

Phylum Mollusca

Hypothetical ancestral mollusc (HAM)

The body is generally divided into three main regions:

1. The foot

2. The visceral mass

3. The mantle

The space between the mantle and the visceral mass is called the **mantle cavity**

In some animals the mantle is responsible for secreting the calcium carbonate shell comprised of the **periostracum**, **prismatic layer**, and **nacreous layer**

The gills are **bipectinate**

The mouth cavity of HAM, like most molluscs, possesses a specialized feeding structure called the **radula**.

The radula is supported by a cartilaginous structure called the **odontophore**

The most primitive molluscs have a nervous system consisting of a **nerve ring** around the anterior part of the gut and 2 **longitudinal nerve cords**

The coelom is much reduced

The **open circulatory system** circulatory system consists of a heart which pumps blood in vessels that pass through the gills

The excretory organs of the molluscs are called **metanephridia**, with a **Nephrostome** and **nephridiopore**

Most of the molluscs produce a free-swimming ciliated larvae called the **trochophore larvae**

In the more primitive molluscs the trochophore develops into the adult, but in other molluscs there is a second larval stage called the **veliger**

Molluscan Diversity

Class Aplacophora (now split into class Caudofoveata and Solenogastres)

Small, worm-like aberrant molluscs

They construct burrows in soft marine sediments which they inhabit head downwards.

They ingest sediment, or may be selective carnivores or scavengers.

Many typical molluscan characteristics are either absent or reduced: no shell, no foot, and the mantle covers the entire body.

Lacking a foot, they move by peristaltic contractions

The posterior body cavity (believed to represent the mantle cavity) houses a pair of gills (ctenidia).

The Caudofoveata and Solenogastres are generally combined to form the class Aplacophora, although this practice is becoming discontinued as the differences between these two small primitive groups become known.

Class Monoplacophora

The dorsal surface is covered with a symmetrical shield shaped shell, the apex of which is a little peaked and directed anteriorly

The ventral surface is broad and flat, with the mantle cavity in the form of 2 grooves located to either side of the foot

The mantle groove contains 5 or 6 pairs of gills

The gills are monopectinate

Compared to HAM, there is a greater repetition (serially repeated) of body parts in the monoplacophorans

Class Polyplacophora

The head is poorly developed and much of the ventral surface is occupied by a broad foot
Possess a dorsal shell that is composed of 8 overlapping plates arranged linearly along the anterior-posterior axis

The lateral margins of the plates are overgrown to varying degrees by the mantle - called the **girdle**

Mantle cavity is limited to two lateral troughs or grooves - **pallial grooves**

Within the grooves lie many bipectinate gills

Class Gastropoda

1. Changes in the shell

In the early fossils the shells were **bilaterally coiled** or **planospiral shells**
But the modern day shells of most gastropods are asymmetrical

Why?

Planospiral shell was not very compact

The asymmetrical shell is more compact because the diameter will not be as great as when each whorl is outside of the previous whorl, as in the planospiral shell

But, this change in symmetry of the shell created a shift in the weight to one side of the animal (e.g., unbalanced)

In order to achieve a better weight distribution, the shell needed to shift - a little upward and posterior

2. The increased development of the head

3. The occurrence of embryonic process known as torsion.

During embryonic development, one side of the visceral mass grows at a much faster rate than the other.

Causes the visceral mass to rotate 180 degrees relative to the head-foot.

Advantages of Torsion

Head retracted first; gills receive water currents

Osphradium is now directed anteriorly

Disadvantage

Gills to become clogged with wastes and sediments - **fouling**

Adaptations to Avoid Fouling

See numerous changes that better separated the inhalent and exhalent water streams

Shell

Most have a single, spiraled shell and can move the entire head and foot into this shell for protection.

Also, many gastropods have a hardened plate called the **operculum** on the back of the foot

Nutrition

Almost all have the radula and many gastropods are herbivores and use it scrap algae from surfaces of rocks

Some gastropods are active predators and in these the radula is often highly modified

Respiration

Aquatic gastropods possess gill for respiration

But terrestrial forms, mantle becomes well vascularized

Class Bivalvia

Several of the characteristics of the group represent adaptations for burrowing

Bivalves have shells that are divided into 2 equal halves

The mantle tissue under went indentation in the anterior-posterior margins and developed 2 centers of calcification

The shells or joined at the dorsal midline - **hinge**

There are specific muscles called **pallial muscles** that insert on the underside of the shell and are attached to the free edge of the mantle

Responsible for pulling in the mantle under the shell

At specific points in the bivalves (anterior and posterior), some of the pallial muscles fused across the width of the organism

These muscles called **adductor muscles** connect the 2 shell across their width

Contraction of these muscles bring the shell together

Protobranchs

Possess a small foot

Possess bipectinate gills

Lateral cilia on the gills generate the water currents

The early protobranchs were *deposit feeders* and utilized a pair of long tentacles for this type of feeding

Each tentacle is associated with 2 large flap-like folds, called **labial palps**

Extending from these palps is an elongate ciliated structure called the **palp proboscis**

The material that is rejected by the labial palps is called **pseudofeces**

Lamellibranchs

Lamellibranch gill - gills became a flattened, sheet-like pieces of tissue

Although the lamellibranch gills function in gaseous exchange, they are primarily used as a feeding device

The principal modification of the gills for filtering was:

1. Lengthening in the anterior-posterior perspective to form a series of gill filaments
2. The *flattening* and *folding* of the gill filaments,

Cilia in between the gill filaments generate the water current and other cilia are used to filter out food from the water

Where adjacent filaments are tightly connected, openings (**ostia**) remain for the passage of water between the filaments

The interior space between the two folded halves of the filaments forms **water tubes**, which connect with the **suprabranchial cavity** - the portion of the mantle cavity above the gills

Overall movement of the ventilating currents

In lamellibranchs, the ventilating currents (or feeding currents) enter posteriorly and ventrally as in protobranchs

Upon reaching the gills, there are cilia that bring it in through the ostia and into the water tubes

Now water flows upward to the suprabranchial cavity, where it turns posteriorly and flows outward through the shell gape

Some kinds of cilia on the gills are used to trap food particles suspended in the water and move the trapped food over the surface of the gills toward **food grooves**

Once here, food is directed anteriorly toward the mouth

Prior to entering the mouth the mucous food thread is first sorted by the *labial palps*

Adaptive Radiation of the Bivalve (especially the lamellibranchs)

- a. Soft Bottom Burrowers
- b. Attached surface dwellers
- c. Unattached Surface Dwellers
- d. Hard Bottom Burrowers

Reproduction

Most are dioecious

Marine forms usually produce free swimming trochophore and veliger larvae

Among many of the freshwater bivalves there are **glochidia larvae**

Glochidia are housed in the outer gills - **marsupium**

Class Cephalopoda

Cephalopods evolved following major readjustments in the HAM body plan

The dorso-ventral axis became elongated and the anterior-posterior axis became compressed

The morphologically ventral portion is now the functional anterior

Also, there was a migration of the head to the ventral part of the body where it fused to the foot

The foot is modified as a series of prehensile tentacles or arms

Feeding

Cephalopods are carnivores

Cephalopods have a powerful parrot like beak and a powerful radula

In some of the octopuses the salivary glands are modified poison glands

Locomotion

Swimming is by means of jet propulsion and is accomplished because of the highly modified muscular mantle and the **siphon**

Shell

Primitively the cephalopods possessed a shell

The fossil record indicates both coiled and non-coiled shell

Some cephalopods (cuttlefishes) have an internal shell positioned in the dorsal part of the body - a *cuddle bone*

The cuddle bone shell is built in layers and is tapered at both ends

Also, the shell is subdivided into compartments

The octopods have lost the shell entirely

For protection, many cephalopods possess **ink sacs**

Allow "ink" to be expelled from the mantle cavity

Cephalopods have well-developed sense organs, including a camera type

Also, the octopuses have well-developed brains and show a remarkable capacity for learning.

Cephalopods are the only molluscan class with a **closed circulatory system**

Sexes are separate

Sperm is transferred to females in packets - **spermatophores**