

# Classification of the Chordata

- There are three subphyla in the Chordata:
  - Subphylum Urochordata: tunicates
  - Subphylum Cephalochordata: lancelets
  - Subphylum Vertebrata: fish, amphibians, reptiles, birds, mammals, etc.

# Subphylum Urochordata

- The Urochordata (“tunicates” named for the tough tunic that surrounds the adult) look like most unpromising candidates to be chordates and relatives of the vertebrates.
- The largest group, the ascidians or sea squirts (Class Ascidiacea) as adults are marine, sessile, filter feeding organisms that live either solitarily or in colonies.



*Ciona intestinalis*  
(a solitary sea squirt)





Photo Copyright © Diane R. Nelson



*Synoicum pulmonaria* a colonial sea squirt



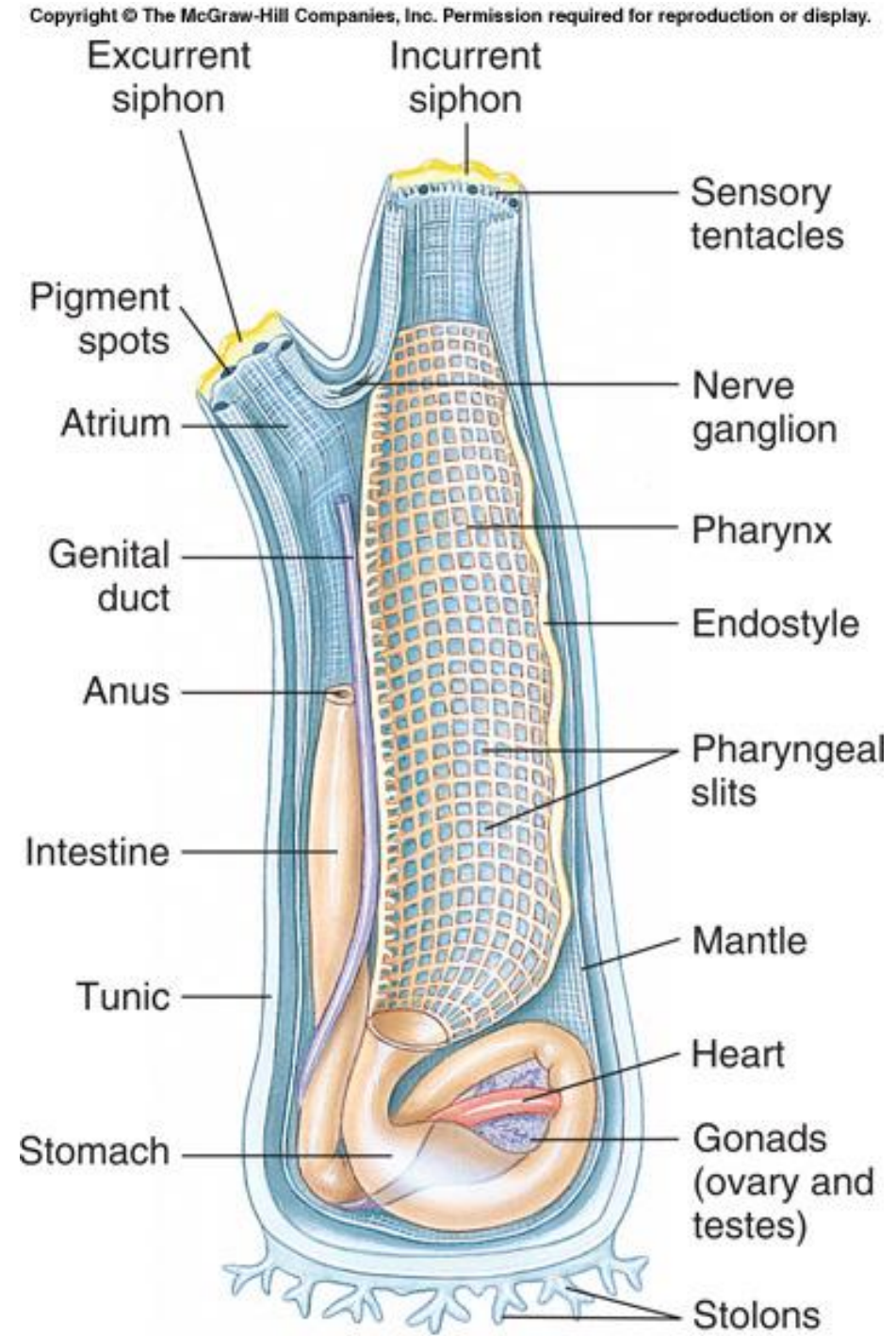
# Ascidians

- Adult ascidians lack a notochord and there is only a single ganglion in place of the dorsal nerve cord.
- Of the five characteristics of chordates adults possess only two: pharyngeal gill slits and an endostyle, both of which they use in filter feeding.

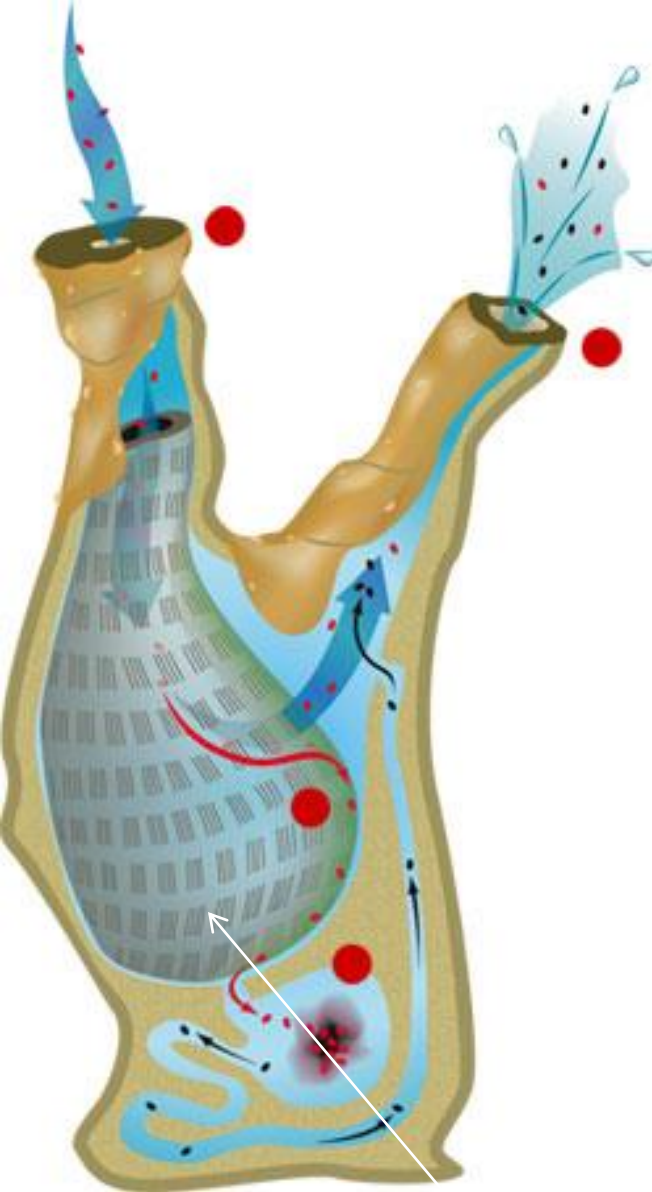
# Ascidians

- The adult sea squirt draws water in through an incurrent siphon and pushes it back out an excurrent one.
- Food particles are filtered out in the pharyngeal slits with mucus from the endostyle used to trap particles.

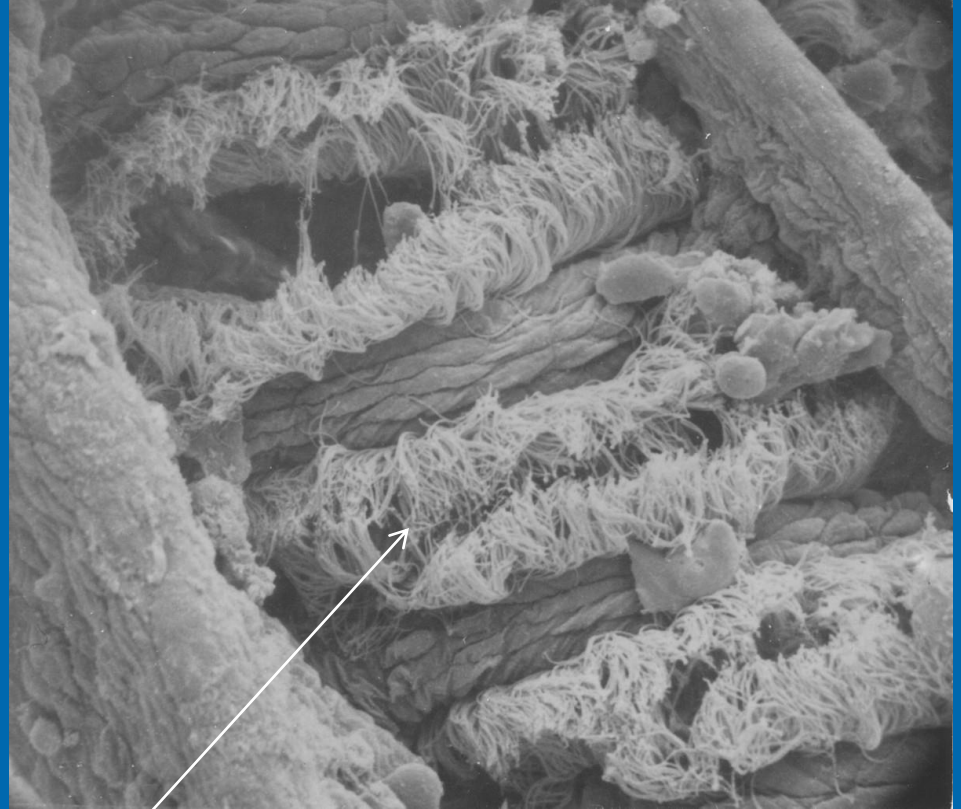
Figure 23.04







Branchial sac orpharynx

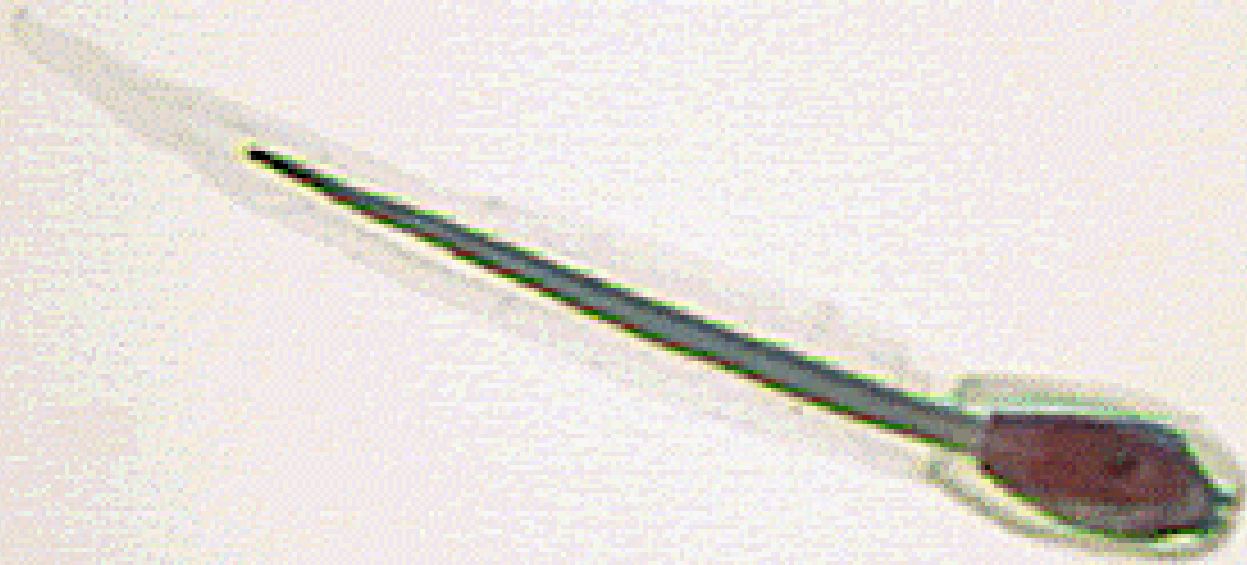


Cilia lining the slits in the branchial sac or pharynx

Ascidian filter feeding process. Water is drawn through the animal by the beating of cilia.

# Larval Ascidian

- Even though the adult ascidian hardly resembles a chordate its larva does.
- Larval ascidians are very small and tadpole-like and possess all five chordate characteristics previously outlined.



BIODIDAC © Houseman, Univ. of Ottawa

Young larval ascidian



# Larval Ascidian

- The larval ascidians role is to disperse and to achieve this it is free swimming. However, it has only a short larval life (minutes to a couple of days) and does not feed during this time.
- Instead it searches for a place to settle and then attaches and metamorphoses into an adult.

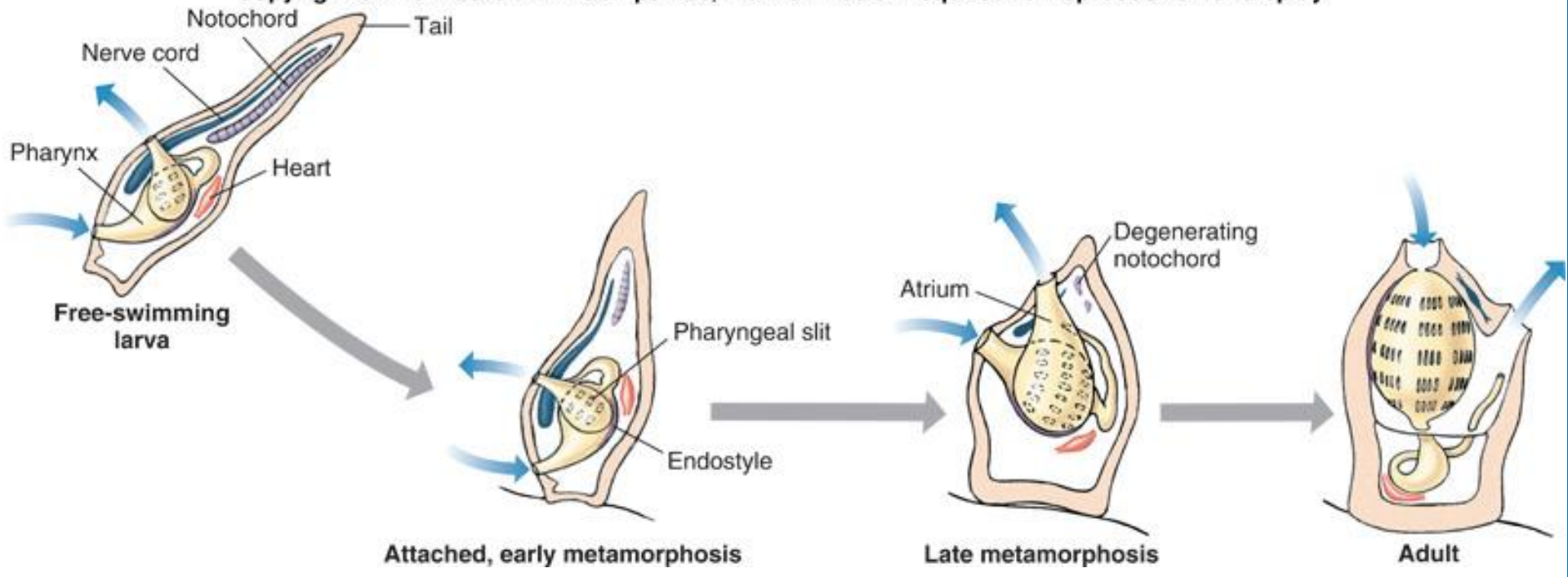
# Ascidian metamorphosis

- During metamorphosis the notochord disappears, the nerve cord is reduced to a single nerve ganglion and a couple of nerves.



Figure 23.06

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.





# Other Urochordate classes

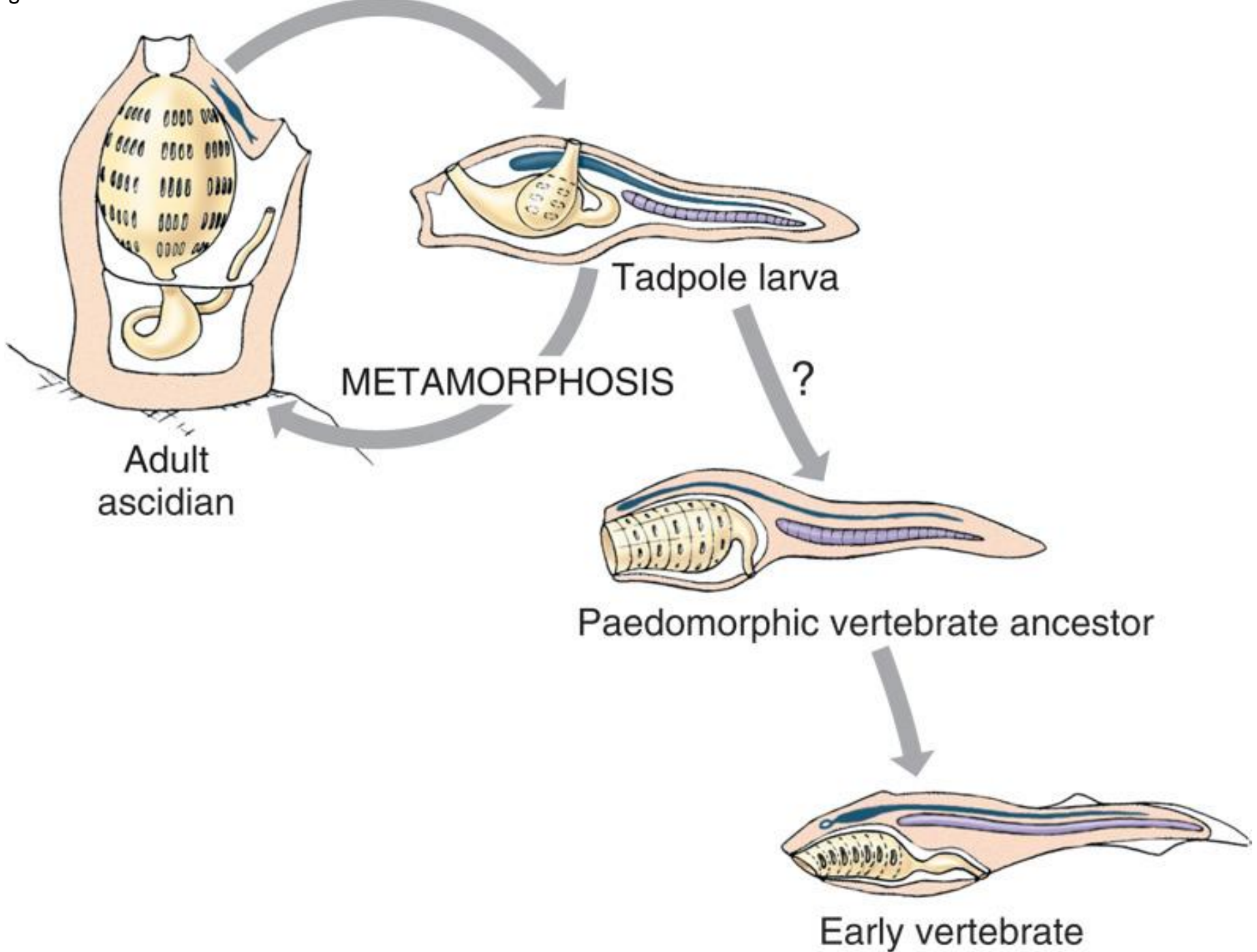
- Besides the ascidians there are two other classes of the Urochordata: the Larvacea and Thaliacea.
- Both are small, transparent planktonic forms. Thaliaceans are cylindrical or spindle shaped whereas larvaceans are tadpolelike and resemble an ascidian larva.

# Garstang's hypothesis of chordate larval evolution

- In the 1920's it was proposed that the vertebrates were derived from an ancestral ascidian that retained its characteristics into adulthood (the process by which juvenile characteristics are retained into adulthood is referred to as pedomorphosis).

Figure 23.12

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.





# Garstang's hypothesis of chordate larval evolution

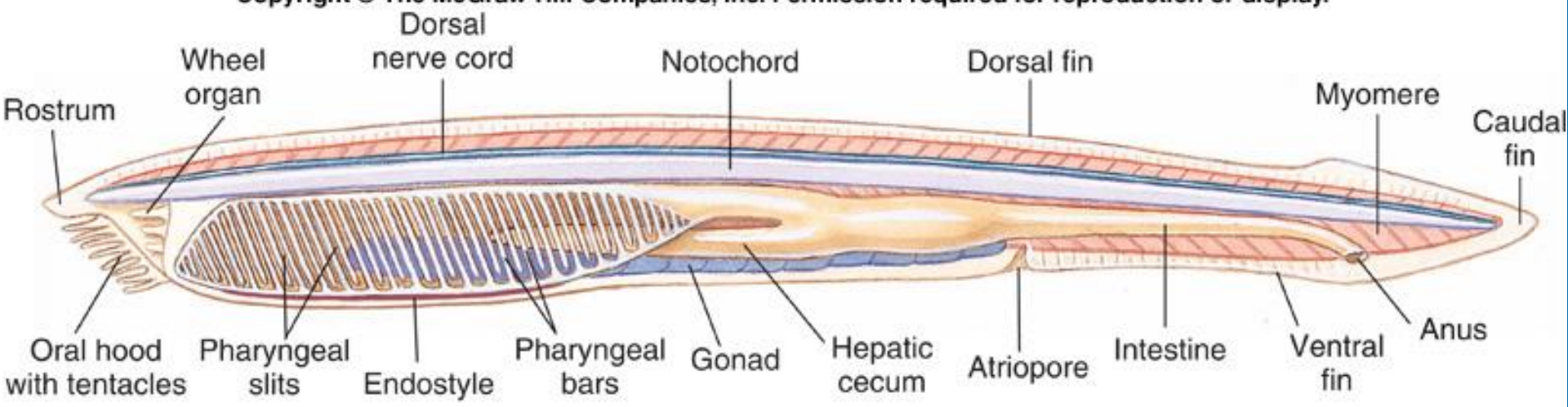
- Garstang's hypothesis is supported by embryological evidence, but more recently molecular analyses have suggested that sessile ascidians are a derived form and that the free-living larvaceans are more likely to be the closest relatives of the chordates.

# Subphylum Cephalochordata

- The cephalochordates are the lancelets, which are small (3-7 cm long) laterally compressed fishlike animals that inhabit sandy sediments of coastal waters. They lack a distinct head and have no cranium.
- They are commonly referred to as Amphioxus as this was the original genus name. There are 29 species, five of which occur in North American coastal waters.

Figure 23.09b

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



**B**

# Amphioxus

- Amphioxus is a filter feeder.
- Water enters the mouth and then passes through the pharyngeal slits, where food is trapped in mucus. Cilia then move the food to the gut.





**A**

Amphioxus

# Amphioxus

- Amphioxus is interesting because it displays the basic chordate characteristics in a simple and obvious form because of its transparency.
- Amphioxus is considered to be the closest living relative of the vertebrates because it shares several characteristics with vertebrates that Urochordates do not possess.

# Amphioxus characteristics shared with vertebrates

- As well as possessing the chordate characteristics, amphioxus shares a number of traits with vertebrates including:
  - Segmented myomeres (muscle blocks)
  - Dorsal and ventral aortas
  - Branchial (gill) arches (blood vessels running over the gills).



# Characteristics of vertebrates *not* possessed by Amphioxus

- Amphioxus however lacks several characteristics that biologists think the ancestor of vertebrates possessed. These include:
  - **Tripartite brain** (with forebrain, midbrain and hindbrain) protected by a **cranium**
  - **Chambered heart**
  - **Muscular gut and pharynx**
  - *List continues on next slide*



# Characteristics of vertebrates *not* possessed by Amphioxus

- **Various special sensory organs** (eyes, chemical and pressure receptors)
- **Neural crest** (ectodermal cells that are found on the embryonic neural tube and are engaged in the formation of the cranium, tooth dentine, some endocrine glands and Schwann cells, which provide myelin insulation to nerve cells).