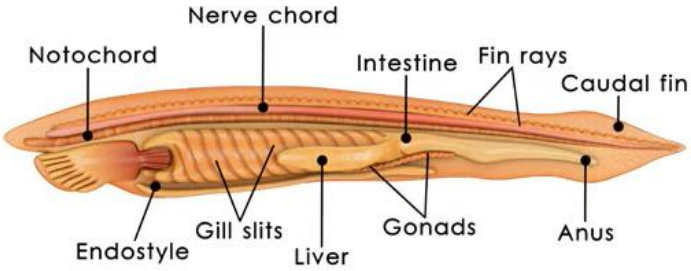
CONCEPT: CHORDATES

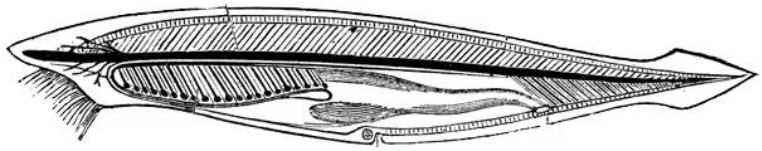
- ***Chordates*** – bilateral, deuterostome animals defined by the presence of 4 features at some point in their life cycle
    - □ ***Dorsal hollow nerve cord*** – hollow tube formed from ectoderm
    - □ ***Notochord*** – flexible rod formed from mesoderm, allows for muscle attachment
    - □ ***Postanal tail*** – muscular tail that extends beyond the anus
    - □ ***Pharyngeal gill slits*** – openings between the pharynx and external environment

EXAMPLE:



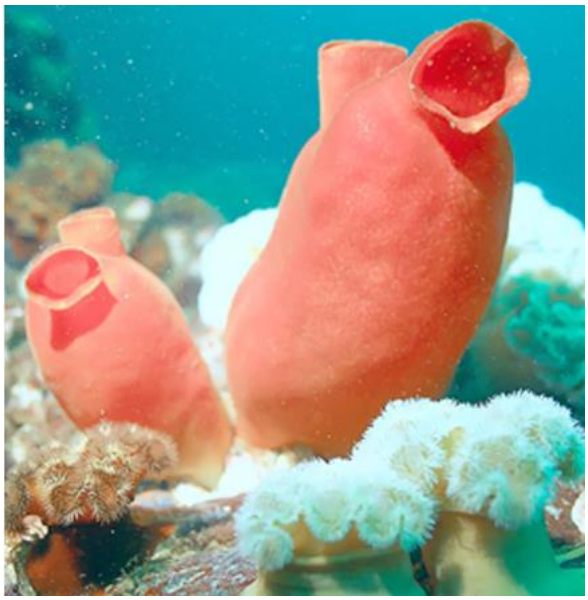
- ***Cephalochordates*** (lancelets) – fish-like suspension feeders with a notochord parallel to the hollow dorsal nerve chord

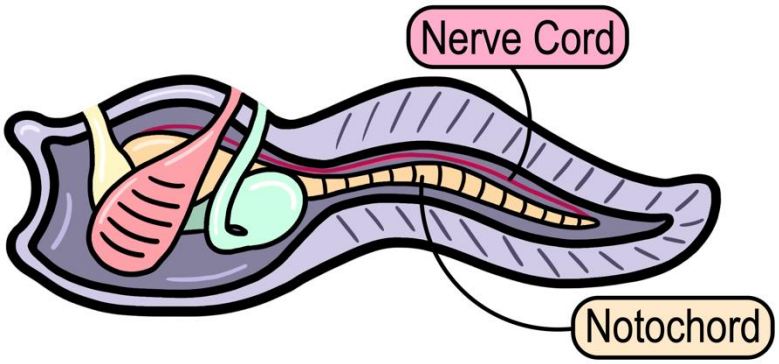
EXAMPLE:



- ***Urochordates*** (tunicates) – chordate features most apparent during larval stage, then becomes sessile organism

EXAMPLE:

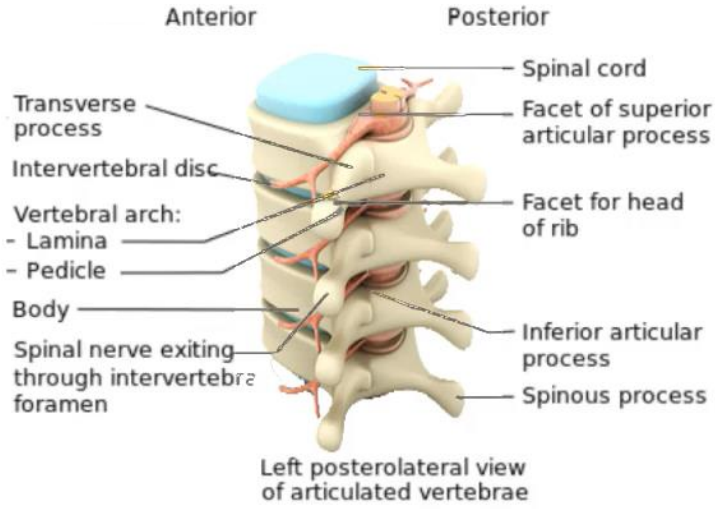


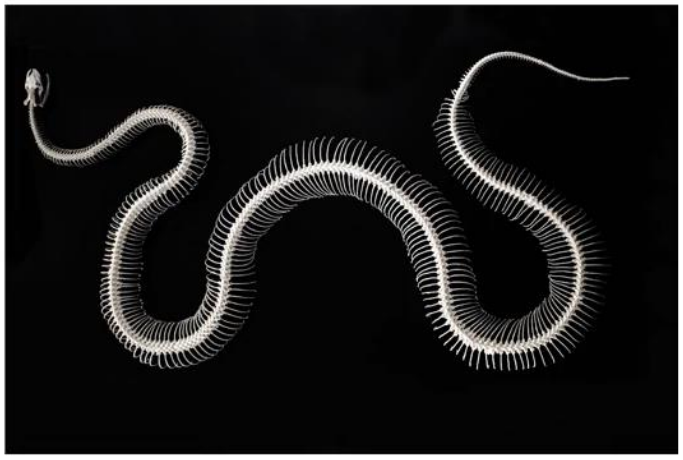


CONCEPT: CHORDATES

- ***Vertebrates*** – animals that have vertebrae and a cranium
    - □ ***Vertebrae*** – dorsal column of segmented bone, or cartilage
    - □ Dorsal hollow nerve cord forms the brain and spinal cord (central nervous system)

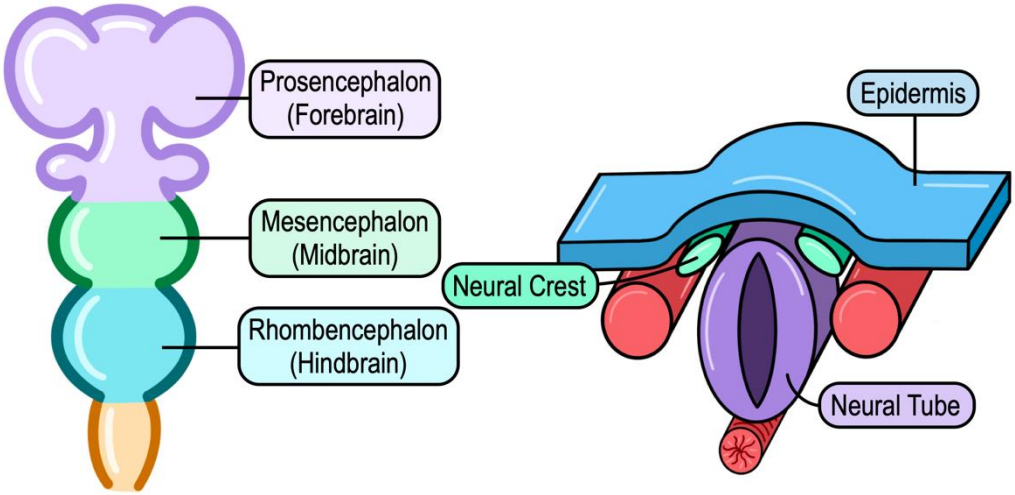
EXAMPLE:





- □ ***Cranium*** – case that encloses the brain made of bone or cartilage
- □ Most have brains divided between the regions forebrain, midbrain, and hindbrain
- □ ***Neural crest cells*** – embryonic cells that contribute to the development of many structures including jaws

EXAMPLE:



- Key evolutionary changes in the history of vertebrates:
    - □ Early lineages had bony exoskeletons, something that is not seen in later lineages
    - □ Jaws – gnathostomes like chondrichthyans
    - □ Bony endoskeleton – ray-fin and lobe-fin fish
    - □ Limbs for movement on land – tetrapods like amphibians
    - □ Amniotic egg – amniotes like reptiles

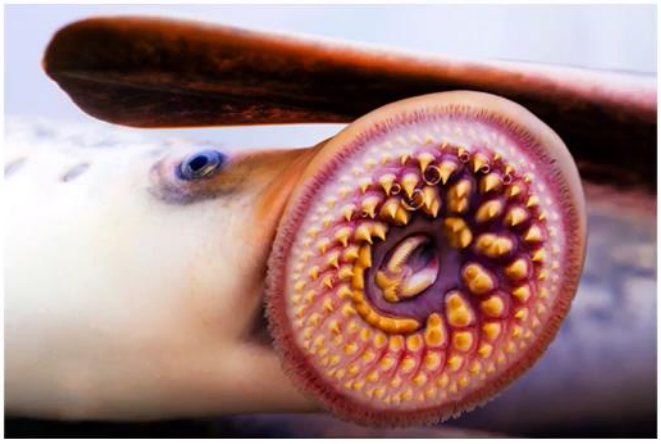
CONCEPT: CHORDATES

- Fish are the most diverse group of vertebrates, more species than all other groups combined
- ***Jawless fish*** (cyclostomes) – lack a backbone, and have cartilage vertebrae
    - □ Hagfish – nature's grossest animal, scavengers that swim like snakes
        - Can rapidly produce several liters of slime, water-absorbing pre-slime secreted through glands along body

EXAMPLE:

- □ Lampreys – parasites with circular, rasp-like mouth to feed on hosts
    - Cartilage skeleton, though not made from collagen like most cartilage

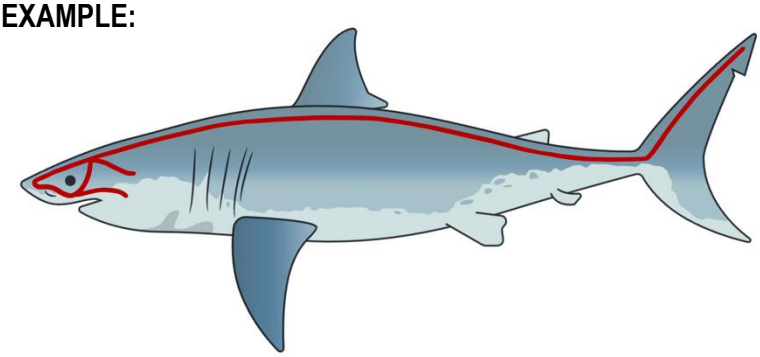
EXAMPLE:



CONCEPT: CHORDATES

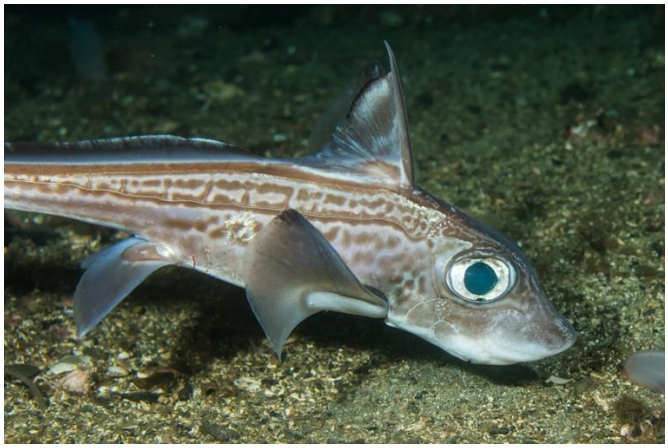
- ***Gnathostomes*** – jawed vertebrates that include fish, amphibians, reptiles, and mammals
    - □ Common features include jaws, larger forebrains, and paired appendages
    - □ Lateral line system – sensory organ system that detects movement and vibrations in water

EXAMPLE:



- ***Cartilaginous fish*** (chondrichthyans) – Sharks, skates, rays, and chimeras, have a cartilaginous skeleton and paired fins

EXAMPLE:



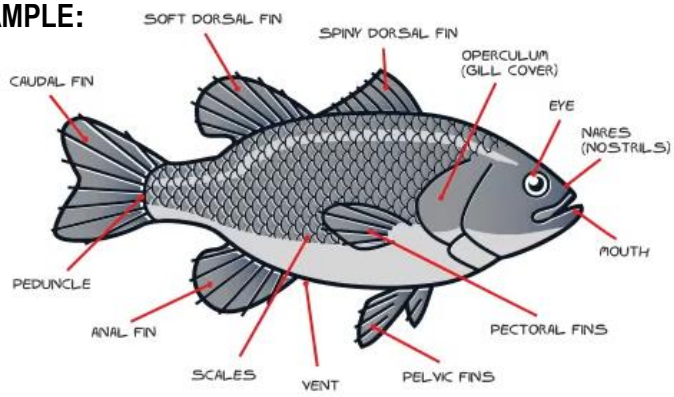
- Sharks use internal fertilization, and include species that are oviparous, oviviparous, and viviparous
- Skates are oviparous, and rays are viviparous

EXAMPLE:

CONCEPT: CHORDATES

- ***Bony fish*** (osteichthyes) – have internal skeleton mostly made of bone, making them much heavier than chondrichthyans
  - □ Operculum – hard, bony flap that protects and covers the gills possessed by most bony fish
  - □ Swim bladder – gas filled sac allowing bony fish to suspend themselves at a specific depth, evolved from lungs

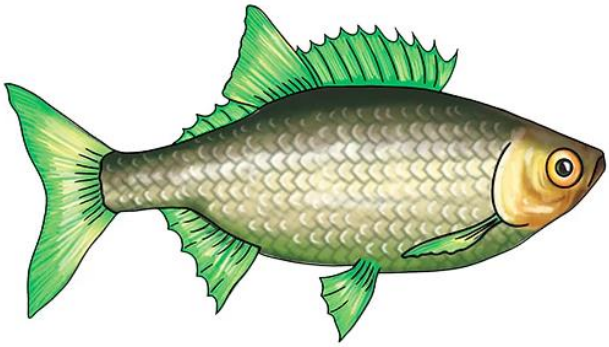
EXAMPLE:

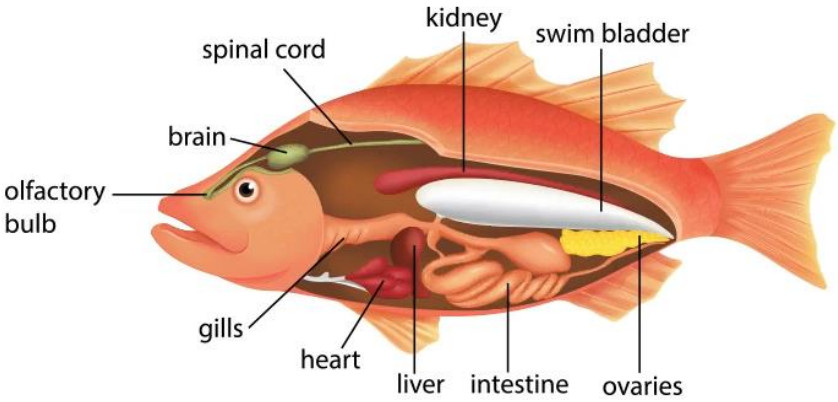


□ ***Ray-fin fish*** (actinopterygii) – named for fins containing parallel bones with webs of skin in between them

- Most diverse group of vertebrates, found in most marine and freshwater environments

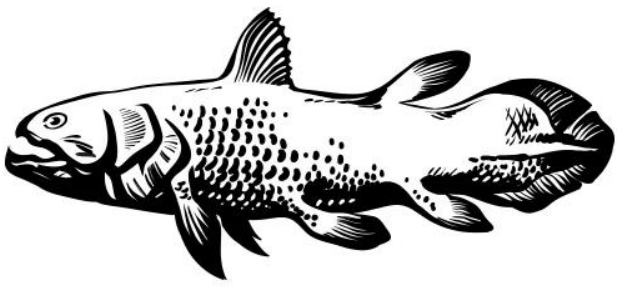
EXAMPLE:





□ ***Lobe-fin fish*** (sarcopterygii) – bony fish with muscular fins made of flesh, terrestrial vertebrate ancestors

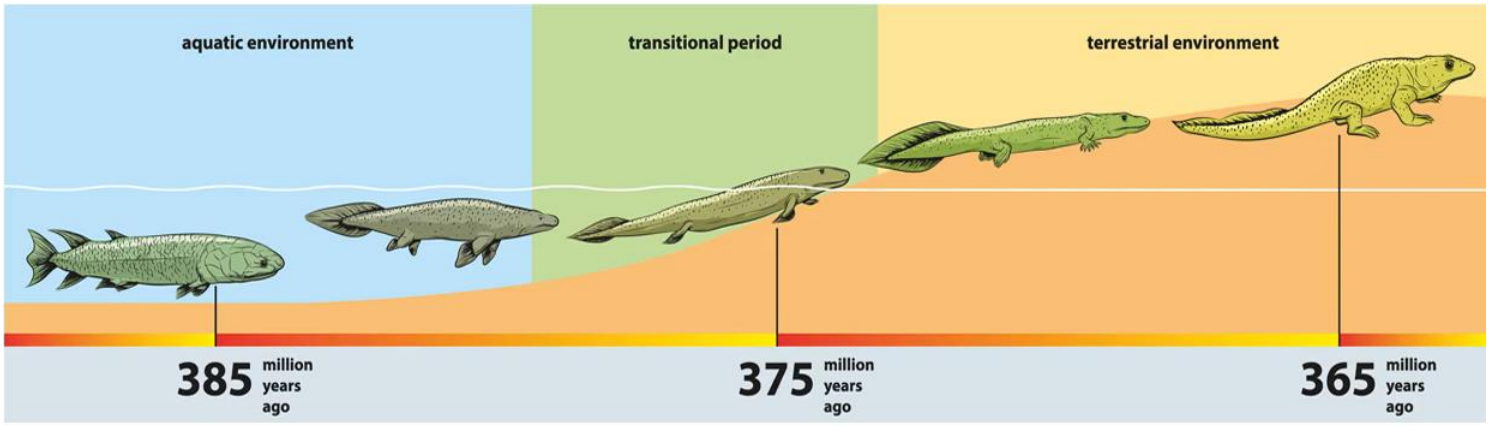
EXAMPLE:



CONCEPT: CHORDATES

- ***Tetrapods*** – four-limbed vertebrates that include amphibians, reptiles and mammals
    - □ Limbs are derived from fish fins to support weight on land, digits help efficiently transfer muscle force
    - □ Early tetrapods were fully, aquatic, while most species today are terrestrial
    - □ Heart and circulatory system had to evolve to deliver sufficient oxygen to the limb muslces while living on land

EXAMPLE:



- ***Amphibians*** – ectothermic tetrapods that live in water and on land, include salamanders, frogs, and apodans
    - □ Ectothermic – main source of body heat is external to the organism, and absorbed by it
    - □ Endothermic – main source of body heat is internal, and generated by the organism's metabolism
    - □ Although most amphibians have lungs, they also respire through their skin, which must be kept moist
    - □ Most lay their eggs in water, and undergo metamorphosis from a larval to terrestrial stage

EXAMPLE: