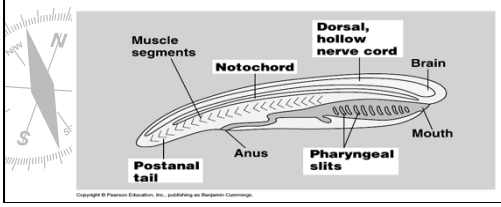
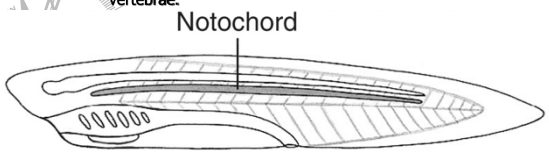
Characteristics of Chordates

- **Notochord**
- **Dorsal nerve cord**
- **Pharyngeal pouches or gill slits**
- **Postanal tail**



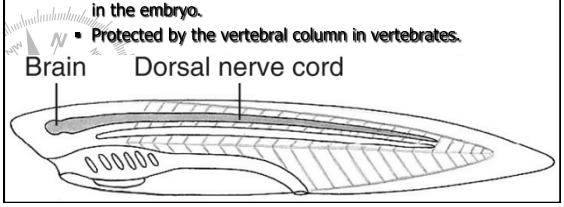
Notochord

- 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.



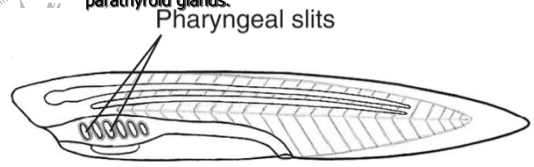
Dorsal Hollow Nerve Cord

- 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.



Pharyngeal Pouches and Slits

- **Pharyngeal slits** are openings that lead from the pharyngeal cavity to the outside. They are formed when pharyngeal grooves and pharyngeal pouches meet to form an opening.
  - In tetrapods, the pharyngeal pouches give rise to the Eustachian tube, middle ear cavity, tonsils, and parathyroid glands.

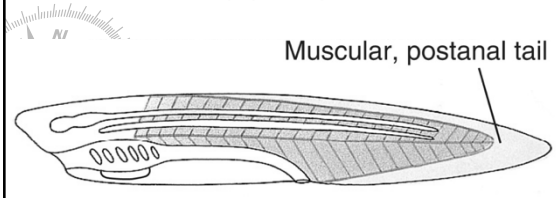


Pharyngeal Pouches and Slits

- The perforated pharynx evolved as a **filter feeding apparatus.**
- Later, they were modified into **internal gills** used for respiration.

Postanal Tail

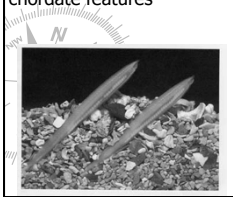
- The **postanal tail,** along with somatic musculature and the stiffening notochord, provides motility in larval tunicates and amphioxus.
  - Evolved for propulsion in water.
  - Reduced to the coccyx (tail bone) in humans.

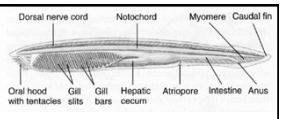


3 SUB PHYLUMS

1) Subphylum Cephalochordata
-aka Amphioxus or Sand Lance

- marine, in sand in shallow water.
- mature individuals possess all chordate features





(Illustration from Linzey, 2001)

Cephalochordates resemble vertebrates and are traditionally viewed as ancestral to vertebrates
- Supported by recent fossils and evaluation of developmental genes

However, other DNA studies suggest that Urochordates are ancestral to vertebrates

This issue remains hotly debated among vertebrate paleontologists

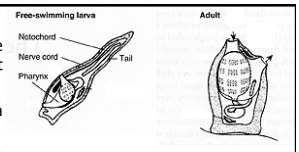
2. **Subphylum Urochordata-**

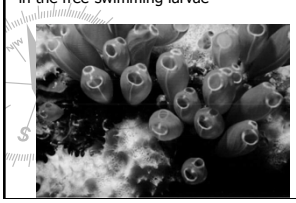
•Larva posses all chordate characteristics while adults exhibit only Pharyngeal pouches.

-also known as Tunicates or Sea Squirts.

-these are marine organisms that are Free-floating or sessile.

-chordate features are most evident in the free-swimming larvae





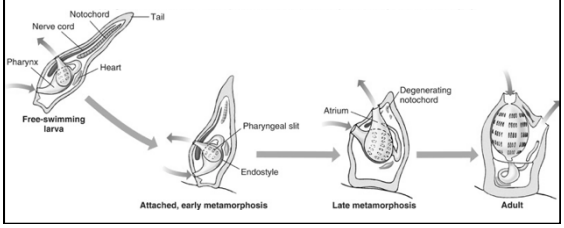
(Illustration from Linzey, 2001)

Urochordata

-Larva posses all chordate characteristics while adults exhibit only Pharyngeal pouches.

•Babies have all the characteristics

•Adults only have pharyngeal gill slits



3. Subphylum Craniata (heads with bony or cartilagenous skeleton)

- Cant call them "vertebrates" because not all all vertebrae but they all have a cranium

-all three chordate features are typically simultaneously evident only during development

- embryonic vertebrates:
  - have a notochord.
  - all vertebrates have a dorsal nerve chord
  - embryonic vertebrates have gill pouches (pharyngeal clefts)

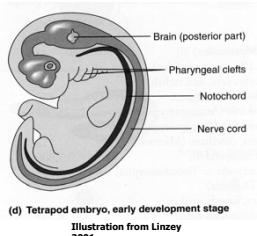


Illustration from Linzey 2001

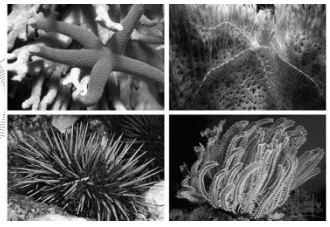
Subphylum Vertebrata

- **All characteristics of chordates**
- **Distinguishing characteristics**
  - **Vertebral column or spine**
  - **Cranium or skull that protects the brain**
  - **Endoskeleton composed of bone or cartilage**

Vertebrate Origins

What is the ancestral origin of the Chordates?

- no fossil record, therefore much speculation
- one popular hypothesis puts the chordates as possibly descendant from echinoderms or from a common ancestor to echinoderms



Subphylum Vertebrata = Craniata

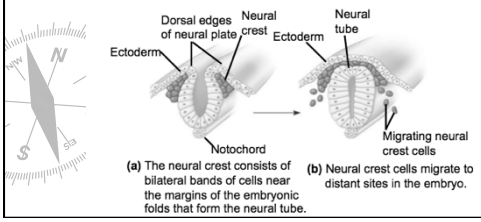
- **Craniates** are chordates that have a head.
- The origin of a head opened up a completely new way of feeding for chordates: **active predation**.
- Craniates share some common characteristics:
  - A skull, brain, eyes, and other sensory organs.

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.

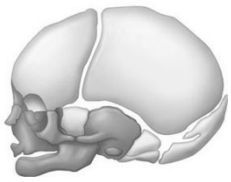
Neural Crest Cells

- 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.



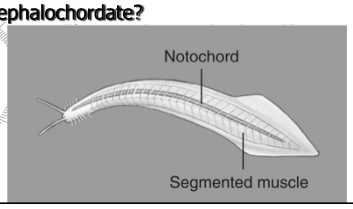
Neural Crest Cells

- 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?



Vertebrate Classification

Class	Common Name		
Agnatha	Jawless fishes	Superclass Pisces	Anamniotes
Chondrichthyes	Cartilaginous fishes		
Osteichthyes	Bony fishes		
Amphibia	Amphibians	Superclass Tetrapoda	Amniotes
Reptilia	Reptiles		
Aves	Birds		
Mammalia	Mammals		

The classes identified above represent the traditional classification scheme. Other schemes exist, particularly with regard to how the various fishes are grouped and whether or not birds are included with the reptiles.

In addition, all vertebrates above the level of Agnatha are sometimes referred to as Gnathostomes (jawed vertebrates)