DIPAC Sea Week Program
Mollusk Fact Sheet:

Taxonomy:

Scientists in studying biology group different life forms into various sets by characteristics that are common to members of those sets. This is the science of taxonomy. For animals, the largest sets are called phyla (singular – phylum) of which the largest phyla are the arthropods (insects and crustaceans) followed by the mollusks (over 110,000 separate kinds or species). To name the different groups and individual kinds of animals, the ancient languages of Latin or Greek are used to describe the unique characteristics of the group.

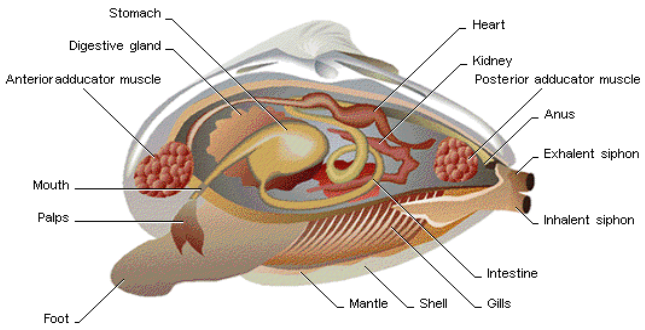
The phylum Mollusca comes from the Latin words “soft body” and is comprised of invertebrate organisms (invertebrate – animals without backbones) with soft, unsegmented bodies covered by a skin-like mantle and they have bilateral symmetry. Most are covered by a calcareous shell secreted by the mantle and have a large foot which is used for creeping, burrowing or attaching. Marine mollusks use gills for breathing and many possess a siphon (tube) for breathing, food capture, and even locomotion.

In the ocean, mollusks rule as the largest phylum. There are over 50,000 marine mollusks, including extinct fossil forms. The most common forms are the snails and clams.

What makes a mollusk?

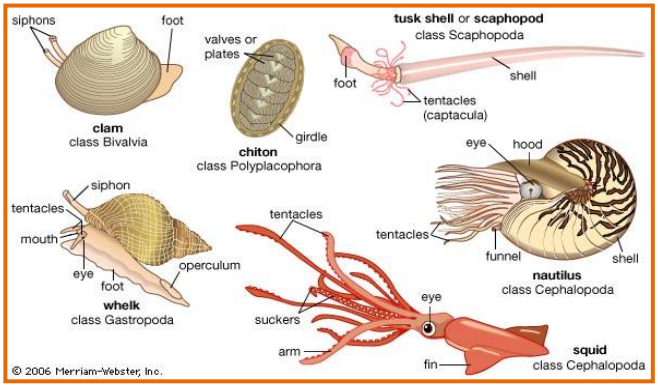
For DIPAC’s elementary level introduction to mollusks, characteristics are simplified to features most common to the marine mollusks of interest to Sea week participants. *Because of the diversity of the phylum, there are exceptions for these characteristics that will be noted in the class presentation.*

1. Soft body
2. gills
3. siphon
4. foot
5. mantle
6. shell

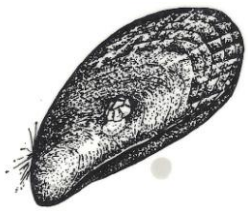


Kinds of Mollusks

The next level of classification under a phylum is the class. Just like around Juneau, we have different schools, within those schools students are divided into different classes. Mollusks are divided into seven classes of which four are most common that we will study further.



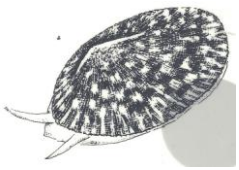
1. **Bivalves** (class Bivalvia) – clams, mussels, scallops and other "shellfish". This class is named for the characteristic two shells that are hinged together to protect the soft-bodies animals. In Greek, bi refers to two and valve refers to shell. Bivalves are common and abundant in Alaska waters and many are also good eating and valuable as fisheries resources. They are primarily filter feeders and ingest microscopic floating plankton for their food.

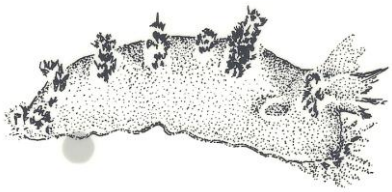


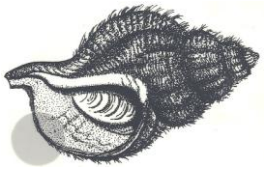
LOCOMOTION

Some bivalves can swim at an impressive rate by using their muscular foot. Scallops move by clapping their shells together rapidly to eject water around the hinge to propel itself through the water. Other bivalves are static & attach to surfaces.

2. **Gastropods** (class Gastropoda) – snails, limpets, nudibranchs (sea slugs). These are the "stomach in their foot" animals, gastro meaning stomach and pod referring to foot. Most have a single shell and are also termed univalves. The exception is the nudibranchs or sea slugs which lack shells altogether. Nudibranchs protect themselves very well, however, by secreting toxins or by ingesting the stinging cells from sea anemones. Nudibranch means "naked gill" from nudi (naked) and branc (gill) as most have their gills exposed on their backs.







3. **Polyplacs** (class Polyplacophora) – chitons. The chitons all have eight shell-like plates on their backs, hence poly (many), plac (plate), phora (bearing). Chitons are found gripped tightly to rocks with their tough suction foot. When dislodged, they protect themselves by rolling up into a ball. Some coastal peoples look for "gumboot" chitons and eat the foot as a chewy delicacy.

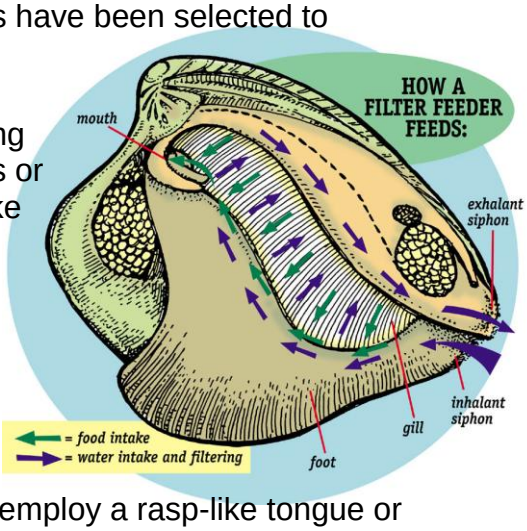
4. **Cephalopods** (class Cephalopoda) – octopuses, squids, cuttlefish. These are the "head on their foot" animals, ceph meaning head and pod referring to foot. Cephalopods literally have their head attached to their foot, which is modified into arms and/or tentacles equipped with many suckers for locomotion and prey capture. Because of their appearance and habits, they have been a subject of fear and myth over the centuries, but are truly amazing animals with high intelligence and unique abilities that scientists are only now starting to discover.

Mollusk Biology:

A comprehensive overview of mollusk biology is much beyond the scope of DIPAC's Seaweek program, given the wide diversity of mollusks. However, several areas of life history are presented on a bi-annual rotating basis – that of feeding habits and protection.

Feeding Habits

Mollusk biology reflects the different feeding strategies and methods used to gather food. Their feeding method also is reflective of their position on the food chain or level of energy transfer. Plants capture the energy of the sun through photosynthesis, which is transferred through the animal kingdom at various levels. Filter feeders and grazers represent the first level in which plants are directly consumed. Animals, which eat them and other animals, are predators and may eat at several levels above that. Several common mollusks have been selected to represent these food chain levels.

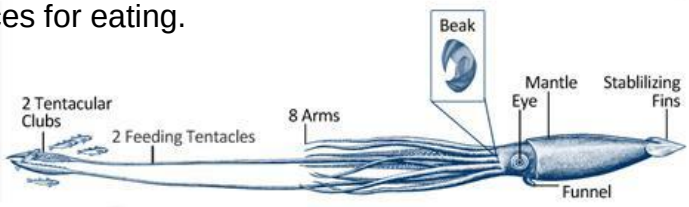


1. **Filter feeders** – clams. These animals depend on sucking in large amounts of water and filtering out the organisms or debris material for their food. Clams employ their tube-like siphon to suck in water which is filtered by hair-like cilia. Collected food is passed into the stomach and waste is excreted back out the siphon. Filter feeders depend on plankton, which may be algae (phytoplankton i.e. plant plankton) or small animals (zooplankton i.e. animal plankton).

2. **Grazers** – limpets, chitons, some snails. These animals employ a rasp-like tongue or radula to scrape algae off substrate or eat other plant material.
(photos: left - radula of a grazer; right - the drilling work of a predator)

3. **Predators:** example 1 – the driller – moonsnails. These animals search for clams buried in the sand or mud and then use their radula to drill a hole in the clam shell. Once a hole is made, the snail scrapes out the soft body using its radula and leaves an empty shell behind, with only a small round hole as evidence of its deed.

4. **Predators:** example 2 – the biter – squid. Squid actively hunt and pursue their prey by using their siphons to jet through to water when chasing after fish and other swimming animals. When in range, their sucker-covered tentacles grab the prey and then stuff the victim down to its mouth. Their parrot-like beak then bites it to immobilize it with venom and then chomps it into bite-size pieces for eating.



Protection and Defense

Their biology and level on the food chain also is reflected in a wide variety of styles of defense and protection.

1. **Hard shell** – one of the basic features of most kinds of mollusks, shelled mollusks also have evolved several sub-sets of defensive strategies to further protect them.

   a. *Clam up* – bivalves like clams and oysters have strong hinge muscles which quickly close their shells tightly together when disturbed. Many snails also have a hard chitinous operculum on their soft foot. When disturbed the snail retreats into its shell leaving only the operculum facing outward, much like shutting the door behind itself.

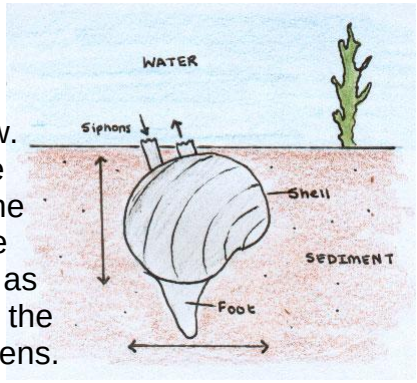
Protection

A familiar form of protection the oyster has against tiny foreign invaders results in the formation of a pearl. A foreign object such as a parasitic worm, small crab or sand particle will enter the shell of the oyster. In defense, the mollusk will begin to cover up this invader or irritant with a substance called "nacre." The oyster will keep layering the nacre over the irritant until eventually a lustrous pearl is formed.

   b. *Cover up* – moon snails have a unique way to keep predatory sea-stars from grabbing them with the star's tube-like feet. As the snail detects the approach of the sea star, it quickly expands its slimy, slippery mantle out from under its shell to completely cover the shell and make it too slippery for the star to grasp it. At the same time it quickly crawls away on its slimy foot.

   c. *Clamp down* – limpets and chitons have a strong muscular foot with which they attach themselves to hard substrate. When disturbed, they quickly contract the foot to form a strong suction cup, which clamps the animal tightly onto the substrate making it very hard to dislodge. Octopus and squid also can use their numerous suckers on their arms and tentacles to hold on when something else tries to grab onto them.

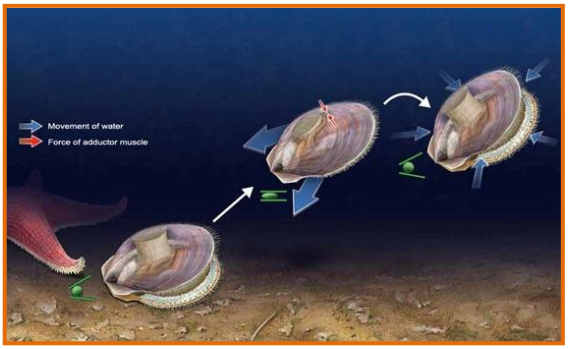
   d. *Dig down* – clams don't just rely on their hard shell and "clamming up" to protect themselves, but they also use their strong foot to dig down into soft substrate such as sand and mud to completely bury themselves out of view. They then extend their siphon tube back to the substrate surface to suck in water for feeding and respiration. At the approach of danger, they withdraw the siphon below the substrate for total concealment, then extend it out again as they sense the threat has passed. Some clams such as the razor clam will also dig further down when danger threatens.

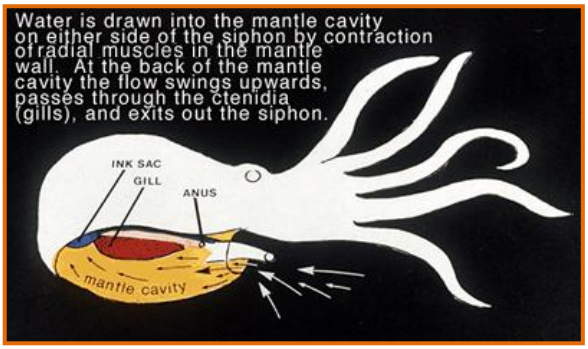


   e. *Tie down* – mussels and sometimes scallops secure themselves to hard substrate by secreting strong, thin byssal threads which form tough attachments. Mussels also aggregate themselves together in dense beds with interlinking threads seeking protection in numbers. Byssal threads are formed by a special byssus gland in the mussel's foot by combining several proteins together and extruding the sticky threads through the shell, which quickly set up and harden onto the substrate, like natural super-glue. Oysters also have a byssus gland that produces a cement rather than threads to attach themselves to substrate and each other.

2. **No shell** – nudibranchs and most cephalopods are mollusks that lack shells, but they compensate with other ways of defense and protection. Some of these defenses are also used by shelled mollusks as well and vice versa.

   a. *Jet away* – scallops, octopus and other cephalopods squirt water out of their bodies to swim away using a watery form of jet propulsion. Scallops, which are bivalves with shells, clap their shells together rapidly to squirt out water in a jerky, almost slow motion form of jet propulsion. The cephalopods use their flexible siphon to rapidly shoot water to jet away for normal swimming, food capture, and to flee danger. The siphon can rotate in any direction so the animals can change speed & direction at will.





   b. *Now you see me, now you don't* – camouflage in various forms is a cephalopod specialty with the octopus particularly adept in its use.

DEFENSE

Nudibranchs may not actually be poisonous to eat, but many of them will eat sea anemones and then retain live anemone stinging cells in their bodies. So a predator that tries to eat a sea slug ends up getting a mouthful of stinging cells – ouch!

      i. Inking is a well-known technique employed by them, in which a dark pigment, melanin, is produced in a special ink gland and is shot out in the path of a threatening predator. The ink acts as a smoke screen to conceal and confuse the predator while the cephalopod makes its escape. The ink also contains tyrosinase, an enzyme, which may cause irritation or numbing of senses of the predator.
      ii. Changing color & shape incredibly fast and into an amazing array of forms, is another defense used by octopuses. Using skin pigment cells called chromatophores, they can almost instantly change color to blend into their surroundings while at the same time alter their flexible skin to match the substrate nearby, including looking like rocks, coral, or even algae. The mimic octopus, found in Indonesian waters, can even change its shape to resemble other fish or animals to fool predators into leaving them alone.
      iii. Hiding is always a good choice and that is usually the first line of defense for them, so along with the above techniques, they will try to retreat to the nearest shelter to get out of harm's way. A few octopuses may also join their clam cousins and quickly burrow into soft substrate to hide.

   c. *Eat me at your own risk* – nudibranchs or sea slugs like their terrestrial cousins land slugs just taste yucky to most predators. Unlike most land slugs, however, nudibranchs are often some of the most colorful and flamboyant animals in the ocean in their appearance. Like brightly-colored tropical frogs, however, their beautiful colors serve as a warning to potential predators – don't eat me!

d. *Watch out, I bite back* – octopus and squid may lack hard shells, but they do have one hard and sharp part that serves them well in defense – their chitinous, parrot-like beak. Coupled with a venom gland, the animal when attacked can bite back and deliver a dose of venom to the attacker to discourage further action or even kill it. For some octopus species, the venom serves to incapacitate its prey when it hunts for food, but is not deadly for humans. A bite from the Giant Pacific octopus reportedly may cause a reaction similar to a bee sting and may cause immediate discomfort that can last for several weeks or longer. However, the small blue-ringed octopus of Australia has venom so powerful that human death can result in just minutes after a bite!

MOLLUSK VOCABULARY:

1. **Mollusks** = soft-bodied invertebrate animal that is characterized by an internal or external shell, a foot, mantle, & visceral mass.
2. **Radula** = a tongue-like structure used by snails for chewing & rasping.
3. **Mantle** = thin layer of tissue that covers most of a mollusk's body and secretes the shell when one is present.
4. **Foot** = part of a mollusk that helps it burrow, move, or attach.
5. **Gills** = organs in which carbon dioxide from the mollusk is exchanged for oxygen in the water.
6. **Visceral mass** = area beneath the mantle that contains the internal organs.
7. **Shell** = structure in mollusks made by glands in the mantle that secrete calcium carbonate.
8. **Siphons** = tubes that water enters and leaves through, carrying in oxygen and food particles, and carrying out carbon dioxide and other wastes.
9. **Incurrent siphon** = siphon that brings water in (along w/ food & oxygen).
10. **Excurrent siphon** = siphon that expels water out (along w/ wastes & carbon dioxide).
11. **Bilateral symmetry** = having a body displaying two similar halves.
12. **Bivalve** = mollusk that lives within a shell made of two sections that are hinged together; includes clams, oysters, mussels, scallops.
13. **Gastropod** = mollusk that moves by means of a broad, muscular foot located on its ventral side; usually one-piece shell for protection; includes limpets, snails, nudibranchs
14. **Cephalopod** = means "head-footed" and is a mollusk having a prominent head and a foot that has been modified into tentacles; includes octopuses and squids.