

Chapter 11

Animal Kingdom (Chordates)

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Introduction

Animals that belong to chordates are fundamentally characterised by the presence of a notochord, a dorsal hollow nerve cord and paired pharyngeal gill slits. The notochord is replaced by a cartilaginous or bony vertebral column in the adult in sub-phylum vertebrata, thus we say all vertebrates are chordates but all chordates are not vertebrates. Besides the basic chordate characters, vertebrates have a ventral muscular heart with two, three or four chambers, kidneys for excretion and osmoregulation and paired appendages which may be fins or limbs.

PHYLUM CHORDATA

Phylum chordata has four fundamental features.

1. **Notochord** (elastic, solid, ensheathed rod-like structure of vacuolated turgid cells which is present throughout the life or only during early embryonic development, located between nerve cord and digestive tube (alimentary canal).

In vertebrates, notochord is replaced by a cartilaginous or bony vertebral column in adults.

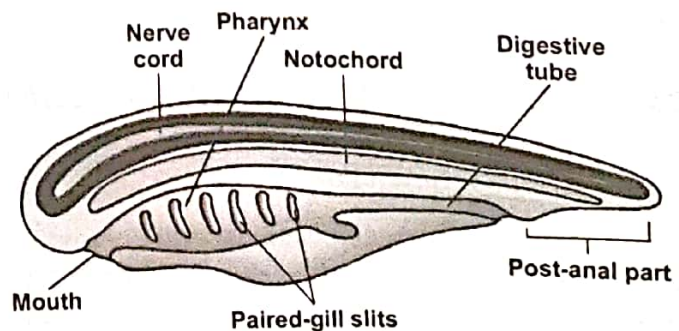


Fig. : Chordata characteristics

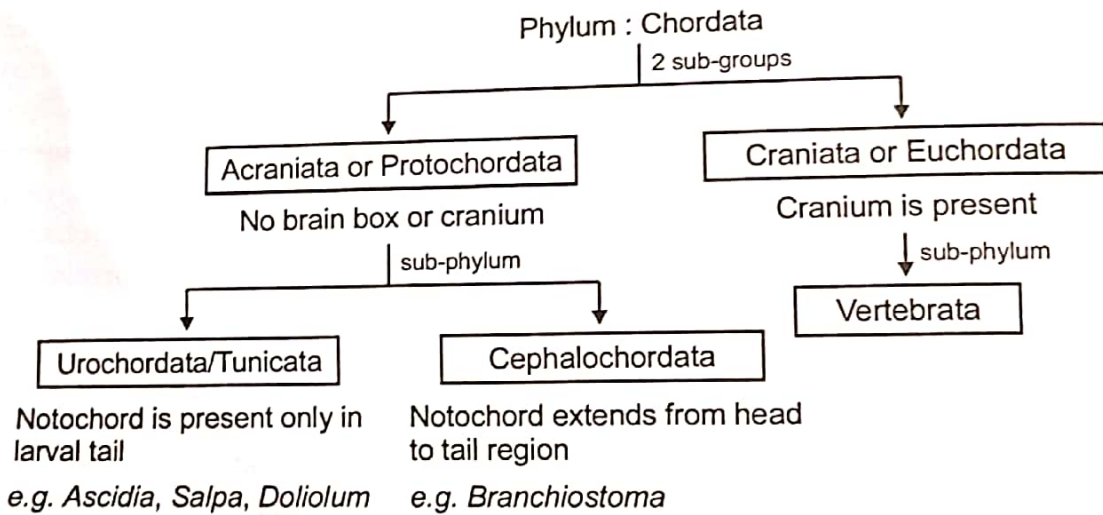
2. **Dorsal hollow nerve cord** : It differentiates into brain and spinal cord. It is present above the notochord.
3. **Paired pharyngeal gill slits** :
 - ❖ Take part in circulation of water for respiration.
 - ❖ In higher chordates, they occur only in embryonic stage.
4. **Post anal tail** : It is present for balancing.

Along with these features chordates are bilaterally symmetrical, triploblastic, coelomate with organ system level of organisation and close circulatory system.

Table : Comparison of Non-chordates and Chordates

Non-chordates	Chordates
1. Notochord absent.	1. Notochord present.
2. Central nervous system is ventral, solid and double.	2. Central nervous system is dorsal, hollow and single.
3. Gill slits are absent.	3. Pharynx perforated by gill slits.
4. Heart is dorsal (if present).	4. Heart is ventral.
5. Post-anal tail is absent.	5. A post-anal tail is present.
6. Gut is dorsal to nerve cord.	6. Gut is ventral to nerve cord.

Phylum chordata is divided on the basis of whether it has cranium (brain-box) or not.



Knowledge Cloud

Urochordata and Cephalochordata which are Acraniates are considered as primitive and often referred to as protochordates or non-vertebrate chordates.

CLASSIFICATION OF PROTOCHORDATA OR ACRANIATES

Sub-Phylum - 1. UROCHORDATA

1. The adult body is enclosed within a leathery **test** or **tunic** formed of a cellulose-like organic substance termed **tunicin**, therefore, this phylum is called **tunicata**.
2. Notochord is only present in the tail of the larva (hence named Urochordata) and disappears in the adult.
3. Circulatory system is open in tunicates.

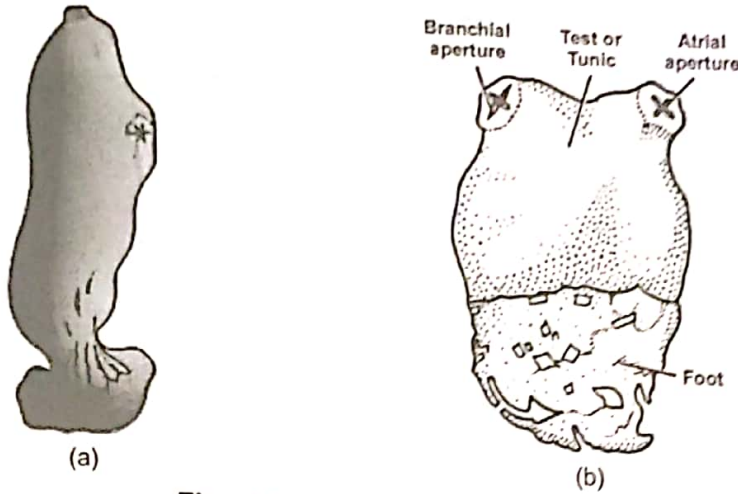


Fig.: (a) *Ascidia*, (b) *Herdmania*

4. Development is indirect.
5. Retrogressive metamorphosis shown by the larva i.e. change from better developed larva to less developed adult.
6. Excretion by neural gland.

Examples : *Ascidia*, *Salpa*, *Doliolum*, *Herdmania* (sea squirt), *Pyrosoma* (colonial bioluminescent form)

Sub-phylum - 2. CEPHALOCHORDATA

1. Notochord extends from head to tail region.
2. Notochord persists throughout the life.
3. Digestive tract is complete. Pharynx large, perforated by numerous persistent gill-slits.
4. Circulatory system well-developed, closed and without heart.
5. Development indirect, including free swimming larva.
6. Respiration through general body surface.
7. Excretion by protonephridia with solenocytes.
8. Paired appendages absent. Median fins (dorsal, ventral and caudal) are present.

Example : *Branchiostoma* (*Amphioxus* or Lancelet)

Amphioxus has both ends pointed like lance, hence it is commonly called lancelet.

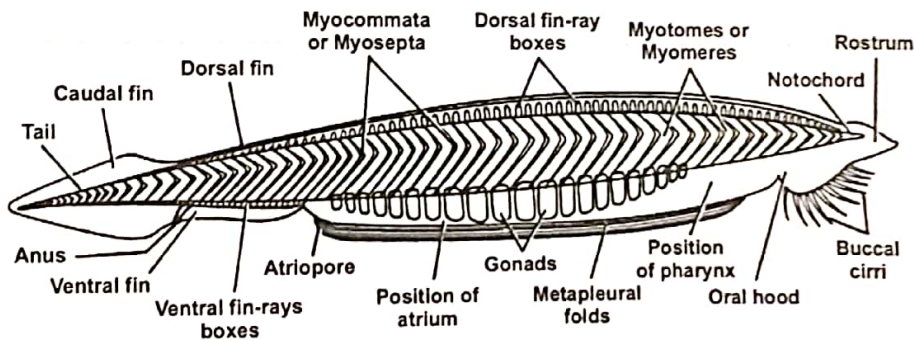
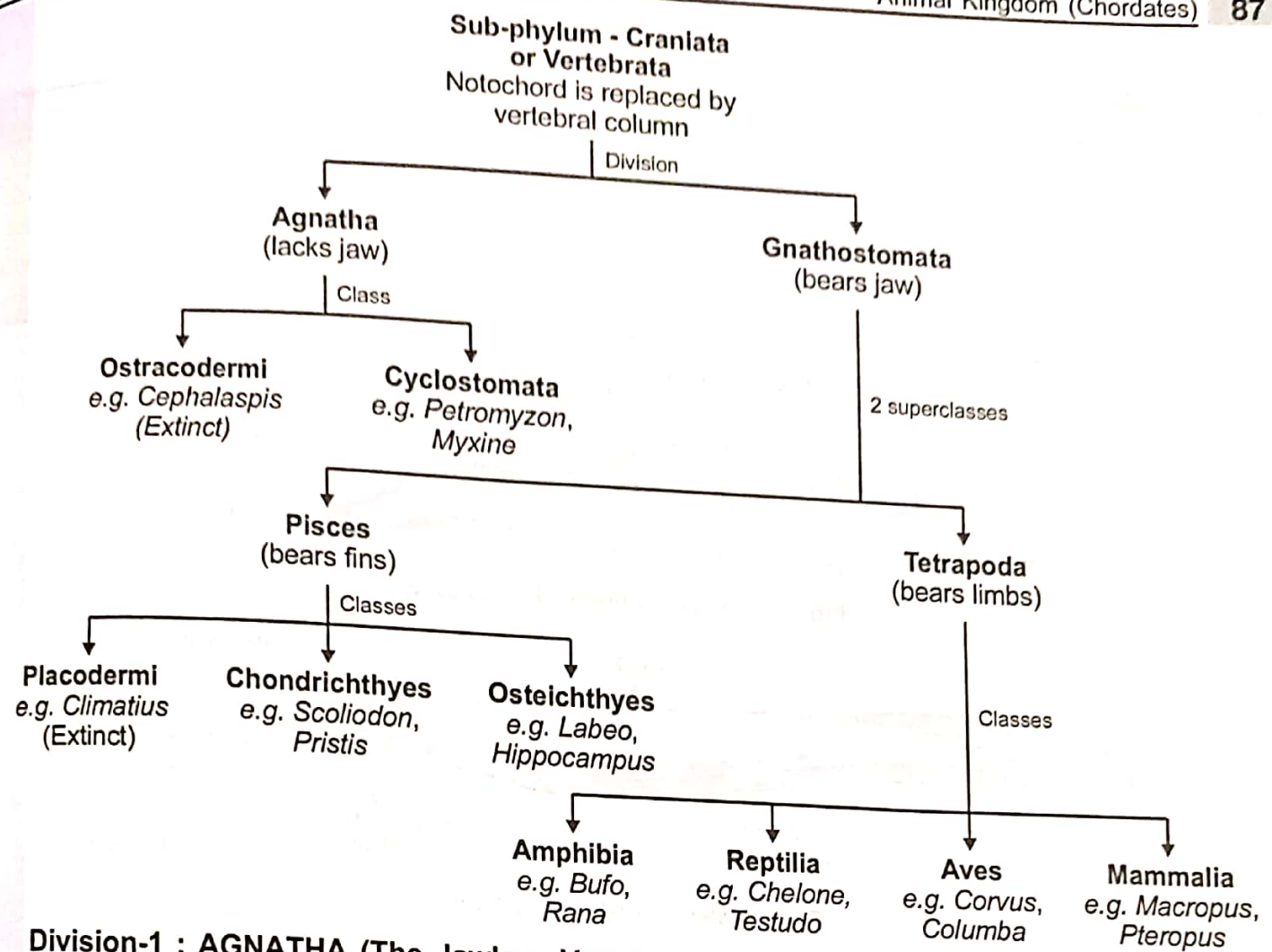


Fig.: *Amphioxus*

Did You Know?

Vertebra : Vertebra is a Latin word whose meaning is joint.

Pyrosoma a Urochordate, lives in colony, is a bioluminescent form which is due to the symbiotic association of its egg with luminescent bacteria.



Division-1 : AGNATHA (The Jawless Vertebrates)

1. They are the most primitive of all craniates.
2. Mouth does not possess jaws hence named **Agnatha**.
3. Notochord persists throughout life.
4. They do not have exoskeleton and paired appendages.
5. They have a single nostril.
6. They are cold-blooded.

CLASS 1. CYCLOSTOMATA

General characteristics of Cyclostomata

1. All living members of this class are **ectoparasites** on some fishes.
2. They have an elongated body bearing usually **6-15 pairs** of gill slits for respiration.
3. Cyclostomes have a sucking circular mouth.
4. Mouth is without jaws hence they are also called as jawless fishes.
5. Their body is devoid of scales and paired fins.
6. Cranium and vertebral column are cartilaginous.
7. Circulation is of **closed** type.
8. Stomach is absent.
9. Cyclostomes are marine but migrate for spawning to fresh water. After spawning, within a few days, they die. Their larvae, after metamorphosis, return to the ocean.

Examples : *Petromyzon* (Lamprey) and *Myxine* (Hagfish).



Knowledge Cloud

Cyclostomes are mostly parasites on some fishes.

Lamprey attaches itself to some fishes and sucks blood from them. In some places, they affect fish production, e.g., *Petromyzon* (Lamprey), *Myxine* (Hag fish). The larva of lamprey is called **Ammocoete larva**. It migrates from fresh water to ocean after metamorphosis.

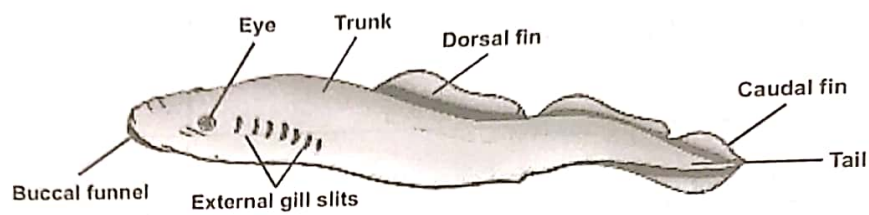


Fig.: Jawless vertebrate - *Petromyzon*

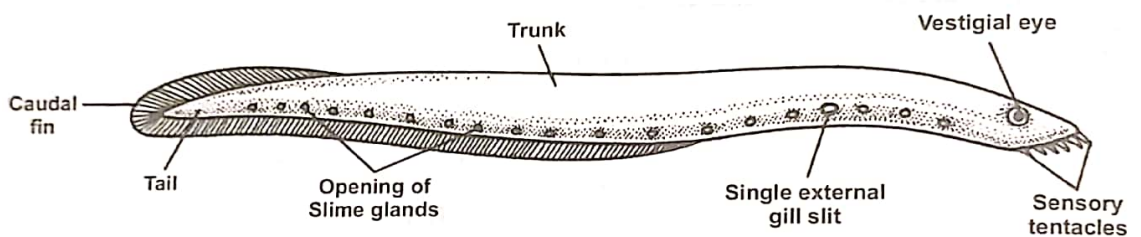


Fig.: Jawless vertebrate - *Myxine*

Table : Differences between Lamprey and Hag fish

7. Acraniata includes
 (1) Urochordata
 (2) Protochordata
 (3) Cephalochordata
 (4) All of these
8. Retrogressive metamorphosis is found in
 (1) *Amphioxus*
 (2) *Rana*
 (3) *Ascidia*
 (4) Protochordata
9. In which of the following notochord is absent?
 (1) Adult tunicate
 (2) Myxine
 (3) *Amphioxus*
 (4) Larval tunicates
10. Which of the following is a common feature of *Amphioxus*, frog, fish and crocodile?
 (1) Skeleton made up of cartilage and bone
 (2) Pharyngeal gill slits at least in developmental stages
 (3) Dorsal solid nerve cord
 (4) Three chambered heart

Division-2 : GNATHOSTOMATA (The Jawed Vertebrates)

1. It includes advanced vertebrates.
2. Mouth has jaws hence it is named **gnathostomata**.
3. Embryonic notochord is usually replaced in adult by a vertebral column.
4. Paired fins or limbs are present.
5. They have paired nostril.
6. They are both cold-blooded and warm-blooded.
7. Gnathostomata is divided into two super classes : **Pisces and Tetrapoda**.

SUPERCLASS-1 : PISCES

1. It includes true fishes.
2. All are aquatic.
3. Paired and unpaired fins are present.
4. Respiration occurs typically by gills.
5. Each eye has a well-developed nictitating membrane, eyelids are absent.
6. Lateral line sense organs are present.
7. Heart is two chambered (S-shaped, venous heart) with sinus venosus and conus arteriosus.
8. **Monocondylic skull**, slimy glands present on skin.
9. Vertebrae are **Amphicoelous type**
10. **Both renal portal and hepatic portal system are found.** Hypophyseal portal system is also present.
11. Kidneys – **Mesonephric**, ammonotelic (sharks-Ureotelic).

CLASS-1 : CHONDRICHTHYES

1. They are **marine animals** with streamlined body.
2. Endoskeleton is made up of **cartilage**.
3. Notochord is persistent throughout life.

4. Their jaws are powerful. Mouth is located **ventrally**.
5. Teeth are modified **placoid scales** which are backwardly directed.
6. Kidneys are mesonephric.
7. Skin is tough, containing minute **placoid scales**.
8. Gill slits are separate and without operculum (gill cover). Except in the **Chimaeras**.
9. Air bladder or swim bladder is **absent**, so they have to swim constantly to avoid sinking.
10. Heart is **two chambered** (one auricle and one ventricle).
11. Organisms belong to this class are **cold-blooded** (poikilothermous) *i.e.* they lack the capacity to regulate their body temperature.
12. Organisms are predaceous, some of them have **electric organs** (*e.g.* *Torpedo*) and some possess **poison sting** (*e.g.* *Trygon*).
13. Sexes are separate and show sexual dimorphism.
14. In males pelvic fins bear claspers which are used in copulation.
15. Fertilisation is internal.
16. Many of them are **viviparous**.
17. There are 10 pairs of cranial nerves.

Examples : *Scoliodon* (Dog fish), *Pristis* (Saw fish), *Trygon* (Sting ray), *Carcharodon* (Great white shark).

Knowledge Cloud

Scoliodon (Dog fish) : Scoliodon is carnivorous. It is a surface feeder. Both upper and lower jaws bear **homodont teeth**, which prevent the escape of the prey. **Ampulla of Lorenzini** receives information of the temperature fluctuations in the surrounding water. Behind the head on each side there are present five oblique openings, known as **gill slits**, which communicate internally with the pharynx. The gill slits expel out the water from the pharynx. The tail fin is **heterocercal**, *i.e.*, the two lobes are unequal. A light coloured lateral line extends from head to the tail. Numerous dermal **placoid scales** are embedded in the skin, which form the exoskeleton of the fish. The male can be distinguished from the female, since the former has a pair of hard elongated **claspers** attached to the pelvic fins. The claspers help in copulation. It is also eaten as food by some persons. It yields liver oil. **Shark is viviparous and bring forth their young alive. Mermaid's purse** is the egg case of shark.

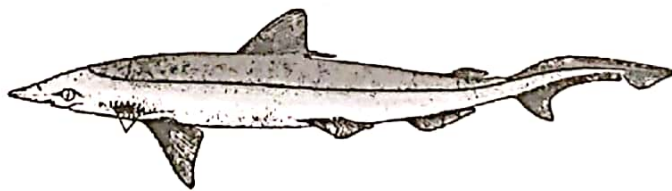


Fig.: *Scoliodon* (Dogfish)

Pristis : Head bears a series of strong tooth like denticles along the margin. It uses the denticles for offence and defence. Caudal fin is heterocercal. This fish is viviparous. It is commonly called **saw fish**.

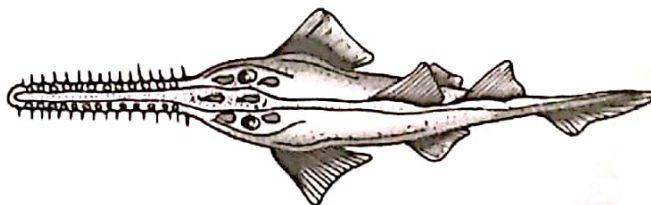


Fig.: *Pristis*