28.3F: Classification of Phylum Mollusca

The phylum Mollusca includes a wide variety of animals including the gastropods ("stomach foot"), the cephalopods ("head foot"), and the scaphopods ("boat foot").

Learning Objectives

- Differentiate among the classes in the phylum mollusca

Key Points

- Mollusks can be segregated into seven classes: Aplacophora, Monoplacophora, Polyplacophora, Bivalvia, Gastropoda, Cephalopoda, and Scaphopoda. These classes are distinguished by, among other criteria, the presence and types of shells they possess.
- Class Aplacophora includes worm-like animals with no shell and a rudimentary body structure.
- Members of class Monoplacophora have a single shell that encloses the body.
- Members of class Polyplacophora are better known as "chitons;" these molluscs have a large foot on the ventral side and a shell composed of eight hard plates on the dorsal side.
- Class Bivalvia consists of mollusks with two shells held together by a muscle; these include oysters, clams, and mussels.
- Members of class Gastropoda have an asymmetrical body plan and usually have a shell, which can be planospiral or conispiral. Their key characteristic is the torsion around the perpendicular axis on the center of the foot that is modified for crawling.
- Class Scaphopoda consists of mollusks with a single conical shell through which the head protrudes, and a foot modified into tentacles known as captaculae that are used to catch and manipulate prey.
Key Terms

- **ctenidium**: a respiratory system, in the form of a comb, in some molluscs
- **captacula**: the foot of a Scaphalopod, modified into tentacles for capturing prey
- **nephridium**: a tubular excretory organ in some invertebrates

Classes in Phylum Mollusca

Phylum Mollusca is a very diverse (85,000 species) group of mostly marine species, with a dramatic variety of form. This phylum can be segregated into seven classes: Aplacophora, Monoplacophora, Polyplacophora, Bivalvia, Gastropoda, Cephalopoda, and Scaphopoda.

Class Aplacophora

Class Aplacophora (“bearing no plates”) includes worm-like animals primarily found in benthic marine habitats. These animals lack a calcareous shell, but possess aragonite spicules on their epidermis. They have a rudimentary mantle cavity and lack eyes, tentacles, and nephridia (excretory organs).

Class Monoplacophora

Members of class Monoplacophora (“bearing one plate”) possess a single, cap-like shell that encloses the body. The morphology of the shell and the underlying animal can vary from circular to ovate. A looped digestive system, multiple pairs of excretory organs, many gills, and a pair of gonads are present in these animals. The monoplacophorans were believed extinct and only known via fossil records until the discovery of Neopilina galathaea in 1952. Today, scientists have identified nearly two dozen extant species.

Class Polyplacophora

Animals in the class Polyplacophora (“bearing many plates”) are commonly known as “chitons” and bear an armor-like, eight-plated dorsal shell. These animals have a broad, ventral foot that is adapted for suction to rocks and other substrates, and a mantle that extends beyond the shell in the form of a girdle. Calcareous spines may be present on the girdle to offer protection from predators. Chitons live worldwide, in cold water, warm water, and the tropics. Most chiton species inhabit intertidal or subtidal zones, and do not extend beyond the photic zone. Some species live quite high in the intertidal zone and are exposed to the air and light for long periods.
Figure \(\PageIndex{1}\): **Chiton morphology**: The underside of the gumboot chiton, Cryptochiton stellari, showing the foot in the center, surrounded by the gills and mantle. The mouth is visible to the left in this image.

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**Class Bivalvia**

Bivalvia is a class of marine and freshwater molluscs with laterally compressed bodies enclosed by a shell in two hinged parts. Bivalves include clams, oysters, mussels, scallops, and numerous other families of shells. The majority are filter feeders and have no head or radula. The gills have evolved into ctenidia, specialised organs for feeding and breathing. Most bivalves bury themselves in sediment on the seabed, while others lie on the sea floor or attach themselves to rocks or other hard surfaces.

The shell of a bivalve is composed of calcium carbonate, and consists of two, usually similar, parts called valves. These are joined together along one edge by a flexible ligament that, in conjunction with interlocking “teeth” on each of the valves, forms the hinge.

Figure \(\PageIndex{1}\): **Empty shell of a bivalve**: The empty shell of the giant clam, Tridacna gigas. Note the pair of shells that are hinged together, a characteristic of members of the class Bivalvia.
Class Gastropoda

Animals in class Gastropoda ("stomach foot") include well-known mollusks like snails, slugs, conchs, sea hares, and sea butterflies. Gastropoda includes shell-bearing species as well as species with a reduced shell. These animals are asymmetrical and usually present a coiled shell. Shells may be planospiral (like a garden hose wound up), commonly seen in garden snails, or conispiral (like a spiral staircase), commonly seen in marine conches.

The visceral mass in the shelled species displays torsion around the perpendicular axis on the center of the foot, which is the key characteristic of this group, along with a foot that is modified for crawling. Most gastropods bear a head with tentacles, eyes, and a style. A complex radula is used by the digestive system and aids in the ingestion of food. Eyes may be absent in some gastropods species. The mantle cavity encloses the ctenidia (singular: ctenidium) as well as a pair of nephridia (singular: nephridium).

![Gastropod foot](figure1.png)

Figure 1: **Gastropod foot**: Gastropods, such as this Roman snail, have a large foot that is modified for crawling.

Class Cephalopoda

Class Cephalopoda ("head foot" animals) includes octopi, squids, cuttlefish, and nautilus. Cephalopods are a class of shell-bearing animals as well as mollusks with a reduced shell. They display vivid coloration, typically seen in squids and octopi, which is used for camouflage. All animals in this class are carnivorous predators and have beak-like jaws at the anterior end. All cephalopods show the presence of a very well-developed nervous system along with eyes, as well as a closed circulatory system. The foot is lobed and developed into tentacles and a funnel, which is used as the mode of locomotion. Locomotion in cephalopods is facilitated by ejecting a stream of water for propulsion ("jet" propulsion). Cephalopods, such as squids and octopi, also produce sepia or a dark ink, which is squirted upon a predator to assist in a quick getaway. Suckers are present on the tentacles in octopi and squid. Ctenidia are enclosed in a large mantle cavity serviced by blood vessels, each with its own associated heart. The mantle has siphonophores that facilitate exchange of water.
Cephalopods: Cephalopods ("head foot") include this octopus, which ejects a stream of water from a funnel in its body to propel itself through the water.

A pair of nephridia is present within the mantle cavity. Sexual dimorphism is seen in this class of animals. Members of a species mate, then the female lays the eggs in a secluded and protected niche. Females of some species care for the eggs for an extended period of time and may end up dying during that time period. Reproduction in cephalopods is different from other mollusks in that the egg hatches to produce a juvenile adult without undergoing the trochophore and veliger larval stages.

Class Scaphopoda

Members of class Scaphopoda ("boat feet") are known colloquially as "tusk shells" or "tooth shells," as evident when examining Dentalium, one of the few remaining scaphopod genera. Scaphopods are usually buried in sand with the anterior opening exposed to water. These animals bear a single conical shell, which has both ends open. The head is rudimentary and protrudes out of the posterior end of the shell. These animals do not possess eyes, but they have a radula, as well as a foot modified into tentacles with a bulbous end, known as captaculae. Captaculae serve to catch and manipulate prey. Ctenidia are absent in these animals.
is depicted here.