PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATE (CRANIATA)

SUPERCLASIS: AGNATHA (JAWLESS FISHES)

CLASS I: MYXINI (HAGFISH)

CLASS II: PETROMYZONTIDA (LAMPREYS)

CLASS OSTRACODERMS

CLASS: PETROMIZONTIDAE (about 38 species)

CLASS:MYXINI (about 70 species)

Non-Living Jawless Fishes

- The earliest vertebrates.
- Their fossis found from late Cambrian and Ordovician deposits.

CYCLOSTOMATA
(morphological similarity)
Paraphyletic group

Living Jawless Fishes

- Lack jaws
- Internal ossification
- Scales
- porelike gill openings
- eel-like body form

CLASS: PETROMYZONTIDA (LAMPREYS)
EXTERNAL FEATURES-MORPHOLOGY

- One nostril
- pineal eye behind nostril

- Eyes moderately developed;
- No eyelid

Two dorsal fins

Caudal fin flattened

Body slender, eel-like

Gill slits: 7 pairs

There is no clear neck area

Anal fin

- Mouth rounded
- Conical horned teeth present (formed from ectoderm)

SKIN (INTEGUMENT) OF PETROMYZONTIDA

- Skin is soft, slimy and consists of multilayer cells (**Epidermis and dermis**)
- The epidermis is composed mostly of **unicellular gland cells.**
- The dermis is composed of bundles of **collagenous and elastic fibres.**
- Between the dermis and body wall musculature, there lies a **subcutaneous layer containing pigment cells, blood vessels and fatty tissue.**
- The pigment cells or chromatophores have the power of migration for changing the skin colour. They are also present in the dermis.
- Skin color: brown, grey, and slightly green

SKELETON AND MUSCULAR SYSTEM

- Fibrous and cartilaginous skeleton
- Notochord present
- Vertebrate reduced or absent

- Muscles are divided into myomeres which are separated by sheets of connective tissue.
- Myotomes are W shaped and move as snake.
- Muscle tissue can be divided into red, pink, and white muscle.
- Red muscle sustains aerobic swimming.
- White muscle has thicker fibers and is much less vascularize.
- Pink muscle fibers are used for very high swimming velocities.

DIGESTIVE SYSTEM

The mouth is surrounded by **a buccal funnel**.
Buccal funnel serve as both sense organs and attached to anywhere.

Conic horn teeths found on the tongue

Oseophagus (For food-Dorsal)

Mouth → Teeth → Pharyngeal cavity → Intestine → Rectum → Anus → Cloaca
(Buccal cavity) (short and narrow) (Straight)

Respiratory Tube (ventral)

- **Absent stomach** and **pnacreas**
- Present **liver; gall bladder; bile ducts**

Secretion of their salivary glands prevent the blood of the victim from coagulation.
Salivary glands only found in mammals and Petromyzontida in vertebrates.

RESPIRATORY SYSTEM

Respiration is performed with gill (7 pairs of gill slits (marsipobranch)

Oesophagus (dorsally)

Mouth cavity → Pharyngeal cavity

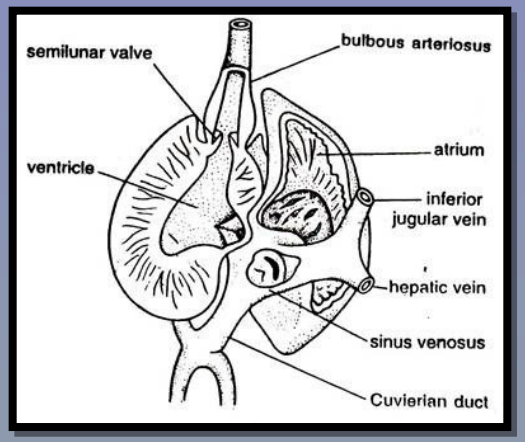
Respiratory tube (ventrally)

There are 7 gill slits on either side of the respiratory tube, each opening to exterior via an external branchiopore

- The water enters and leaves the body through gill slits.
- The direction of water flow is regulated by valves and sphincters associated with the external branchiopore.
- The gaseous exchange takes place inside the gill slits.

CIRCULATORY SYSTEM

comprises a **heart, veins** and **capillaries**



- No true lymphatic system is found
- The heart is remarkably large and slightly 'S' shaped
- The heart is enclosed in a pericardial cavity supported by cartilaginous plate

Sinus venosus (Collection of dirty blood)

↓ Valve

Atrial

↓ Valve

Ventricule (Thick wall)

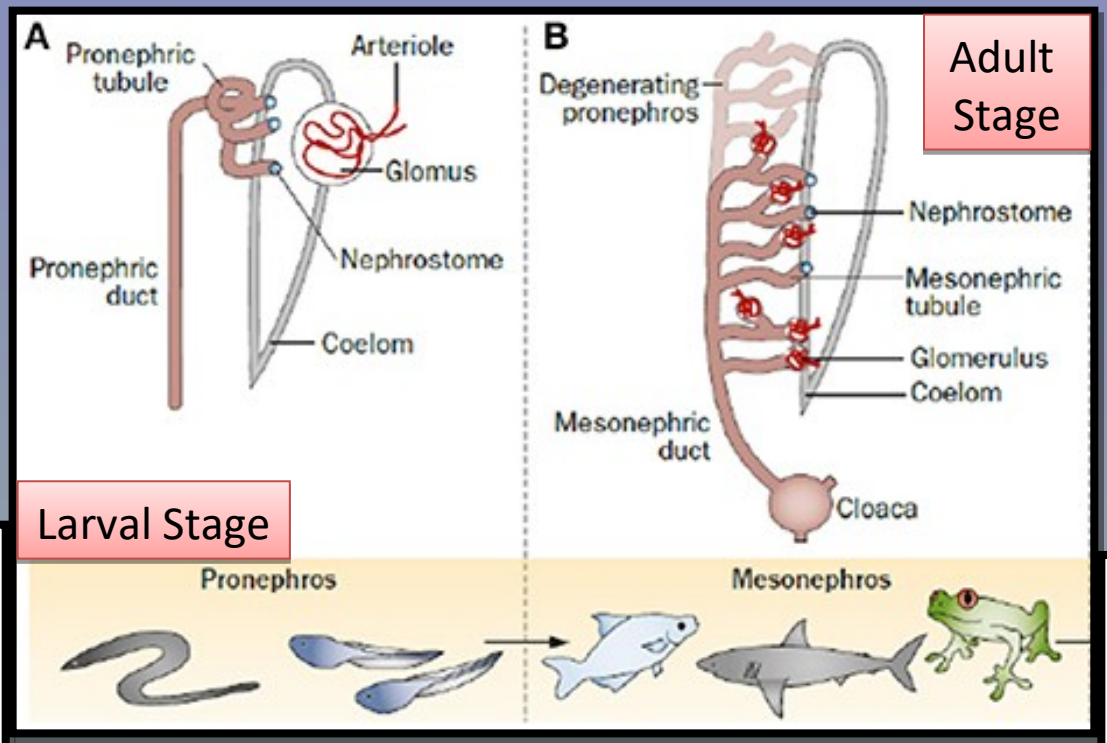
↓

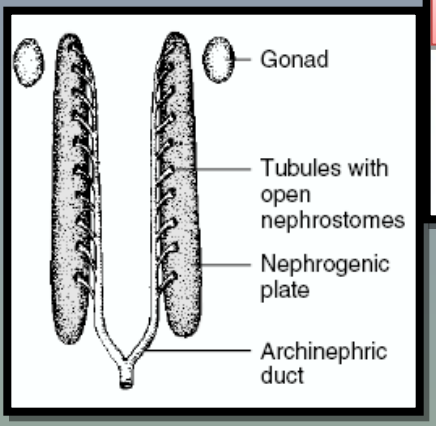
Ventral Aorta → Afferent gill veins → **Gill Slits** → CO2-O2 Exchange → **Capillary Vessel**

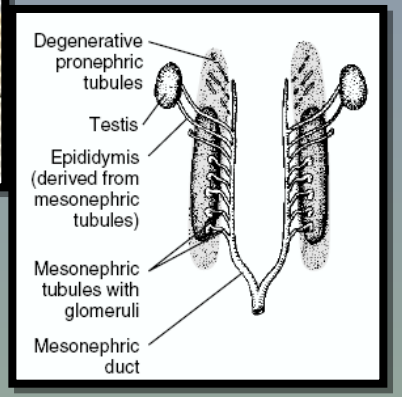
Efferent gill veins → **Dorsal Aorta** → **Organs**

- The red cells of lamprey are nucleated and spherical in shape of about 710 µ in size.
- It contains about six times as much haemoglobin as is contained in human red cells.

UROGENITAL SYSTEM (EXCRETORY AND REPRODUCTIVE)





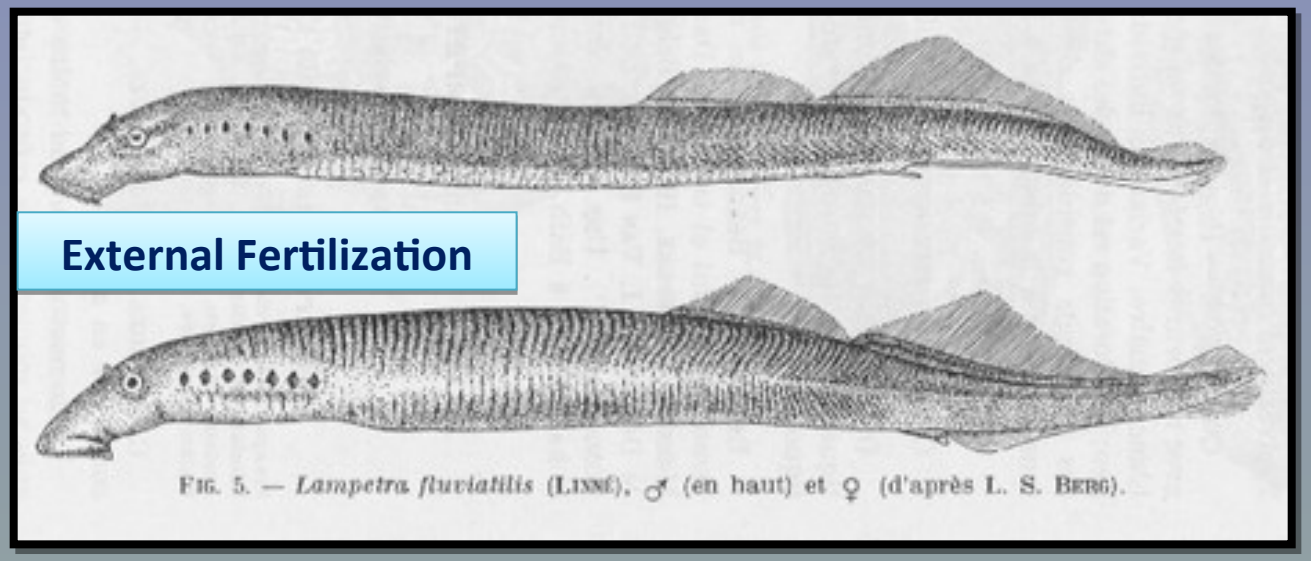


- Kidneys drain via archinephric duct to cloaca
- Main nitrogenous waste is **Ammonia**

Apart from its excretory function the kidney also contains **lymphoid tissue** and **fat,** and **take part in the production and destruction of red and white corpuscles.**

UROGENITAL SYSTEM (EXCRETORY AND REPRODUCTIVE)

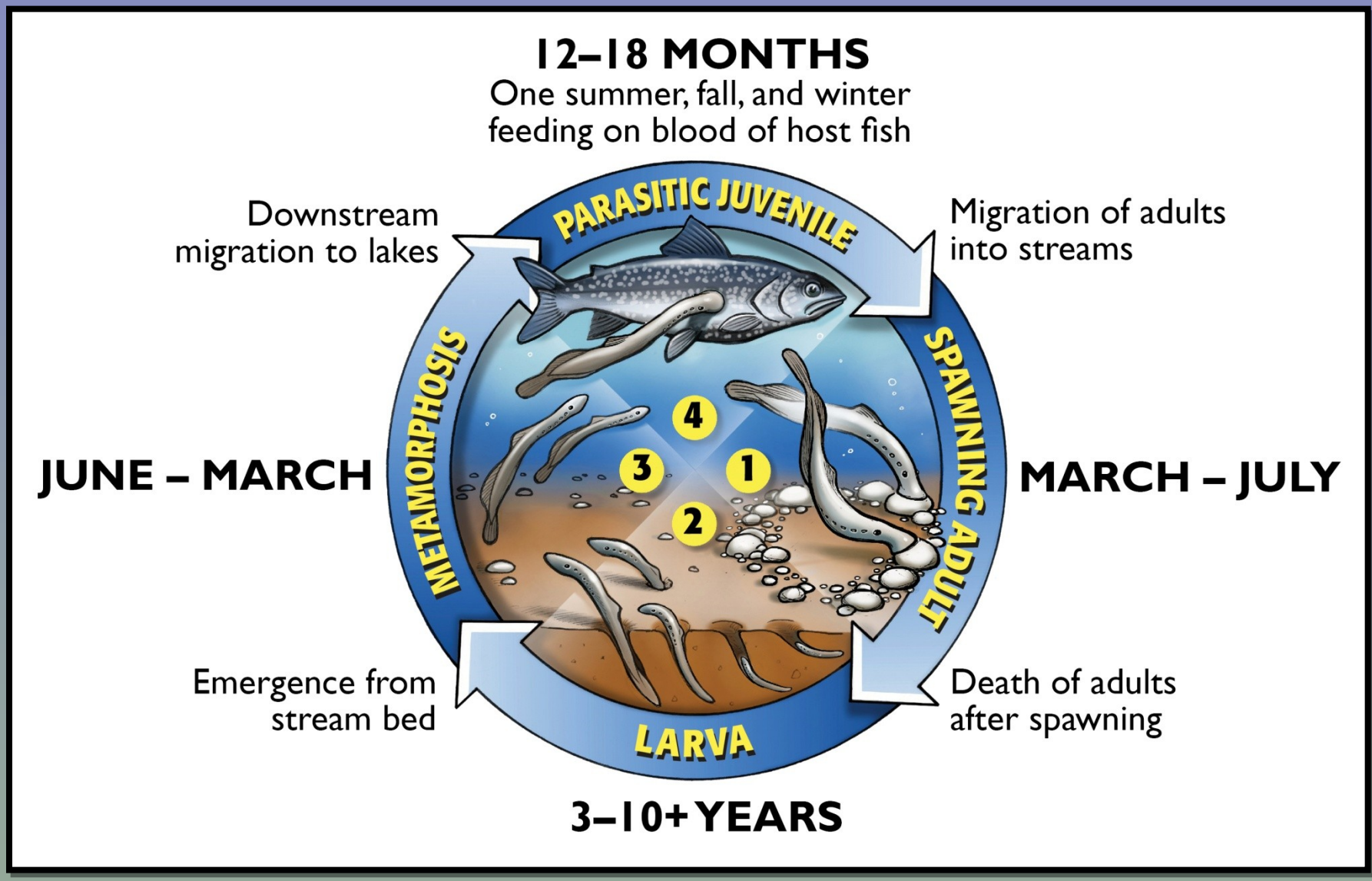
Larval Stage: Sexes are unclear-**HERMAPHRODITE**
Adult Stage: Sexes separetly



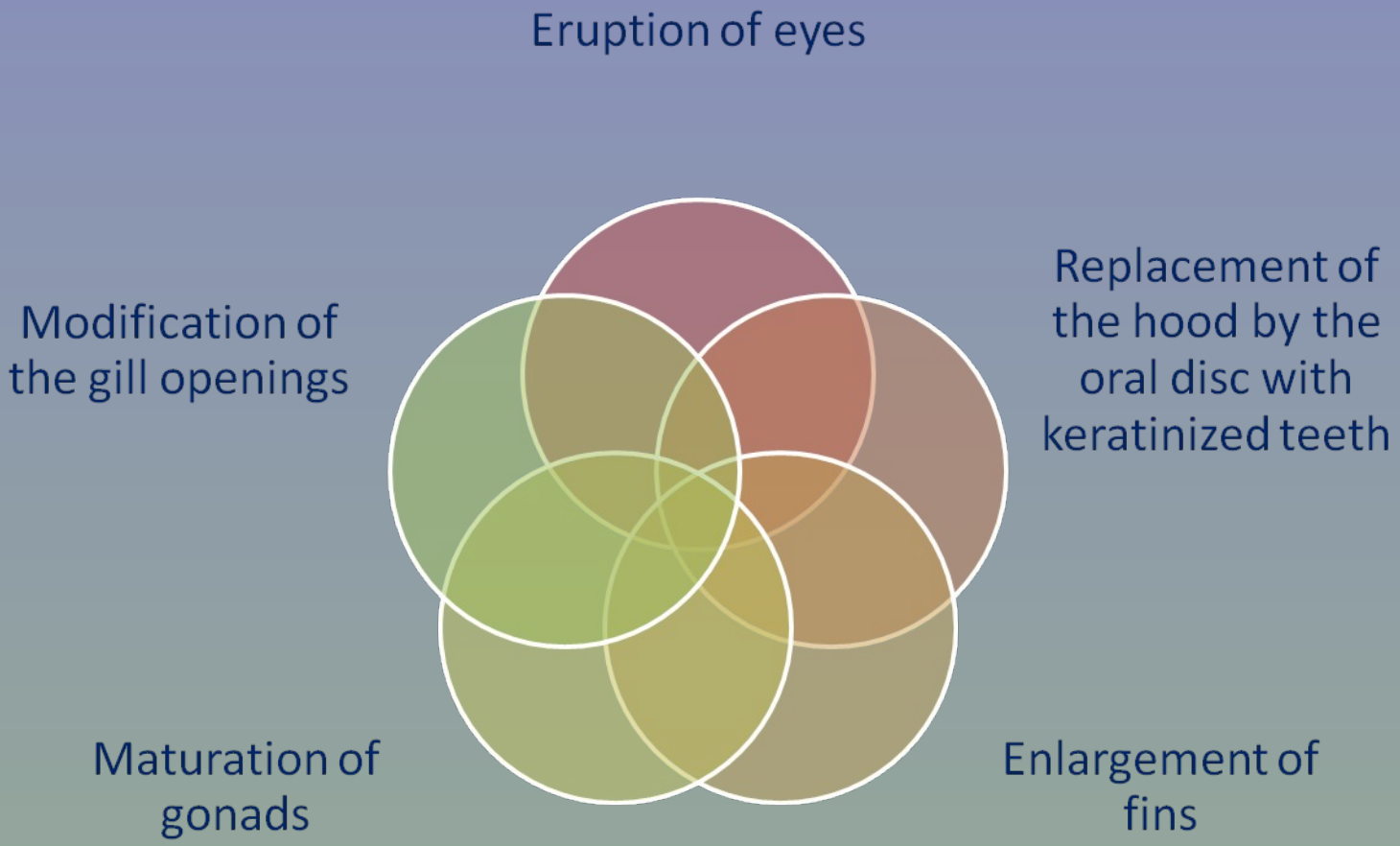
External Fertilization

Fig. 5. — *Lampetra fluviatilis* (Linné), ♂ (en haut) et ♀ (d'après L. S. Berg).

All lampreys ascend freshwater streams to breed.
Marine forms are **anadromous**
After spawning, adults die soon.
They have got larval stage which is called **Ammocoetes**
The larvae grows very slowly (for 3 to 7 years) and live as suspension feeders .
Then rapidly **metamorphose** into adults.

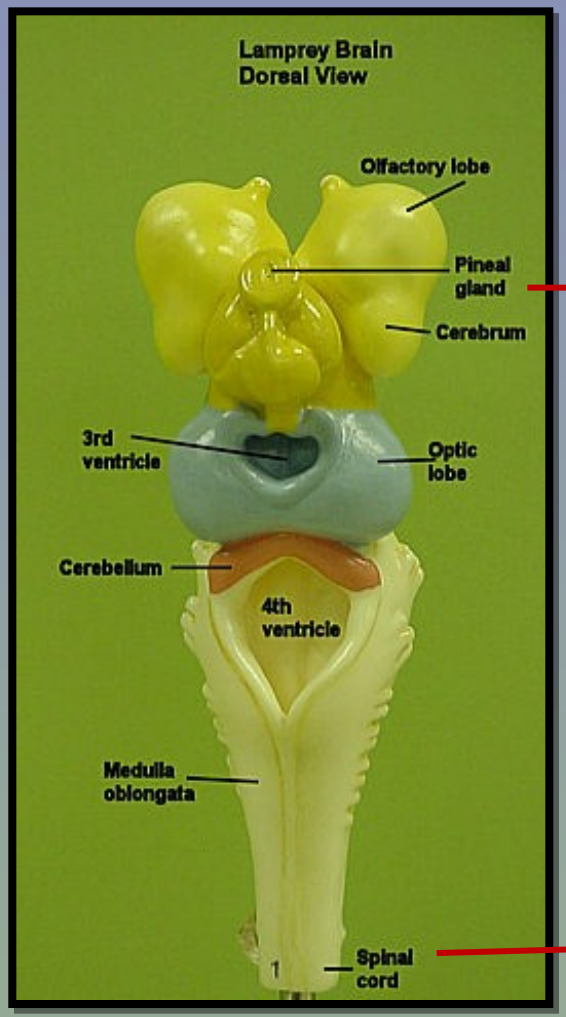

12–18 MONTHS
One summer, fall, and winter feeding on blood of host fish
Downstream migration to lakes
PARASITIC JUVENILE
Migration of adults into streams
JUNE – MARCH
METAMORPHOSIS
SPAWNING ADULT
MARCH – JULY
4
3
1
2
Emergence from stream bed
LARVA
Death of adults after spawning
3–10+ YEARS

Changing of Lampreys During Metamorphosis



NERVOUS SYSTEM AND SENSE ORGANS

Well developed and shows high degree of cephalization
10 pairs of cranial nerves



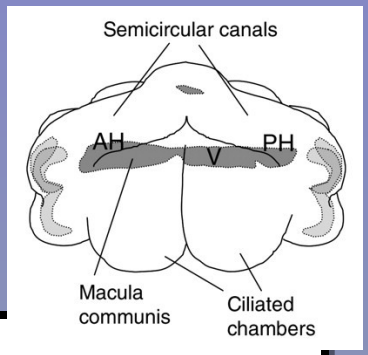
Prosencephalon: Olfactory lobe
Pituitary gland
Epiphysis

Mesencephalon: Optic lobe

Rhombencephalon Cerebellum
Medulla oblangata

uniform transparent grey colour

Develops from the diencephalon of the brain
Function is not well understood
In ammocoetes larvae pineal eye helps in changing colour of body



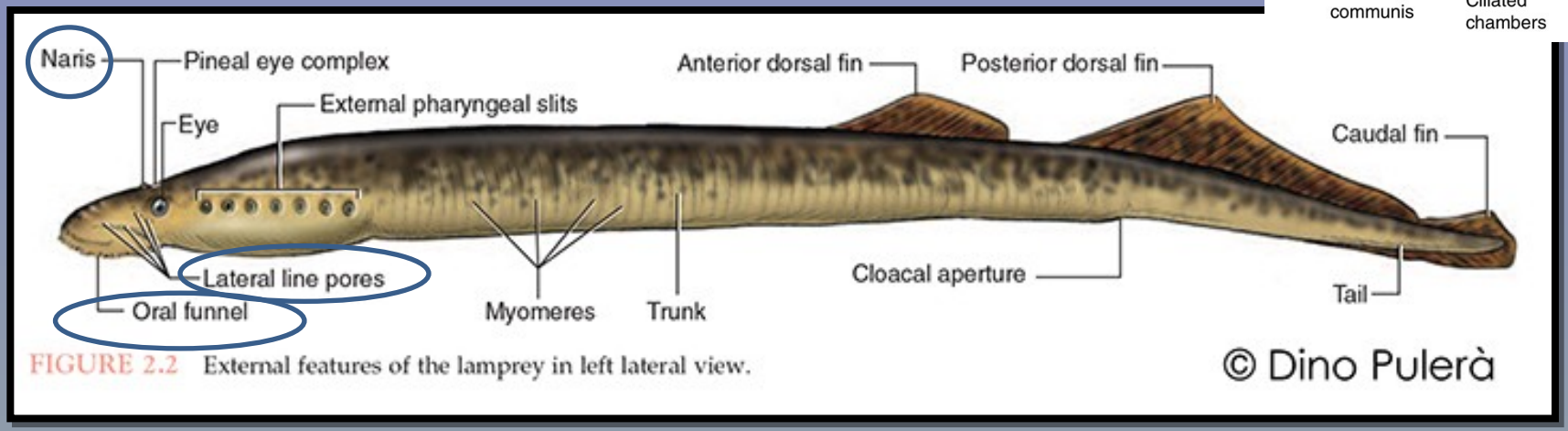


FIGURE 2.2 External features of the lamprey in left lateral view.

Lateral line System: It comprises receptors present in the form of little patches of sensory cells found on the **head** and **body.**

➢ Helps in searching food, in escaping from enemies and in orienting the body while swimming.

Olfactory Organ: They have a single, median olfactory organ. The single nostril opens behind into a rounded nasal or olfactory sac through a short duct.

The Vestibular Organ: There are **two semicircular canals** which open into sac called **vestibule**

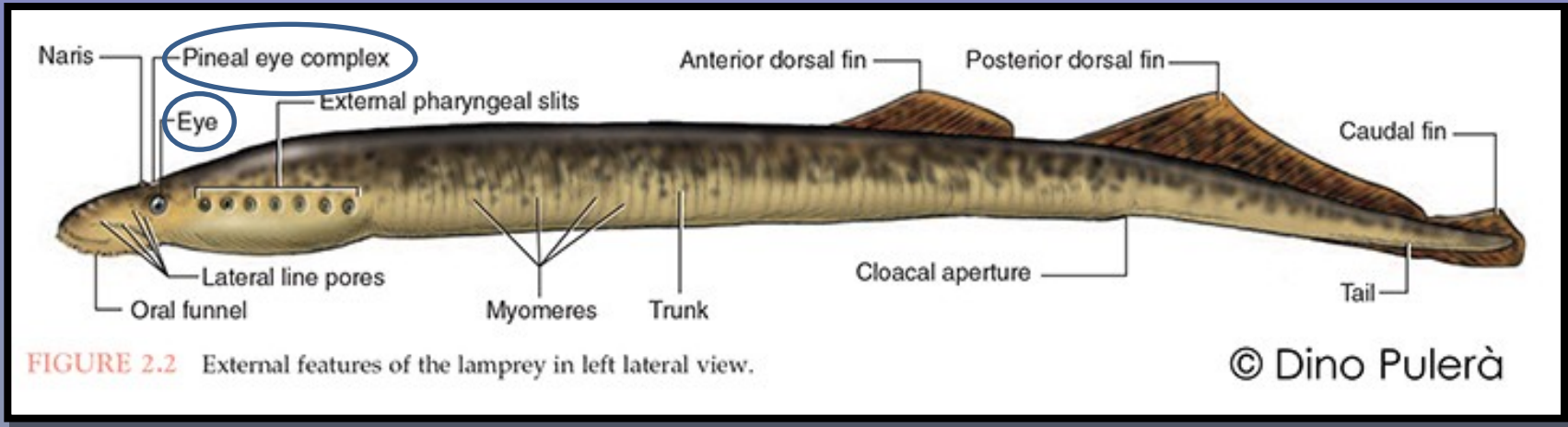


FIGURE 2.2 External features of the lamprey in left lateral view.

Photoreceptors: Lampreys possess light sensitive cells in the skin and in the eyes. These are abundantly present in the tail and when light falls on them, the animal rapidly moves away. The pigment present is probably a porphyropsin.

Pineal Eye: The pineal eye or epiphysial eye also develops from the diencephalon of the brain. The pineal eye first develops as two equal sacs. One sac is present on the dorsal side and is larger, it is known **as pineal eye** whereas another sac lies ventral to the first one and is called **para-pineal organ.**

THE ENDOCRINE ORGANS OF LAMPREY

1. The hypophysis: The **pituitary gland** or **hypophysis** is present between diencephalon and nasopharyngeal pouch.

2. Thyroid gland: After metamorphosis, the **thyroid gland** develops from the endostyle of the ammocoete larva. It secretes thyroxin hormone.

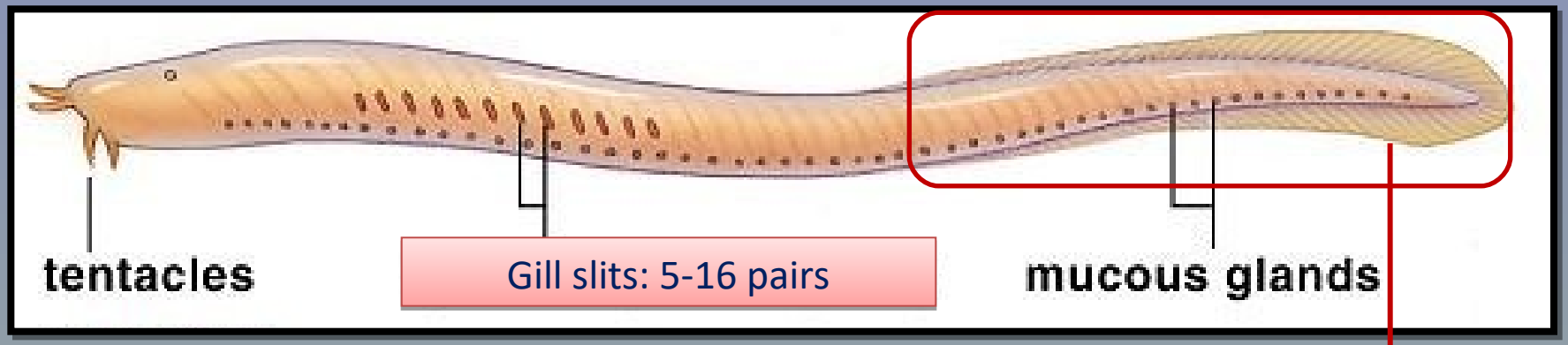
3. Parathyroid gland: These are very small sized glands and lie diffused in dorsal and ventral parts of pharyngeal pouches.

4. Pancreas: The endocrine pancreas lies suspended in liver and intestinal wall as small masses of endocrine cells.

CLASS: MYXINI (HAGFISHES)
EXTERNAL FEATURES-MORPHOLOGY

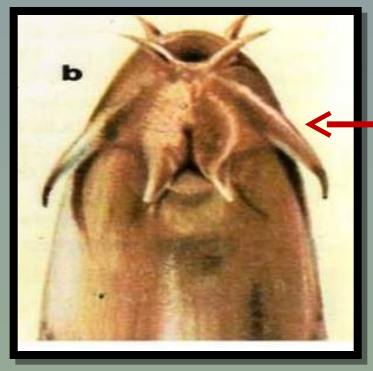
- Eyes poorly developed;
- almost blind
- No eyelid

Body long, slender, eel-like



There is no clear neck area

Dorsal, caudal and anal fins combined. No clear dorsal and anal fin

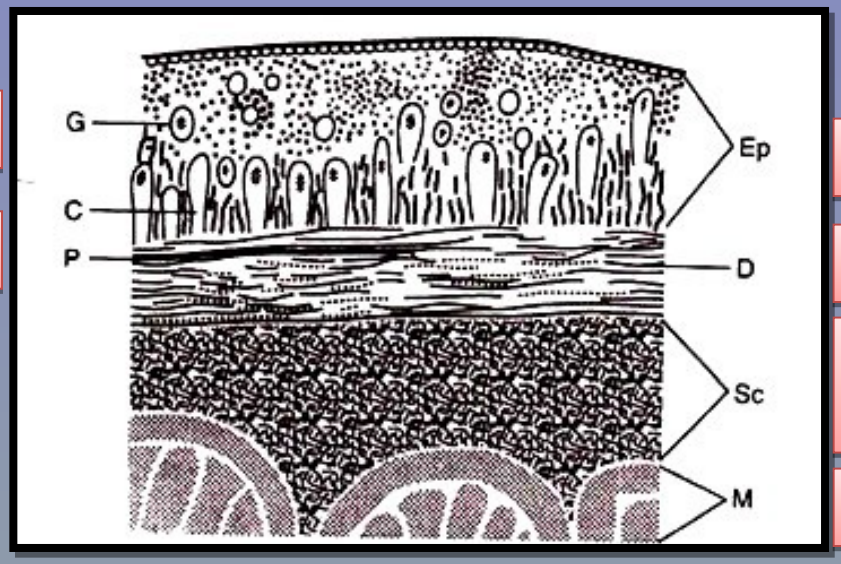


- Sucker and horse-shoe shaped mouth
- Four pairs of sensing tentacles
- One large conical tooth
- Two pairs of tooth-like rasps on the top of a tongue-like projection

SKIN (INTEGUMENT) Of MYXINI

Granular gland cells

Pigment cells



Epidermis

Dermis

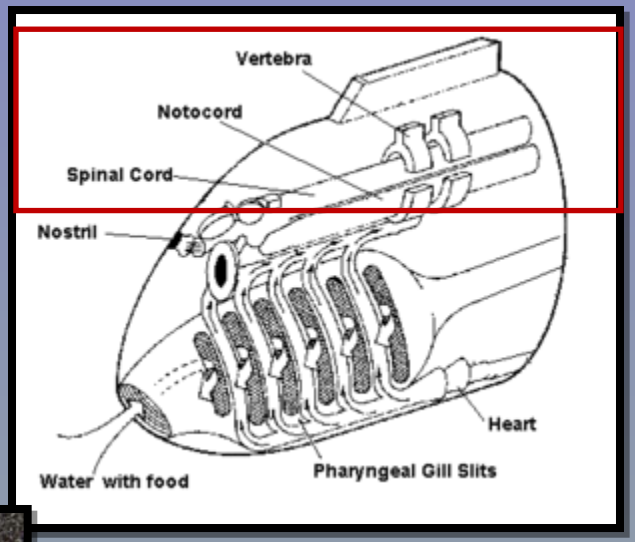
Subcutaneous connective tissue

Myotomal muscle

- Skin is soft, slimy and consists of multilayer cells (**Epidermis and dermis**)
- The epidermis is composed mostly of **unicellular gland cells.**
- The dermis is composed of bundles of **collagenous and elastic fibres.**
- Between the dermis and body wall musculature, there lies a **subcutaneous layer containing pigment cells, blood vessels and fatty tissue.**
- Skin color: Pinkish

SKELETON AND MUSCULAR SYSTEM

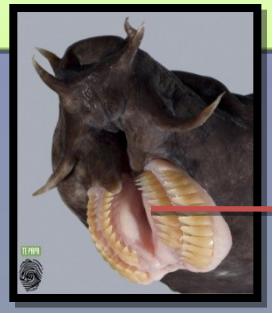
- Fibrous and cartilaginous skeleton
- Notochord present
- Vertebrate reduced or absent
- Cranium underdeveloped



- Muscles are divided into myomeres which are separated by sheets of connective tissue.
- Myotomes are W shaped and move as snake.

DIGESTIVE SYSTEM

Four pairs of tentacules present around the mouth
Feeding with invertebrate, dead or dying fishes
Hagfish may go for up to seven months without eating any food (slow-metabolism)
Buccal funnel absent



1 large conical teeth found on the tongue

Oseophagus (For food-Dorsal)

Mouth → Teeth → Pharyngeal cavity (short and narrow) → Intestine (foregut and hindgut) → Rectum → Anus → Cloaca

Respiratory Tube (ventral)

- **Absent stomach**
- Present **liver; gall bladder; bile ducts**

RESPIRATORY SYSTEM

Respiration is performed with gill (5-14 pairs of gill slits (marsipobranch)

Oesophagus (dorsally)

Mouth cavity → Pharyngeal cavity

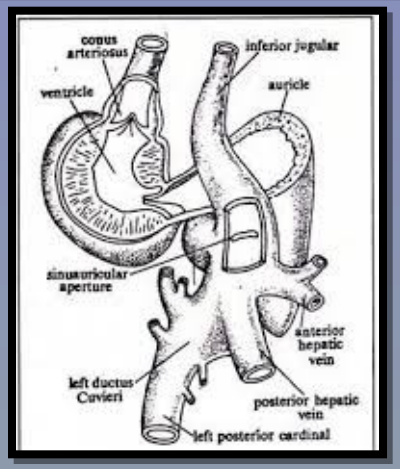
Respiratory tube (ventrally)

There are5-14 gill slits on either side of the respiratory tube, each opening to exterior separately

- The water enters and leaves the body through gill slits.
- The direction of water flow is regulated by valves and sphincters associated with the external branchiopore.
- The gaseous exchange takes place inside the gill slits.

CIRCULATORY SYSTEM

comprises a **heart, veins** and **capillaries**



- The circulatory system is special because the venous circulation is not connected to the arterial side in the ordinary way.
- The blood pressure on the venous side is very low.
- The main heart of hagfish is known as branchial heart. Hagfish is peculiar because it has heart-like organs, and these are caudal heart, portal heart and cardinal heart.
- The branchial heart lies closed to the bilobed liver.

Sinus venosus (Collection of dirty blood)

↓ Valve

Atrial

↓ Valve

Ventricule (Thick wall)

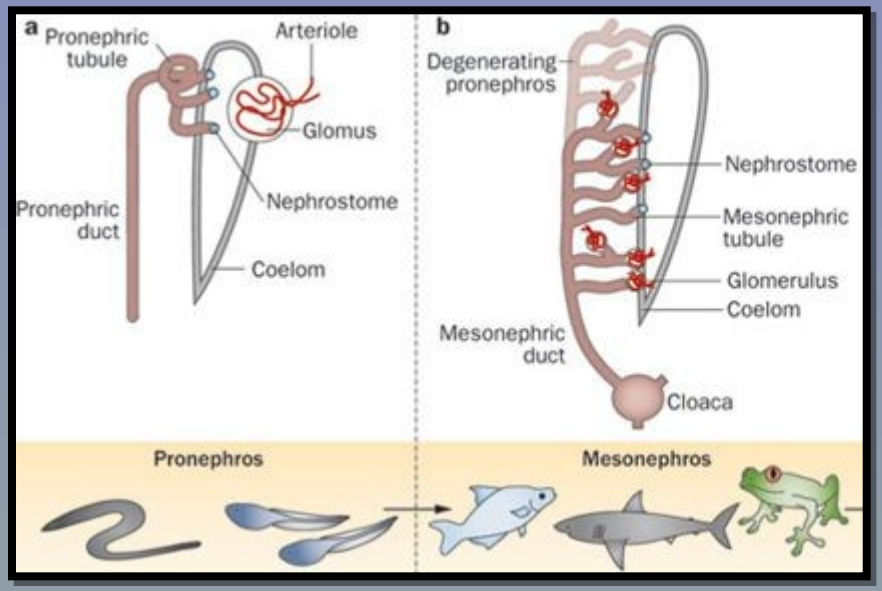
↓

Ventral Aorta → (Afferent gill veins) → **Gill Slits** → (CO2-O2 Exchange) **Capillary Vessel**

Capillary Vessel → (Efferent gill veins) → **Dorsal Aorta** → **Organs**

UROGENITAL SYSTEM (EXCRETORY AND REPRODUCTIVE)

- The kidneys of Myxine are divisible into two parts, the **pronephros** and **mesonephros** which are segmentally arranged.
- **The pronephros is retained in adult hagfish which is hardly marked off from the mesonephros.**



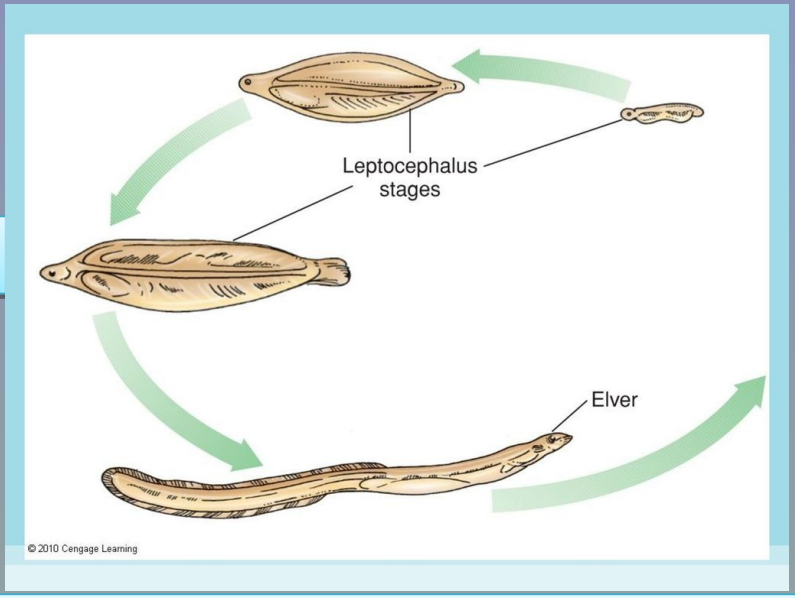
There is no **urine production by pronephros** but has **phagocytic** and **haemopoitic** functions.

- **The mesonephros** is the main kidney and is responsible for filtering the blood for excretion or reabsorption in the body.
- The hagfish cannot survive long in water that has either a very high or a very low concentration of salts.
- The osmotic pressure of the blood is controlled by adrenocortical hormones.
- They are in **osmotic equilibrium** with sea water.

UROGENITAL SYSTEM (EXCRETORY AND REPRODUCTIVE)

No larval stage. Sexes are unclear (**HERMAPHRODITE) when the hagfish is immature. Sexes separetly in mature stage.**

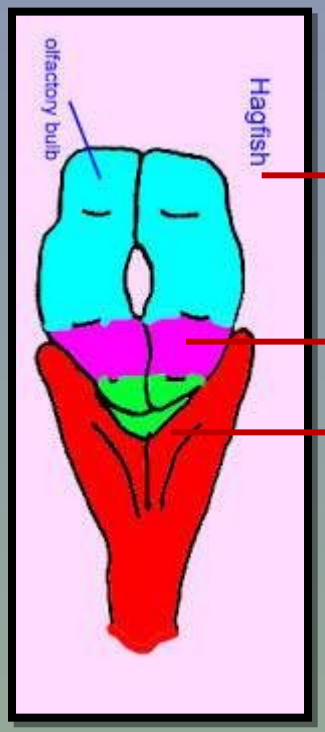
External Fertilization



There is a single gonad in hagfish.
Copulatory organs are absent in both sexes .
Large yolk-eggs, keratinized with hooks.
They are 2 to 3 cm in diameter.

NERVOUS SYSTEM AND SENSE ORGANS

- The spinal cord is en-sheathed exclusively by fibrous tissue.
- The myelencephalon is large and the rest of the sectors of the brain are not well-developed in comparison to that of lampreys.
- The olfactory lobes are larger.
- The ventricles of the brain are greatly reduced.
- **10 pairs of cranial nerves**



Prosencephalon: Olfactory lobe
Pituitary gla
Epiphysis

Larger

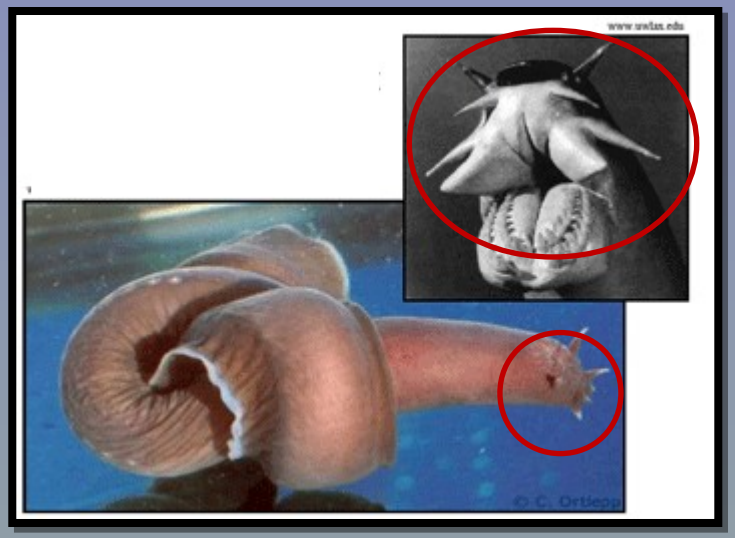
Mesencephalon: Optic lobe

Rhombencephalon Cerebellum
Medulla oblangata

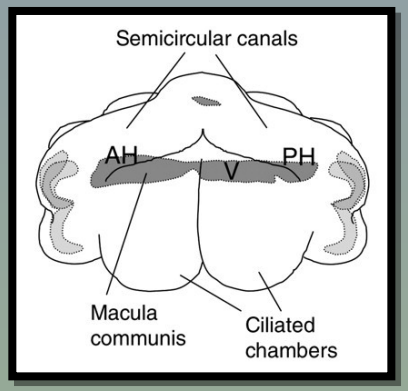
Reduced

Eyes: The paired eyes are rudimentary and sunk below the skin.
The eyes lack nerves and muscles.
The pineal eye is absent.

Lateral line System: Not well-developed



Tentacules serve as sense organs



Olfactory Organ: They have a single, median olfactory organ. The single nostril opens behind into a rounded nasal or olfactory sac through a short duct.
The nasohypophysial tube opens internally into the roof of the pharynx.

The Vestibular Organ: There are **one semicircular canals**

DIFFERENCES BETWEEN PETROMYZONTIDA AND MYXINI

- Live in marine and freshwater habitats
- Anadromous
- Larval stage
- Metamorphosis

	Lampreys	Hagfishes
Dorsal fins	One or two; well developed in adult	None or only a trace
Pre-anal fin	Absent	Present
Eyes	Moderately developed	Highly degenerate
Oculomotor muscles & nerves	Present	Absent
Oral disc	Present	Absent
Teeth	On both tongue and disc	On tongue plus one on "palate"
Lingual laminae	One transverse; two longitudinal	Two longitudinal pairs
Pokal cell cone	Absent in teeth	Present in teeth
Barbels	Absent	Present
Intestine	Ciliated	Unciliated
Spiral fold of intestine	Present	Absent
Buccal glands	Present	Absent
Nasohypophyseal opening	On top of head	In front of head
Nasohypophyseal sac	Not opening into pharynx	Opening into pharynx
Number of gills	Always 7	5 to 14
External gill openings	7, close to head	1 or 5-14, remote from head
Internal gill opening	Into a single suboesophageal tube communicating with oral cavity	separately and directly into pharynx
Gill pouches	Ectodermal origin	Endodermal origin
Pharyngo-cutaneous duct	Absent	Present
Skull	Mostly cartilaginous with incomplete roof	Roof entirely membranous and feebly developed
Branchial skeleton	A conspicuous basketwork	Rudimentary
Neural arches	Present but rudimentary	Lacking
Dorsal and ventral roots of spinal nerves	Distinct	United
Ductus Cuvieri	Left one obliterated	Right one obliterated
Kidney	Mesonephros	Pronephros anteriorly, mesonephros posteriorly
Eggs	Small, unkeratinized and without hooks	Very large, keratinized and with hooks
Segmentation	Holoblastic	Meroblastic

- Live in marine habitats
- No larval stage

ORIGIN AND FOSSILS

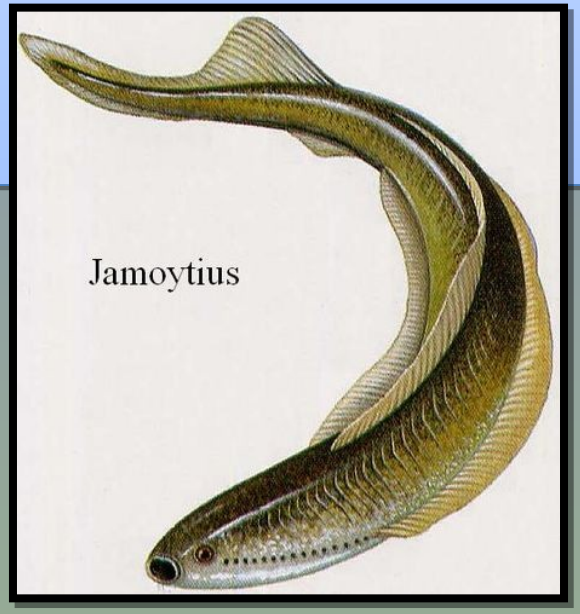
- The origin and ancestry of this group is debatable and is not fully understood.
- The endoskeleton of these animals is made up of cartilage and therefore, their fossil records are not satisfactorily preserved in geological record.

HOWEVER

They are descended from Ostracoderms

Because of;

1.They possess a single nostril in the middle of head.
2.They do not possess lower jaw.
3.They lack paired fins
4. There is no bony vertebral column.



CLASSIFICATION

SUBPHYLUM: VERTEBRATA (CRANIATA)

SUPERCLASS: AGNATHA (JAWLESS)

CLASS I: MYXINI (HAGFISHES)

About 70 species
Genus: *Myxine; Epaptreus*
Habitat: Marine

Myxinie glutinosa

Epaptretus sp.

CLASSIFICATION

CLASS II
PETROMYZONTIDA
(LAMPREY)

About 38 species
Genus: Petromyzon; Ichthyomyzon; Lampetra;
Habitat: Freshwater-Marine
Anadromous

Petromyzon marinus

Lampetra fluviatilis

Lampetra lanceolata
Doğu Karadeniz'den kayıt var.