ANIMAL

KINGDOM 03

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UNIT – 01 (SEMESTER 2nd)

TOPICS TO BE COVERED

A. Primitive Chordates and their affinities.
B. General Characteristics and Classification of Protochordate
C. Type Study : Amphioxus

CHORDATA

[Chordae = string + Ata = bearing / Chordatus = cord or notochord]

Among all animal group **phylum Chordata** is regarded as highly evolved and important phylum.

Main Characters of Phylum – Chordata

Phylum Chordata encompasses a diverse group of animals that share several key characteristics:

a) Notochord: Chordates possess a flexible, rod-like structure called the notochord, which provides support and acts as a precursor to the vertebral column in most vertebrates.

b) Dorsal Nerve Cord: They have a dorsal nerve cord, located above the notochord, which develops into the central nervous system, including the brain and spinal cord.

c) Pharyngeal Slits: Chordates possess pharyngeal slits, which are openings in the pharynx that connect to the outside environment. In aquatic forms, these slits function in filter-feeding, respiration, or sound production.

d) Endostyle or Thyroid Gland: Many chordates have an endostyle, a glandular structure in the pharynx that plays a role in filter-feeding and may develop into the thyroid gland in higher vertebrates.

e) Post-Anal Tail: Chordates typically exhibit a post-anal tail, extending beyond the anus, which aids in locomotion and balance.

f) Bilateral Symmetry: All animals are Bilateral symmetrical

Classification

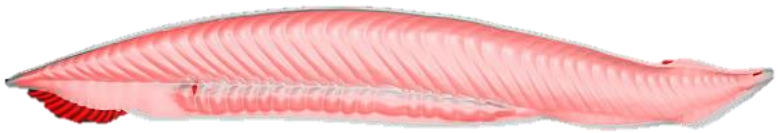
Phylum – **Chordata**

Sub-Phylum

HEMICHORDATA (PROTOCHORDATA)	TUNICATA (UROCHORDATA)	ACRANIATA (CEPHALOCHORDATA)	CRANIATA (VERTEBREATA)
• Unsegmented • Tongue worm • Burrowing animals	• Unsegmented • Head absent.	• Segmented • Head absent.	• Segmented • Head Present

PRIMITIVE CHORDATES AND THEIR AFFINITIES

Primitive chordates refer to a group of animals that belong to the phylum Chordata and exhibit characteristics that resemble the early evolutionary stages of the chordate lineage. These organisms share certain features with other chordates, such as a notochord, a dorsal nerve cord, and pharyngeal slits. However, they may lack some of the more advanced characteristics found in higher chordates, such as vertebral columns.



Some examples of primitive chordates and their affinities include:

1. Lancelets (Subphylum Cephalochordata): Lancelets, also known as amphioxus, are small marine animals that closely resemble the ancestral chordate form. They possess a notochord, a dorsal nerve cord, and pharyngeal slits throughout their lives. Lancelets are suspension feeders and spend their lives buried in the sand with only their mouthparts exposed.

2. Tunicates (Subphylum Tunicata or Urochordata): Tunicates, also called sea squirts, are marine animals that exhibit a combination of chordate and invertebrate characteristics. As adults, they typically have a sac-like body covered by a tough outer covering called a tunic. While adult tunicates may not display all the typical chordate features, their larvae possess a notochord, a dorsal nerve cord, and pharyngeal slits.

3. Hagfishes (Class Myxine): Hagfishes are eel-like marine animals known for their slimy appearance and scavenging habits. They lack jaws, paired fins, and vertebrae, making them primitive within the chordate lineage. Hagfishes have a cartilaginous skull, a notochord that persists into adulthood, and a reduced dorsal nerve cord.

GENERAL CHARACTERISTIC AND CLASSIFICATION OF PROTOCHORDATA (HEMICHORDATA)

TYPE STUDY - AMPHIOXUS

[Greek Hemi = Half , Chordata = string pod]

Hemichordata are low grade of chordate animals, in the body of which half notochord is present.

General Characteristics

1. They are very primitive type chordate animals. They are found in solitary or colonial form.
2. Body is soft, worm like. Body is divided into **Proboscis, Collar** and **Trunk.**
3. Body wall is made up of single layered Epidermis. Absence of tail, atrium and skeletal tissue.
4. Notochord is present
5. Circulatory system simple and of open type
6. **Pharyngeal Slits**: Protochordates possess pharyngeal slits or gill slits, which are openings in the pharynx (throat) region.
7. Nervous system present in ectoderm only

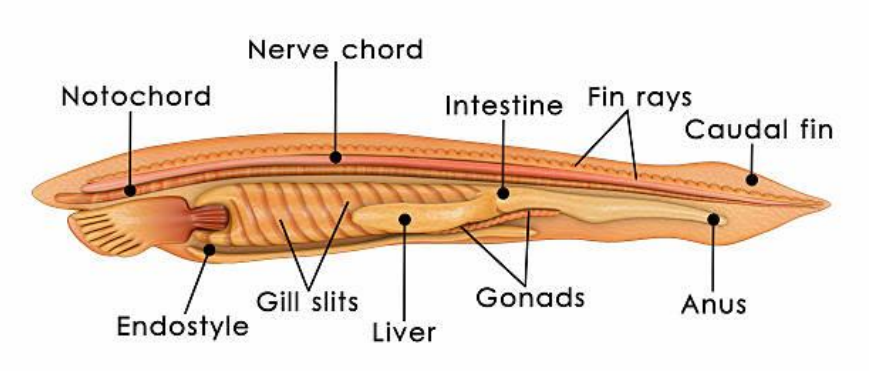
8. **Post-anal Tail**: Protochordates typically possess a post-anal tail, which extends beyond the anus. The tail aids in locomotion and provides balance.
9. **Lack of Vertebrae**: Unlike vertebrates, protochordates lack a true vertebral column or backbone. Instead, they rely on the notochord for support.
10. Male and Female organs are separate or present in same individual. Sexual Reproduction.
11. Fertilization is external.
12. Development Indirect and free swimming **Tornaria Larva**.

TYPE STUDY : AMPHIOXUS (BRANCHISTOMA)

Amphioxus, also known as lancelets or Branchiostoma, is a genus of small marine animals belonging to the subphylum Cephalochordata. These primitive chordates share many characteristics with the early ancestors of vertebrates.

CLASSIFICATION :

Phylum – Chordata
Sub Phylum – Cephalochordata
Class – Leptochordii
Genus – *Amphioxus*



CHARACTERS :

1. Body Shape: Amphioxus has an elongated, fish-like body that is laterally compressed. They are typically around 2-7 centimeters in length.

2. Notochord: Amphioxus possesses a notochord that runs along the entire length of its body. The notochord provides support and rigidity.

3. Dorsal Nerve Cord: They have a dorsal nerve cord that extends along the back of their bodies. This nerve cord serves as the primitive central nervous system.

4. Pharyngeal Slits: Amphioxus has multiple pairs of pharyngeal slits or gill slits located in the pharyngeal region. These slits allow water to enter the pharynx and aid in filter-feeding, gas exchange, and sometimes locomotion.

5. Endostyle: They possess an endostyle, a glandular structure located in the ventral region of the pharynx. The endostyle produces mucus that helps in filter-feeding and is also involved in iodine metabolism.

6. Buccal Cirri: Amphioxus has oral cirri or buccal cirri, which are finger-like projections around the mouth. These cirri aid in the capture and handling of food particles.

7. Post-anal Tail: They have a post-anal tail, which extends beyond the anus. The tail is muscular and aids in locomotion and balance.

8. Myomeres: Amphioxus has segmented muscle blocks called myomeres, which are arranged along the length of its body. These myomeres allow for flexible movement and locomotion.

9. No Cranium or Vertebrae: Amphioxus lacks a true cranium or skull and does not possess vertebrae. Instead, it relies on the notochord for support and protection.

10. Suspension Feeding: Amphioxus is a suspension feeder, primarily feeding on microscopic particles suspended in the water. It uses the movement of cilia and the action of its pharyngeal slits to filter out food particles.

NOTE : They are commonly called as **Lancelets** because its shape is like of a spear or lance.

DIGESTIVE SYSTEM :

The digestive system of amphioxus, also known as lancelets or Branchiostoma, is relatively simple yet efficient for their filter-feeding lifestyle. Here is an overview of the digestive system of amphioxus:

1. Mouth: Amphioxus has a small, slit-like mouth located on the ventral side of its body. The mouth opens into the pharynx, which is the first part of the digestive system.

2. Pharynx: The pharynx is a muscular tube that extends from the mouth to the beginning of the intestine. It contains numerous pharyngeal slits or gill slits, which serve both respiratory and feeding functions.

Water enters the pharynx through the mouth and passes out through the pharyngeal slits, while food particles are trapped and directed to the digestive tract.

3. Endostyle: Amphioxus possesses an endostyle, a glandular structure located in the ventral region of the pharynx. The endostyle secretes mucus, which helps in trapping food particles from the water as it passes through the pharynx.

4. Oesophagus: The Oesophagus is a short tube that connects the pharynx to the intestine. It allows the passage of food from the pharynx to the digestive tract.

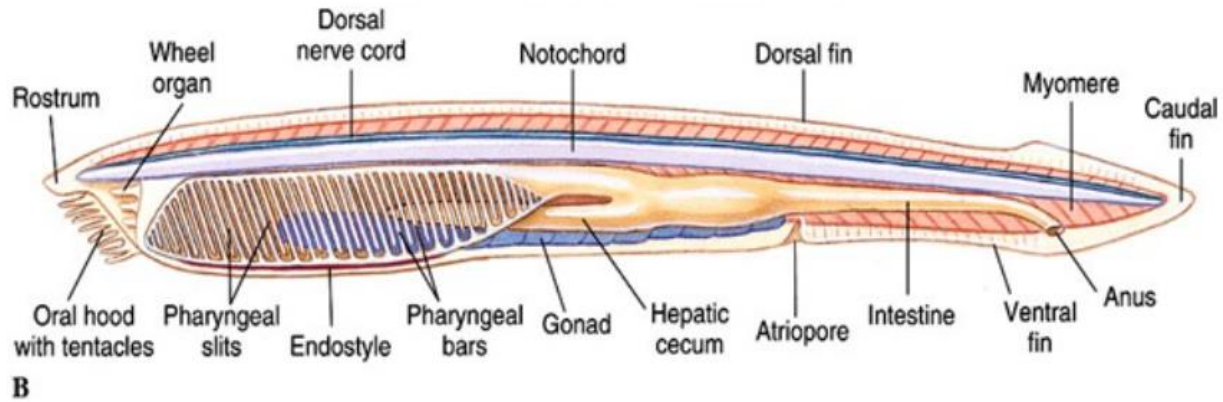
5. Intestine: The intestine is the main site of digestion and nutrient absorption in amphioxus. It is a straight tube that extends from the esophagus to the posterior end of the body. The intestine is lined with cells that secrete digestive enzymes to break down food particles into simpler forms.

6. Hepatopancreas: Amphioxus possesses a structure called the hepatopancreas, which is located near the intestine. The hepatopancreas secretes enzymes and helps in the digestion of fats and other complex molecules.

7. Anus: At the posterior end of the body, amphioxus has an anus through which undigested waste materials are eliminated from the digestive system.

8. No Stomach or Specialized Digestive Organs: Unlike many other animals, amphioxus lacks a distinct stomach or other specialized digestive organs such as a liver or gallbladder. Instead, digestion and absorption primarily occur within the intestine and hepatopancreas.

Amphioxus is a filter feeder, using its pharyngeal slits and mucus-producing endostyle to capture and filter small food particles from the water. The simple digestive system of amphioxus reflects its diet and overall morphology as a primitive chordate.



CIRCULATORY SYSTEM :

Amphioxus, also known as lancelets or Branchiostoma, has a relatively simple circulatory system that is adapted to its small size and simple body structure. Here is an overview of the blood circulatory system of amphioxus:

1. Circulatory Fluid: The circulatory fluid in amphioxus is called hemolymph. It is a watery fluid that lacks specialized cells such as red blood cells or true blood vessels.

2. Aortic Arch: Amphioxus has a single, contractile blood vessel called the aortic arch, which runs along the ventral side of the pharynx. The aortic arch serves as the main pumping organ and propels the hemolymph in a forward direction.

3. Branchial Vessels: From the aortic arch, several branchial vessels extend to the pharyngeal region. These vessels supply hemolymph to the gill bars, where gas exchange takes place.

4. Gill Bars: Amphioxus possesses numerous gill bars in its pharyngeal region, which are richly supplied with blood vessels. The gill bars are involved in both respiration and filter-feeding.

5. Diffusion: Hemolymph in amphioxus moves through the branchial vessels and gill bars, where gas exchange occurs. Oxygen from the water diffuses into the hemolymph, while carbon dioxide is released from the hemolymph into the water.

6. Sinus System: Amphioxus does not have a well-defined closed circulatory system with true blood vessels. Instead, the hemolymph flows through interconnected spaces called sinuses or lacunae that permeate the tissues of the body. The sinuses allow the hemolymph to bathe the cells directly, facilitating exchange of gases, nutrients, and waste products.

7. Hemolymph Return: After circulating through the gill bars and body tissues, the hemolymph returns to the aortic arch, where it is once again pumped forward to continue circulation.

It's important to note that amphioxus lacks a heart or complex blood vessels found in vertebrates. Its circulatory system is less efficient than the circulatory systems of more advanced organisms. However, it is sufficient for the needs of a small, filter-feeding animal like amphioxus, which has a relatively low metabolic rate.

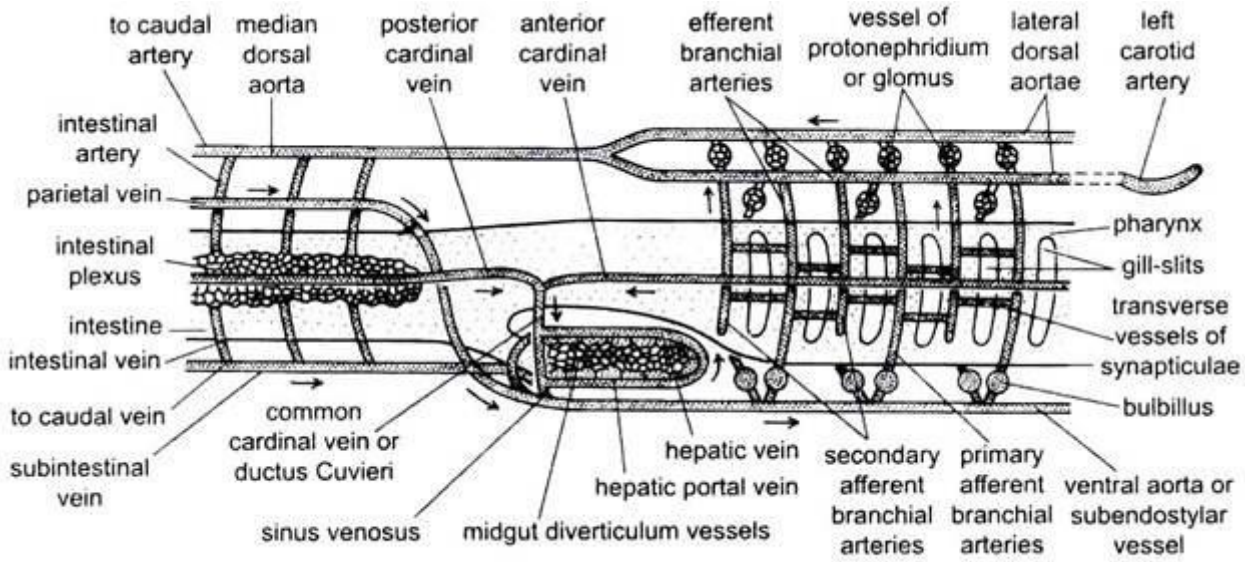
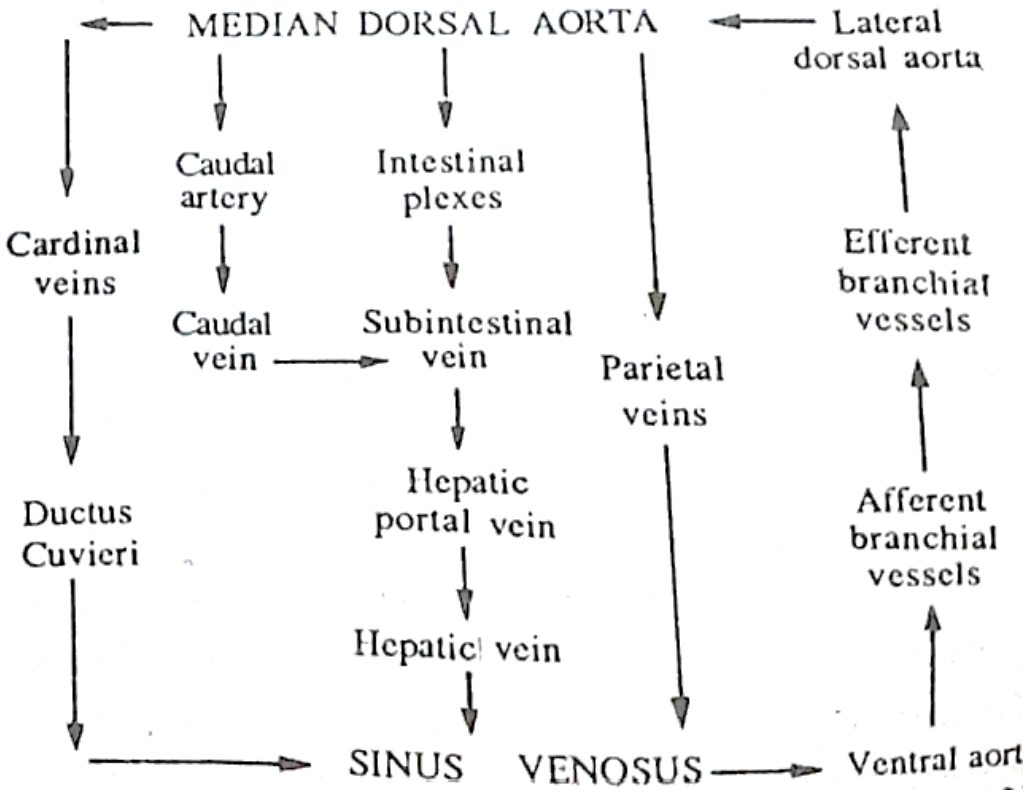


Fig. 6.21. *Branchiostoma*. Blood vascular system in right lateral view.



EXCRETORY SYSTEM :

Amphioxus, also known as lancelets or Branchiostoma, possesses a relatively simple excretory system that helps regulate water and ion balance in its body. Here is an overview of the excretory system of amphioxus:

1. Nephridia: Amphioxus has paired excretory organs called nephridia, which are responsible for osmoregulation and waste removal. The nephridia are segmentally arranged along the length of the body.

2. Nephrostomes: Each nephridium consists of a funnel-shaped opening called a nephrostome that collects coelomic fluid from the body cavity. The coelomic fluid contains waste products and excess ions.

3. Nephric Tubules: From the nephrostomes, the coelomic fluid enters the nephric tubules, which are long, coiled tubes that extend internally through the segments of the body.

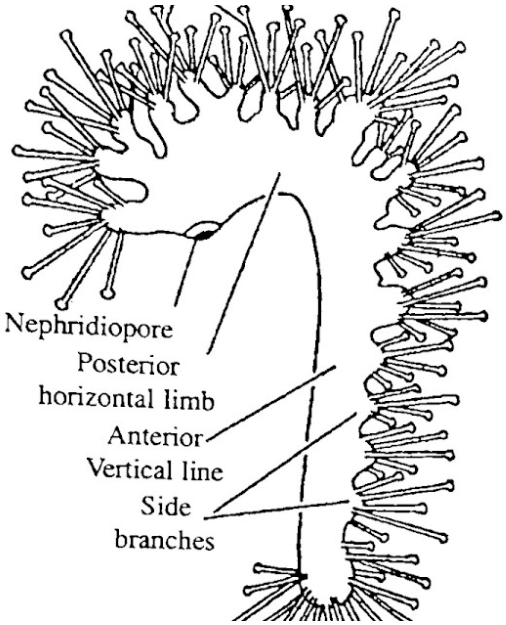
4. Filtration and Reabsorption: As the coelomic fluid passes through the nephric tubules, filtration occurs, removing waste products and excess ions from the fluid. Some reabsorption of valuable substances, such as nutrients and ions, may also take place in the tubules.

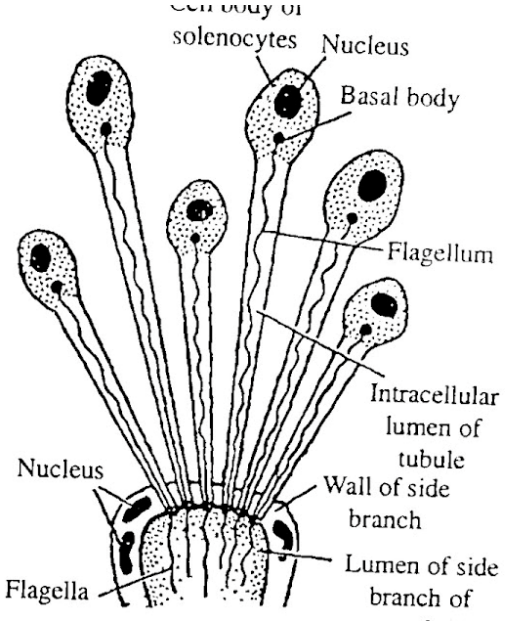
5. Bladder: At the posterior end of the body, the nephric tubules connect to a bladder-like structure, called the urinary bladder. The bladder stores the excreted fluid temporarily before it is expelled from the body.

6. Excretion: The excess waste products and ions, along with some water, are expelled from the bladder through a pore located near the anus. The expelled fluid is discharged into the surrounding water.

The excretory system of amphioxus is not as complex as that of more advanced vertebrates. It lacks specialized organs like kidneys found in vertebrates, but the nephridia perform basic excretory functions in maintaining water and ion balance. The relatively

simple excretory system of amphioxus is adapted to its marine environment and the low metabolic rate of this primitive chordate.





NOTE ON PROTONEPHRIDIA

Amphioxus, or lancelets, possess protonephridia as their excretory organs. Protonephridia are found in each segment of the body and play a crucial role in osmoregulation and waste elimination. They are composed of three main components:

Flame Cells: Flame cells, also known as solenocytes, are the functional units of the protonephridia. These specialized cells line the interior of the protonephridial tubules. Each flame cell consists of a tuft of cilia that project into the tubule lumen. The beating cilia create a flickering flame-like appearance, hence the name "flame cells."

Protonephridial Tubules: The flame cells are connected to a network of tubules that run along the length of the body segments. The tubules are lined with specialized cells that facilitate fluid movement and regulate solute transport.

Nephridiopores: At the external surface of the body, each segment possesses a small pore called a nephridiopore. The nephridiopores serve as the exit points for the fluid and waste products expelled from the protonephridia.

The protonephridia in amphioxus function in maintaining water and ion balance, as well as excreting metabolic waste products. Coelomic fluid, which contains waste products and excess ions, enters the protonephridial tubules through the flame cells' beating cilia. As the fluid passes through the tubules, reabsorption and secretion processes occur to regulate the composition of the excreted fluid.