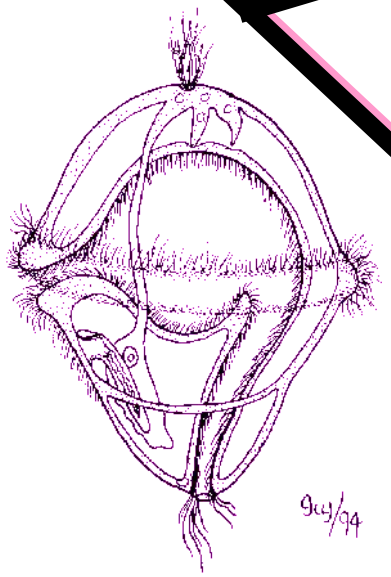
Phylum Mollusca

Adapted from Lesser Known Protostome Phyla. SICB 2001. J.R. Garey.

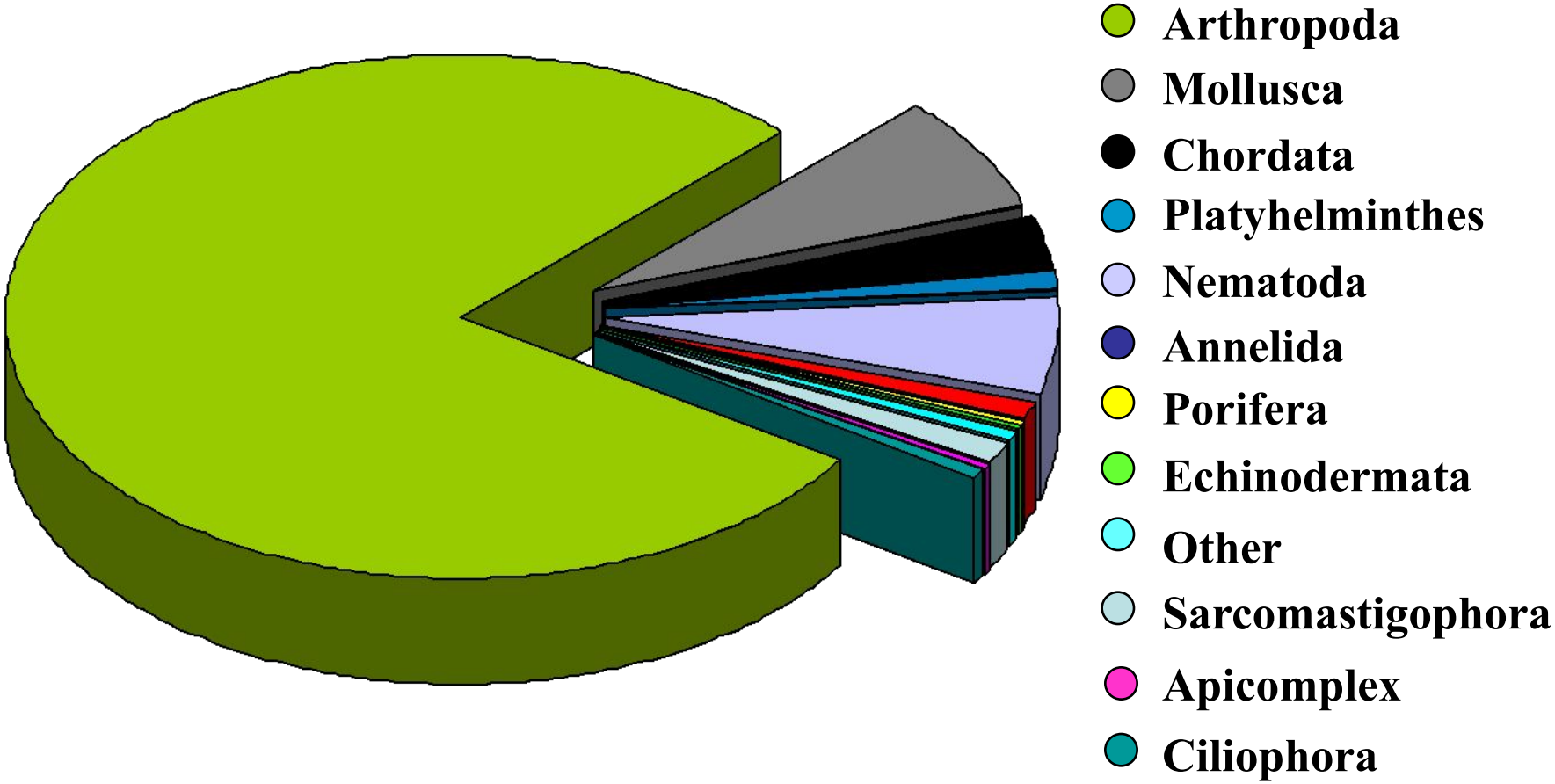


Possess trochophore larvae

Porifera
Cnidaria
Ctenophora
Platyhelminthes
Gastrotricha
Gnathostomulida
Cycliophora
Rotifera
Annelida
Mollusca
Sipuncula
Nemertea
Bryozoa
Brachiopoda
Phoronida
Arthropoda
Onychophora
Tardigrada
Nematomorpha
Nematoda
Priapulida
Kinorhyncha
Loricifera
Echinodermata
Hemichordata
Chordata

Mollusca and Annelida are closely allied phyla

93,000 species of described molluscs (extant) +
70,000 more species from fossil record

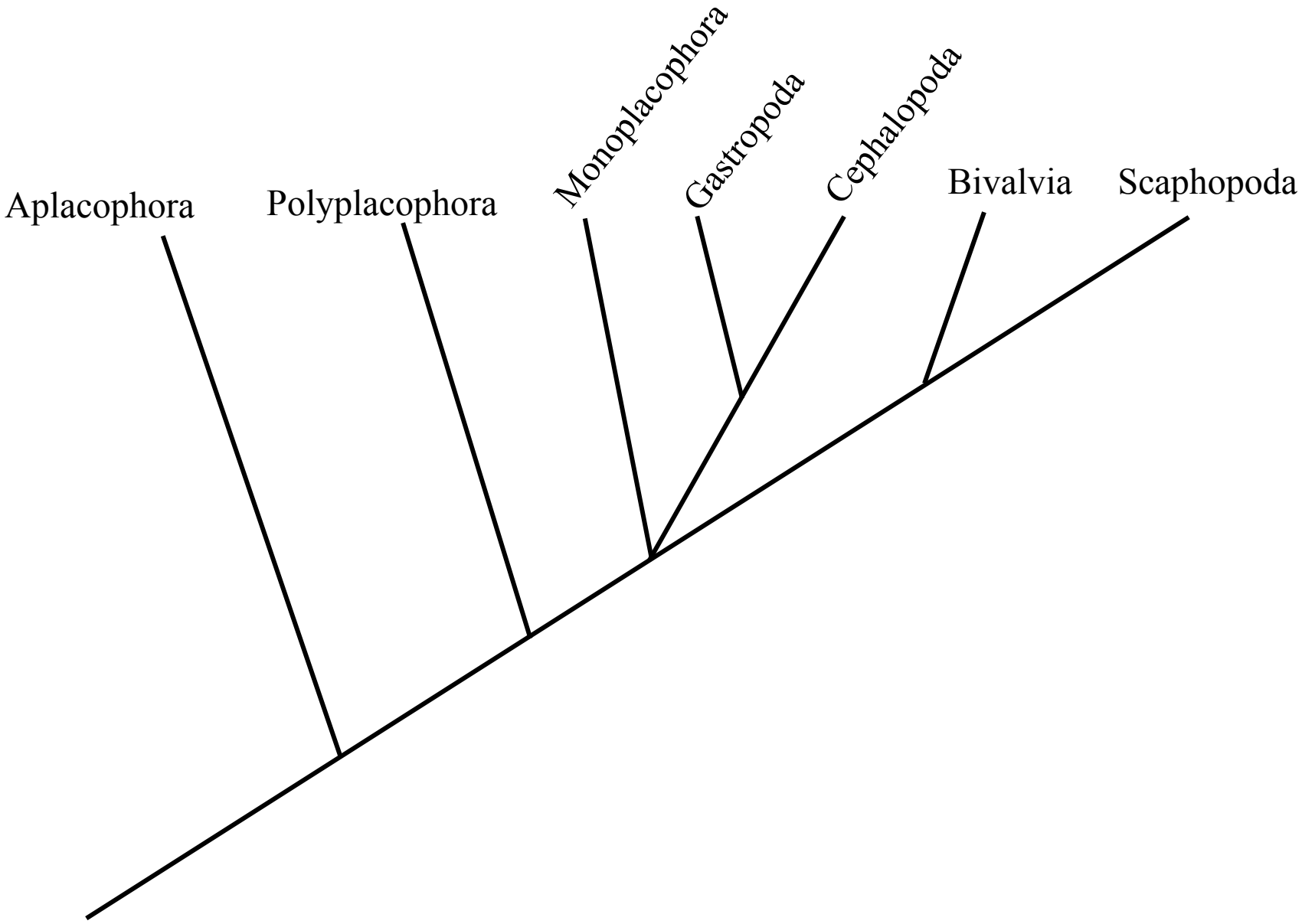


Defining characteristics of Mollusca

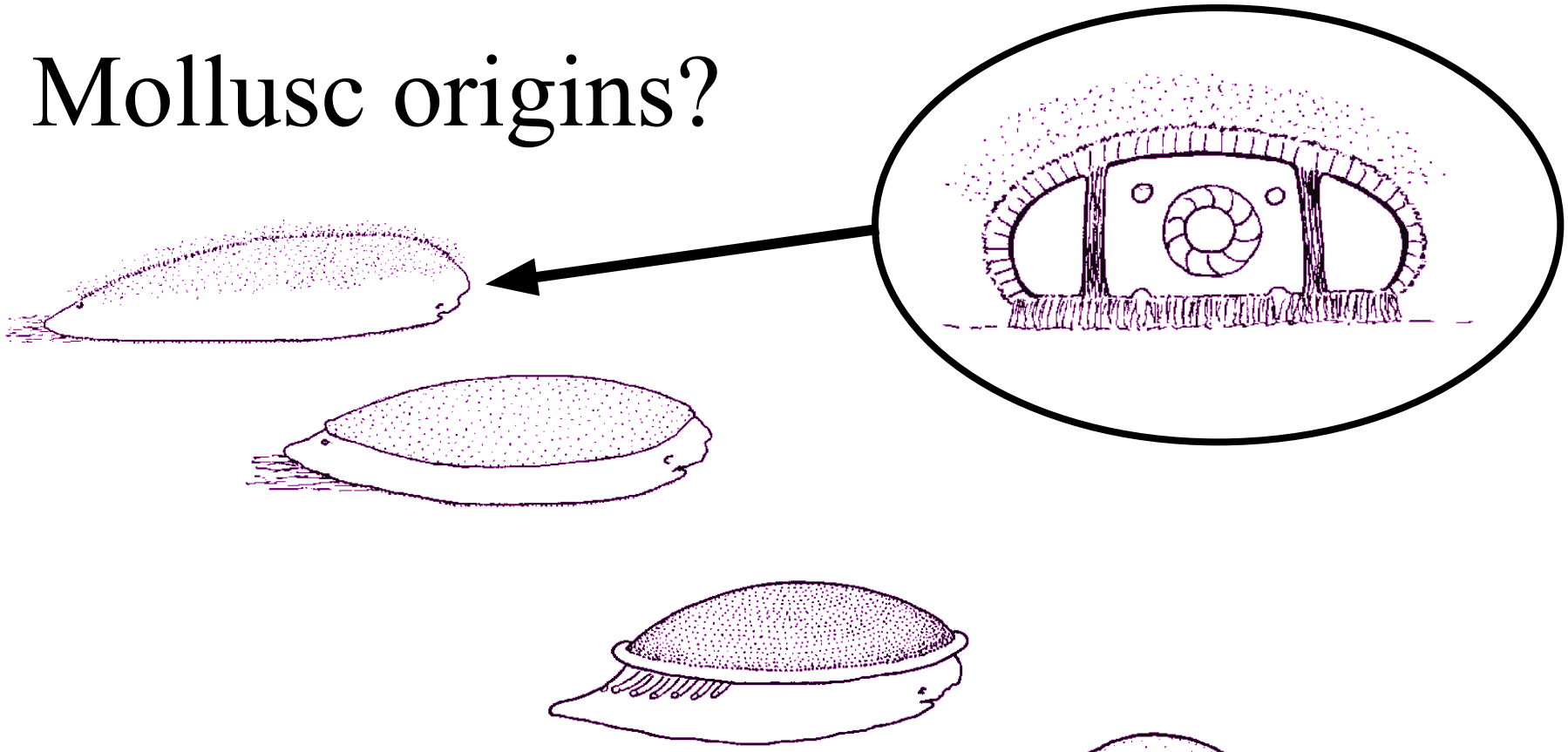
- Bilateral symmetry, cephalization
- Coelom (around heart)
- Mantle
  - draped over viscera
  - secretes shell
- Complete digestive tract, Radula
- Trochophore larvae (often also veliger larvae)
- Locomotion by muscular foot
- Heart, liver, gills (ctenidia), kidney

Phylum. Mollusca

- *Class.* Aplacophora
- *Class.* Polyplacophora
- *Class.* Monoplacophora
- *Class.* Gastropoda
- *Class.* Cephalopoda
- *Class.* Bivalvia
- *Class.* Scaphopoda

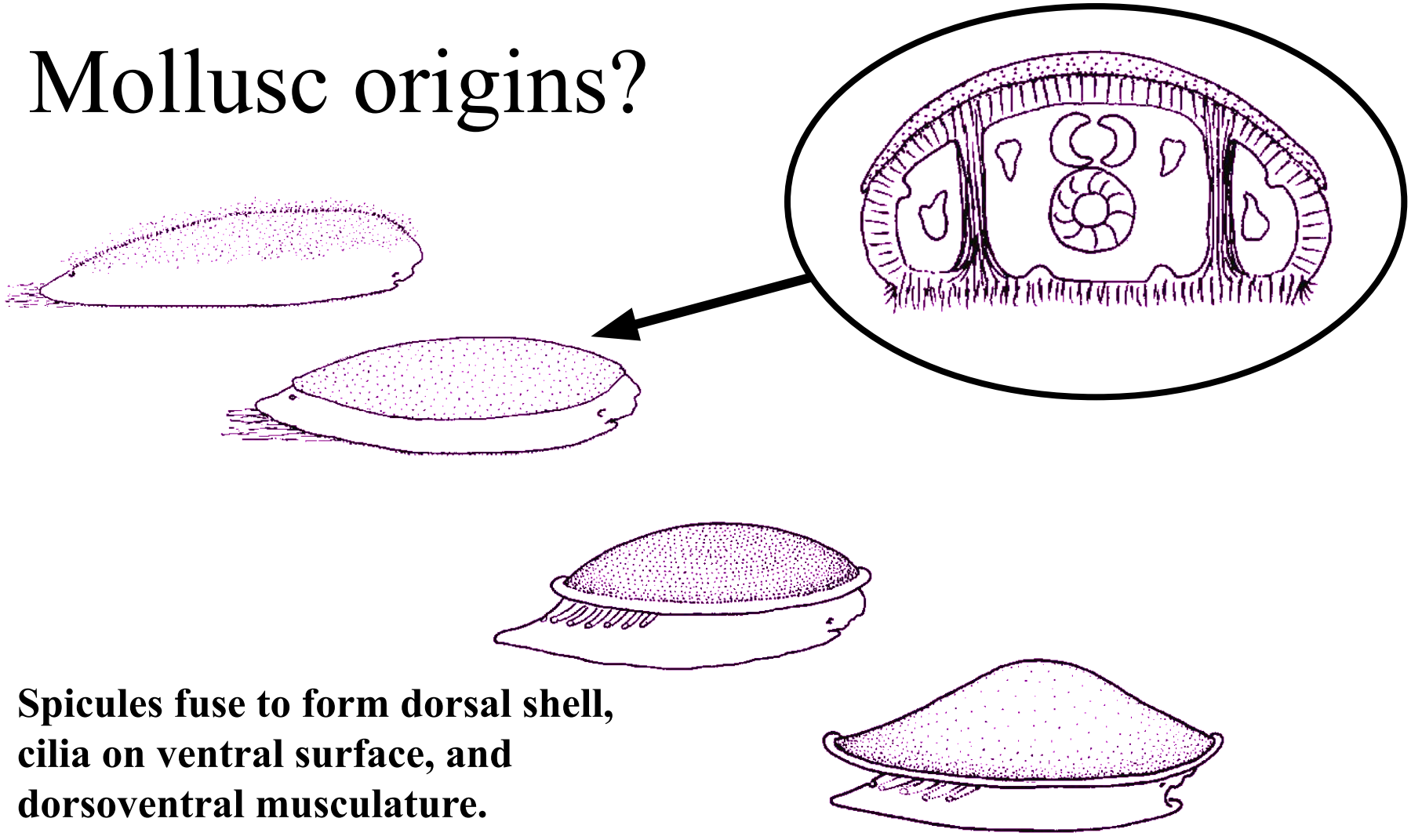

Aplacophora
Polyplacophora
Monoplacophora
Gastropoda
Cephalopoda
Bivalvia
Scaphopoda

Mollusc origins?



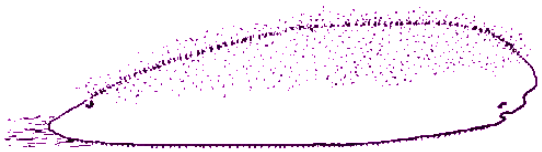
Platyhelminthe-like ancestor with spicules on dorsal surface, cilia on ventral surface, and dorsoventral musculature.

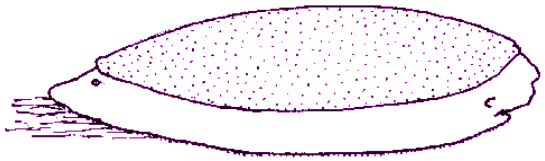
Mollusc origins?

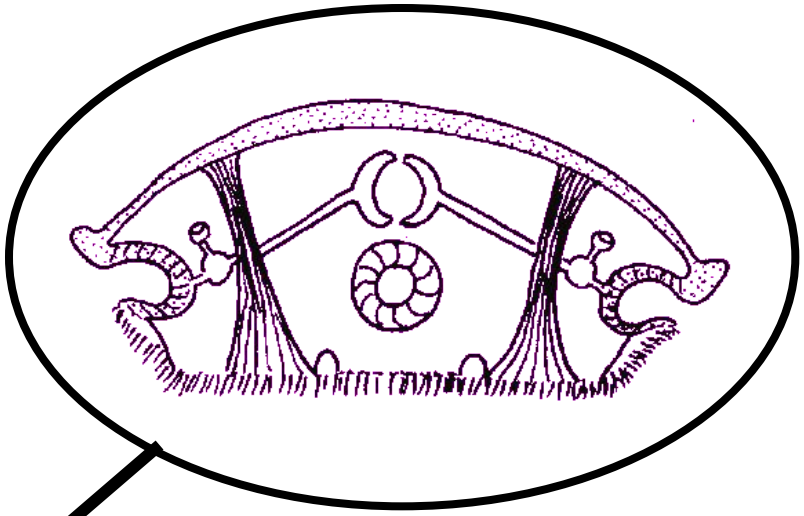


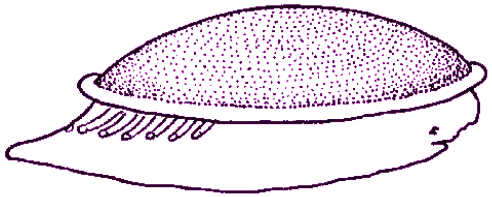
Spicules fuse to form dorsal shell, cilia on ventral surface, and dorsoventral musculature.

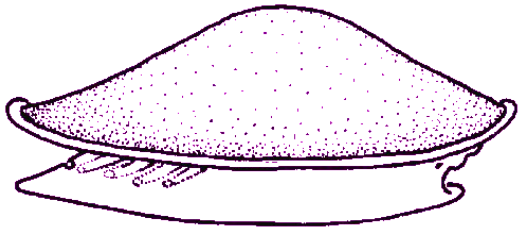
Mollusc origins?





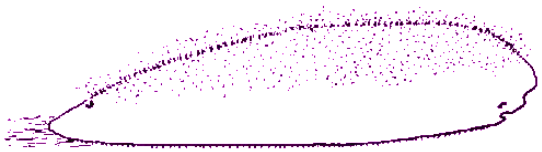


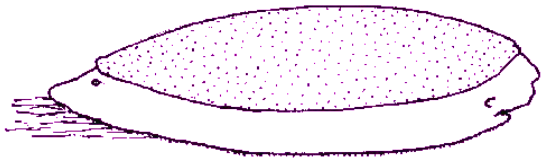


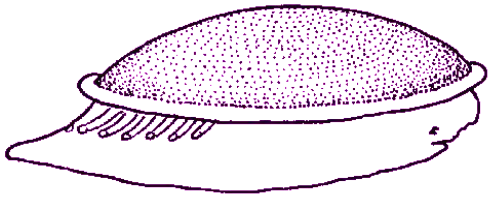


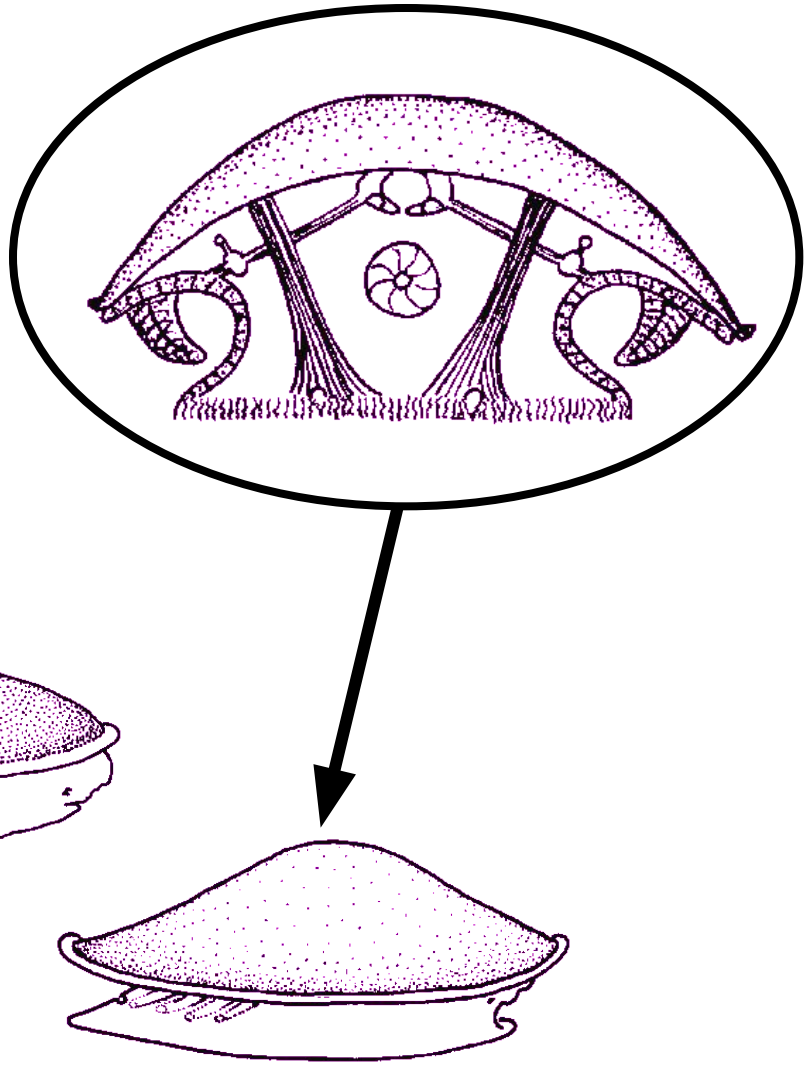
Spicules fuse to form dorsal shell, cilia on ventral surface, dorsoventral musculature, gonads and excretory pores in mantle cavity

Mollusc origins?



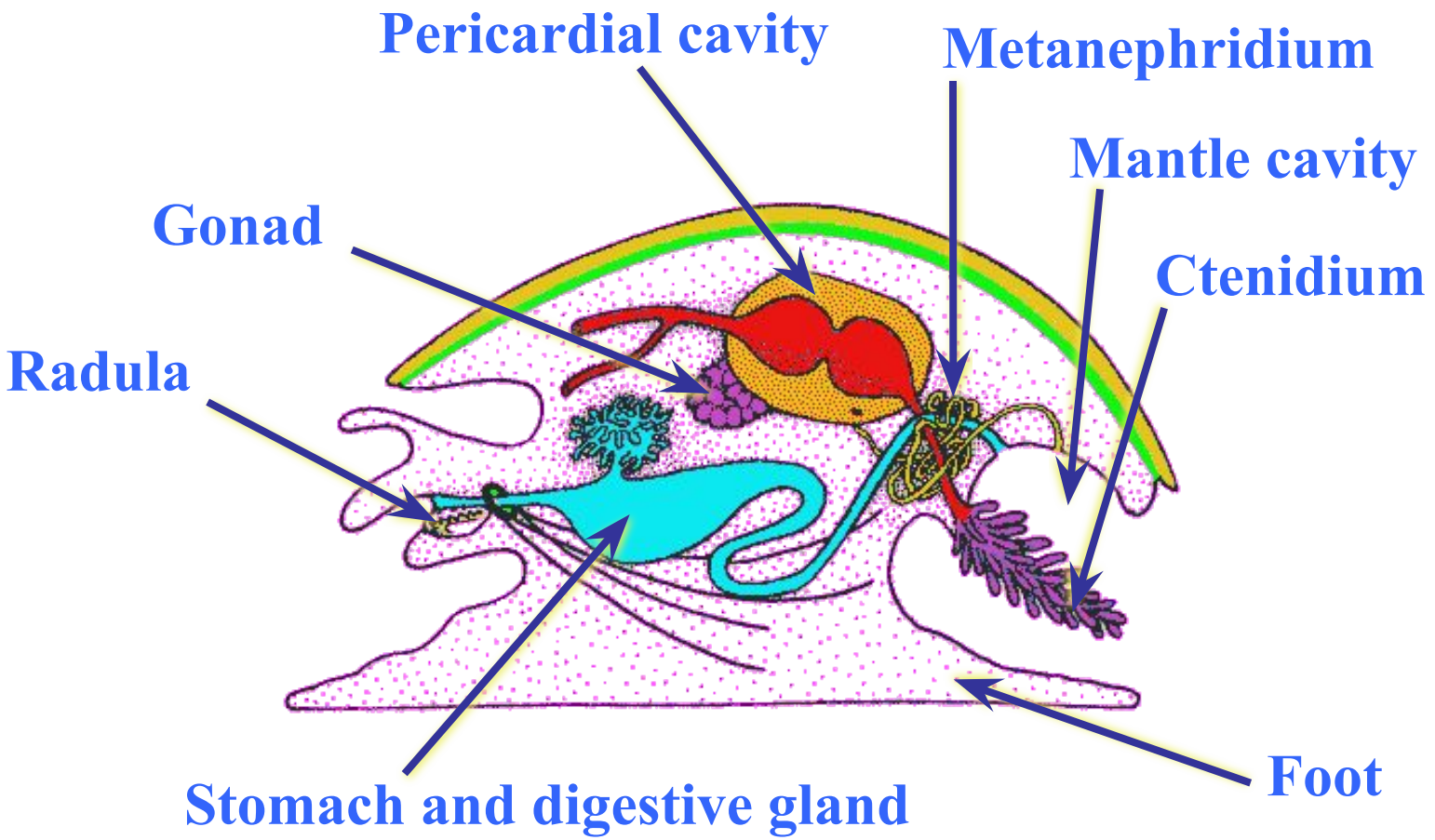






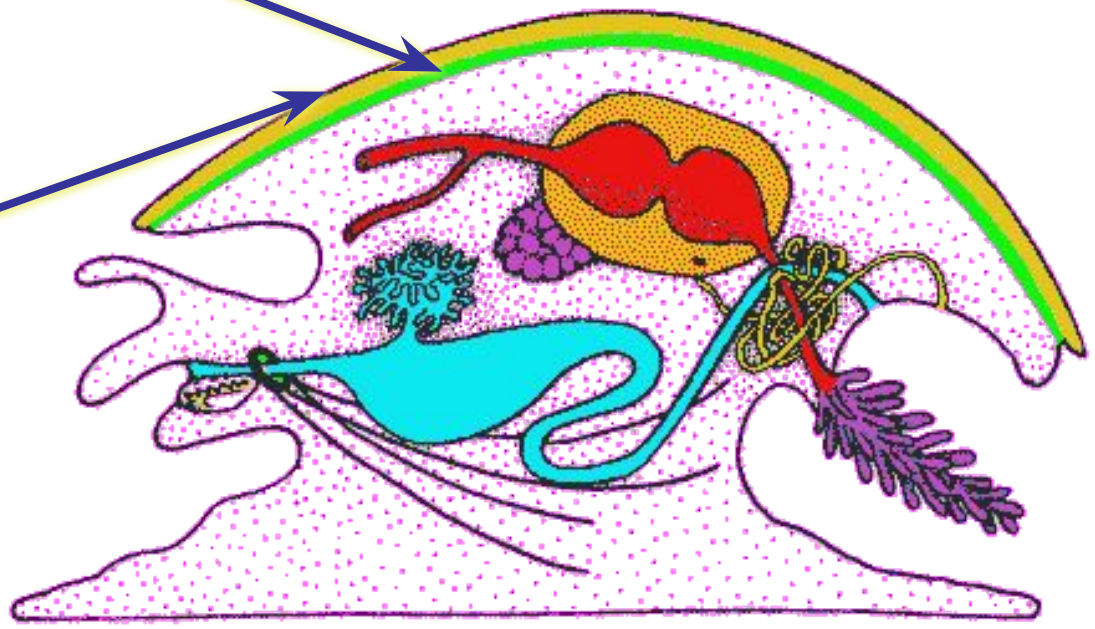
Spicules fuse to form dorsal shell, cilia on ventral surface, dorsoventral musculature, gonads, excretory pores, and ctenidia, in mantle cavity.

HAM: Hypothetical ancestral mollusc



Dorsal mantle covers the visceral mass.

Secretes the shell



Mollusc shell

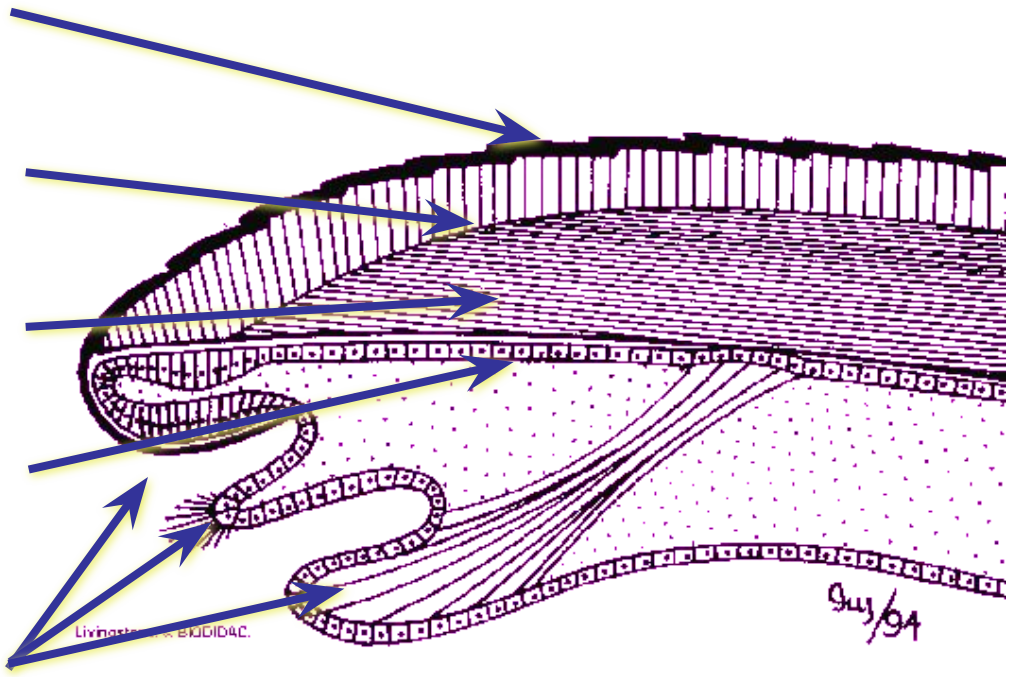
Periostracum

Prismatic layer

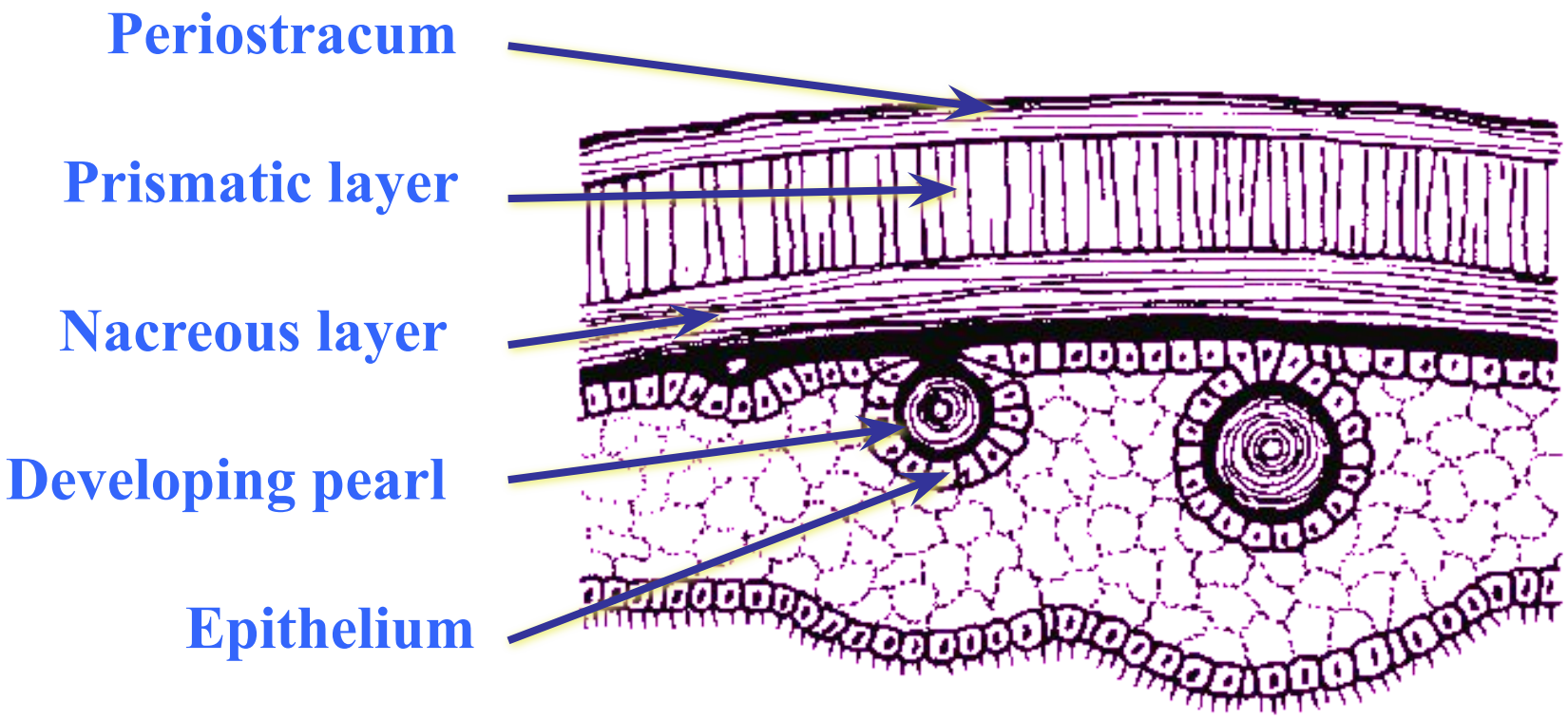
Nacreous layer

Mantle epithelium

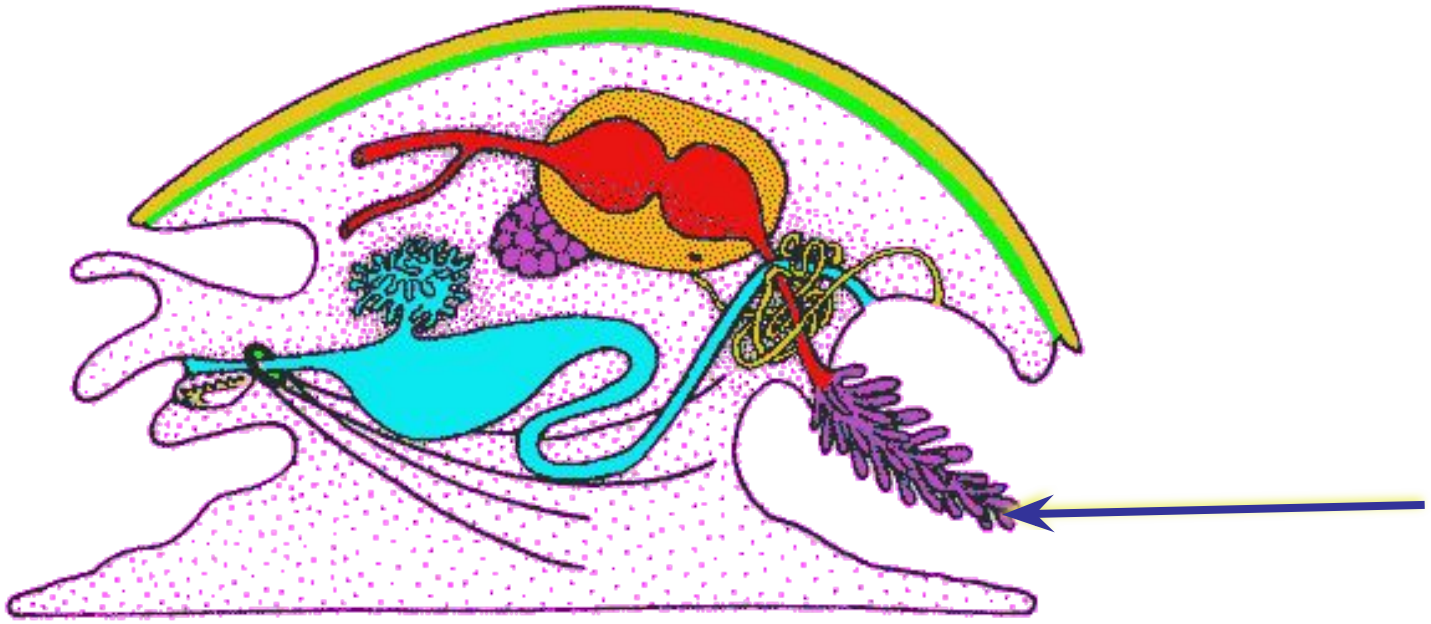
Mantle lobes



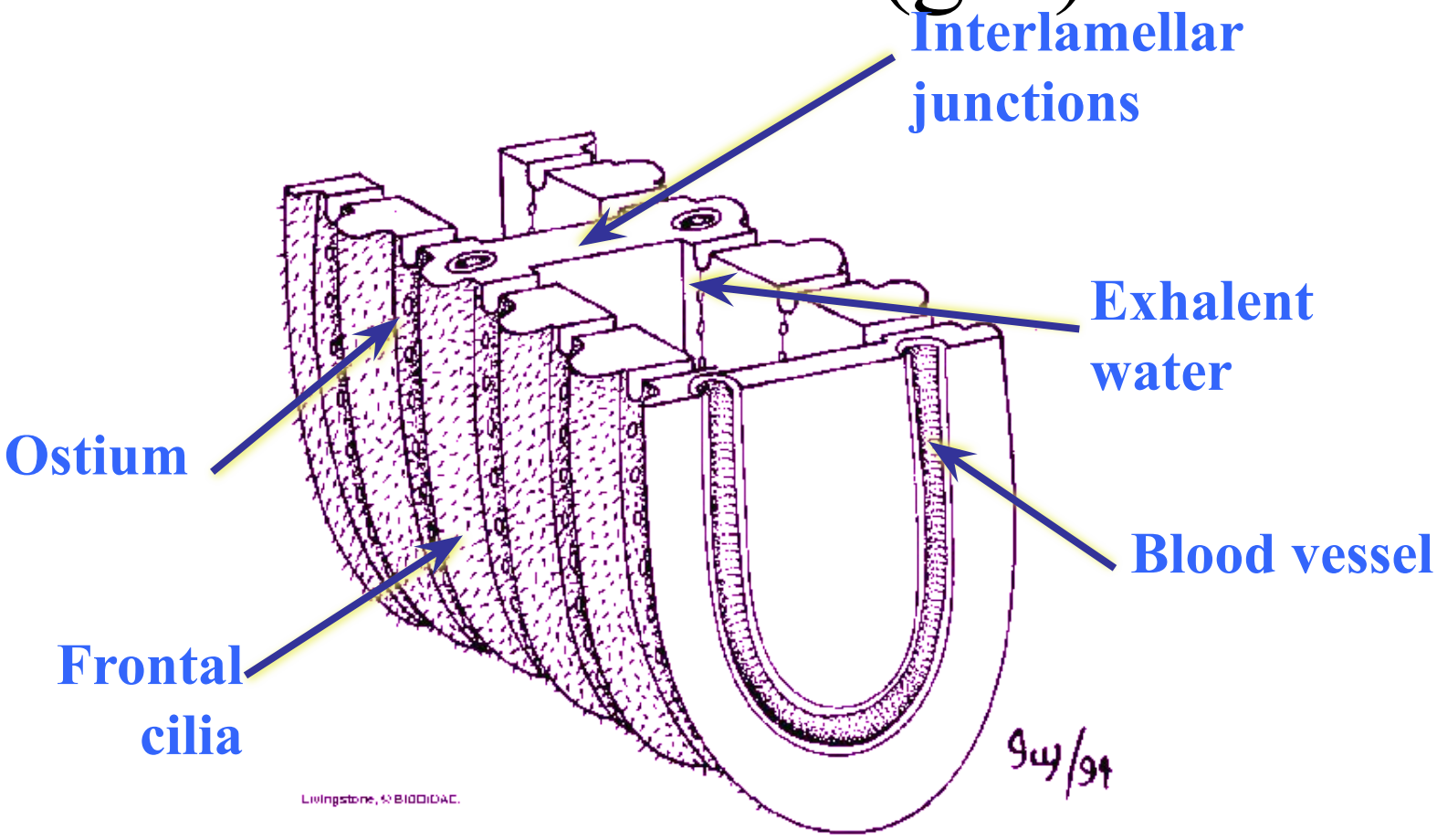
Pearl formation



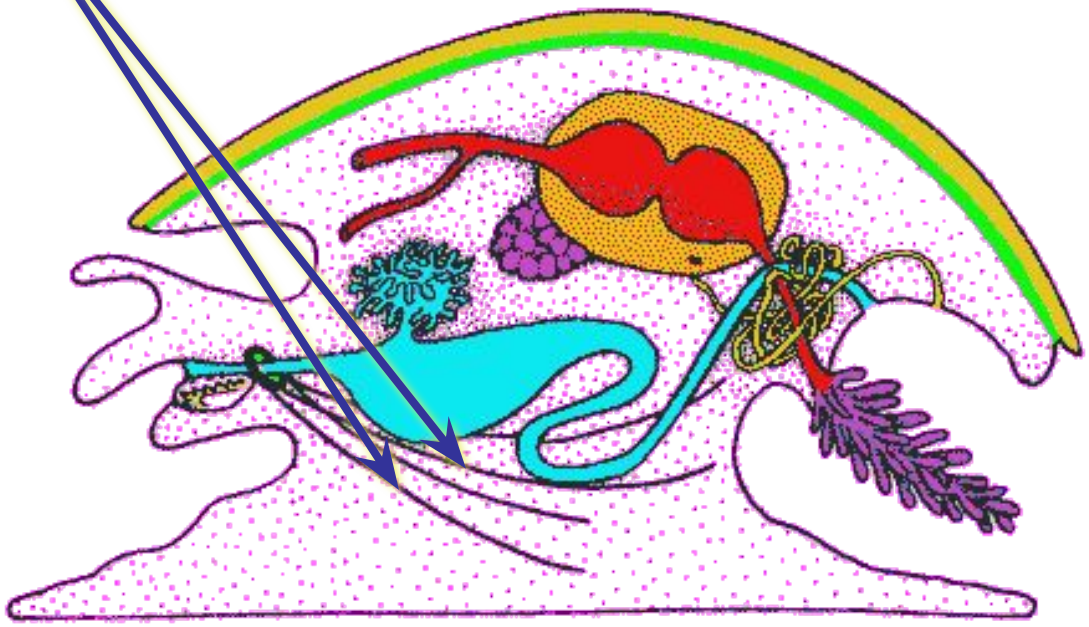
Ctenidium (Respiration)



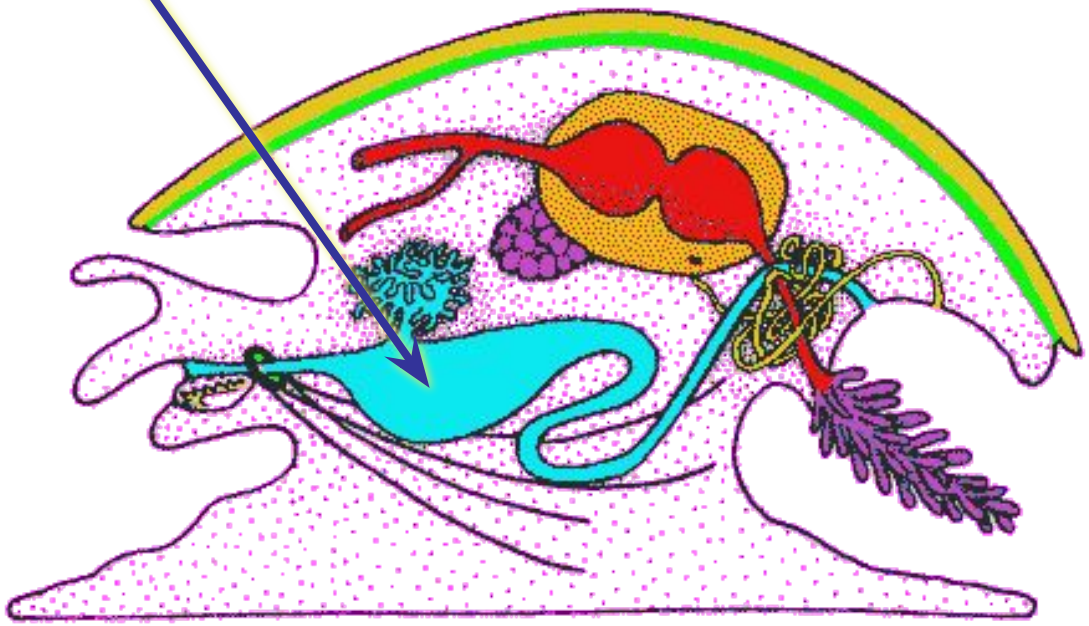
Ctenidium (gill)



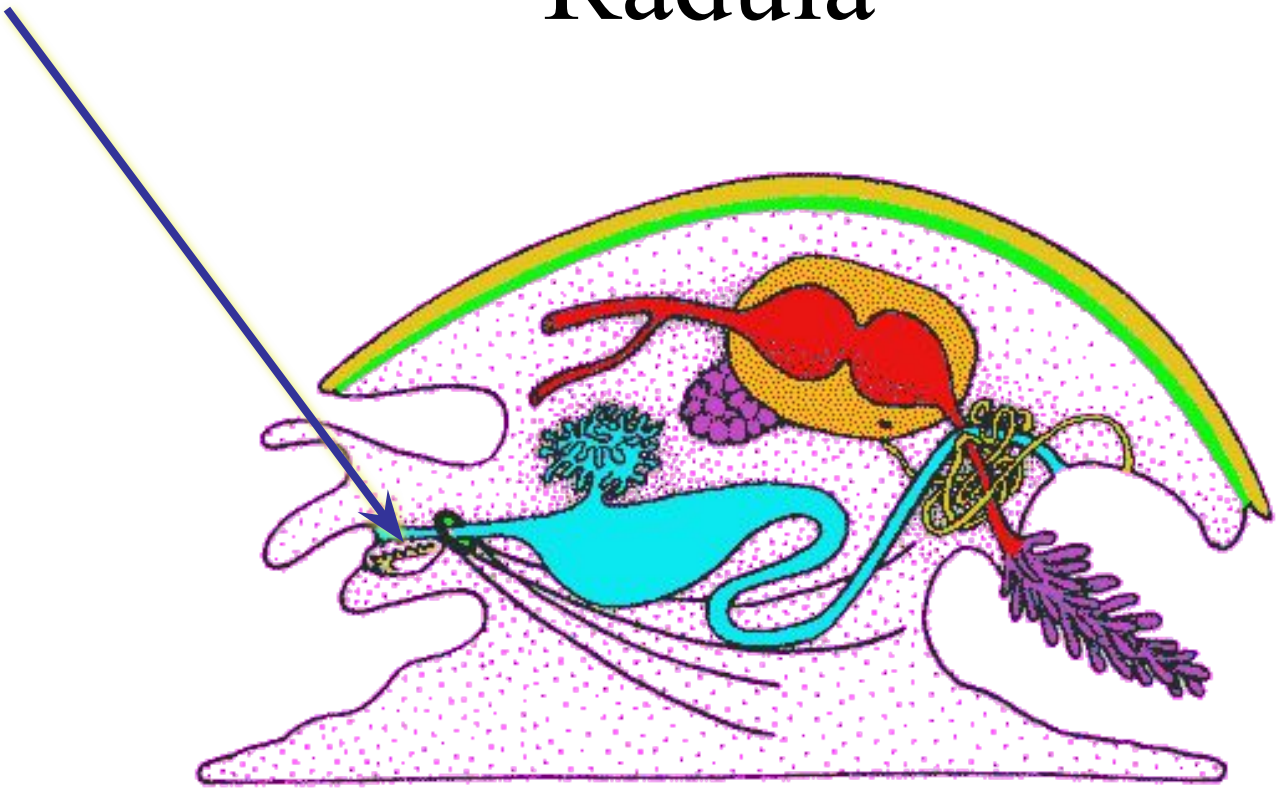
Paired ventral nerve cords



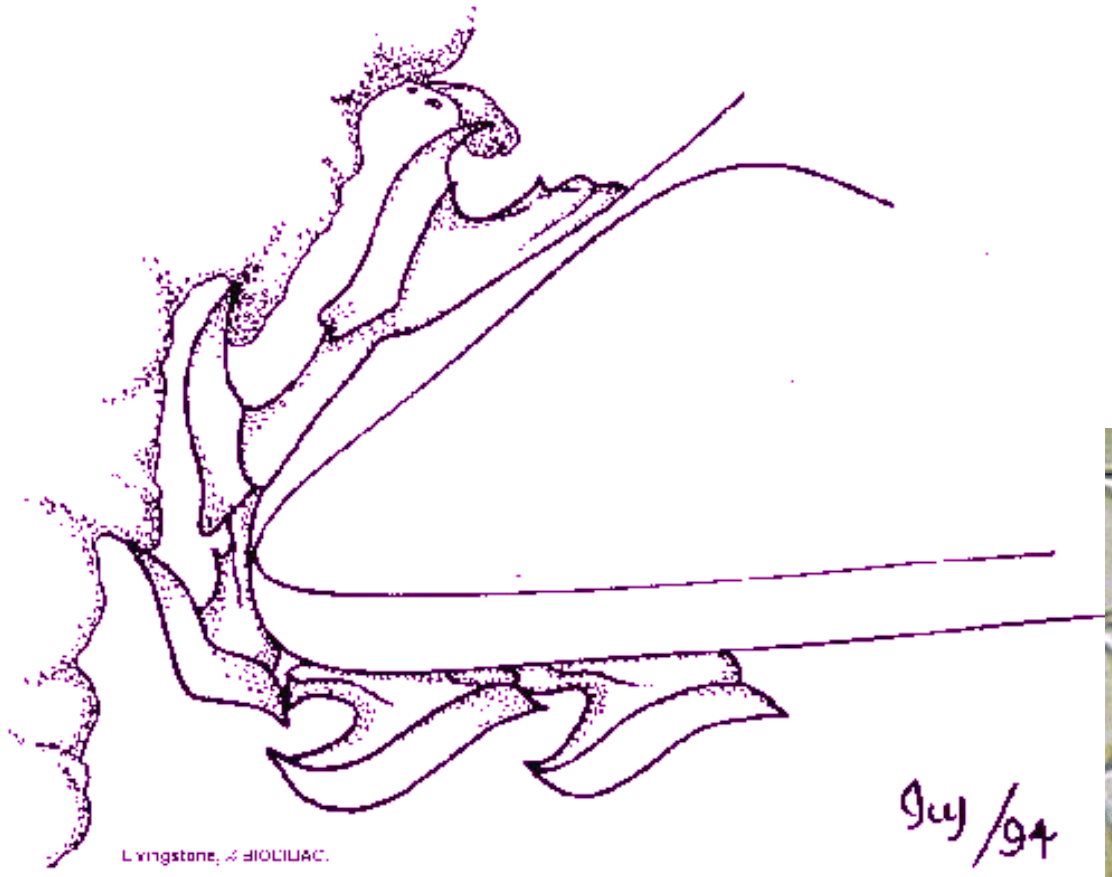
Complete digestive system



Radula



Radula


Livingstone, © BIODIDAC.
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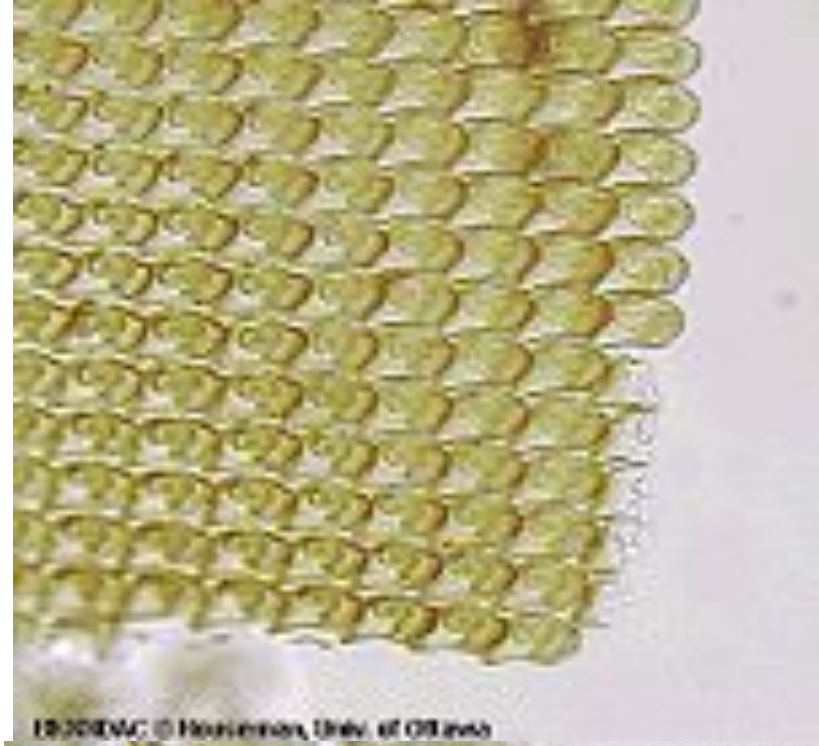


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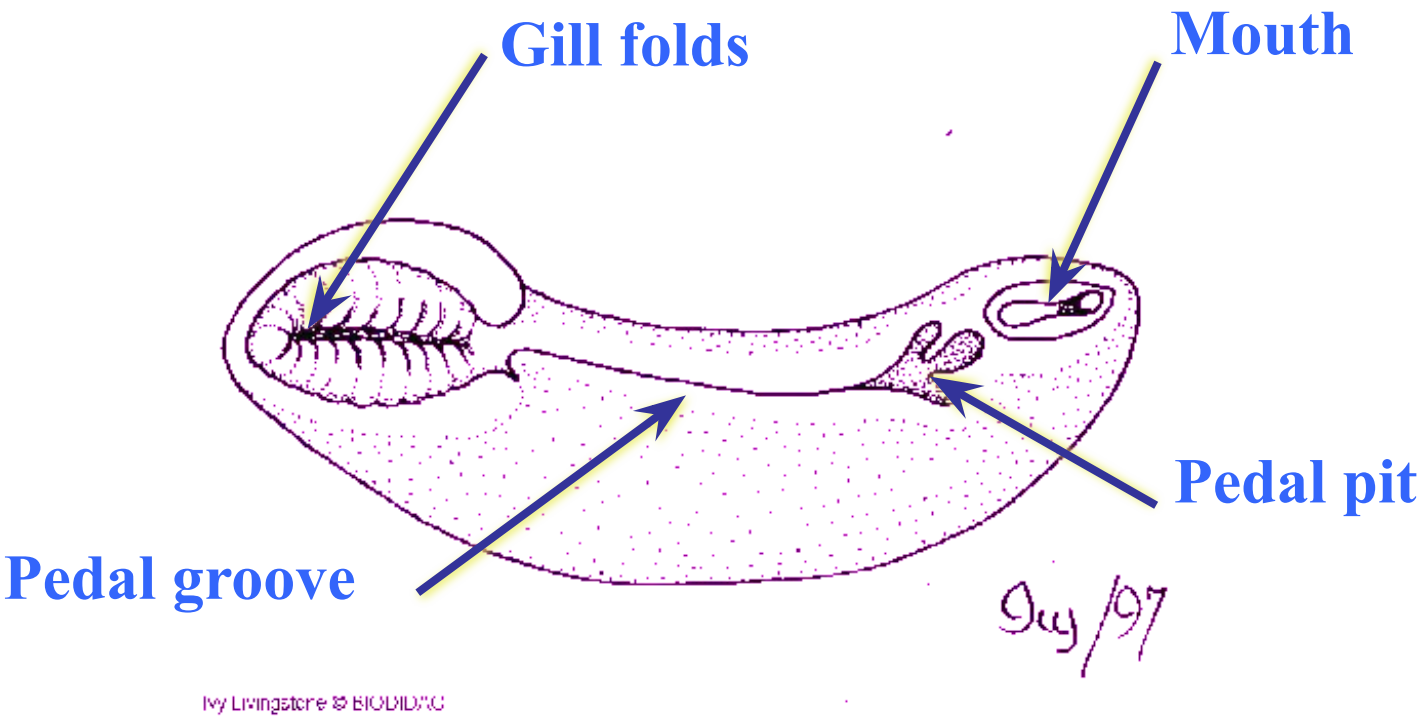
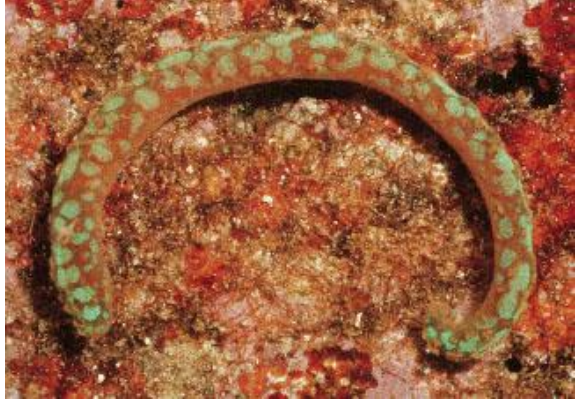
Aplacophora



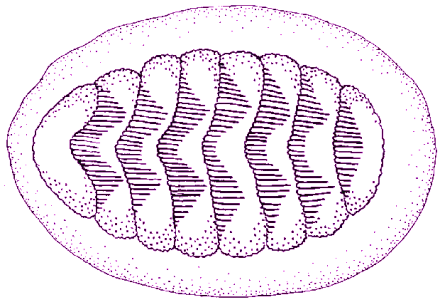
Class Aplacophora

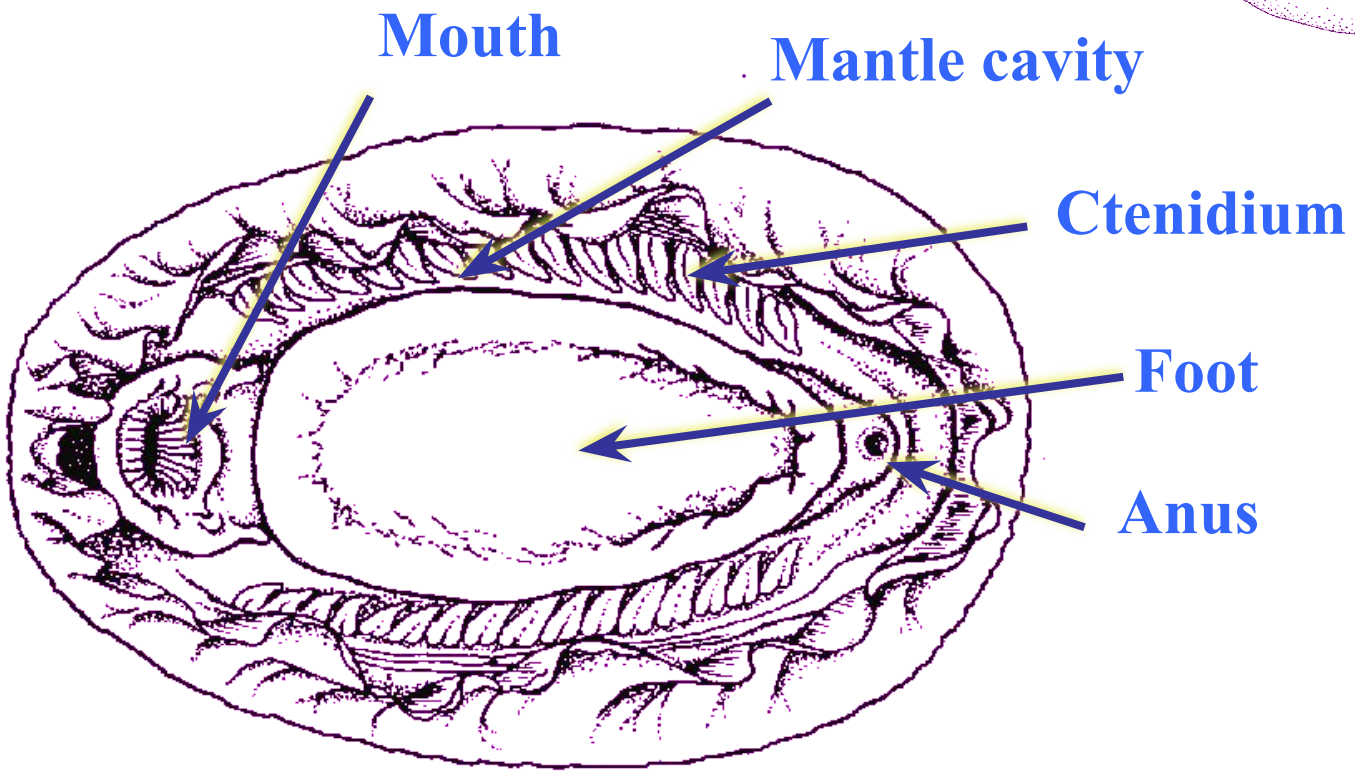


- 320 spp, all marine
- No fossil record (!) & poorly studied
- Calcareous spines and scales in epidermis (no true shell)
- Radula used for grasping
- Burrow in the substrate
- Eat cnidarians

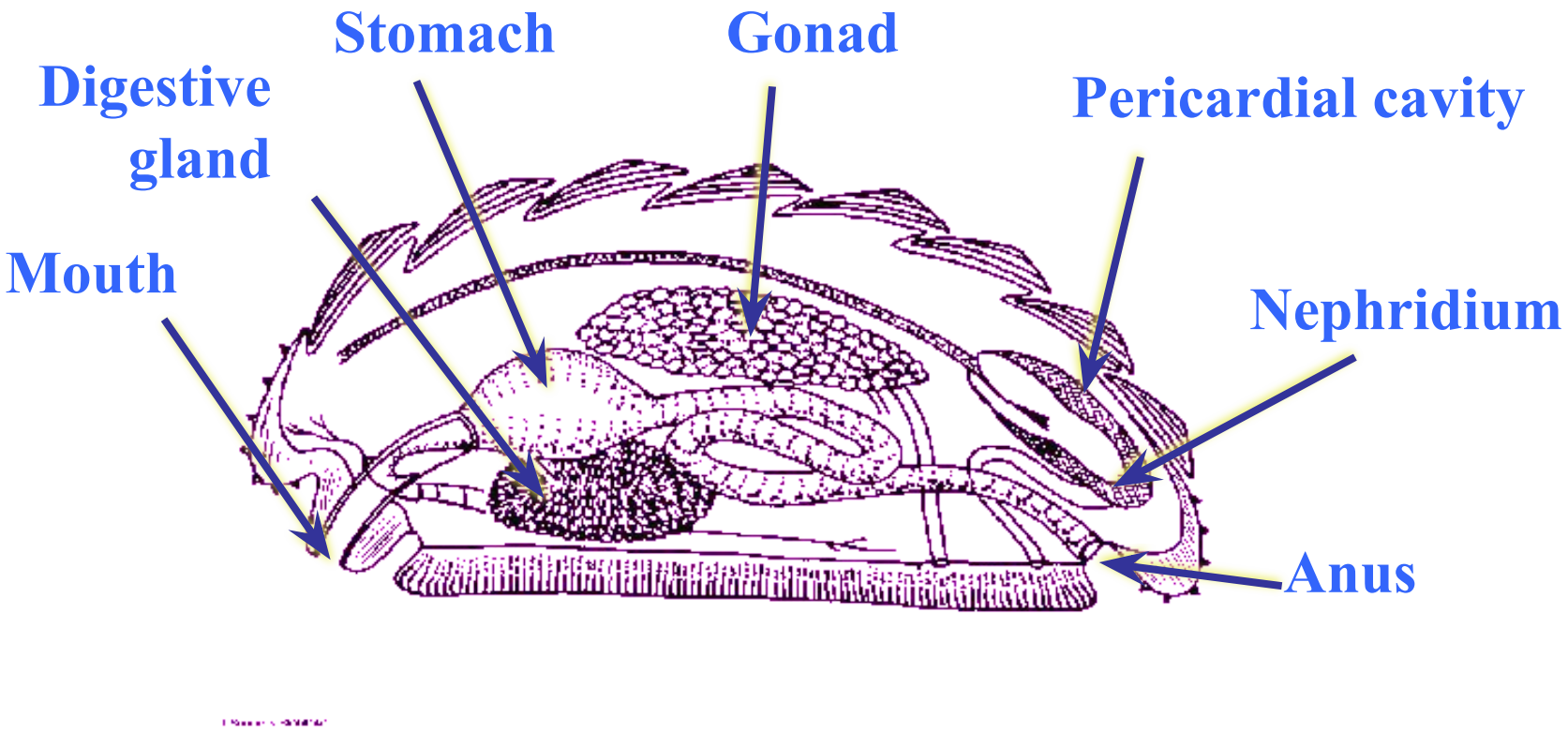
Polyplacophora

Polyplacophora





Polyplacophora



Polyplacophora

- The “chitons”
- 800 spp, marine
- Typically, shell = 8 dorsal plates
- Ctenidia use counter-current gas exchange
- Commonly encountered in the intertidal zone

Class Gastropoda

- Single external shell
- Radula for scraping food
- Moves in wave like contractions through slime
- Can be hermaphrodites, though commonly not
- Ex) Snails, slugs

Class Gastropoda

- Snails live on land or in fresh or salt water
  - They have eyes on tentacles on their head
- Slugs live on land and Sea Slugs (a.k.a. nudibranches) live in the ocean
  - Slugs do not have shells
  - Have exchange of oxygen (diffusion) across their entire body

Gastropoda

- More active than mono and polyplacophorans
  - Highly cephalized: tentacles, eyes
- Gonochoristic
- Veliger larva (an advanced version of the trochophore larva)

Class Gastropoda

Three evolutionary innovations occurred among the gastropods: changes in the shell, increased development of the head, the embryonic process of torsion

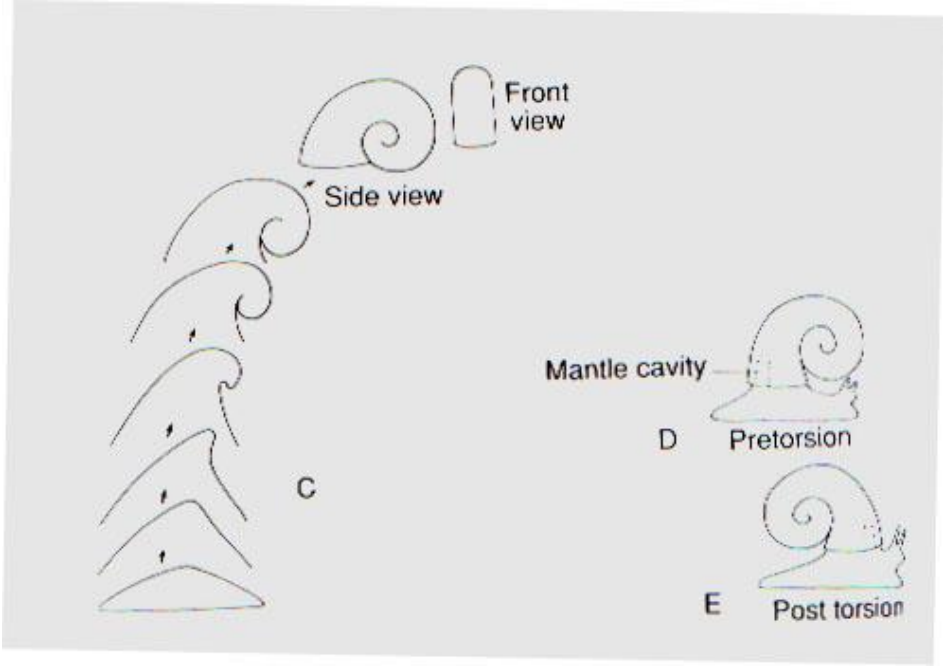
1. Changes in the Shell

The shell became higher and conical with a reduced aperture

The shell also became coiled

Shells initially were **planospiral -** bilaterally symmetrical shell with the whorls lying in the same plane

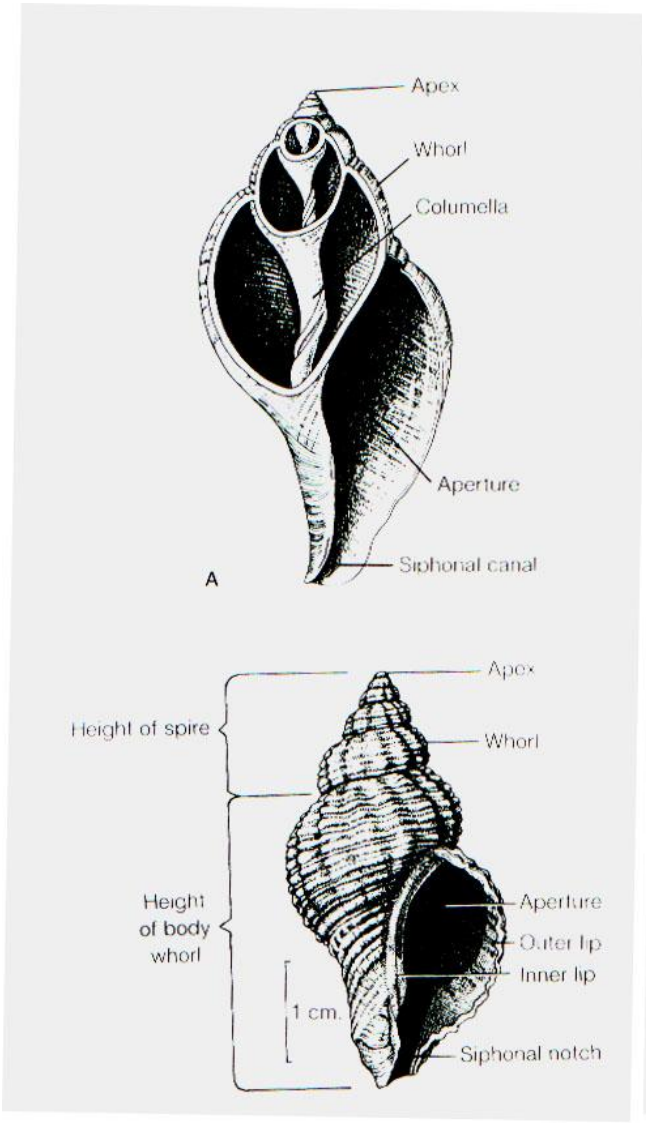
Modern day shells are asymmetrical - each successive coil is a little outside and offset a little above the one below



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 that plugs the shell aperture when the body is withdrawn



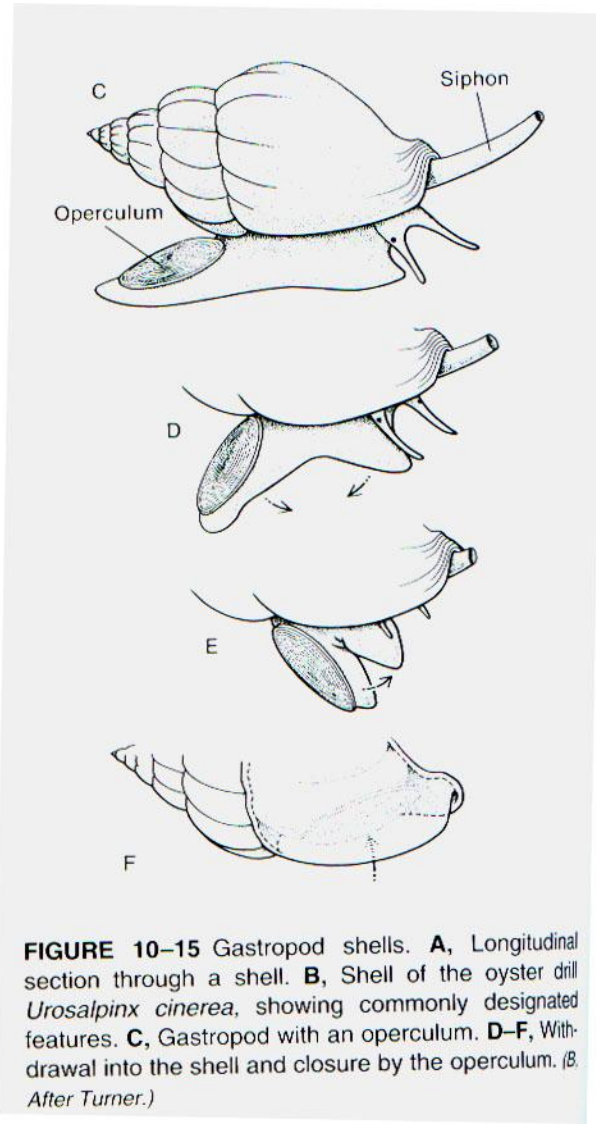
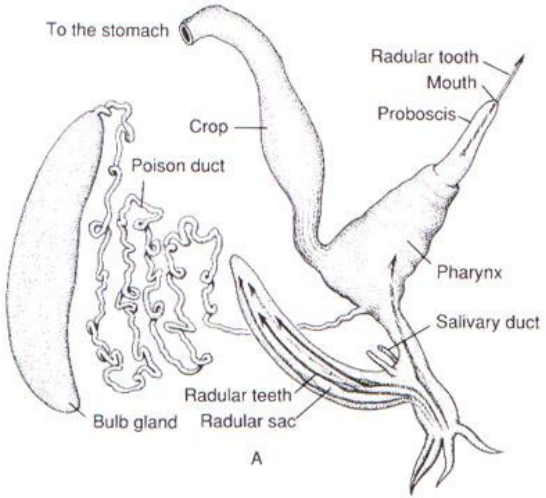


FIGURE 10–15 Gastropod shells. **A,** Longitudinal section through a shell. **B,** Shell of the oyster drill *Urosalpinx cinerea*, showing commonly designated features. **C,** Gastropod with an operculum. **D–F,** Withdrawal into the shell and closure by the operculum. *(B, After Turner.)*

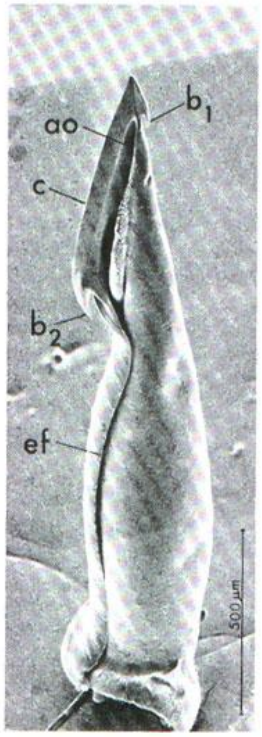
Nutrition

Many gastropods are herbivores and use their radula scrap algae from surfaces of rocks

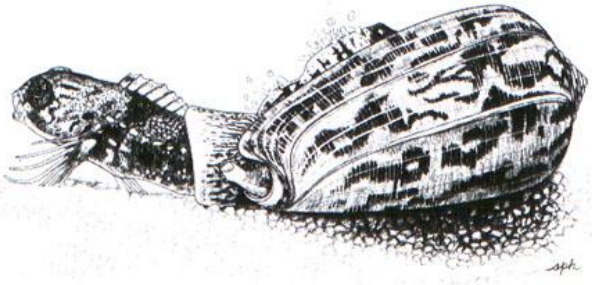
Some gastropods are active predators and in these the radula is often highly modified, e.g., as a drill (oyster drills) or harpoon (venomous gastropods)



A



B

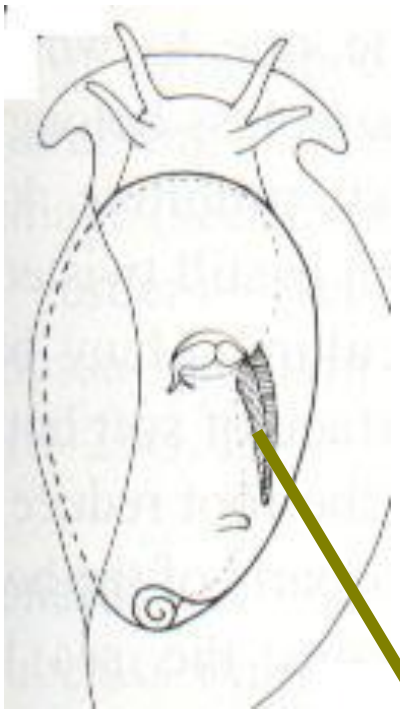

C

Cone snail

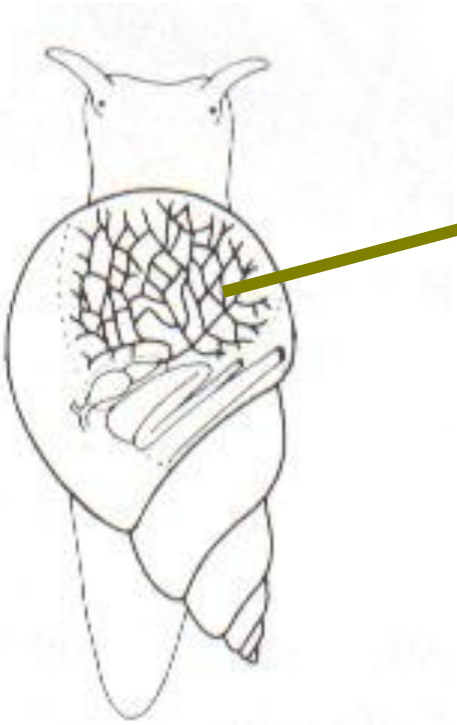
Respiration

Aquatic gastropods possess gills for respiration

Terrestrial gastropods obtain oxygen via a well vascularized mantle



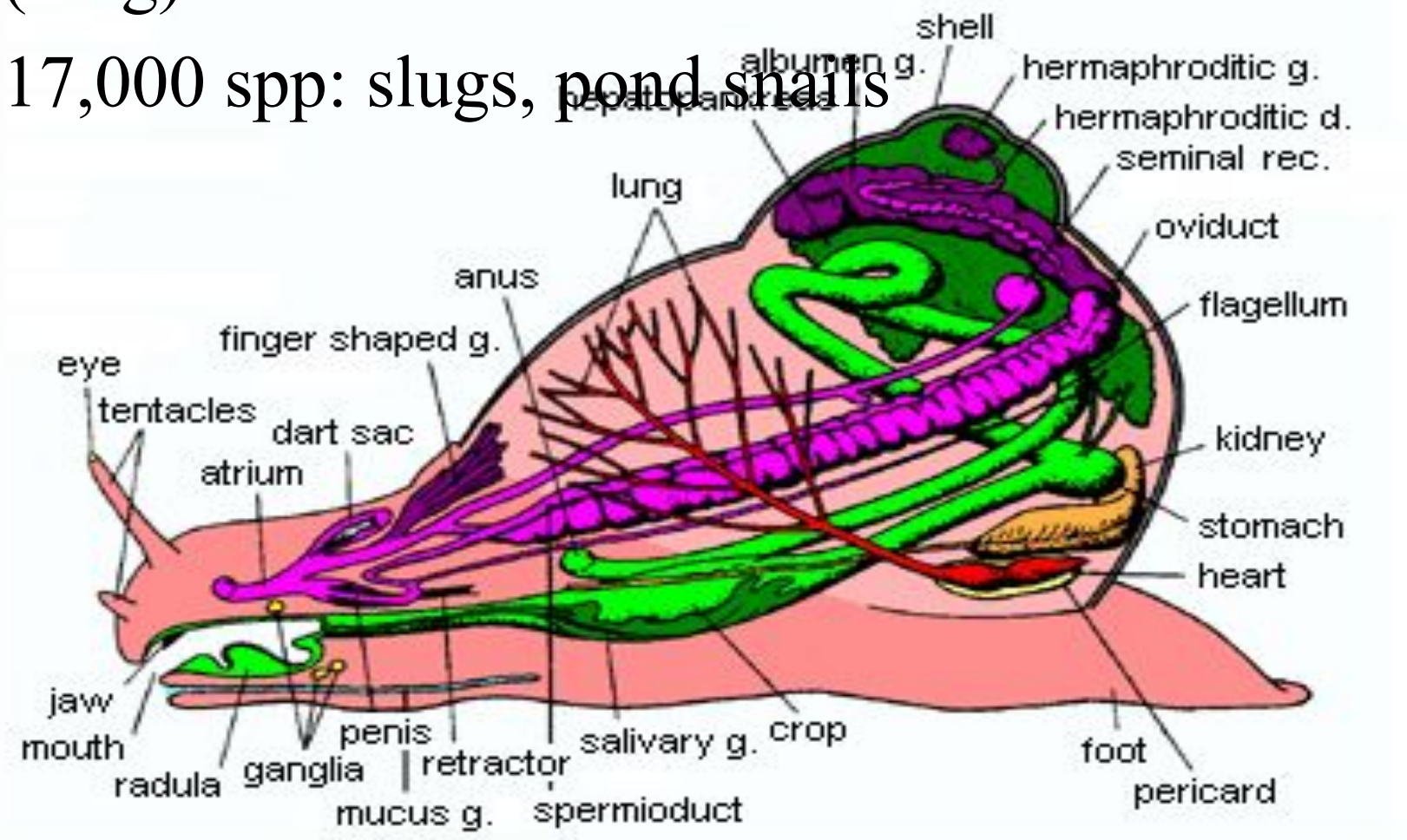
gills



Vascularized mantle

Pulmonata

- Highly vascularized mantle for gas exchange (lung)
- 17,000 spp: slugs, pond snails



Sea Slugs!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Sea Slugs!

Mollusks (Phylum Mollusca)

- **Bivalvia – clam:**
  - **two valves, connected by dorsal hinge ligament**
  - **adductor muscles (used by living clam to close the shell)**
  - **gills in mantle cavity**

    wedgelike foot

Class Bivalvia – Two Shells

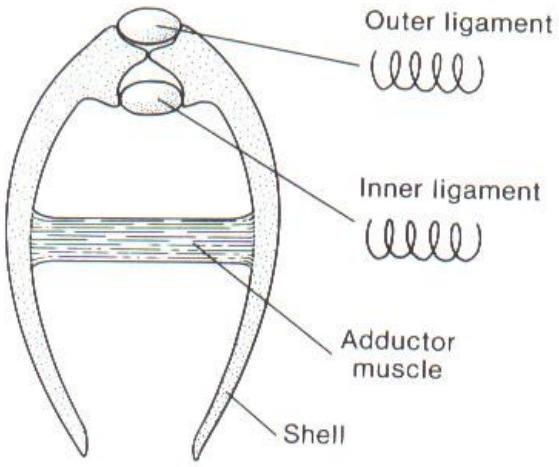
- Three layers make up the shell of a bivalve
  - Inner most protects the body of the animal
  - Middle layer strengthens the shell with calcium carbonate
  - Outer layer protects against acid in the water

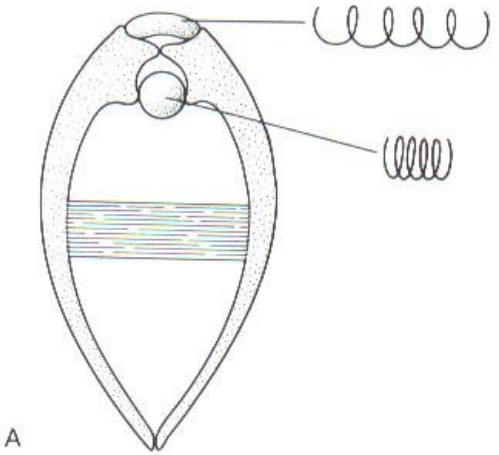
Class Bivalvia

Shells divided into 2 equal halves or **valves**

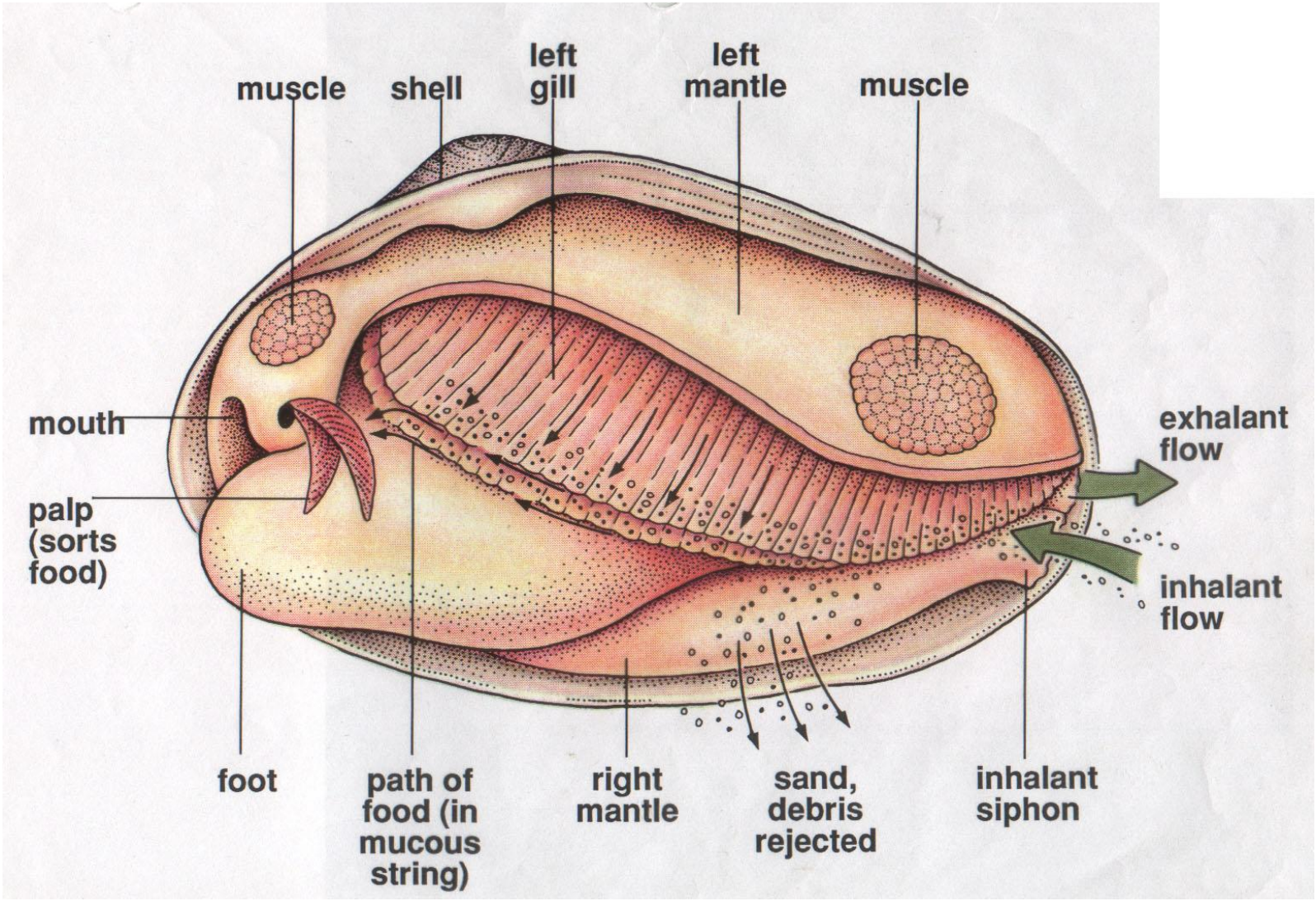
Mantle tissue is indented in the anterior-posterior margins, with 2 centers of calcification

Shells joined at the dorsal midline by a non calcified protein ligaments called the **hinge**





Movement of the Ventilating Currents



Adaptive Radiation of Bivalves

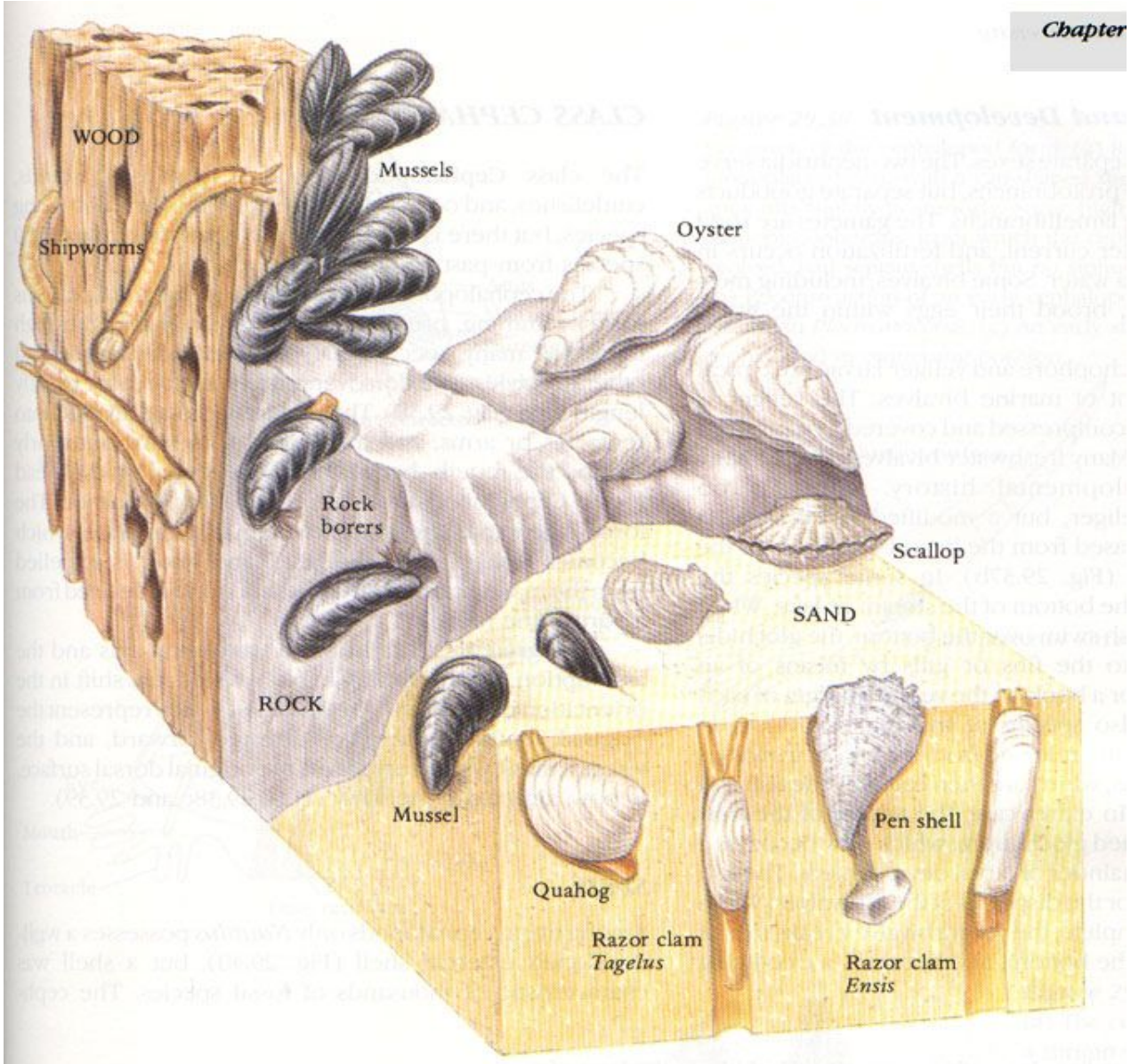


Figure 29.35

Bivalve life styles. All of these species would not found together in the same

Reproduction

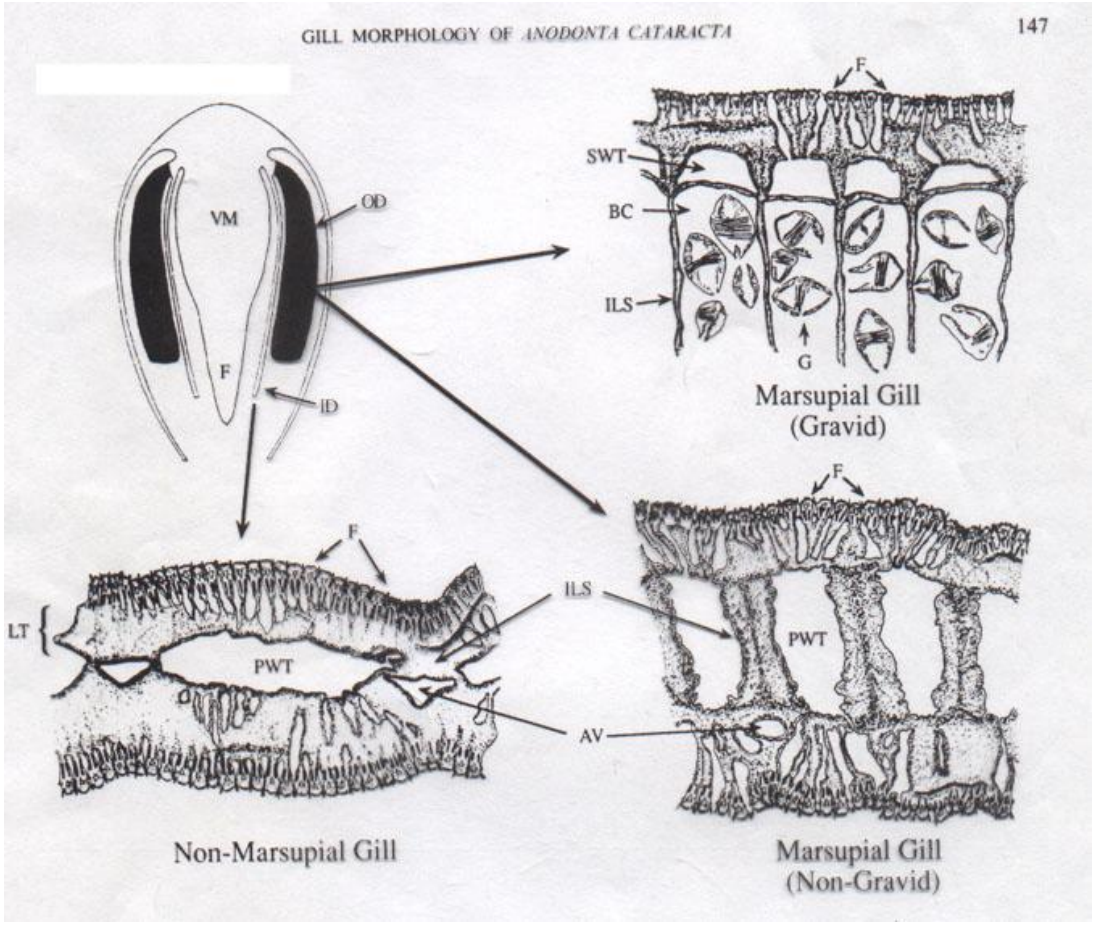
Most are dioecious

Marine forms usually produce free swimming trochophore and veliger larvae

Many of the freshwater bivalves have a different life history pattern; produce larvae called **glochidia**

Glochidia are housed in the outer gills; they use there outer gill as a brood camber - **marsupium**

When the glochidia are released they parasitize the fins and gills of fishes



Mollusks (Phylum Mollusca)

:

- **Cephalopoda – squid:**

  muscular foot with tentacles (with suction discs)

  thick mantle but no external shell (true for most cephalopods)

  - **excurrent siphon (for jet propulsion)**

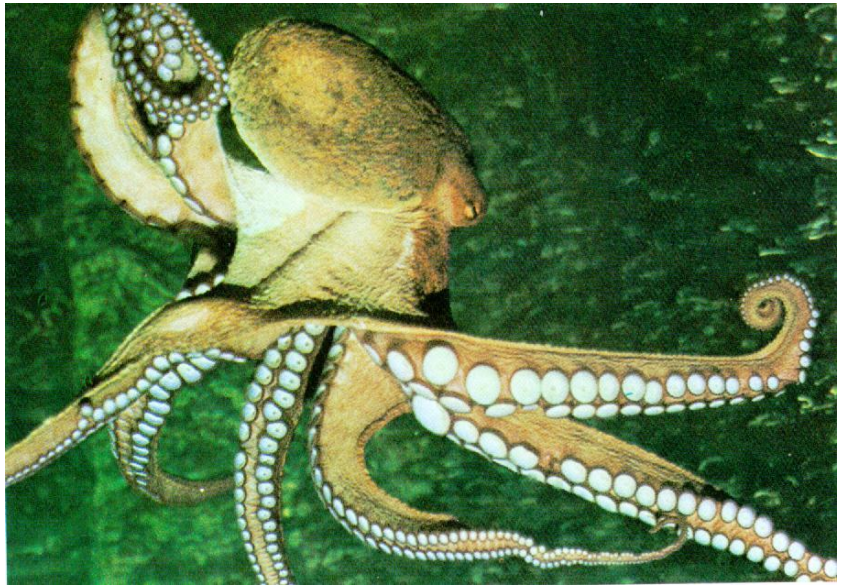
  large eyes

Class Cephalopoda

- Means “head foot”
- Includes octopuses, squids, cuttlefishes and chambered nautiluses
- Free swimming and predatory
- Tentacles with suction cups to grasp prey
- Have jaws called beaks to destroy their prey
- Has the largest invertebrate brain

Cephalopods

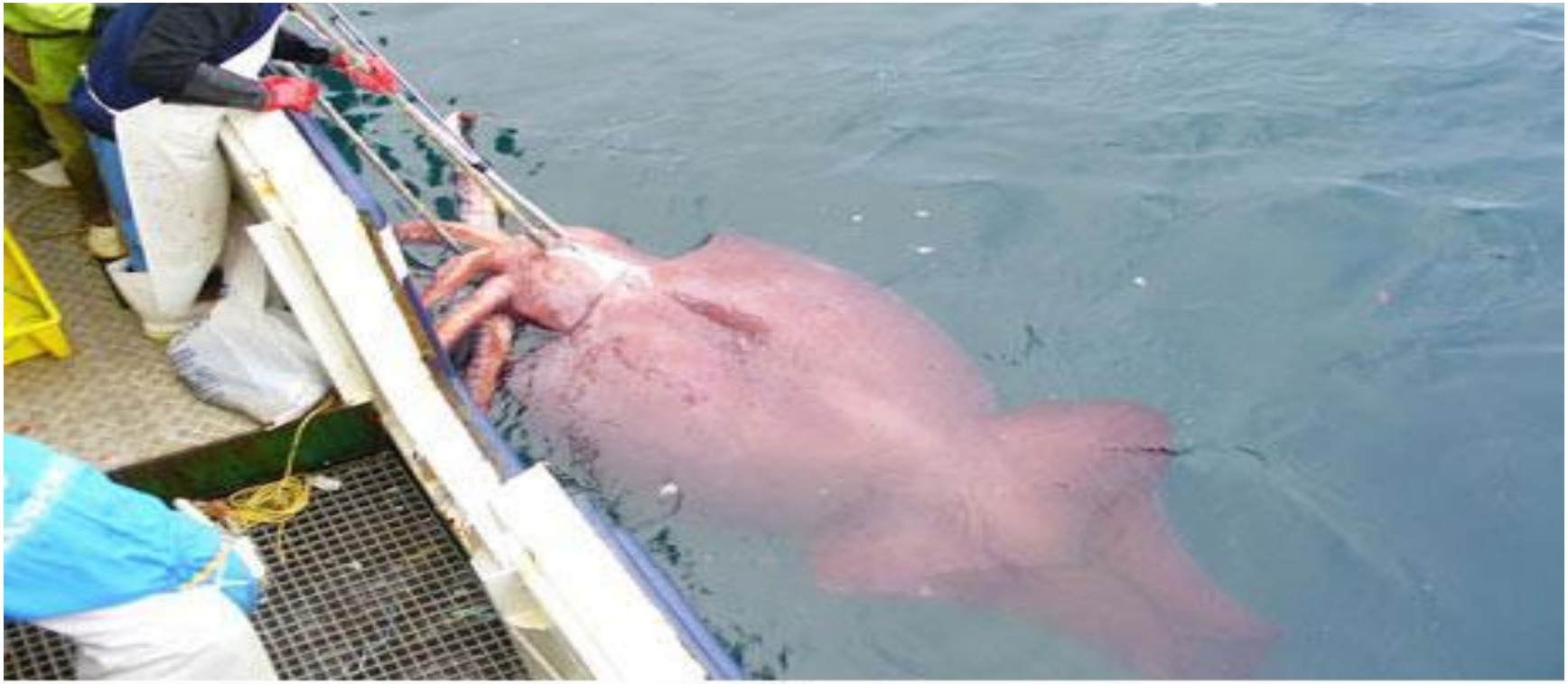
- Can learn to perform tasks
- Has complex eyes
- Closed circulatory system
- Are sexual - internal
- Have ink to confuse predators

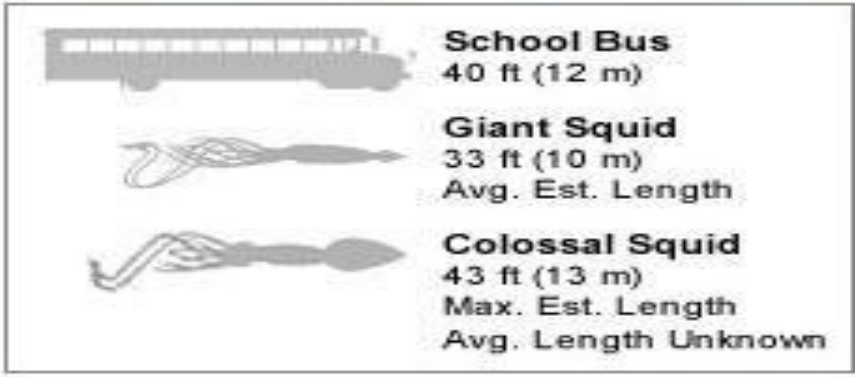


Cephalopoda

- Swift, agile carnivores
- Closed circulatory system, 2 hearts
- Separate sexes
- Foot modified to form arms, tentacles, siphon
- Brain, cranium, complex image-forming eye
- 700 extant spp, 10,000 extinct spp
- Arose from limpet-like monoplacophorans
- Ergo, ventral became function anterior, etc

Cephalopods





Cephalopoda

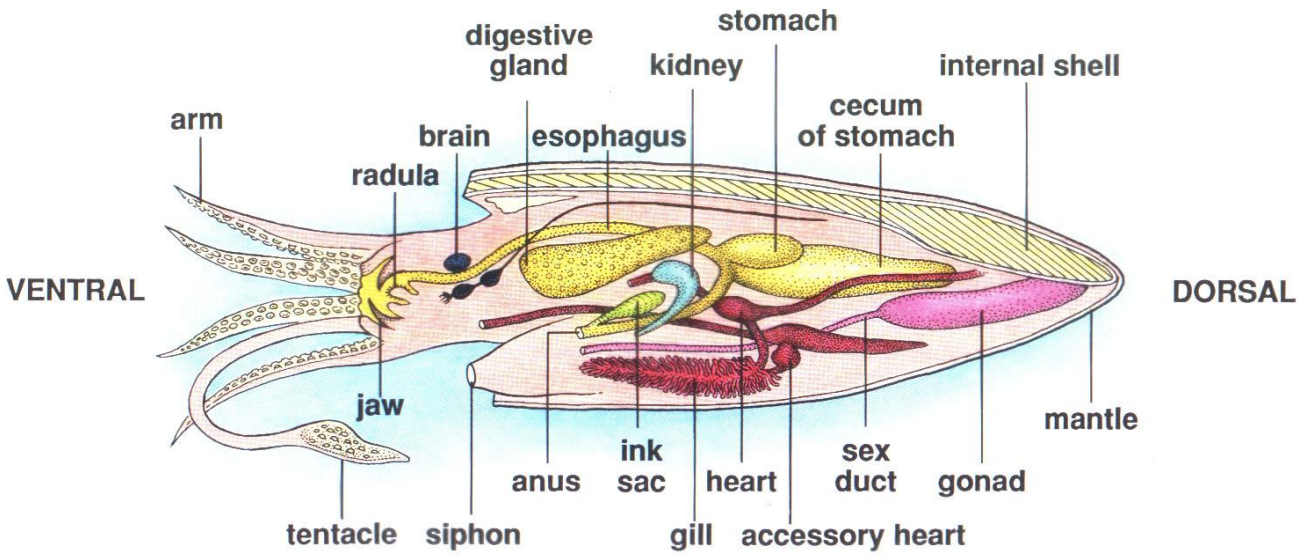
- Endocochleate cephalopds
  - Reduce internal shell, or shell absent
  - Squids, cuttlefish, octopi

Locomotion

- Cephalopods are excellent swimmers: streamlined body; tentacles and fins as stabilizers
- Swim by means of jet propulsion, using the highly modified muscular mantle and the **siphon**

  By relaxing the mantle the mantle cavity is expanded and water can be drawn in

  By contracting the mantle water can be forced out of the mantle cavity by means of the small siphonal opening



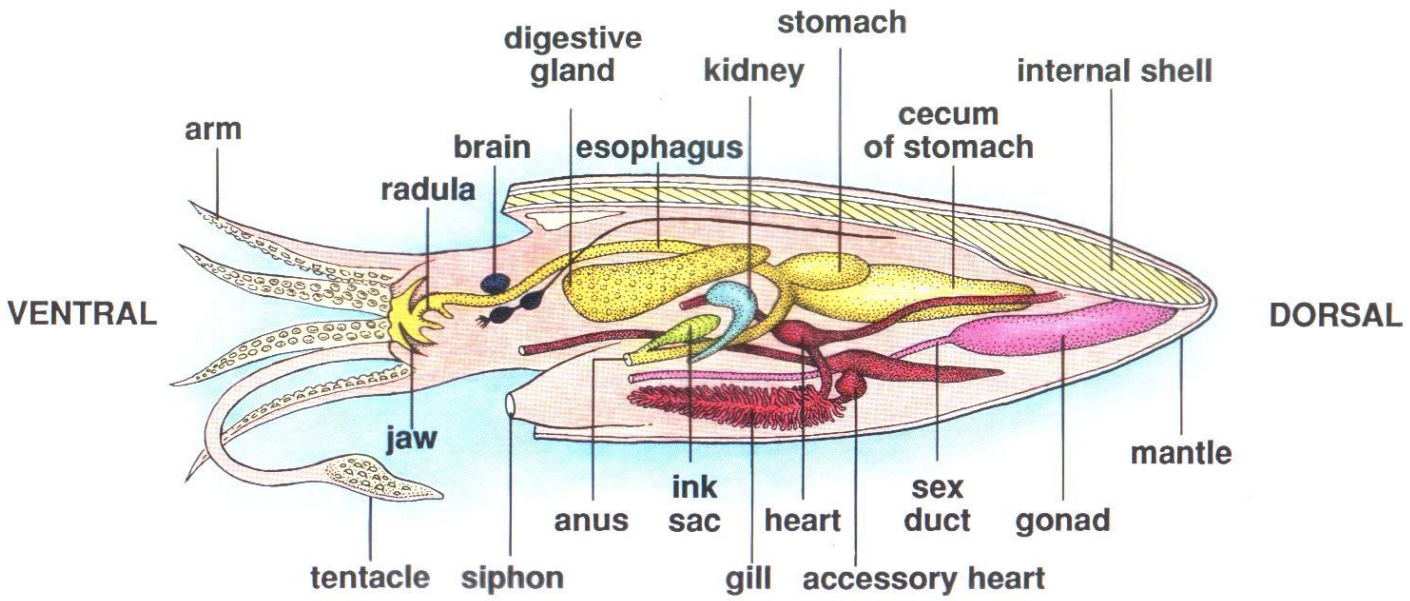
Feeding

Cephalopods are carnivores

Have a powerful parrot like beak that is used to tear prey apart.

They also have a powerful radula

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



Other General Features

For protection, they possess an **ink sacs**

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

Some have well-developed brains and show a remarkable capacity for learning.

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

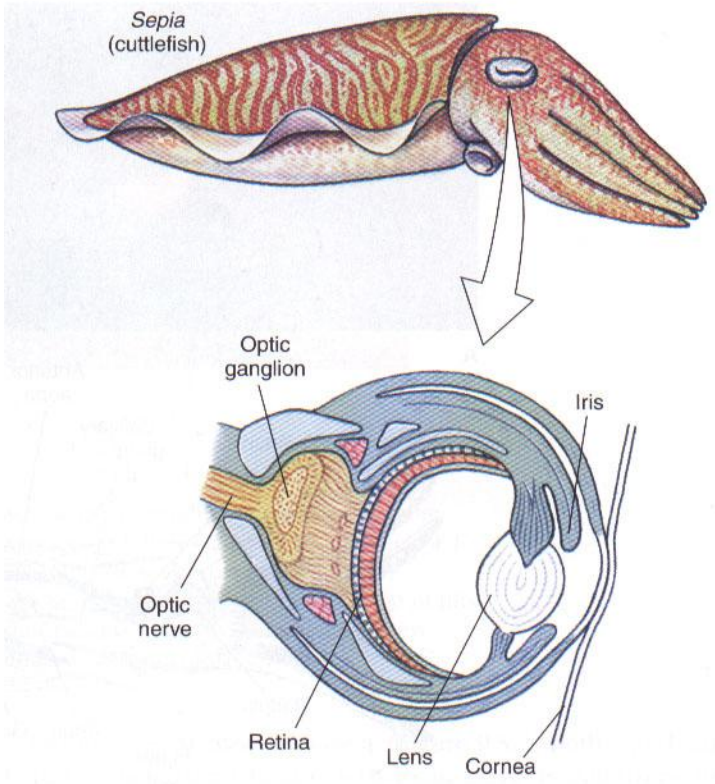


FIGURE 9-33

Eye of a cuttlefish (*Sepia*). The structure of cephalopod eyes shows a high degree of convergent evolution with the eyes of vertebrates.

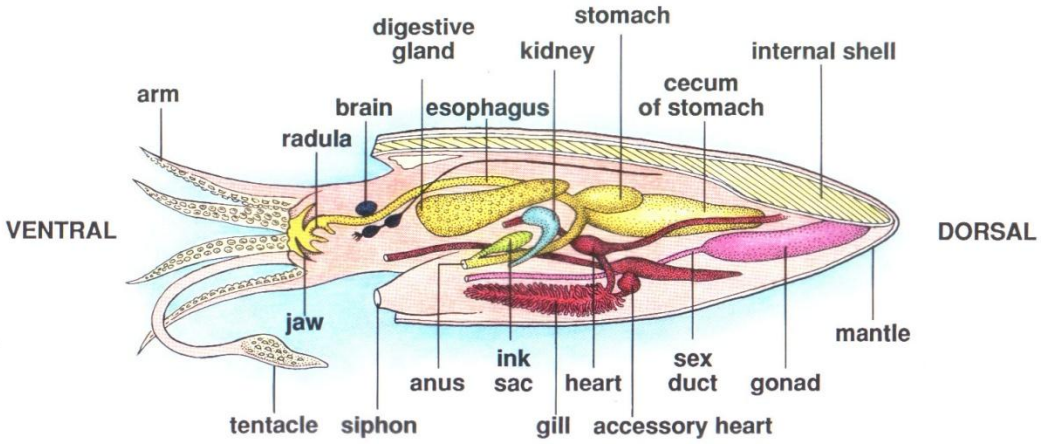
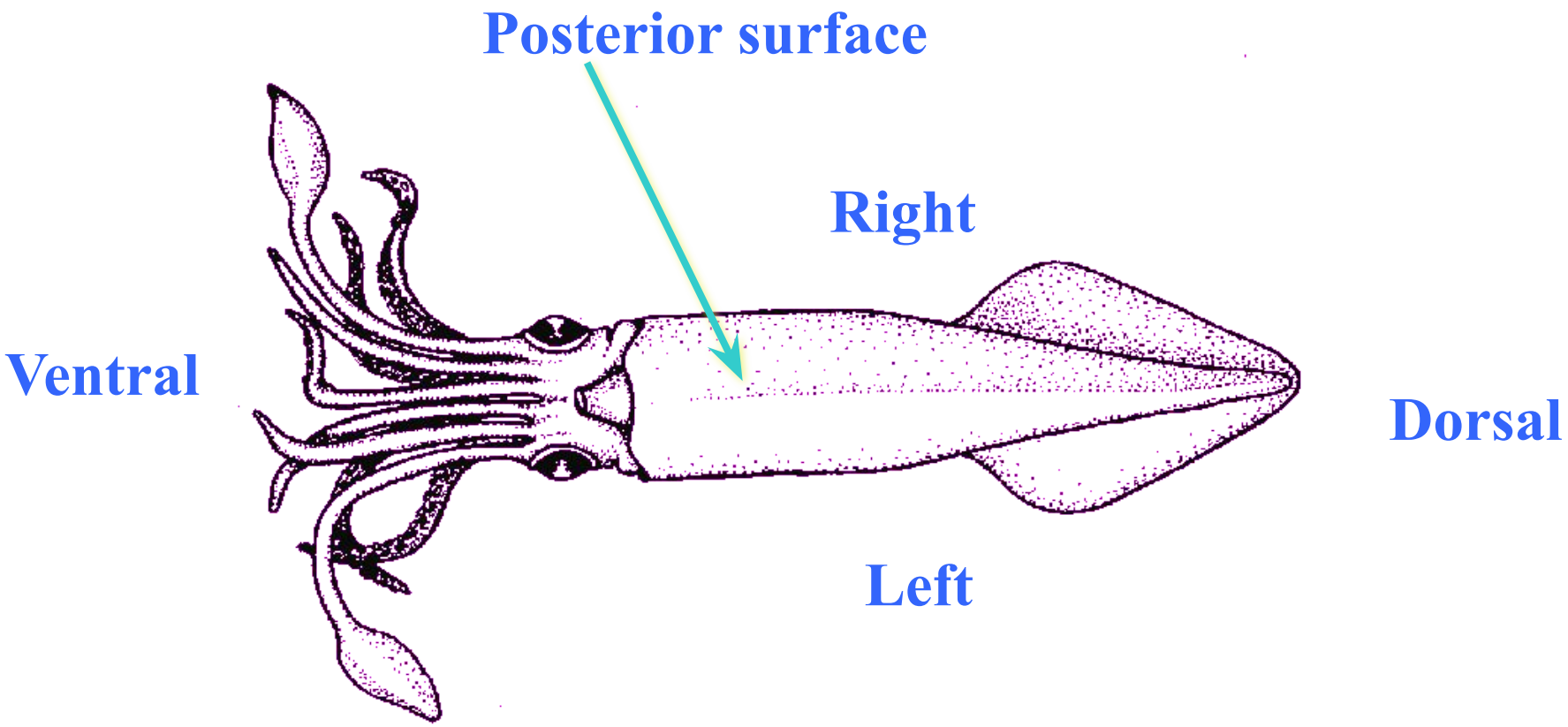
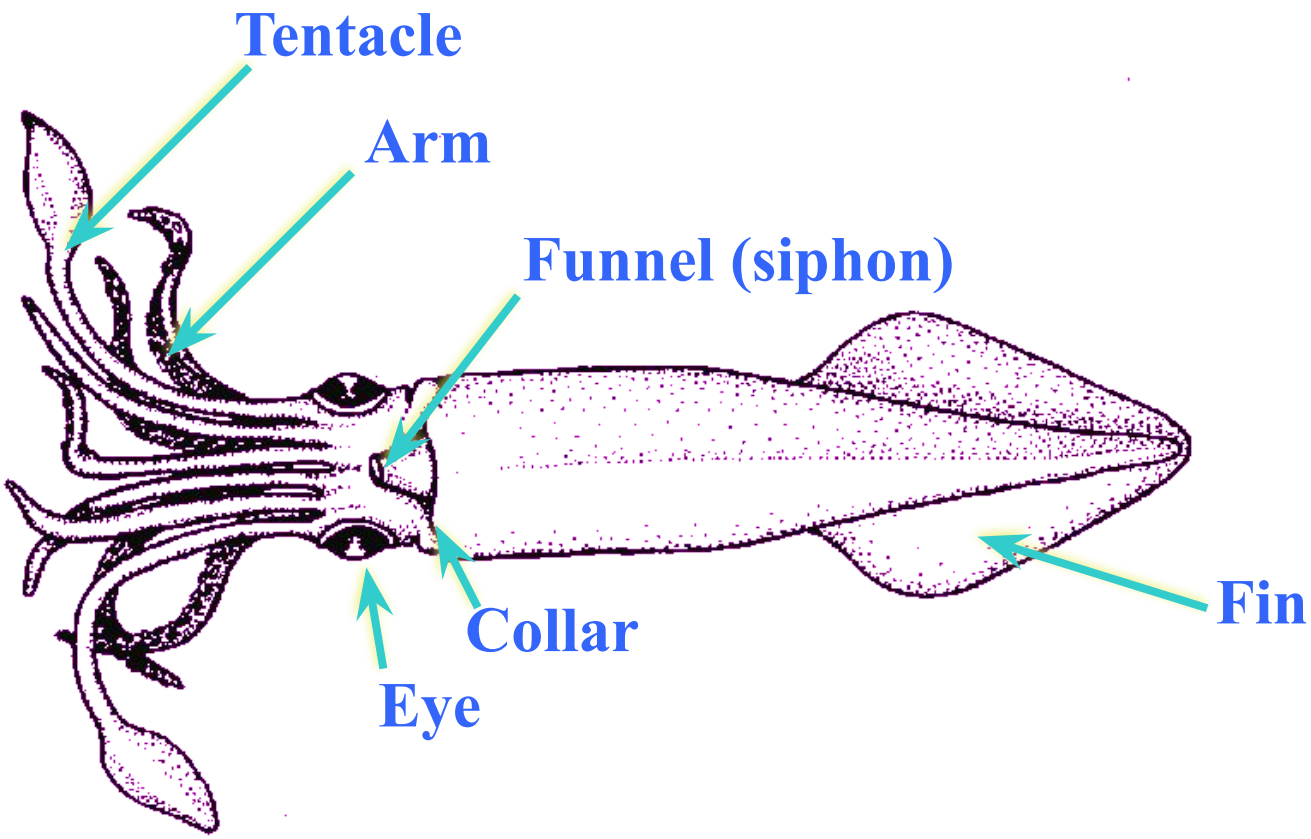
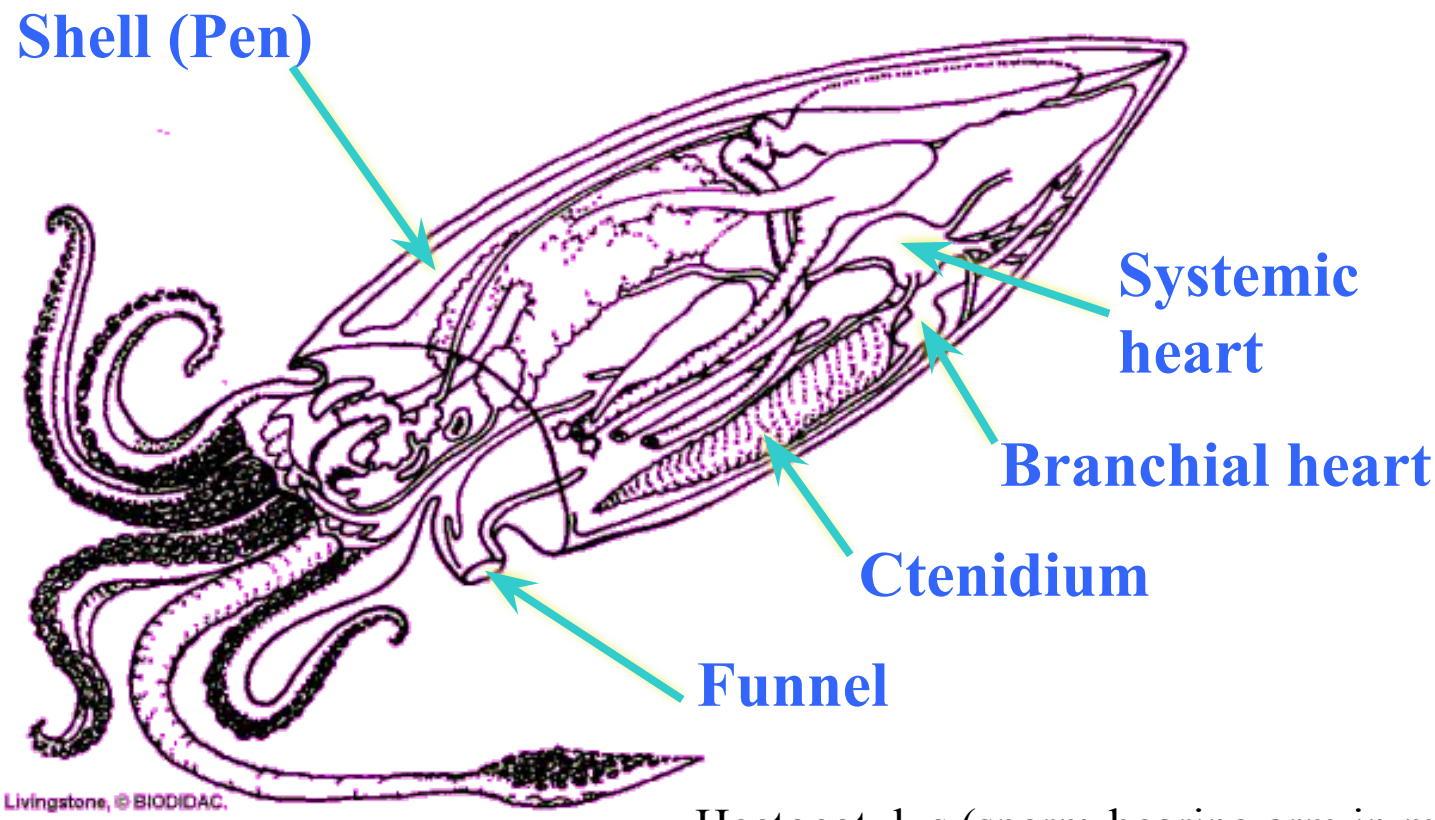



Photo: Dave Knight

Cephalopoda

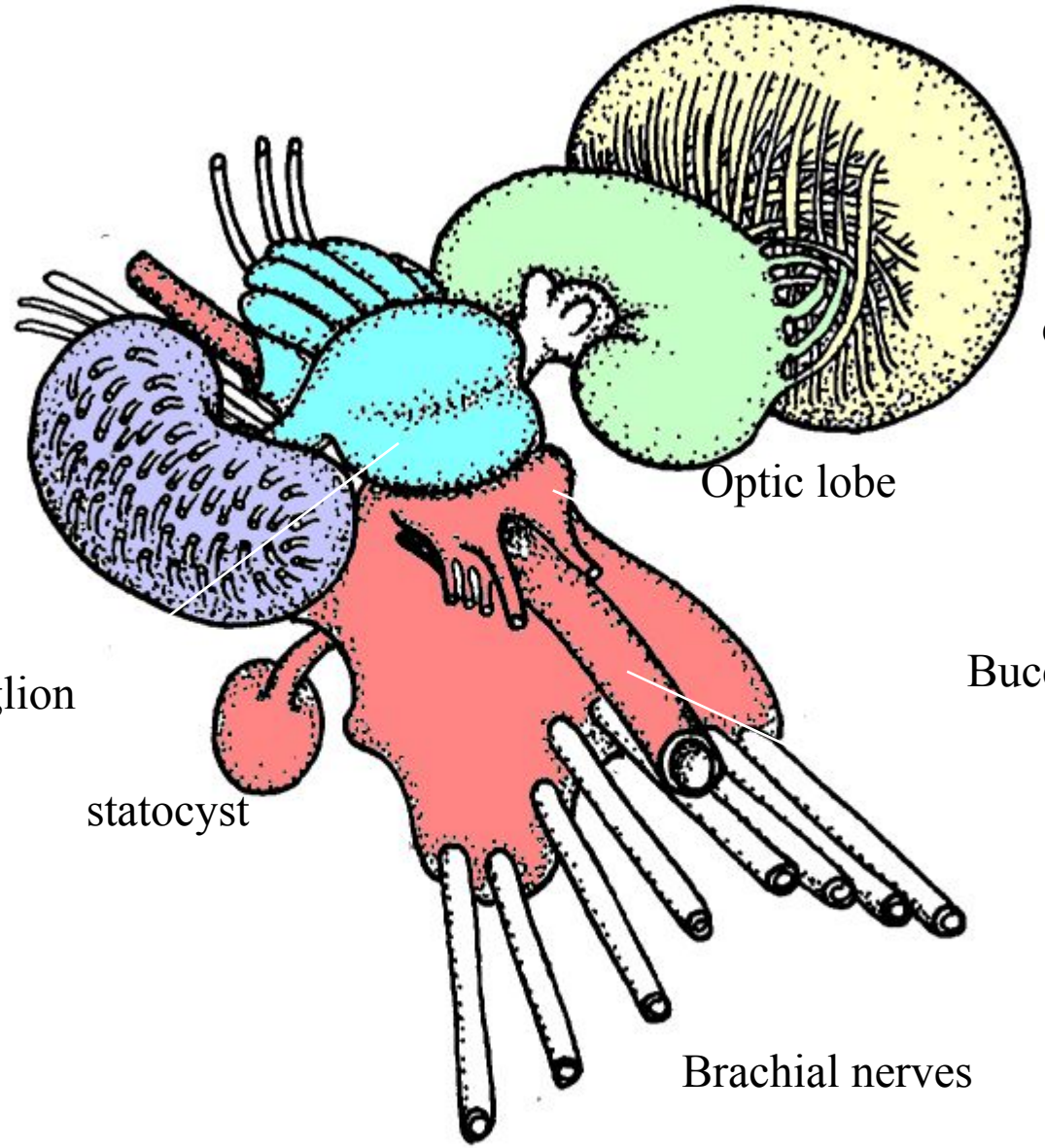



Tentacle
Arm
Funnel (siphon)
Fin
Collar
Eye



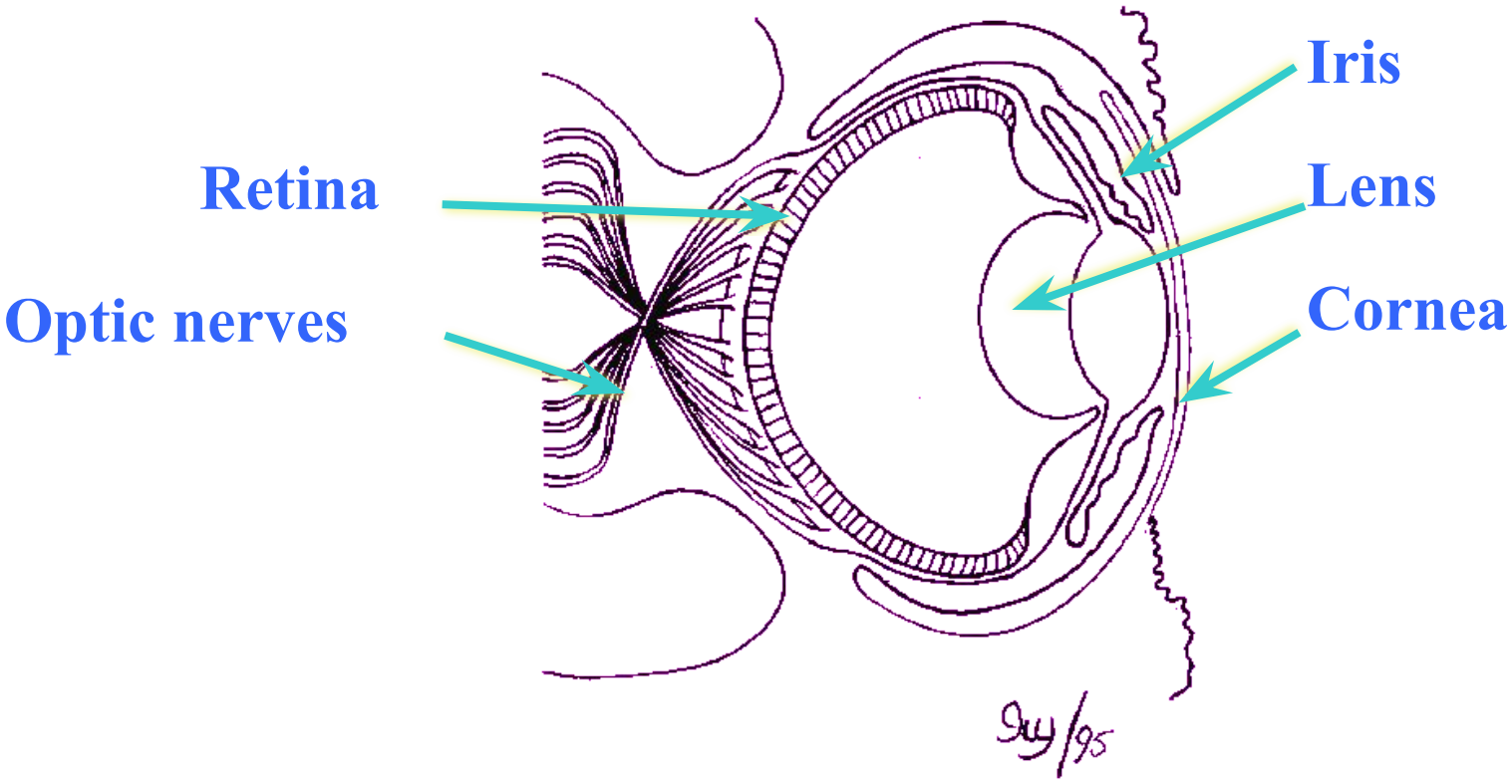
Hectocotylus (sperm-bearing arm in males)

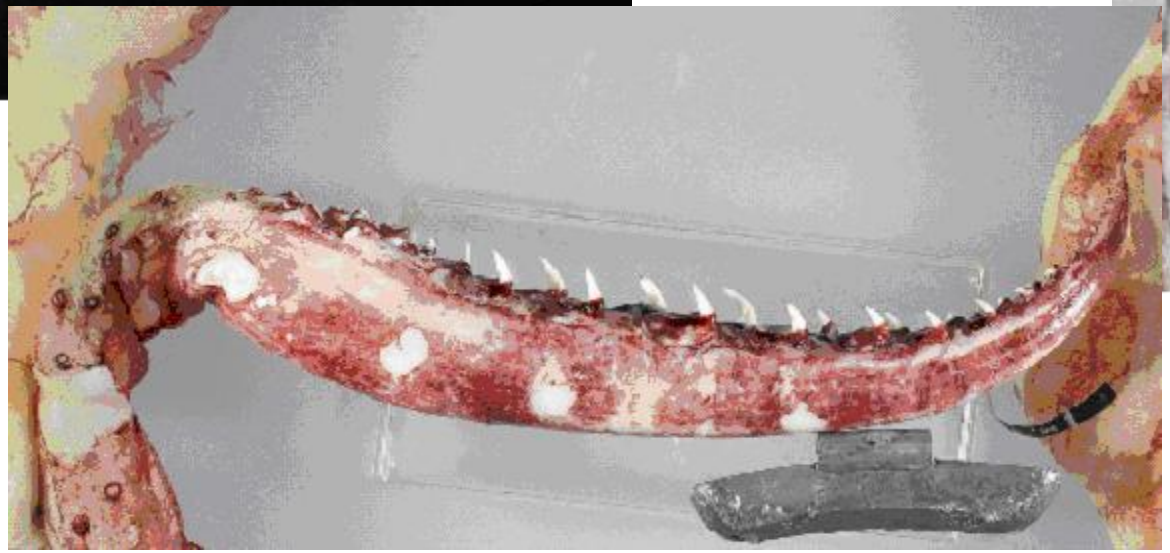
Reproduction: trochophore and veliger are bypassed and hatch into planktonic juveniles



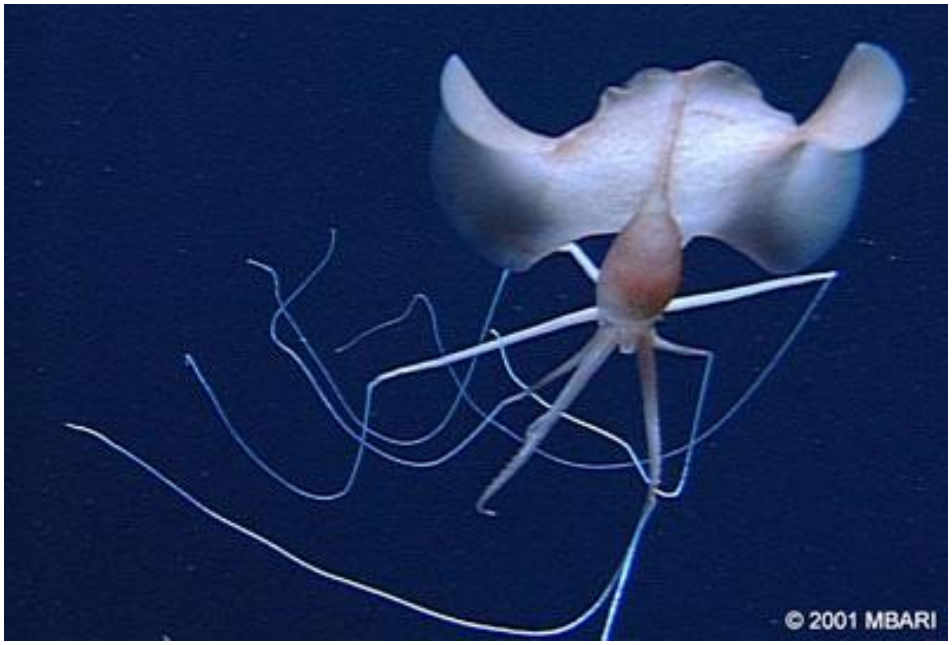
Brain is surrounded by a cranium

Cephalopod eye





Examples of Cephalopods



A giant squid (3.15-metre-long) has netted off the UK coast; first time in 15 years.

The squid, believed to be female and three years old, did not survive being brought to the surface.

The Mimic Octopus

PHOTOS BY ROGER STEENE

EVEN A SEA SNAKE: Not only can a mimic octopus change its shape to imitate a sea snake (a real version is at right), it can also quickly change its coloration to match by using 'color sacs' and 'reflectors' in its skin.

Cephalopoda

- Ectocochleate cephalopods
  - Have external shell with internally subdivisions used for buoyancy control
  - This ancestral group is almost completely extinct
  - E.g. *Nautilus*

Nautilus is the only cephalopod with an external shell and lacking chromatophores

Chromatophores (color cells)

Iridocytes (reflective cells)

- Millions of these allow rapid changes in color, polarized signals
- Also have photophores for bioluminescence

Cephalopods except Nautilus have ink sac