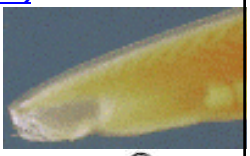
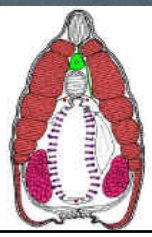
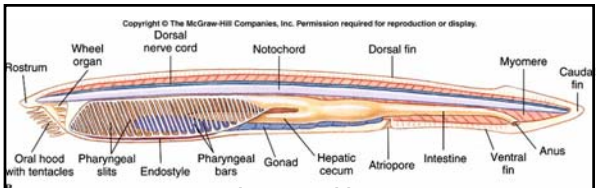
Chordates

Subphylum Cephalochordata (lancelets)

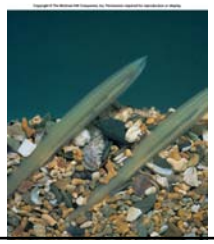
- Notochord extends into head
- Marine, burrow in sand
- All 5 chordate traits present
- Segmented trunk musculature
- Bilaterally compressed
- Filter feeds using cilia and mucous
- Sister group of vertebrates?????







Lancelet or Amphioxus



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Chordates

Subphylum Vertebrata (Craniata)

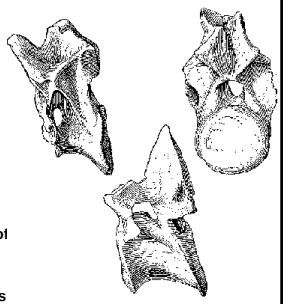
Evolution shaped by adaptations of:

Living endoskeleton
- Grows with body
- Cartilage, then bone

Pharynx
- Increased respiratory function supported high metabolic rates

Nervous system
- Evolution of new cell types (neural crest cells) promoted development of head and sensory organs

Paired appendages
- Pectoral and pelvic girdles and limbs
- Originated for balance in swimming



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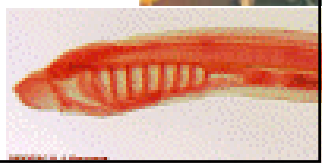
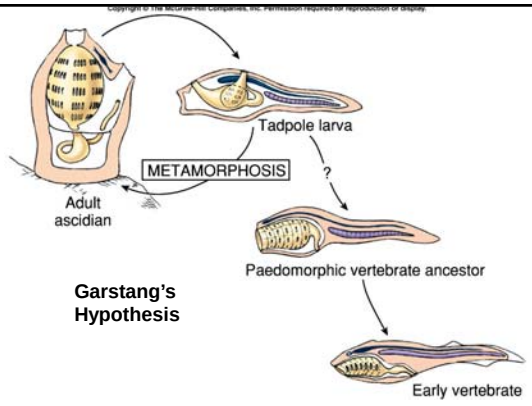
Chordates

Subphylum Vertebrata (Craniata)

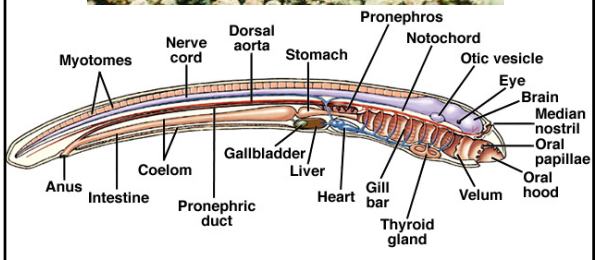
Vertebrate Ancestry

- Garstang's hypothesis – tunicate larvae began to reproduce (paedomorphosis)
- Cephalochordates (lancelets) once thought to be vertebrate ancestor – now sister group?
- Lamprey larva (ammocoete) as a model
  - Muscular pump to filter feed
  - Brain and sense organs
  - Gill filaments with lamellae





Garstang's Hypothesis



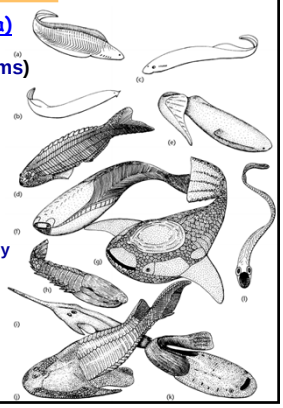
Ammocoete Larva

Chordates

Subphylum Vertebrata (Craniata)

Earliest vertebrates (Ostracoderms)

- Jawless fishes (Agnatha)
- Late Cambrian to late Devonian
- No paired fins, but evolved later
- Head and body covered with bony plates
- Basic vertebrate head pattern evolved in this group



Chordates

Subphylum Vertebrata (Craniata)

Extinct jawed vertebrates (Gnathostomata)

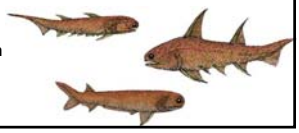
- Presence of jaws and paired fins

Placoderms

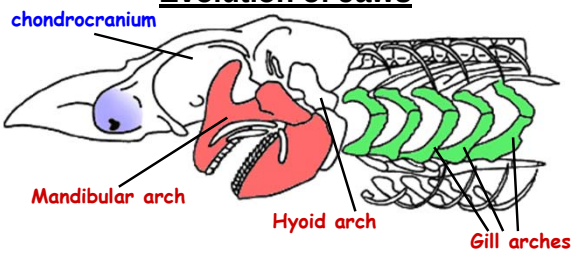
- Bony anterior shield and tooth plates
- Many small bottom feeders, but some large carnivores

Acanthodians

- Most small, weakly armored
- Had gill cover (operculum)
- Believed to give rise to modern bony fishes



Evolution of Jaws



Jaws = modified cartilaginous gill arches

Evidence:

- jaws and gill arches have upper and lower bars with hinge
- both arose from neural crest cells
- jaw muscles homologous with original gill support muscles

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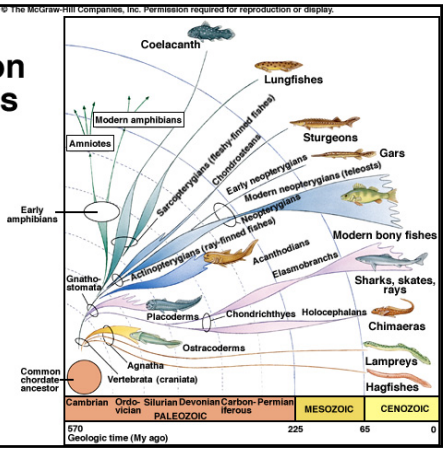
Evolution of fishes



Chordates

Subphylum Vertebrata (Craniata)

Living fishes

- **Constitute half of all vertebrate species**
- **Found in all aquatic habitats**
- **Efficient respiration with gills**
- **Numerous sensory innovations**
- **Paired fins are precursors to tetrapod limbs**

Chordates

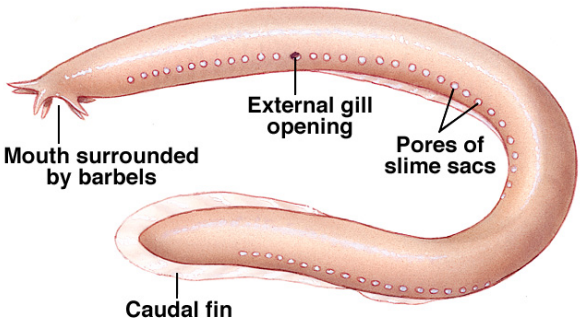
Subphylum Vertebrata (Craniata)

Living Agnathans (jawless fishes)

Hagfish

- **No jaws, scales, or paired fins**
- **Marine scavengers with rasping plates**
- **Slime glands along body**
- **Good sense of smell and touch**

The Atlantic hagfish *(Myxine)*



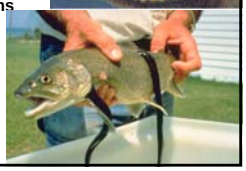
Chordates

Subphylum Vertebrata (Craniata)

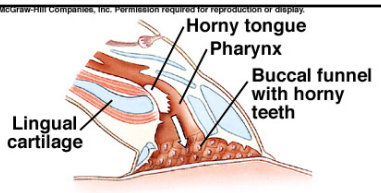
Living Agnathans (jawless fishes)

Lamprey

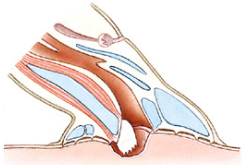
- No jaws, scales, or paired fins
- Many parasitic, use oral disc with teeth, rasping tongue
- Long larval stage in freshwater streams
- Marine species are anadromous
- Decimated Great Lakes fisheries



Sea lamprey feeding



Attachment to fish with horny teeth and suction



Tongue protruded for rasping flesh