

Paper 2.1 - Chordata

Unit- 1. Introduction

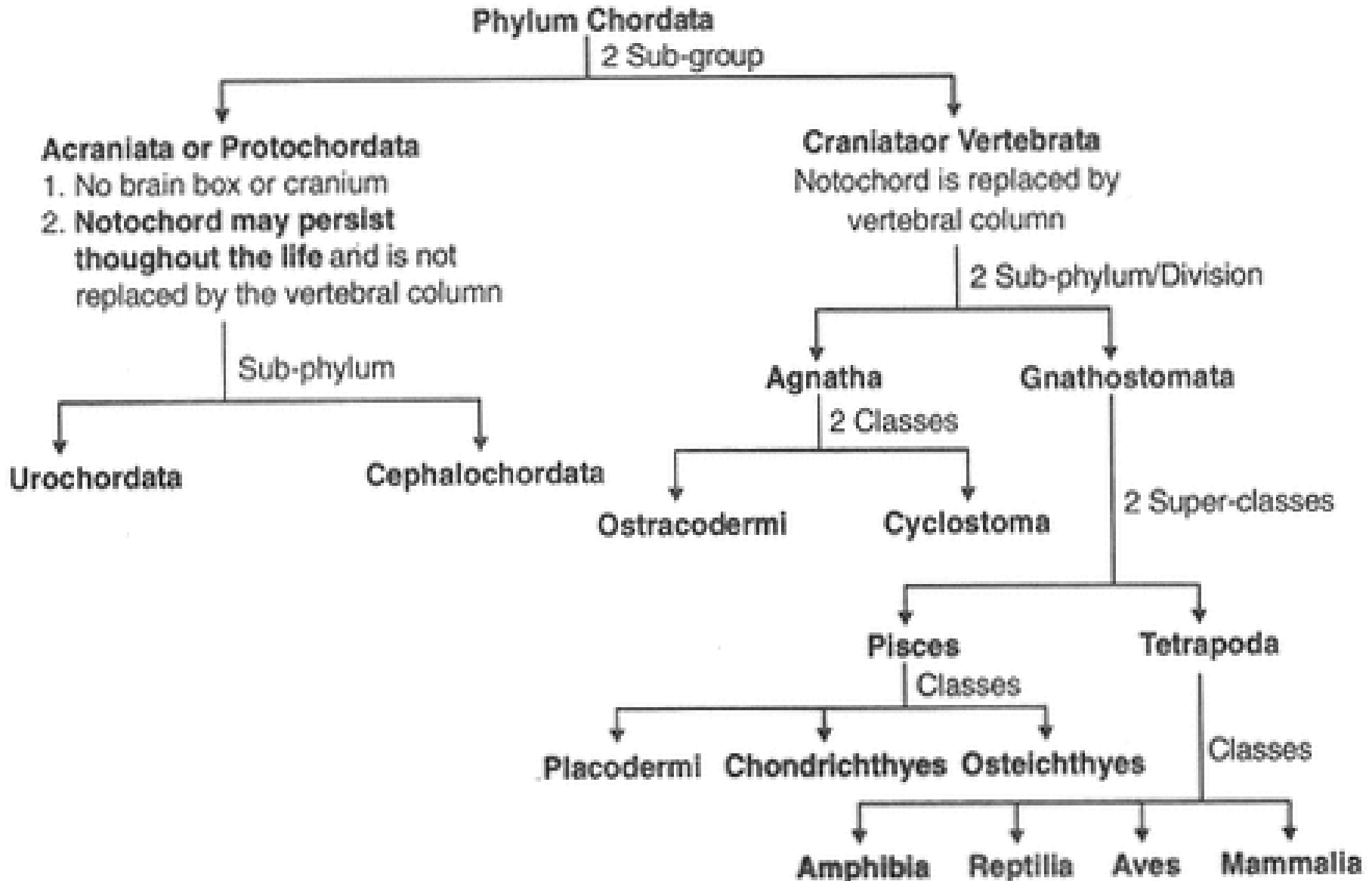
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- **Protochordates are an informal category of animals (i.e., not a proper taxonomic group), named mainly for convenience to describe invertebrate animals that are closely related to vertebrates.**
- **This group is composed of the Phylum Hemichordata and the Subphyla Urochordata and Cephalochordata.**



Classification of Chordata



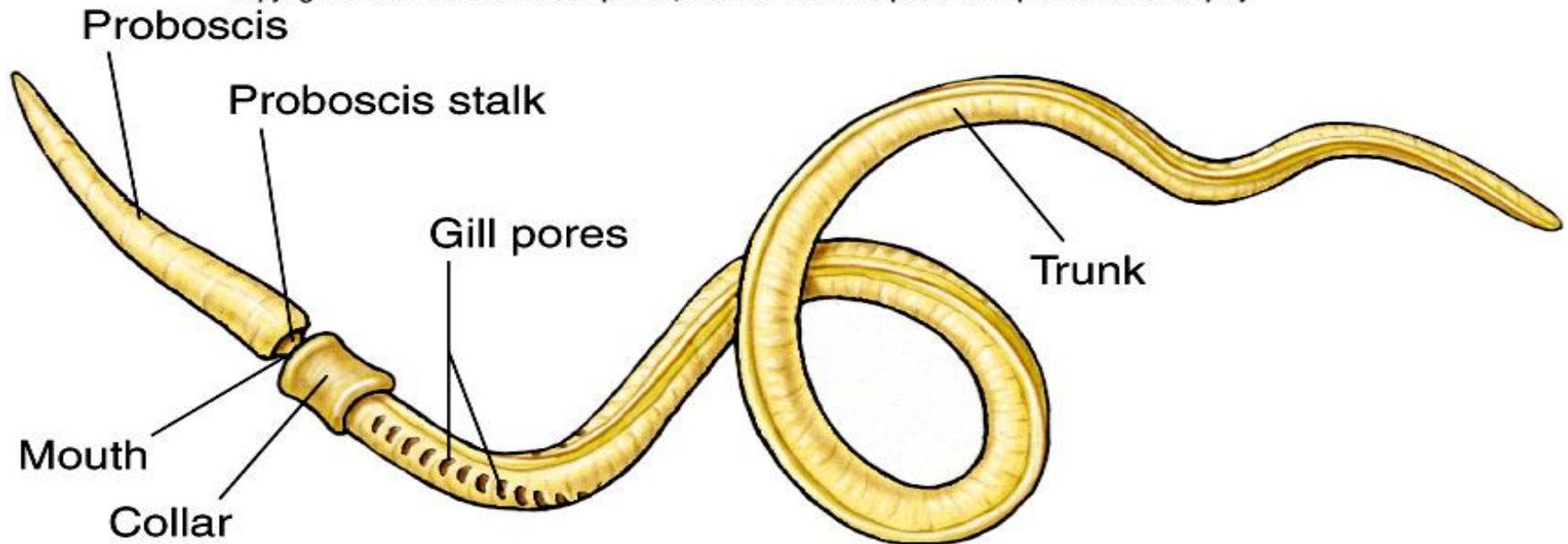
General Characteristics of Protochordata

- ❑ Elastic, solid, unsheathed rod-like structure of vacuolated turgid cells called notochord is present may be throughout the life or only during early embryonic development mentioned above.
- ❑ Their central nervous System is dorsal, hollow and single which is different from non-chordata as their CNS is ventral, solid and double.
- ❑ Paired pharyngeal gill slits(pharynx is perforated by gill slits) is present which takes part in circulation of water for respiration and in higher chordates, they occur only in embryonic stage.
- ❑ Ventral heart is present and gut lies ventral to nerve cord.
- ❑ Post-anal tail is present and if present then it's for balancing.
- ❑ They are bilaterally symmetrical, triploblastic, and coelomate with organ system level of organisation.
- ❑ Urochordata and cephalochordata which are acraniates are considered as primitive and often referred to as protochordates or non-vertebrate chordates.

Hemichordata

- The Phylum Hemichordata consists of marine worms that share some, but not all of the characteristics of chordates. These animals have pharyngeal gill slits and a dorsal nerve cord, which is usually solid.
- The three body parts are proboscis, collar and trunk. Acorn worms are examples of hemichordates.

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Hemichordata

General Characteristics

- Solitary and colonial, mostly tubicolous, exclusively marine.
- Body soft, fragile, vermiform and divisible into proboscis, collar and trunk.
- Body wall with a single-layered epidermis.
- Coelom enterocoelous, divisible into protocoel, mesocoel and metacoel.
- Buccal diverticulum, earlier considered as notochord, present in the proboscis.
- Digestive tract complete; in the form of straight or U-shaped tube.
- Gill-slits, when present, are paired and one to numerous.

Phylum Hemichordata (85 species)

Class Pterobranchia (Sea Angels)

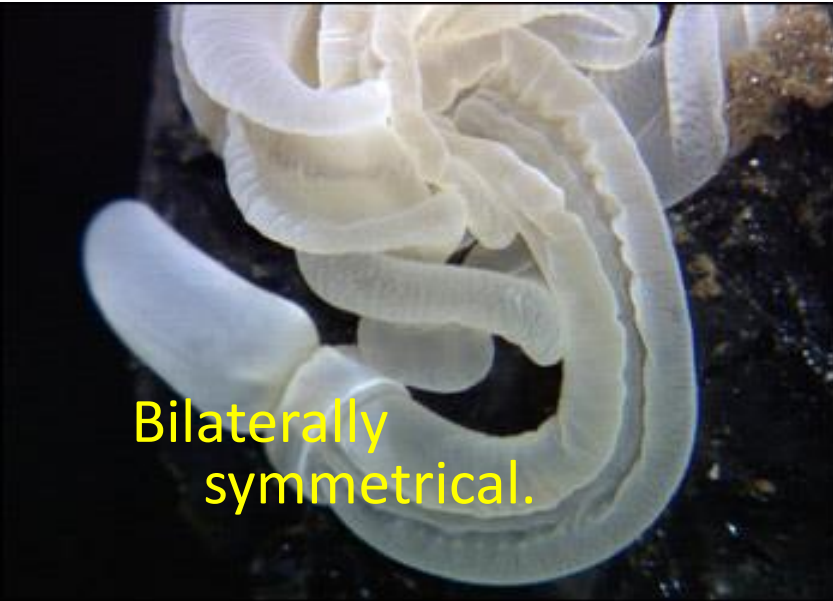
Class Enteropneusta (acorn worms)



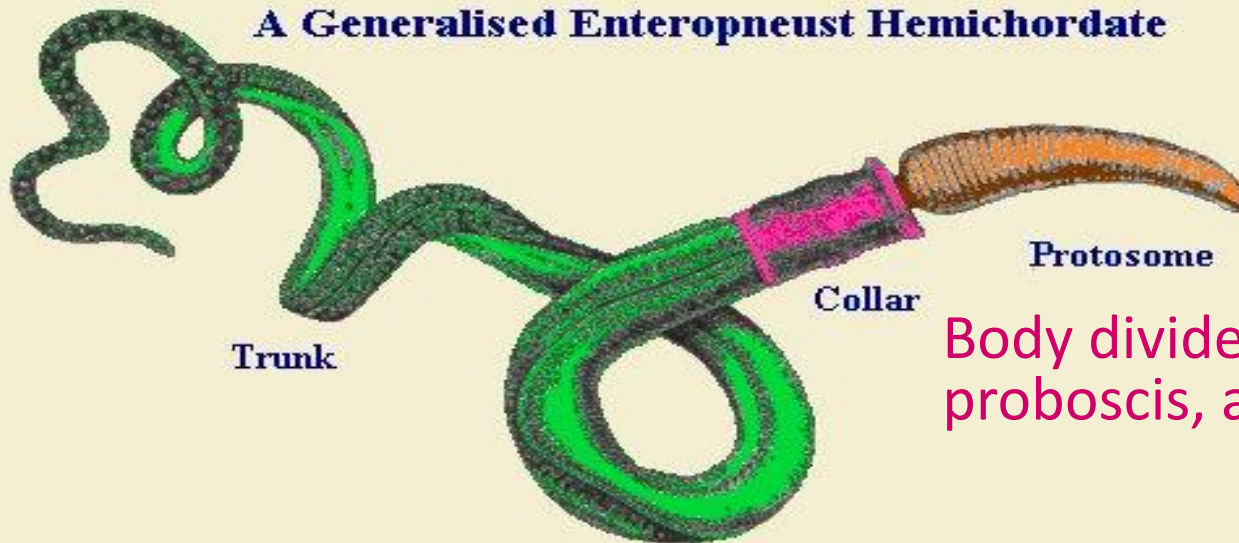
Small group of marine worms that show similarities to Echinoderms and Chordates

Phylum Hemichordata

Characteristics of Hemichordata:-



A Generalised Enteropneust Hemichordate



Body divided into three sections, a proboscis, a collar and a trunk.

2012 New Hemichordate Worm found

- Found about 1.5 miles (2.5 kilometers) beneath the surface of the Atlantic Ocean
- Has large lips on either side of its head region that reminded researchers of the floppy-eared Stars Wars character
- Full scientific name is *Yoda purpurata*, or "purple Yoda."



Southern Purple Enteropneust
Yoda purpurata n. gen, n. sp

Discovered a new type of acorn worm, scientists have. Named it after Yoda, they did.



Subphylum Urochordata

- Uro, tail and chorda, cord
- Class ascidians
 - Tunicates or sea squirts



General Characteristics

- ❑ Possesses a Notochord, a hollow nerve cord and a post anal tail.
- ❑ Body has more than two cell layers and includes tissues and organs.
- ❑ Has a U shaped gut.
- ❑ Body has no coelomic body cavity.
- ❑ Body wholly enclosed in a 'tunic' of secreted protein and cellulose-like material.
- ❑ Are hermaphroditic, normally with only one ovary and testis.
- ❑ Has a nervous system composed of an anterior ganglion from which individual nerves issue.

- ❑ Has no excretory organs.
- ❑ Has a distinct larval stage.
- ❑ All are filter feeders.
- ❑ Live in marine environments.
- ❑ About 2,000 species currently known.

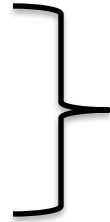


Three classes of Urochordates

-Ascidians

-Larvaceans

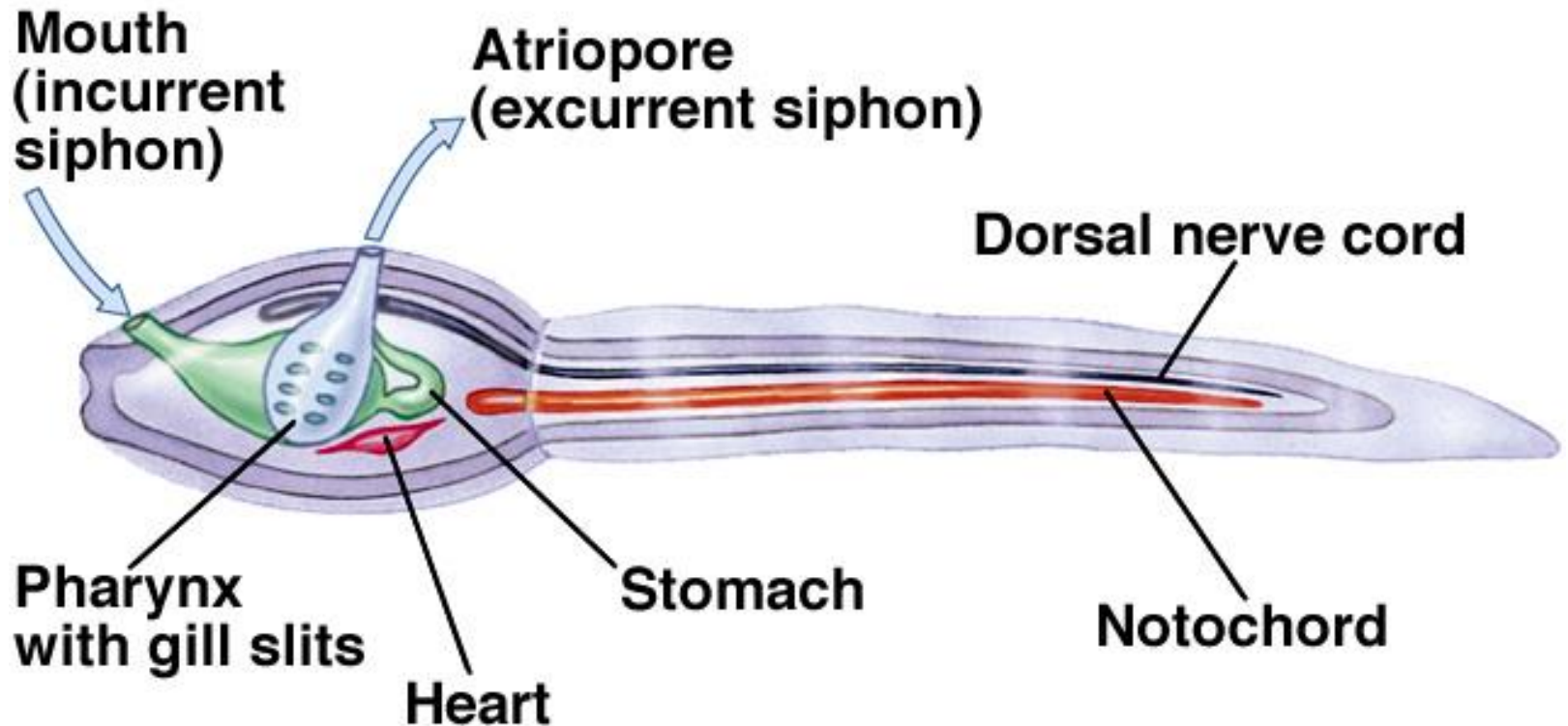
-Thaliaceans

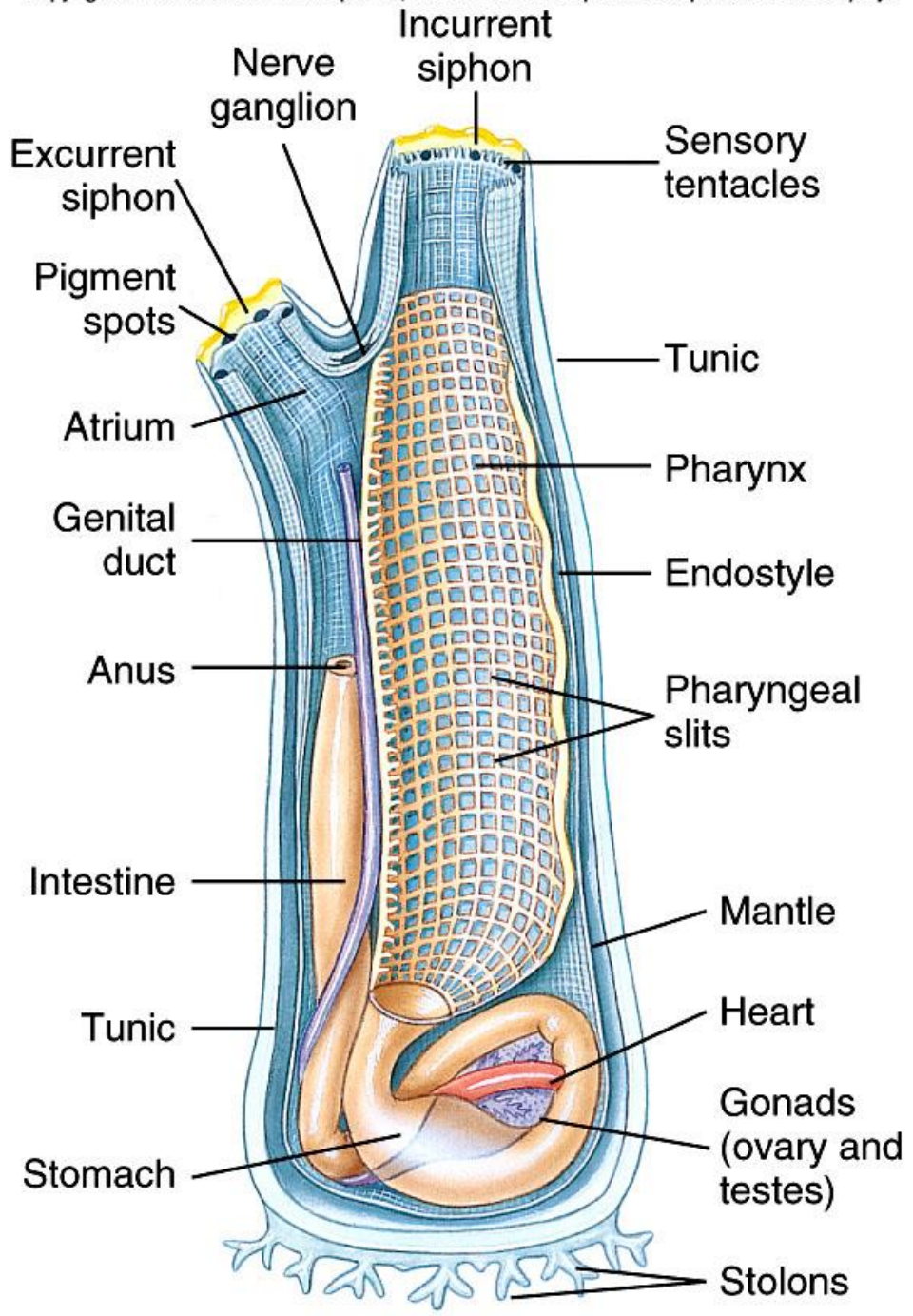


retain the larval form throughout life



Larval Tunicate





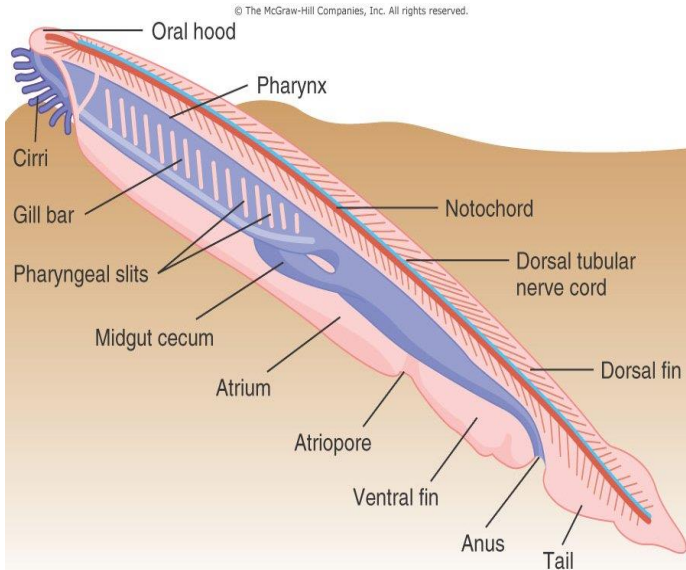
Cephalochordata

Cephalochordata includes two genera,

1. Asymmetron and 2. Branchiostoma (Amphioxus).

Cephalochordates are small fish like animals which show Chordate characters.

The notochord extends the entire length of the body. They show a dorsal, tubular neural tube without a definite brain.



General Characteristics

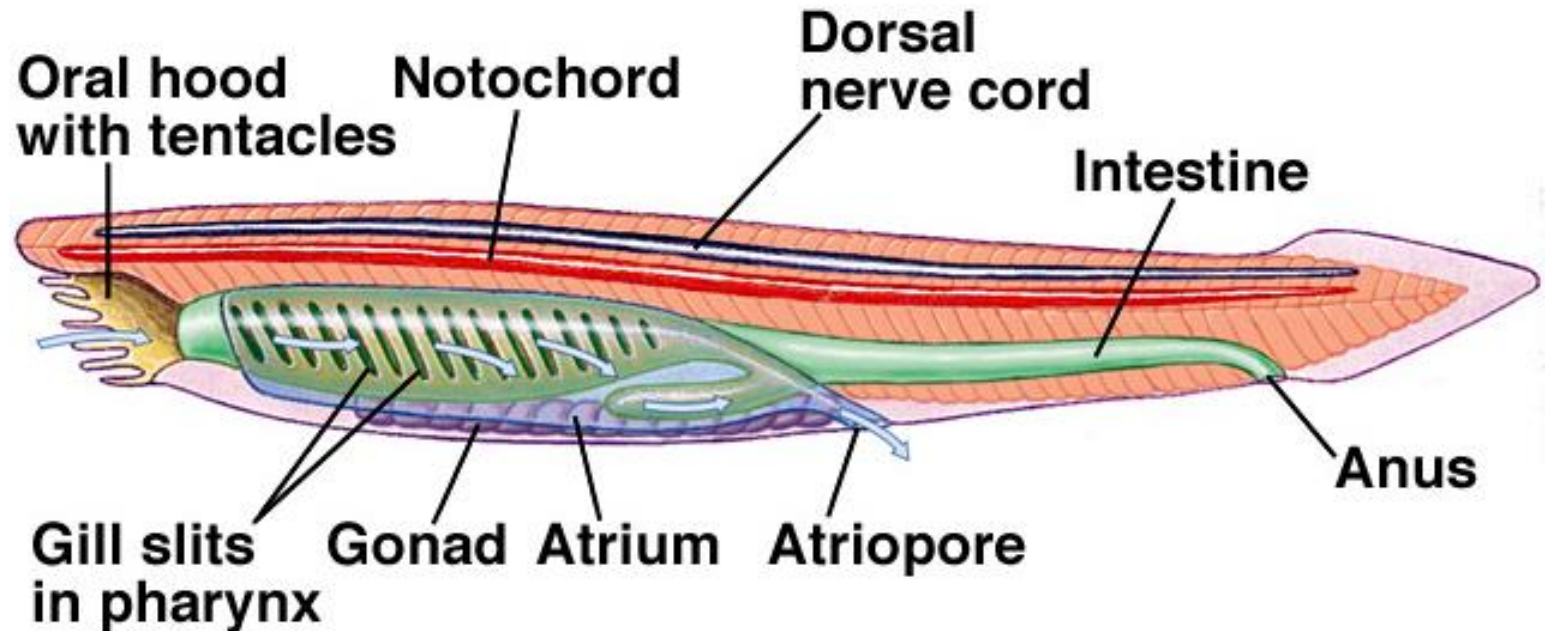
- Body is fish-like and is useful for burrowing and swimming.
- It has a head.
- It shows a tail.
- Appendages are absent.
- Dorsal, caudal and ventral fins are present.
- Body-wall shows one-cell thick, non-ciliated epidermis, dermis, connective tissue, striated muscle and parietal peritoneum.
- It has no exoskeleton.
- Notochord extends from the anterior end to posterior end.
- Enterocoelic coelom is present. However, reduced in the pharyngeal region by atrium.

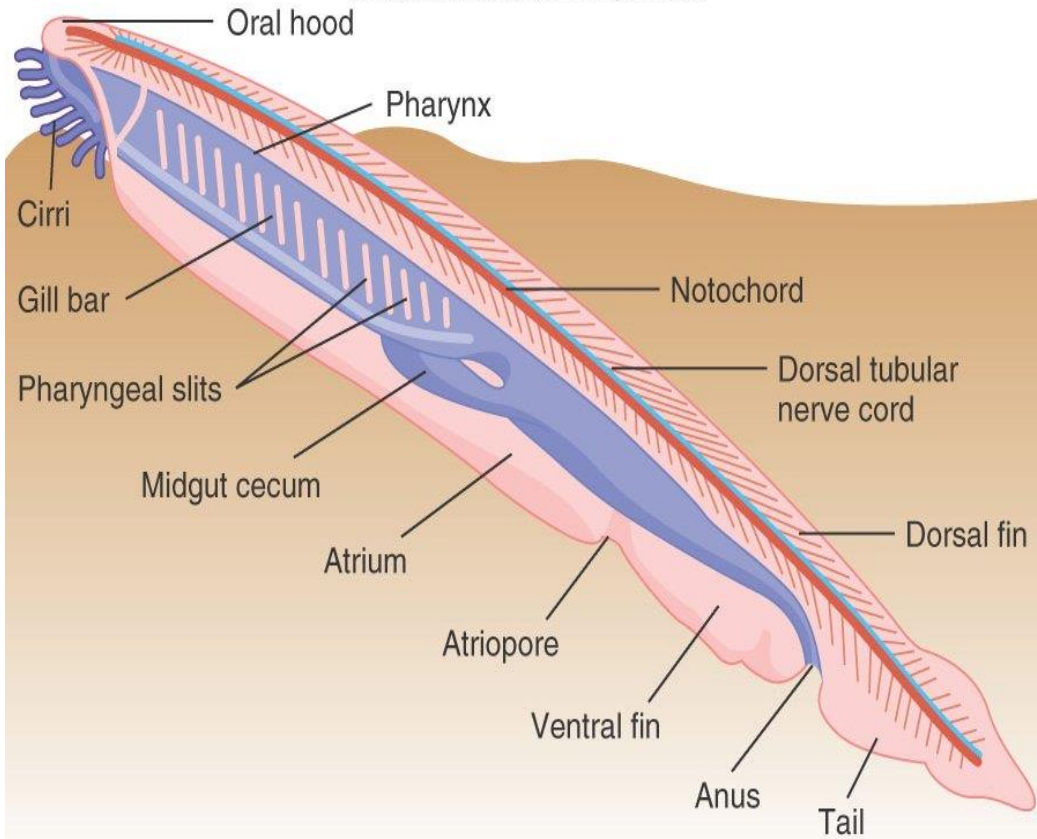
- Alimentary canal is long. It includes a large pharynx with many gill-slits ciliary mode of feeding is developed.
- Gills will perform respiration.
- Circulatory system is closed.
- Heart and respiratory pigments are absent.
- Hepatic portal system is present.
- Excretory system shows paired protonephridia with solenocytes.
- Brain is not present
- Two pairs of cerebral and several pairs of spinal nerves are present.

- ❑ Sexes are separate. Gonads are metamerically arranged and without gonoducts.
- ❑ Asexual reproduction will not take place.
- ❑ Fertilization is external.

Lancelet Structure

Amphioxus



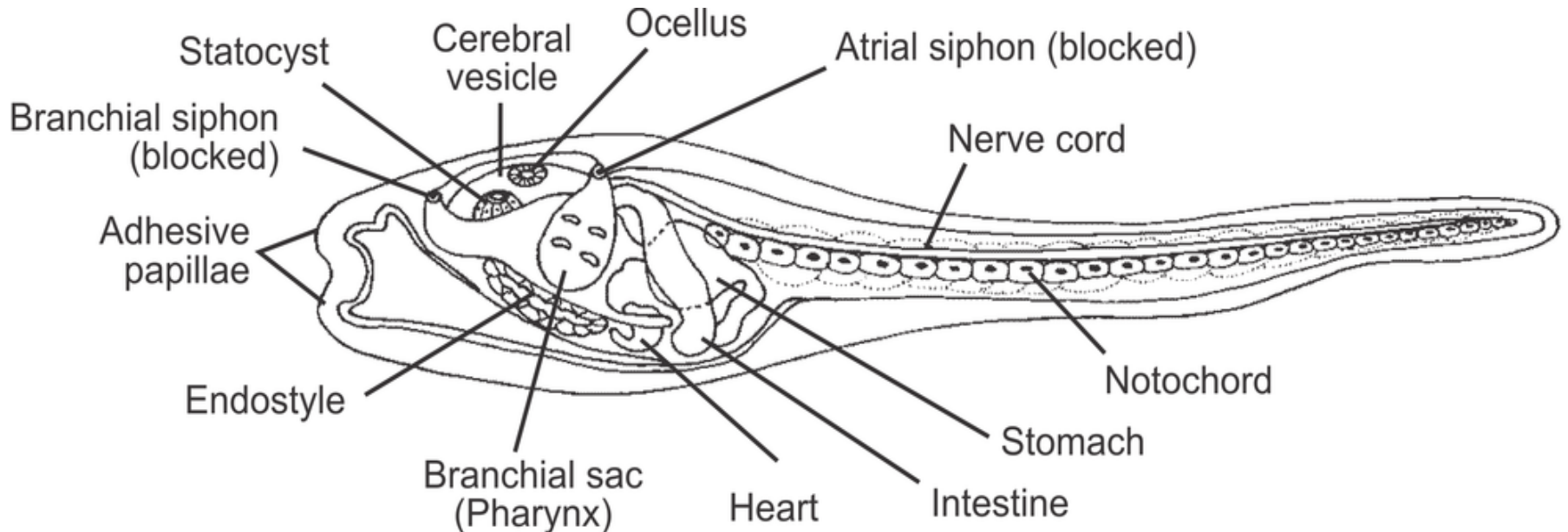


Retrogressive Metamorphosis in Herdmania

- Metamorphosis is a change from the juvenile to adult stage in which larval stage is quite different from the adult stage.
- In retrogressive metamorphosis the larva possesses advanced characters which are lost during the development and the adult is either sedentary or degenerated with primitive characters.
- Urochordate adults, being sedentary show degenerative characters while the free swimming tadpole larva shows advanced chordate characters which are lost during metamorphosis.
- Parasitic crustaceans, like *Sacculina* and copepod parasites and stylopids and scale insects (Insecta) also show retrogressive metamorphosis.

Ascidian Tadpole Larva

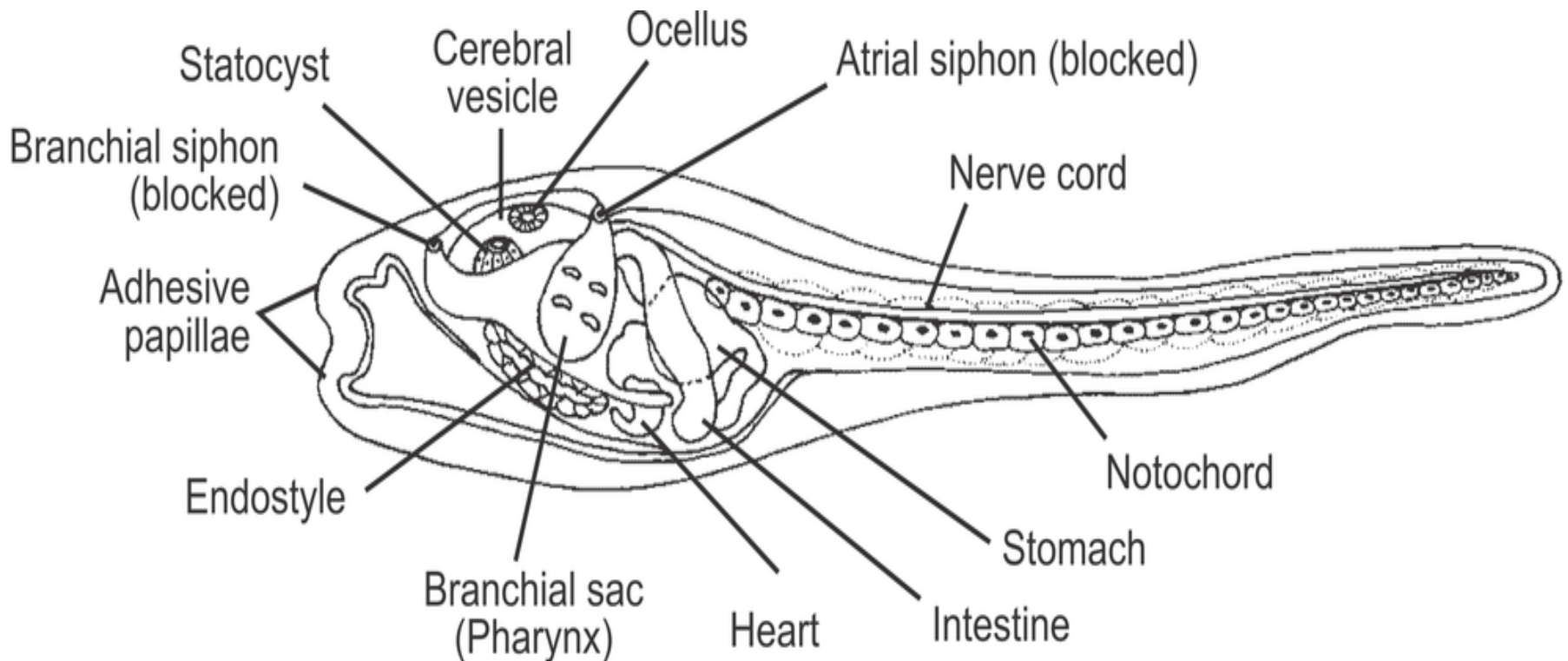
- The tadpole larva of *Herdmania* is only 1-2 mm long when it hatches out of the egg.
- It does not feed and hence has only 3 hours of survival during which it has to swim about in search of a suitable substratum for attachment.
- The larva needs advanced features for its free swimming existence, which is so necessary for dispersal of the population to distant places which the sedentary adult has no means to do.



The advanced chordate characters of the larva:

- There is a rod-like notochord in the tail to which are attached muscle bands for swimming.
- There is a dorsal hollow nerve cord which is enlarged to form brain at the anterior end. A photoreceptor ocellus and a balancing organ, the statocyst are attached to the brain.
- There are only two pairs of gill slits in pharynx but the mouth is closed by a membrane and intestine is rudimentary.
- Endostyle on the ventral side of pharynx is very well developed which functions like thyroid gland and helps in metamorphosis.

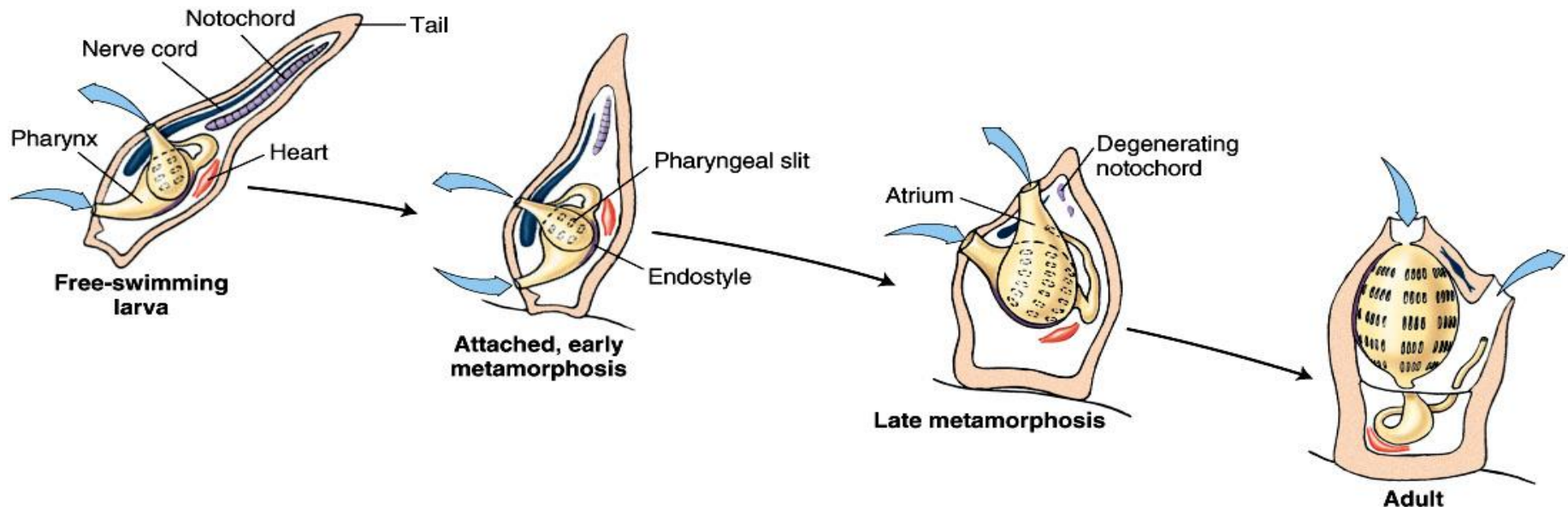
- Heart is on the ventral side of gut but is non-functional.
- The larva possesses three ectodermal adhesive papillae on the anterior end which help in firm attachment on the substratum.



Changes in larva during metamorphosis:

- Larva attaches to the substratum with the help of chin warts, head downward and tail up.
- Rapid growth takes place between the chin warts (adhesive papillae) and mouth and almost no growth on the opposite side of body.
- Sense organs, namely ocellus and statocyst are lost.

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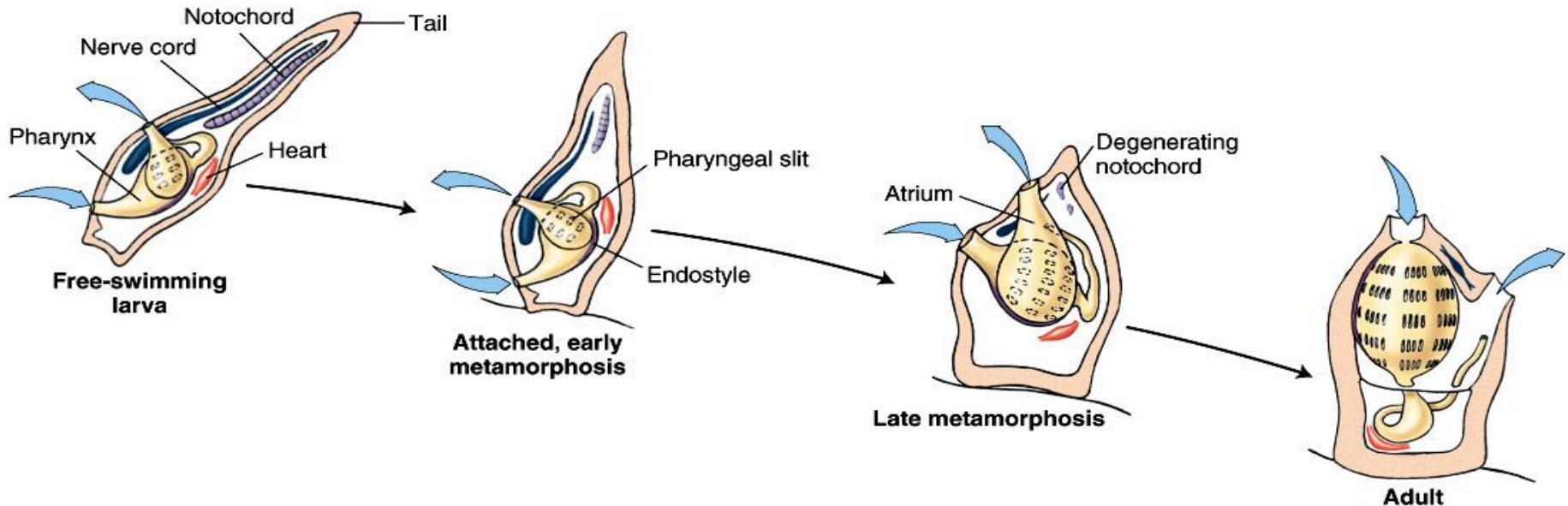


- **Due to rapid growth on one side, body starts rotating in such a way that mouth gradually migrates to the upper side.**
- **Meanwhile pharynx enlarges and stigmata increase in number. Intestine becomes functional and atrial opening is formed on the opposite side of oral aperture.**
- **Both tail and notochord are gradually absorbed in the body during metamorphosis.**
- **The hollow nerve cord is reduced into a solid nerve ganglion on the dorsal side.**

When the metamorphosis is over, *Herdmania* is transformed into a bag-like sedentary animal attached to the rock by a foot and having branchial and atrial openings for inlet and outlet of water respectively.

Pharynx becomes enormously enlarged with a large number of stigmata for filter feeding and digestive system becomes well developed. However, other advanced chordate characters of the larva are degenerated into simple structures, due to which it is called retrogressive metamorphosis.

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Larval Tunicate

