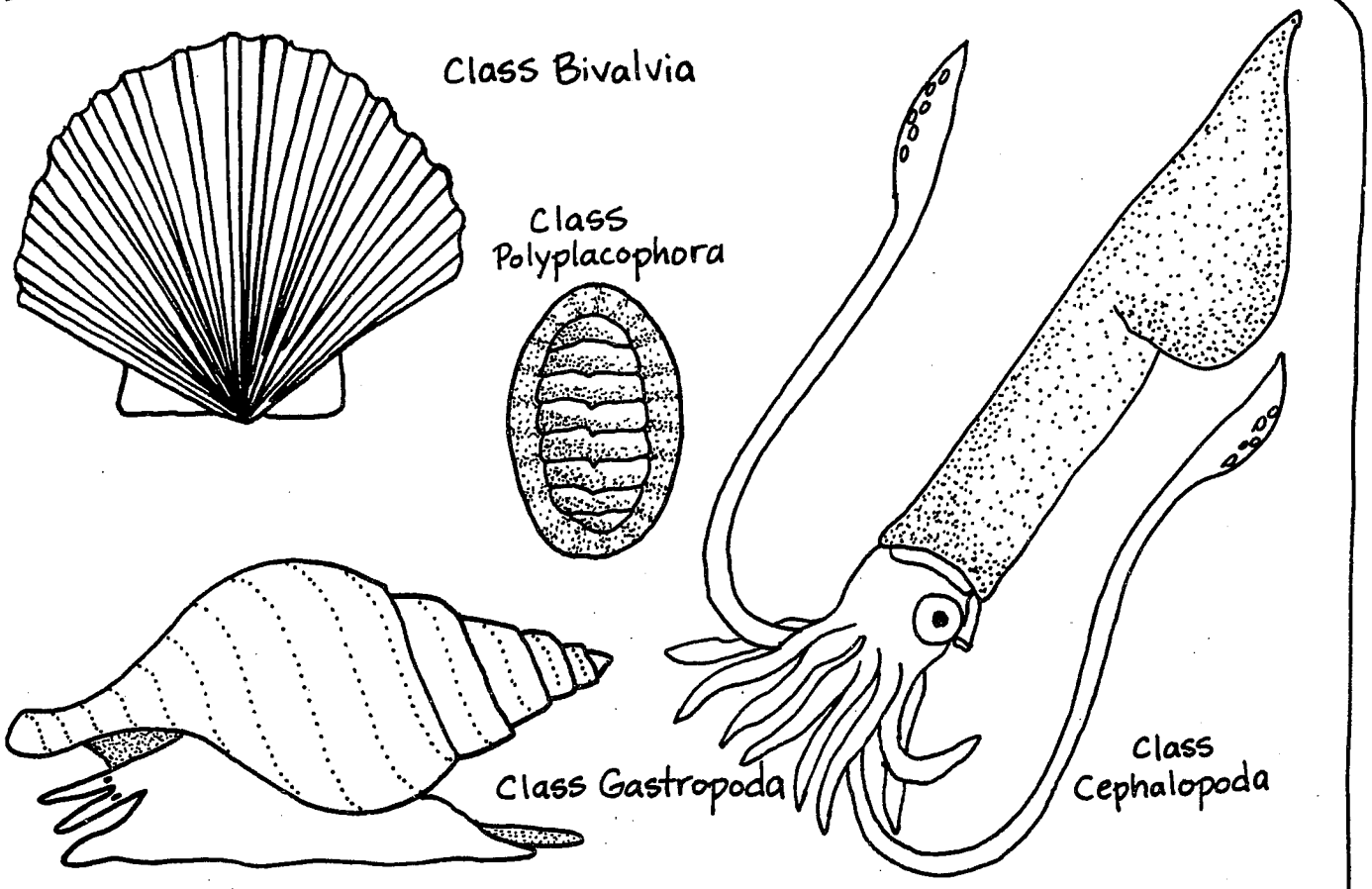
Mollusks



Beachgoers unintentionally ostracize or ignore many invertebrates along the shore. Mollusks, however, seldom go unnoticed, because of their showy shells. People who wouldn't give the time of day to a worm will fall all over a snail or a clam. Such is life at the seashore.

The phylum Mollusca contains 100,000 species divided into seven classes, four of which are found close to shore: class Gastropoda, the snails; class Polyplacophora, the chitons; class Bivalvia, the two-shelled (clam-like) mollusks; and the class Cephalopoda, the squids and octopi. Although mollusks are primarily marine, there are freshwater and terrestrial species.

Despite the apparent lack of similarities between these classes, all mollusks have several features in common. Their body is divided into three regions: the head, the foot, and the visceral mass. The head contains the mouth and sensory organs in all classes but the bivalves, in which the head is indistinct. The fleshy foot is used for crawling, swimming, or burrowing. Organs of respiration, circulation, reproduction, digestion, and excretion are located in the visceral mass—the main part of the body. These organs include a heart, a stomach, intestines, gonads, and kidneys.

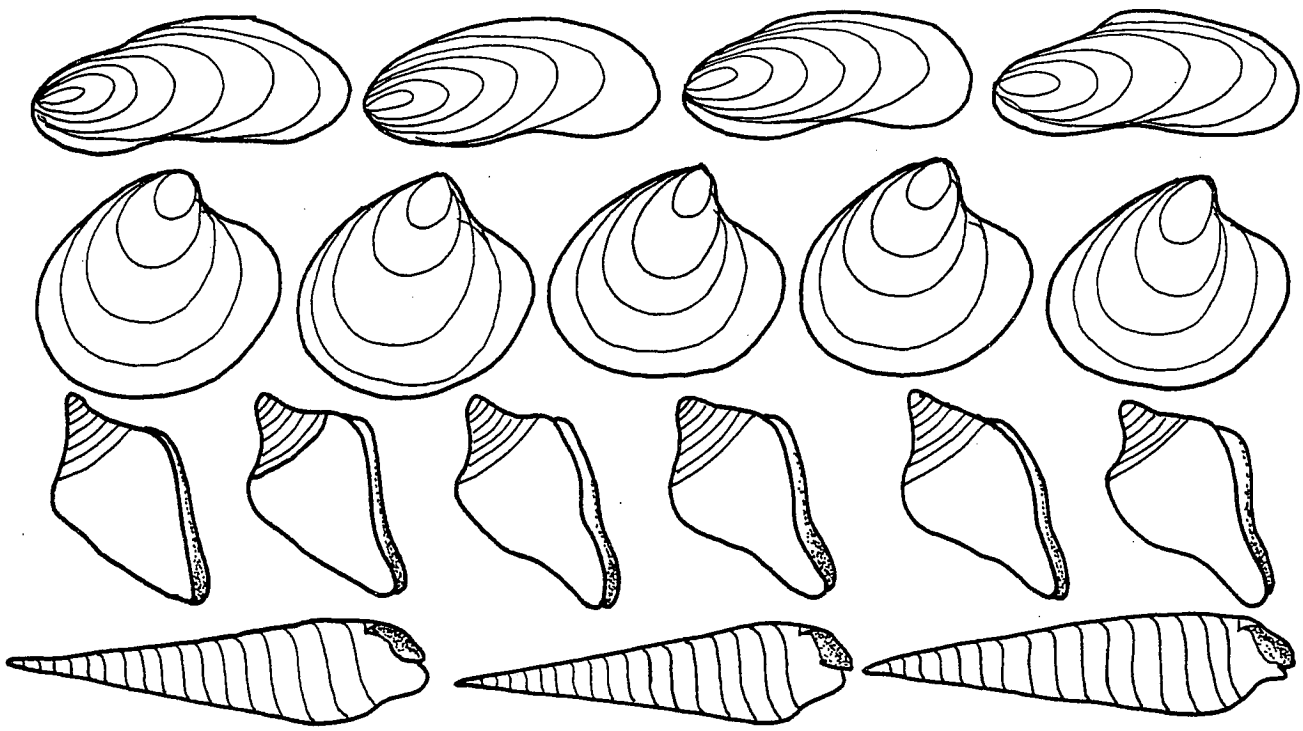
A Shell Is a Skeleton

While eating clams, no one has to worry about choking on a bone. That is not to say that clams do not have skeletons. Like most mollusks, clams have a calcareous (limestone) exoskeleton called a **shell.** Just as our skeleton provides a place for the attachment of muscles, so does the shell of a mollusk. Being soft-bodied and generally slow-moving, mollusks also need shells for protection from predation and other forces of nature. Periwinkle snails on the shore are subjected to pounding waves, scorching sun, and dry periods between the tides. By withdrawing into their shells, mollusks protect themselves from desiccation, mutilation, and predation.

Seashells are much more familiar to people than are the mollusks that made the shells. Some people may not even realize that a shell was once part of a living creature. Empty shells are often thought to be discards, leftovers from when the mollusk changed shells. Actually, mollusks never change shells. As young larvae they begin to form a shell, and that shell grows with them for the rest of their lives.

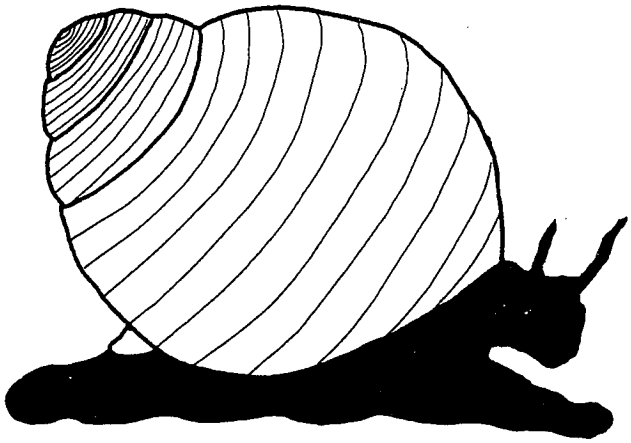
This shell is produced by a thin tissue layer called the *mantle.* The mantle hangs over the body, touching the shell in only a few places. Elsewhere there is a tiny space between the mantle and the shell, and it is into this space that the new shell material is secreted. The mantle produces calcium carbonate and organic chemicals in layers that often crisscross, greatly strengthening the shell. A protein layer (the periostracum) usually covers the outside. Pigment cells in the mantle produce the colorful patterns of mollusk shells. Beneath the mantle and the visceral mass is a cavity containing gills and ducts, where waste is expelled. When the mollusk dies, its shell remains behind, hopefully to be put to good use by a hermit crab or one of the countless other organisms that use empty shells as habitats and hiding places. As the empty shell deteriorates, the minerals in it are returned to the sea.

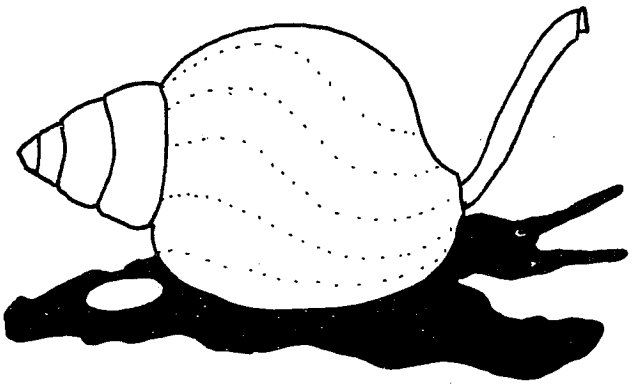
Empty shells should be collected judiciously, if at all. Once they have been studied, they should be returned to the shore. Many species of mollusk have been nearly eradicated by shell collectors who kill the live animal and keep its shell. Ironically, the shell designed to protect the mollusk has hastened its demise.



Feeding

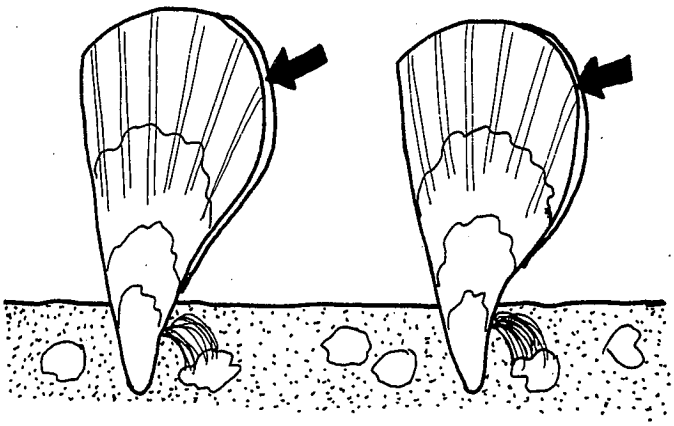
All mollusks except the bivalves have a feeding organ called the radula. The radula is a tongue-like structure covered with fine teeth. Depending on the feeding habits of the mollusk, the radula is adapted for grating, scraping, grasping, or cutting. *Littorina littorea,* an intertidal periwinkle snail, uses its radula to scrape minute bits of algae off rocks. Mucus on the radula entangles food particles.

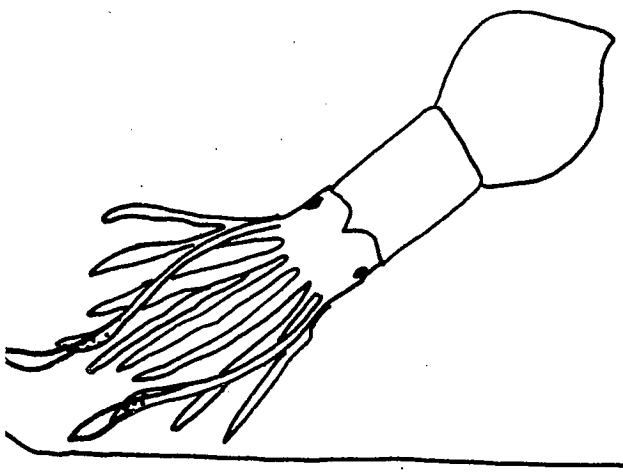




Many carnivorous snails, such as the Northern whelk, *Buccinum undatum,* have an extensible proboscis. This tube-like organ contains the radula, mouth, and esophagus. While holding a bivalve in a death grip with its foot, the Northern whelk wedges apart the two shells of the bivalve with the edge of its own shell. Once the shell is opened, the whelk inserts its proboscis and eats the bivalve's body.

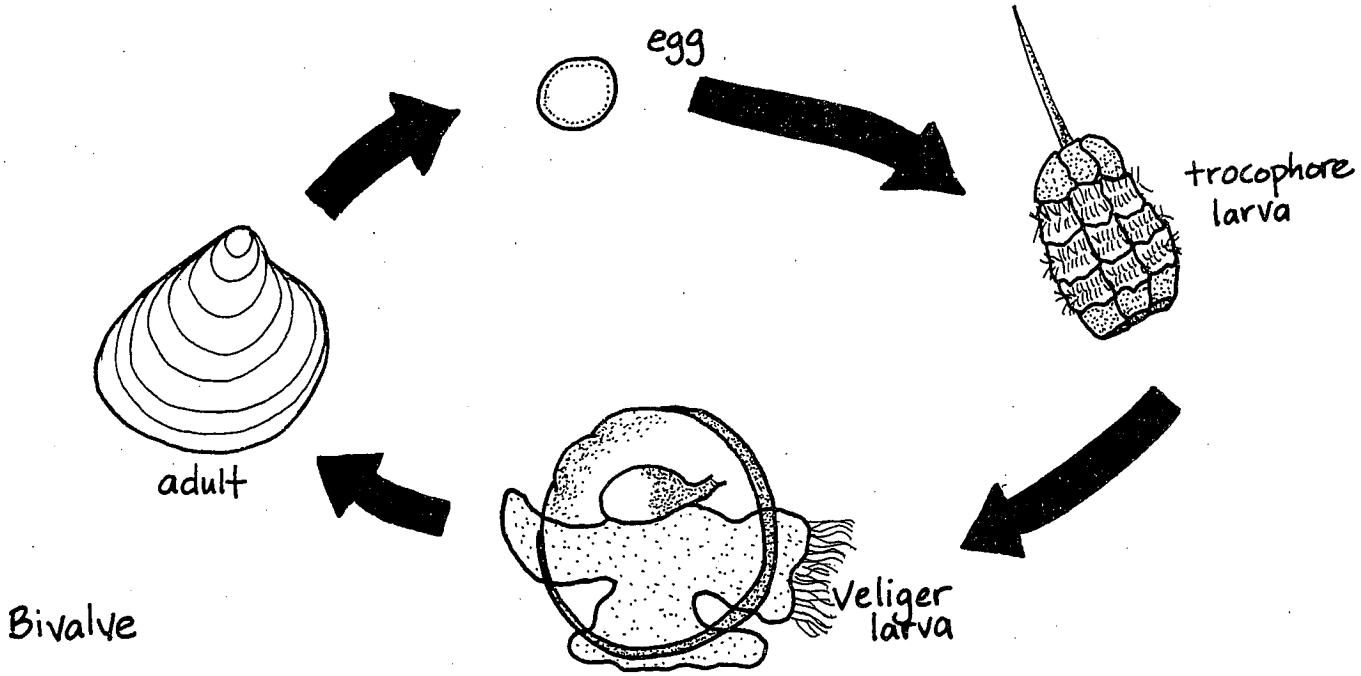
Most bivalves are filter or suspension feeders. The Rigid pen shell, *Atrina rigida,* which lives partially buried in the bottom, is an example. Cilia on its gills create a current, bringing water and the plankton suspended in it into the partially opened shell. The gills filter out the plankton, which becomes trapped in mucus and is transported to the mouth.





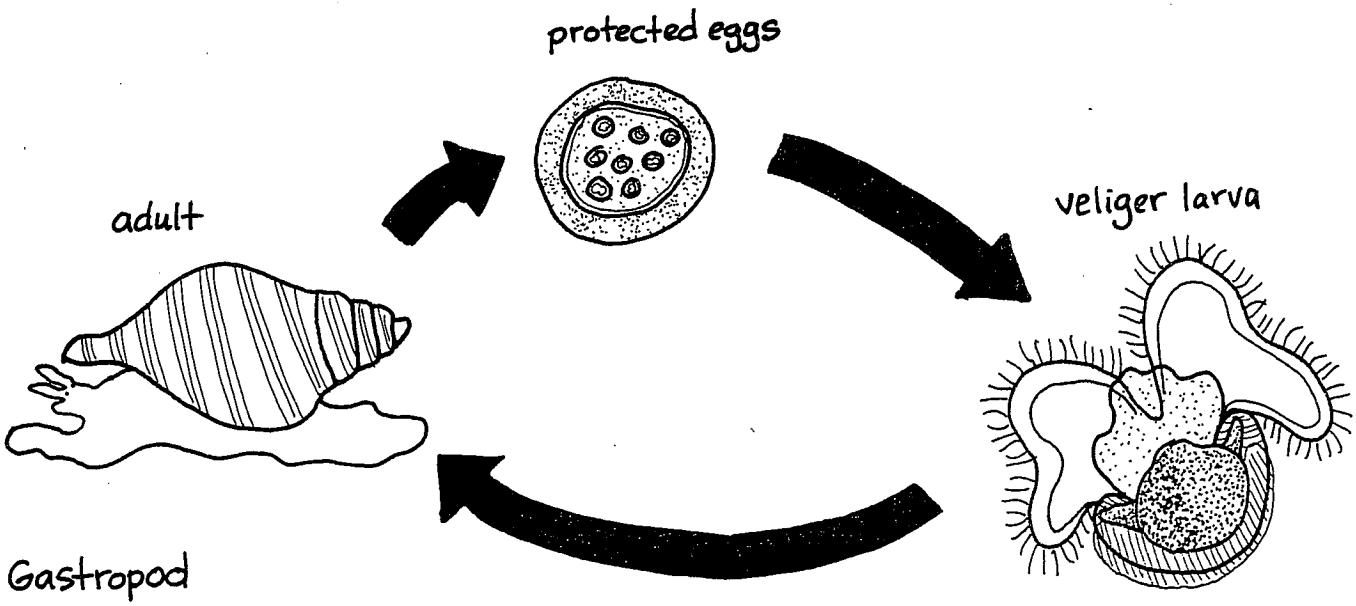
Cephalopods also have a radula, but their primary feeding structure is their beak. Squid swim after their prey and use their two longest arms to seize their victims, usually fish or smaller squid. The other eight arms help to hold down the prey and draw it toward the mouth. Then the squid uses its strong parrot-like beak to tear chunks of flesh out of its prey.

Mollusk Life History



Most mollusks are dioecious; males and females are separate individuals. Bivalves typically release their sperm and egg cells directly into the water, where fertilization then occurs. The planktonic fertilized egg develops first into a free-swimming trocophore larva. This planktonic larva is characterized by a ring of ciliated cells around its center. Gradually the trocophore develops into a veliger larva, which swims and traps food with two large lobes called the velum. A shell gland begins to secrete a small shell. Later the velum is shed and the bivalve larva settles to the bottom, where it grows into an adult, if all goes well.

Most gastropods are also dioecious, but fertilization is internal. The fertilized eggs are generally deposited in a protective ribbon, string, case, or capsule that lies on or is attached to the bottom. Usually the trocophore stage occurs within the egg, so upon hatching, a swimming veliger larva emerges. As a foot develops, the larva settles to the bottom. Some gastropods emerge from their egg case as fully developed miniature snails.



Gastropods

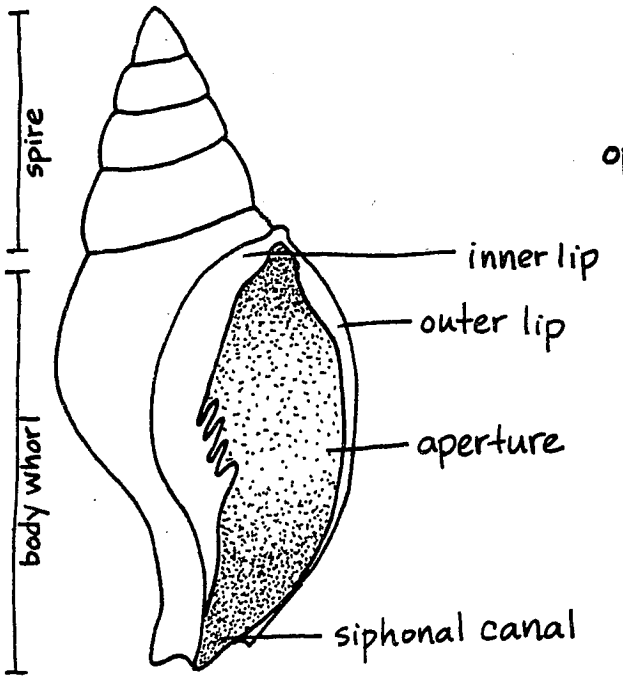
With 75,000 species, gastropods (literally "stomach foot") comprise the largest class of mollusks. Another term for this class is univalve, meaning "one-shell." With apologies to malacologists, this class can be loosely referred to as the snails. Most gastropods have a well-developed head with tentacles and eyes at the base of the tentacles, and a radula. With a class this size, however, there are exceptions to every rule. Many gastropods have no shell (subclass Opistobranchia), but those that do, have one shell, usually spiral. The shells of some gastropods are hidden beneath their mantle.

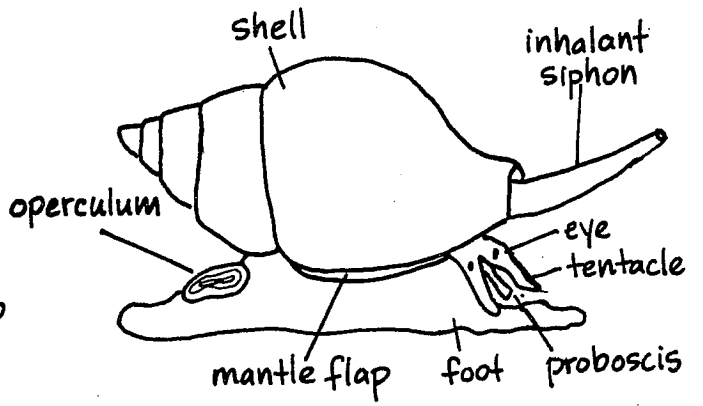
Gastropods usually have a sole-like muscular foot adapted for crawling. Ciliated cells on the underside of the foot secrete a mucus trail over which the snail moves. Some gastropods, such as the worm shells, are sessile; they don't move at all. Although some gastropods live on hard bottoms, most live on sand or mud.

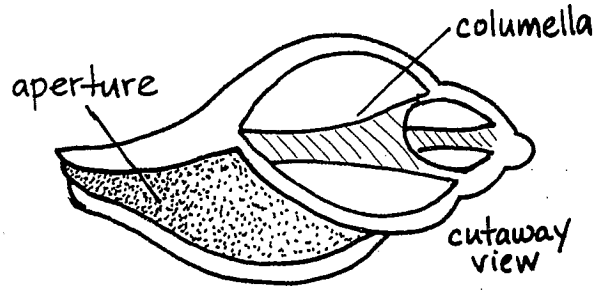
A snail's shell serves as a portable shelter. But snails are not loose inside their shell and cannot completely leave it. They have muscles attached to the columella, the central axis of the shell. The gastropod's head and foot extend out of the shell through the aperture, but can be completely withdrawn into the shell by a retractor muscle. The foot usually has a horny disc, the operculum, attached to it. When the snail pulls inside the shell, the operculum acts as a door, closing off the aperture and leaving the snail safely sequestered inside. Not only does this thwart some predators, but it helps prevent the snail from drying out should it be stranded high on the shore.

To keep a current of water circulating over their gills, many snails have an inhalant siphon, which is actually a rolled-up section of the mantle. The siphon may also have other uses, such as a sensory probe.

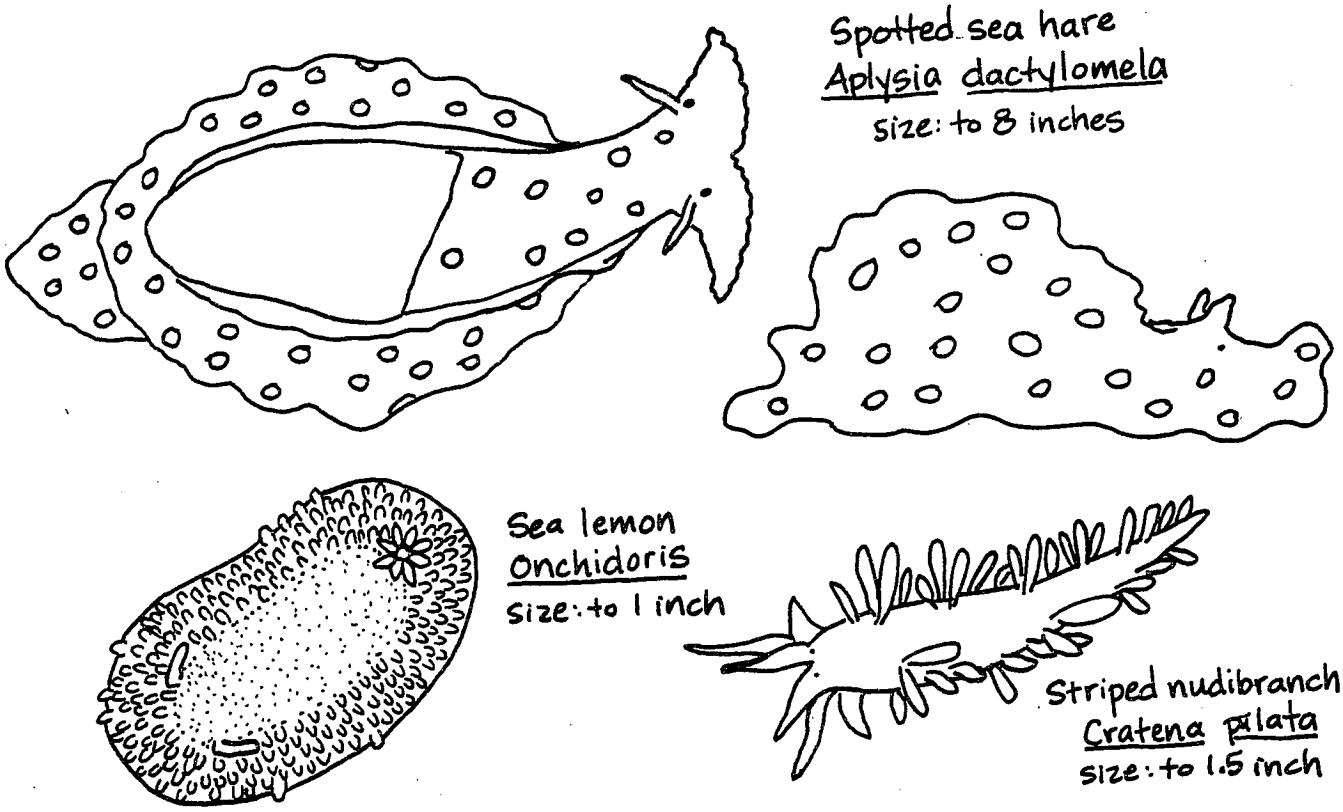
Gastropods have relatively well-developed sense organs. Most have simple eyes that are able to detect light intensity. The tentacles are used as feelers and chemoreceptors. Statocysts, equilibrium organs found in the foot, help the snail to orient with respect to the bottom. Patches of skin located on the snail's gill membranes are used to detect particles in the water passing over the gills.







Nudibranchs and Sea Hares



Nudibranchs, commonly called sea slugs, are gastropods without shells. They are found living intertidally or subtidally among sessile creatures such as tunicates, sponges, and hydroids. Unlike many other snails, nudibranchs have no proboscis, but they do have a radula, and many have jaws.

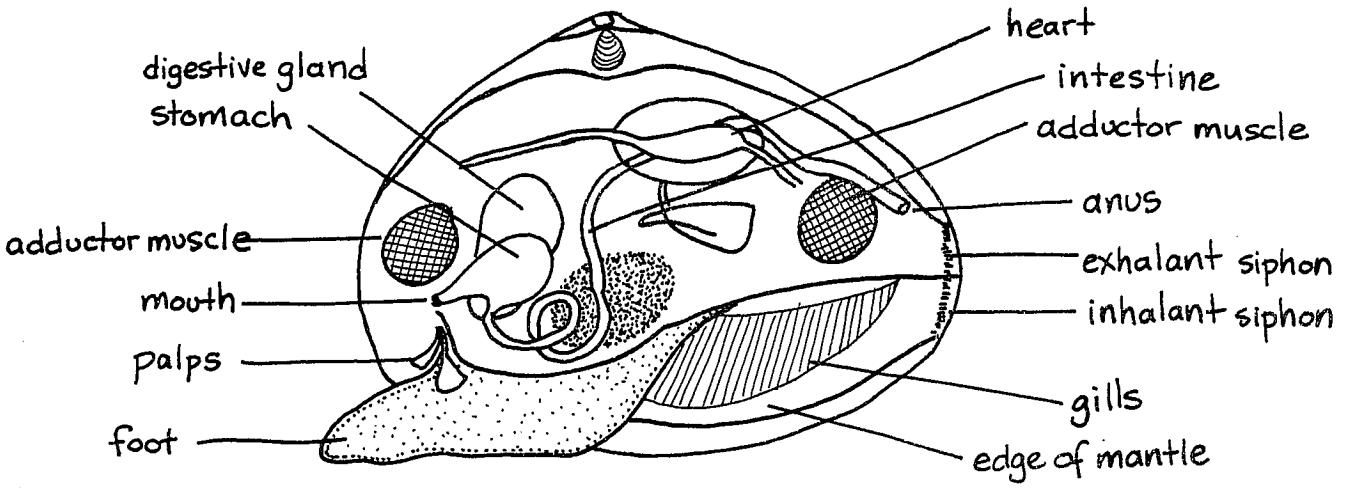
One group of nudibranchs, the eolids, have appendages called cerata all over their backs, which act as gills (nudi means "naked", branch means "gills"). The cerata increase the surface area of the skin, through which the nudibranch breathes. Each group of nudibranchs eat a particular type of prey. Eolids use their jaws to cut chunks of tissue from hydroids and anemones, but do not get stung in the process. The stinging cells of the prey pass intact through the nudibranch's digestive system to the tips of the cerata. Nudibranchs use the stinging cells to defend themselves. The Striped nudibranch, *Cratena pilata,* found along the entire coast, is an eolid nudibranch.

Another group of nudibranchs are the dorids. Dorids lack cerata but breathe with gill-like filaments that extend in a whorl around their anus. They specialize in eating sponges, bryozoans, and tunicates. A common dorid nudibranch all along the coast is *Onchidoris,* the Sea lemon.

Sea hares are very large gastropods with a thin shell buried under their skin, or no shell at all. They have a cauliflower-like gill under a flap of skin on the right side of their body. Two wide wing-like extensions of the foot stick out from their body. Some sea hares can swim by moving these flaps.

The Spotted sea hare, *Aplysia dactylomela,* is common in south Florida in spring when it comes into shallow water to lay its eggs, which may number over eighty million. Sea hares are herbivorous and use their jaws and radula to ingest algae. When disturbed, they squirt out a harmless, gooey purple ink.

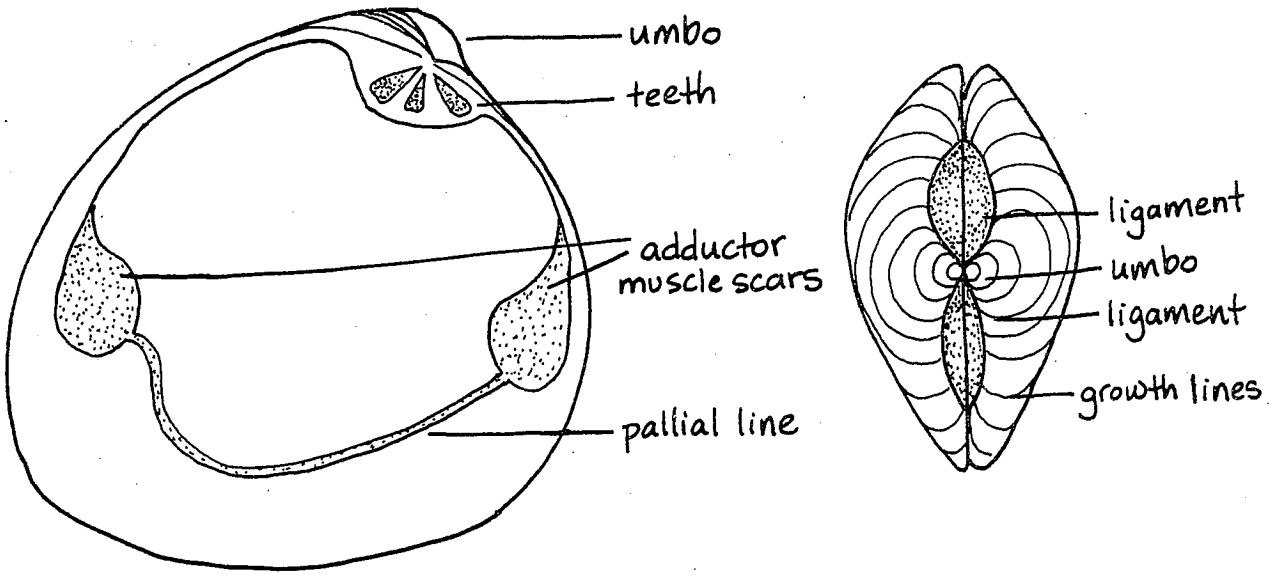
Bivalves



Bivalves are mollusks with a shell made of two halves, called valves, that are hinged together at the top. One or two large muscles keep the shell pulled shut. There are scars on the inside of the shell where these muscles are attached. When the muscles relax, an elastic ligament causes the valves to open. Along the hinge, interlocking teeth keep the valves from slipping. Between most of the shell and the mantle is a minute empty space into which new shell material is secreted. The mantle tissue attaches to the shell near the edge and leaves a scar there, the pallial line. The oldest part of the bivalve shell is the bump near the hinge, called the umbo.

The soft body of the bivalve is found within the shell. Bivalves have no head or radula. Usually they have a hatchet-shaped foot adapted for burrowing. As the bivalve extends its foot into the sand, the tip of the foot expands and acts like an anchor. Then the rest of the bivalve pulls itself down. Bivalves that do not burrow have a reduced foot.

In burrowing bivalves, the part of the mantle opposite the hinge is usually modified into two tubular siphons extending to the surface of the sand. One siphon brings water into the bivalve. Cilia on the gills create a current and send this water over the gills. There, mucus traps food particles, which are then sent in a groove to the mouth. Fleshy pads, the palps, near the mouth push the mucus-food mixture into the mouth. Naturally, the gills also extract oxygen from the water. Water is then expelled through the exhalant siphon. Most, but not all, bivalves are filter-feeders.



Shipworms

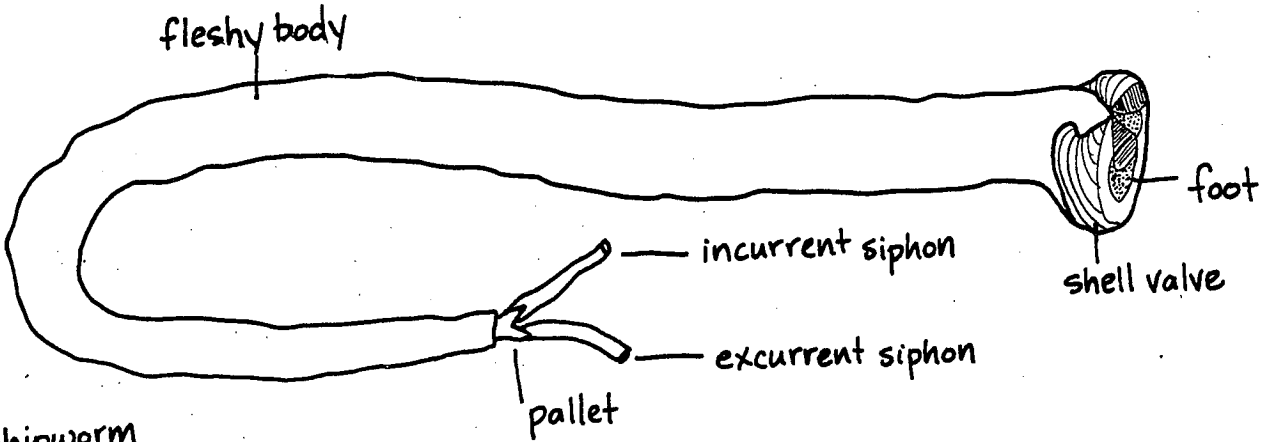
Wooden docks have a tenuous hold on life. Winter ice can shear off their pilings. Hurricanes can reduce them to rubble. Ships can ram into them. But perhaps their most unrelenting enemy are the shipworms *Teredo* and *Bankia*.

Shipworms are not worms. They are worm-like bivalves that bore into wood using the serrated edges of their small shells. At the front end, shipworms have a foot and a two-valved shell. At the back end are siphons and pallets. Between the front and the back is the long fleshy body of the shipworm, which can reach one foot in length.

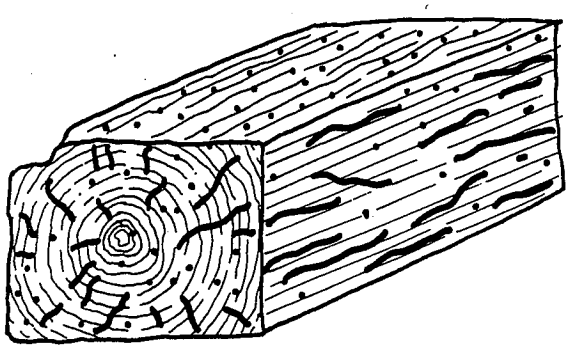
A shipworm larva settles on any submerged wood in salt water: boats, pilings, docks, or floating timbers. Using a cutting motion with its shells, it bores a pinhole large enough to accommodate its body and then continues to bore, enlarging the tunnel as it grows. The siphons and pallets remain near the pinhole opening. One siphon pumps water into the shipworm; the other pumps out waste water. The paddle-like pallets seal off the pinhole when the siphons are withdrawn. Shipworms never widen the original pinhole entrance and they remain in the tunnel for life. If a shipworm is removed from its tunnel, it cannot excavate a new one.

Shipworms are covered entirely by their mantle, which secretes a thin shelly substance that lines the tunnels. Tunnels follow the grain of the wood. Eventually the wood becomes so riddled with shipworm tunnels that it completely disintegrates. Apparently the shipworm feeds on sawdust as it bores. Additional nutrition may be provided by food particles entering with water in the siphon.

Shipworms are found all along the coast and are especially prevalent in warm water. They are difficult to discourage, but coating the wood with creosote or non-corrosive metal alleviates some of the problem. Another creature that bores into wood is an arthropod called a *gribble* (see page 133).



Shipworm
Toredo
size: 6-12 inches



wood with shipworm burrows

Cephalapods

The most advanced and complex mollusks belong to the class Cephalopoda. Cephalopods include the Nautilus, the squids, and the octopi. The Nautilus of the southwest Pacific is the only cephalopod with a fully developed shell. Squid have a small internal shell. Octopi have no shell at all.

Unlike other mollusks, cephalopods are active swimmers. Water is drawn into their mantle cavity and then forced out through a siphon near the mouth. This propels the cephalopod in the opposite direction. The siphon can be pointed in any direction.

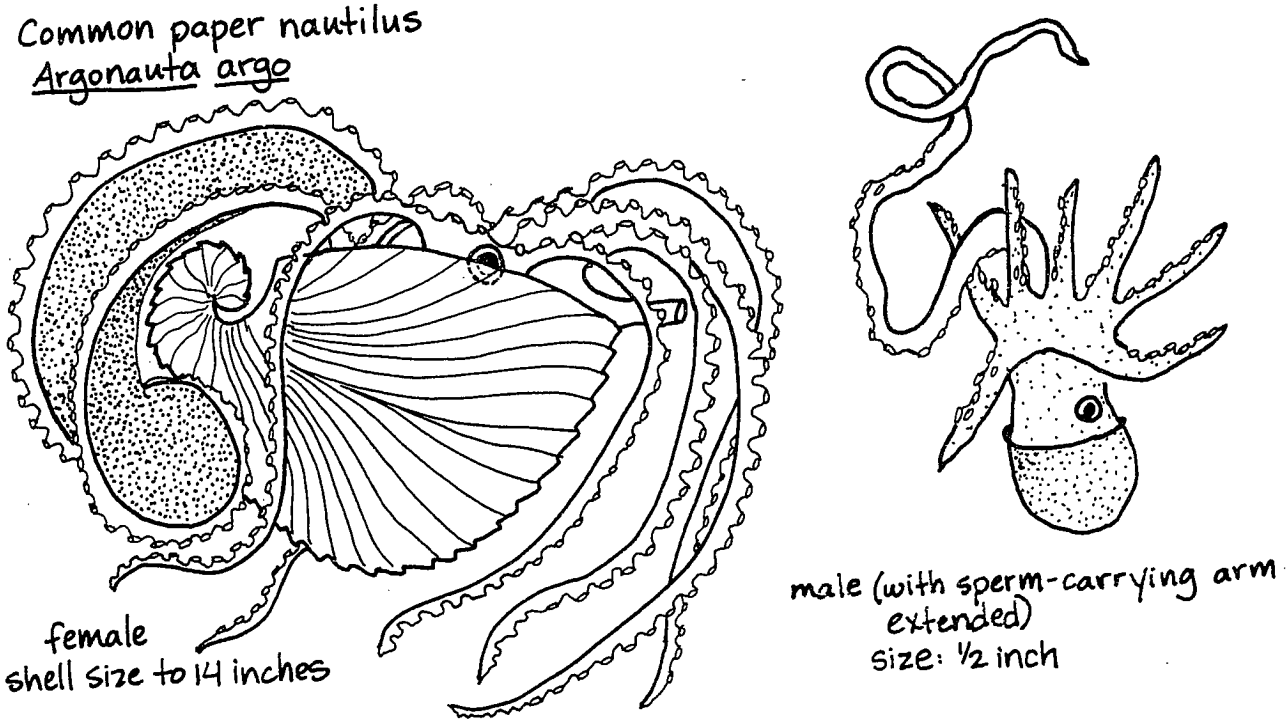
Cephalopods are predators. They locate prey with their eyes, which are very much like our own. Their eyes form images (not just shadows) and may also detect colors. Arms encircling the cephalopod's head are used to capture and hold prey. Once the prey is nabbed, the cephalopod bites into it with its beak. Then the radula brings the food into the mouth. Most cephalopods escape their predators by swimming, rapidly changing color, or squirting ink into the water through their siphon. The ink may confuse the predator, who probably has poor vision and can't discern a blob of ink from an octopus.

Most cephalopods are dioecious; males and females are separate individuals. Males have one arm modified to insert a sperm packet into the mantle cavity of the female.

The Argonaut or Paper nautilus, *Argonauta argo,* is a close relative of the octopus. Female argonauts have two specialized veil-like arms, which each secrete half of a beautiful parchment-like egg case. This shell is carried by the female, who uses it as a shelter for herself and as a brood chamber for her eggs. She is not attached to the shell, however, and may leave it at any time.

The male Argonaut is only half-an-inch long, but his sperm-carrying arm may be ten times his length. This long arm breaks off inside the female's mantle cavity, where it continues to wiggle around until the sperm are released. Early biologists thought this arm was a parasitic worm! Some male Argonauts live within the female's egg case.

Argonauts are pelagic and swim near the surface, where they prey on fish. The shell of the female washes ashore on beaches from New Jersey to Texas.



Squids

Squid are the fastest swimmers among the invertebrates. Their bodies are sleek and aerodynamically shaped, allowing them to fly through the water (and occasionally through the air) with incredible agility and speed. Fins along the side of their bodies act as stabilizers. Out of the water, squid look soggy and flaccid—a sorry sight compared with their graceful shape under water. Squid found off the coast of the United States have a stiff internal shell called the pen.

Ten arms surround the squid's head. Actually, only eight of them are properly called arms. They are short and thick, with suction discs all along their inner surface. The other two arms are called the tentacles. They are thin and at least twice the length of the arms. The ends of the tentacles are spoon-shaped and covered with suckers.

Squid prey primarily on fish. As a school of fish swims by, the squid rushes in and grabs one with its tentacles. With its beak, it bites out a chunk behind the fish's head, or bites off the head entirely, and tears off large pieces of meat. The radula pulls the bites of food into its mouth. The squid usually leaves behind the fish tail and gut.

The Atlantic long-finned squid, *Loligo peali,* is abundant in shallow water from Canada to the Caribbean. It is fished commercially, and sold for food or bait. Eggs of this squid are laid in gelatinous strings on the bottom. Adults die after spawning. Another squid found along the entire coast is the Common short-finned squid, *Ilex illecebrosus.* It, too, is sold as fish bait, and is especially popular with cod fishermen. Both the long-finned and short-finned squid eat krill as well as fish. The Brief squid, *Lolliguncula brevis,* lives along the coast from New Jersey to Florida.