will now detach from the shell. If not, saw through them, as close to the shell as possible.
- (5) As you slowly pry open the mussel, peel the soft mantle away from the shell.

When a mussel is threatened, its **adductor muscles** [“uh-DUCK-ter”] clamp the two shells together. Blue mussels often anchor themselves to hard rocks on shorelines. This is the **intertidal zone**, where the tide constantly rises and falls. *Think! What events in the intertidal zone might provoke a mussel to slam shut and seal up for a while? Try to think of at least three:*

Sheetrock and Interior Trim

Detach the upper valve completely. The entire body is wrapped in a flimsy blanket of tissue called the **mantle**. The mantle might be tattered on top, damaged when you opened your mussel. 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 mussel makes its shell so smooth on the inside?*



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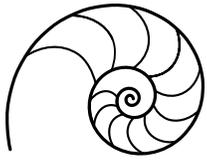
Foundation

Find the mussel's **foot**. Remember, that the ancestral snail's foot was big and muscular for crawling. But in the mussel, it's reduced to a small stump, useless for crawling. Yet it still serves an important function: It creates the beard-like **byssal threads** that anchor the animal to its rock. To do this, the mussel presses its little foot against the rock. The **byssal gland** then secretes a liquid protein that oozes down a groove in the foot (find this!). Finally, this stream of protein hardens into a tough thread.

Thus the foot has now taken on the OPPOSITE of its original function: It was once used for moving around, but now keeps the animal motionless! *So how do you suppose the modern mussel gets its food, compared to the ancestral snail?*

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?*



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The **heart** has a room of its own, called the **pericardial cavity** [“PAIR-i-CARD-ee-al”]. Find it near the dorsal edge (see diagram).

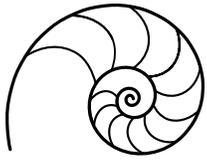
This little room is probably covered with a wrinkly membrane, which you can remove with scissors or scalpel. The heart is just a tiny nugget of muscle. It receives oxygen-rich blood from the gills then pumps it to the rest of the body. The blood is colorless – not

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 mussels can get by with such an inefficient oxygen-delivery system?*

If your teacher has opened a live mussel to show you, you might see its heart slowly swell and relax! A gentle squeeze with forceps might cause it to contract in response.

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. 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 anterior 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.)*

If your teacher opened a live mussel, 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.



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

Notice that mussels 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 did the bivalve body evolve into a headless, less symmetrical form? (Hint: What was the original function of a cephalized, bilateral body?)*
