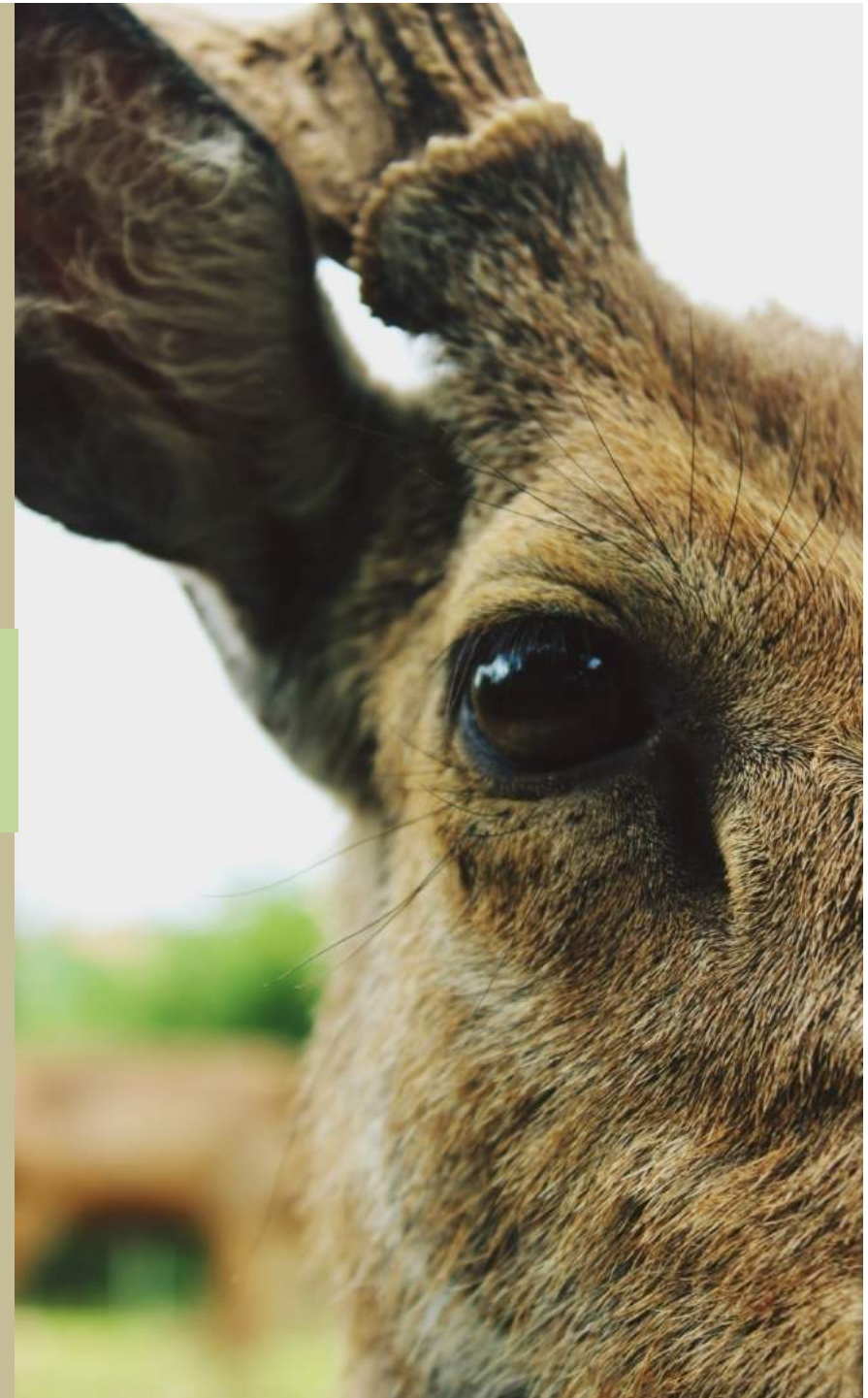
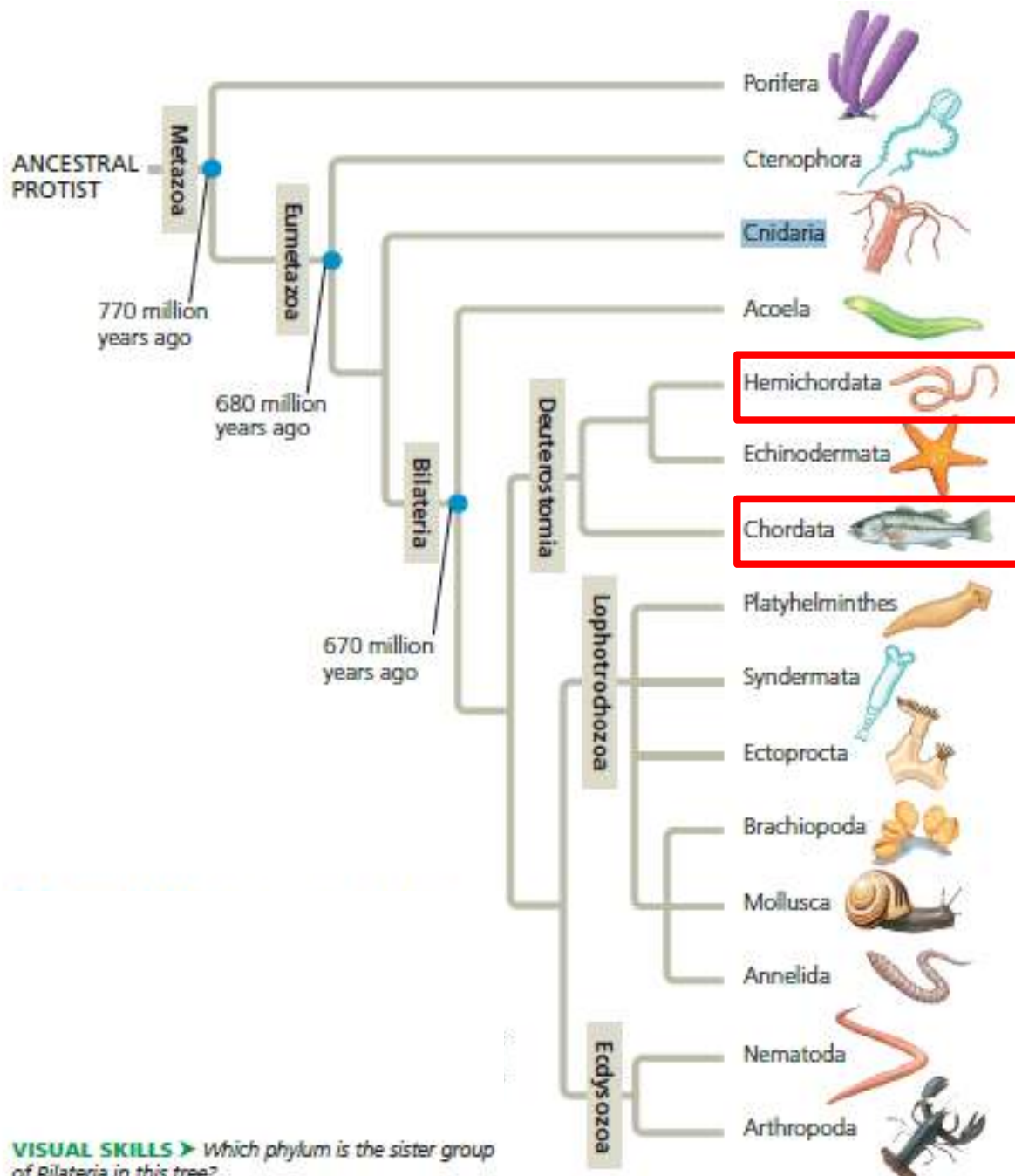


TAKSONOMI HEWAN

CHAPTER 10: HEMICHORDATA & CHORDATA

Husni Mubarak, S.Pd., M.Si.
Tadris Biologi
IAIN Jember





VISUAL SKILLS ▶ Which phylum is the sister group of Bilateria in this tree?

Deuterostomia

Hemichordata (85 species)



An acorn worm

Chordata (57,000 species)

Lebih dari 90% Chordata memiliki tulang belakang (termasuk vertebrata).



A tunicate

Spt Echinodermata dan Chordata, Hemichordata jg merupakan anggota Deuterostomia.

Berbagi karakter dengan Chordata yaitu berupa **Gill Slits & Dorsal Nerve Cord.**

Classical deuterostome developmental features are **radial regulative cleavage**; formation of the **mouth from a second opening (deuterostomy)**; and coelom formation by enterocoely.

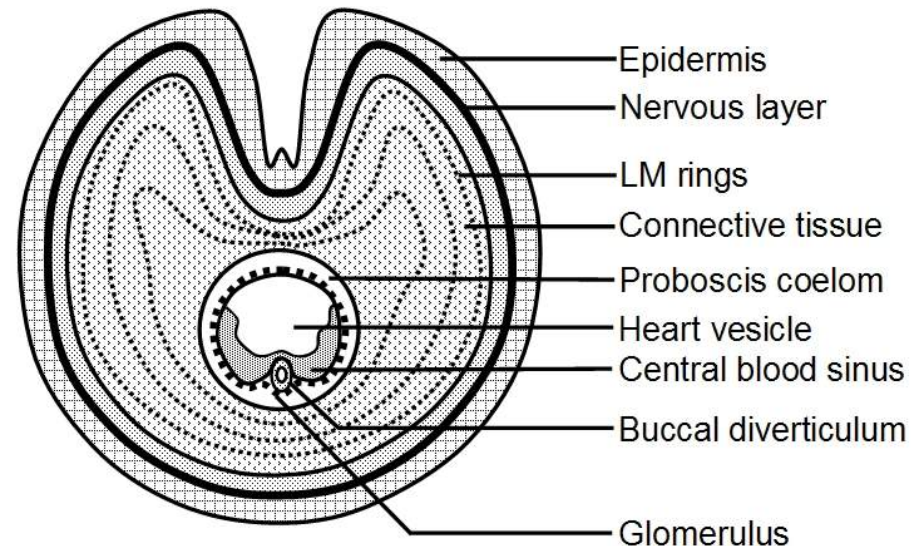
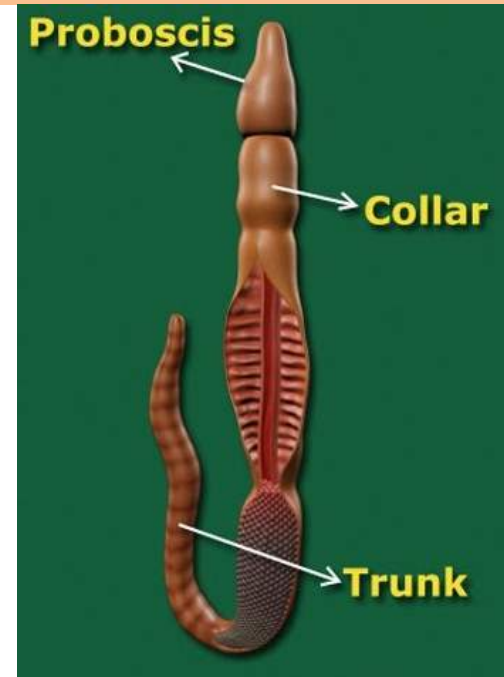
All deuterostomes are coelomate.

PHYLUM HEMICHORDATA



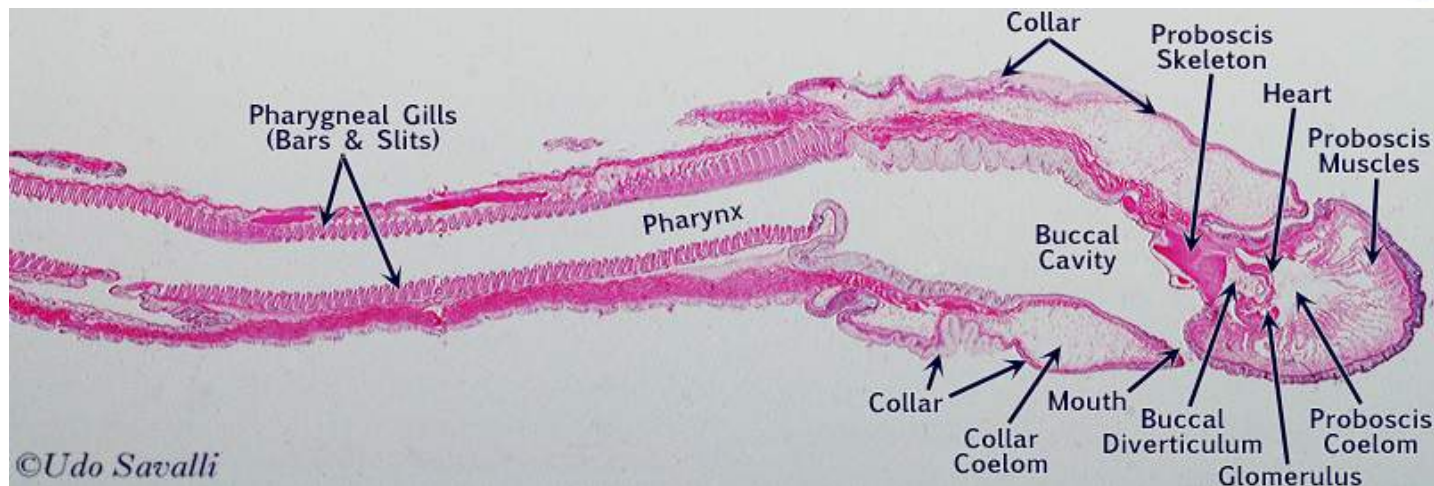
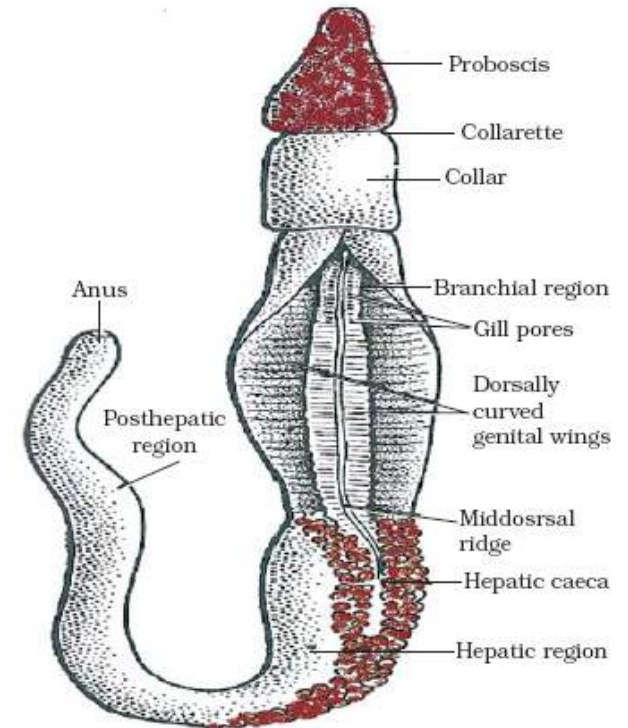
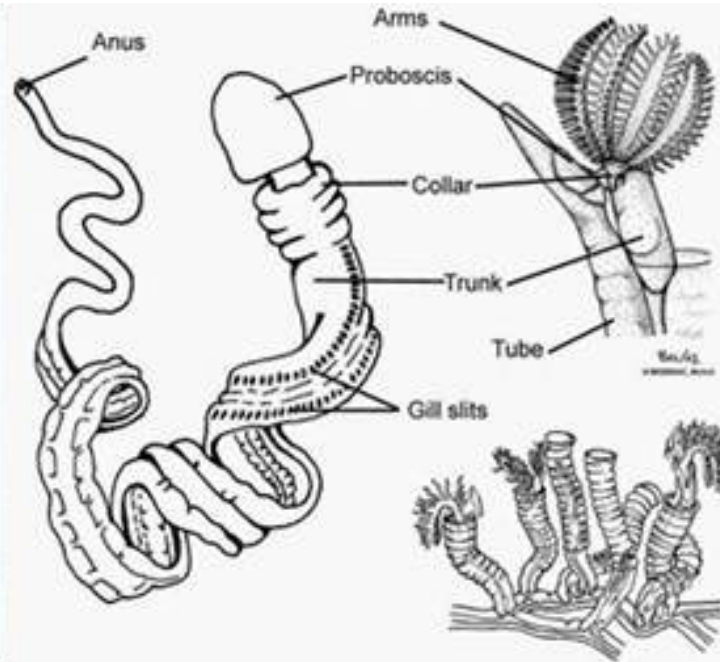
Hemichordata - General Characteristics

- Body divided into **proboscis, collar,** and **trunk; buccal diverticulum** in posterior part of proboscis
- **Buccal Diverticulum**, a tubular outgrowth from the mouth cavity forward into the proboscis, resembled a rudimentary notochord—the dorsal, or back-side, supporting axis of the more primitive vertebrates
- **Class Enteropneusta** free-moving and of burrowing habits; **Class Pterobranchia** sessile, mostly colonial, living in secreted tubes
- Free-living
- Bilaterally symmetrical, soft bodied; wormlike or short and compact with stalk for attachment
- Triploblastic

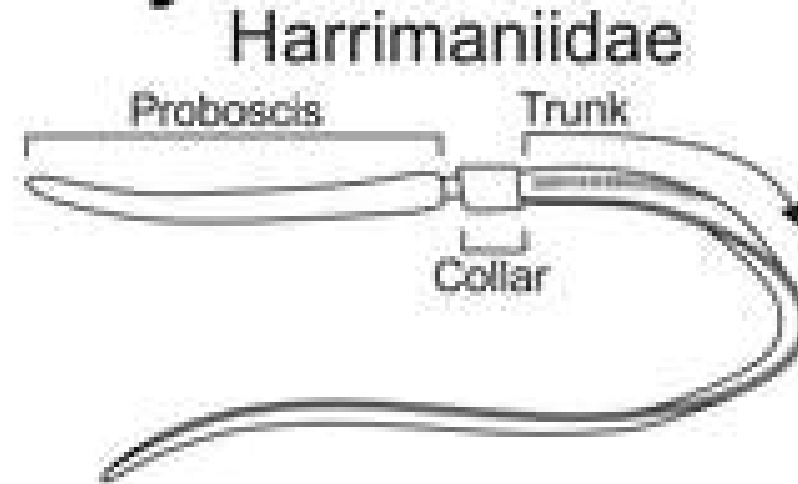
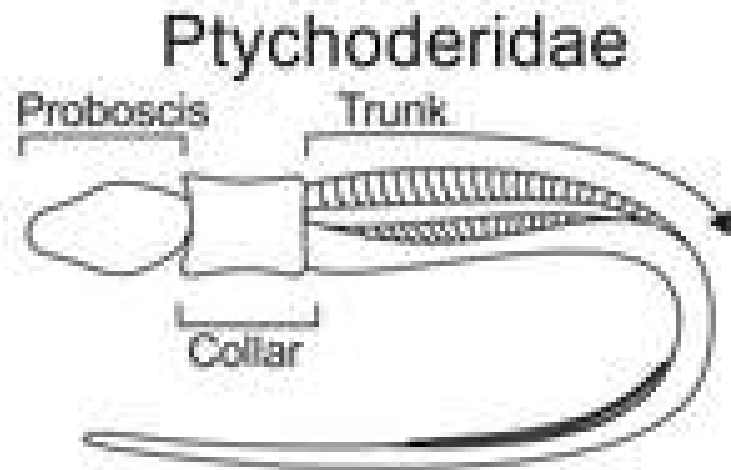


T.S. Proboscis of Saccoglossus otagoensis

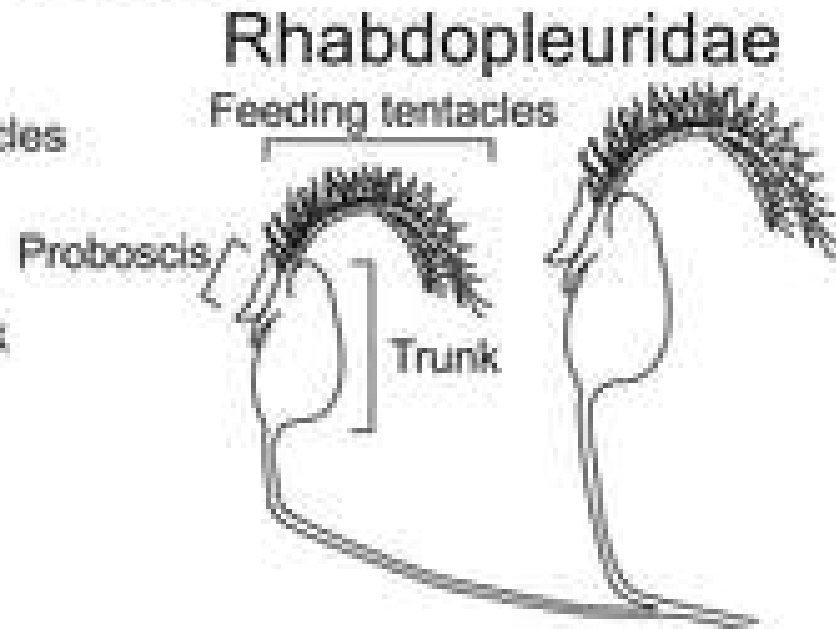
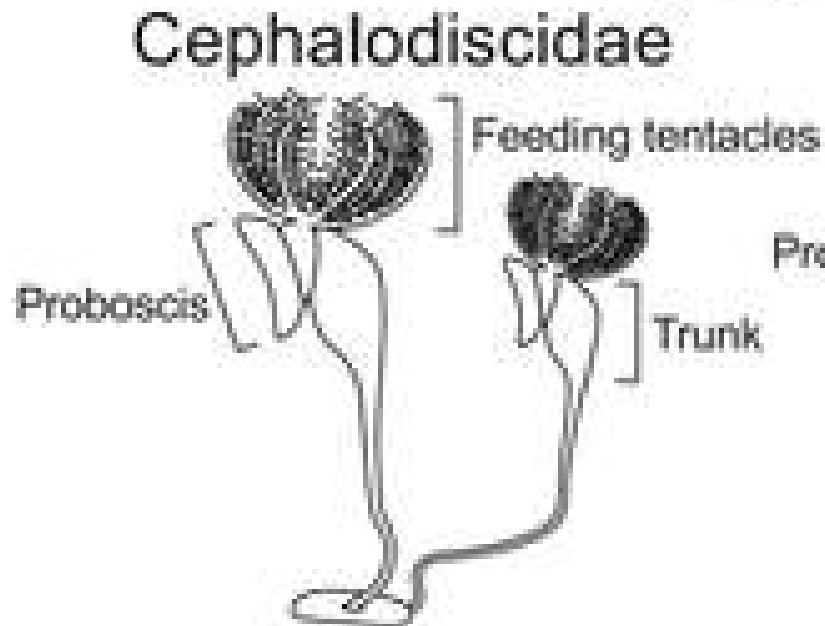
Hemichordata - General Characteristics



Solitary

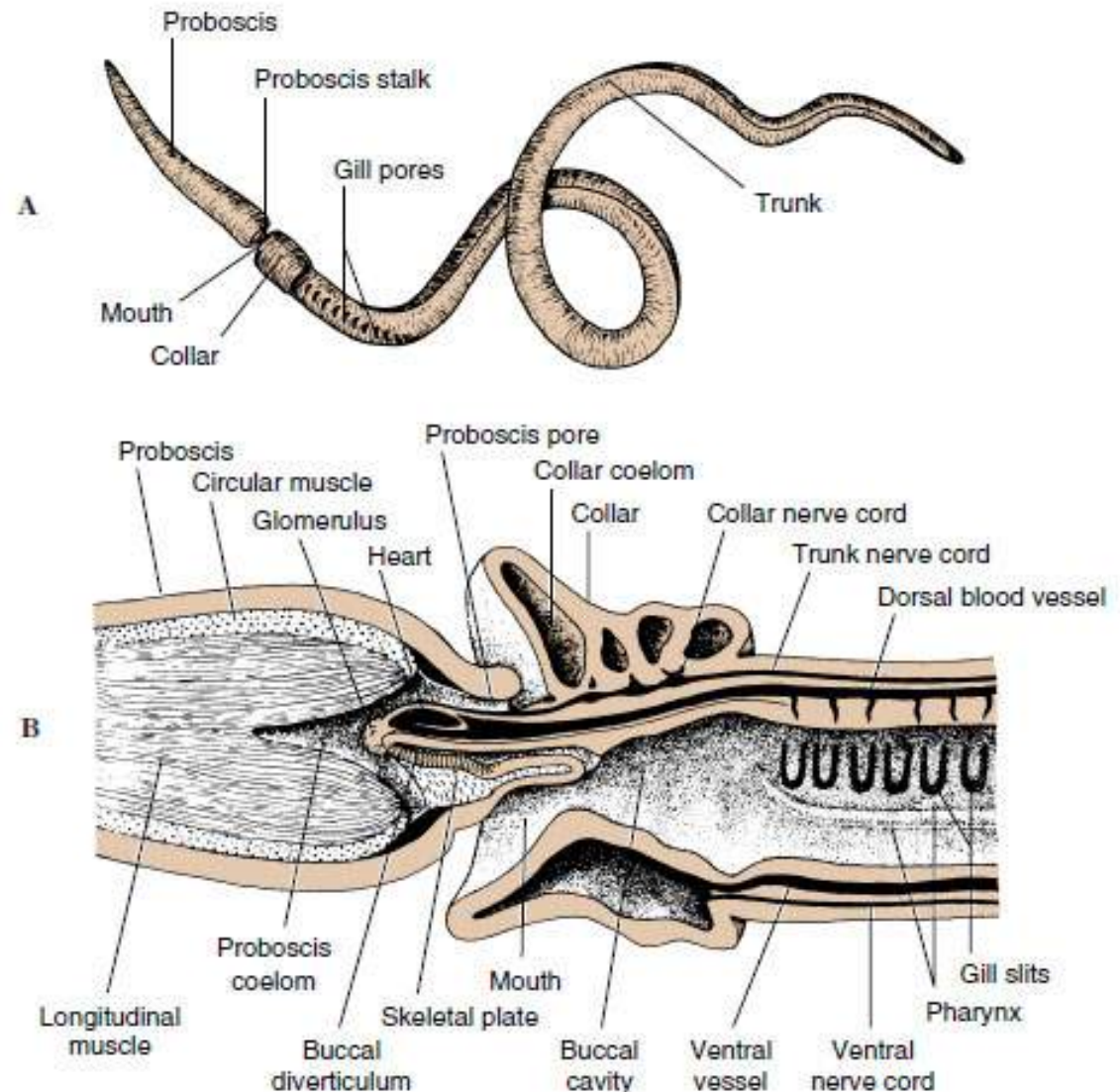


Colonial



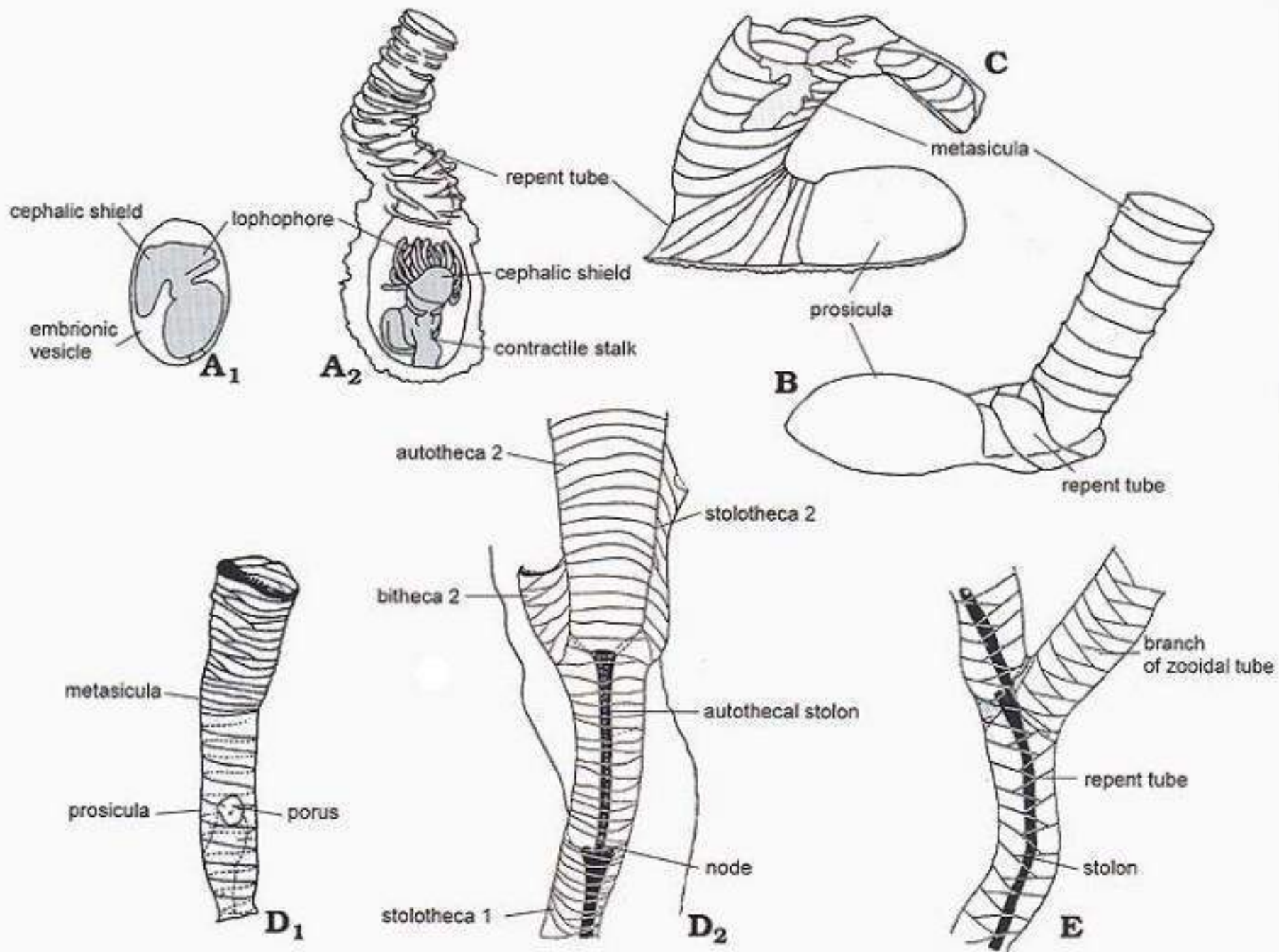
Hemichordata - General Characteristics

- **Single coelomic pouch in proboscis**, but **paired pouches in collar** and **trunk**
- Ciliated epidermis
- Digestive system complete
- Longitudinal and circular muscles in body wall in some
- A subepidermal nerve plexus thickened to form dorsal and ventral nerve cords, with a ring connective in the collar; some species with hollow **dorsal nerve cord**
- Sensory neurons in proboscis likely function in chemoreception



Hemichordata - General Characteristics

- Colonies form by asexual **budding in pterobranchs**; asexual reproduction by **fragmentation in enteropneusts**
- **Sexes separate in Enteropneusta**, with gonads projecting into body cavity; tornaria larva in some Enteropneusta
- **A single glomerulus** connected to blood vessels may have excretory function and is considered a **metanephridium**
- Respiratory system of **gill slits/ celah insang (few or none in pterobranchs)** connecting the pharynx with outside
- Circulatory system of dorsal and **ventral vessels and dorsal heart**



PHYLUM CHORDATA



Ascidians



Salps



Larvaceans



Lancelets



Hagfish



Lampreys



Cartilaginous Fish



Ray-finned Fish



Lobe-Finned Fish



Amphibians



Reptiles



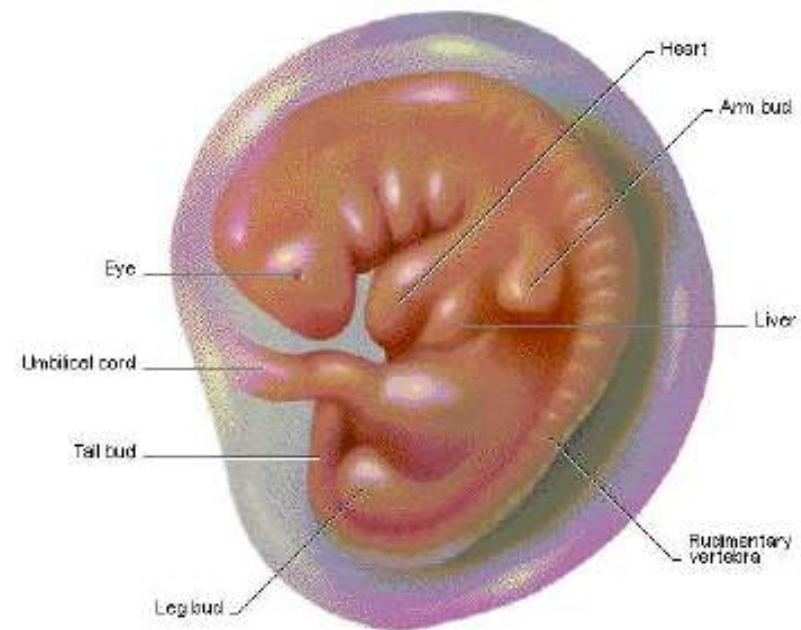
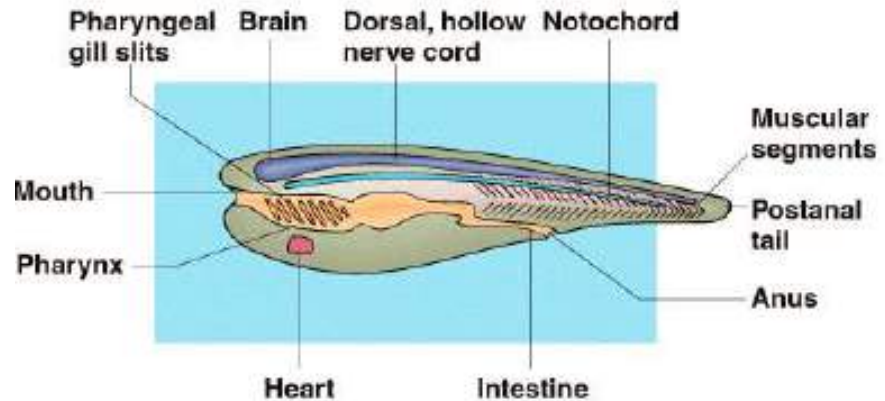
Birds



Mammals

Chordata - General Characteristics

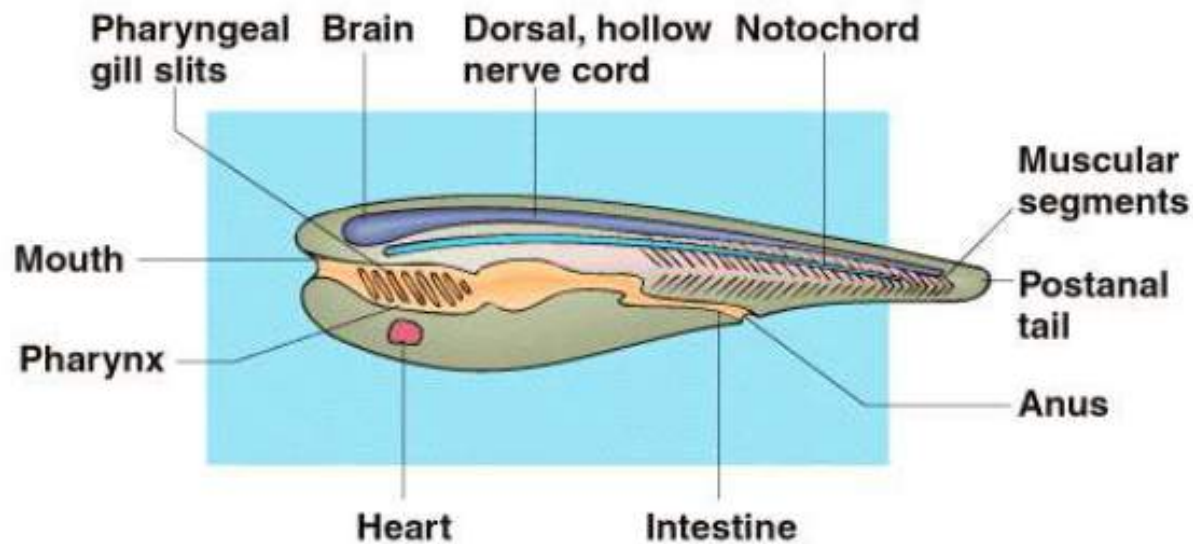
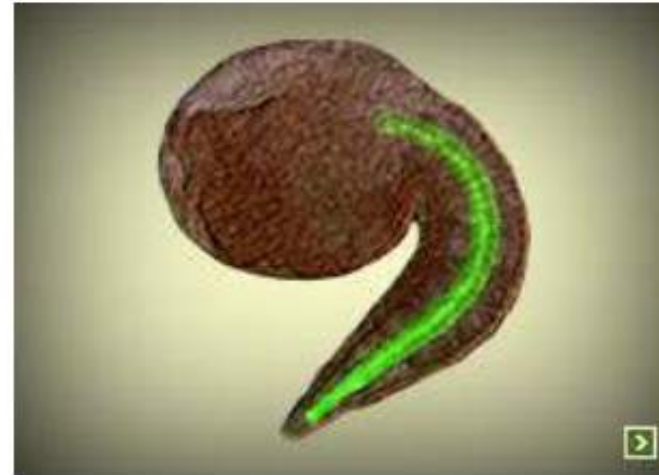
- Bilateral symmetry; segmented body; three germ layers; well developed coelom
- **Notochord (a skeletal rod/ batang rangka)** present at some stage in the life cycle
- Single, dorsal, **tubular nerve cord**; anterior end of cord usually enlarged to form brain
- **Pharyngeal pouches** present at some stage in the life cycle; in aquatic chordates these develop into pharyngeal slits



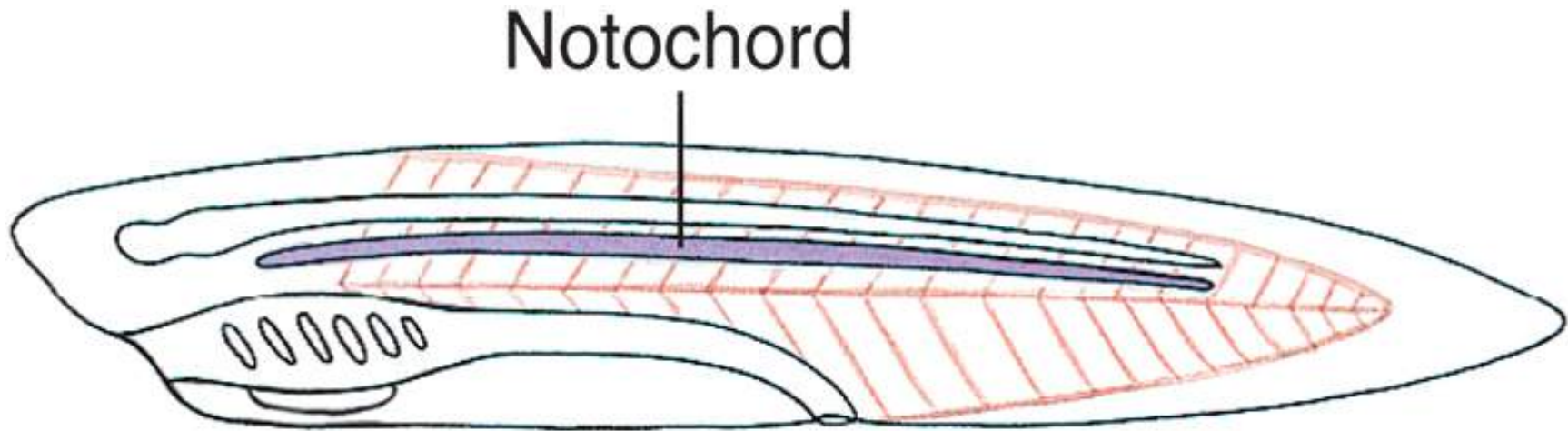
Chordata - General Characteristics

Notochord

- A long rod of stiffened tissue
- Not bone or cartilage



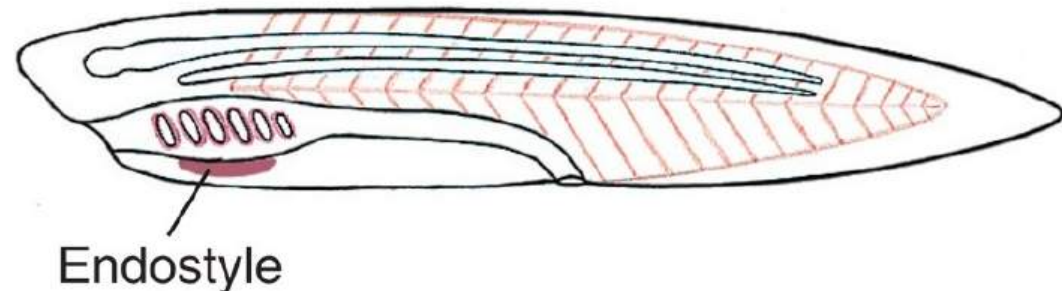
- The **notochord** is a flexible, rod-like structure derived from mesoderm.
 - The first part of the endoskeleton to appear in an embryo.
 - Place for muscle attachment.
 - In vertebrates, the notochord is replaced by the vertebrae.
 - Remains of the notochord may persist between the vertebrae.

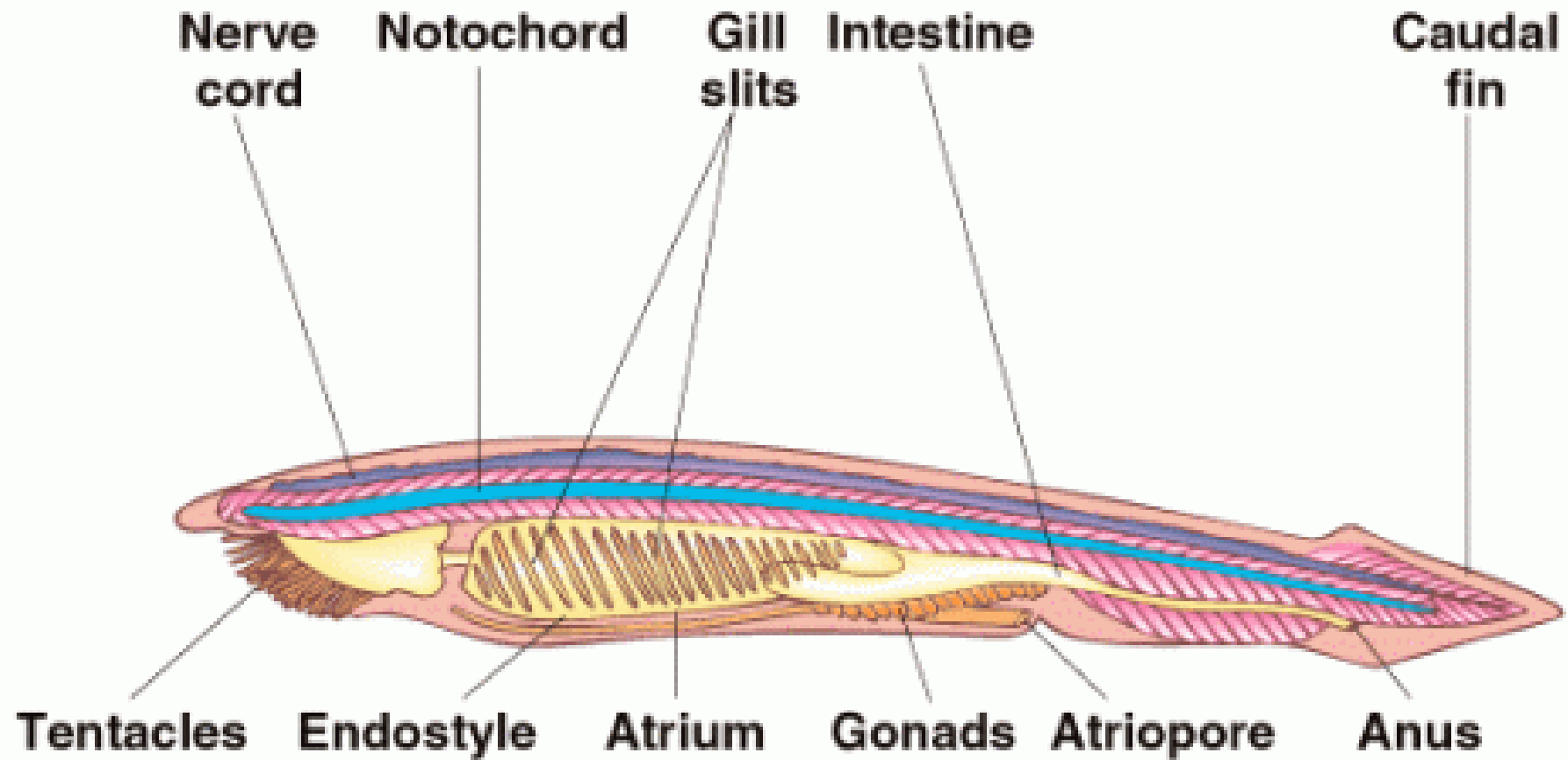


Chordata - General Characteristics

- **Endostyle** in floor of pharynx or a thyroid gland derived from the endostyle
- **Postanal tail projecting** beyond the anus at some stage but may or may not persist
- Complete digestive system
- **Segmentation**, if present, restricted to outer body wall, head, and tail and not extending into coelom

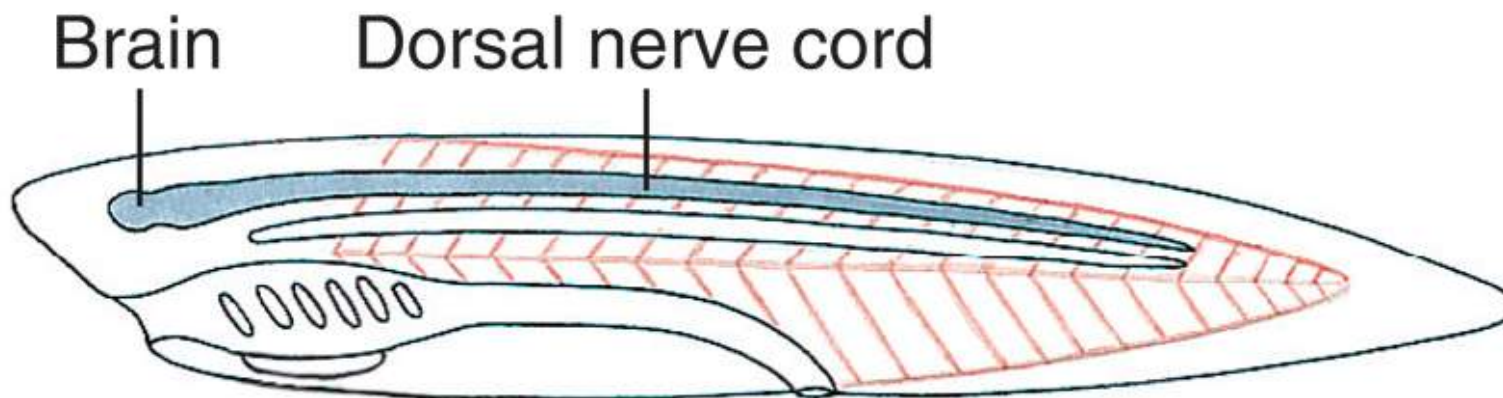
The **endostyle** in the pharyngeal floor, secretes mucus that traps food particles.

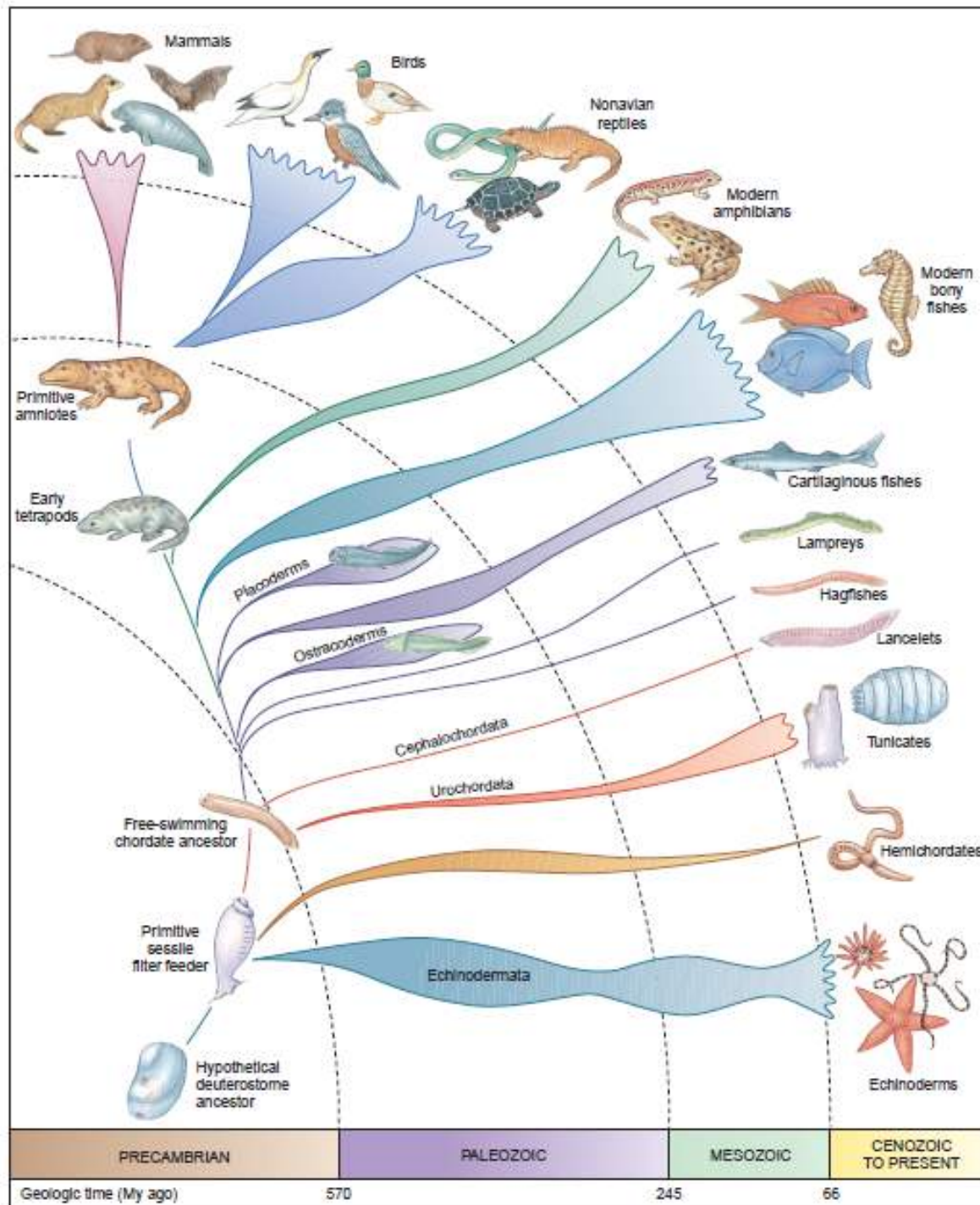


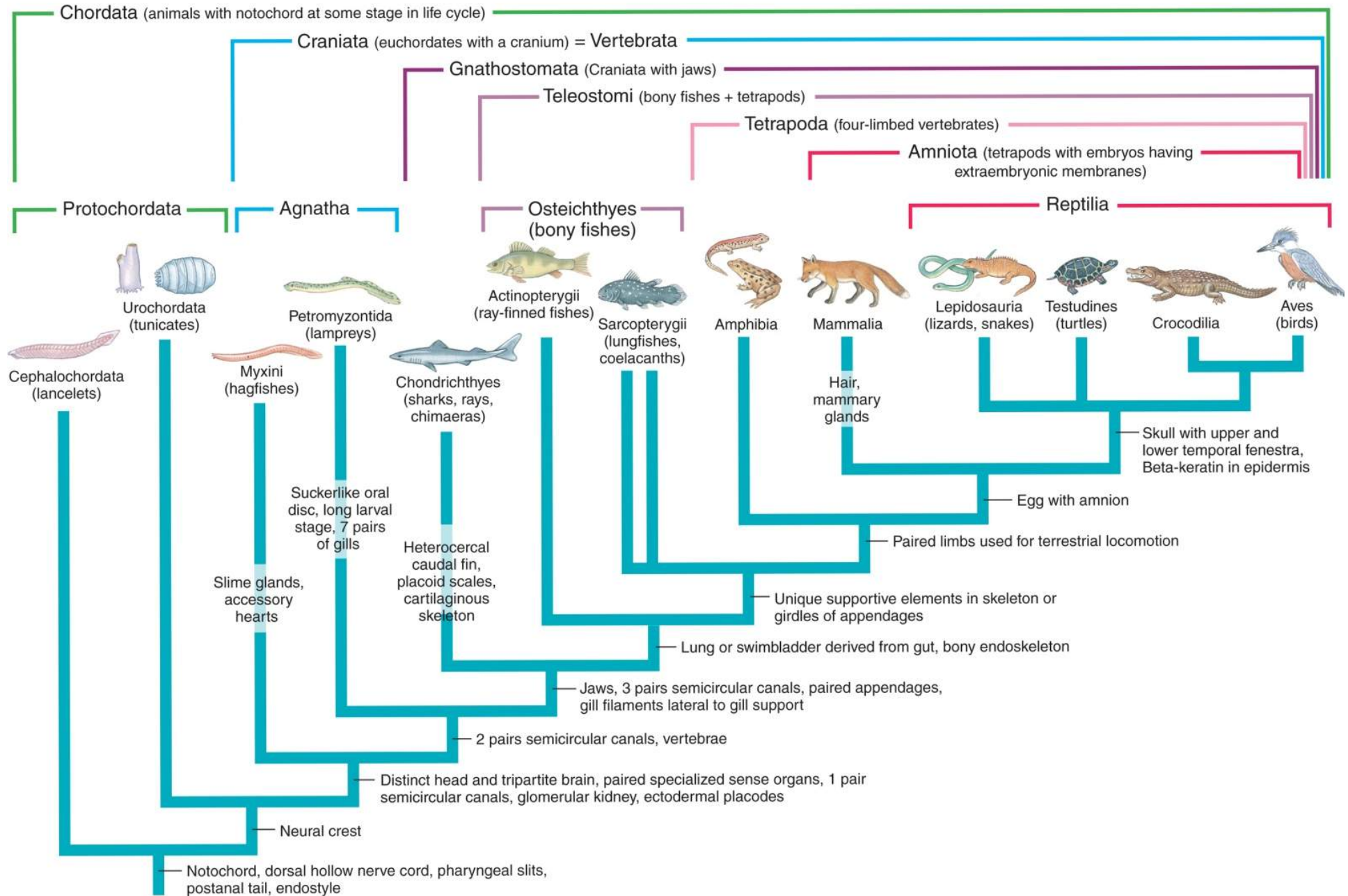


Dorsal Tubular Nerve Cord

- In chordates, the **nerve cord** is dorsal to the alimentary canal and is a tube.
 - The anterior end becomes enlarged to form the brain.
 - The hollow cord is produced by the infolding of ectodermal cells that are in contact with the mesoderm in the embryo.
 - Protected by the vertebral column in vertebrates.







CORRECTION

Correction: A Higher Level Classification of All Living Organisms

Michael A. Ruggiero, Dennis P. Gordon, Thomas M. Orrell, Nicolas Bailly, Thierry Bourgoïn, Richard C. Brusca, Thomas Cavalier-Smith, Michael D. Guiry, Paul M. Kirk



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Citation: Ruggiero MA, Gordon DP, Orrell TM, Bailly N, Bourgoïn T, Brusca RC, et al. (2015) Correction: A Higher Level Classification of All Living Organisms. PLoS ONE 10(6): e0130114. doi:10.1371/journal.pone.0130114

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Rank

Superkingdom

Kingdom

Subkingdom

Infrakingdom

Superphylum

Phylum

Subphylum

Infraphylum

Superclass

Class

Subclass

Infraclass

Superorder

Order

Main ranks are in bold type; unnamed taxa are not counted.

doi:10.1371/journal.pone.0130114.t001

**KLASIFIKASI
HEMICHORDATA &
CHORDATA**

INFRAKINGDOM
DEUTEROSTOMIA

Phylum Chordata

Subphylum Cephalochordata

Order Amphioxifomes

Subphylum Urochordata

Class Appendicularia

Order Copelata

Class Ascidiacea

Order Enterogona

Order Pleurogona

Class Thaliacea

Order Doliolida

Order Pyrosomida

Order Salpida

Subphylum Vertebrata [= Craniata]

Phylum Hemichordata

Class Enteropneusta (e.g., Harmaniidae)

Class
Pterobranchia

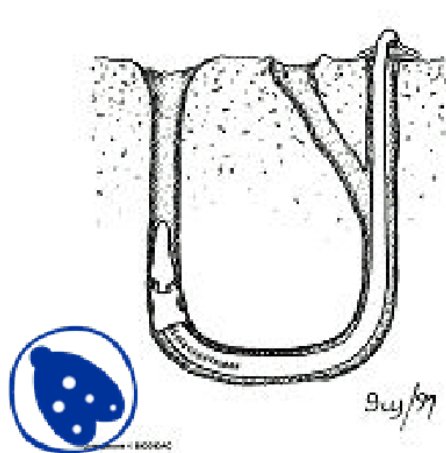
Subclass Cephalodiscida (*Cephalodiscus*)

Subclass Graptolithina

Order Rhabdopleurida

Phylum Hemichordata- acorn worms

- Missing link?
 - Larvae are similar to echinoderm larvae.
 - Dorsal, hollow nerve cord and pharyngeal slits.
- Deposit feeders.
- Reproduction- dioecious.
- Habitats- tidal flats, hydrothermal vents.
- 85 species.
- Example- Saccoglossus.



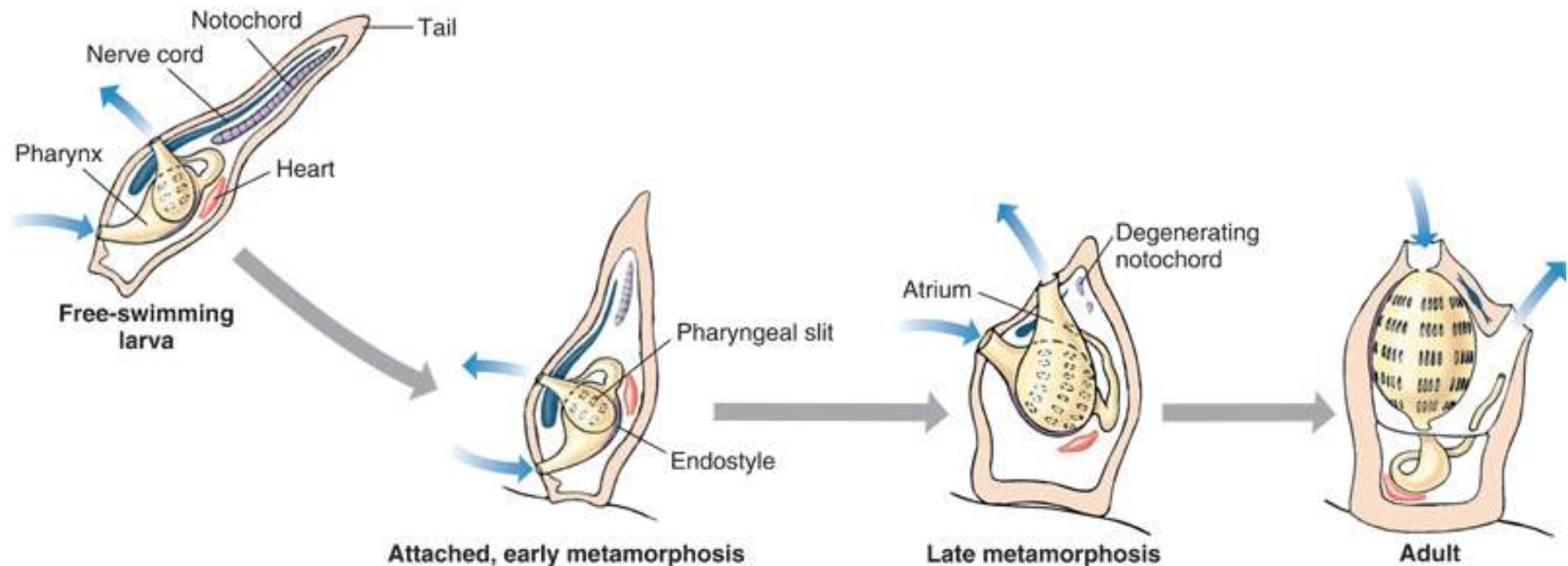
Subphylum Urochordata

- **Tunicates (subphylum Urochordata)** are found in all seas.
- Most are sessile and highly specialized as adults.



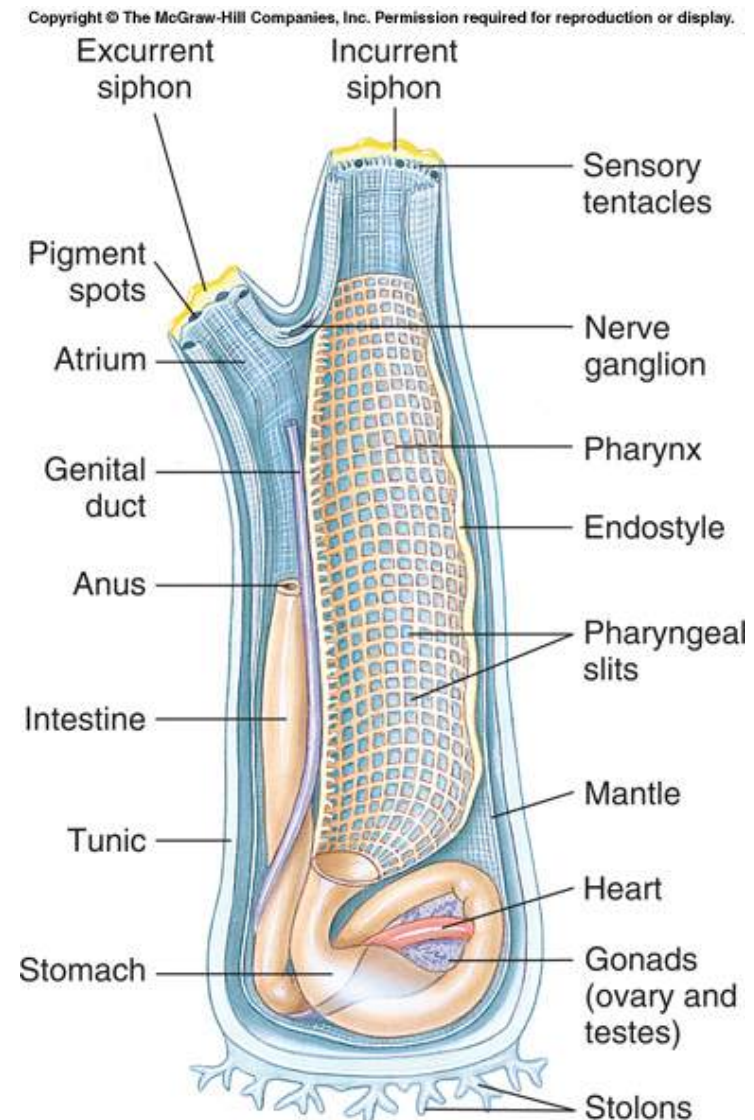
Subphylum Urochordata

- In most species, only the larvae show all of the chordate hallmarks.
 - **Tadpole larva**



Subphylum Urochordata

- Tunicates filter feed using the pharyngeal slits and a mucous net secreted by the endostyle.



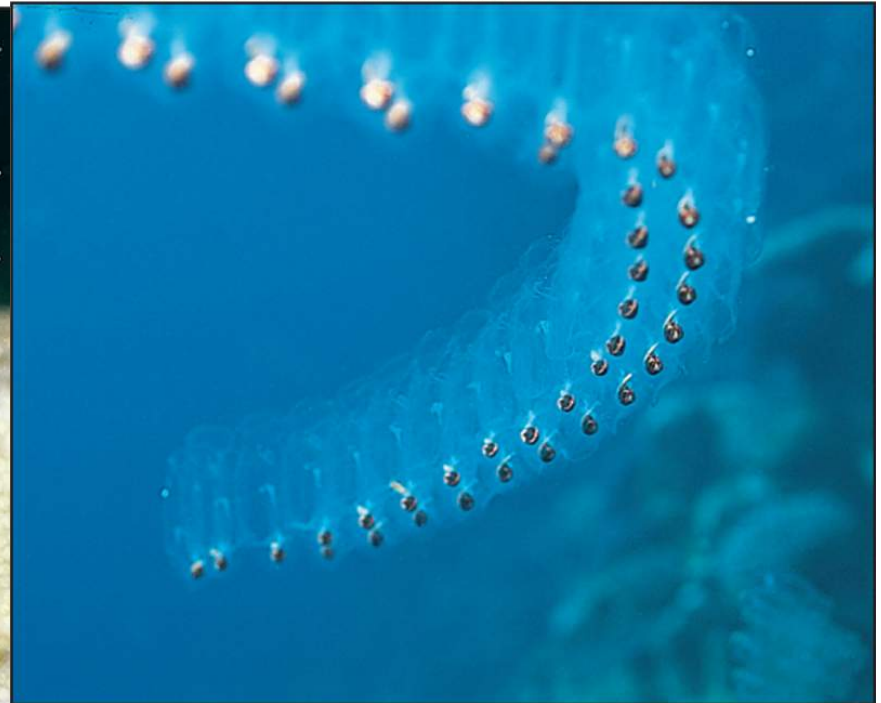
Subphylum Urochordata

- Some tunicates are colonial.

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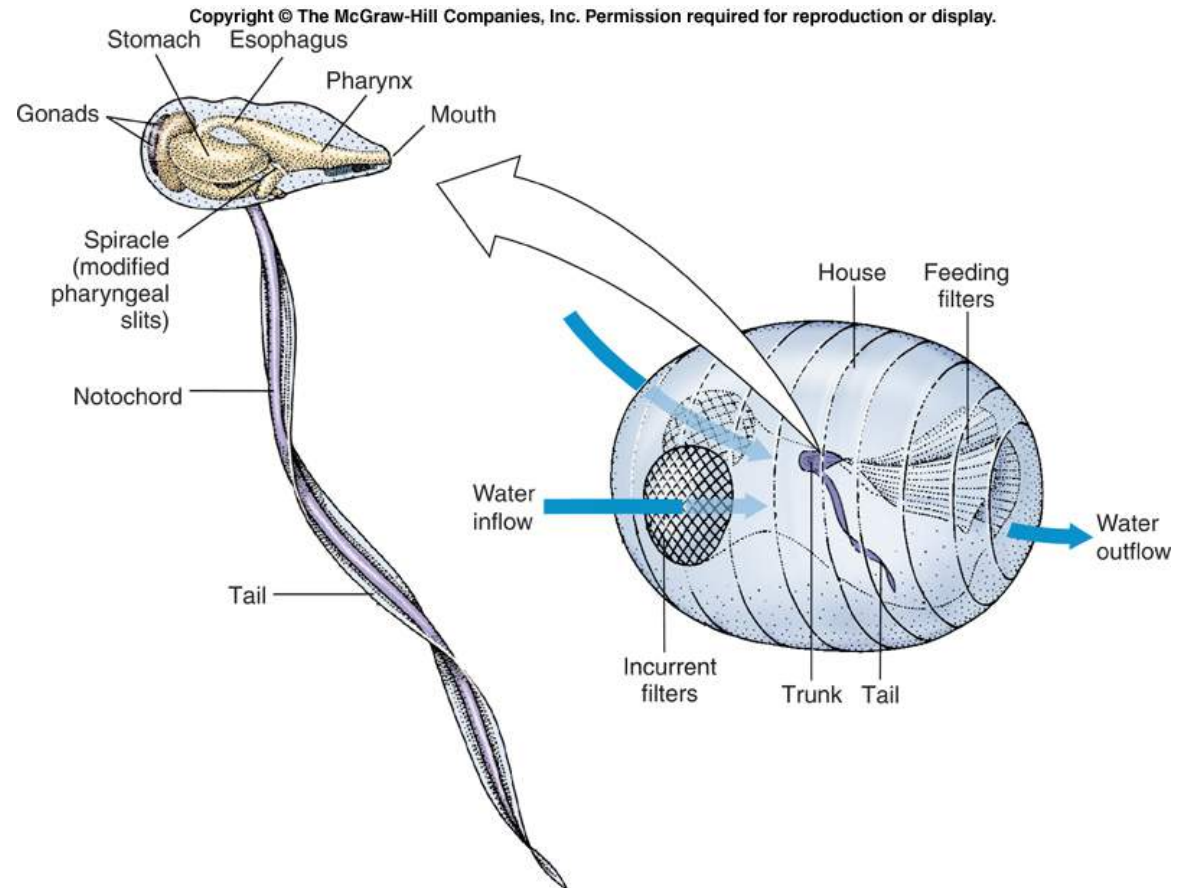


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Subphylum Urochordata

- Larvaceans are paedomorphic.
 - Adults retain larval characteristics.



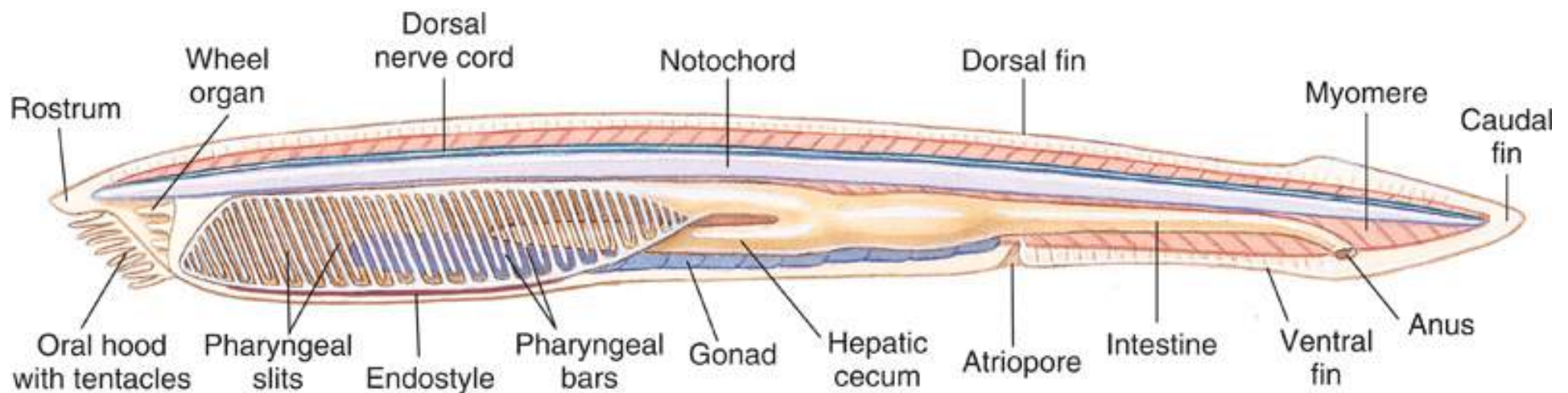
Subphylum Cephalochordata

- **Cephalochordates** are the **lancelets**, also called **amphioxus**.



Subphylum Cephalochordata

- All five chordate characters are present in a simple form.
- Filter feeding is accomplished using **pharyngeal slits** and a mucous net secreted by the **endostyle**.



Subphylum Cephalochordata

- The **dorsal, hollow nerve cord** lies just above the notochord.
- The circulatory system is closed, but there is no heart.
 - Blood functions in nutrient transport, not oxygen transport.
- **Segmented trunk musculature** is another feature shared with vertebrates.

Subphylum Cephalochordata

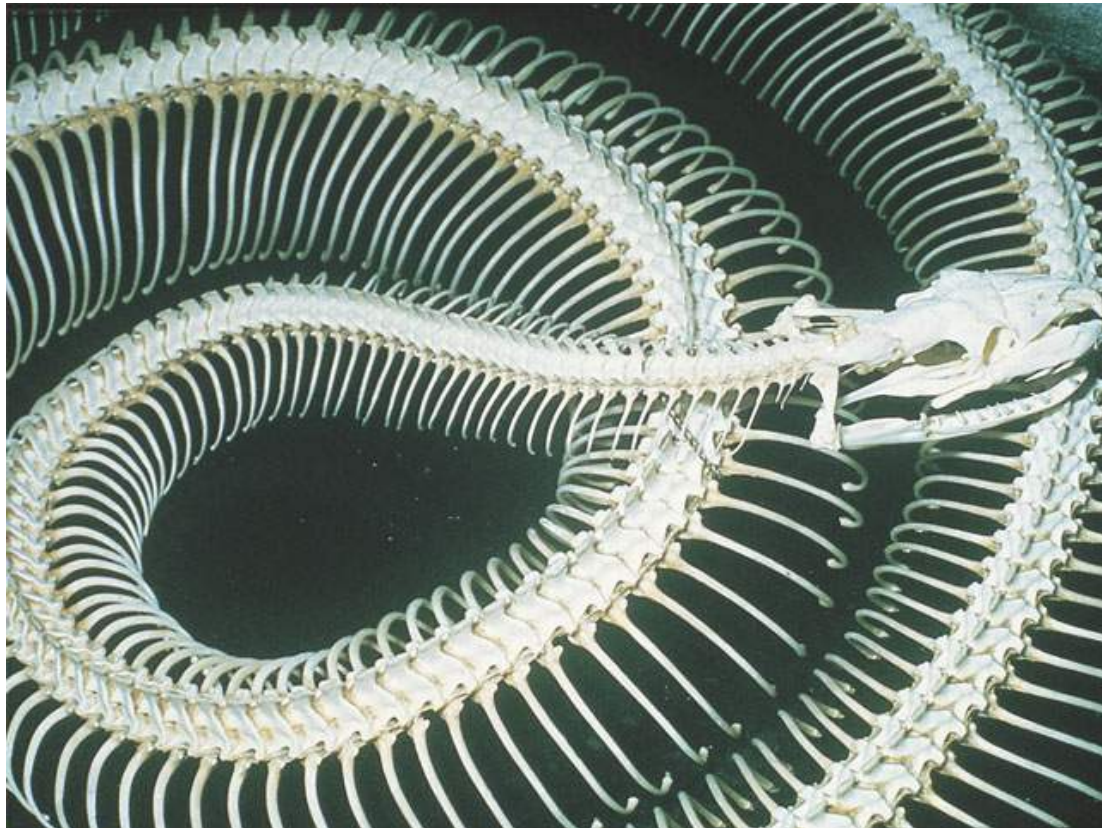
- Many zoologists consider amphioxus a living descendant of ancestors that gave rise to both cephalochordates and vertebrates
 - Would make them the living sister group of the vertebrates

Subphylum Vertebrata

- **Subphylum Vertebrata** is a monophyletic group that shares the basic chordate characteristics with the urochordates and cephalochordates.

Subphylum Vertebrata

- The animals called **vertebrates** get their name from **vertebrae**, the series of bones that make up the backbone.



Subphylum Vertebrata

- There are approximately 52,000 species of vertebrates which include the largest organisms ever to live on the Earth.
 - Fishes
 - Amphibians
 - Reptiles
 - Birds
 - Mammals

Subphylum Vertebrata = Craniata

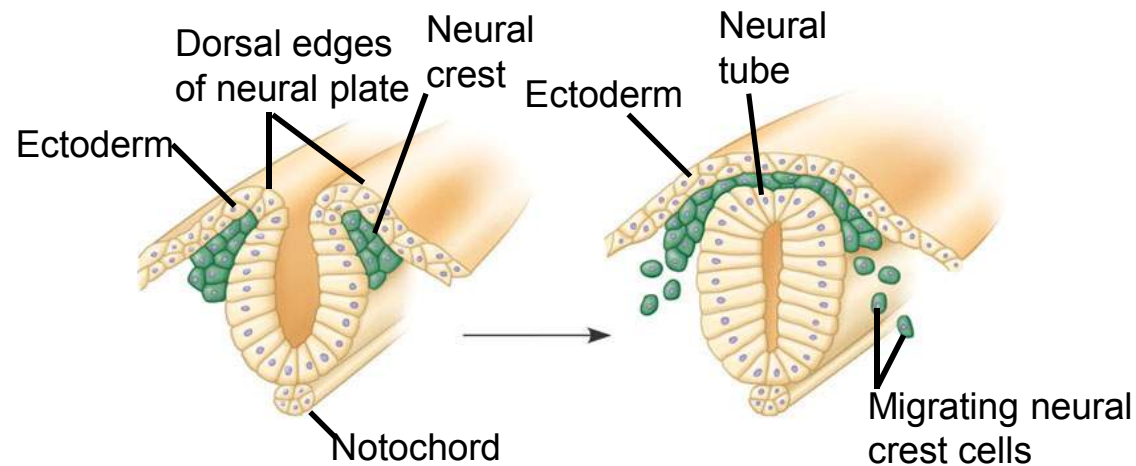
- **Craniates** are chordates that have a head.
- The origin of a head opened up a completely new way of feeding for chordates: **active predation**.
- Craniates share some common characteristics:
 - A skull, brain, eyes, and other sensory organs.

Endoskeleton

- Vertebrates have an **endoskeleton** made of cartilage or bone.
 - All have a **cranium** to protect the brain.
 - Almost all have **vertebrae** to protect the spinal cord.
 - Important for muscle attachment.

Neural Crest Cells

- One feature unique to vertebrates is the **neural crest**, a collection of cells that appears near the dorsal margins of the closing neural tube in an embryo.

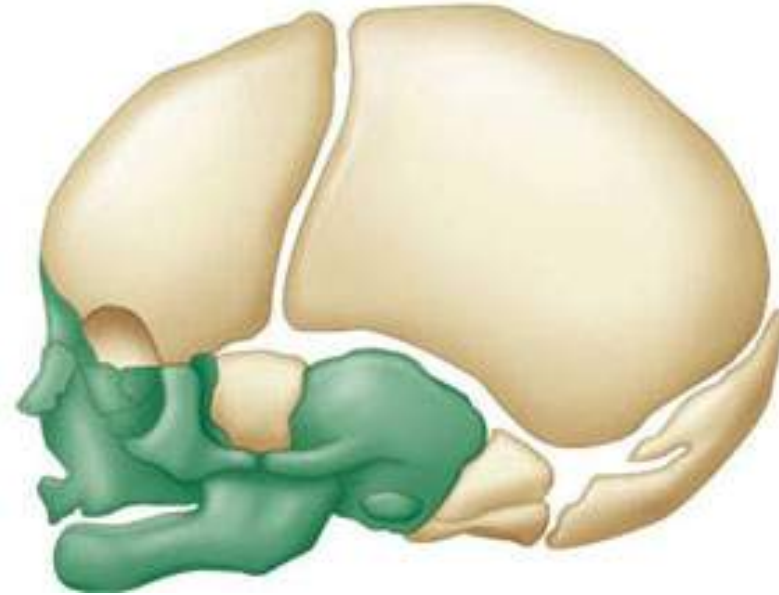


(a) The neural crest consists of bilateral bands of cells near the margins of the embryonic folds that form the neural tube.

(b) Neural crest cells migrate to distant sites in the embryo.

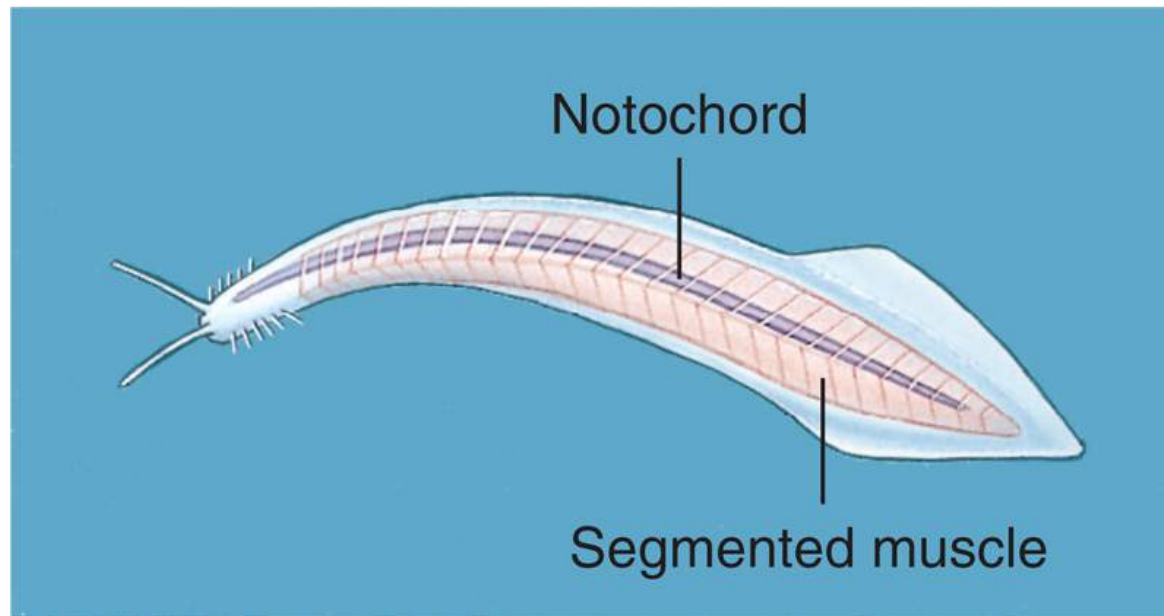
Neural Crest Cells

- Neural crest cells give rise to a variety of structures, including some of the bones and cartilage of the skull.



The Origin of Vertebrates

- Vertebrates evolved at least 530 million years ago, during the Cambrian explosion.
- *Pikaia* was an early chordate discovered in the Burgess Shale.
 - Cephalochordate?



The Origin of Vertebrates

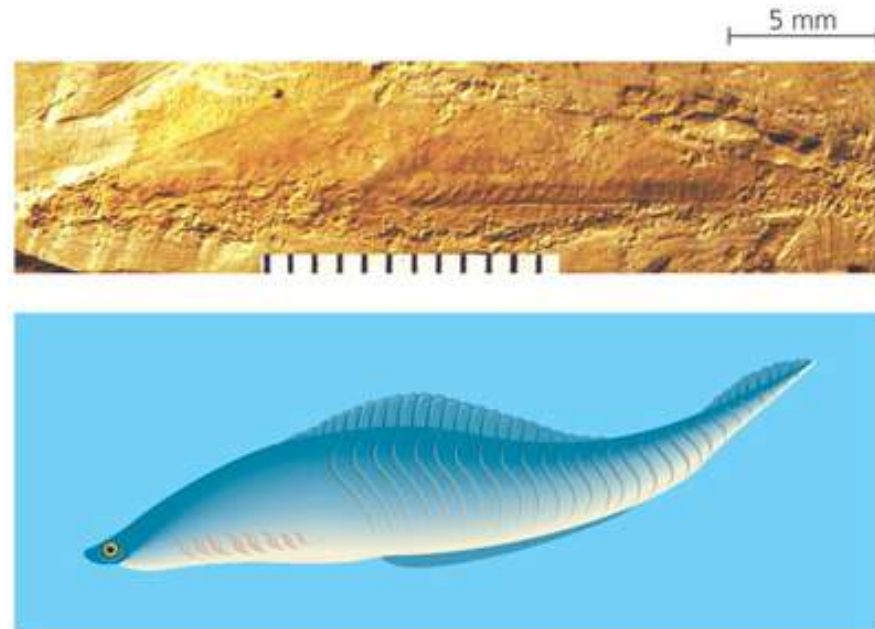
- The most primitive of the early vertebrate fossils are those of the 3-cm-long *Haikouella*.
 - Eyes and brain present, but no skull.
 - It is transitional in morphology between cephalochordates and vertebrates
 - Some hypothesize *Haikouella* is the sister taxon of vertebrates.



(a) *Haikouella*. Discovered in 1999 in southern China, *Haikouella* had eyes and a brain but lacked a skull, a derived trait of craniates.

The Origin of Vertebrates

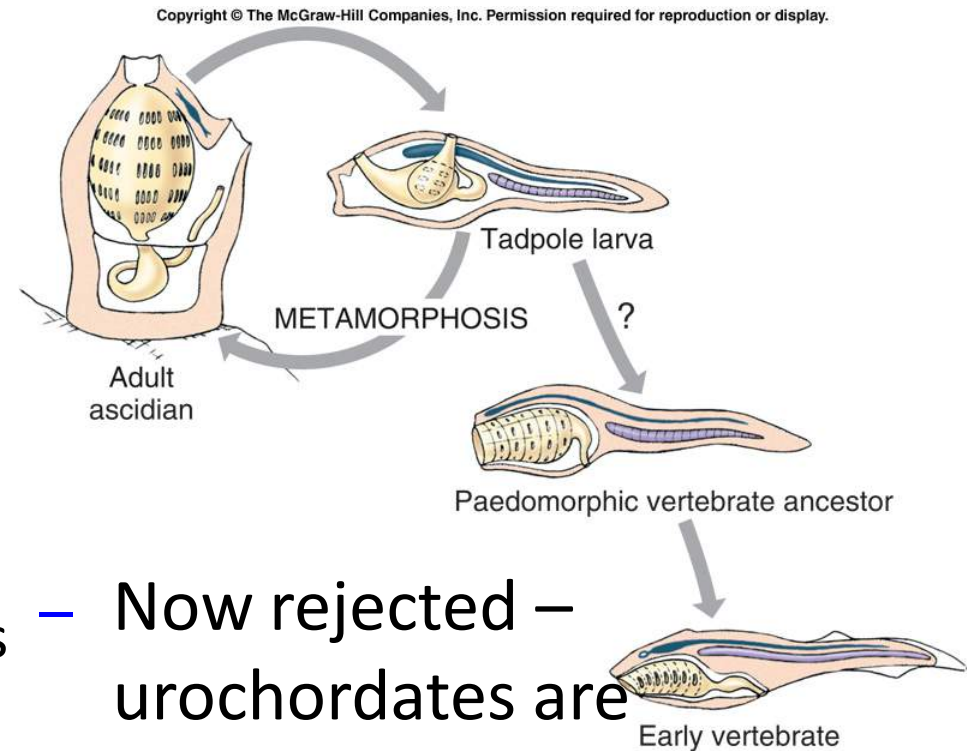
- In other Cambrian rocks, paleontologists have found fossils of even more advanced chordates, such as *Haikouichthys*.
 - Skull present.



(b) *Haikouichthys*. *Haikouichthys* had a skull and thus is considered a true craniate.

The Earliest Vertebrates

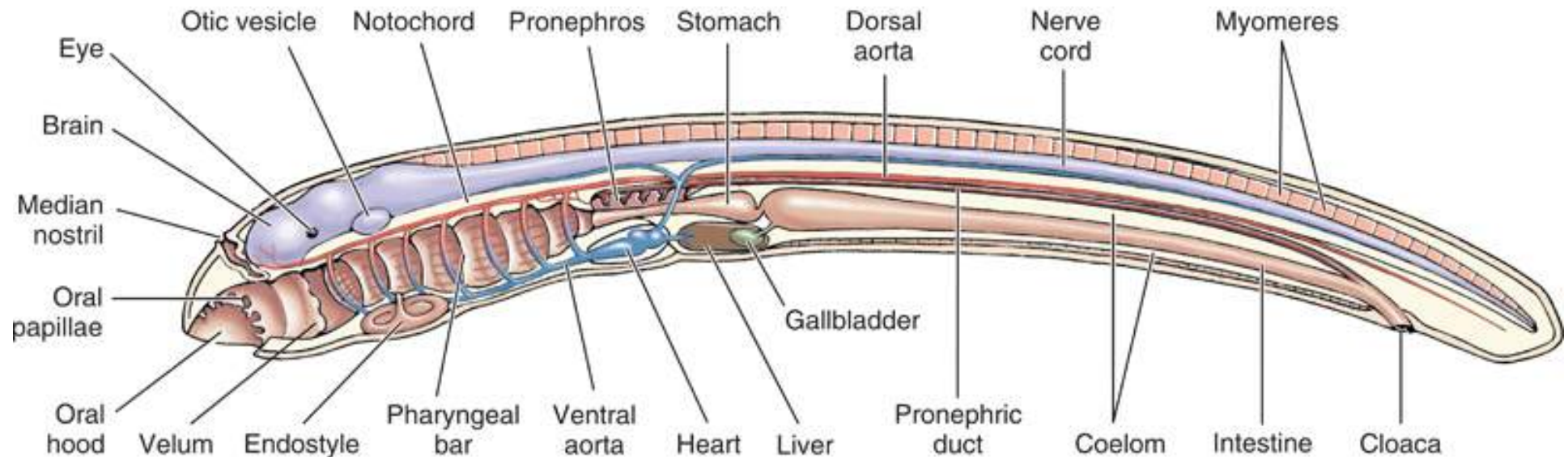
- In 1928, Walter Garstang proposed that the tadpole larvae of tunicates may have led to early vertebrates.
- The larva may have failed to metamorphose into an adult tunicate.
 - **Paedomorphosis** – retention of larval traits in an adult body.



- Now rejected – urochordates are likely a derived condition.

Ammocoete Larva of Lampreys

- Lampreys have a freshwater larval stage, the **ammocoete**, that resembles amphioxus.
 - Filter feeders
 - Closely approaches ancestral body plan.

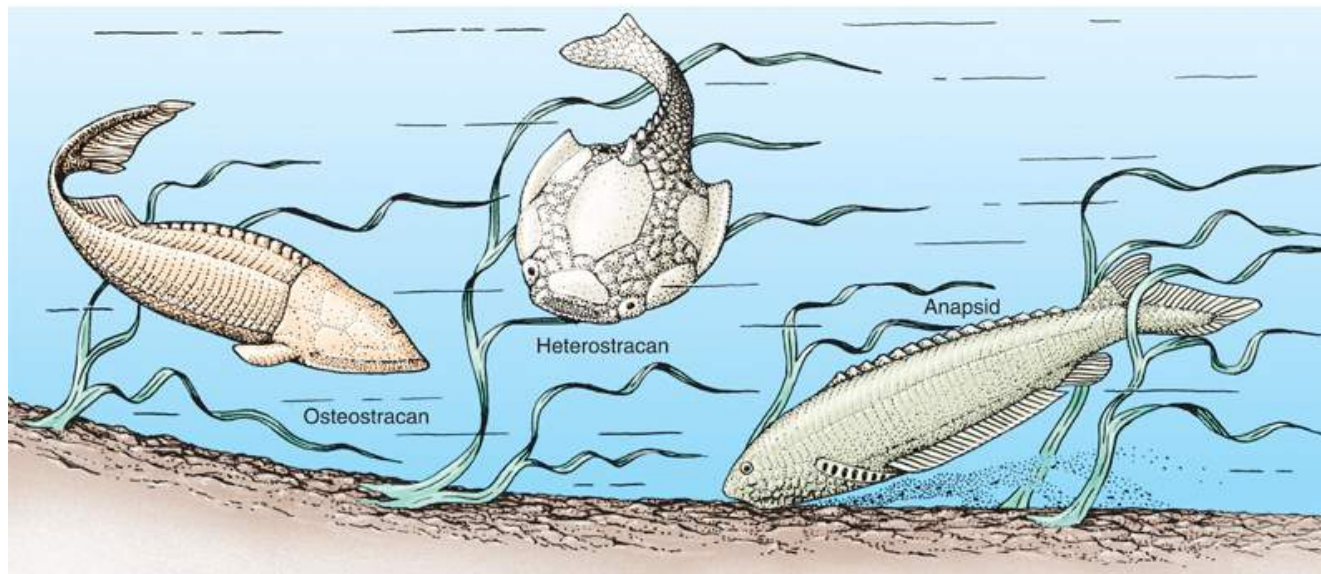


The Earliest Vertebrates

- The earliest known vertebrate fossils belong to two fishlike 530 million year old vertebrates.
 - *Haikouichthys*
 - Recently discovered (1999) they push back vertebrate origins to the early Cambrian.

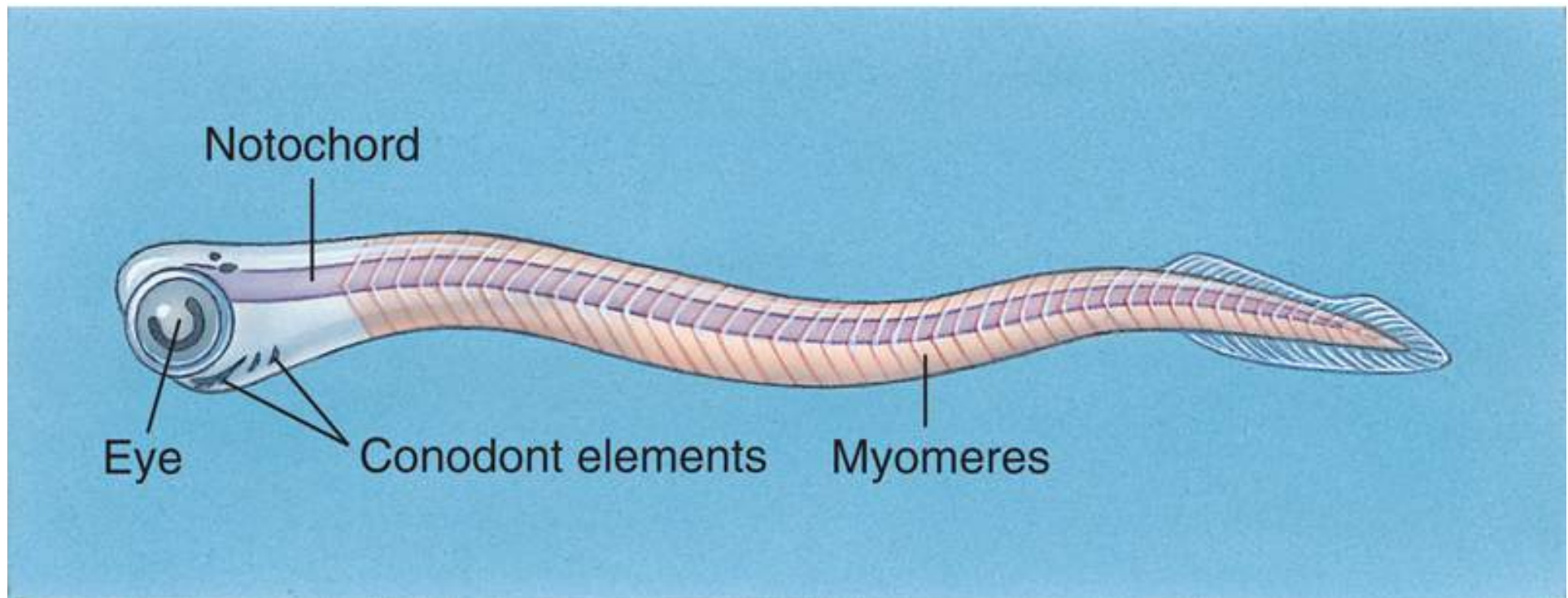
The Earliest Vertebrates

- Other early vertebrate fossils include the armored jawless fishes called **ostracoderms** from the late Cambrian.
 - Heterostracans had dermal armor, but lacked paired fins.
 - Osteostracans had paired pectoral fins as well as dermal armor.
 - Anaspids were more agile and streamlined.



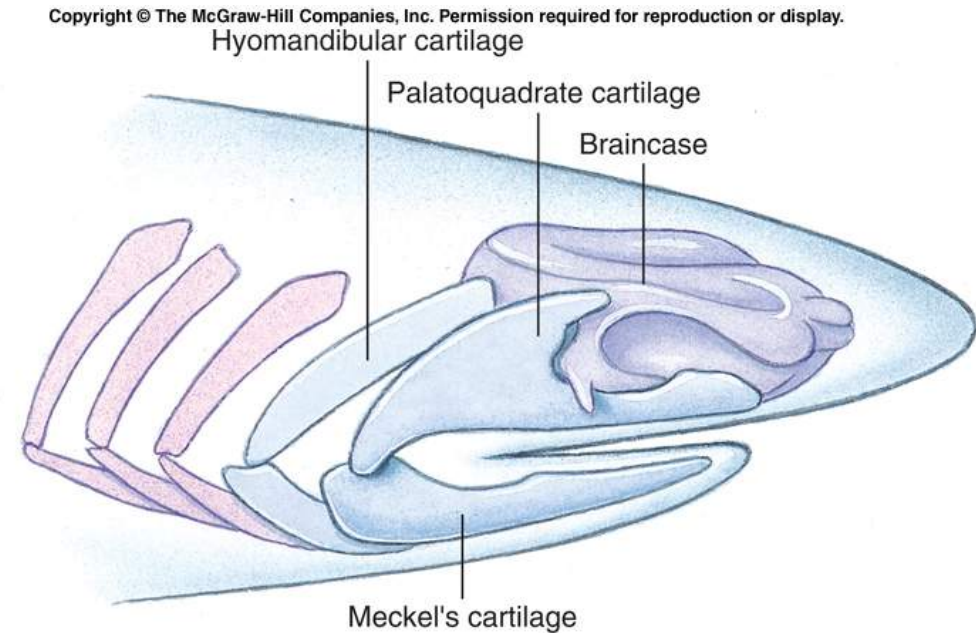
The Earliest Vertebrates

- Conodonts resemble amphioxus, but have greater cephalization.



The Earliest Vertebrates

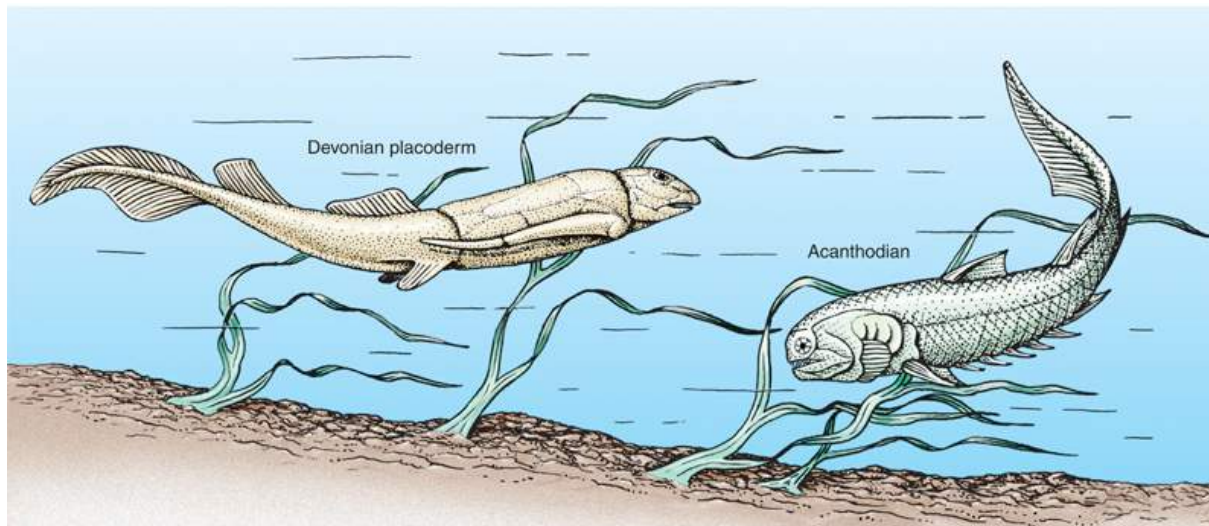
- Vertebrates lacking jaws are known as **agnathans**.
 - Paraphyletic
- **Gnathostomes** refers to the jawed vertebrates, both living and extinct.



- Jaws arose from modifications to the first and second gill arches.
- Mandibular arch may have first become enlarged to assist gill ventilation - perhaps to meet increasing metabolic demands of early vertebrates.
- Monophyletic

The Earliest Vertebrates

- **Placoderms** were among the first jawed vertebrates.
 - Silurian, extinct in the Devonian.
- Another group of early jawed vertebrates, the **acanthodians**, with paired fins and large spines may have given rise to the bony fishes.





SOFT SKILL

“Apa perbedaan tulang belakang dan tulang Punggung?”