Respiration in mollusca (SEM II, cc –III)

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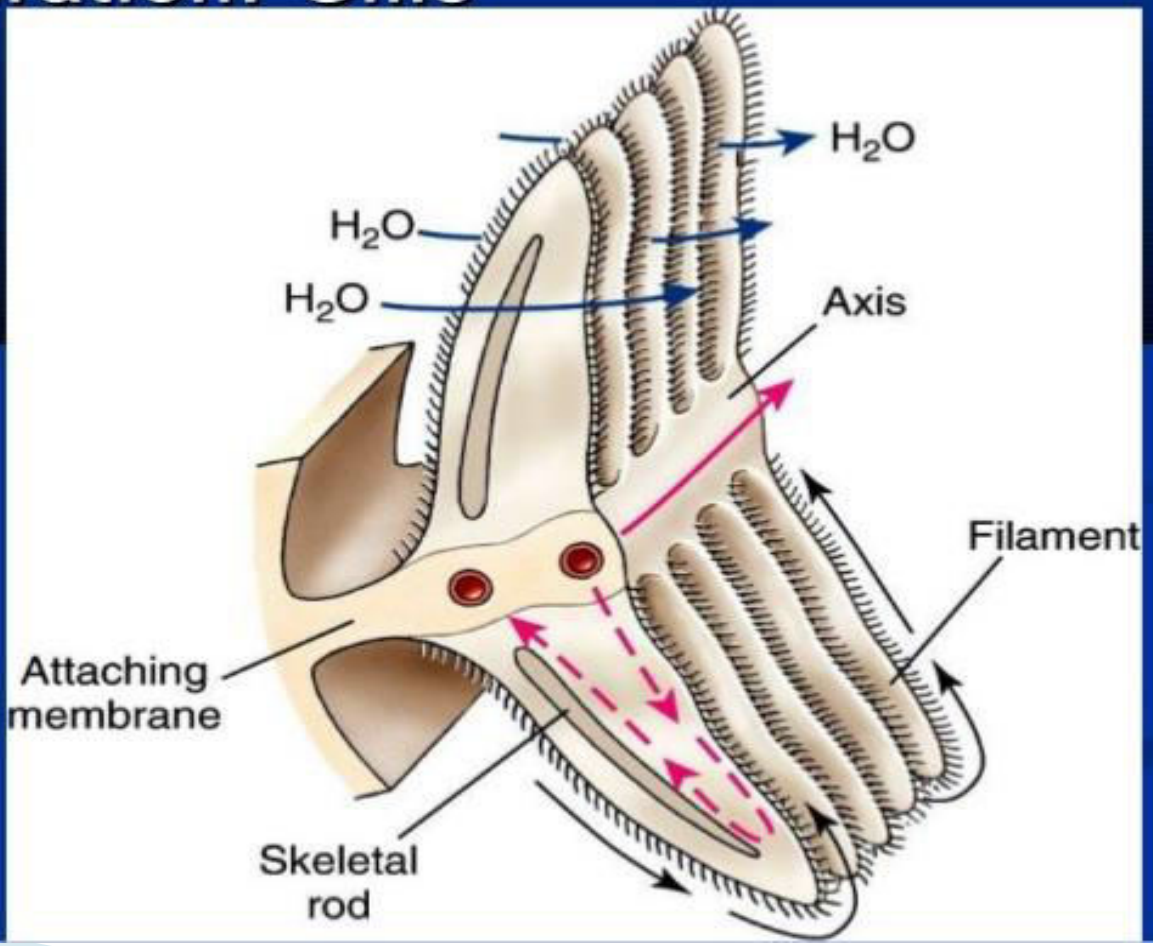
Mollusks use gills as a form of resperation as well as filters for foods, though it is known that most mollusk species only use their gills for breathing. The gills are also refered to as "ctenidia". Aquatic mollusks (i.e snails, clams and squid) breathe through the gills inside their mantel cavities. But land mollusks use an adapted mantle cavity lined with blood vessels to breath "skin breathing".

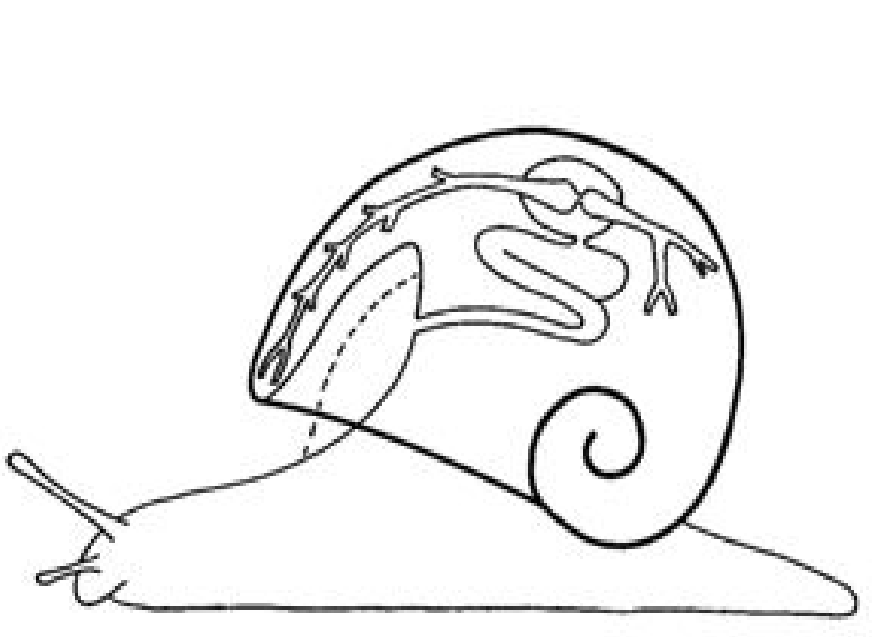
- Externally the mantle cavity is recognised by its large entrance opening, the respiratory opening or pneumostome. It can be seen on the right side of the mantle in the shell aperture, opening and closing periodically. When the snail is not breathing, it closes its pneumostome with a circular muscle, to avoid losing to much water by evaporation.

Apertural view of a living snail. From this point of view the mantle and the respiratory opening can especially well be seen.

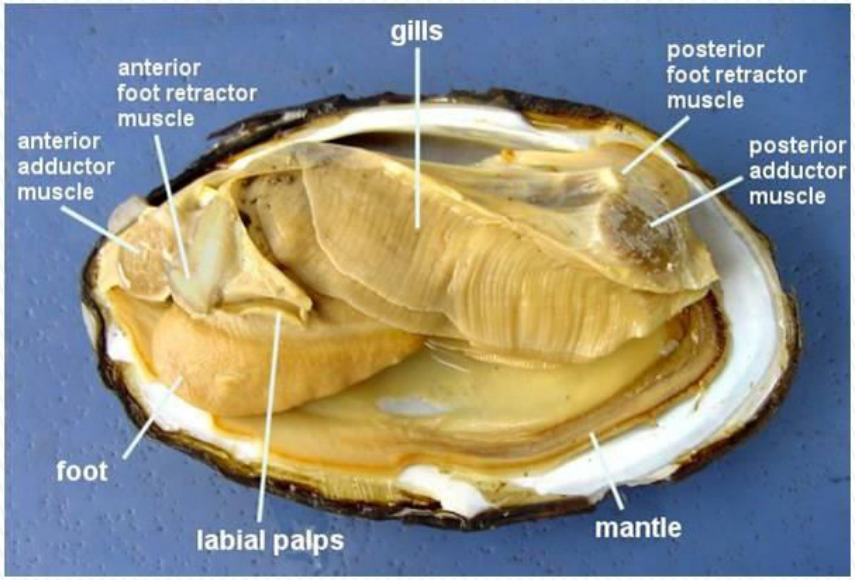
Respiration: Gills

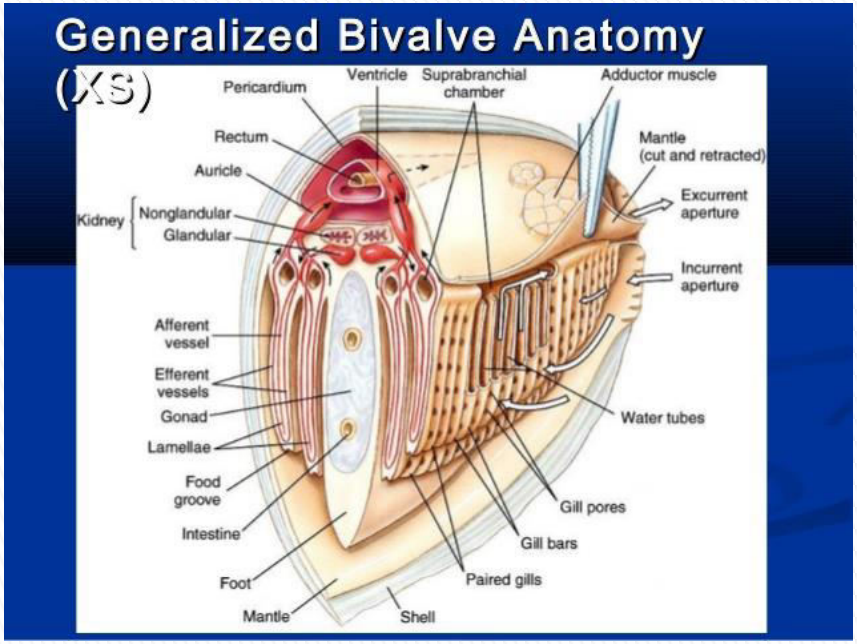


- To inhale, the snail widens the respiratory cavity by lowering the cavity floor. Due to the resulting low pressure, air rich in oxygen flows into the cavity (see illustration on the right).



The process of breathing in a Roman snail: The mantle cavity floor is used like a human diaphragm.


gills
anterior
foot retractor
muscle
posterior
foot retractor
muscle
anterior
adductor
muscle
posterior
adductor
muscle
foot
labial palps
mantle


Generalized Bivalve Anatomy
(XS)
Pericardium
Ventricle
Suprabranchial
chamber
Adductor muscle
Rectum
Mantle
(cut and retracted)
Auricle
Excurrent
aperture
Kidney
Nonglandular
Glandular
Incurrent
aperture
Afferent
vessel
Efferent
vessels
Gonad
Water tubes
Lamellae
Food
groove
Gill pores
Intestine
Gill bars
Foot
Paired gills
Mantle
Shell

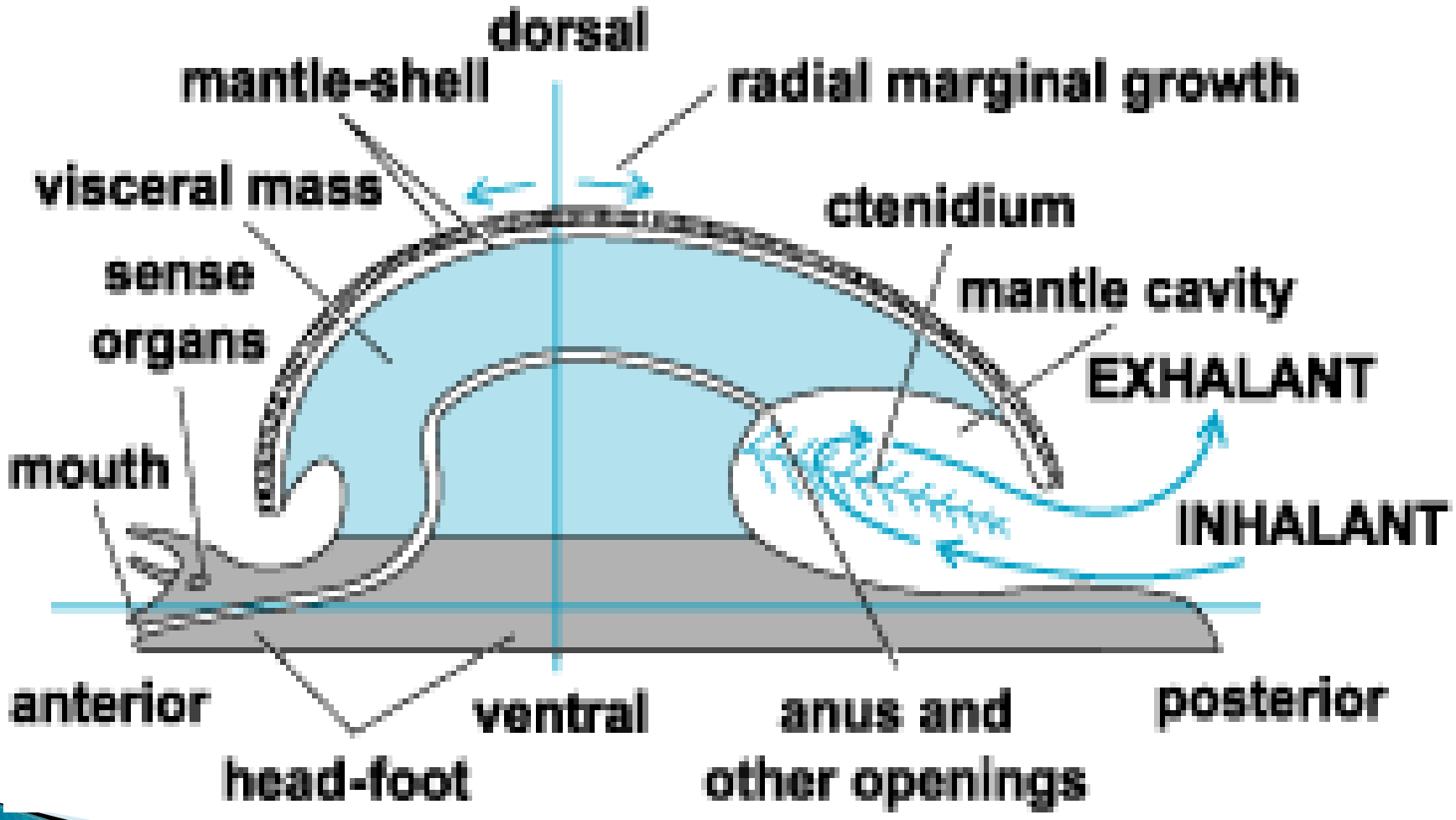
- Gas exchange takes place at the cavity's roof. There the tissue is particularly thin, so oxygen (O_2) diffuses into the blood fluid circulating there. In the opposite direction carbon dioxide (CO_2) diffuses from the blood into the air, following the gradient of gas contained in air and blood respectively. To assist this gas exchange, the snail closes the pneumostome and raises the cavity floor, thus increasing pressure inside the pallial cavity and the rate of oxygen diffusion into the blood.
- To exhale the depleted air, the snail finally opens the pneumostome and raises the cavity floor to press out the air. So the respiratory cavity floor performs the same task as does the human diaphragm in respiration.

- This described respiratory organ of the Roman snail is called its lung, in analogy to the human lung, though it resembles a single alveole, more than the whole organ of a vertebrate's lung. The Roman snail, *Helix pomatia*, because it breathes oxygen from dry air with such a snail lung, is placed systematically in the group of lung snails or pulmonate snails (*Pulmonata*). Those not only live on dry land, but also in fresh water. There they are optimally adapted to the sometimes changeful environmental conditions.

All octopuses have eight arms with rows of suckers on them. They do not have bones. The main part of an octopus's body is called the mantle. Inside the cavity of the mantle are the octopus's organs, including the gills and three hearts. They are vital to its respiratory system. An octopus breathes by drawing water into the cavity that is formed by the mantle. The water provides oxygen for the gills. The water is then pushed out of the body by the siphon. The gill hearts pump blood to the gills. When the blood reaches the gills, the blood dumps waste and loads up on oxygen. The oxygen-rich blood is then pumped to the 3rd heart. This heart, called the systemic heart, pumps blood throughout the squid's body.

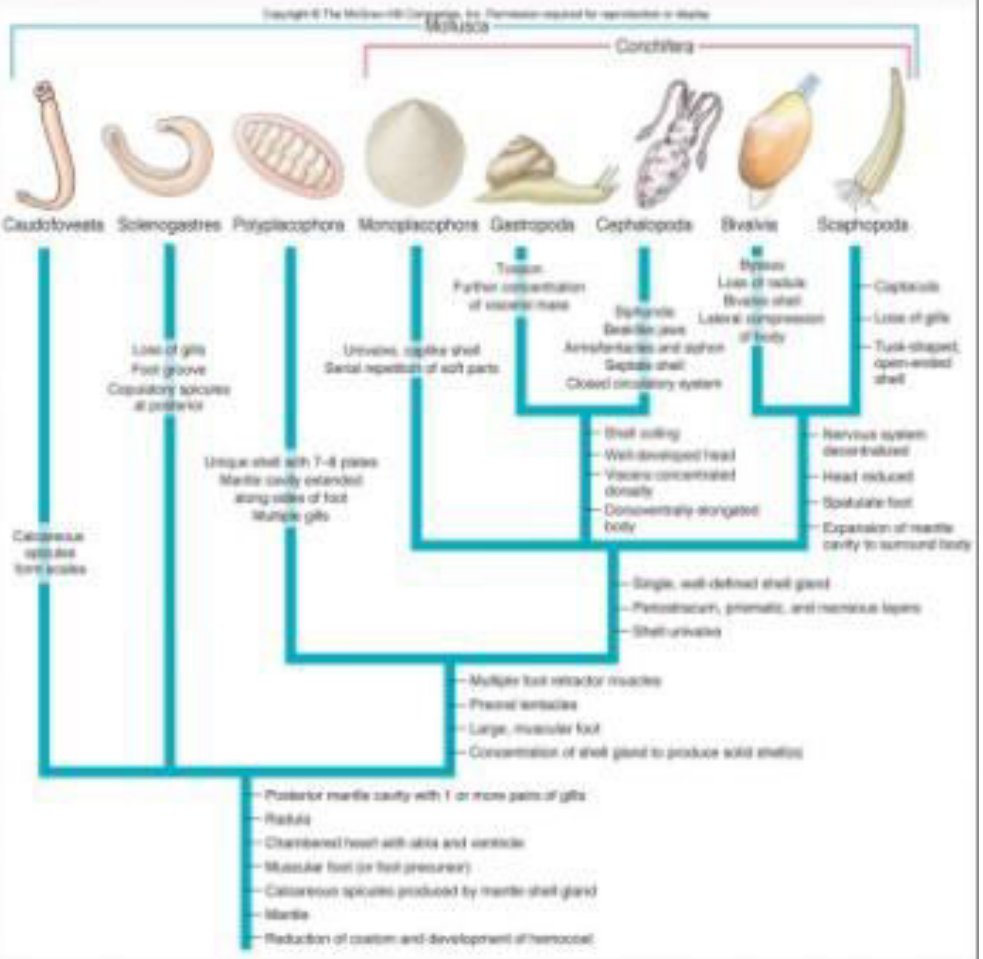
- The sea slug, like almost marine gastropods, breathe with a gill. Many freshwater species, and most of terrestrial species, have a pallial lung. Gastropods with gills are paraphyletic. The sea slug is paraphyletic. The respiratory protein in almost all gastropods is called hemocyanin. Although, some have hemoglobin as respiratory protein. In many sea slugs, the gills are arranged in the shape of a rose. It is made up of feathery plumes on their backs. Some sea slugs have warty or smooth backs and have no visible gill organ. This means that respiration may take place directly through the skin like a sponge.

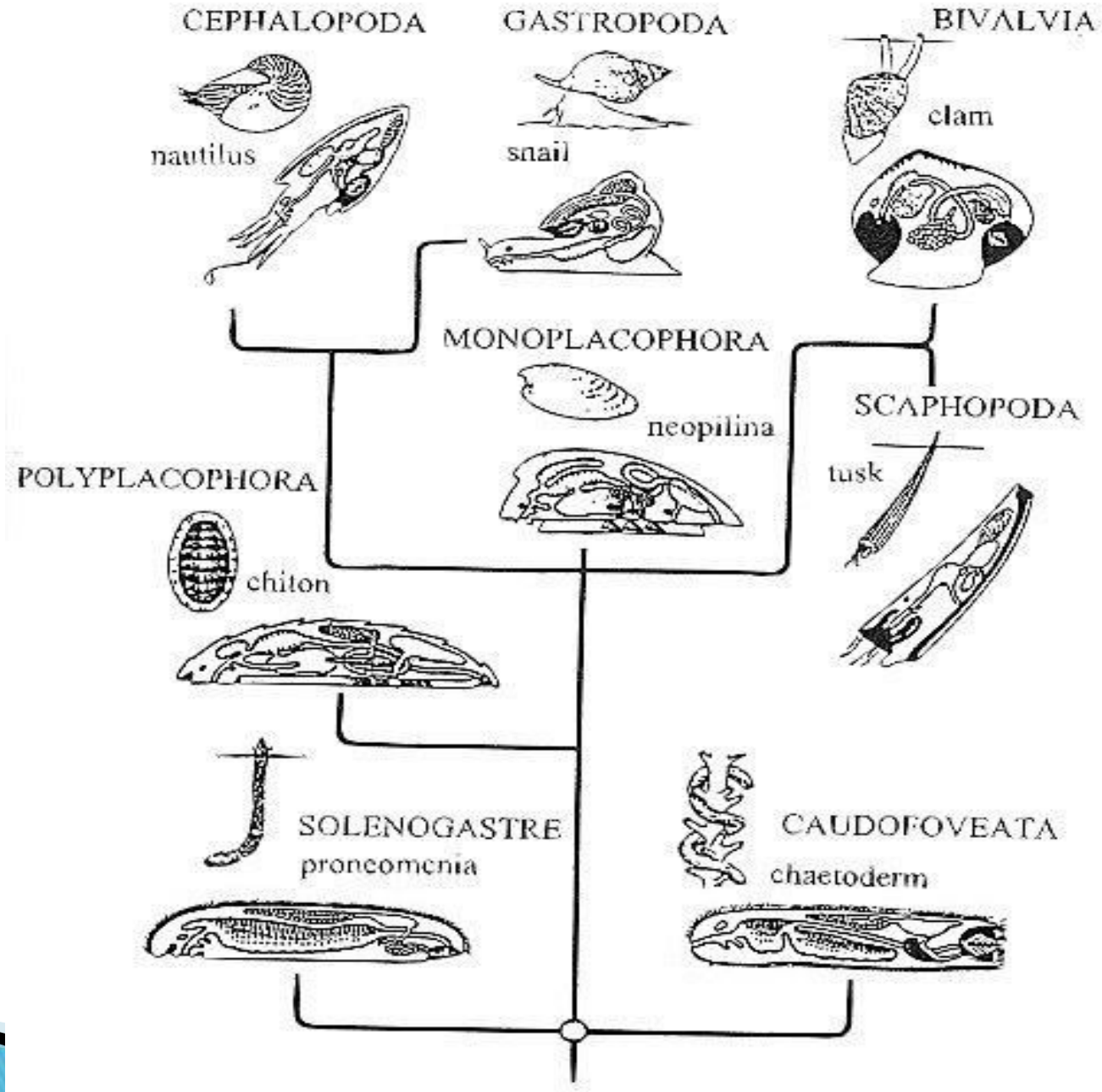
- Squid respire with gills. The squid has two bronchial hearts at the base of the gills. Both bronchial hearts send unoxygenated blood through the gills. Seawater is constantly circulated over their gills. The oxygen from the water diffuses across the cell wall and into their gills. Blood is pumped through the gills and picks up the oxygen and carries it throughout the squid's body. The third ventricular heart then pumps this oxygenated blood throughout the body.


dorsal
mantle-shell
radial marginal growth
visceral mass
ctenidium
sense organs
mantle cavity
EXHALANT
mouth
INHALANT
anterior
ventral
anus and other openings
posterior
head-foot

Major Mollusc Classes

- Four major classes of molluscs:
  - **Class Polyplacophora** – the chitons
  - **Class Gastropoda** – snails & slugs
  - **Class Bivalvia** – clams, mussels, oysters
  - **Class Cephalopoda** – octopus & squid




CEPHALOPODA
GASTROPODA
BIVALVIA
nautilus
snail
clam
MONOPLACOPHORA
neopilina
SCAPHOPODA
tusk
POLYPLACOPHORA
chiton
SOLENOGASTRE
proneomenia
CAUDOFOVEATA
chaetoderm