

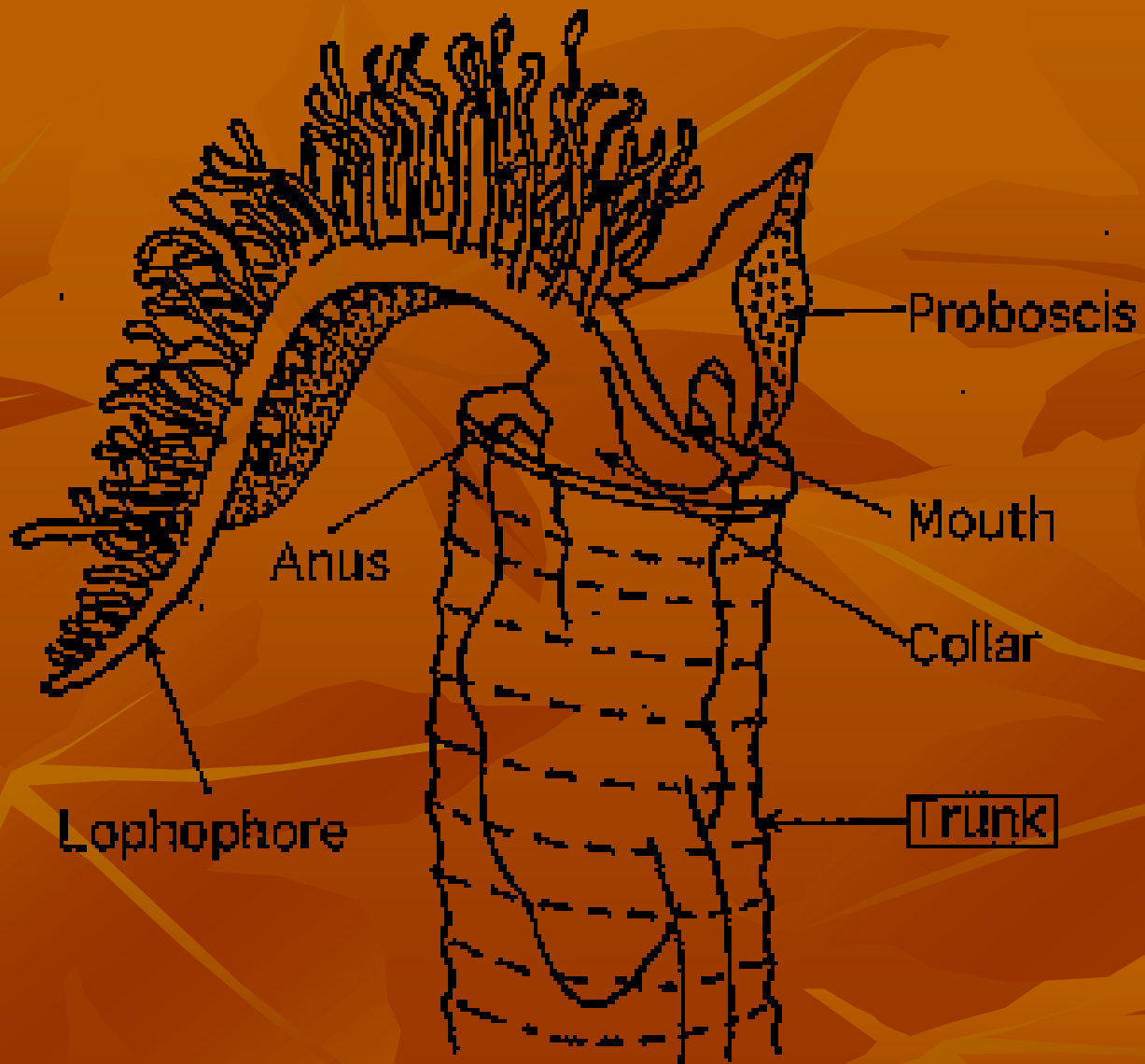
CHARACTERISTICS OF CHORDATES

- **A.** Notochord, or a rod of vacuolated cells, encased by a firm sheath that lies ventral to the neural tube in vertebrate embryos and some adults.
- **B.** Hollow nerve cord that lies dorsal to the notochord
- **C.** Pharyngeal pouches
- **D.** Endostyle - elongated groove in the pharynx floor of protochordates that may develop as the thyroid gland in chordates

In the subphylum Vertebrata, all members possess the four chordate characteristics at some time in development, but often these structures are altered significantly in adult animals.

These four characteristics may be found in some of the ancestors of chordates and are commonly placed in an informal grouping called Protochordates. These serve as living representations of the missing fossils in vertebrate evolution.

- **PROTOCHORDATES**
- **A. Phylum: Hemichordata**
- **Characteristics:**
 1. **Pharyngeal clefts usually present**
 2. **Dorsal nerve cord**
- **Similarities with invertebrates exclusive of chordates include:**
 1. **Ventral nerve cord, solid.**
 2. **No notochord; stomochord present.**
 3. **Free-swimming larva--tornaria.**



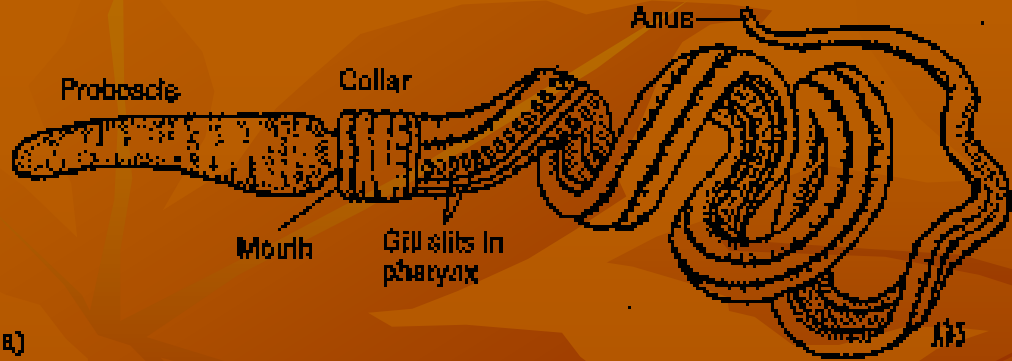
■ • Pterobranchia (pterobranchs).

- Mostly sessile, stalked, colonial
- Gather food by muco-ciliary arms (lophophores).
- Few or no pharyngeal slits.

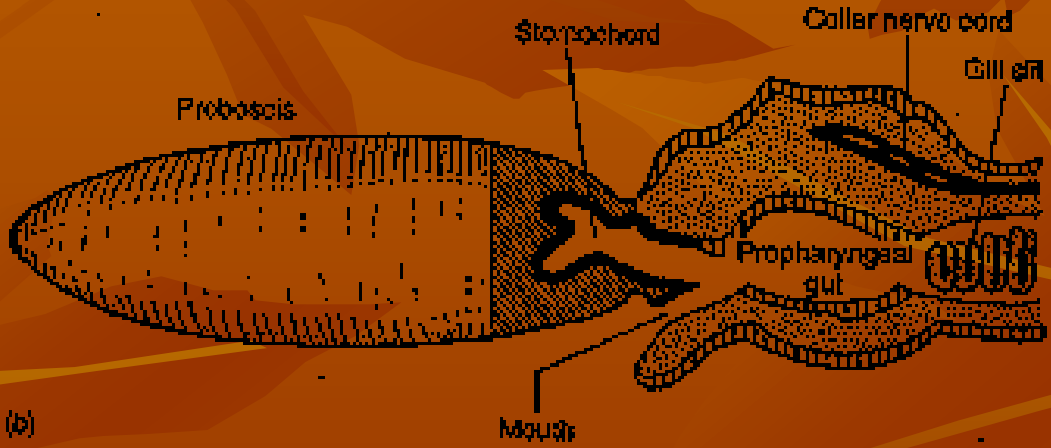
2. Class: Enteropneusta (Acorn Worms).

- **Mostly free-swimming, sedentary, burrowing.**
 - **Proboscis, mouth at anterior end of collar leads into pharynx, pharyngeal slits present.**
 - **Gather food by muco-ciliary proboscis.**
 - **Dorsal hollow nerve cord only in collar**

- *Balanoglossus* has some characteristics in common with chordates, such as gill slits and a dorsal nerve cord; however, this species also has a ventral nerve cord, and the nerve cords in general are not hollow like most chordates, but instead are solid. This particular species has a worldwide distribution, lives in shallow sea water, and can range between a few centimeters to up to two meters (6' 6" !!).



(a)



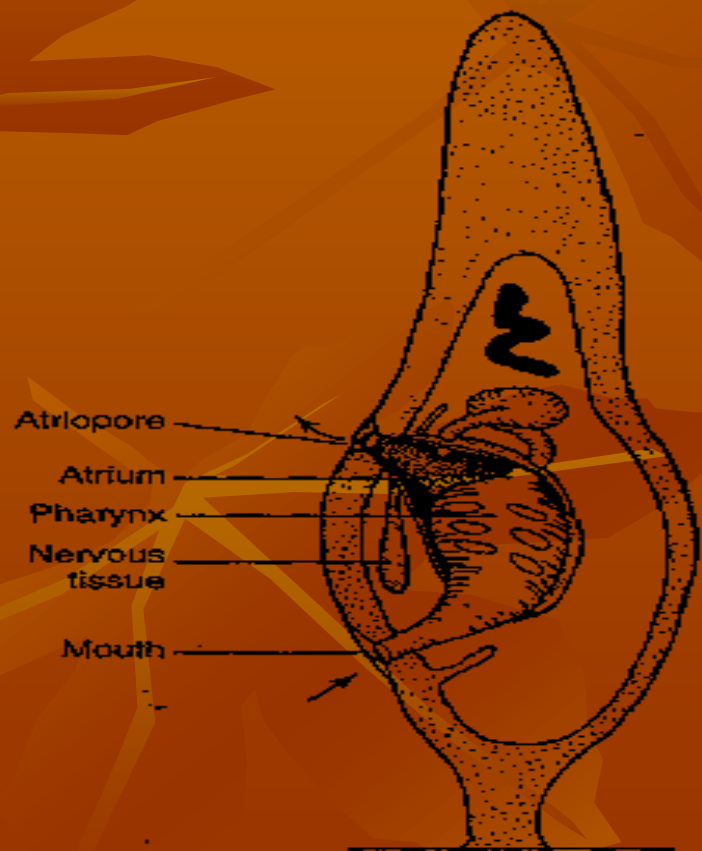
(b)

- **B. Urochordata (Tunicata)**
- • **About 2000 species.**
- **Usually have notochord during early development (confined to tail--strengthens tail for locomotion); not retained in ascidians.**
- **Heart pumps blood in one direction for a time and then reverses the pump in the other direction.**
- **No head, tail, or metamerism in adults that metamorphose.**
- **Cellulose-like tunic.**

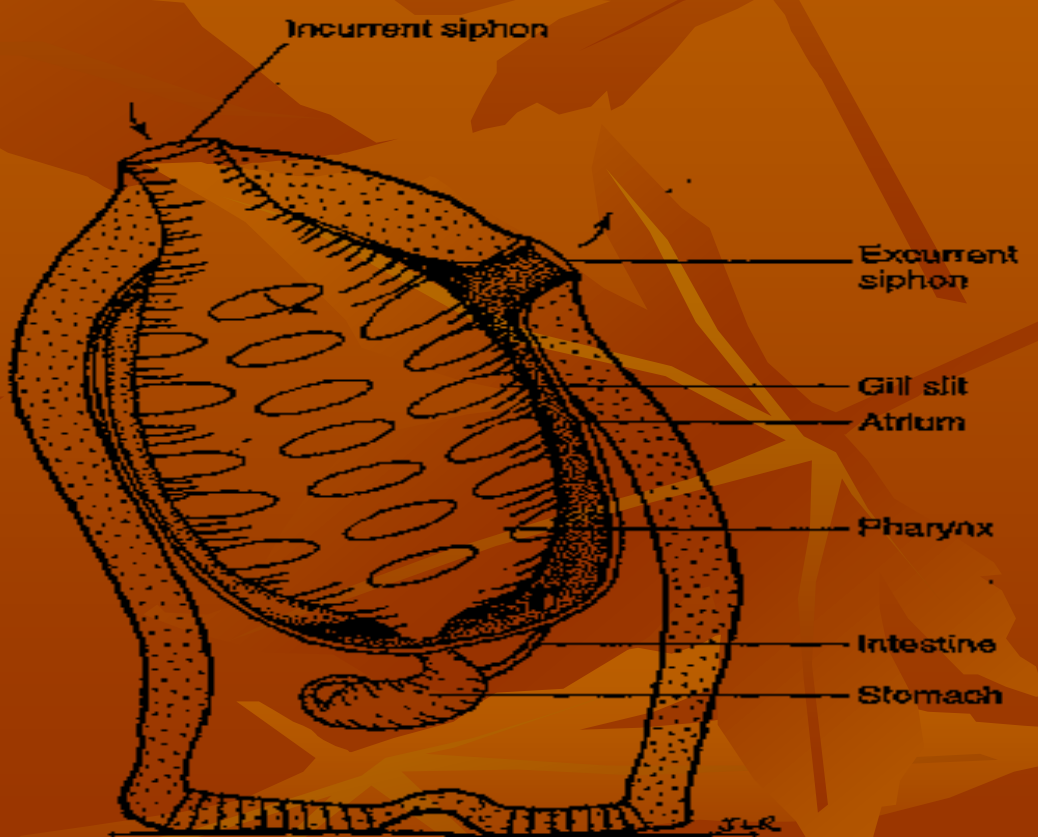
- Major groups (3):
- 1. Ascidiacea (sea squirts).
 - a. Larvae.
 - Have notochord and dorsally located nerve cord.
 - Food and respiratory water enters through incurrent siphon and then passes on to pharynx.
 - Pharynx and atrium begin to develop in the larva.
 - b. Adults.
 - At metamorphosis the larva attaches to substrate by adhesive suckers located at its anterior end and tail is resorbed.
 - Notochord disappears.
 - Rearrangement of internal organs.
 - No special sense organs.



(a) Free-swimming larva



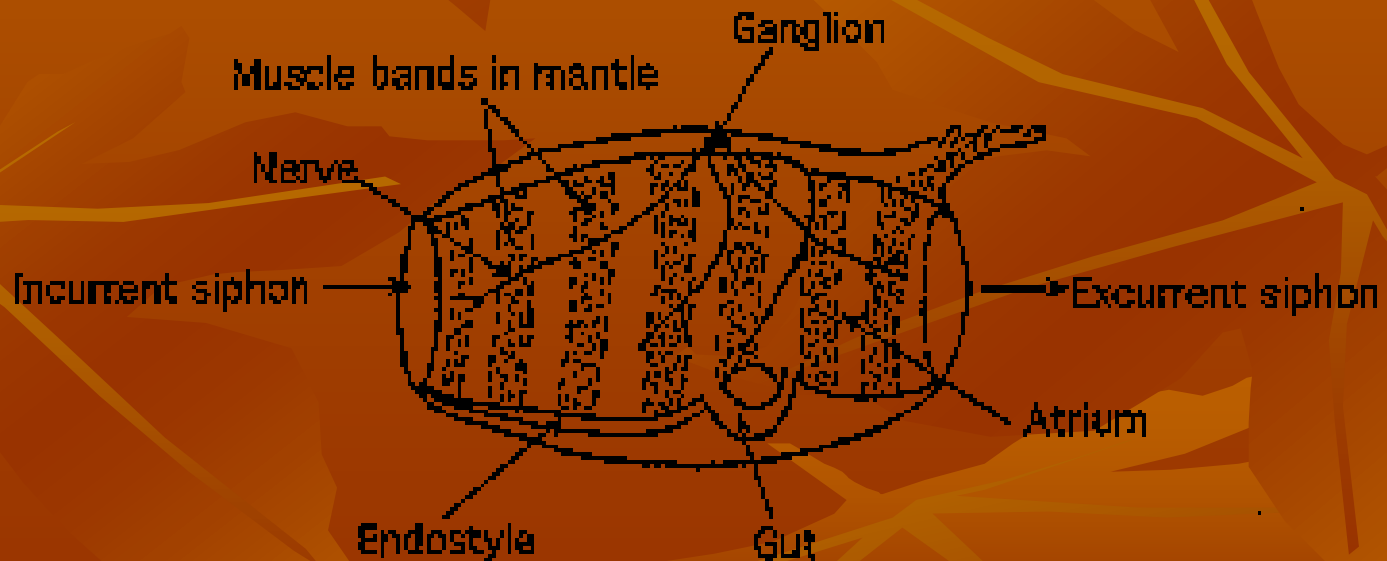
(b) Metamorphosis



(c) Sessile adult

2. Thaliacea.

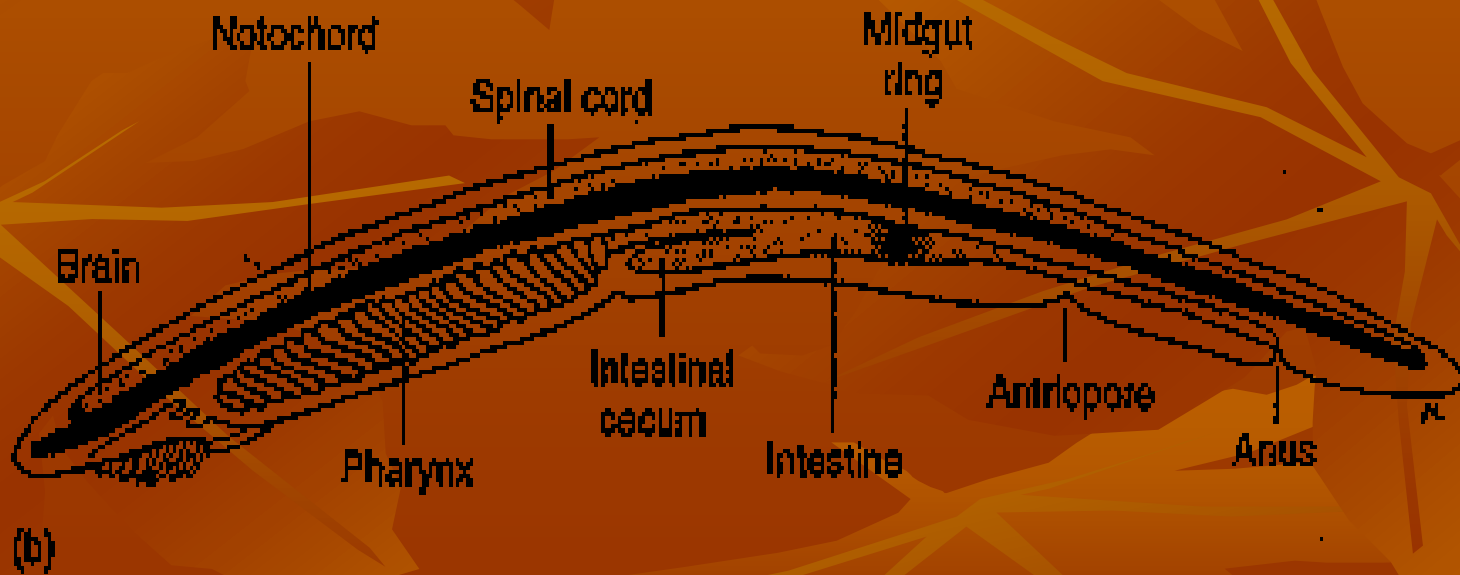
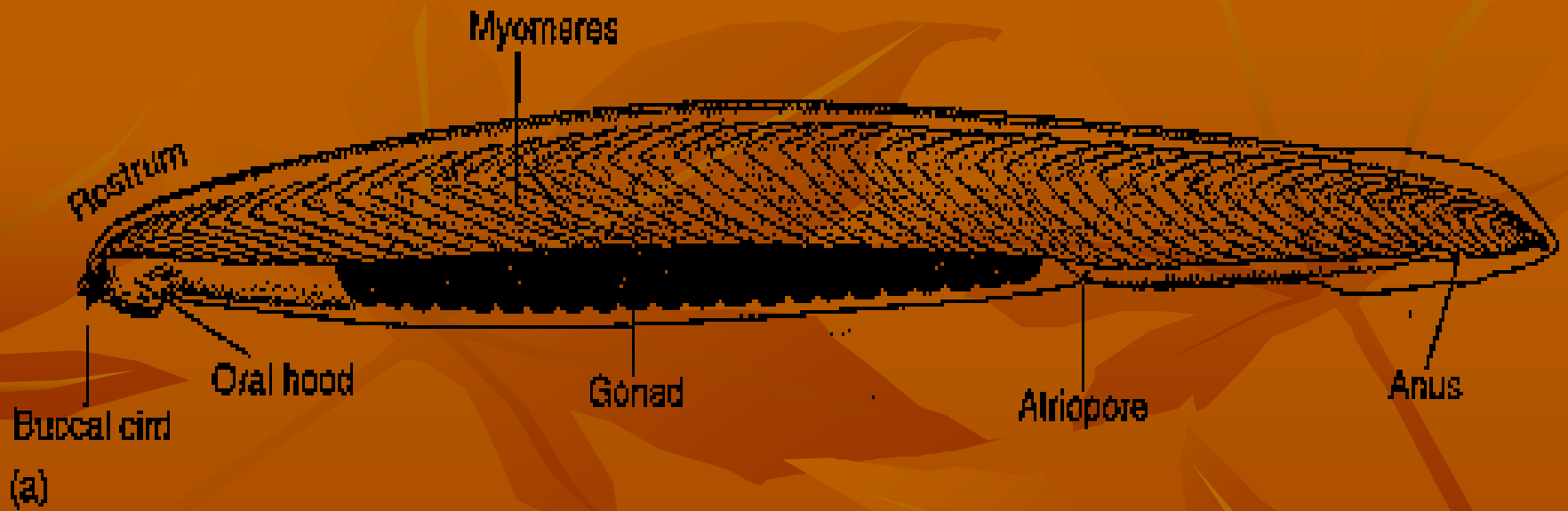
- Pelagic tunicates; barrel-shaped.
- Move by expelling water from their excurrent siphon.



- **3.Larvacea.**• Also pelagic and free-swimming throughout life.• Resemble larval ascidians (example of paedogenesis).• Retain notochord throughout life--aids in stiffening tail for locomotion



- **C. Cephalochordata (lancelets).**
 - About 45 species.
 - Branchiostoma
 - Eel-like, free-swimming, sedentary, burrowing.
 - Persistent notochord.
 - Epidermis single cell layer.
 - Caudal, dorsal, and ventral fins.
 - Musculature--myomeres and myosepta (metamerism).
 - No highly organized sense organs.



Amphioxus

D. Differences between cephalochordates and vertebrates.

- • **Almost no cephalization.**
- **No paired sense organs.**
- **No vertebral column.**
- **High number of gill slits.**

- • **Segmented musculature extends to anterior tip of head.**
- **No paired appendages.**
- **Outer layer of skin (epidermis) one-cell thick.**
- **No muscular heart.**
- **Excretory protonephridia resemble those on non-chordates**

E. Protochordate and vertebrate relationships.

- **1. Evidence for relationship between chordates and certain other invertebrates.**
- **• Protochordates and vertebrates resemble echinoderms and hemichordates because they are deuterostomes. Characteristics of this group include:**

Origin of Free-Swimming Vertebrates

In contrast to protochordates (hemichordates, urochordates, and cephalochordates), vertebrates are actively-feeding, predatory organisms that move by lateral undulation of an elongate body.

- cephalochordates are like vertebrates in having the derived feature of an elongate body as adults, but are still (primitively) filter feeders; that is, they feed while motionless, moving food-laden water by means of cilia on their gill bars.
- • Hemichordates and most urochordates are also filter-feeders, moving water through their gill slits, but are sessile as adults. When ascidian tunicates metamorphose, the notochord is resorbed.

- Note, however, that ascidian and larvacean urochordates have a free-swimming larval stage (with a notochord); ascidians metamorphose to sessile adults, but larvaceans become sexually mature as mobile "larvae."



Thank you