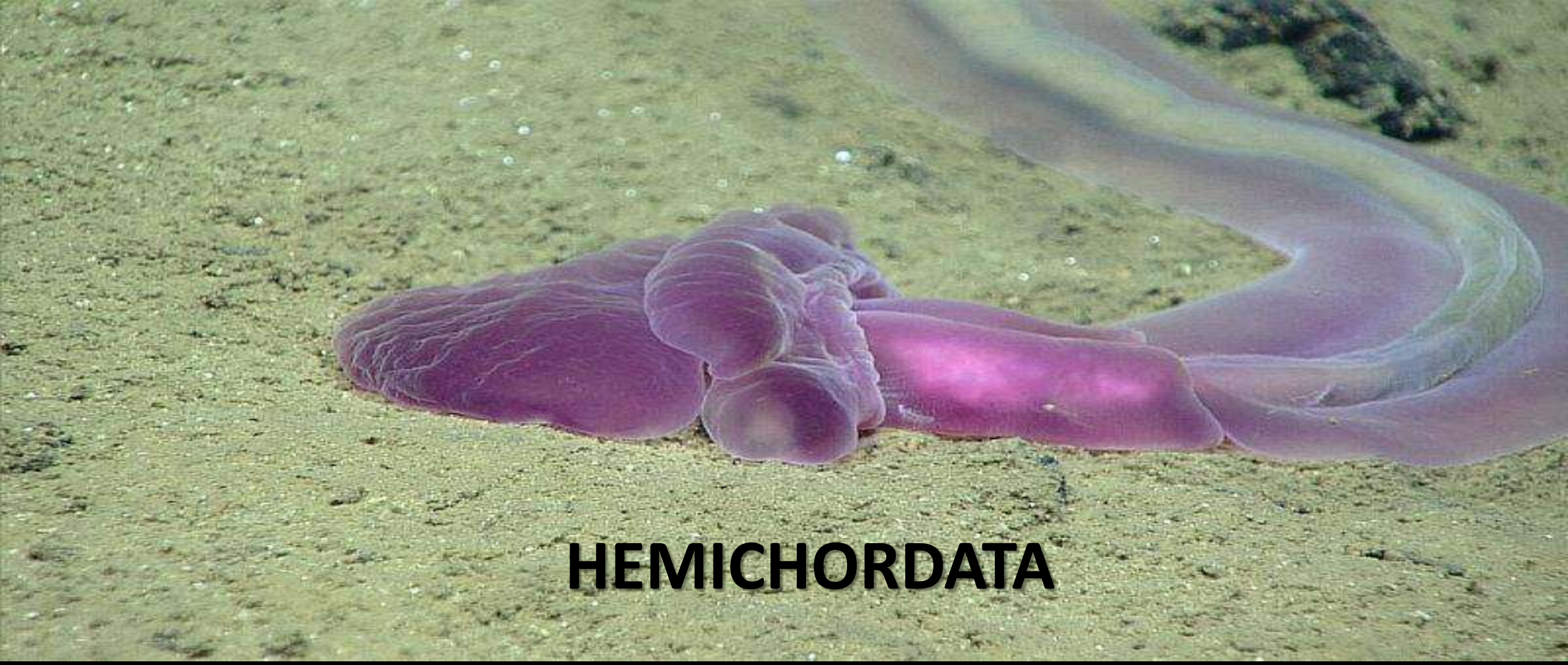


HEMICHORDATA

Dr. Najiya al-Arifa
Assistant Professor
Department of Zoology
Lahore College for Women University, Lahore

INTRODUCTION

- **Hemichordata** is a phylum of marine deuterostome animals
- Hemichordates share **common ancestor** with chordata and the rest of the deuterostomes
- Members of the phyla Hemichordata and Chordata are derived from a common **diploblastic or triploblastic ancestor**

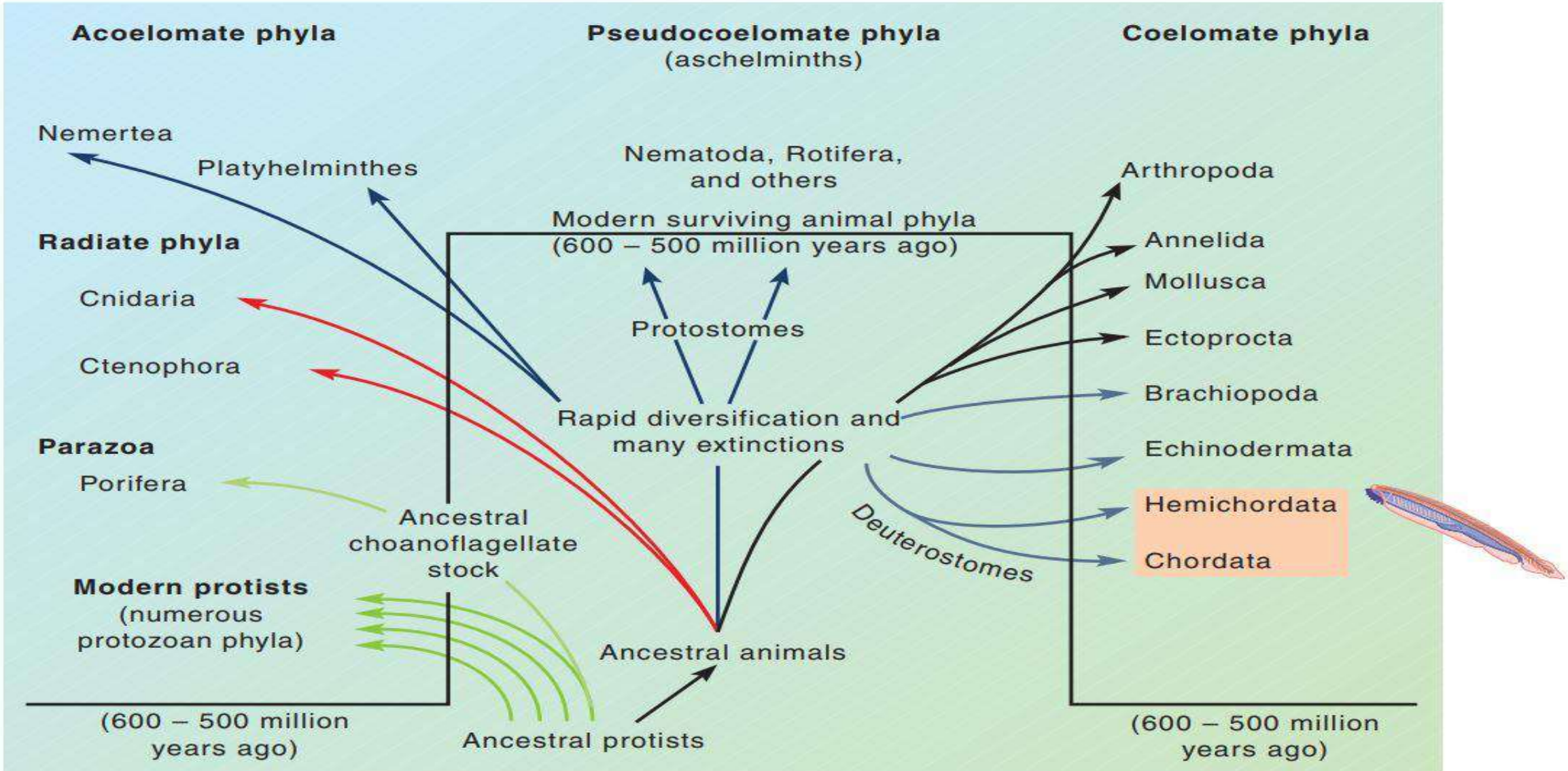


Figure 1: Phylogenetic Relationships among the Hemichordata and Chordata

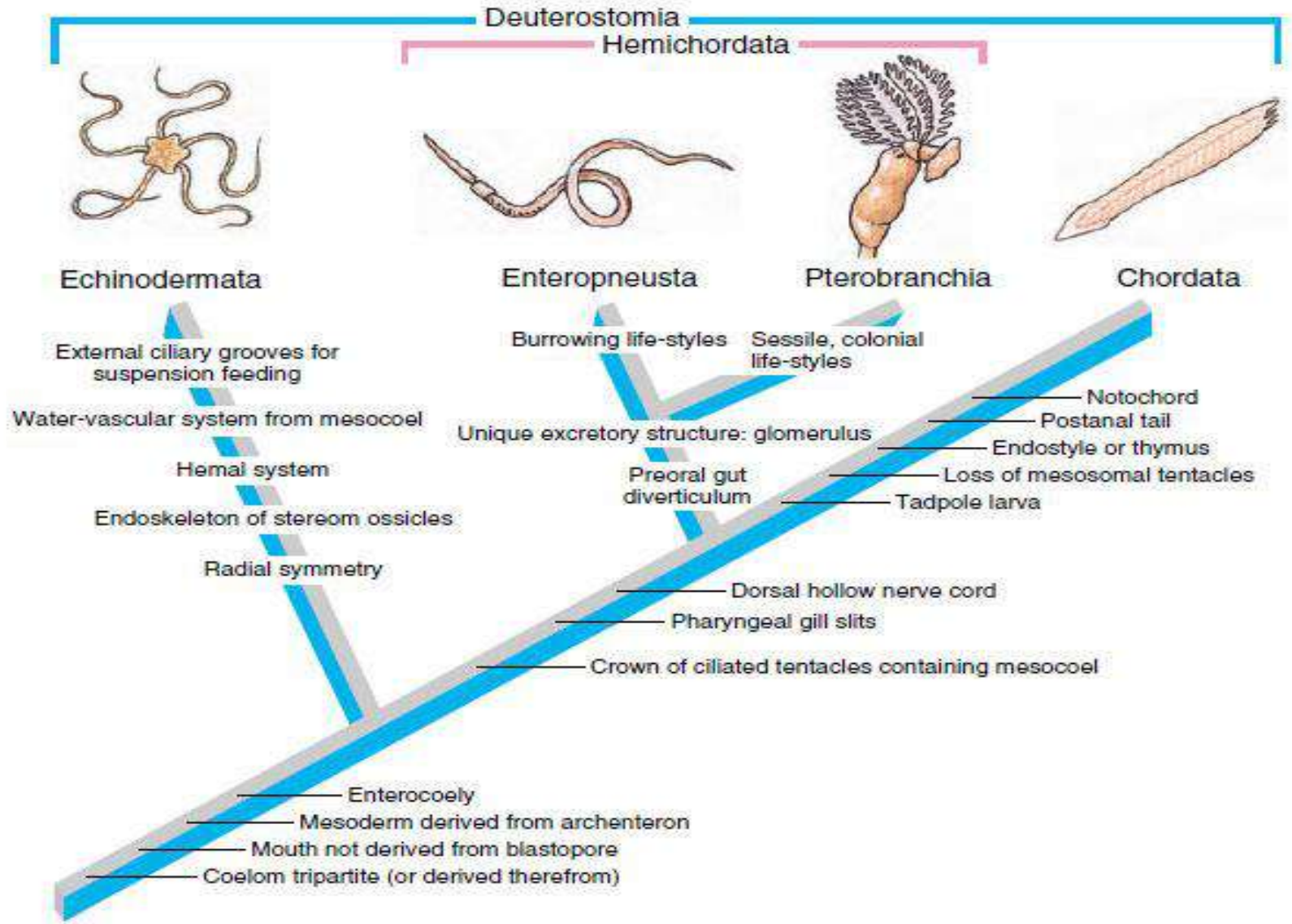


Figure 2: Cladogram showing hypothetical relationships among deuterostome phyla

HEMICHORDATA

- They appear in the Lower or Middle **Cambrian** period
- Hemichordates and chordates are distantly related deuterostomes derived from a common, as yet undiscovered, diploblastic or triploblastic ancestor
- It is represented by two classes
  - **Enteropneusta** (acorn worms)
  - **Pterobranchia**
- They live in or on marine substrates
- They feed on sediment or suspended organic matter

Figure 3: Cambrian Period is a period of time on the prehistoric timeline that runs from about 541 million years to about 485 million years ago

HEMICHORDATA

- Body is divided into three regions
  - **Proboscis**
  - **Collar**
  - **Trunk**
- Ciliated pharyngeal slits
- Open circulatory system
- Complete digestive system
- Dorsal, sometimes tubular nerve chord

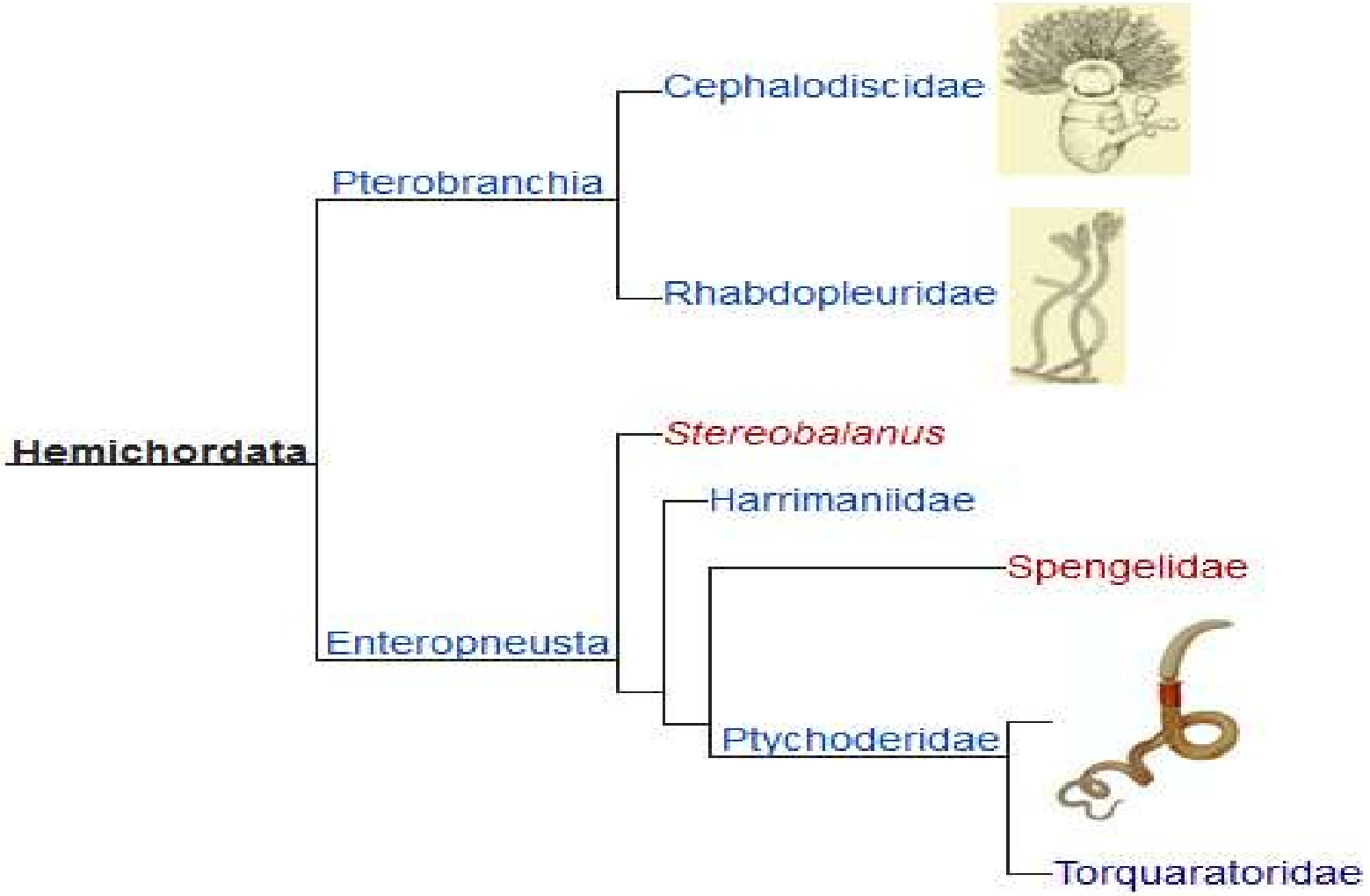


Figure 4: Phylogenetic relationship between hemichordates

CLASS ENTEROPNEUSTA

- **Acorn worms** are solitary worm-shaped organisms
- They generally live in burrows
- They are deposit feeders, but some species are pharyngeal filter feeders
- **Family Torquaratoridae** are free living detritivores. Many are well known for their production and accumulation of various halogenated phenols and pyrroles

Figure 5: Acorn Worm

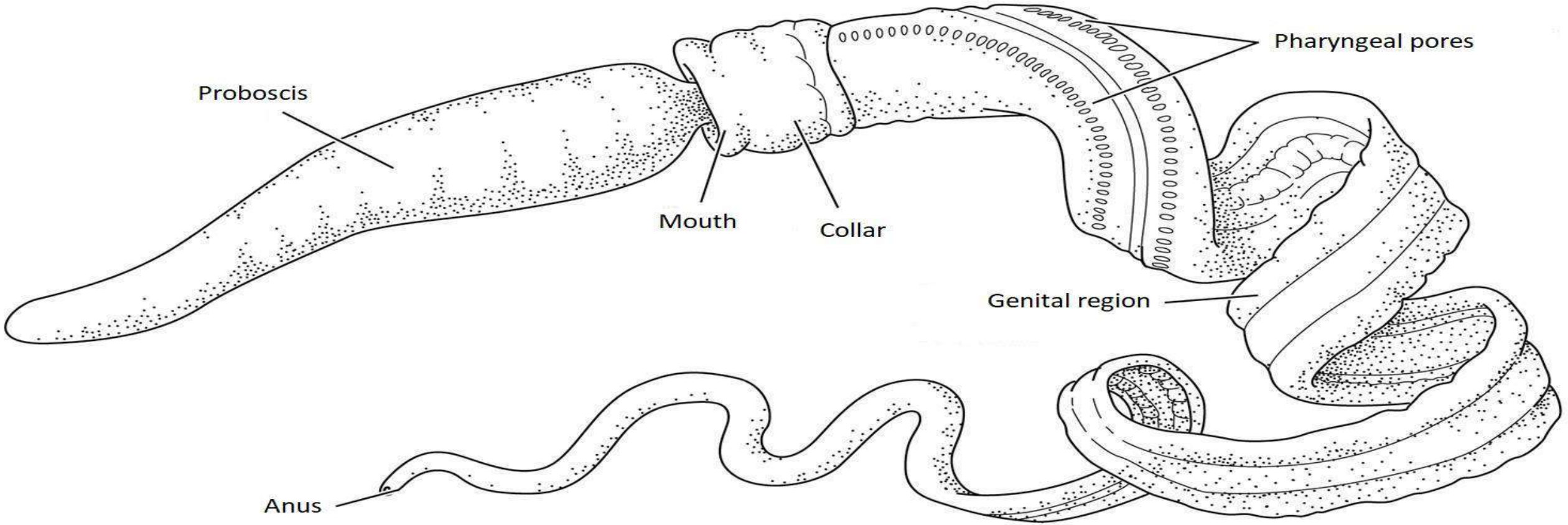


Figure 6: Acorn Worm

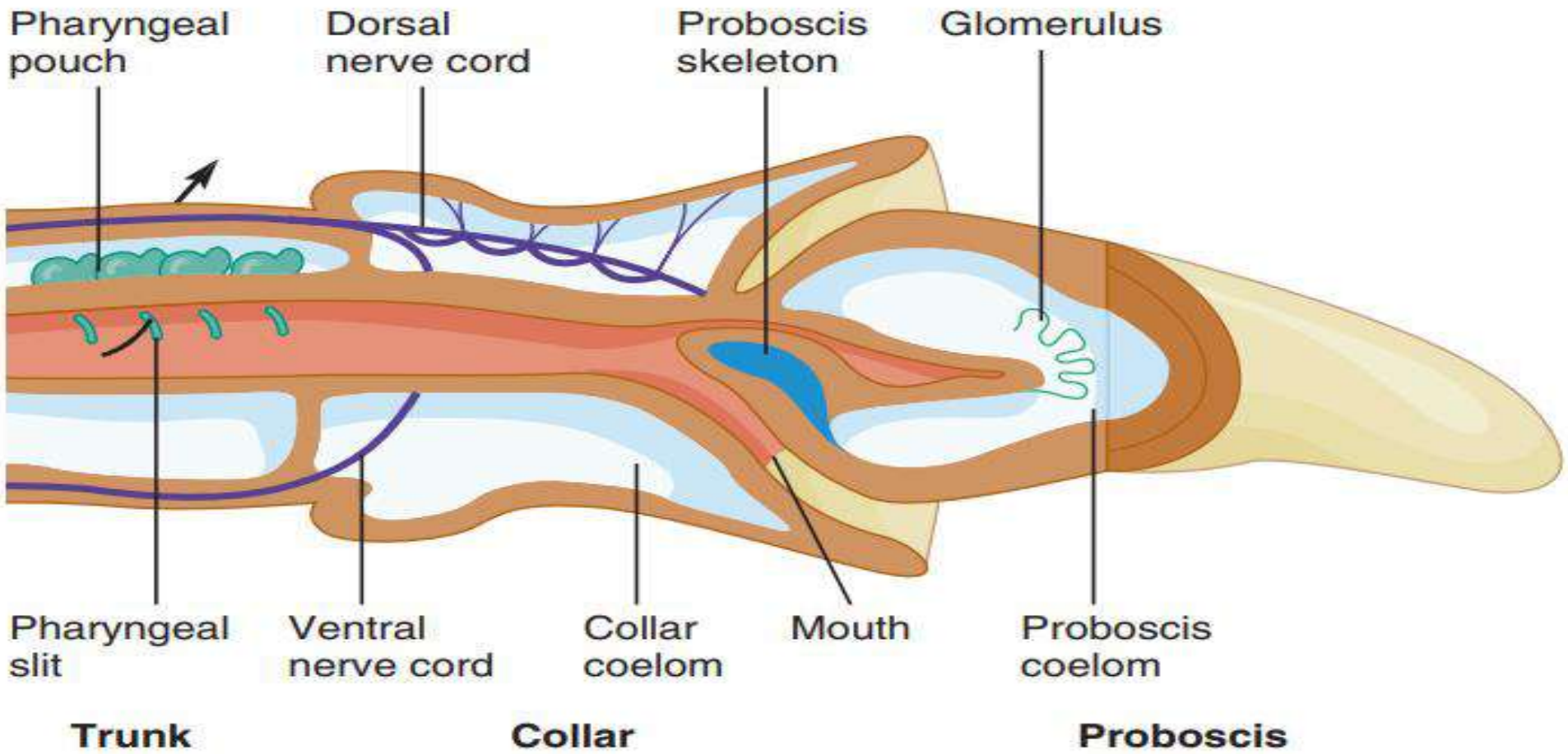


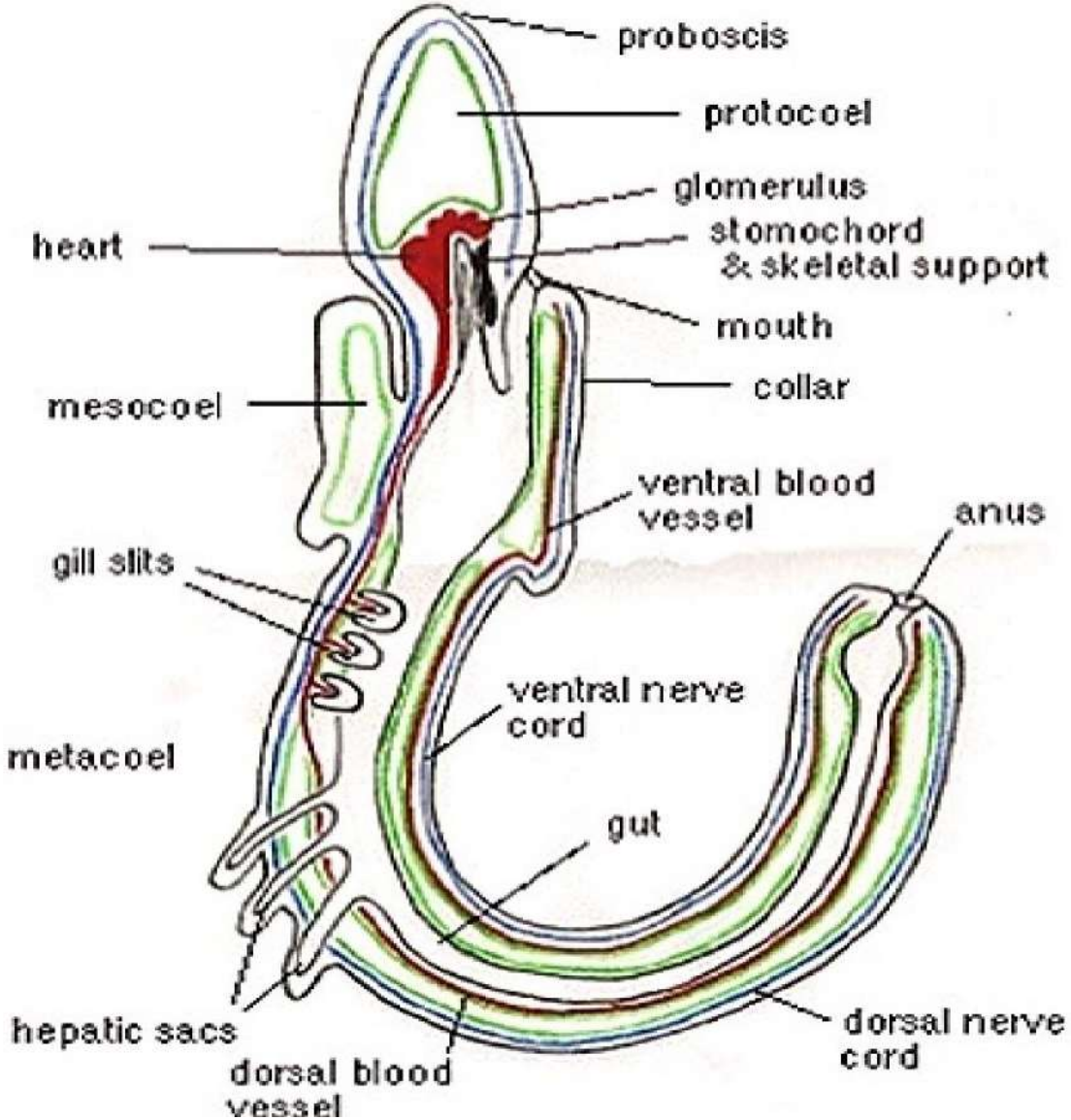
Figure 7: Class Enteropneusta. Longitudinal section showing the proboscis, collar, pharyngeal region, and internal structures. The black arrow shows the path of water through a pharyngeal slit

CHARACTERISTICS

1. Cilia and mucus
2. Digestive tract
3. Nervous system
4. Gas exchange
5. Circulatory system
6. Excretion and osmoregulation
7. Reproduction and development

1. CILIA AND MUCUS

- Cilia and mucus assist acorn worms in **feeding**
- Detritus and other particles adhere to the mucus-covered proboscis
- Tracts of **cilia transport food** and mucus, both posteriorly and ventrally
- Ciliary tracts converge near the mouth and form a **mucoid string** that enters the mouth
- Acorn worms may reject some substances trapped in the mucoid string by pulling the proboscis against the collar
- Ciliary tracts of the **collar and trunk** transport rejected material and discard it posteriorly



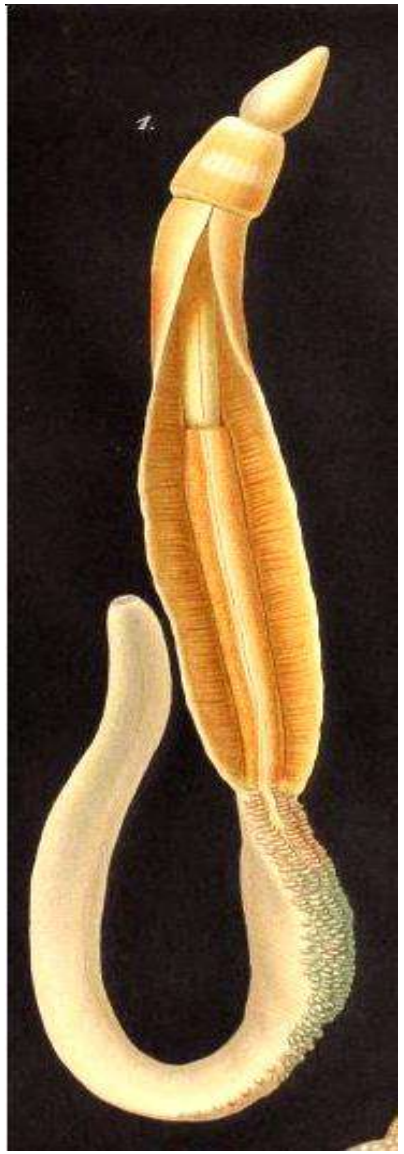


Figure 8: Acorn worm

2. DIGESTIVE TRACT

- The digestive tract of enteropneusts is a simple tube
- Food is digested as diverticula of the gut, called **hepatic sacs**, release enzymes
- The worm extends its posterior end out of the burrow during **defecation**

3. NERVOUS SYSTEM

- The nervous system of enteropneusts is ectodermal in origin and lies at the base of the ciliated epidermis
- It consists of dorsal and ventral nerve tracts and a network of epidermal nerve cells, called a **nerve plexus**
- In some species, the dorsal nerve is tubular and usually contains giant nerve fibers that rapidly transmit impulses
- There are no **major ganglia**. Sensory receptors are unspecialized and widely distributed over the body

4. GAS EXCHANGE

- Because acorn worms are small, respiratory gases and metabolic waste products (principally **ammonia**) probably are exchanged by diffusion across the body wall
- In addition, respiratory gases are exchanged at the **pharyngeal slits**
- Cilia associated with pharyngeal slits circulate water into the mouth and out of the body through the pharyngeal slits
- As water passes through the pharyngeal slits, gases are exchanged by diffusion between water and blood sinuses surrounding the pharynx

5. CIRCULATORY SYSTEM

- The circulatory system of acorn worms consists of one dorsal and one ventral **contractile vessel**
- Blood moves anteriorly in the dorsal vessel and posteriorly in the ventral vessel
- Branches from these vessels lead to **open sinuses**
- All blood flowing anteriorly passes into a series of blood sinuses, called the **glomerulus**, at the base of the proboscis
- Excretory wastes may be filtered through the glomerulus, into the **coelom of the proboscis**, and released to the outside through one or two pores in the wall of the proboscis
- The blood of acorn worms is **colorless**, lacks cellular elements, and distributes nutrients and wastes

6. EXCRETION AND OSMOREGULATION

- The worm extends its posterior end out of the burrow during **defecation**
- At low tide, coils of fecal material, called **castings**, lie on the substrate at burrow openings

Figure 9: Acorn worm on beach

Figure 10: Burrowing marine worms
buried under the sand with their castings on top

Hemichordata – Dr. Najiya al-Arifa

7. REPRODUCTION AND DEVELOPMENT

- Enteropneusts are **dioecious**
- Two rows of gonads lie in the body wall in the anterior region of the trunk, and each gonad opens separately to the outside
- Fertilization is **external**
- Spawning by one worm induces others in the area to spawn—behavior that suggests the presence of **spawning pheromones**
- Ciliated larvae, called **tornaria**, swim in the plankton for several days to a few weeks
- The larvae settle to the substrate and gradually transform into the adult form

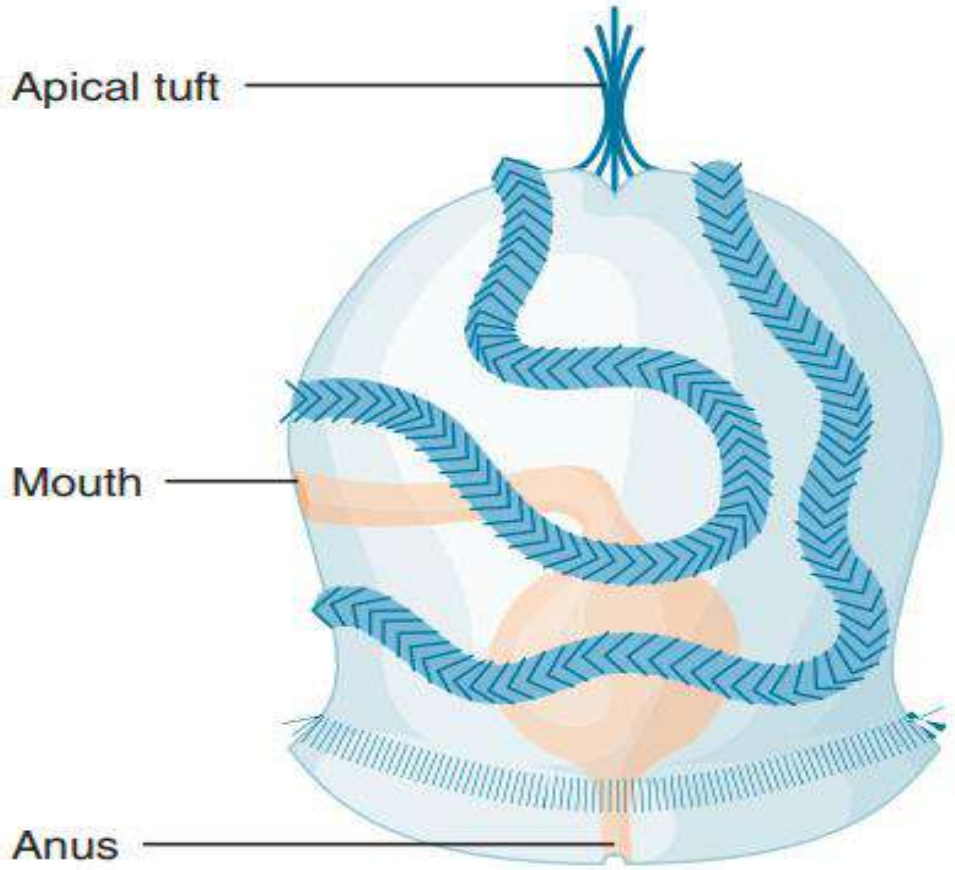


Figure 11: Tornaria Larva of an Enteropneust (Balanoglossus). When larval development is complete, a tornaria locates a suitable substrate, settles, and begins to burrow and elongate (1 mm)

CLASS PTEROBRANCHIA

- It is a small class of hemichordates found mostly in deep, oceanic waters of the Southern Hemisphere
- A few live in European coastal waters and in shallow waters near Bermuda
- Zoologists have described approximately 20 species of pterobranchs
- Pterobranchs are small, ranging in size from 0.1 to 5 mm
- Most live in secreted tubes in asexually produced colonies

Figure 12: Pterobranchia

CHARACTERISTICS

- Body is divided into 3 regions, as in enteropneusts
  - Proboscis
  - Collar
  - Trunk
- The proboscis is expanded and shield-like
- It secretes the tube and aids in movement in the tube
- The collar possesses two to nine arms with numerous ciliated tentacles
- The trunk is U-shaped

- Pterobranchs use water currents that cilia on their arms and tentacles generate to filter feed
- Cilia trap and transport food particles toward the mouth
- Although one genus has a single pair of pharyngeal slits, respiratory and excretory structures are unnecessary
- Gases and wastes exchange by diffusion since Pterobranchs are very small in size

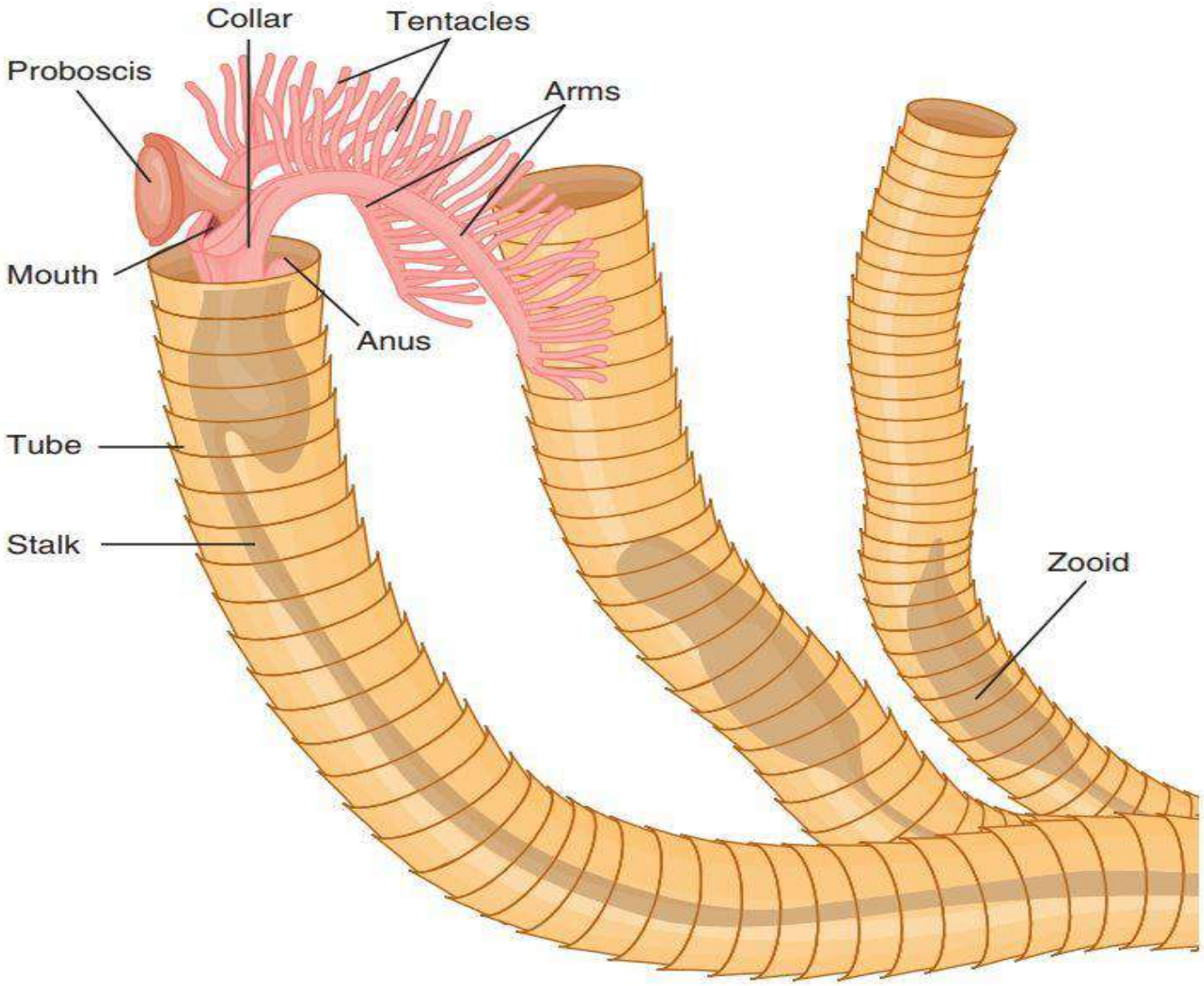


Figure 13: Eternal Structure of the Pterobranch, Rhabdopleura. Ciliated tracts on tentacles and arms direct food particles toward the mouth (5 mm)

REPRODUCTION AND DEVELOPMENT

- Asexual budding is common in pterobranchs and is responsible for colony formation
- Pterobranchs also possess one or two gonads in the anterior trunk
- Most species are dioecious, and external fertilization results in the development of a **planula-like** larva that lives for a time in the tube of the female
- This non-feeding larva eventually leaves the female's tube, settles to the substrate, forms a cocoon, and **metamorphoses** into an adult

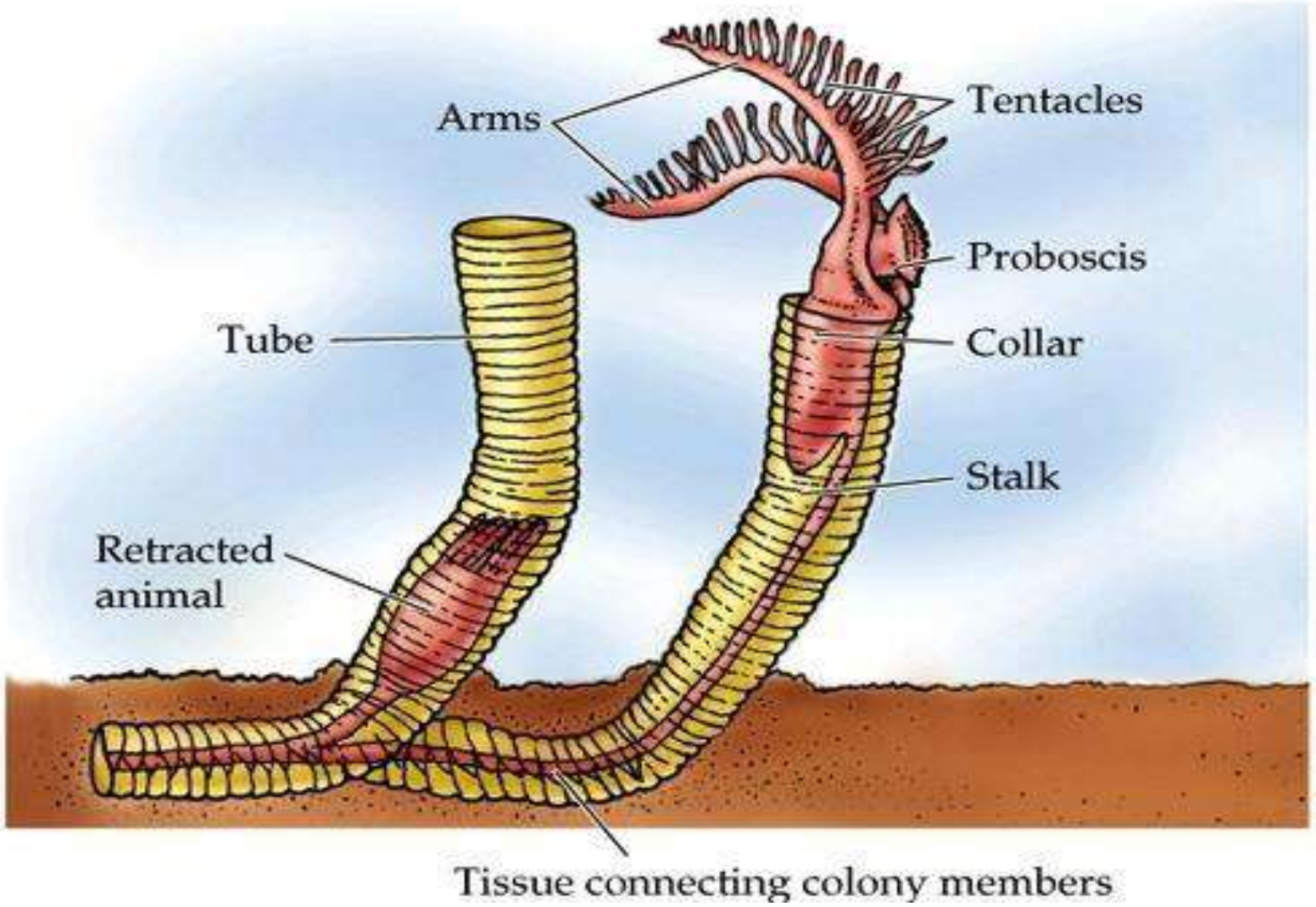


Figure 14: Pterobranchs colony formation

LINKS

- *Balanoglossus capensis* (Cape Acorn Worm) live and moving

https://youtu.be/tilD7AqjxhI

- E/V Nautilus: The Acorn Worm, In a Class of Its Own

https://youtu.be/4rexMwCRUjg

- Hemichordate Spawning

https://youtu.be/6_XiAFw3gPs

Thank you