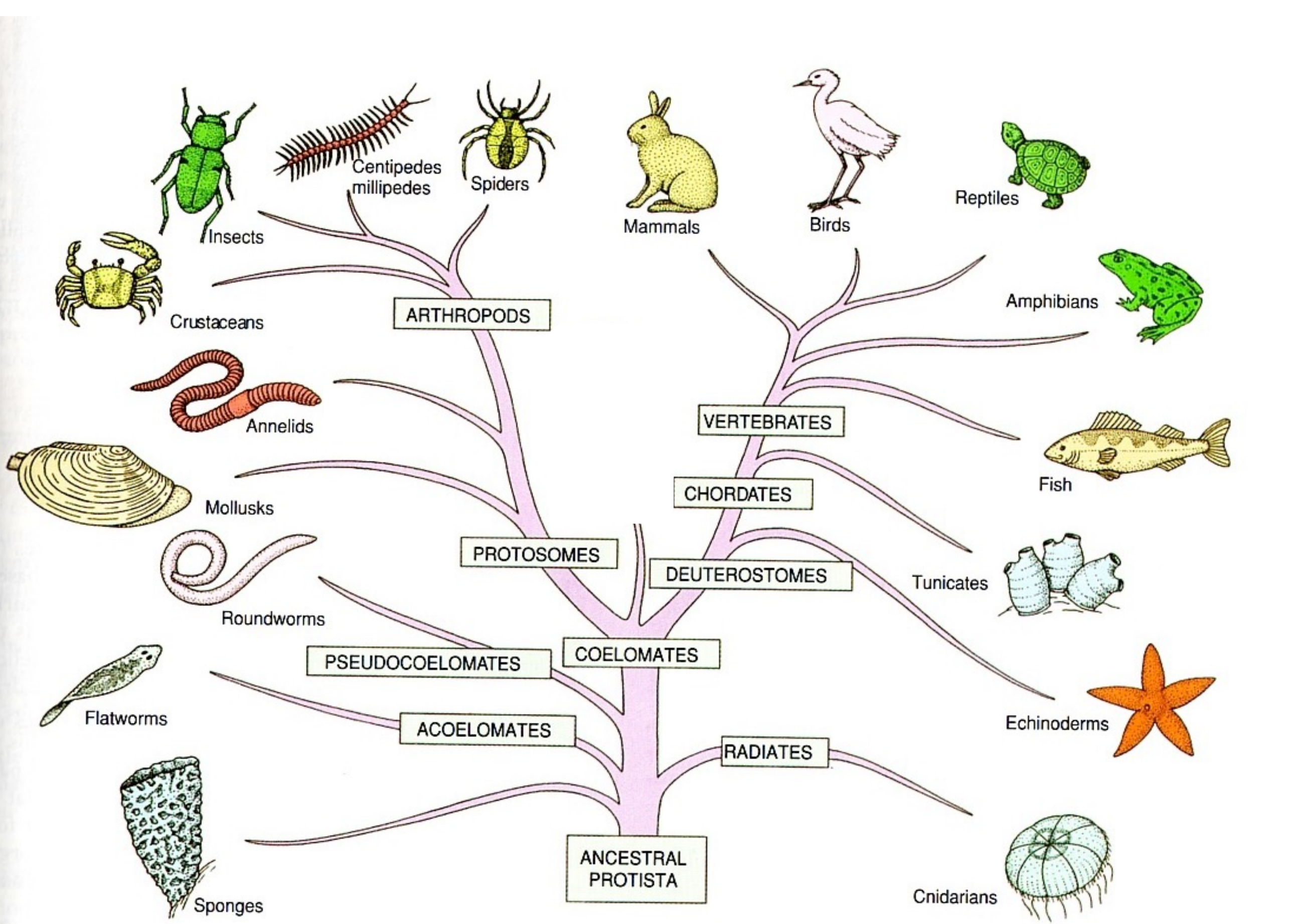
Hemichordates and Chordates

FISH310


Insects
Centipedes
millipedes
Spiders
Crustaceans
ARTHROPODS
Annelids
Mollusks
Roundworms
Flatworms
Sponges
PROTOSOMES
PSEUDOCOELOMATES
ACOELOMATES
COELOMATES
DEUTEROSTOMES
RADIATES
ANCESTRAL
PROTISTA
Mammals
Birds
Reptiles
Amphibians
VERTEBRATES
Fish
CHORDATES
Tunicates
Echinoderms
Cnidarians

Insects
Centipedes
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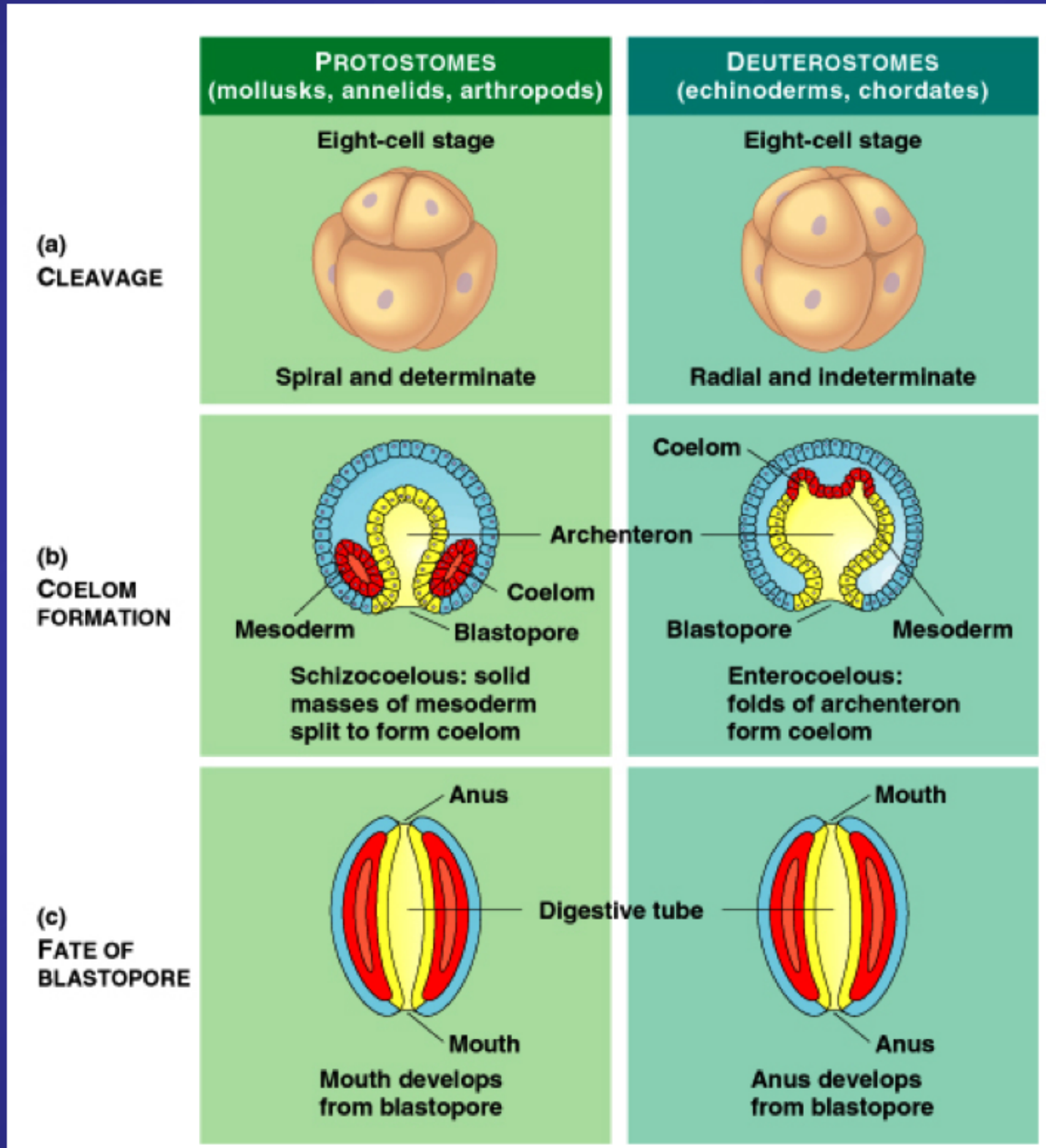
VERTEBRATES
Fish
CHORDATES
DEUTEROSTOMES
Tunicates
Hemichordata
Echinoderms
RADIATES
Cnidarians

Hemichordata & Chordata

Characteristic: Deuterostomes

- Radial Cleavage
- Enterocoely (folds of archenteron form coelom)
- Indeterminate development
- Blastopore becomes the anus



Phylum Hemichordata

- A conspicuous dorsal extension of the pharynx forms an anterior buccal tube, or stomochord.

relationship

http://flickr.com/photos/buck82/7299361/

Scientific Name Saccoglossus kowalevskii
Comments The grid lines are 0.25 inches apart
Creator David Remsen
Copyright © 1995 Marine Biological Laboratory, Woods Hole

http://flickr.com/photos/dn/520804120/

relationship

- lack notochord, therefore not _____
- pharyngeal gill slits
- dorsal hollow, nerve chord (some species)
- What other characteristics used?

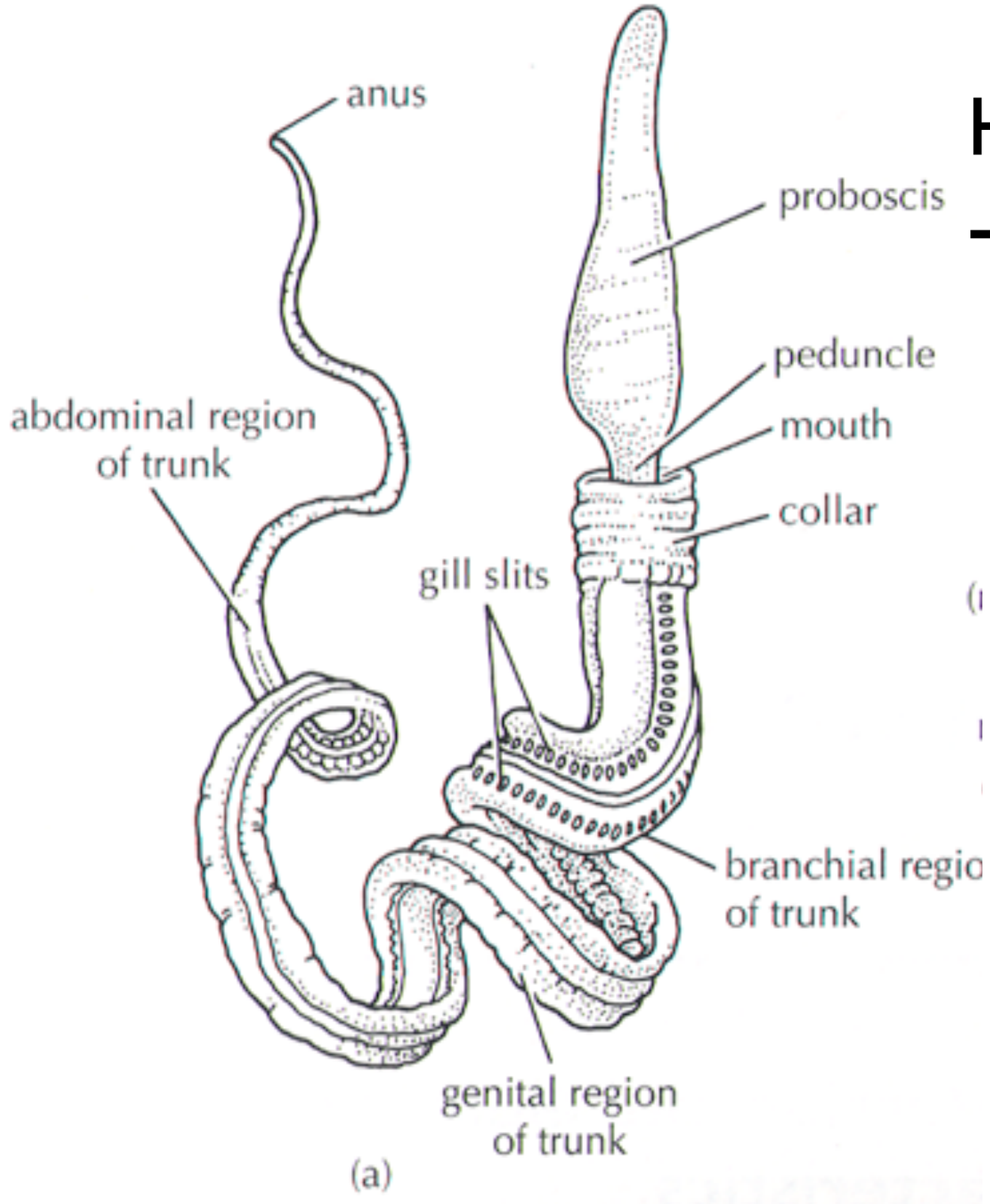
relationship with Echinoderm

- 18s rRNA sequence
- gene expression patterns
- mitochondrial codon characteristics

Phylum Hemichordata

- **Class Enteropneusta** (G: gut breathing)
- Class Pterobranchia (G: feather gill)

Class Enteropneusta



Highly muscular
- burrowing / food collection

Figure 21.1

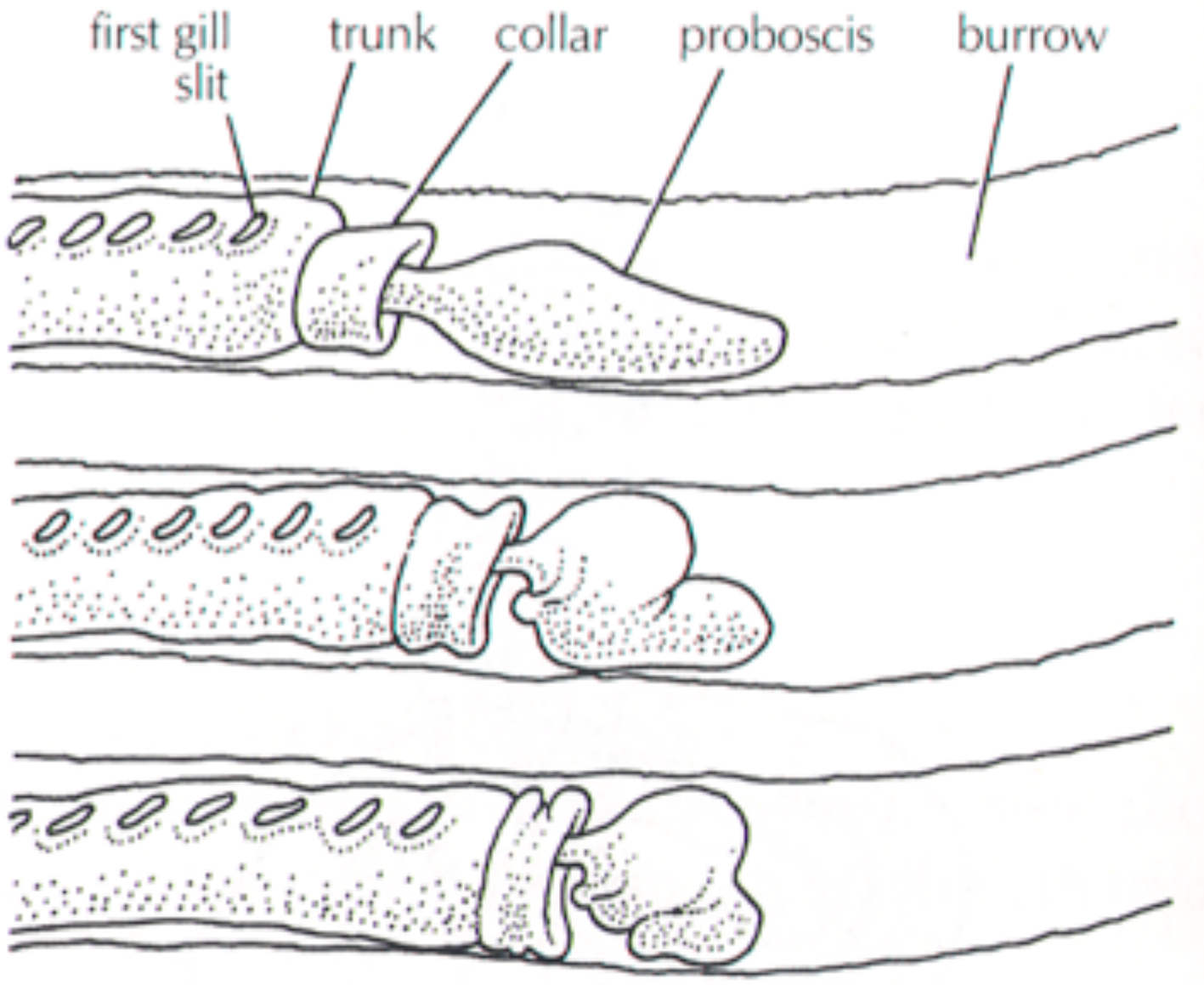
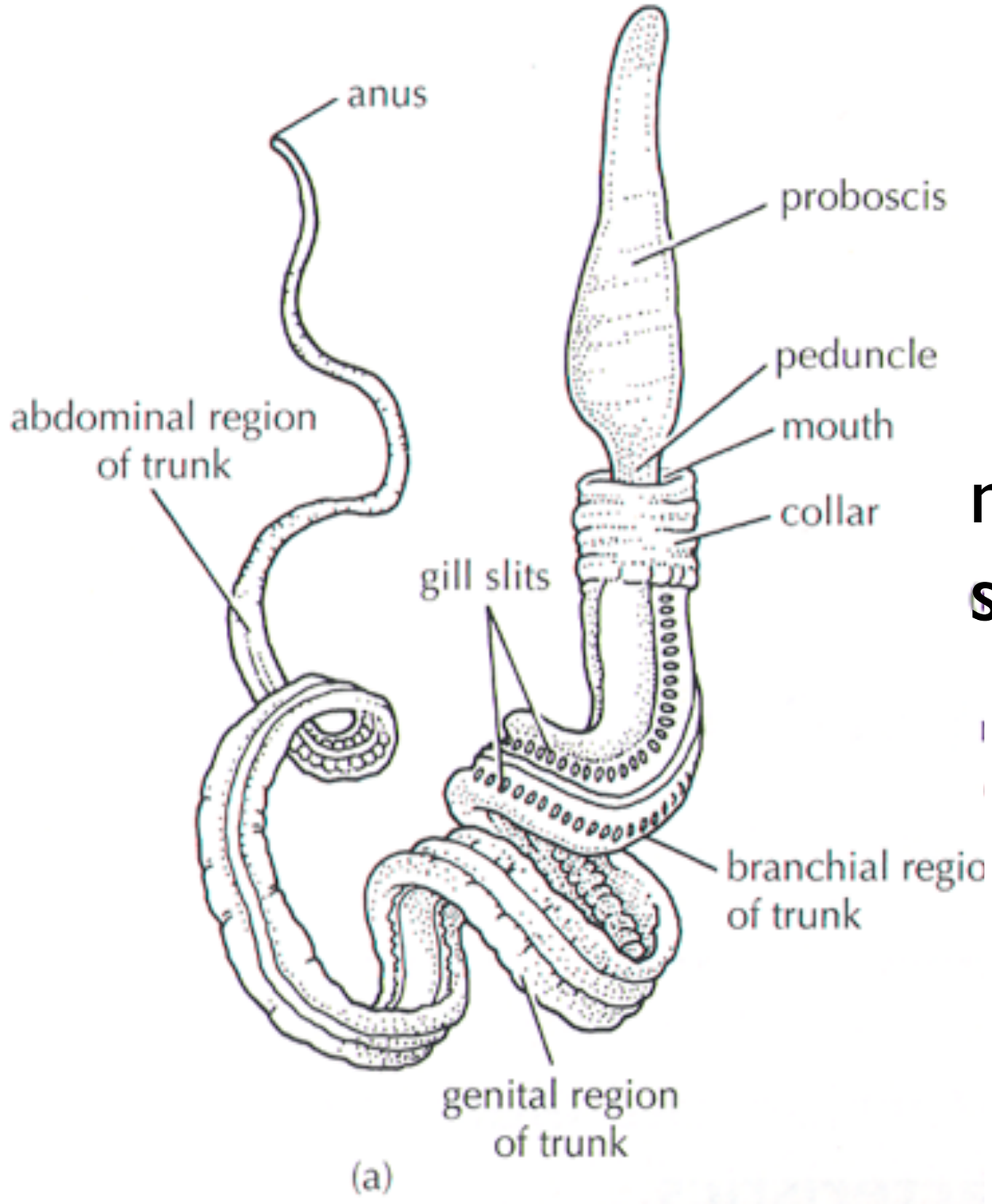


Figure 21.2

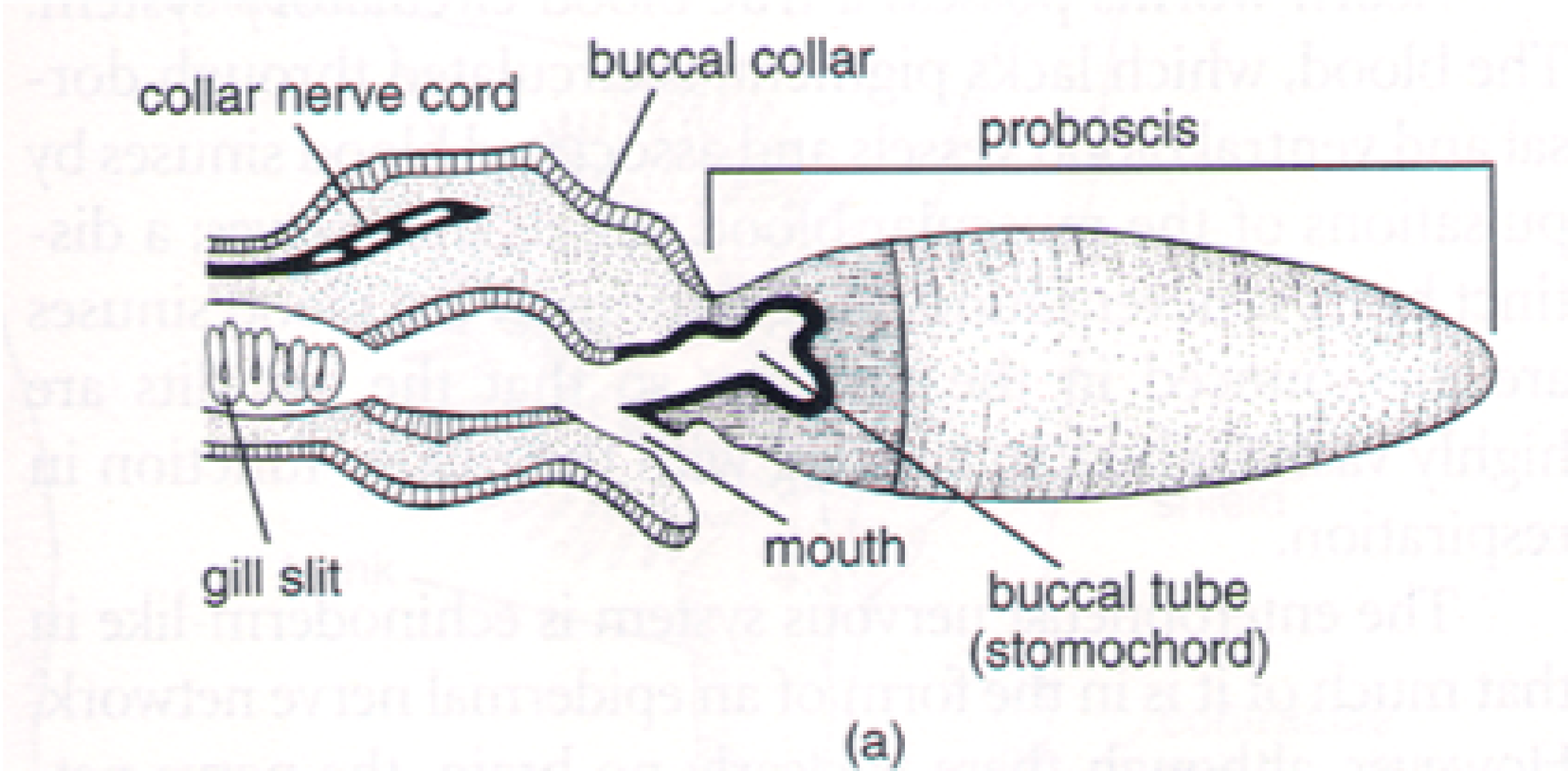
Class Enteropneusta



mouth on ventral anterior surface

Figure 21.1

Class Enteropneusta



stomochord - supports

Class Enteropneusta

Class Enteropneusta

- Family Harrimaniidae
  - Genus Saccoglossus
    - *Saccoglossus bromophenolosus*
    - *Saccoglossus pusillus*
    - *Saccoglossus kowalevskii*
    - *Saccoglossus cambriensis*
  - Genus Harrimania
    - *Harrimania planktophilus*
- Family Ptychoderidae
  - Genus Balanoglossus
    - *Balanoglossus carnosus*
  - Genus Ptychodera
    - *Ptychodera flava*
  - Genus Glossobalanus
    - *Glossobalanus minutus*

S. bromophenolosus is found from Maine to Nova Scotia and in at least two bays in Washington State. The worm was likely introduced to Washington State by the oyster industry in the early 1900s.

http://faculty.washington.edu/bjswalla/Hemichordata

Class Enteropneusta

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- Family Harrimaniidae
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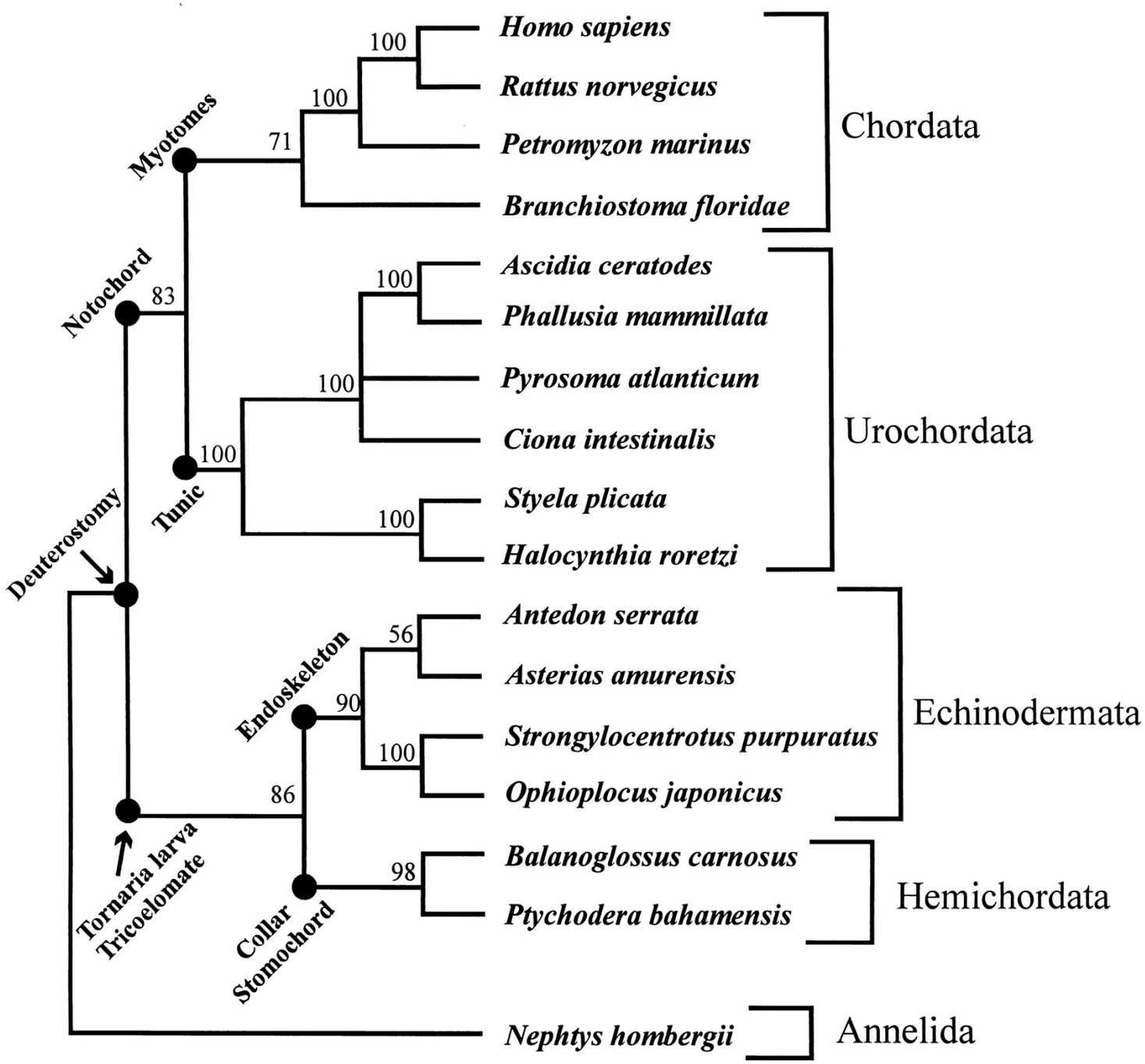
    - *Glossobalanus minutus*

Close up of the gill pores on a the trunk of live *S. bromophenolosus.*

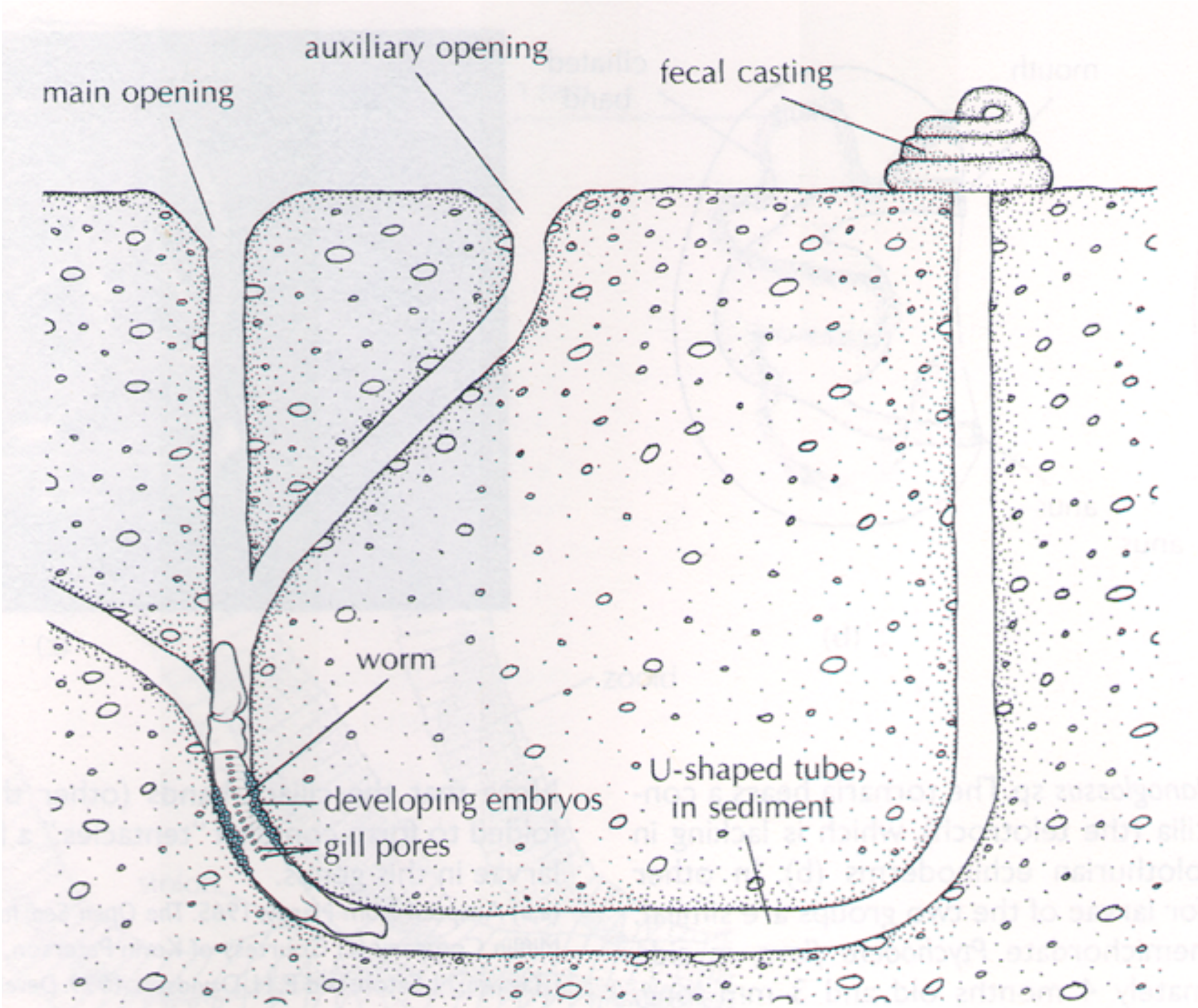
http://faculty.washington.edu/bjswalla/Hemichordata



Cameron, Chris B. et al. (2000) Proc. Natl. Acad. Sci. USA 97, 4469-4474

Enteropneust feeding

- Many are **deposit feeders**
  - mucous bound castings
- **Mucociliary feeders**
- **Suspension feeders**

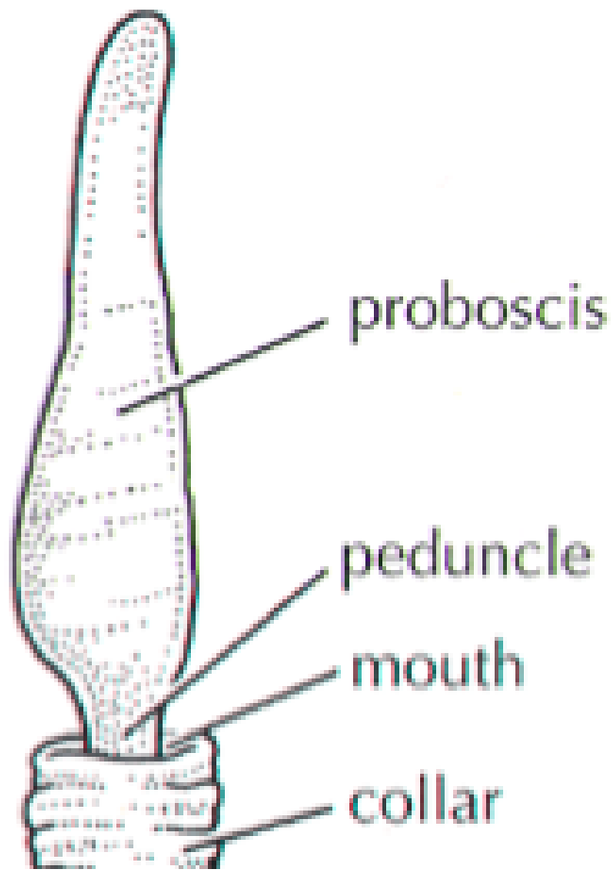

auxiliary opening
main opening
fecal casting
worm
developing embryos
gill pores
U-shaped tube
in sediment

Deposit feeders

www.flickr.com/photos/wildsingapore/444653133/

Mucociliary feeding

planktonic organisms
and detritus adhere
to mucous on
proboscis



digestive tract

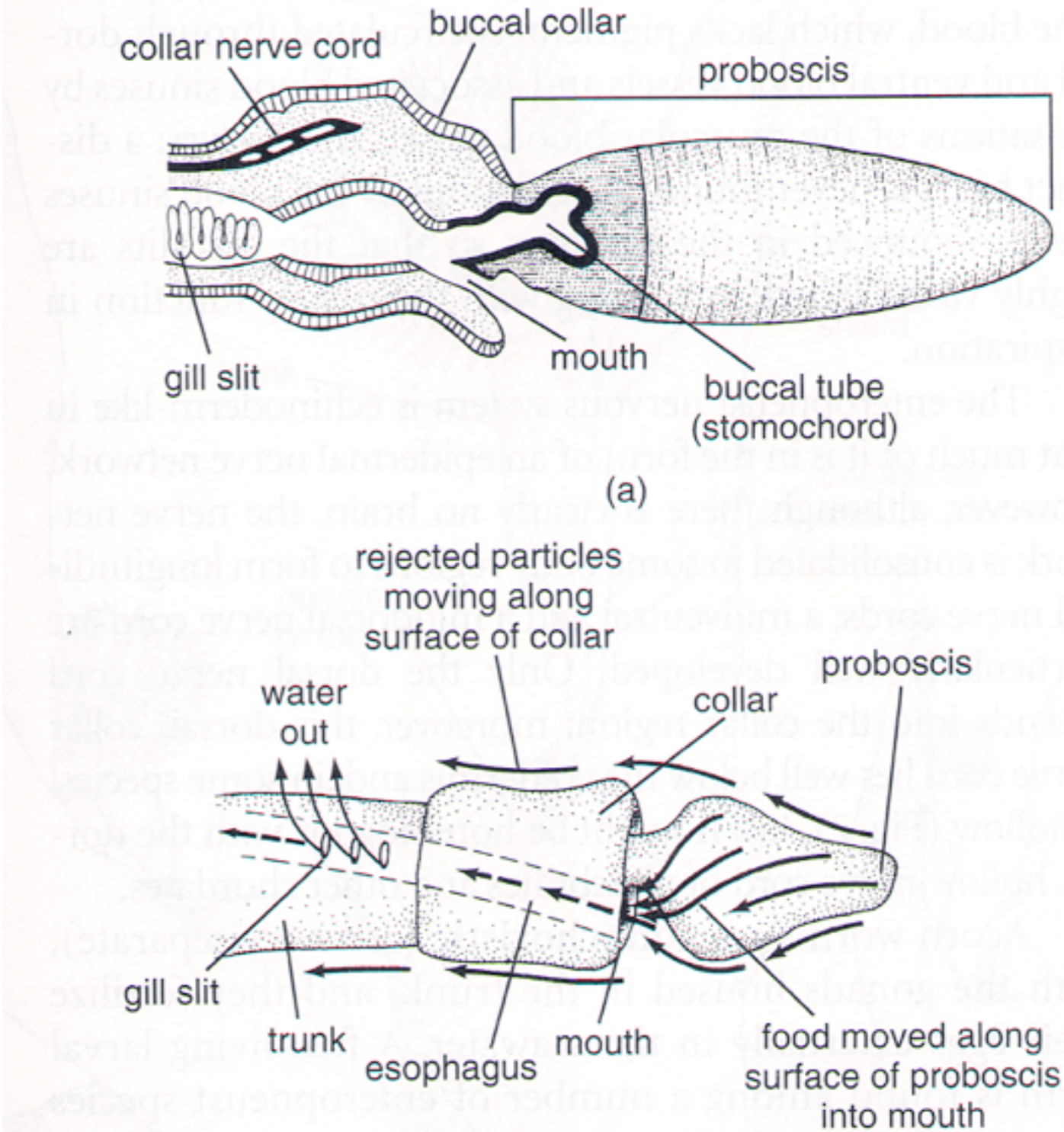
mouth

esophagus

pharynx

intestine

anus



food is moved via ciliated cells

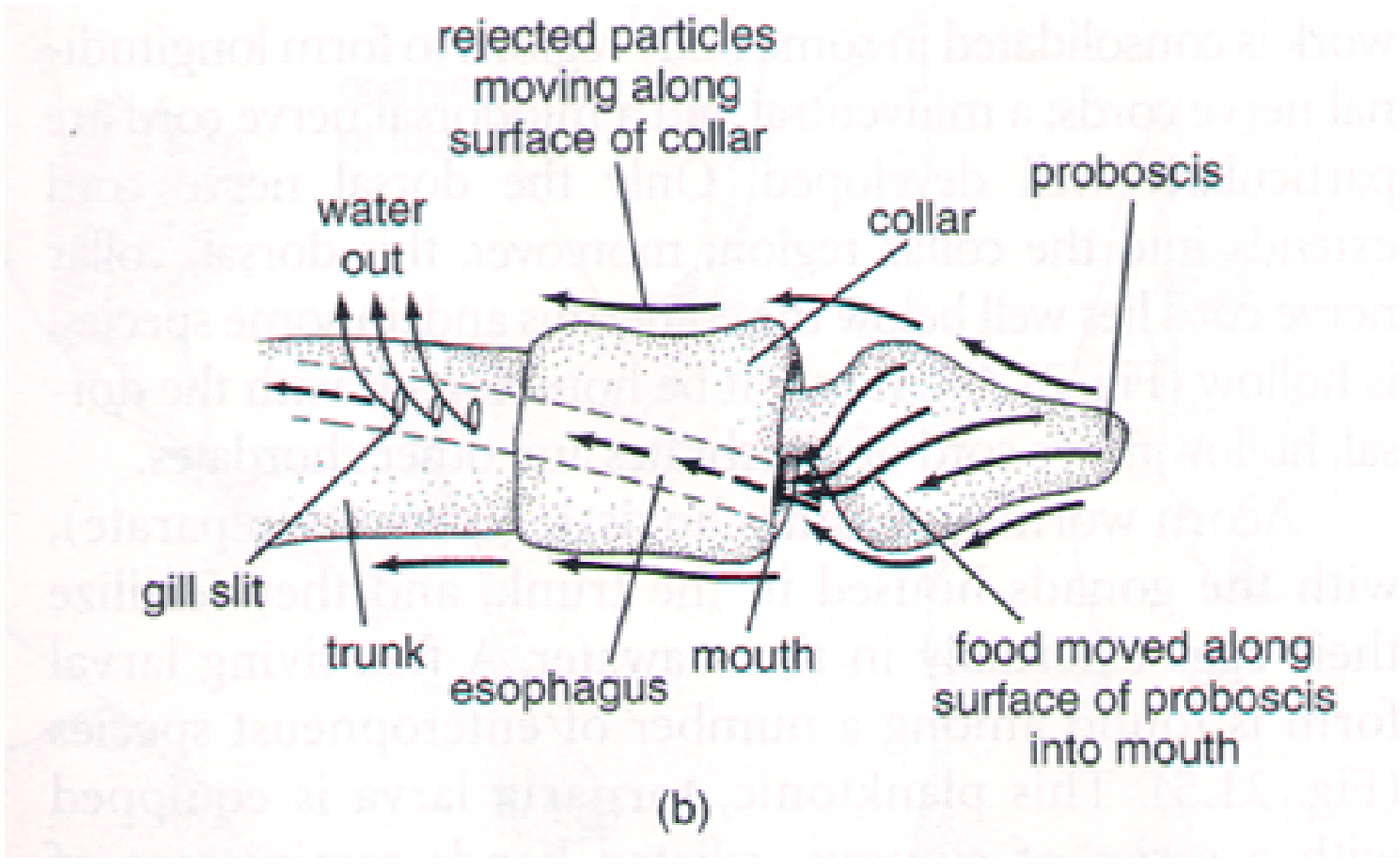
Figure 21.4

Class Enteropneusta

G: gut breathing

pharynx

cilia line gill slits



Phylum Hemichordata

- Class Enteropneusta (G: gut breathing)
- **Class Pterobranchia** (G: feather gill)

Class Pterobranchia

- Originally collected in deep water dredging near Antarctic
- Recently several shallow water populations found

Class Pterobranchia

Rhabdopleura species

Class Pterobranchia

Genus Cephalodiscus

Cephalodiscus gracilis

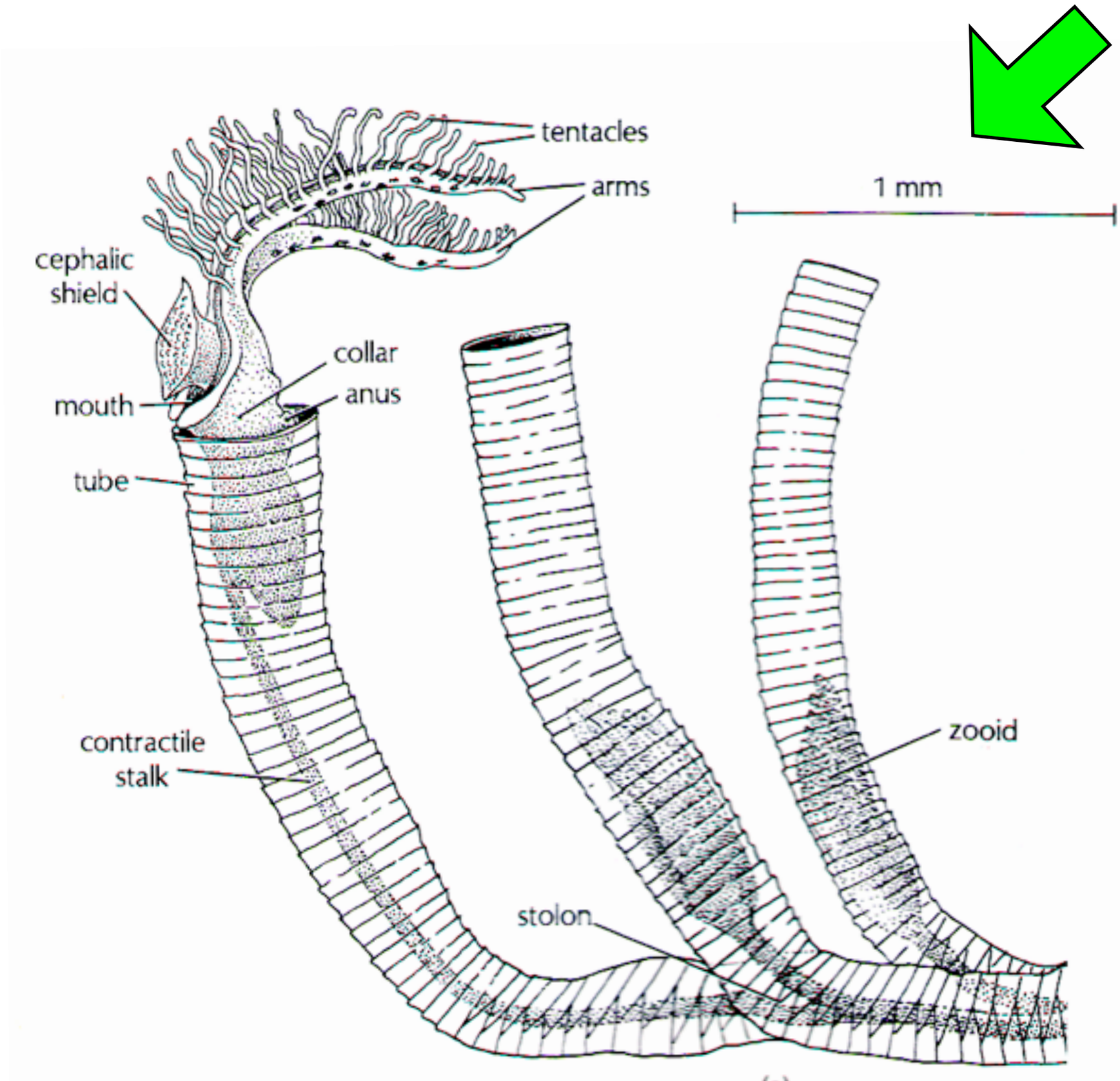
Genus Rhabdopleura

Rhabdopleura normani

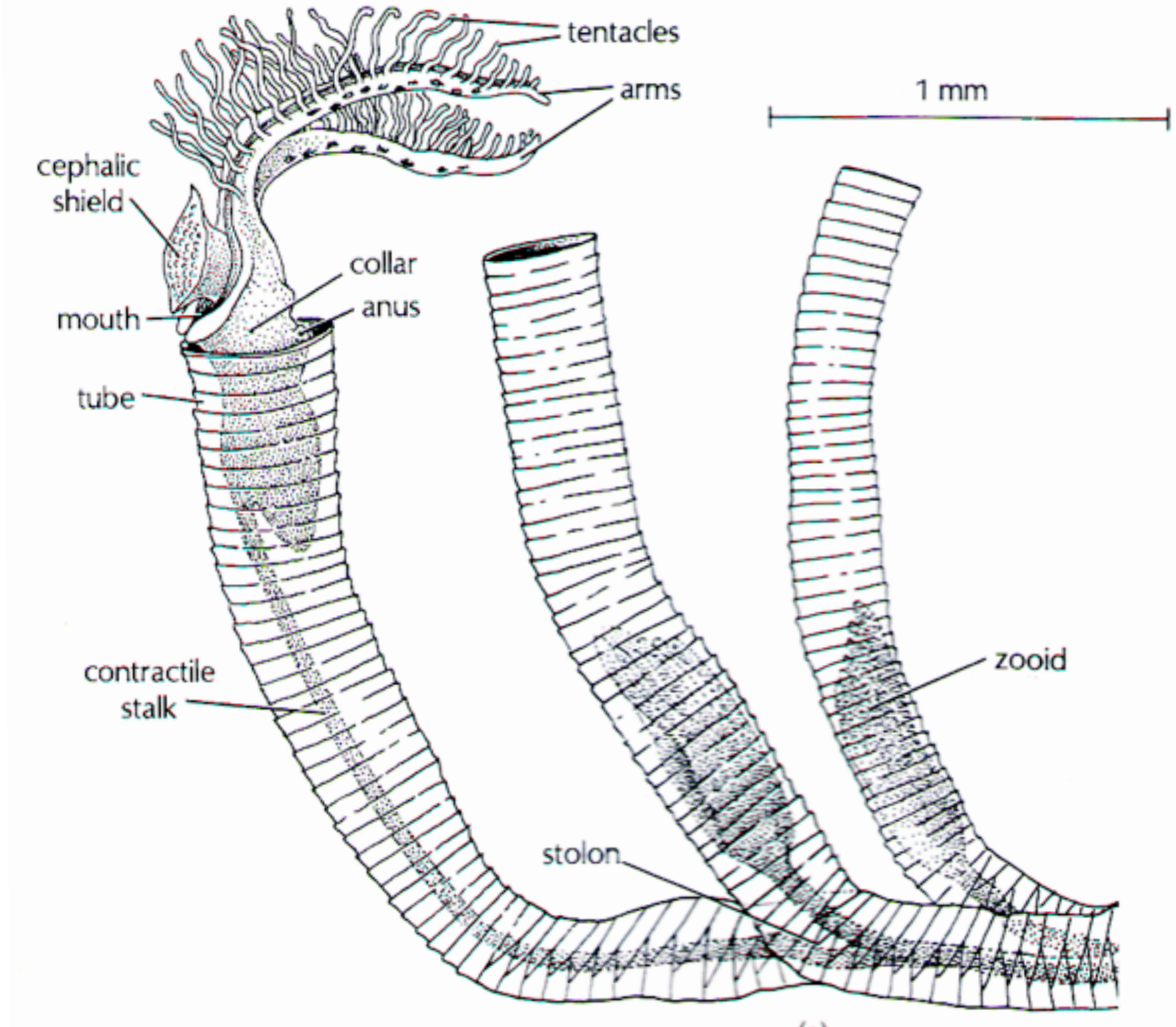
Class Pterobranchia

- **Distinguish from enteropneusts**
  - ciliated, anterior tentacles
  - U-shaped gut
  - never have more than 1 pair of gill slits
  - occupy rigid tubes

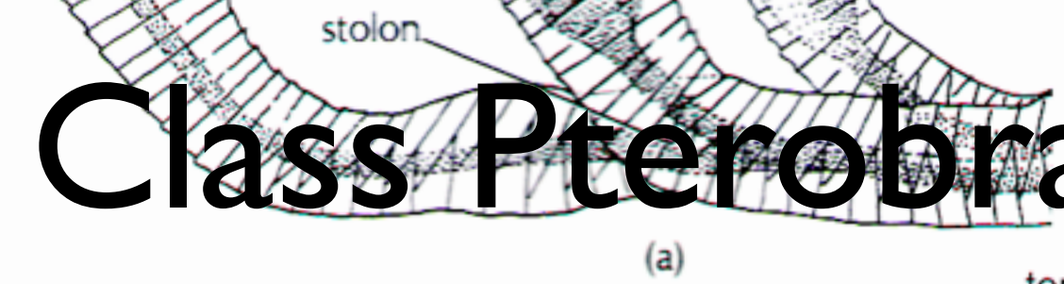
Class Pterobranchia



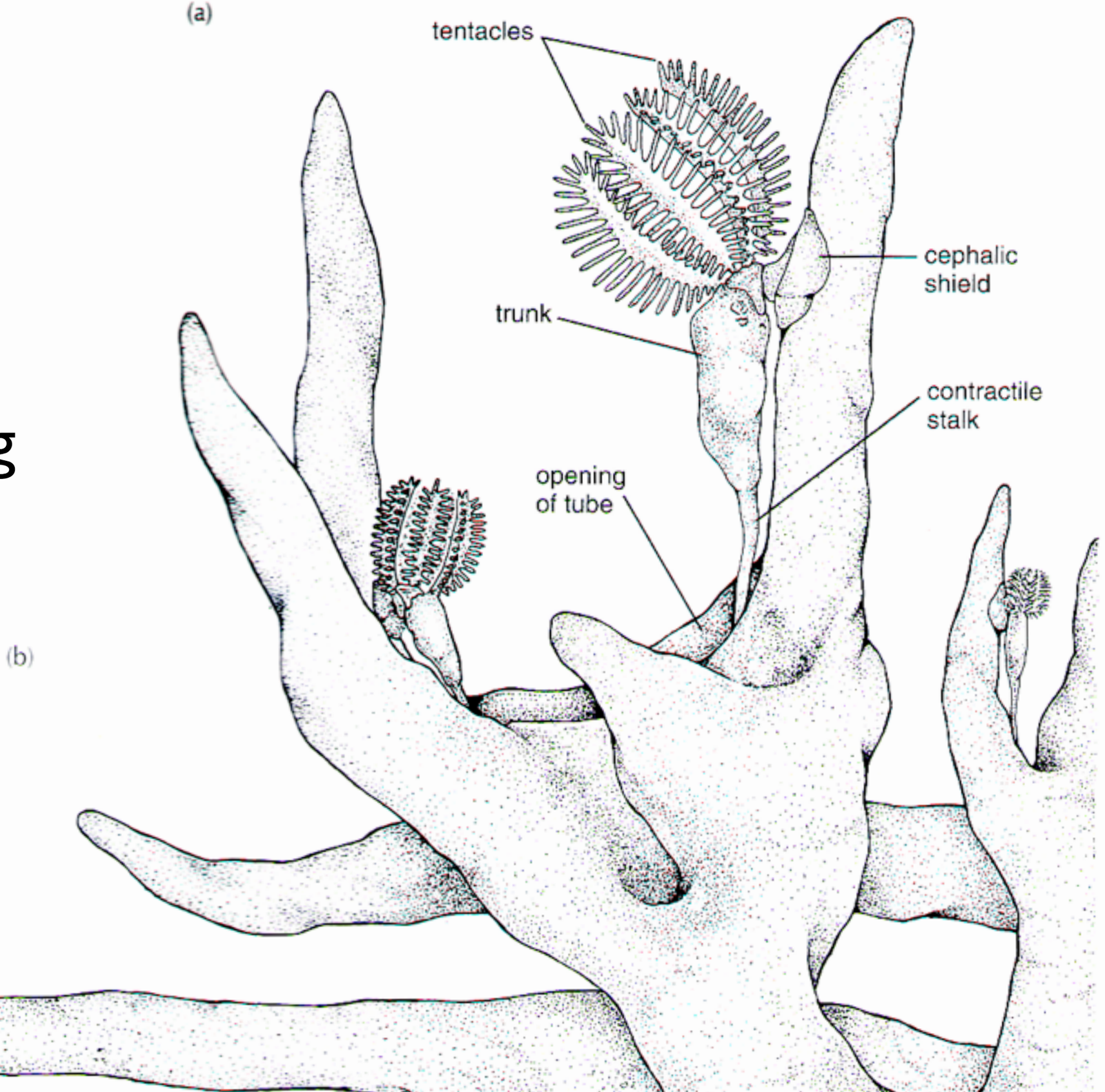
Class Pterobranchia



Class Pterobranchia



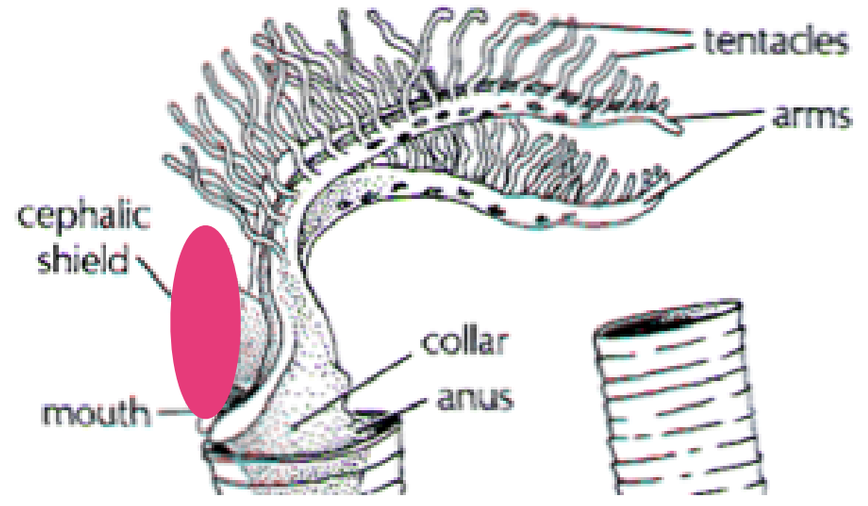
(a)



(b)

Budding

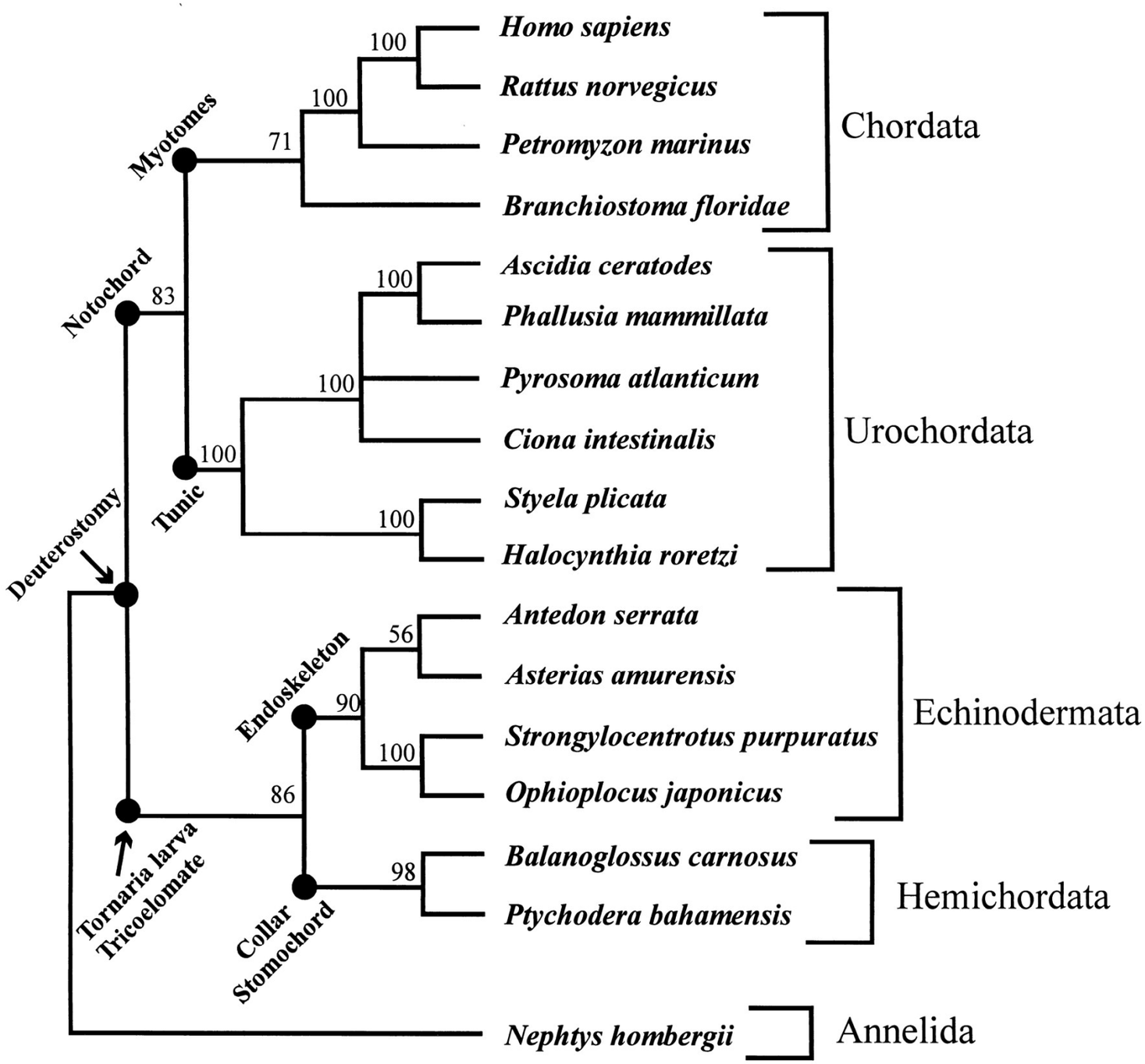
cephalic shield



- contains glands that secrete tubes
- serves as an attachment organ
- used as muscular proboscis to crawl
  - within tube
  - solid substrate (near tube)

Phylum Chordata

- Subphylum Urochordata
  - Class Ascidiacea
  - Class Larvacea
  - Class Thaliacea
- Subphylum Cephalochordata
- Subphylum _____



Cameron, Chris B. et al. (2000) Proc. Natl. Acad. Sci. USA 97, 4469-4474

Phylum Chordata

- Nerve cord is dorsal and hollow
- The body is supported in at least some stage of development by a stiff rod
  - running the length of animal
  - ventral to nerve cord
- Pharynx is perforated with numerous ciliated slits (_____)

Subphylum Urochordata

aka tunicates

- Notochord and nerve cord are found only in the larval stage, being resorbed at metamorphosis

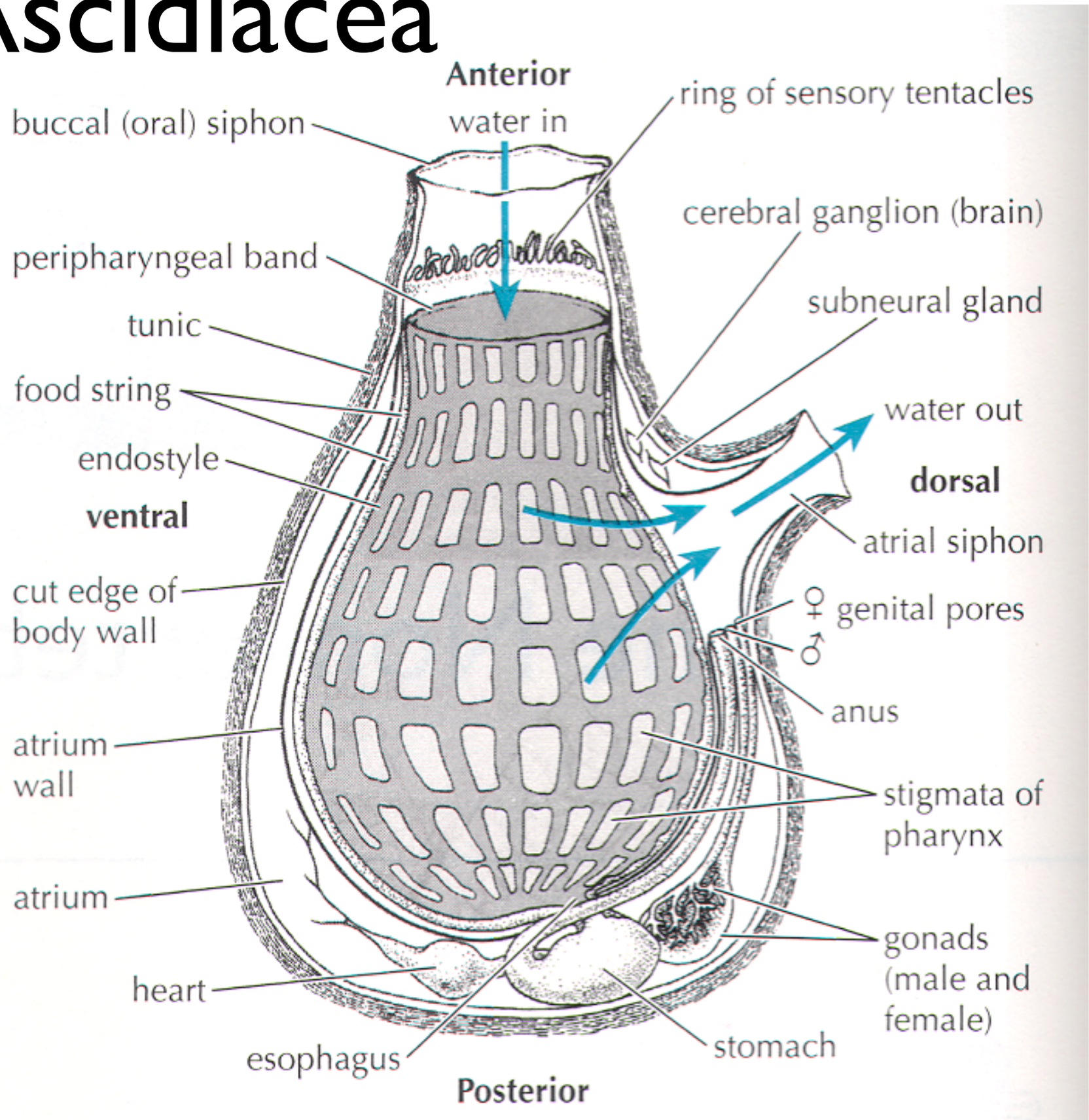
Subphylum Urochordata

- Class Ascidiacea
- Class Larvacea
- Class Thaliacea
- Class Sorberacea*

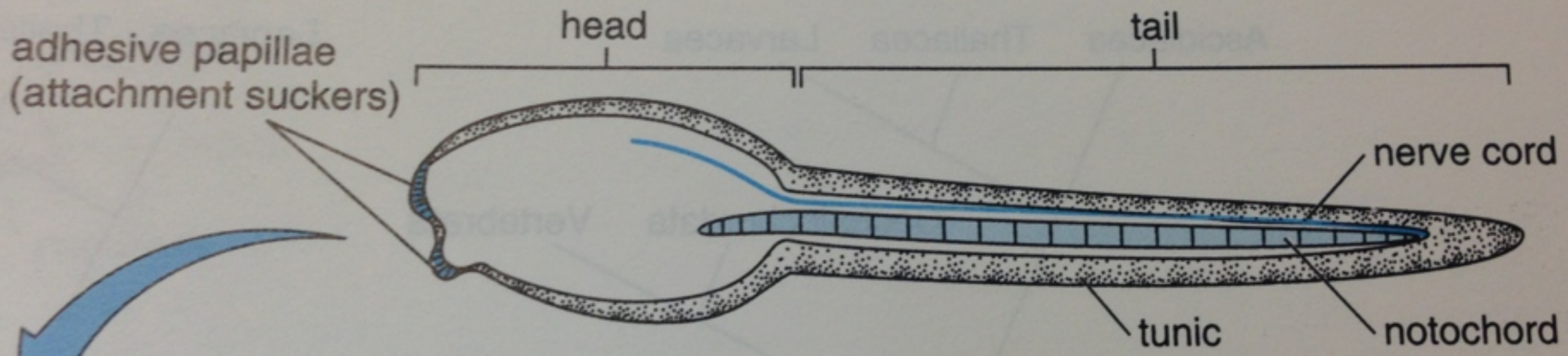
Subphylum Urochordata

- **Class Ascidiacea**
- Class Larvacea
- Class Thaliacea
- Class Sorberacea*

Class Ascidiacea

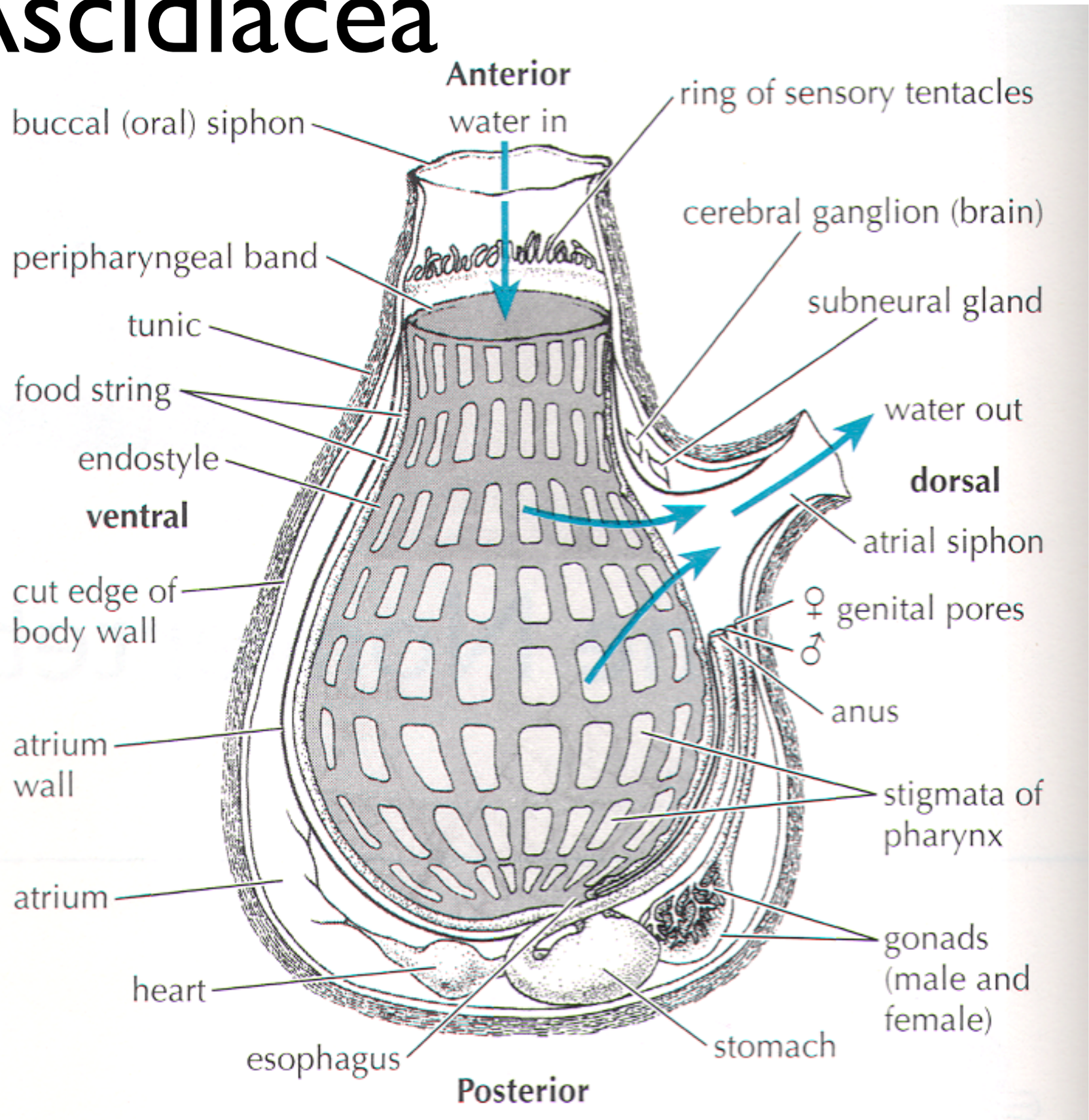


Class Ascidiacea



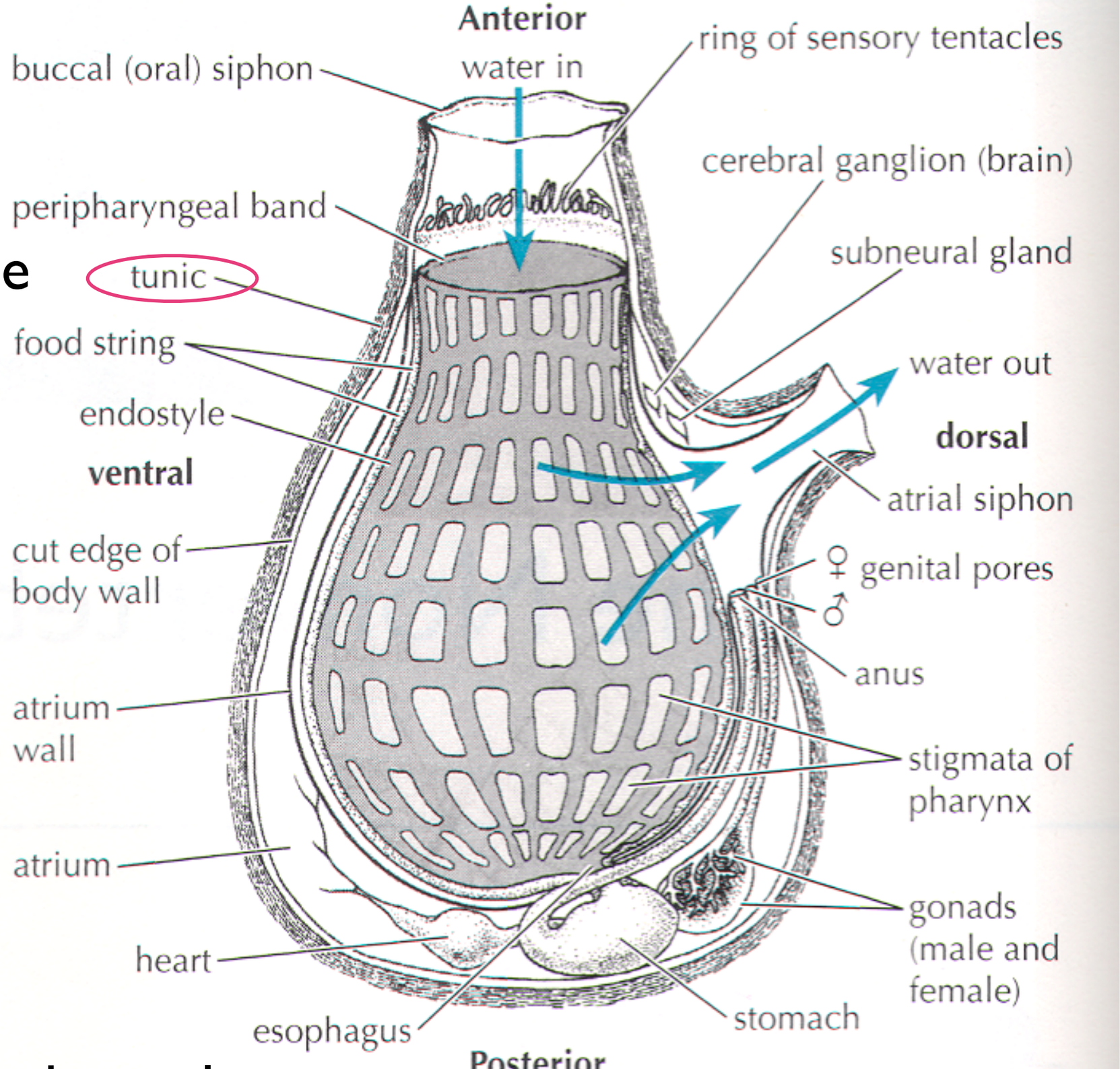
(a)

Class Ascidiacea



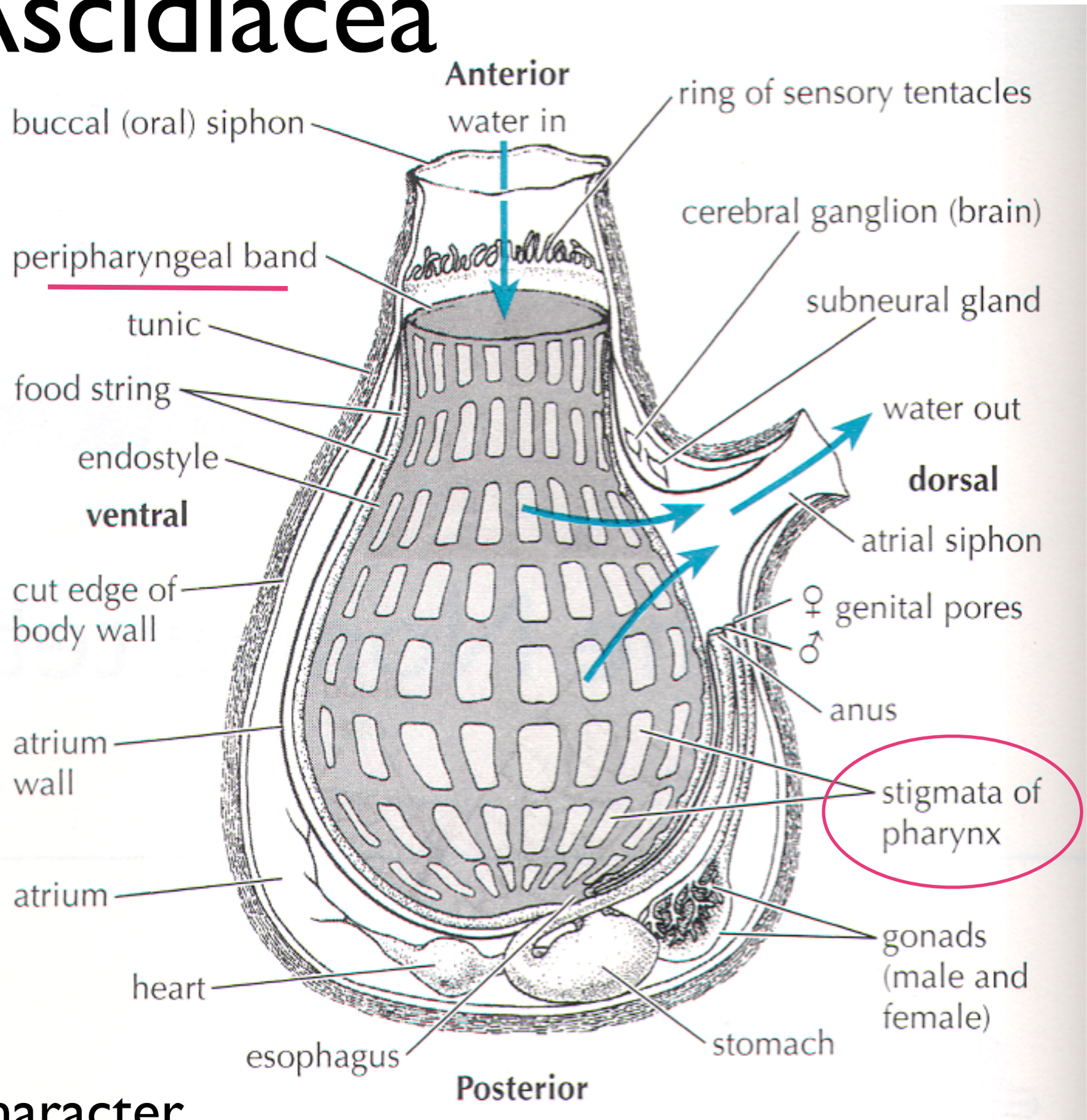
Class Ascidiacea

protective protein and polysaccharide



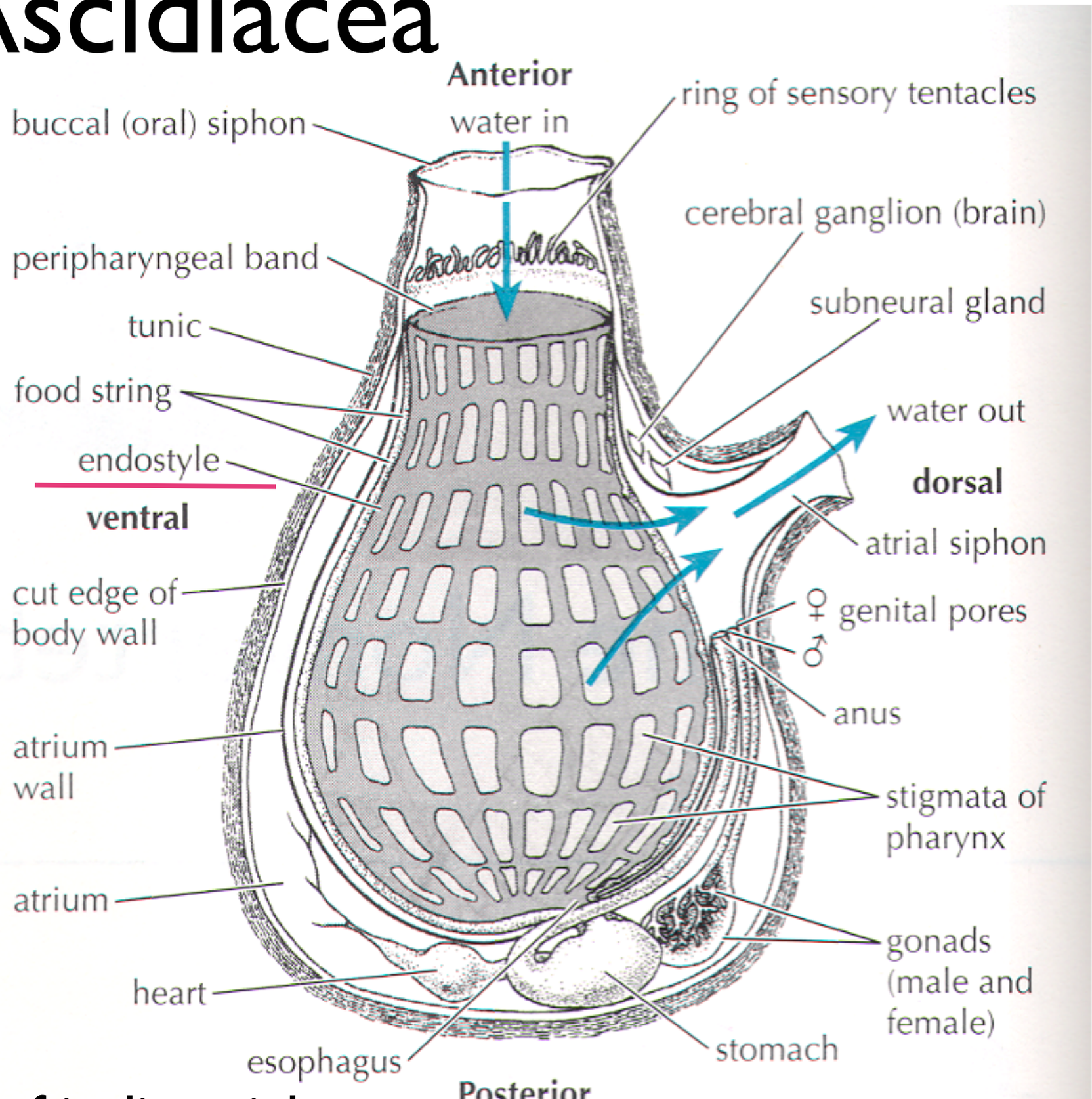
lack nerves and muscles

Class Ascidiacea

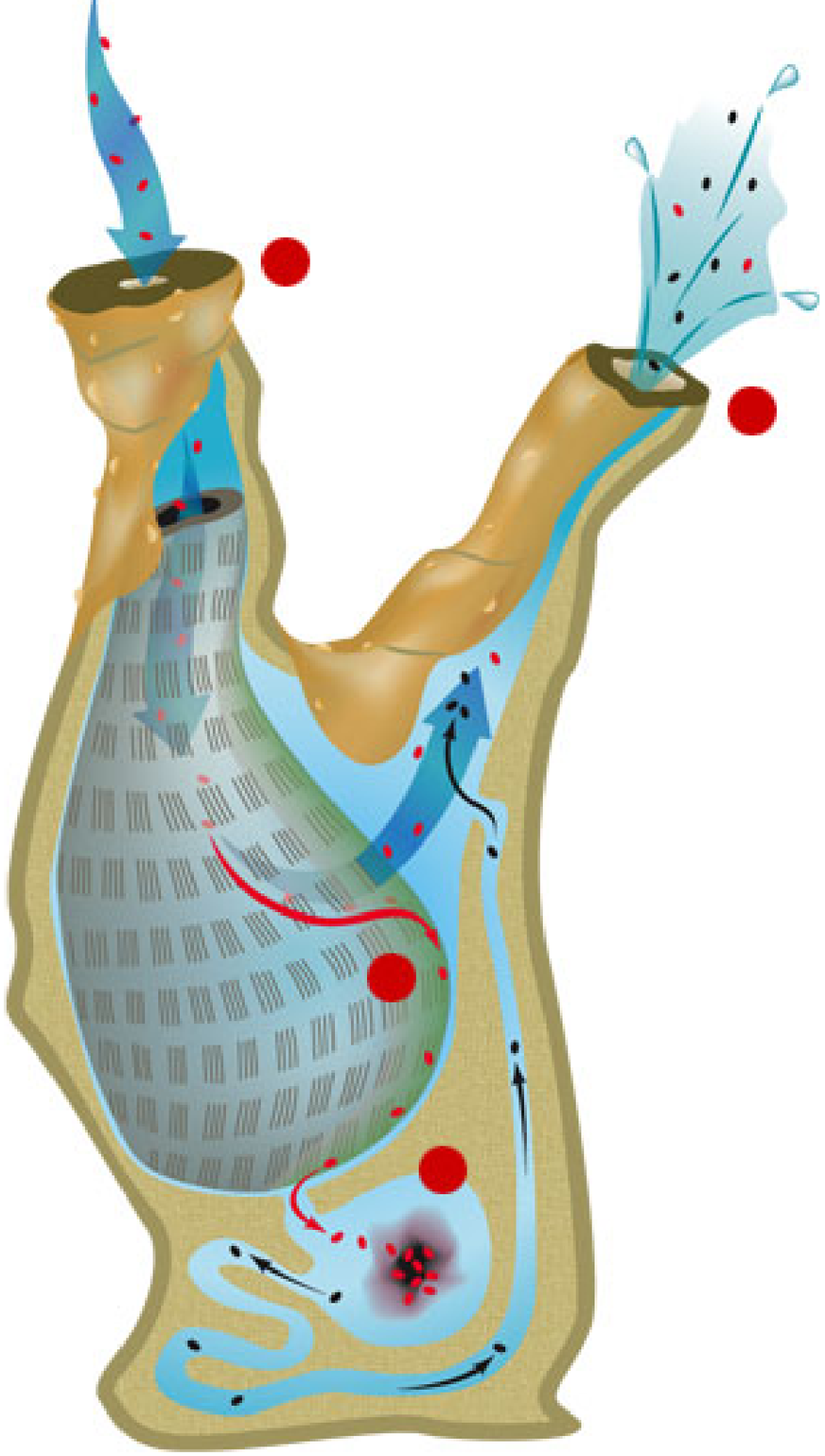


taxonomic character

Class Ascidiacea



secretes net of iodine rich mucous



LIVING WATER PISTOLS—As sea squirts feed on algae and bacteria, or when they are gently squeezed, they shoot water out of tiny pipes. These bursts of water give it the name "sea squirt." (Photo by Dann Blackwood, USGS)

Click on the red dots for more information.

ANATOMY OF A SQUIRT

Sea squirts are tunicates, a type of sea life with a firm, rubbery outer covering called a "tunic," from which the name derives. As each organism feeds on algae and bacteria, they suck water in through one pipe and push it out a second. These bursts of water gave it the name "sea squirt." (Illustration by Jayne Doucette, WHOI Graphic Services)

sea squirt invasion

Invasive Sea Squirt Could Cause Problems

A colonial sea squirt from the *Didemnum* (pronounced die-DEM-num) group of marine animals has recently been found fouling boats, marina structures and oyster trestles in Ireland.

This particular species of *Didemnum* is fast-growing and has the potential to outcompete and smother a large number of species and habitats, including some of the most diverse and unique areas of the Irish coastline.

PACIFIC NW CRITTER WATCHERS

Invasive Tunicates in Washington State

Tunicates Home | Ciona savignyi | Styela clava | Didemnum

Report a sighting to WDFW: (360) 902-2700

Don't forget to report it on your REEF survey form too!

Club Tunicate
Styela clava
Photo by Janna Nichols

Transparent Ciona Tunicate
Ciona savignyi
Photo by Janna Nichols

Invasive Didemnum
Didemnum sp.
Photo by Gretchen Lambert

sea squirt invasion

The blob that's invading the Sound

By Warren Cornwall
Seattle Times staff reporter

HOOD CANAL — Like knights heading into battle, two dozen people in rubber-coated diving suits and 40-pound air tanks clanked down the gravel beach.

They each clutched weapons: windshield ice scrapers, barbecue tongs, a spatula nabbed from the kitchen.

Their hated enemy lay beneath Hood Canal's frigid waters, a creature that had scorned a previous assault, expanding its territory at a ferocious rate.

It's a 6-inch-long blob of goo called a

PREV 1 of 3 NEXT

enlarge MARK HARRISON / THE SEATTLE TIMES

Invasive tunicates, such as these seen in Hoodsport, are taking over parts of Puget Sound. Their presence may be further evidence that the Sound is under stress and vulnerable to invaders.

Ciona savignyi at Seacrest (Alki Cove 2) in Elliott Bay, Seattle.
On the jackstraw pilings near the wreck of the Honey Bear.
- Photo by Rich Zade

Culinary importance

Aquaculture

2006 - 18 million (FAO)

Culinary importance

Aquaculture

2006 - 18 million (FAO)

“rubber dipped in ammonia”

Scientific model

JGI

Ciona intestinalis v2.0

Search | BLAST | Browse | GO | KEGG | KOG | AdvancedSearch | Download | Info | Home | HELP!

David Keys, JGI (photo), Leila Hornick, JGI (artistic rendering)

The *Ciona intestinalis* genome is the smallest of any experimentally manipulable chordate. This organism provides a good system for exploring the evolutionary origins of the chordate lineage, from which all vertebrates sprouted.

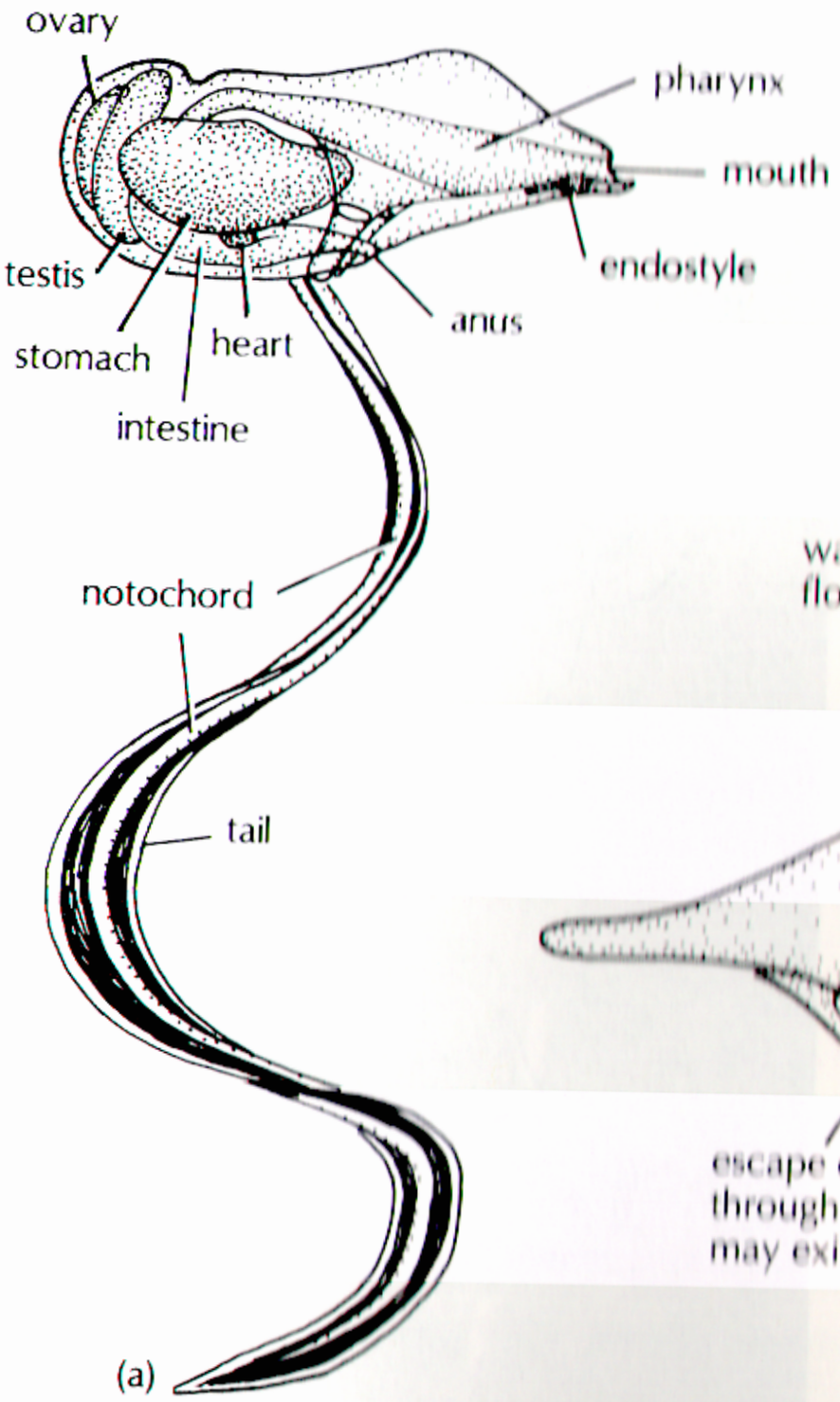
C. intestinalis has a good genomic infrastructure (EST and cDNA collections, BAC and cosmid libraries, etc.), easily visualized cells and morphogenetic processes, existing methods for transient transgene expressions, and is available throughout the world all year long. In addition, there is a deep classical literature on ascidian development, and an active community of researchers worldwide.

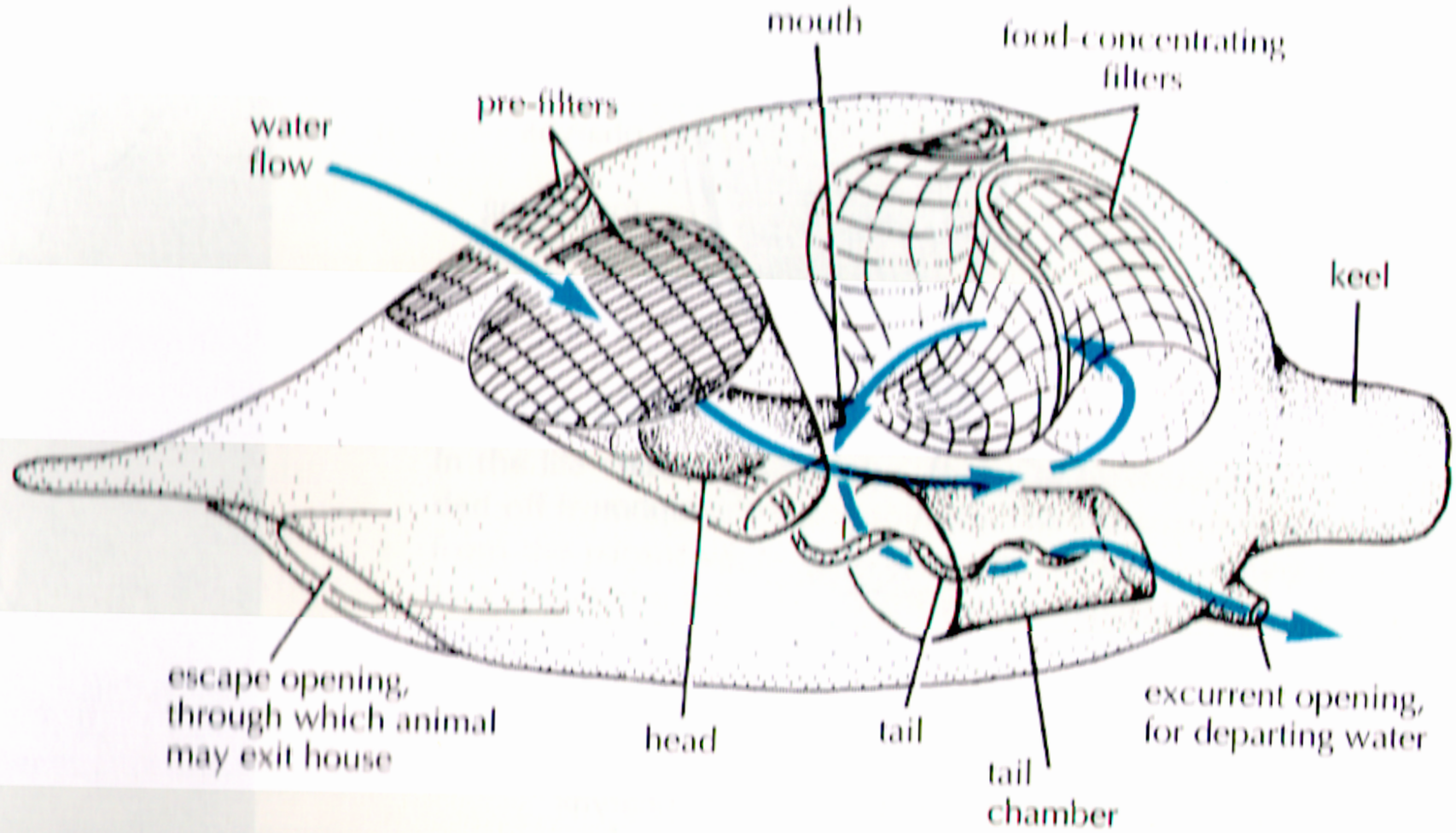
The complete *C. intestinalis* genome sequence will provide a foundation for genome-scale analysis of regulatory networks through development.

Subphylum Urochordata

- Class Ascidiacea
- Class Larvacea
- Class Thaliacea
- Class Sorberacea*

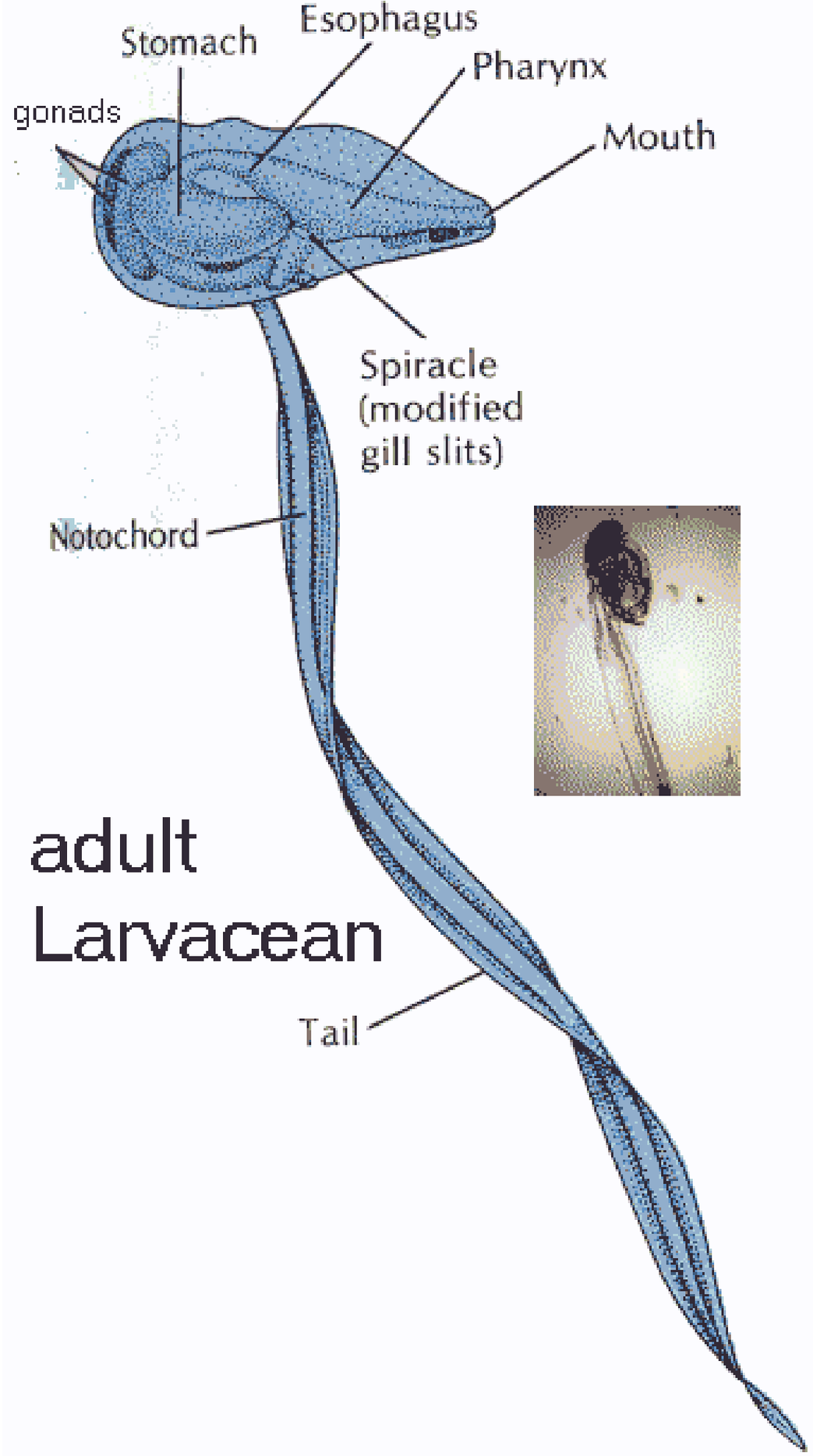
Class Larvacea





Class Larvacea

Ecological importance?



Subphylum Urochordata

- Class Ascidiacea
- Class Larvacea
- Class Thaliacea
- Class Sorberacea*

Class Thaliacea

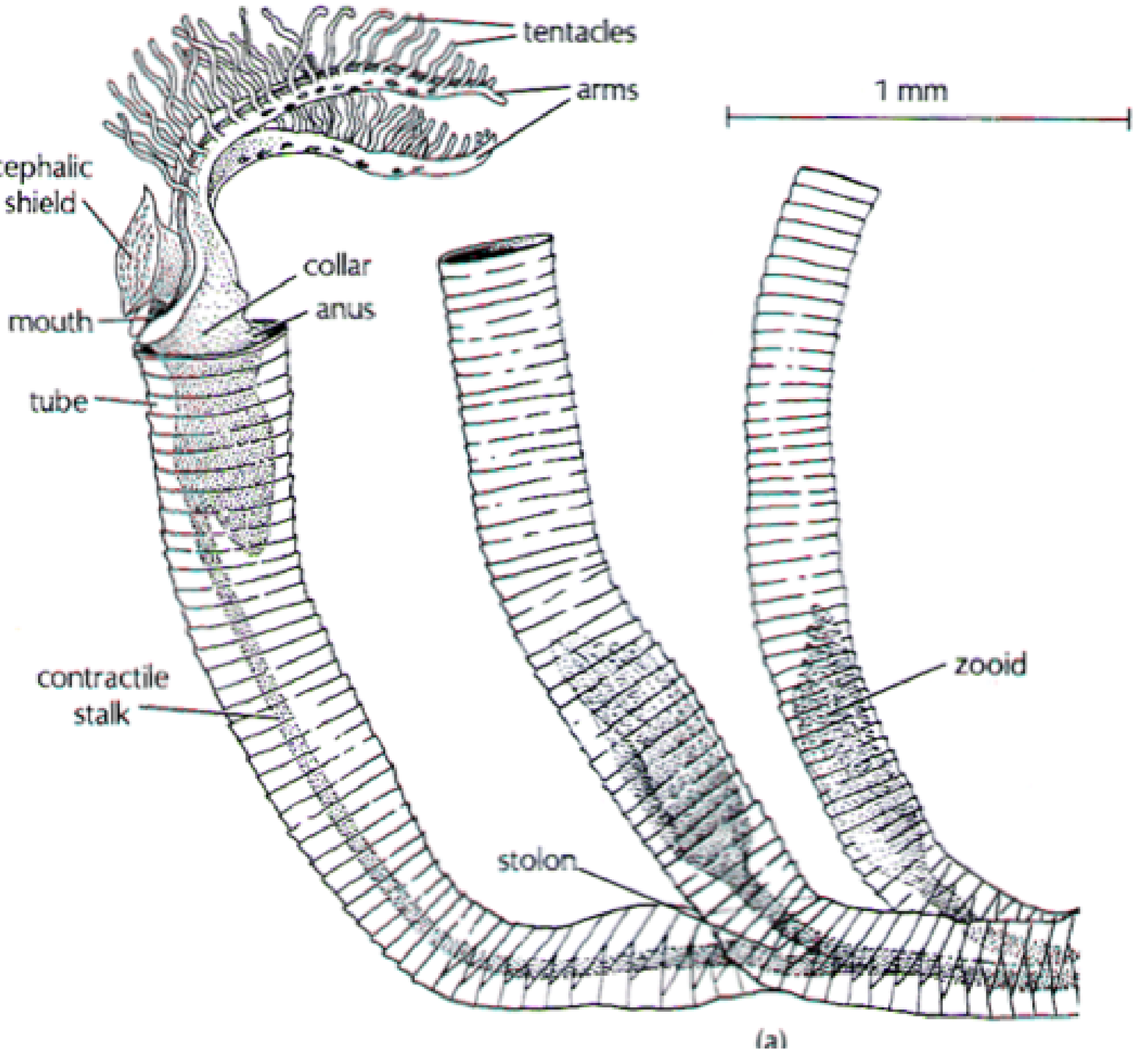
7. Pyrosomes are colonial tunicates, animals related to sea squirts, that look like fuzzy paint rollers, with individuals arranged around a hollow tubular center. This one has a spiny single-celled animal called a radiolarian, hitching a ride at one end.

Class Thaliacea

7. Pyrosomes are colonial tunicates, animals related to sea squirts, that look like fuzzy paint rollers, with individuals arranged around a hollow tubular center. This one has a spiny single-celled animal called a radiolarian, hitching a ride at one end.

Who were the colonial hemichordates?

Class Pterobranchia



(a)

Subphylum Urochordata

- Class Ascidiacea
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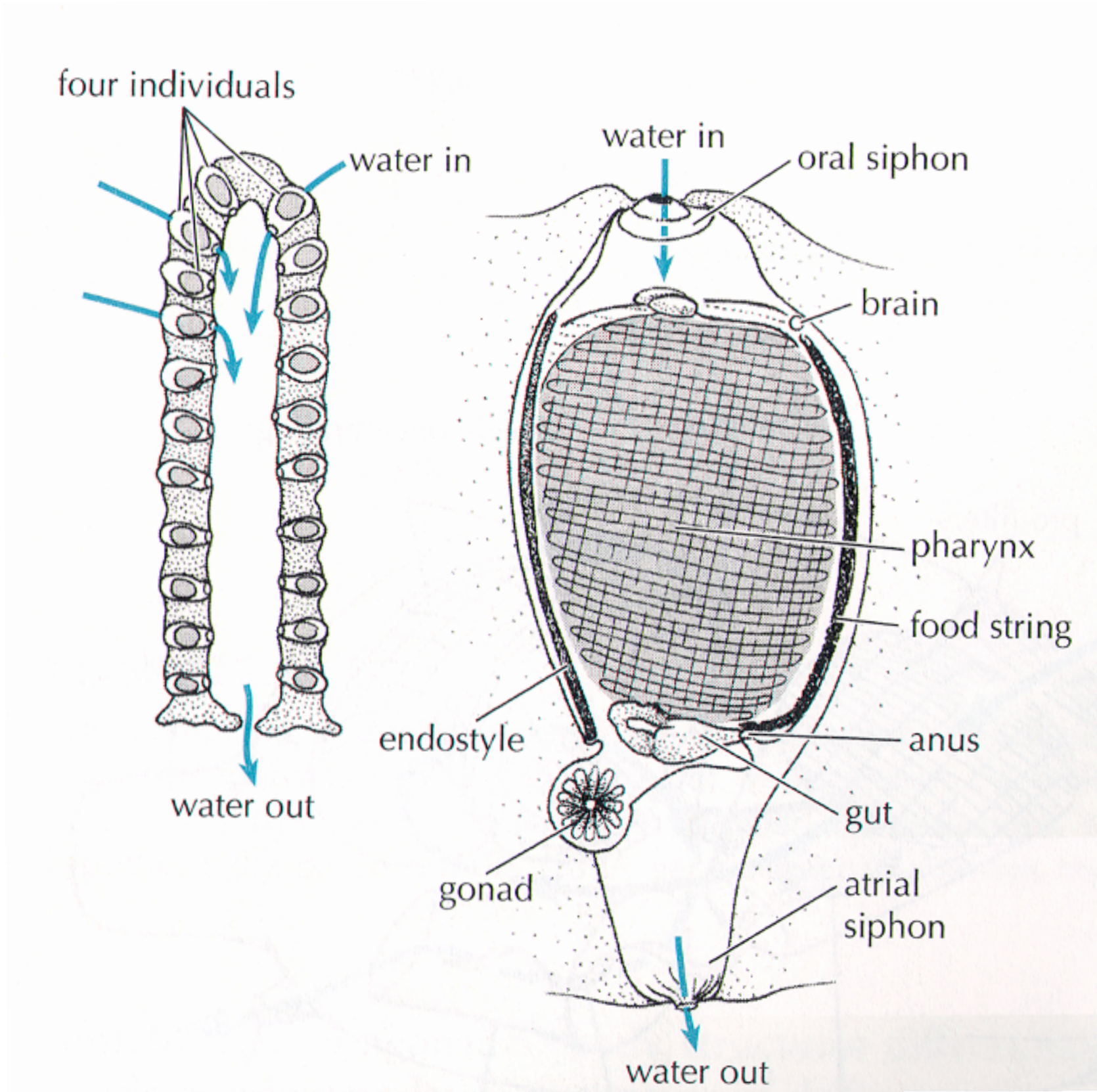
Class Thaliacea



Class Thaliacea

Subphylum Urochordata

- Class Ascidiacea
- Class Larvacea
- Class Thaliacea
- Class Sorberacea

Class Sorberacea