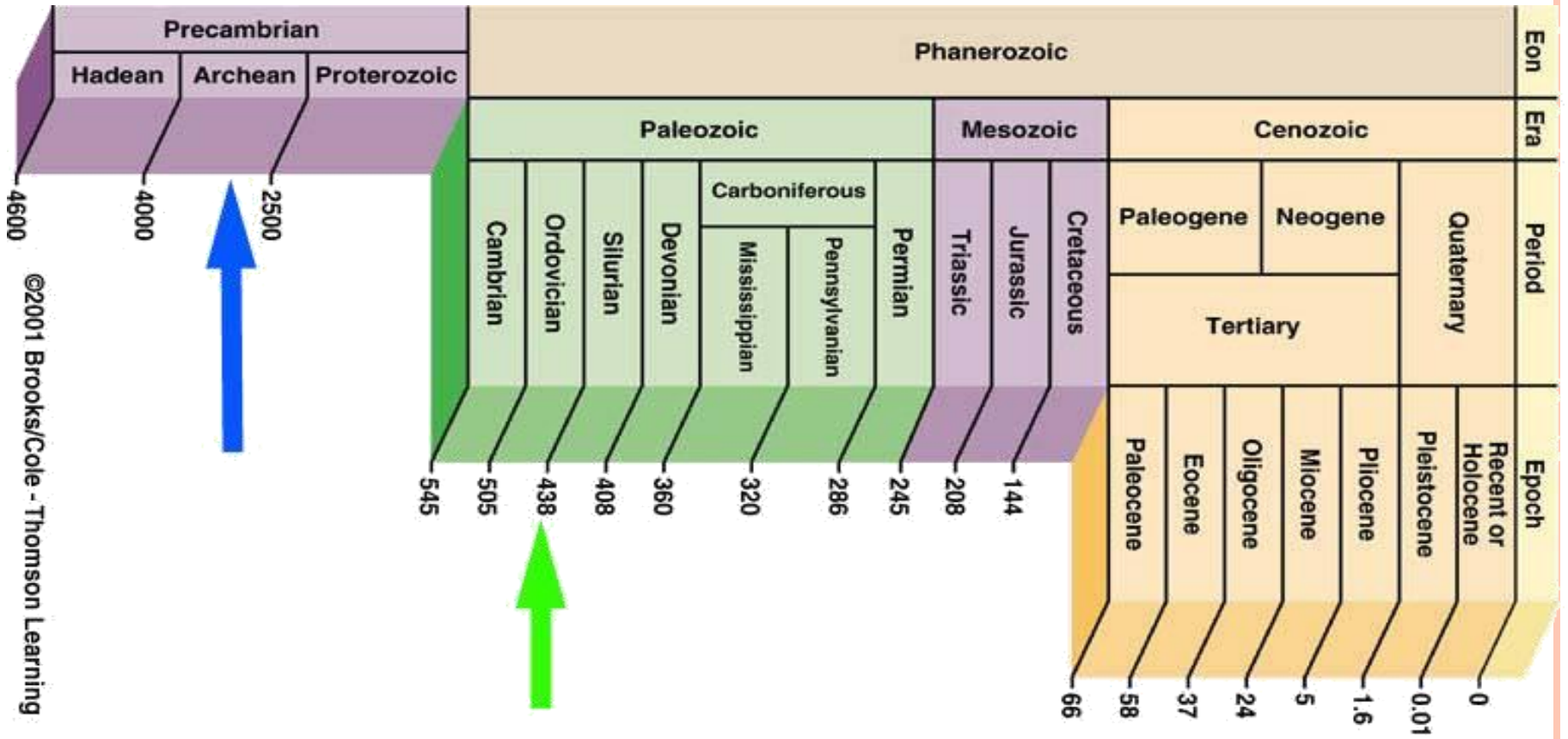


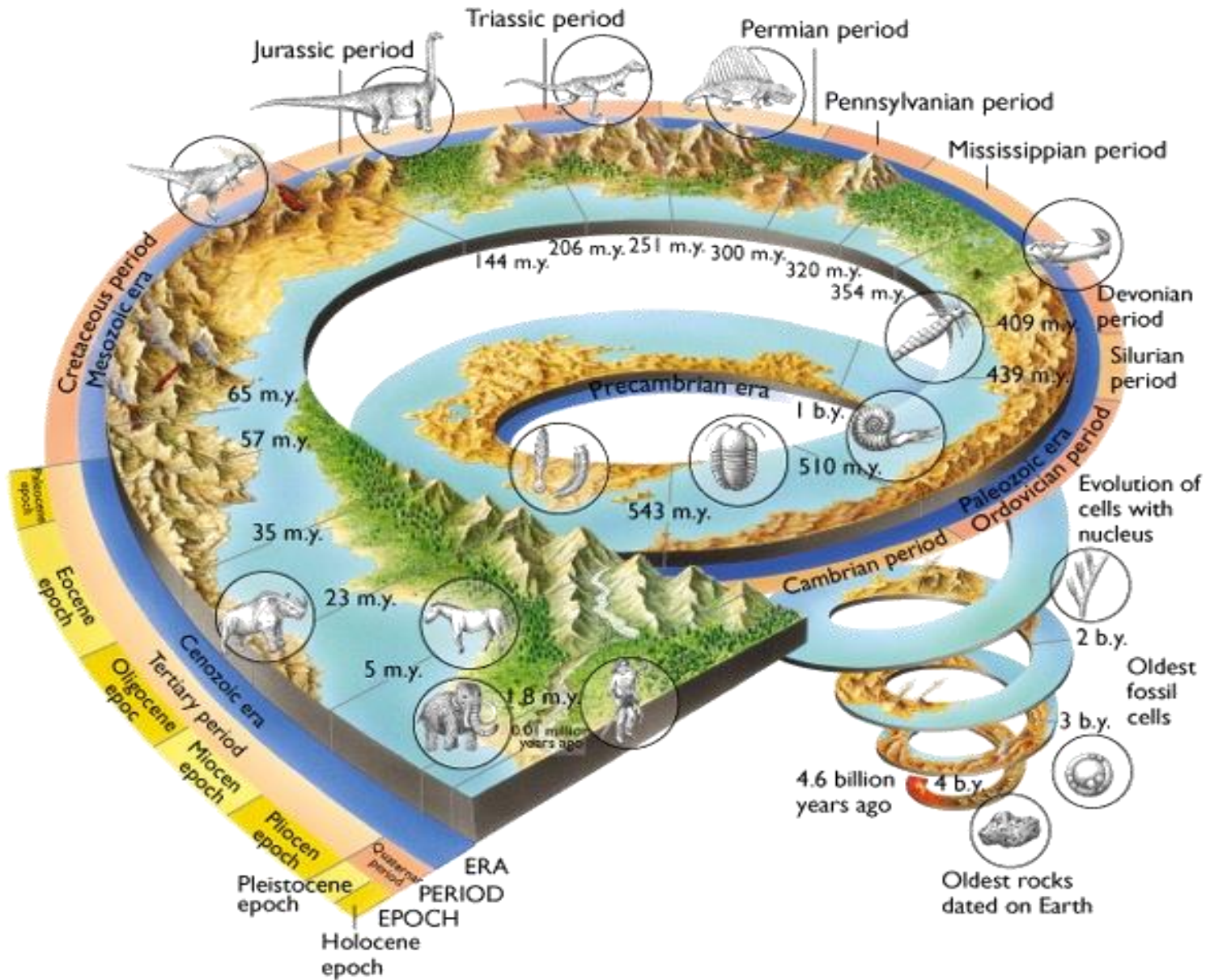
Geological time scale



©2001 Brooks/Cole - Thomson Learning



Chordate Zoology



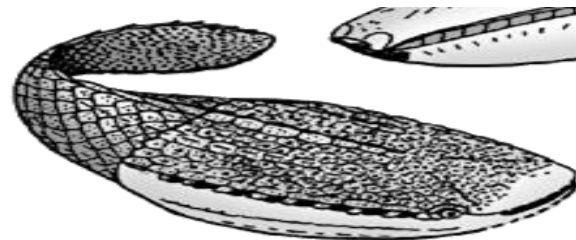
Lecture 5. Subphylum Vertebrata

Classification

- └ Superclass Agnatha
 - └ Class Ostracodermi
 - └ Class Cyclostomata
- └ Superclass Gnathostomata
 - └ Class Placodermi — *extinct* (armored gnathostomes)
 - └ Class Chondrichthyes (cartilaginous fish)
 - └ Subclass Elasmobranchii — (plate gills)
 - └ Subclass Bradyodonti (slow tooth)
 - └ Class Osteichthyes (bony fish)
 - └ Subclass Acathodii (spiny)
 - └ Subclass Actinopterygii (ray-finned fish)
 - └ Subclass Sarcopterygii (lobe-finned fish)
 - └ Class Amphibia (amphibians)
 - └ Class Reptilia
 - └ Class Aves (birds)
 - └ Class Mammalia (mammals)

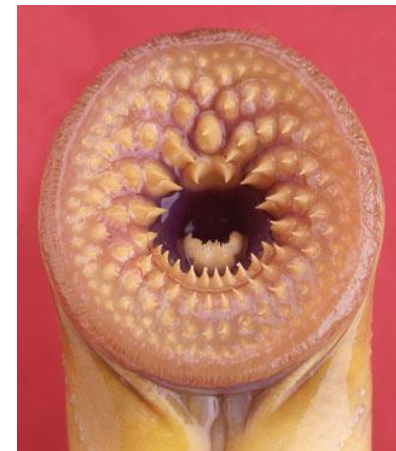
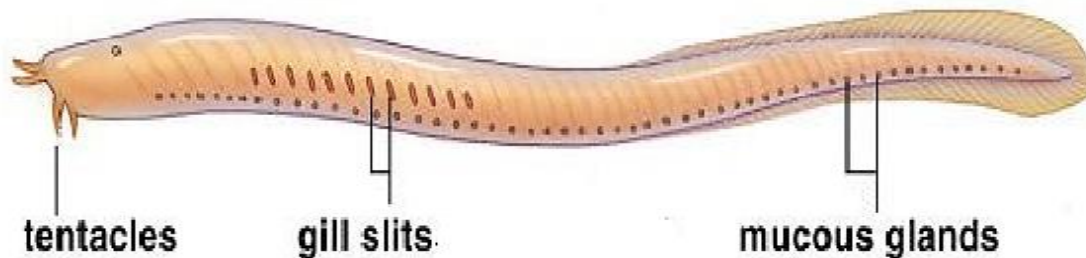
Superclass Agnatha

- Consists of an ancient group of animals similar to fish but with some very noticeable differences.
- The term Agnatha means “no jaws” in Greek. The Agnathans lack jaws and paired fins
- As with sharks (another ancient group), the internal skeleton consists primarily of cartilage
- The only living Agnathous animals are the cyclostomata (ringed-mouthed)
- But the ostracoderms (first vertebrates to appear in most fossil series) also show Agnathous condition and have some other features common with the cyclostomata.



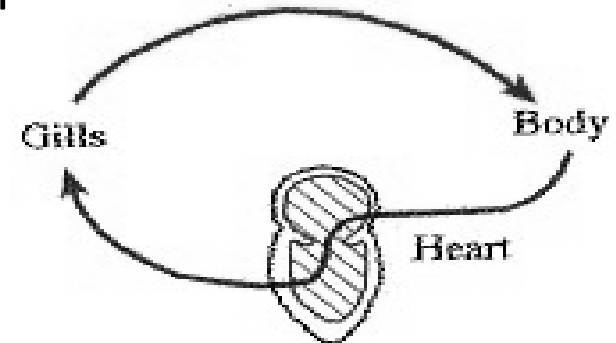
General Characteristics of Agnathans

- Lack jaws hence the name agnatha (without jaw)
- Vertebral spine is cartilaginous in nature
- Head with a cranium that encases a brain
- Mouth is generally round/ circular
- They don't have any appendages, external body parts
- No scales or exoskeleton
- Most are bottom dwellers and wriggle along the sea floor or streambeds



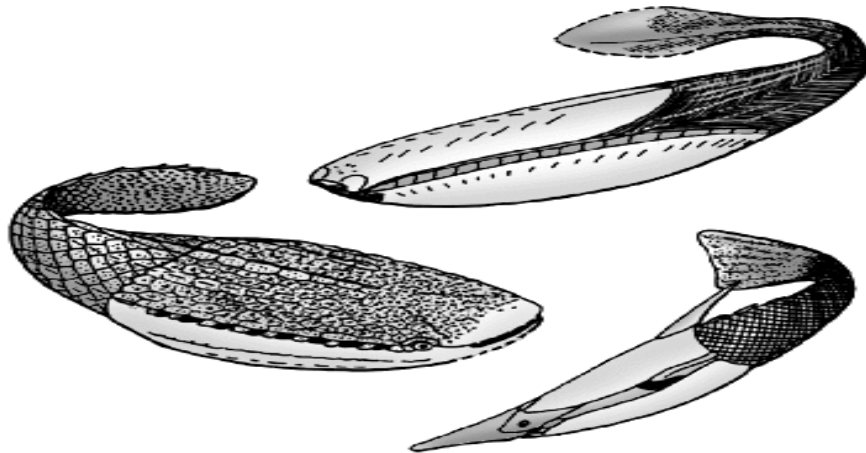
Characteristics of Agnathans cont.....

- They don't have an identifiable stomach.
 - ✓ Their metabolism is slow, so they don't have to eat as much
 - ✓ They are Fluid feeders
- Some are **Osmoconformers** e.g. hagfish and some are **osmoregulators**
- They have a simple chambered hearts for blood circulation.
 - ✓ It is a closed circulatory system with 3 types of blood vessels.
 - ✓ Agnathans have a single circulatory system
- Fertilization and development is external
 - ✓ There is no parental care.
 - ✓ They are Oviparous



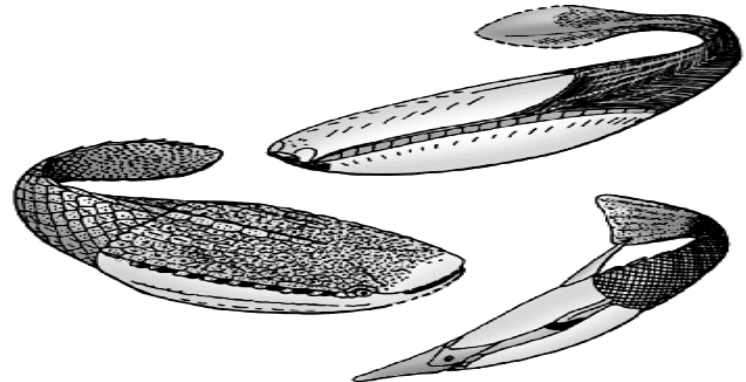
Class Ostracodermi

- Is an extinct class of early jawless fish which lived from the Early Ordovician (470 mbp) to the Late Devonian (370 mbp)
- The fossils show extensive shielding of the head
- Some species may have lived in fresh water
- Ostracoderms have long been regarded as closely related -or even ancestral- to jawed vertebrates, but the few characteristics they share with the latter are now considered as primitive for all vertebrates.



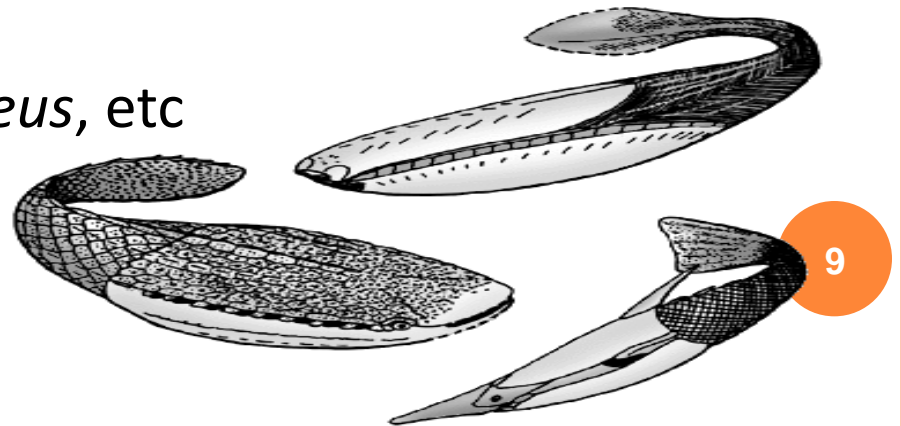
Characteristics of Ostracoderms

- They were small fish like animals (only few centimeters long)
- They were jawless (No lower jaw) & toothless
- Possessed an extensive dermal armor with the body divided into a scaly trunk and a tail
- Had no other fin than the caudal fin
 - ✓ So sluggish swimmers & bottom dwellers
- Their dermal plates and scales were made up of acellular bone, or aspidine,
 - ✓ This is thought to be a primitive condition for the dermal bone of all bony vertebrates



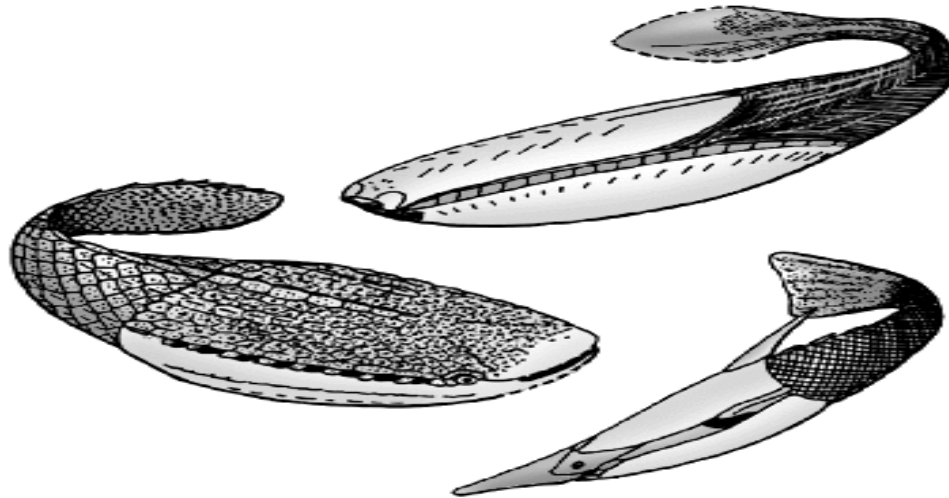
Characteristics of Ostracoderms cont.....

- Pteraspidomorphs had no calcified endoskeleton however some show traces of calcified cartilage.
- The internal surface of the dermal plates in heterostracans shows impressions of the gills, brain, two vertical semicircular canal and distinctly paired nasal capsules.
- Nasal capsules of heterostracans seem to have opened ventrally into a separate median duct comparable to the nasopharyngeal duct of hagfishes
- Most Pteraspidomorphs were marine but lived very near to the shore, in lagoons and deltas.
- Examples, *Pteraspis*, *Psammosteus*, etc



Limitations of Ostracoderms

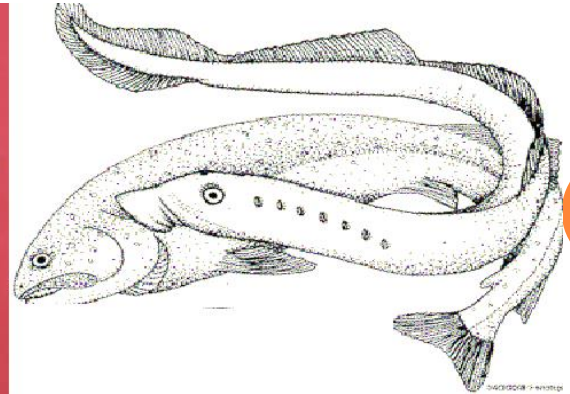
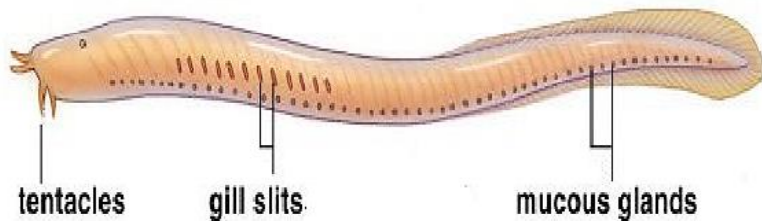
- Habitat limitations
 - ✓ Weak swimmers due to heavy armor that also result into inflexibility
 - ✓ Restricted to benthos
- Food limitations
 - ✓ No jaws → restricted to plankton, suspended organics → slow growth



Class Cyclostomata (round or circular mouth)

Characteristics of Cyclostomes

- Eel - like in structure
- Lack exoskeleton/scales
- Prey / parasitize on fishes.
- Notochord persists in adults
- Lack jaws but have rows of horny teeth that move in circular motion
- Axons of neurons are unmyelinated
- Marine habitat with size of 10-90cm in length

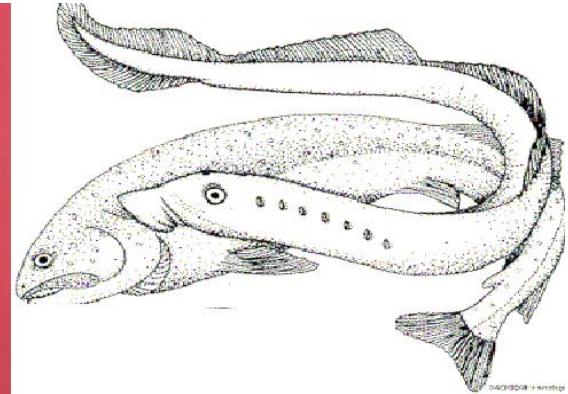


- Orders of this class are Petromyzontia and Myxinoidea

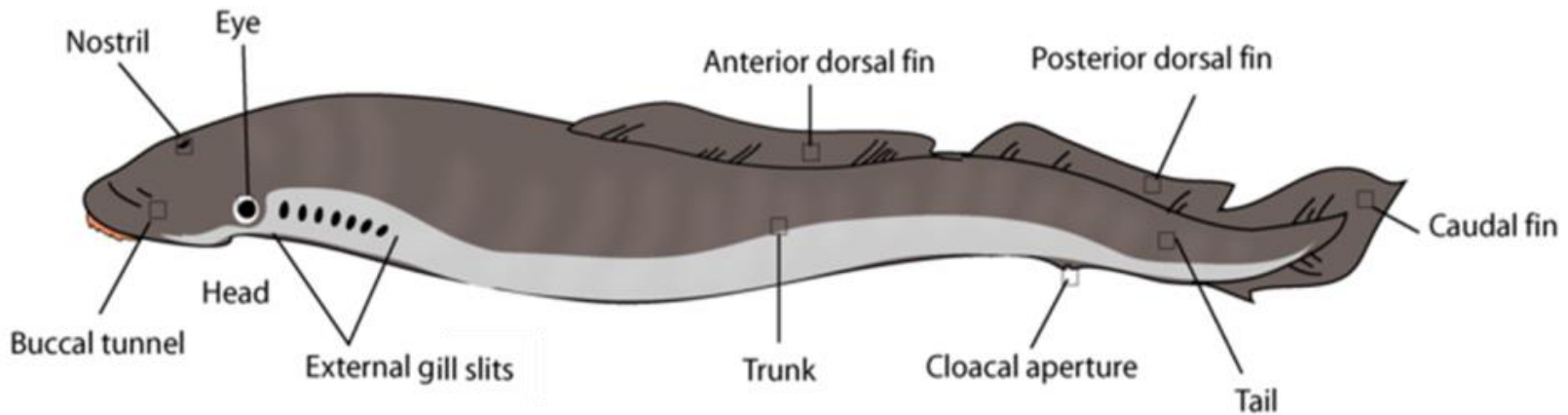
I: Order: Petromyzontia (or Hyperoartii)

Characteristics

- Have seven gill pouches open directly to exterior
- Have a circular sucking mouth used in parasitizing other fishes
- Lack paired fins but have fin rays
- Have a single dorsal nasal opening on top of the head
- Endoskeleton including the braincase is made of cartilage and notochord



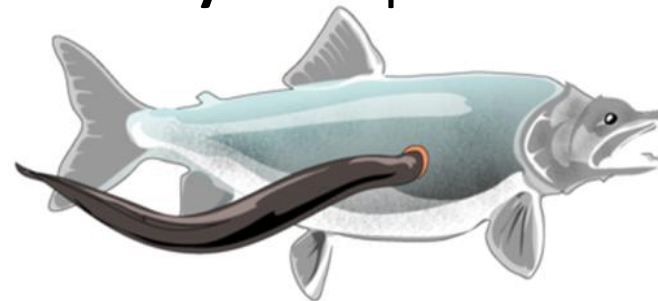
- Have a soft body without scales
- Have a pineal (cone-like) eyes
- Fertilization is external & developmet is idirect
 - ✓ Ammocoetes larva metamorphoses to adult.
 - ✓ Ammocoete, lives secretive life buried where it filter feeds on algae and detritus



Petromyzontia, form & function

Size & Habitat

- Some Lampreys are marine and some are freshwater species.
 - ✓ Examples are the sea lamprey (*Petromyzon marinus*), Pacific lamprey (*Entosphenus tridentate*), Freshwater lampreys (*Entosphenus similes*)
- Adult lampreys are eel like & are about 30 cm long
- Lives parasitically in the sea probably for about 2.5 years
 - ✓ Then migrate to fresh water where they spawn.
 - ✓ Fertilized eggs develop into an ammocoete larvae which don't have suckers and lives buried in mud feeding on micro organisms for 5 years.
 - ✓ After metamorphosis the young adult migrates to the sea
- This kind of migration is called **anadromy** and species with this kind of migration are said to be anadromous



Petromyzontia, form & function cont.....

Body colour

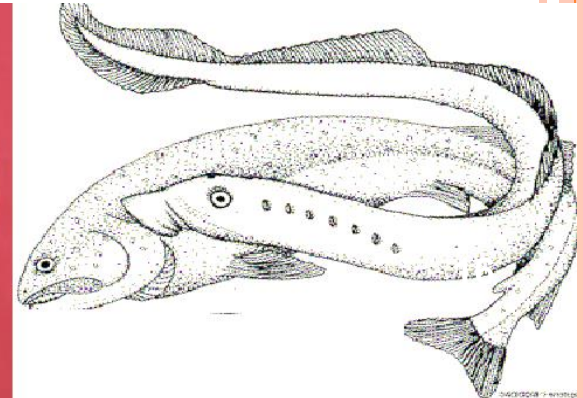
- Adult Lampreys are dark on the back and white below
- The body surface is smooth with no scales
- The skin is many layered
 - ✓ It secretes slime with antibacterial effects
- The dermis contains pigmented cells called the chromatophores
 - ✓ These are star shaped cells whose pigment is able to migrate hence making the animal pale or dark
 - ✓ This change is especially marked in larvae and it is produced by variation in the amount of pituitary secretion



Petromyzontia, form & function cont.....

Nutrition

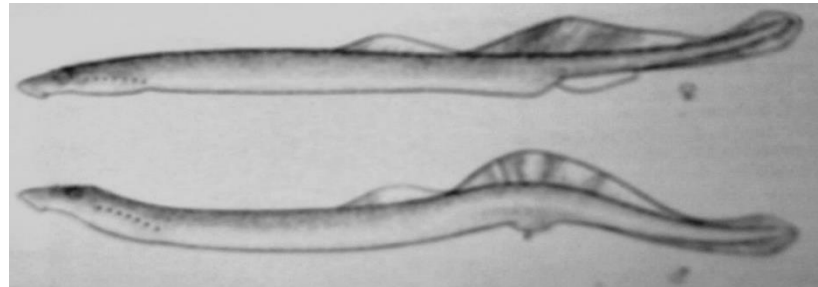
- Lamprey larva is sedentary filter feeders but the adults are ectoparasites primarily of other fishes
 - ✓ They attach to the host with the oral disk
 - ✓ Use the keratin plates that cover the tongue and oral disk to rasp a hole through the skin
 - ✓ Then absorb the fish's blood and tissue
- Lampreys have a simplified digestive system
 - ✓ Food travels from the mouth through the oesophagus to the intestines.
 - ✓ There is no true stomach.
 - ✓ They have a liver, gall bladder and bile duct but no separate pancreas



Petromyzontia, form & function cont.....

Reproduction

- Lampreys are dioecious
- Fertilization is external but there are some modifications of the cloaca in both sex to ensure fertilization and proper placing of eggs in a nest
 - ✓ The lips of the cloaca of a ripe male are united to form a narrow penis like tube.
 - ✓ The cloacal lips of a female are enlarged and often red
- Parasitic forms are anadromous
- Like salmon – they are ***semelparous***

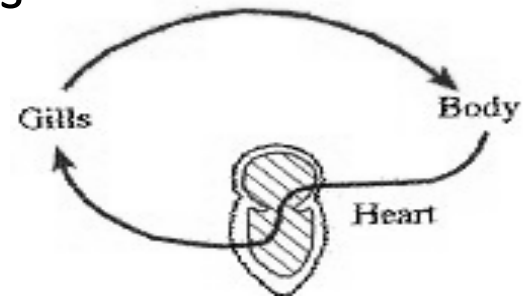


Petromyzontia, form & function cont.....

- Nonparasitic lampreys are called **brook lampreys**
 - ✓ retain the juvenile form, filter feed, and mature earlier
 - ✓ are derived from the parasitic form by loss of the parasitic phase
 - ✓ are not anadromous, they inhabit fresh water bodies

Circulation and gaseous exchange

- Have a closed circulatory system
- There is a well developed heart which lies behind the gills and it is three chambered
- Blood contain haemoglobin as that of other vertebrates
- These animals have about 7 pairs of gills



Petromyzontia, form & function cont.....

Nervous system and Sense organs

- Lampreys have a well developed sensory structure including eyes and a lateral line system
- In addition to possession of eyes the lampreys have a pineal eye which is normally associated with *reproduction, metamorphosis* and *change in colouration* in larvae
 - ✓ The pineal eye doesn't have a lens and it is not associated with movement.

Petromyzontia, form & function cont.....

Excretion and Osmoregulation

- Blood of fresh & marine water lampreys is hyperosmotic & hypoosmotic respectively
- When they are in fresh water they must deal with the tendency of water to flow in and minerals out
 - ✓ Produce dilute urine (to remove excess water that moves in osmotically)
 - ✓ the salts are re-absorbed back in the kidney tubules
 - ✓ Their bodies are also impermeable to water
 - ✓ Active uptake of Na^+ and Cl^- from the environment by special ion uptake cells in the gills
- Lampreys are therefore the **osmoregulators**

Assignment 1:

Describe the life cycle of *Petromyzon marinus*

Note: Max number of pgs = 3