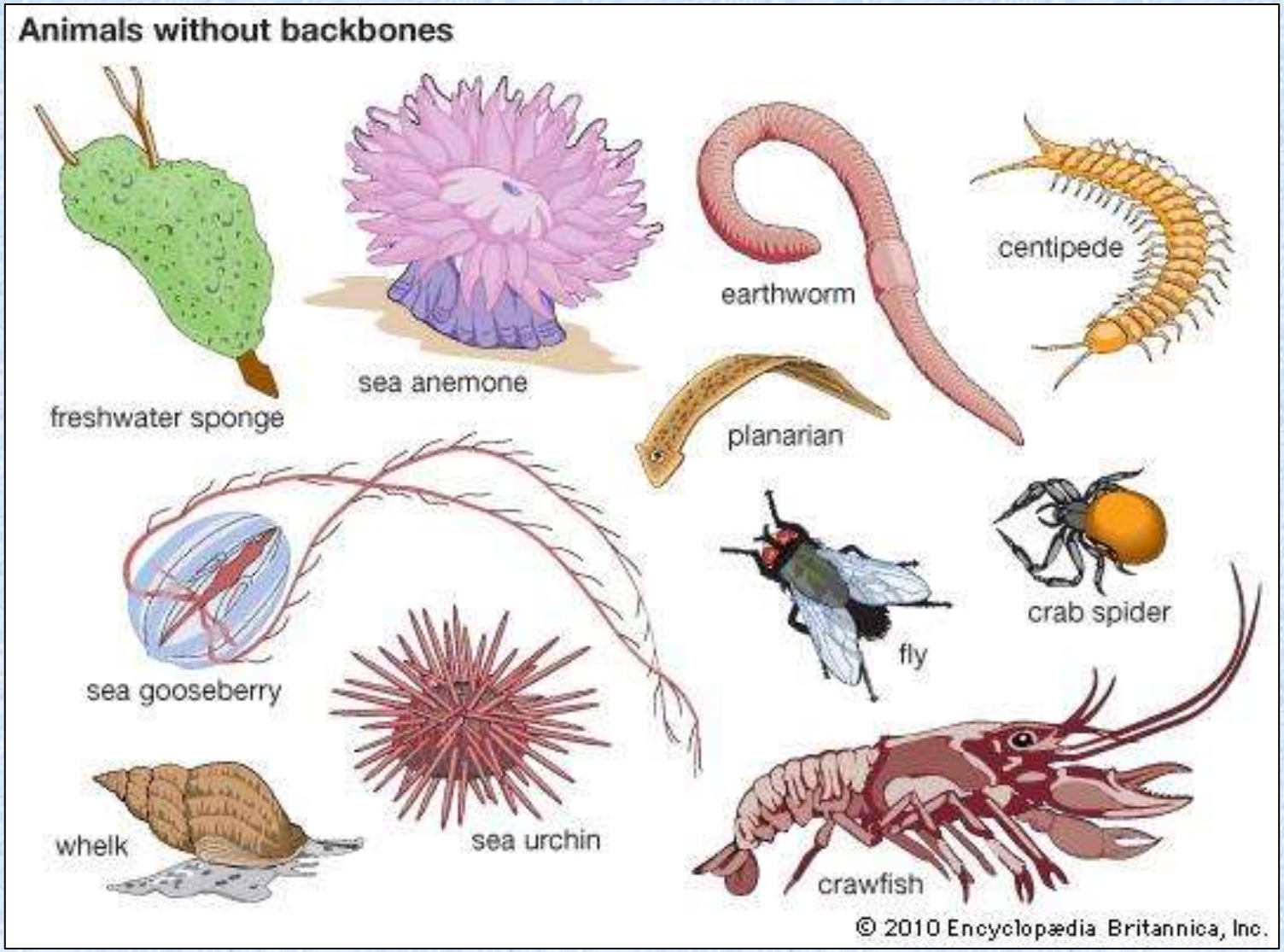
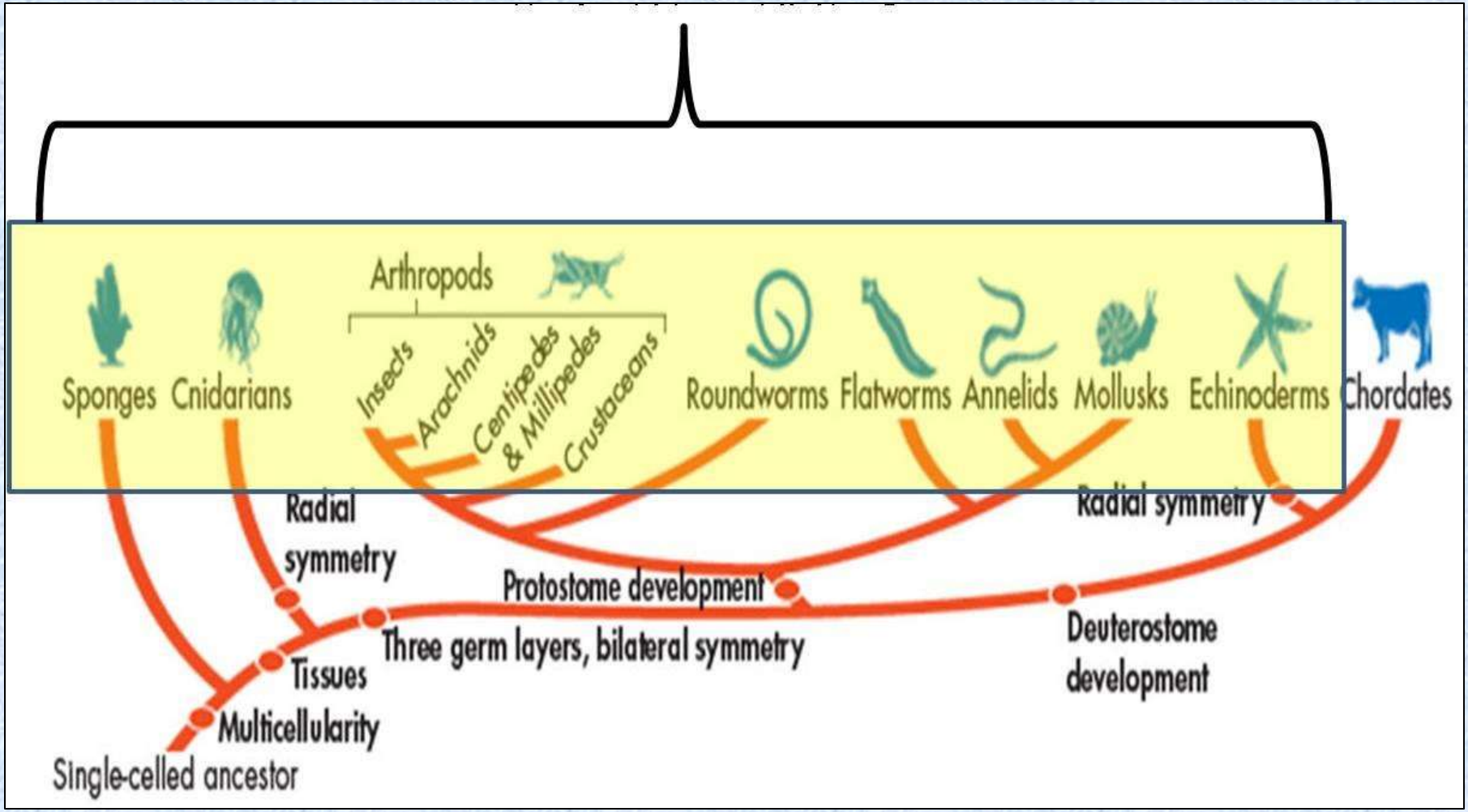
Invertebrates

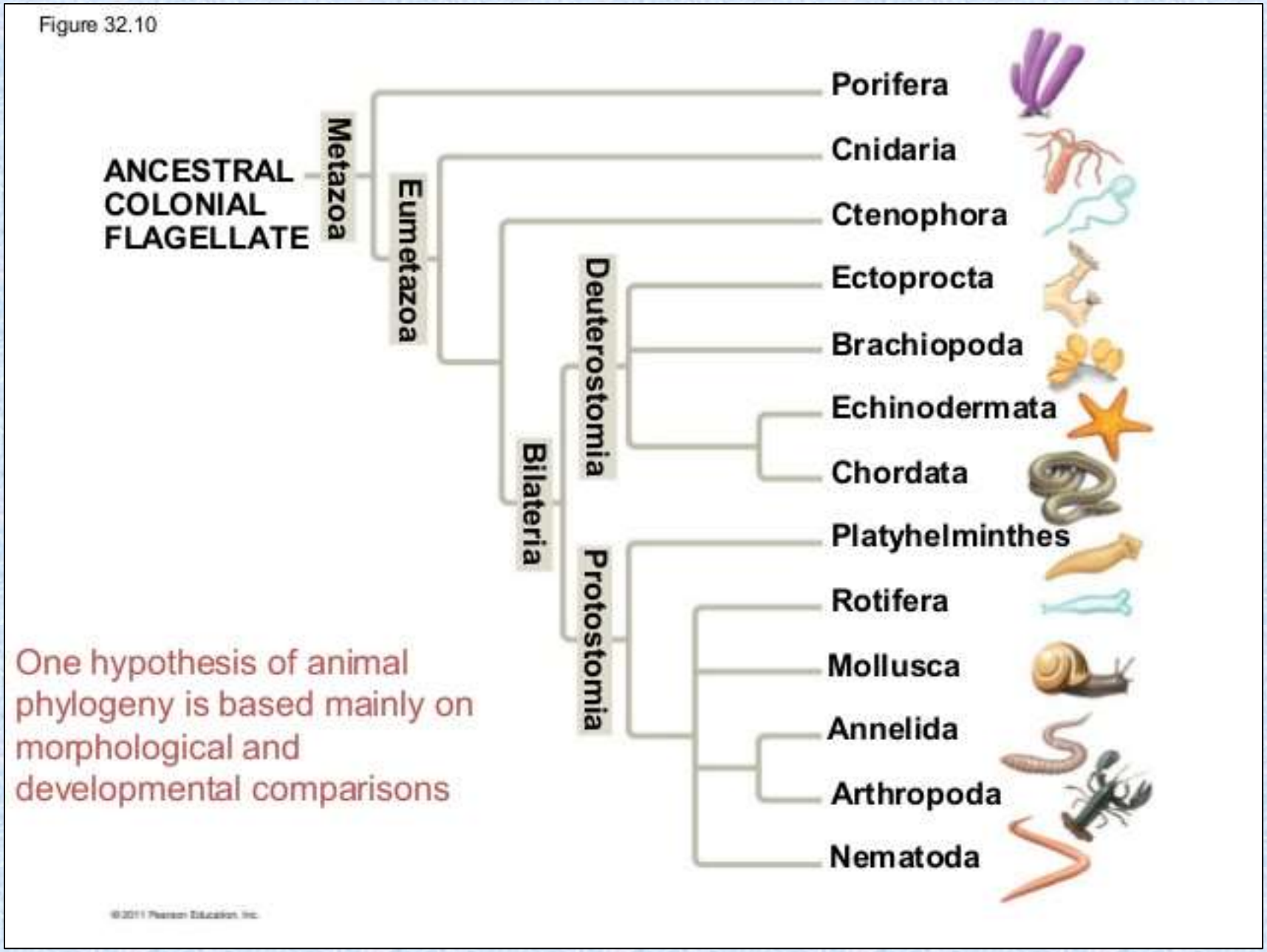


Invertebrates:

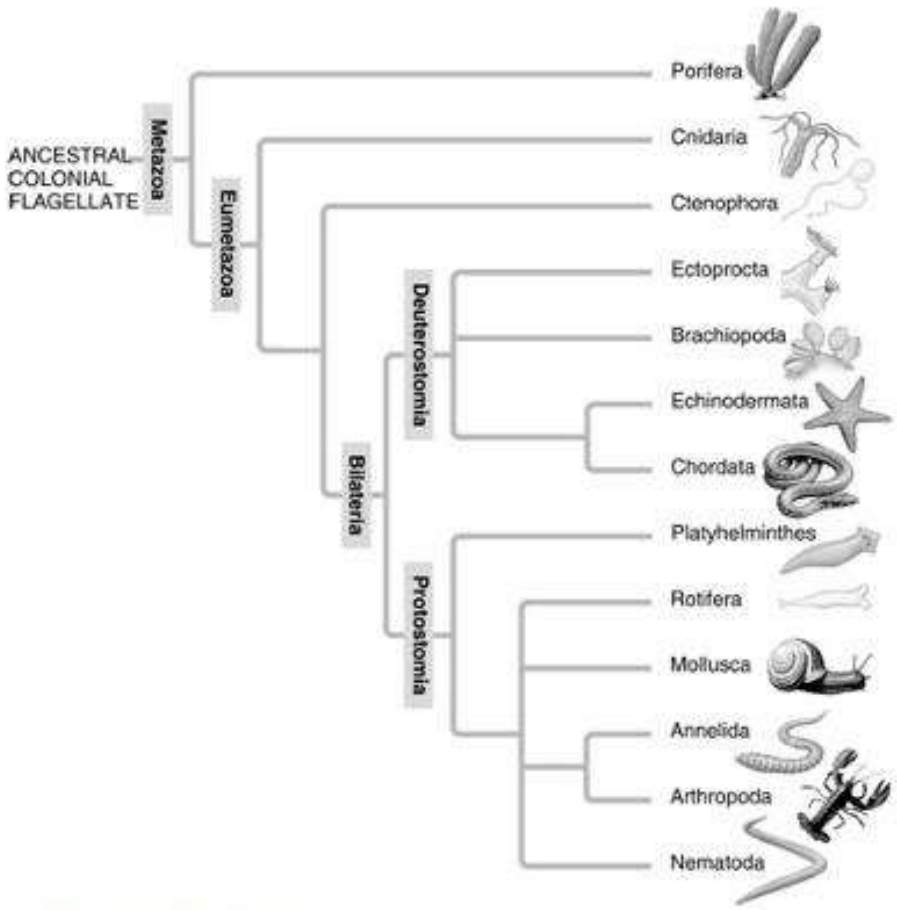
- Are animals without backbones
- Represent 95% of the animal kingdom



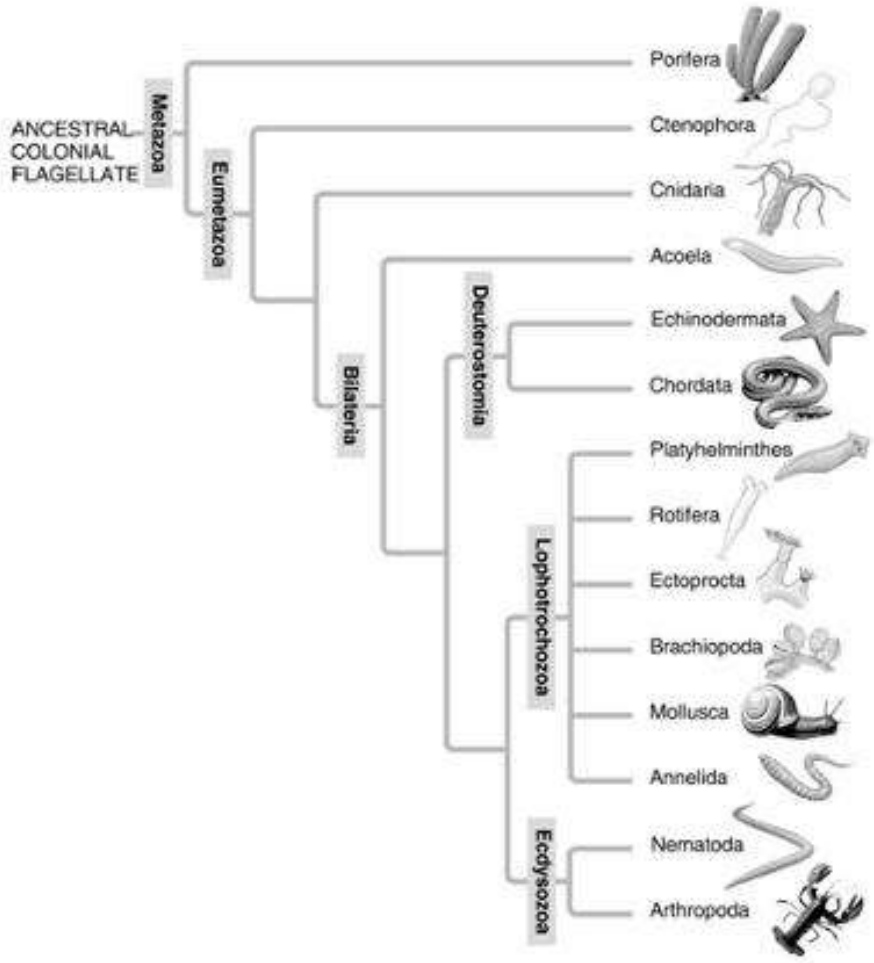
Animal Diversity



Morphological vs. Molecular Character Phylogeny?



A: Morphological phylogeny.



B: Molecular phylogeny.

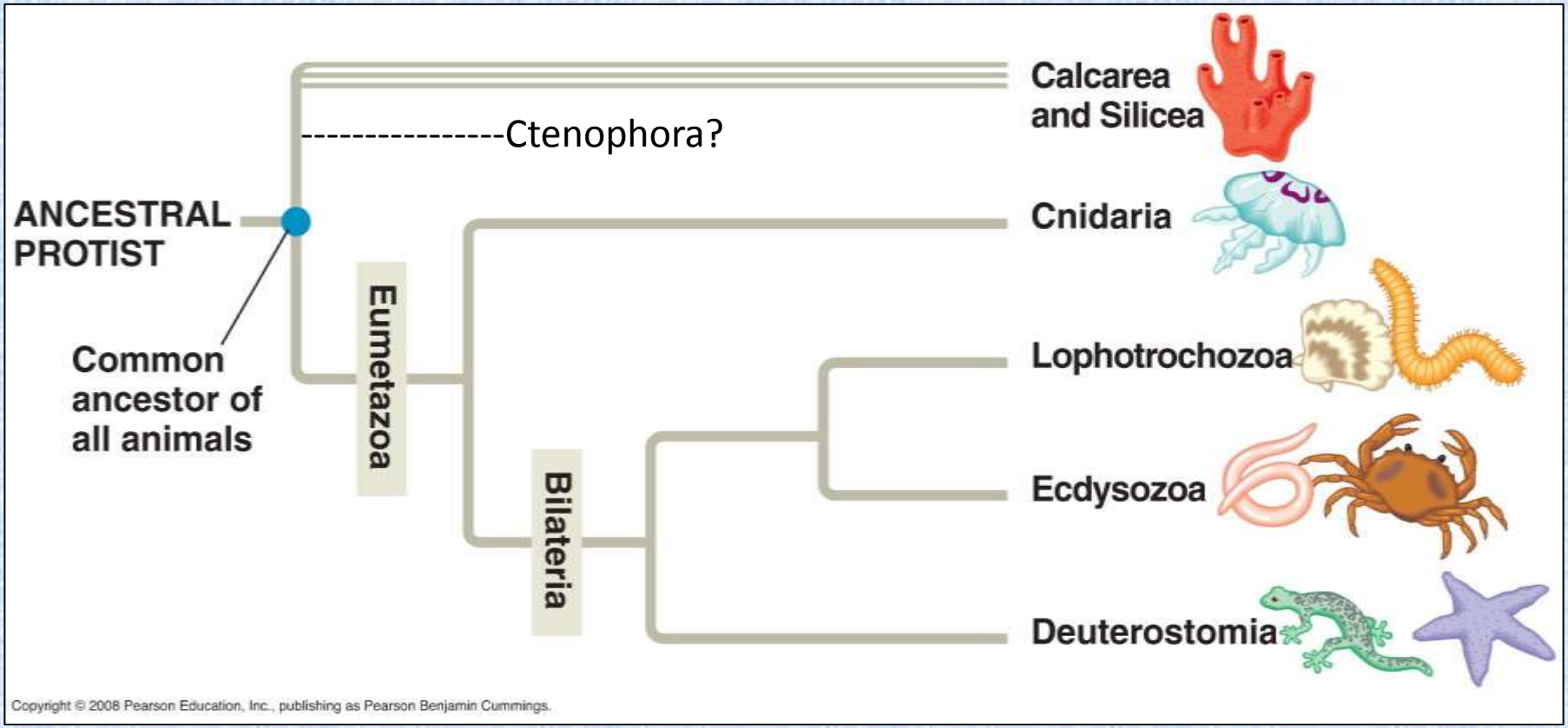
A tree is a hypothesis supported or not supported by evidence. Groupings change as new evidence become available.

Sponges - Porifera

Natural Bath Sponges – over-collected, now uncommon

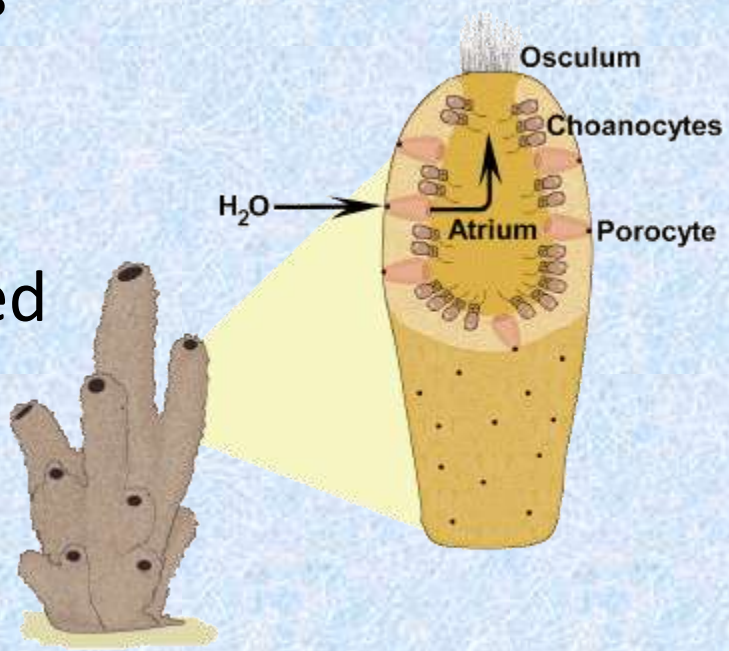
Sponges

- Perhaps oldest animal phylum (Ctenphora possibly older)
- may represent several old phyla, some now extinct

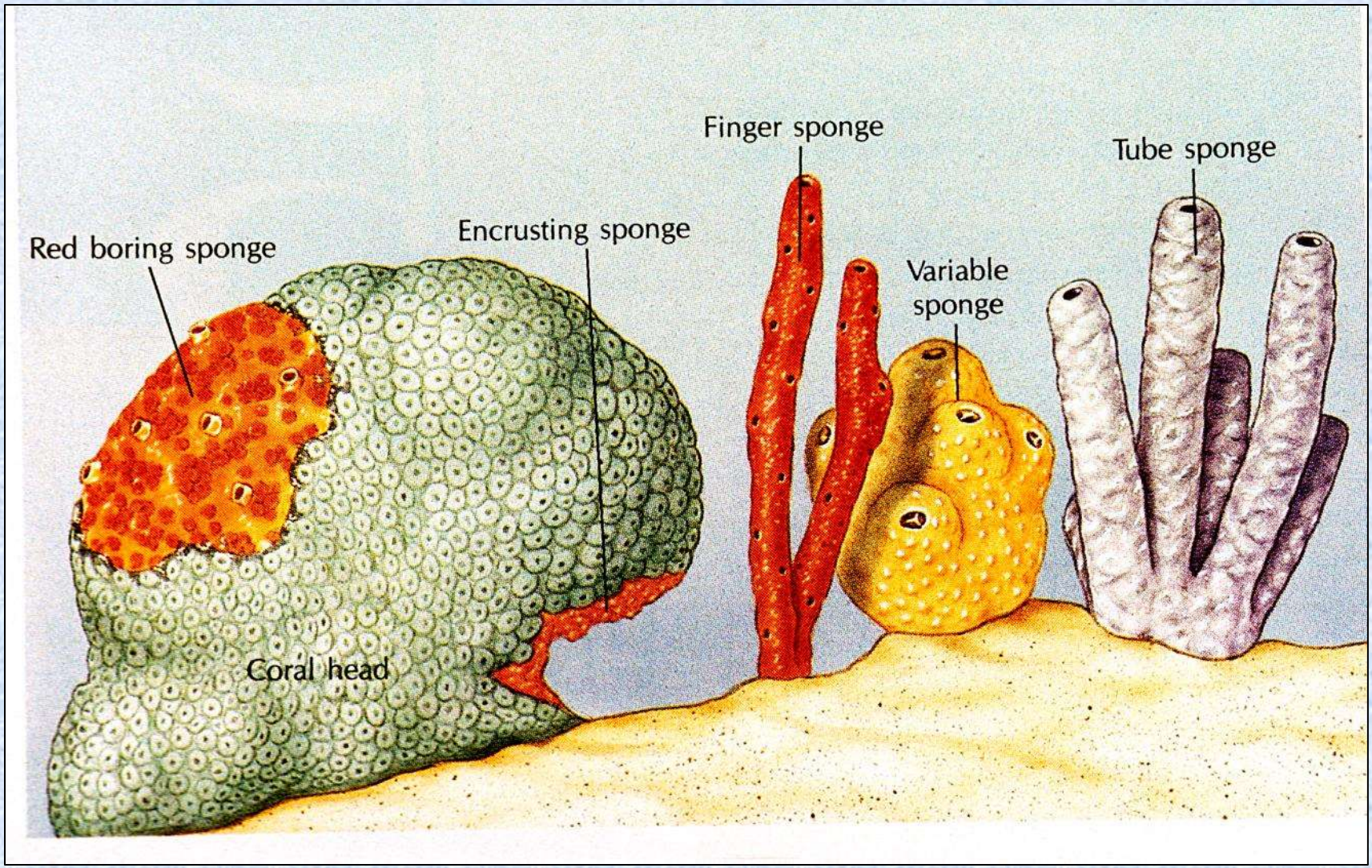


Sponges - Porifera

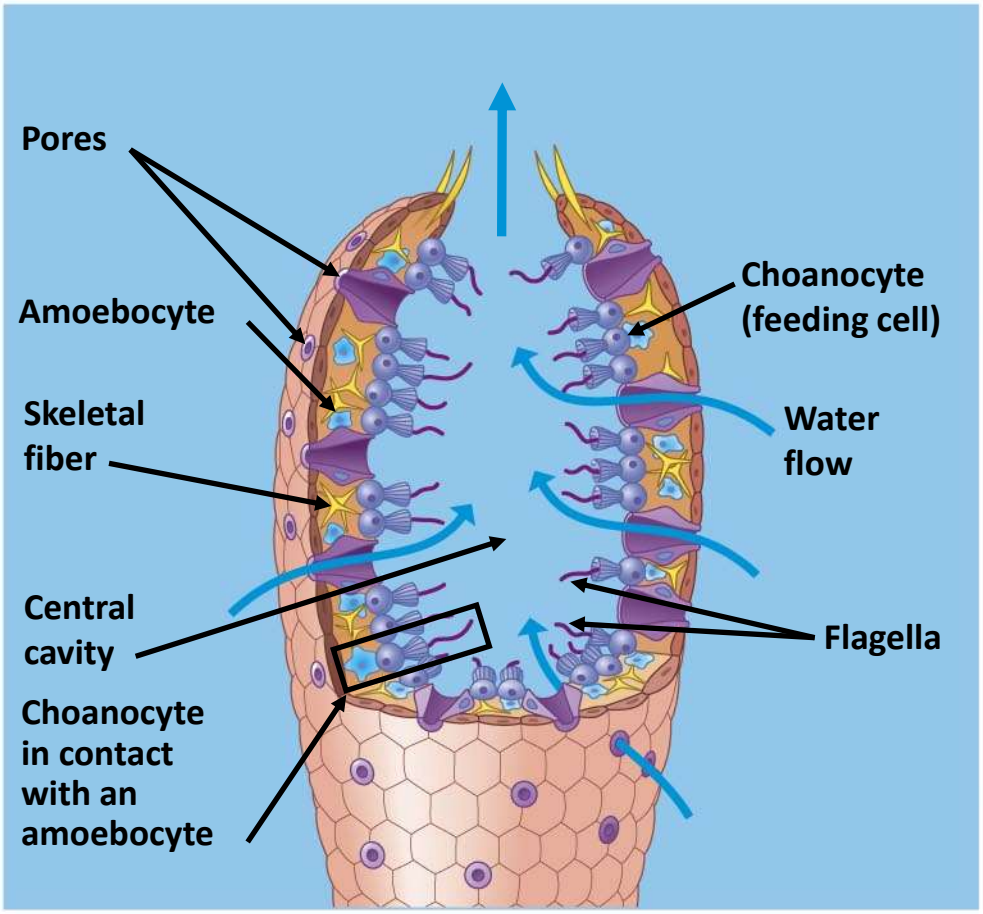
- Mostly marine
- Sessile animals
- Lack true tissues;
- Have only a few cell types, cells kind of independent
- Most have no symmetry
- Body resembles a sac perforated with holes, system of canals.
- Strengthened by fibers of spongin, spicules

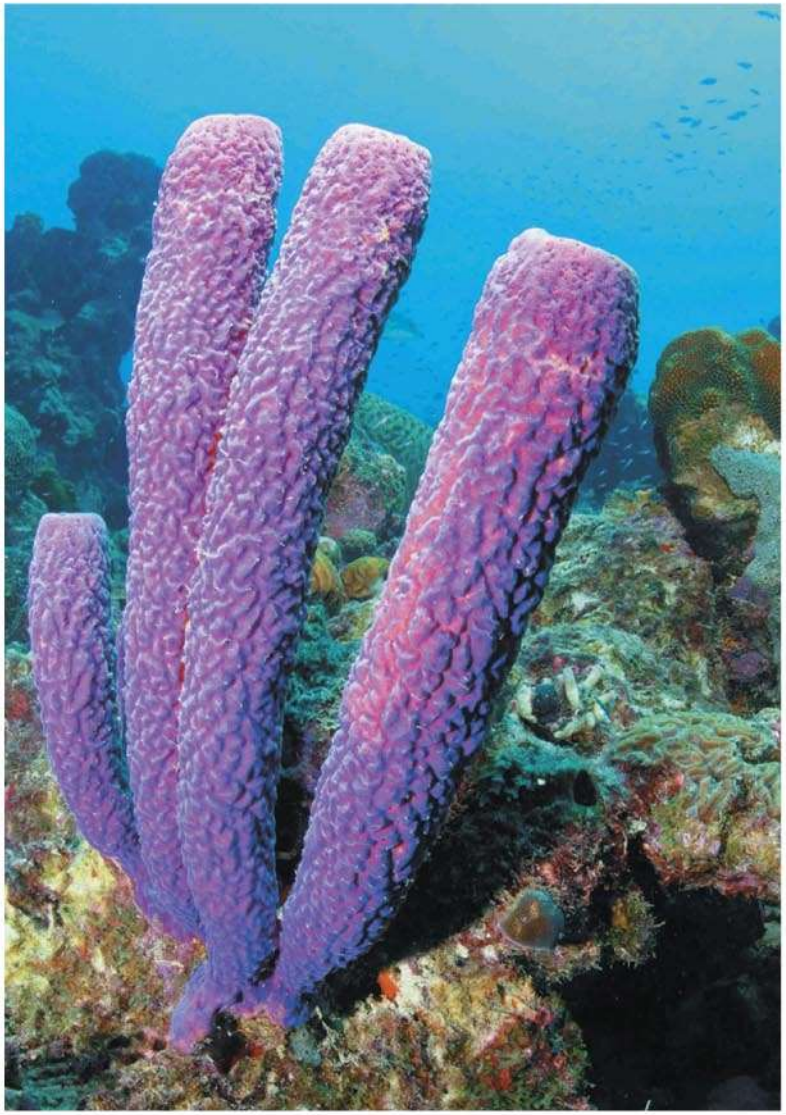


Sponges have a variety of shapes



Sponges



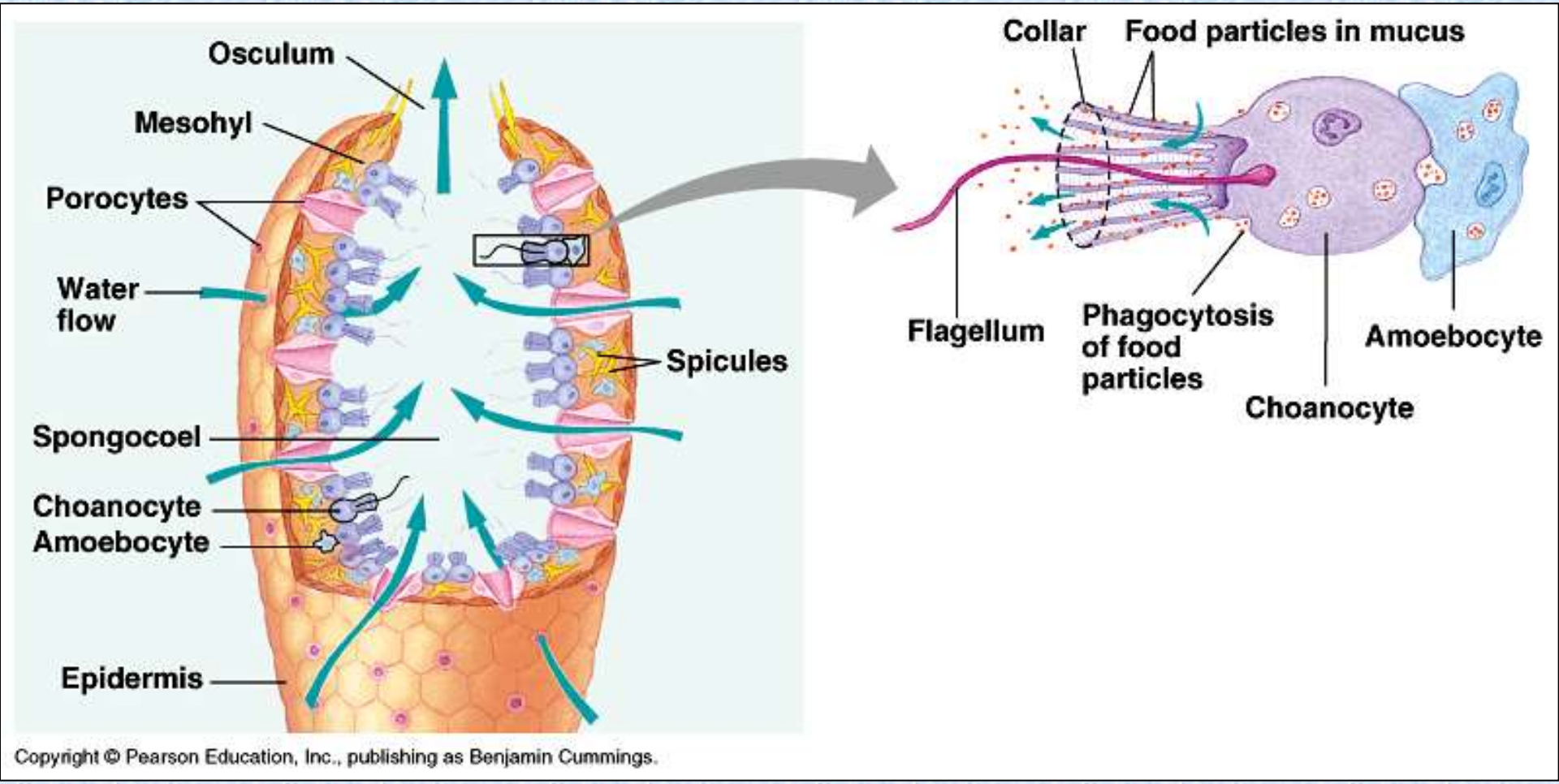


Sponges - Porifera

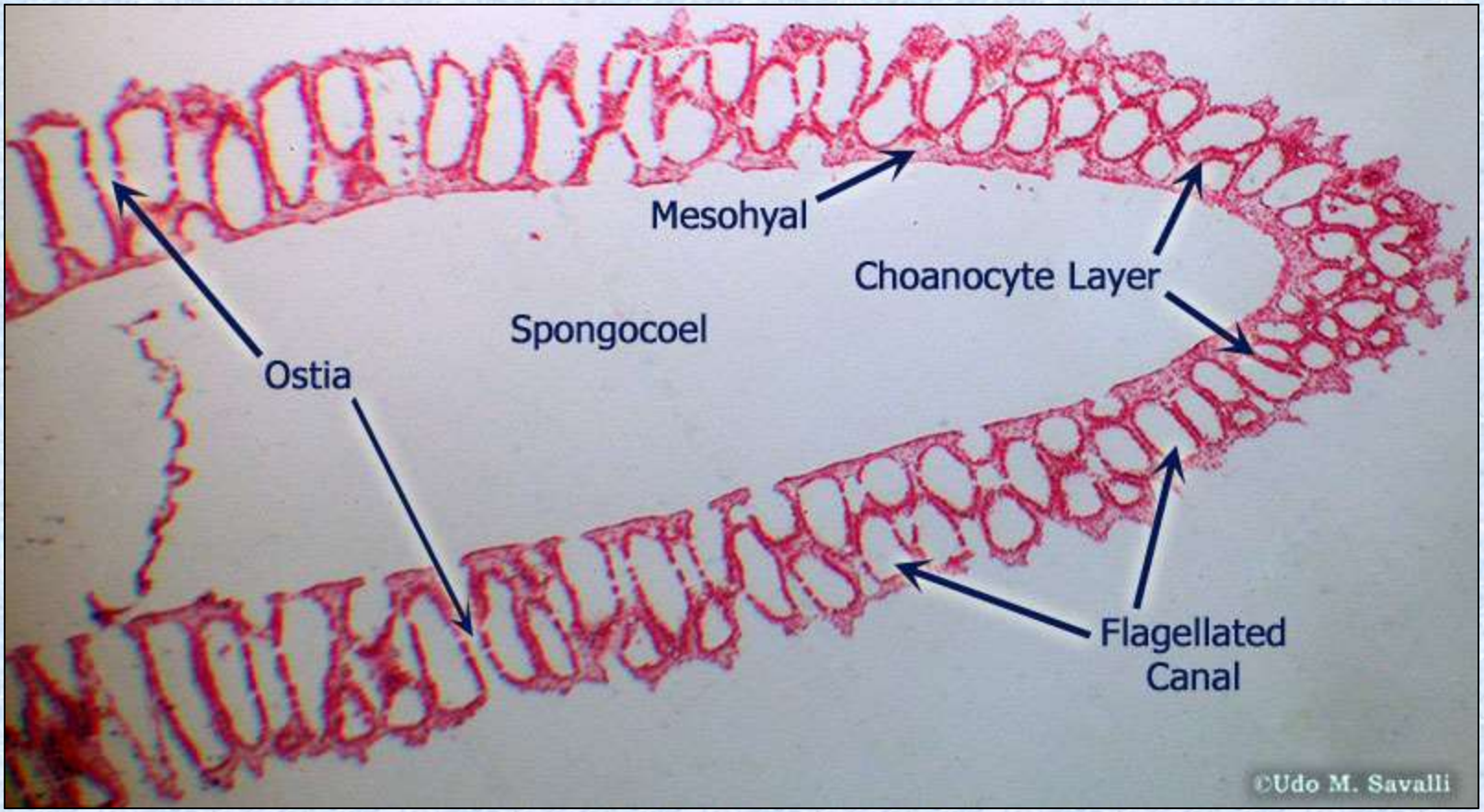
- Sessile filter feeder
- No mouth
- Sac-like body, perforated by pores.
- Interior lined by flagellated cells (choanocytes).

  Flagellated collar cells generate a current, draw water through the walls of the sponge where food is collected.
- Amoeboid cells move around in the mesophyll and distribute food.

Sponges - Porifera



Grantia x.s.


Mesohyal
Choanocyte Layer
Spongocoel
Ostia
Flagellated Canal
©Udo M. Savalli

Sponge Reproduction

Asexual reproduction

- Fragmentation or by budding.
- Sponges are capable of regeneration, growth of a whole from a small part.

Sexual reproduction

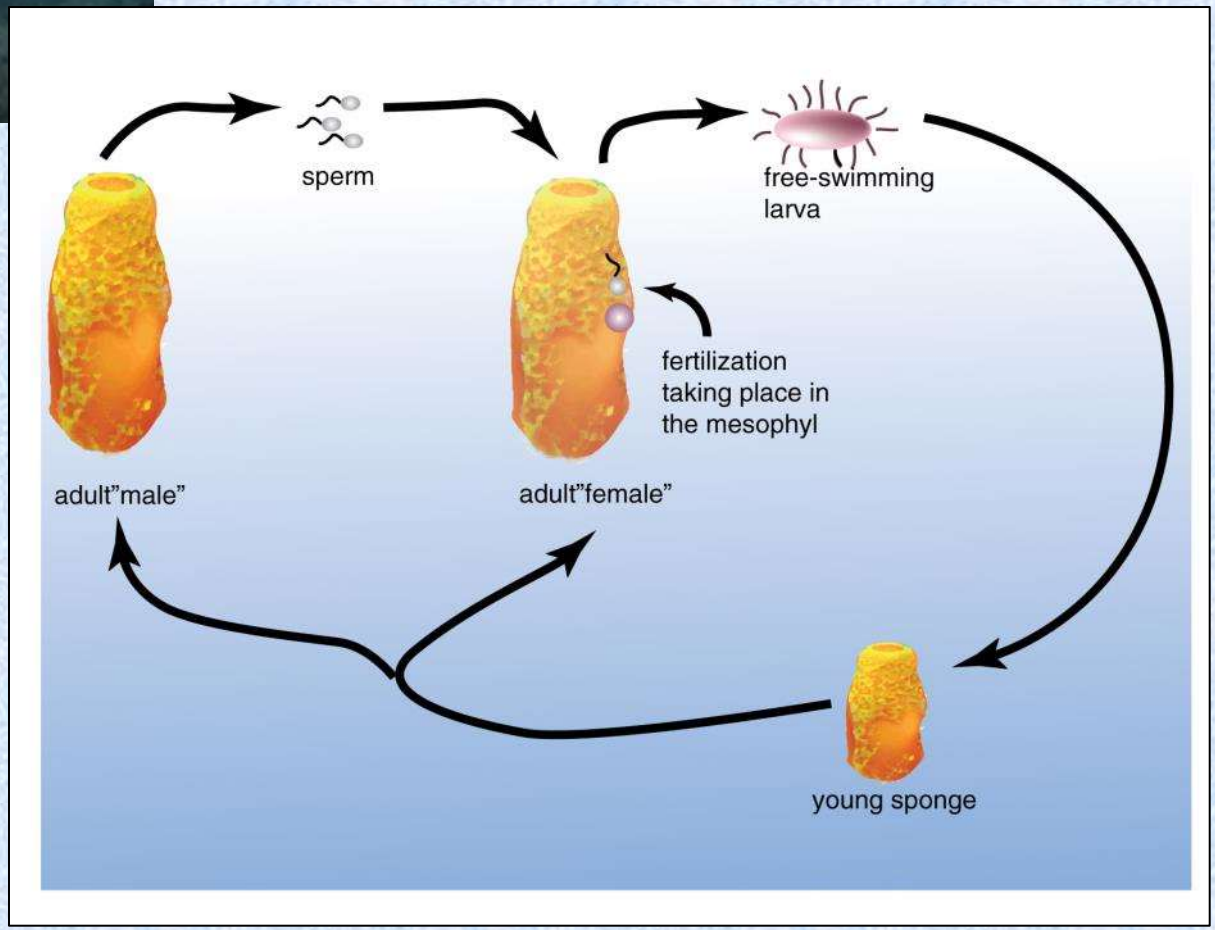
- Hermaphrodites, produce both eggs and sperm
- Eggs and sperm released into the central cavity
- Produces a flagellated larva that swims to a new location.

Reaggregation – can be ground up, rebuilds itself

YouTube Timelapse of Sponge Aggregation
https://www.youtube.com/watch?v=SvtDMo7fjAc

Sponges
Sexual Reproduction

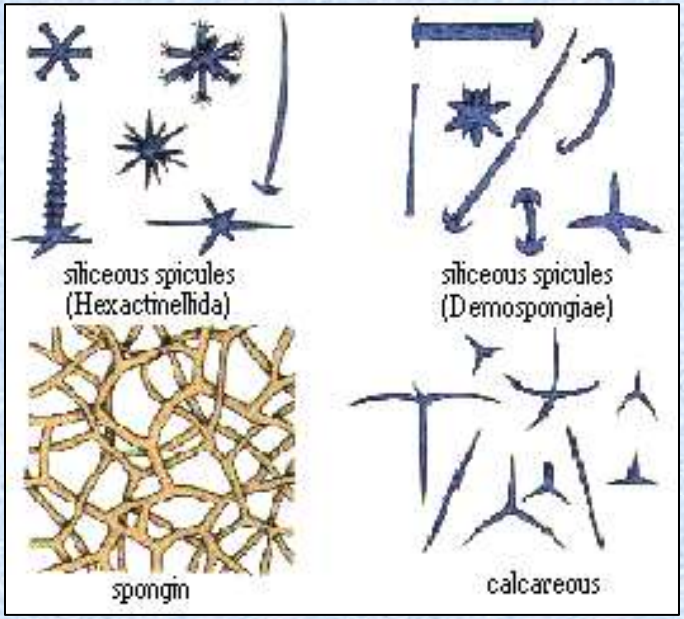
Sponge Larva



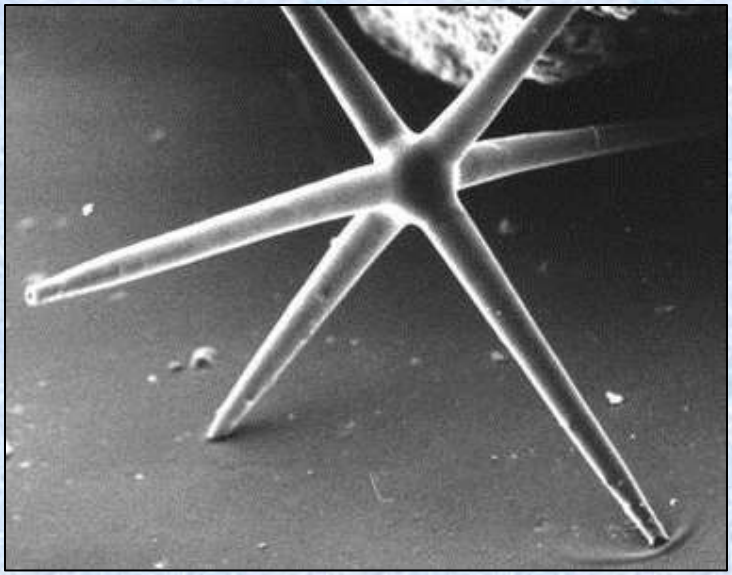
Sponge Classification

900 species

Groups based on spicules
3 major groups



- Glass Sponges – spicules composed of silicates
- Calcareous Sponges – spicules composed of calcium carbonate
- Spongin sponges



Freshwater Sponge in Missouri - *Spongilla*

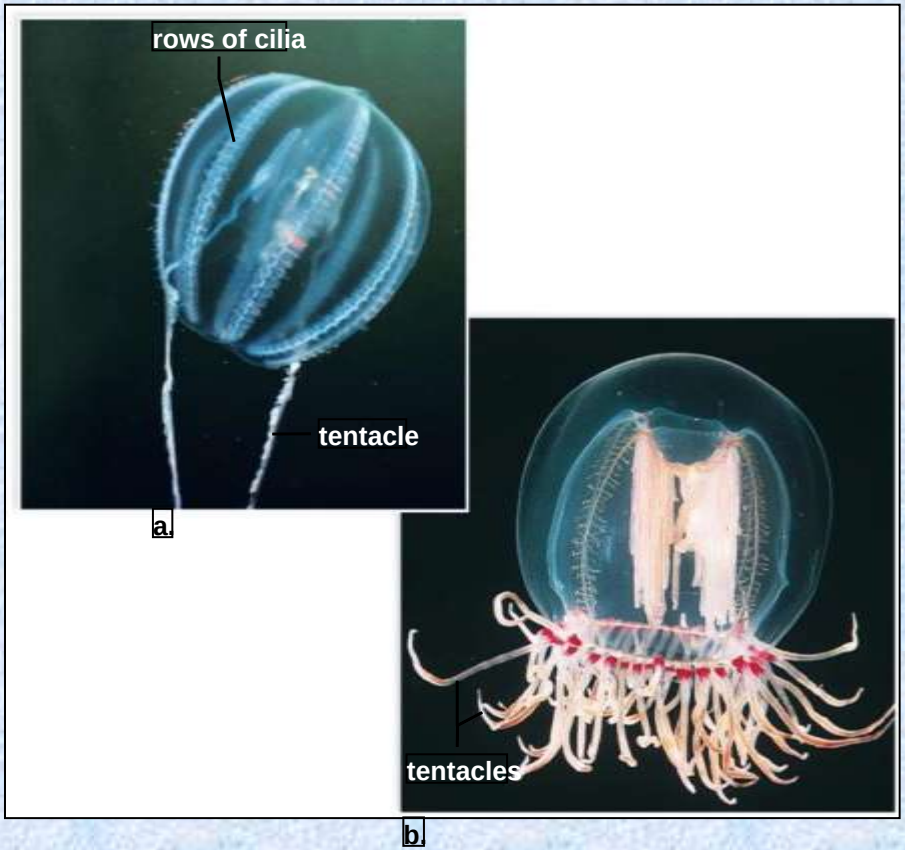
Photo by Greg Stoner, taken at the Lake of the Ozarks

Insect larva of the spongilla fly (Order Neuroptera), lives only in freshwater sponges

About 30 species in North America

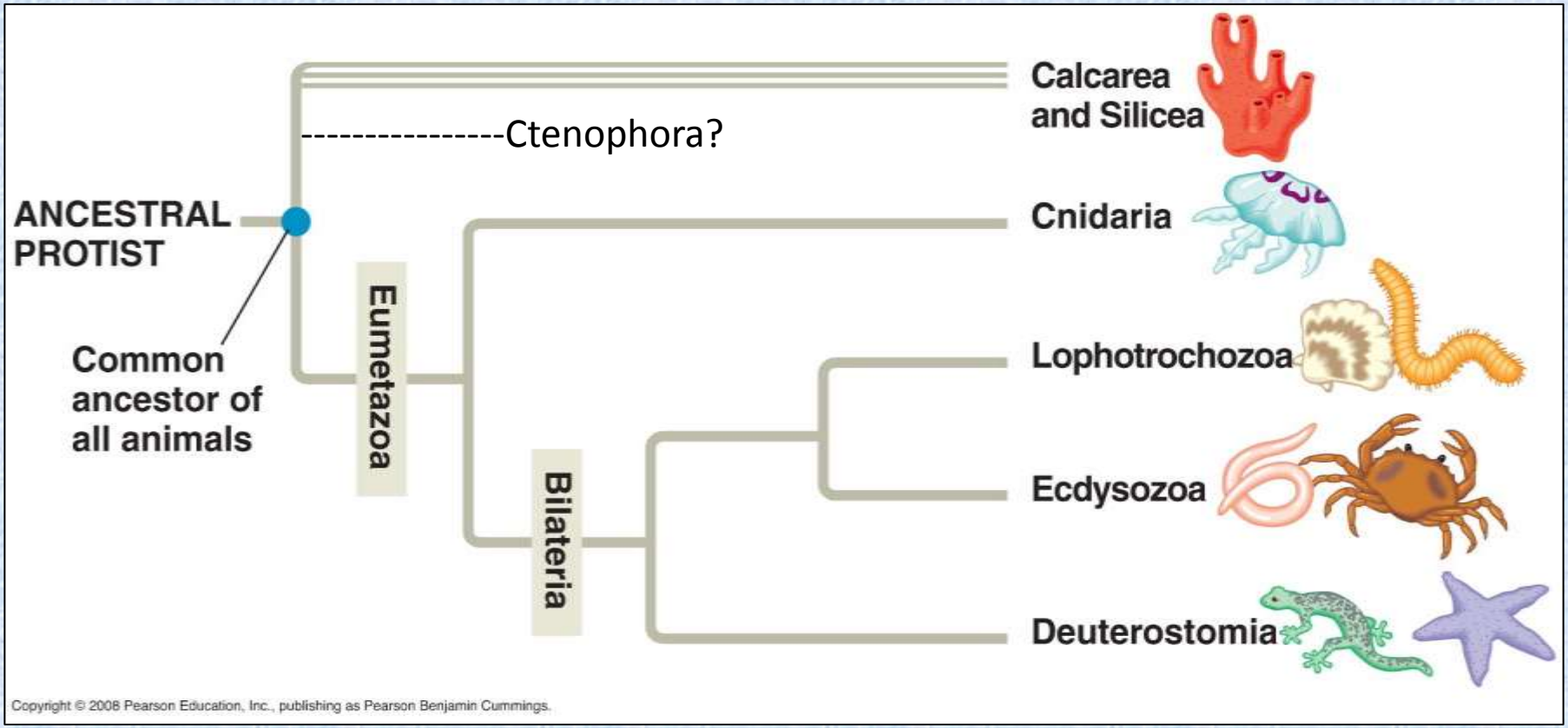
Radiates - Cnidarians (Jellyfish) and Ctenophora (Comb Jellies)

- Radially symmetric
- Consist of two or three layers of cells organized around a central chamber
- Cells in tissues
- Mouth and digestive cavity



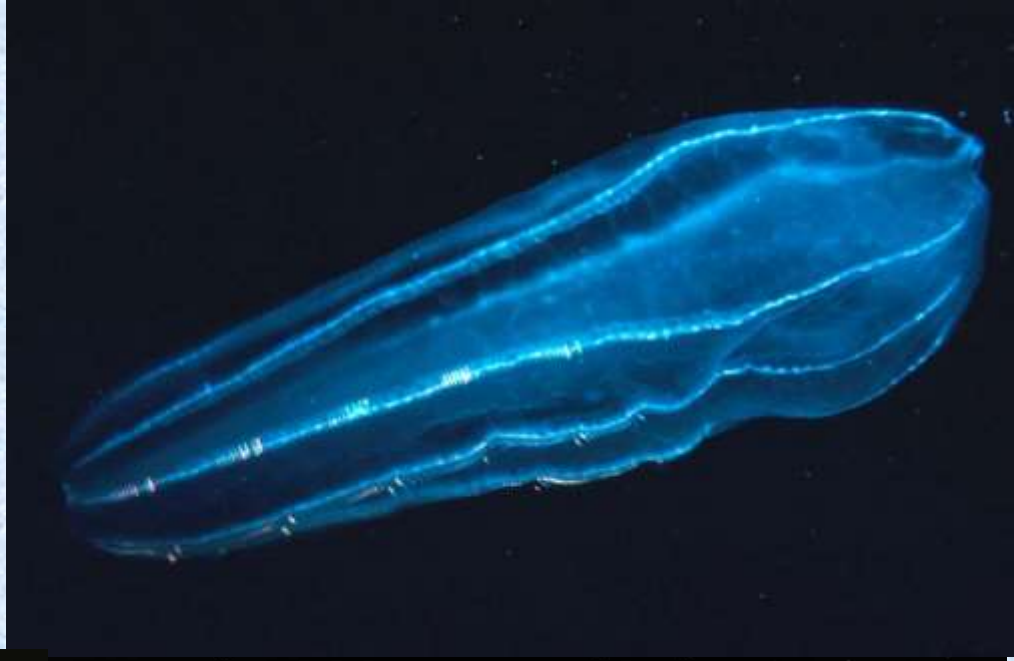
Ctenophora and Cnidaria

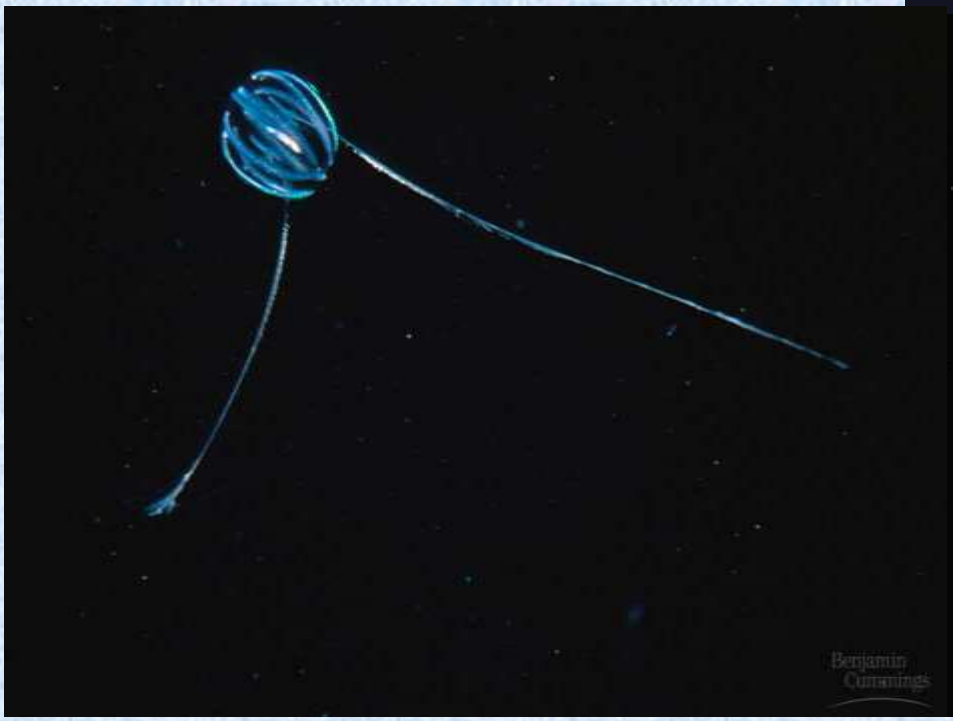
DNA evidence suggests Ctenophores might be older than sponges?

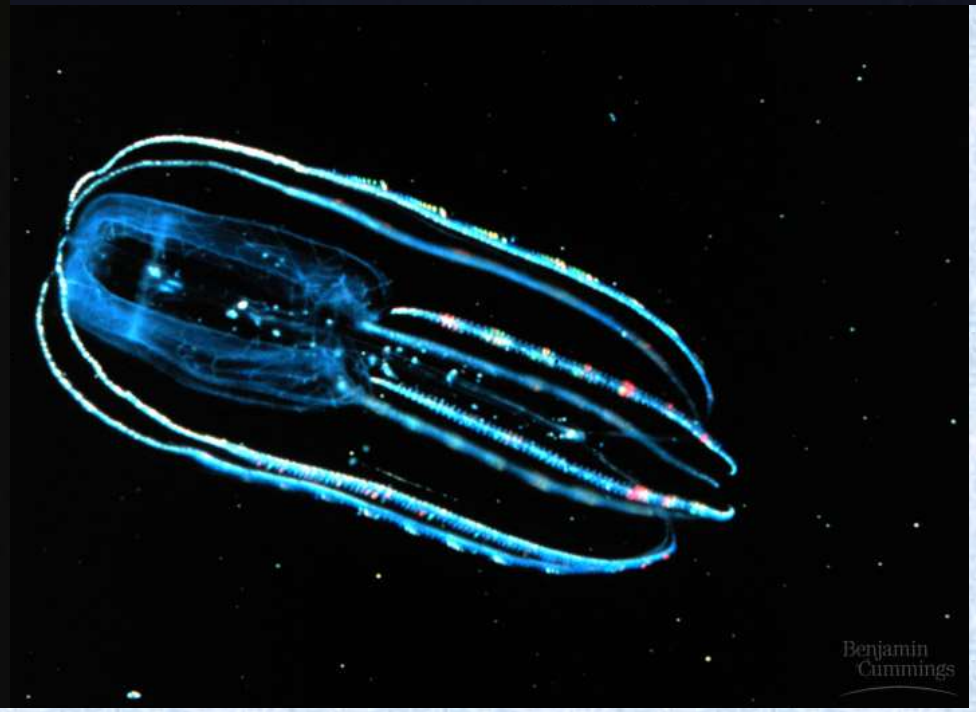


Phylum Ctenophora

- The Comb jellies
- Resemble Jellyfish medusas.
- Sticky cells on tentacles
- Use cilia for locomotion.





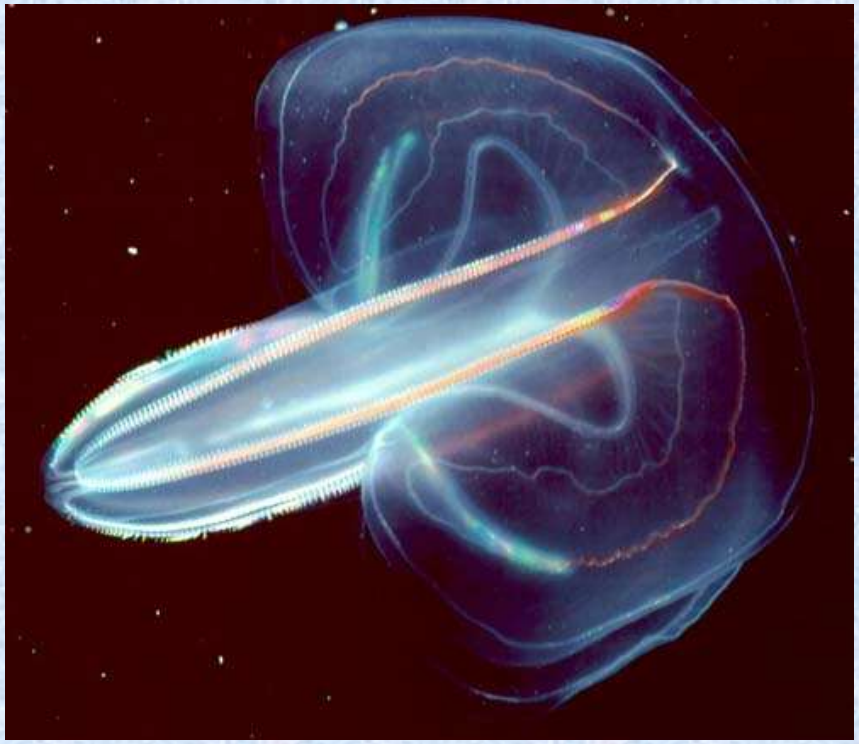


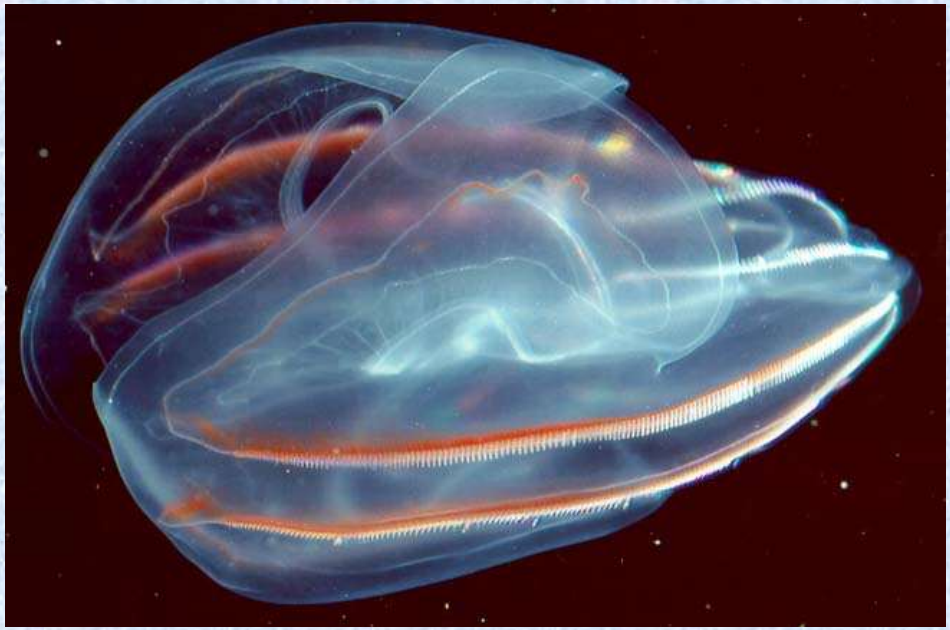
Comb Jellies - Ctenophora

- Solitary, free-swimming marine
- Small, transparent, sometimes *bioluminescent.*
  - Bioluminescent organisms can produce their own light.
- Body composed of **mesoglea,** a jellylike substance.
- DNA sequences suggest possibly more ancient than sponges.
  - Comb jellies may have been the first organisms to evolve, or evolved separately from the Protists.
- Largest animals propelled by beating of cilia.
- Capture prey with colloblasts, sticky cells on tentacles.

Ctenophora

- Hermaphrodites
- Solitary, do not form colonies
- Lack stinging cell
- Capture prey by sticky colloblast cells on tentacles

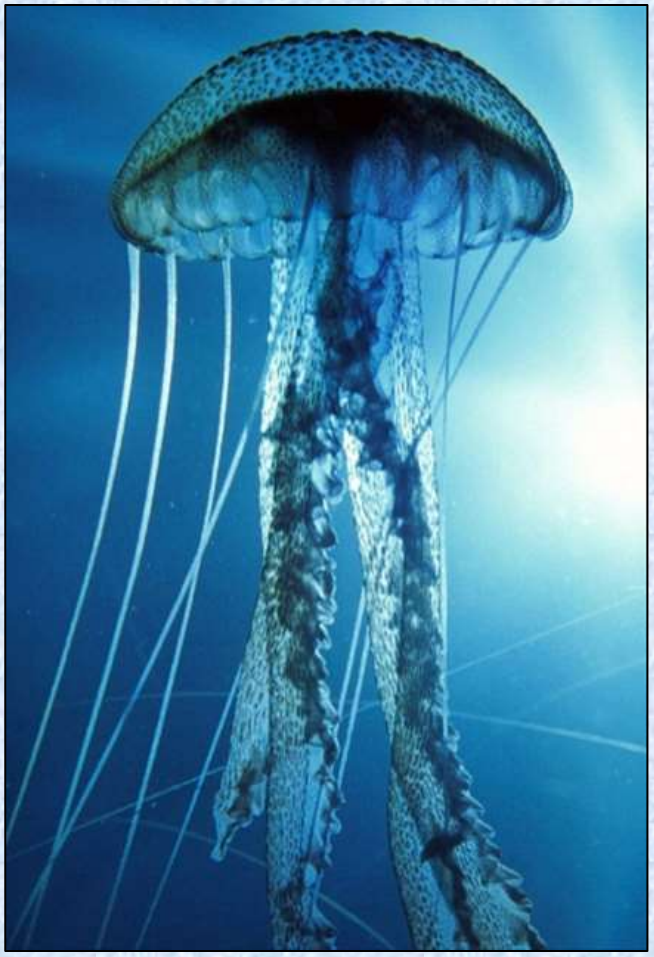




Cnidarians

Jellyfish, Anemones, Coral, Hydras

- Radial symmetry
- 2 distinct tissues
  - Outer layer – Protective epidermis
  - Inner layer – Gastrovascular cavity
- Mesoglea - noncellular matrix between layers, makes up bulk of animal.
- Diffuse nervous system
- Gastrovascular cavity
- Incomplete digestive system
- Stinging cells - cnidocytes
- Polyp and medusa forms



Cnidarian Diversity

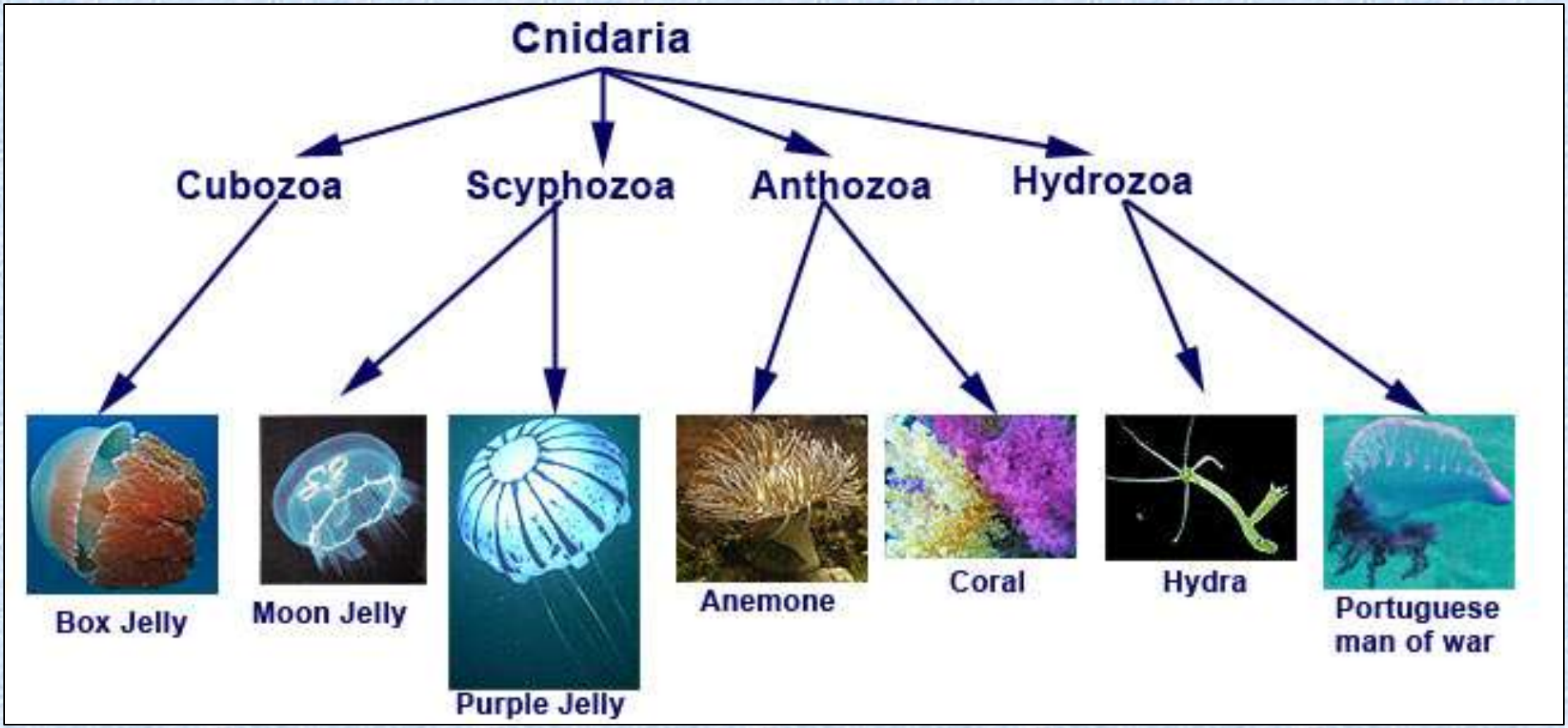
a. Sea anemone, *Condylactis*

b. Cup coral, *Tubastrea*

c. Portuguese man-of-war, *Physalia*

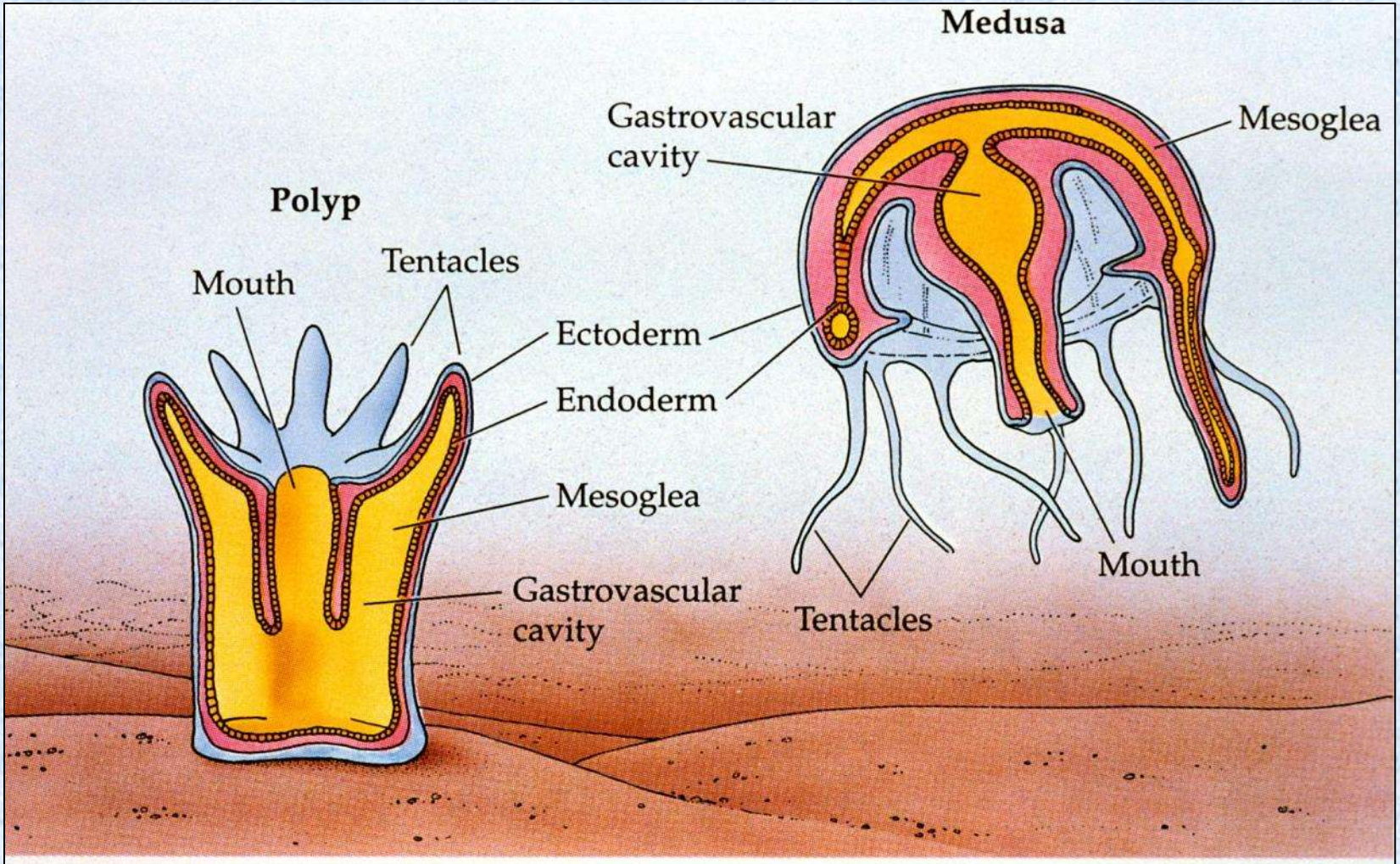
d. Jellyfish, *Aurelia*

Cnidarian Diversity

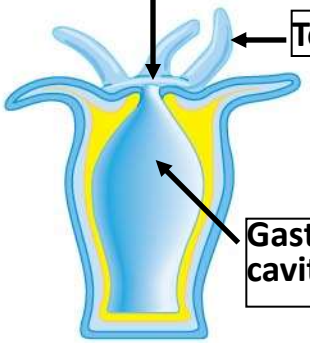


Polyp and **medusa** body forms.

The polyp mouth is directed upward, while the mouth of a jellyfish or medusa is directed downward



150 Cnidarians Have Two Body Forms, Figure 26.11

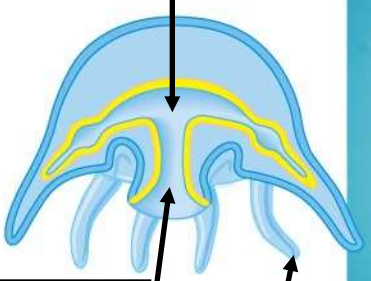


Polyp form

Coral

Hydra

Sea anemone



Medusa form

Jelly

Cnidocyte

Cells with Stinging Hairs

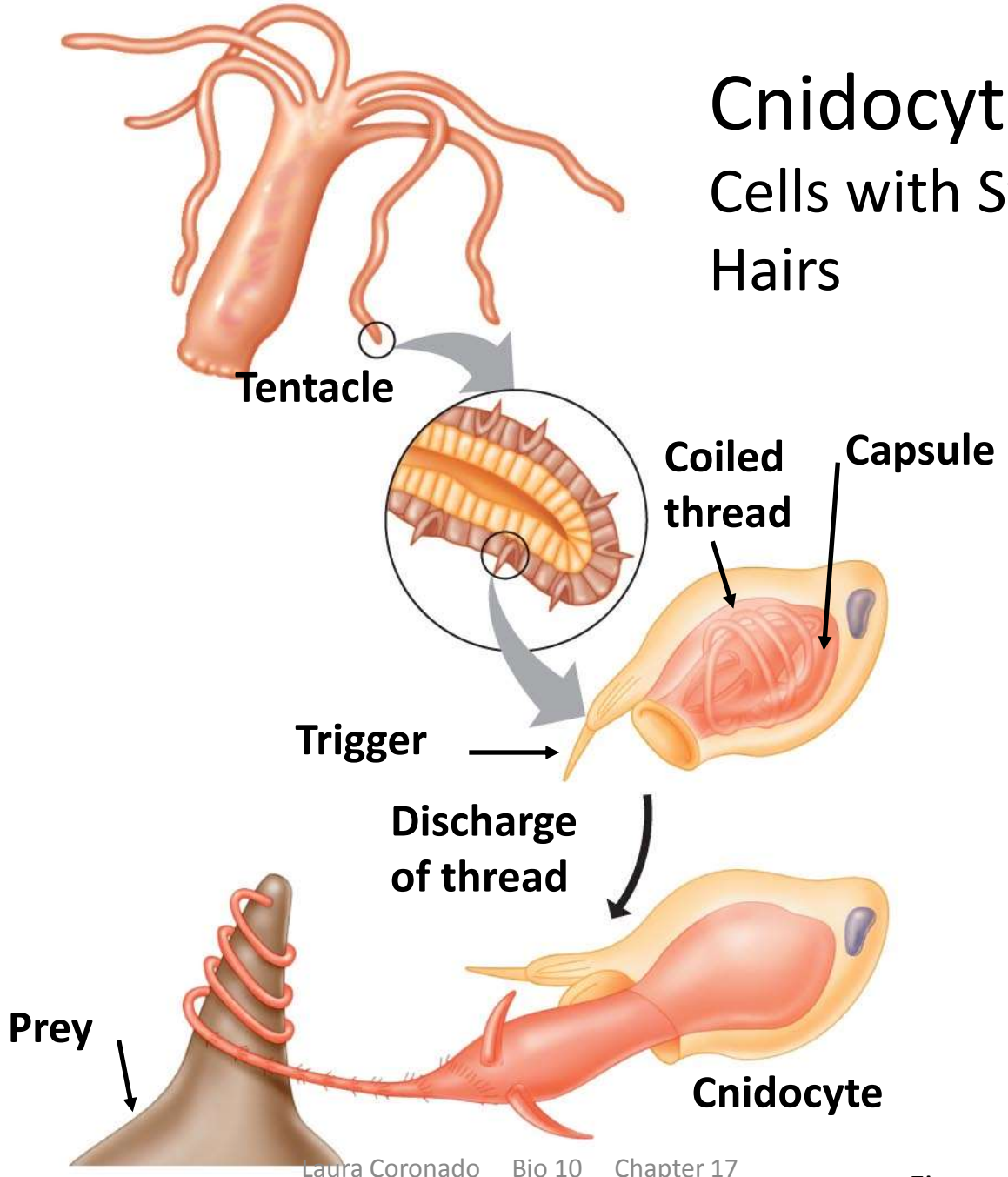
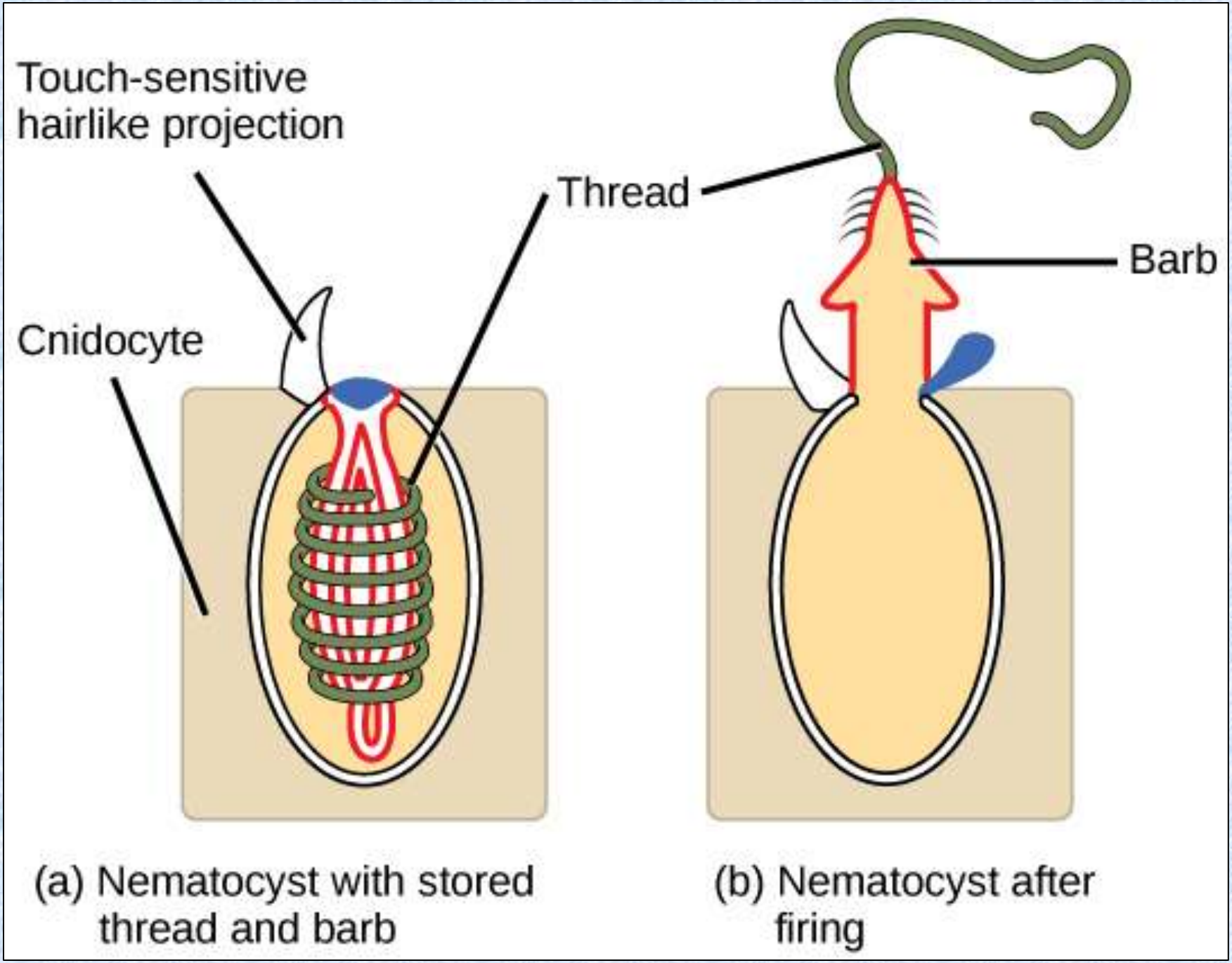
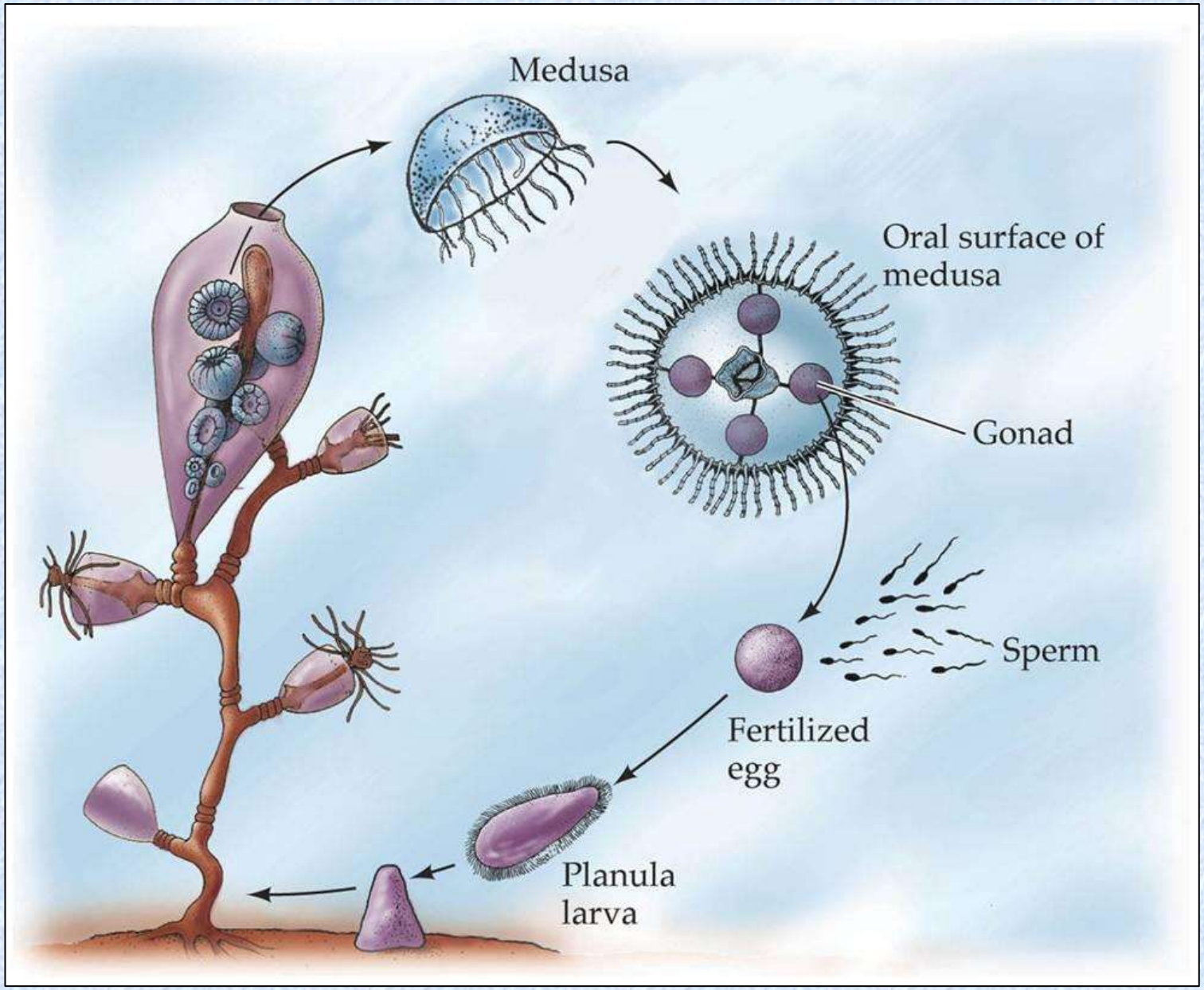


Figure 17.10


Touch-sensitive hairlike projection
Thread
Barb
Cnidocyte
(a) Nematocyst with stored thread and barb
(b) Nematocyst after firing

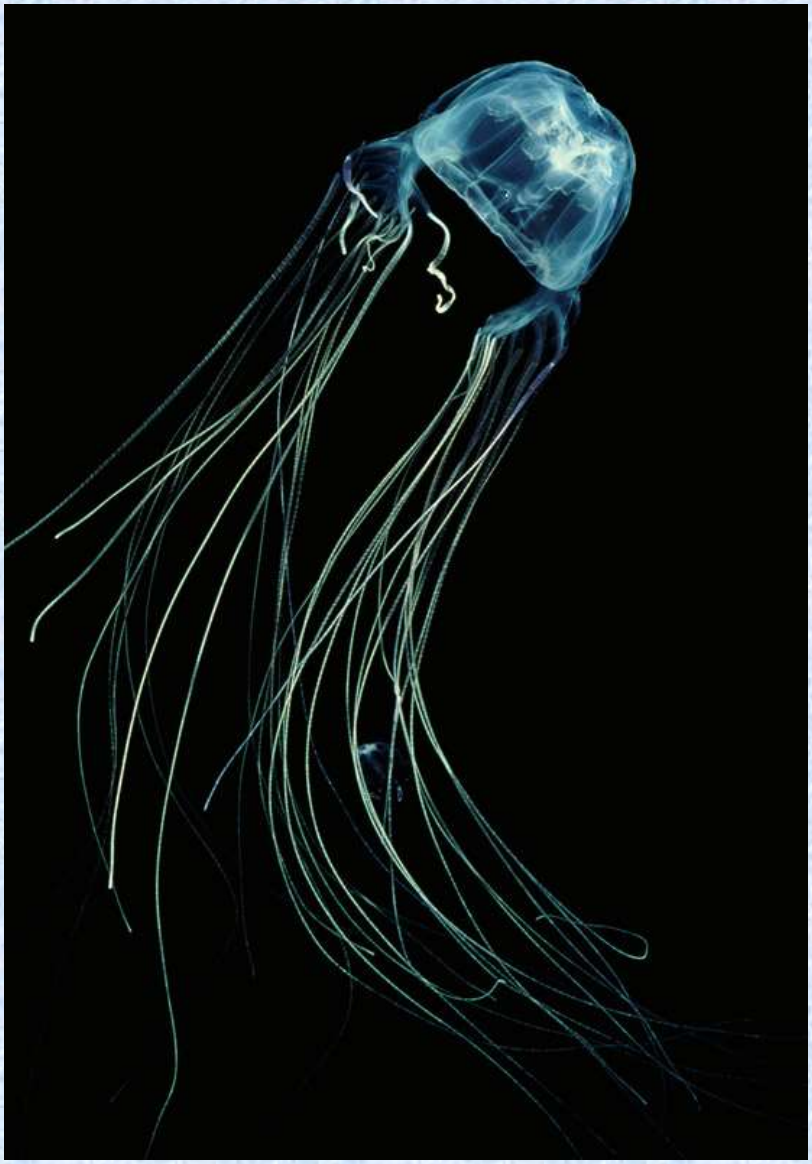
Obelia Life Cycle – alternates between polyp and medusa stages



Cnidarian Diversity

True jellyfish (Box jellies)

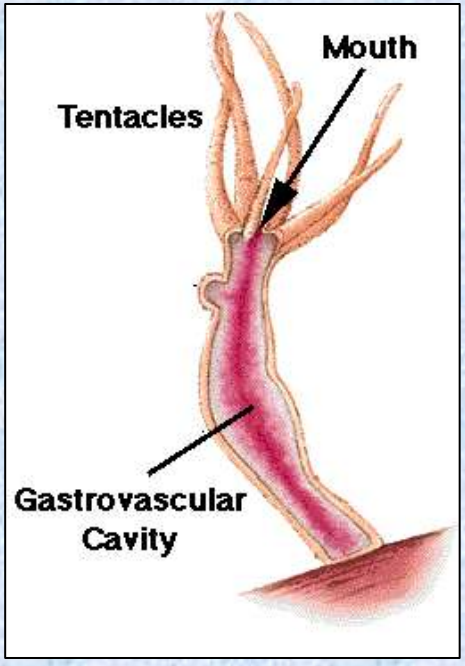
- Medusa is primary stage and polyp remains small
- Stinging tentacles
- Feed on invertebrates and are food for marine animals.
- Spend most of their time floating near surface
- Equator to poles.
- Largest to 2 m diameter

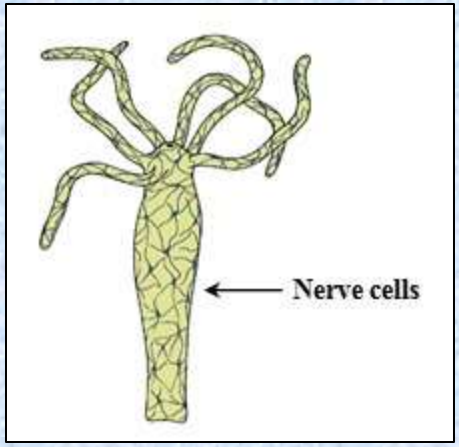


Purple striped jelly, *Pelagia panopyra*

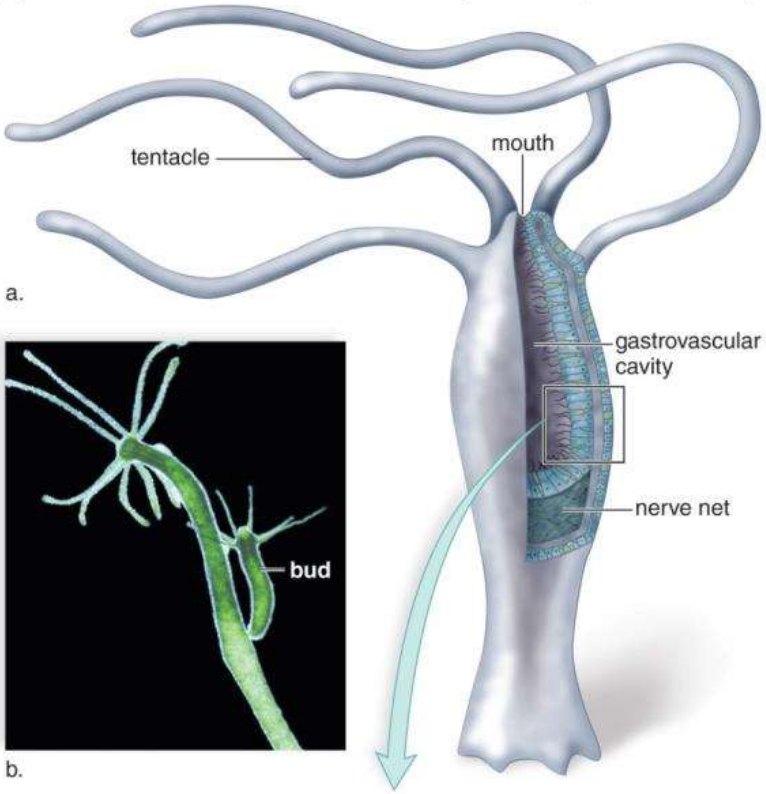
Hydrozoans

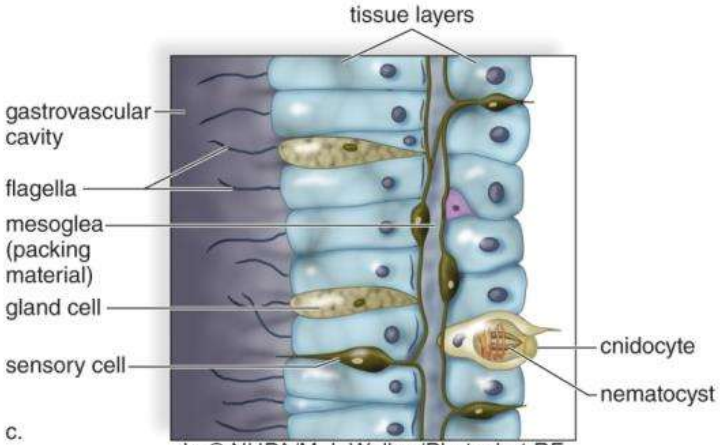
- Most marine, colonial
- Hydra – a freshwater Cnidarian
- Small tubular poly body about one-quarter inch in length
- Gastrovascular cavity is central
- Tentacles can respond to stimuli.
- Can reproduce sexually and asexually
- **Nerve net -** Interconnected nerve cells, can contract and extend



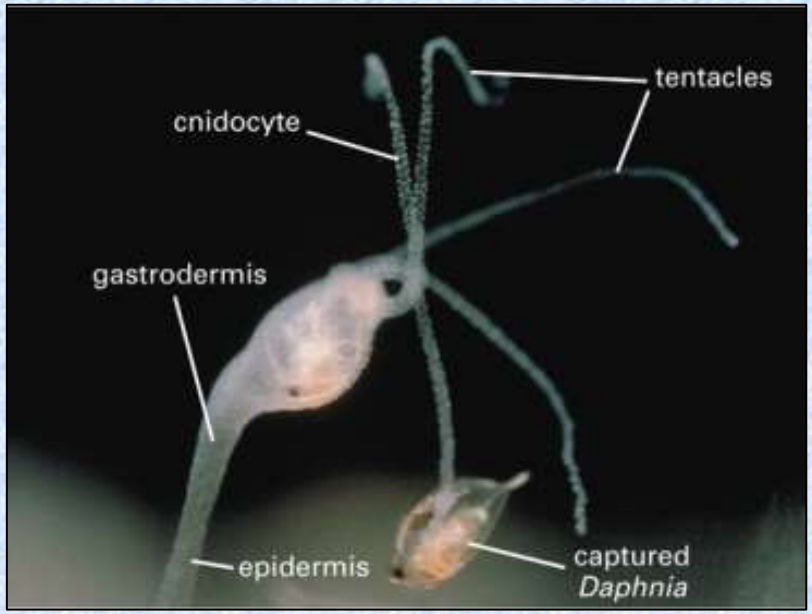


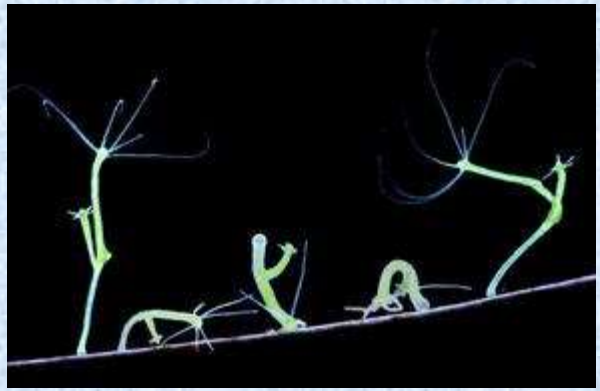
Hydra – polyp dominates





Cut off its “head” and it sprouts a new one
Freshwater

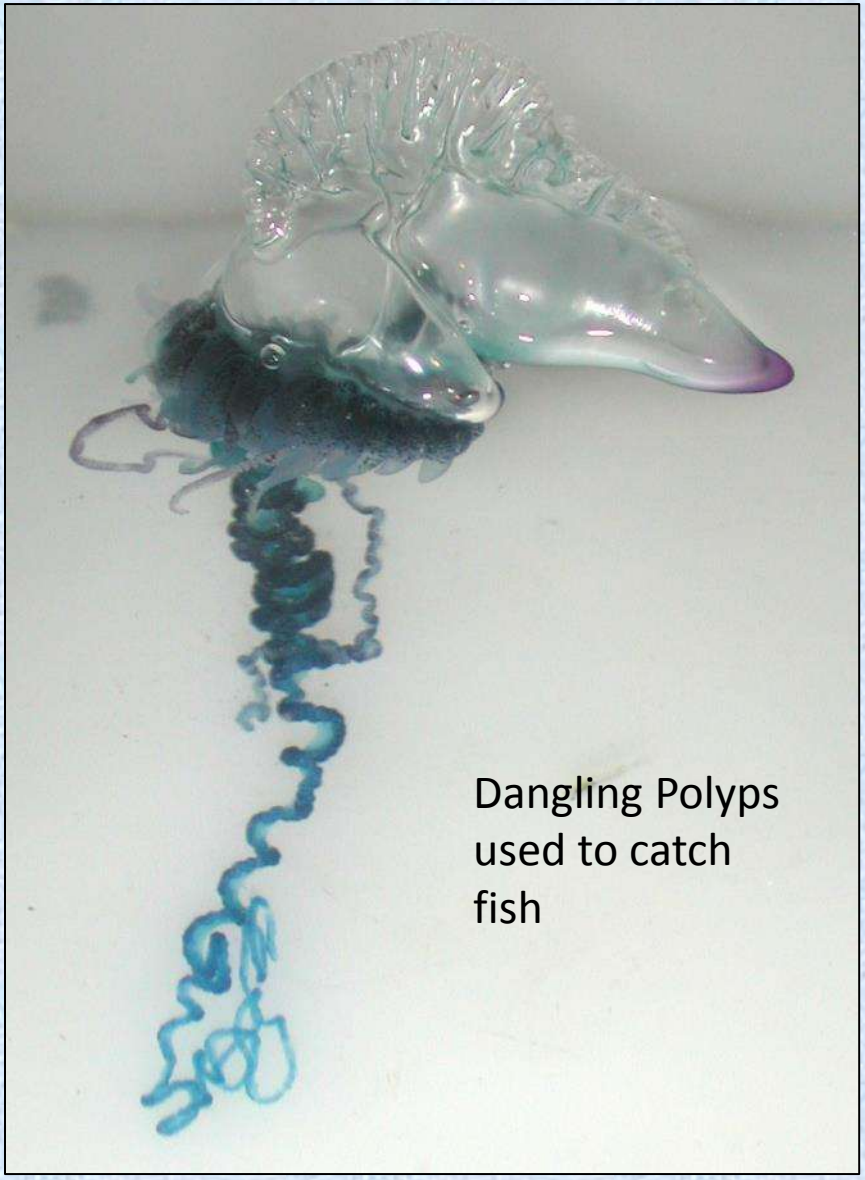




Hydra “walking” ➔

Portuguese man o' war - *Physalia physalis*

Actually a colony of Hydra-like polyps, not a medusa

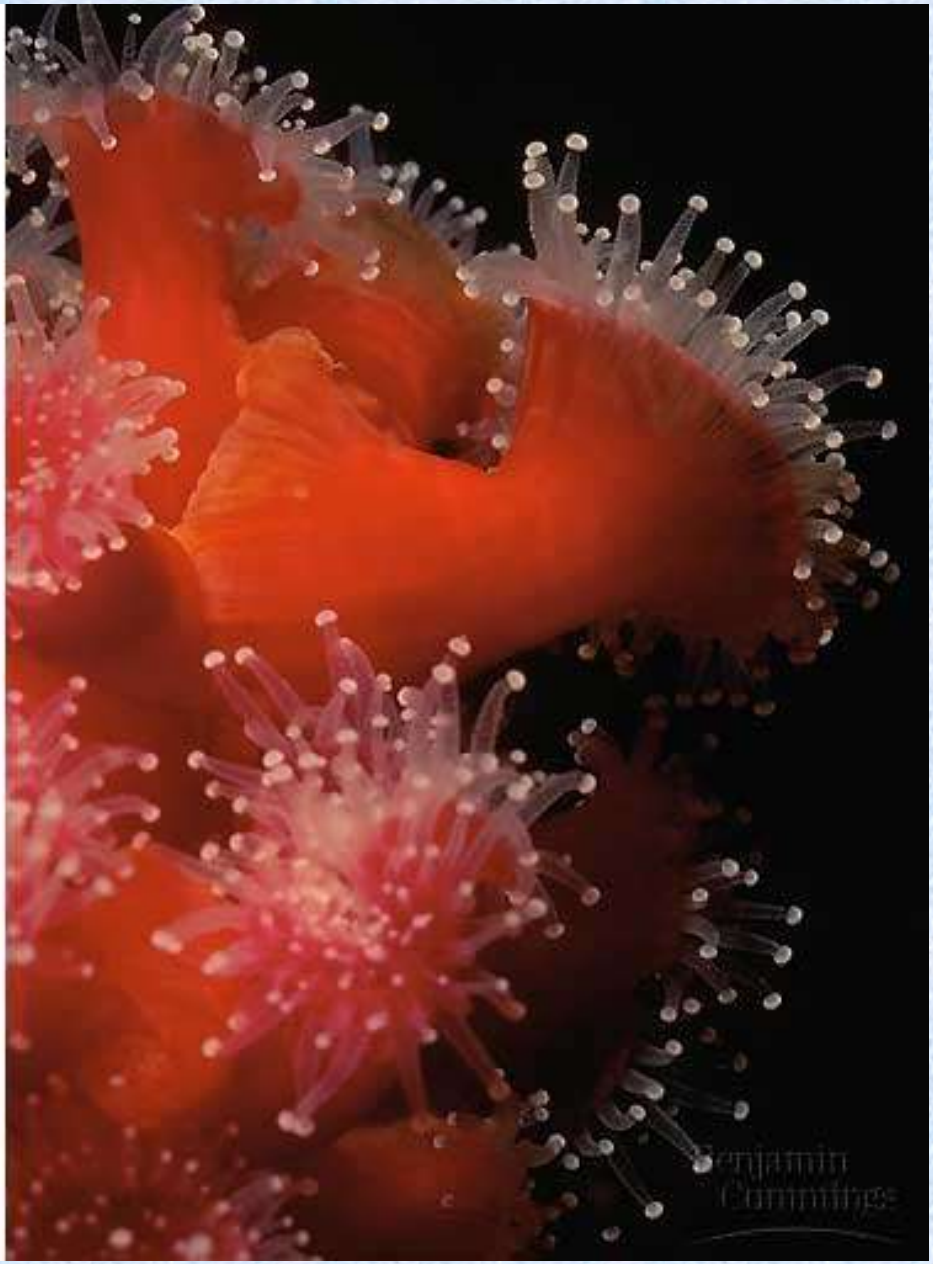


Dangling Polyps used to catch fish

Sea anemones

- Sessile polyps that live attached to a substrate
- Have upward-turned oral disk containing mouth surrounded by tentacles containing nematocysts

Sea Anemones



Sea Amenone – Clownfish - Mutualism

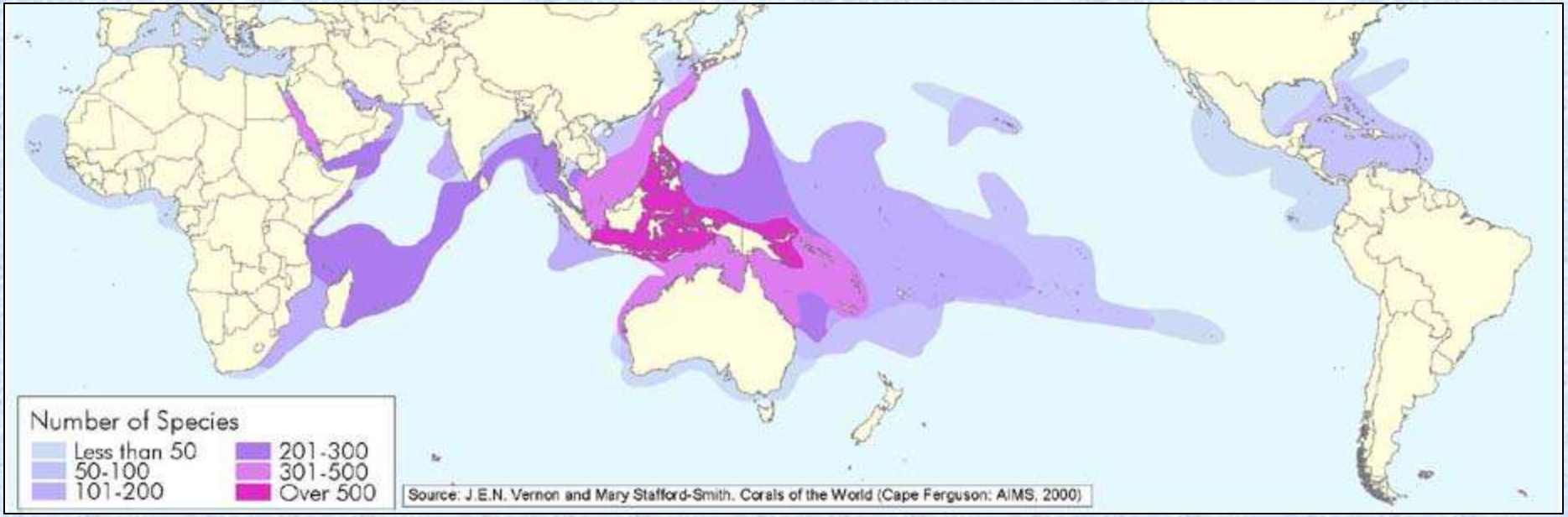
Corals

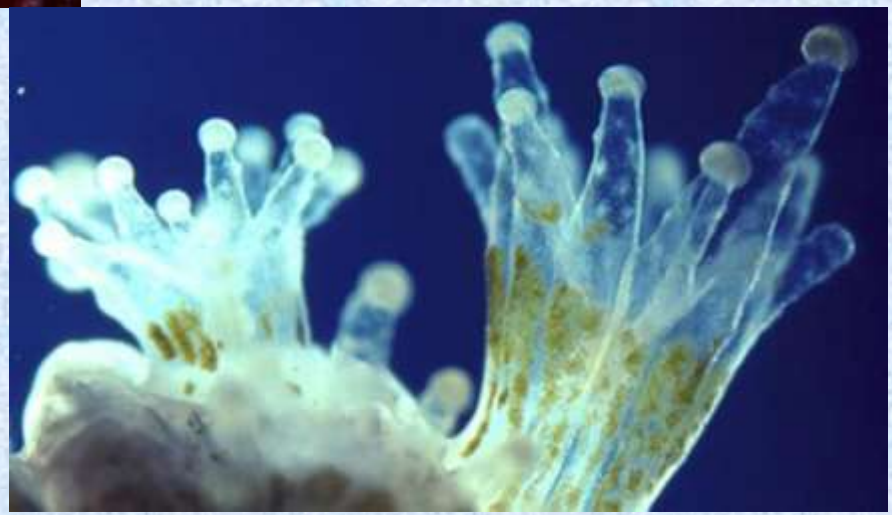
- Like sea anemones, encased in calcium carbonate
- Live in colonies and build coral reefs
- Form Great Barrier Reef along Australia's coast
- Symbiosis with dinoflagellate "zooanthellae"
- Subject to bleaching and die-off

Corals form extensive reefs

Where are corals found?

Corals can be found throughout the oceans, from deep, cold waters to shallow, tropical waters





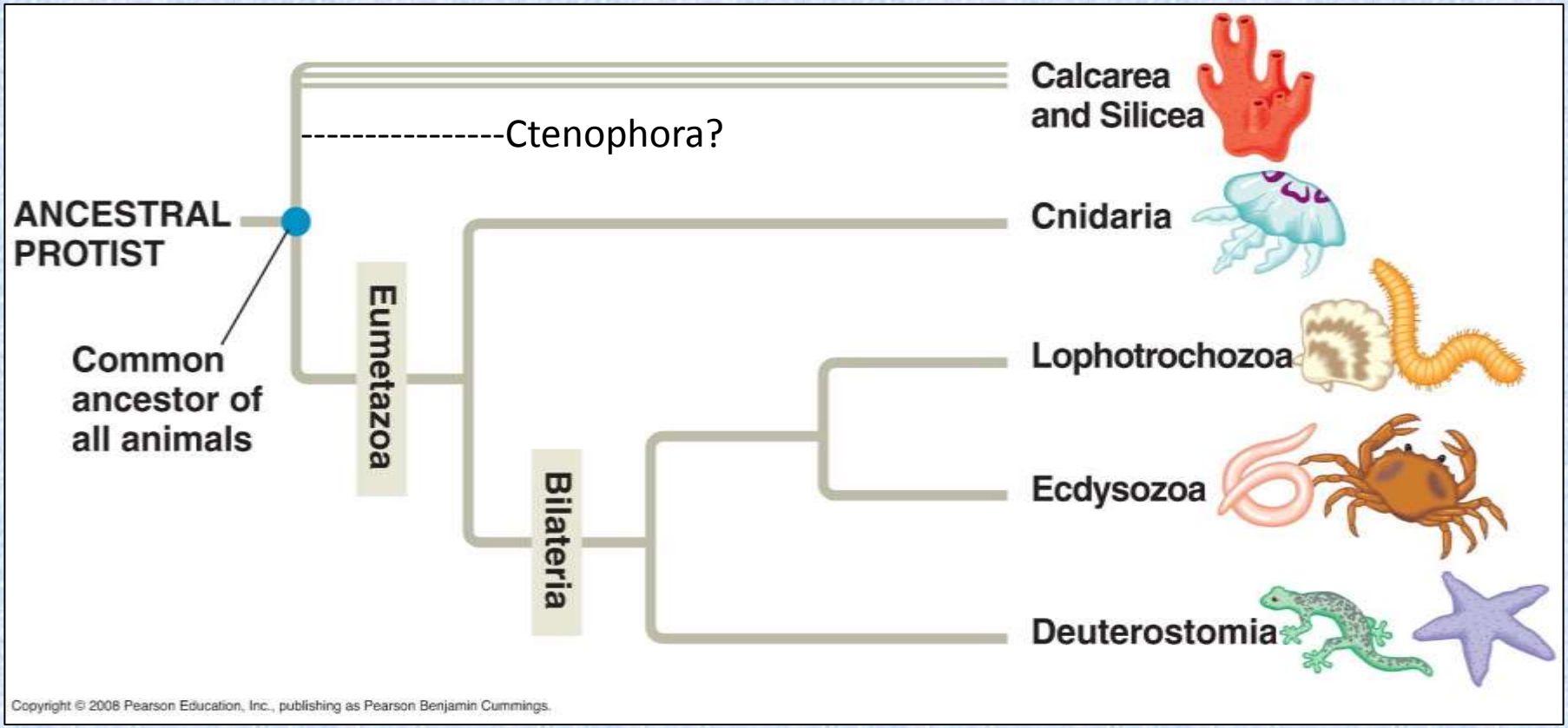
Zooanthellae – algal partners

Coral Bleaching – normal symbiosis between corals and single-celled algae which live inside their bodies starts to break down, loss of zooanthellae, death of coral. Warming temperatures is blamed.

In 1998, 16% of the hard corals in the world died. That's right, almost a fifth of all the coral in the world knocked out in a single year, and most people have never even heard about it.

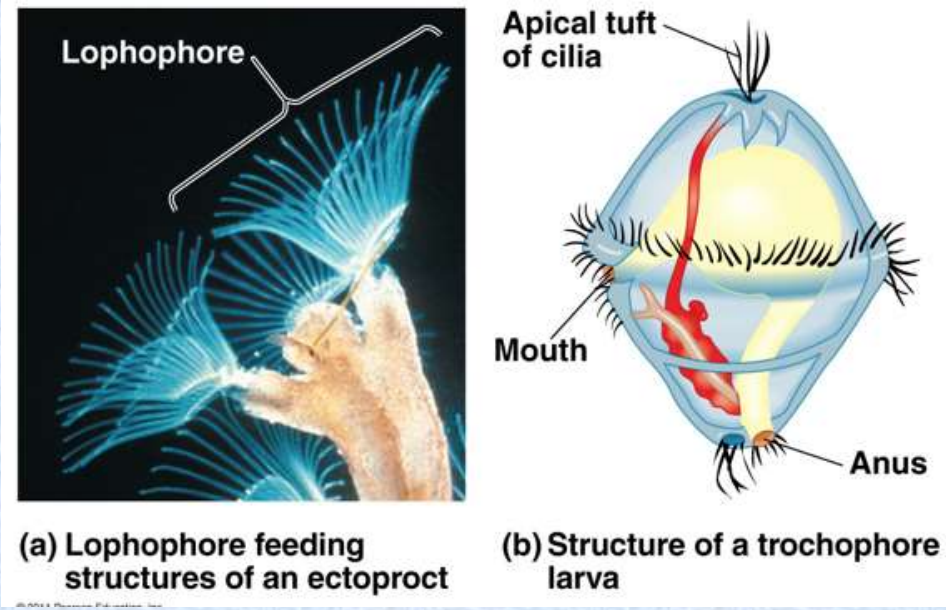
Lophotrochozoa Group

Diverse group of protostomes



Lophotrochozoa

- Clade Lophotrochozoa was identified by molecular data
- Some develop a *lophophore* for feeding, others pass through a *trochophore larval stage*, and a few have neither feature
- Lophotrochozoa includes the flatworms, rotifers, ectoprocts, brachiopods, molluscs, and annelids
- 3 germ layers
- Well developed organs
- True coelom



Lophophorans

Aquatic

Lophophore feeding structure

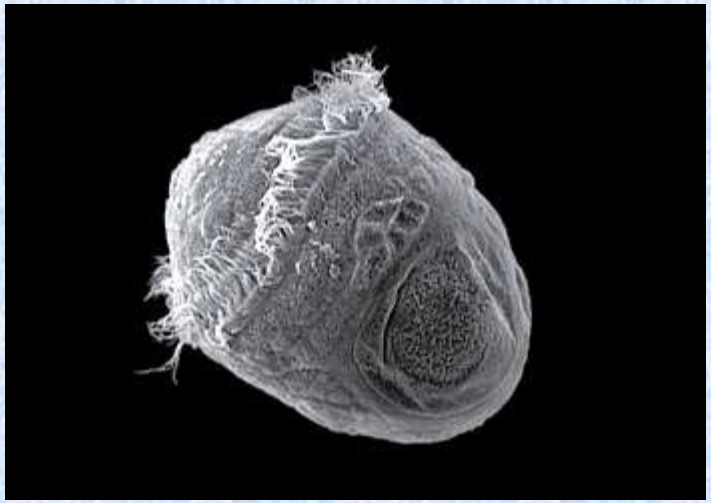
Traditionally considered protostomes

3 closely related groups

- Bryozoans
- Brachiopods
- Phoronids

Lophophore – mouth surrounded by ciliated tentacles

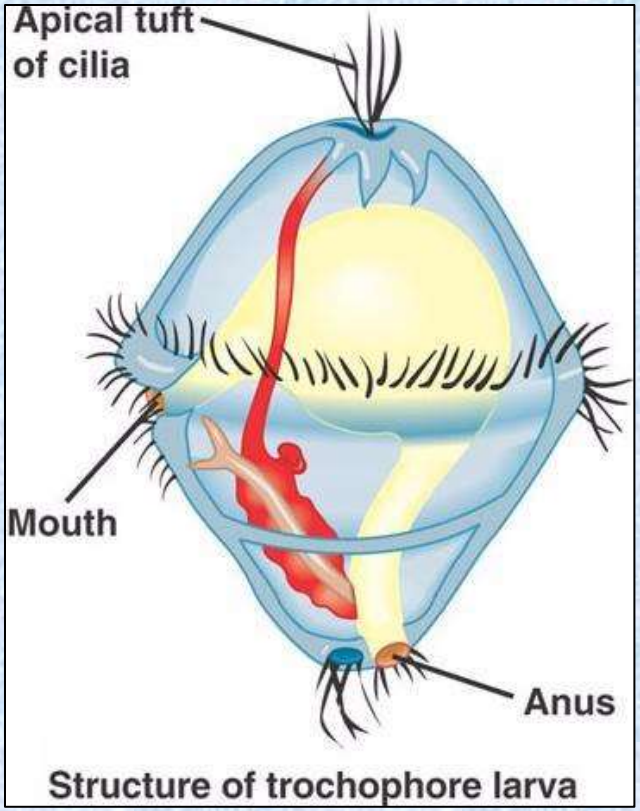
Trochozoans



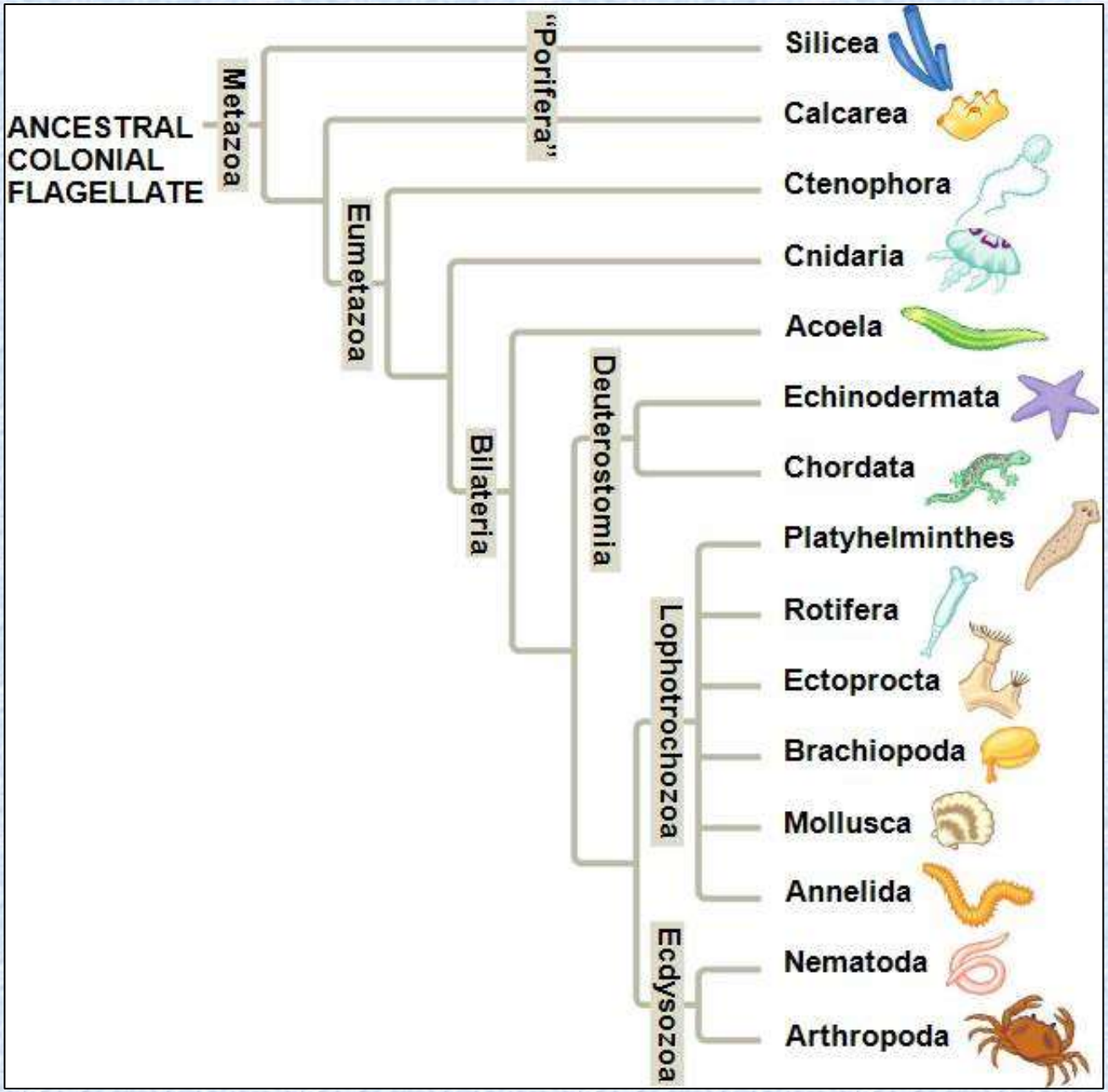
Free-swimming planktonic marine larva with several bands of cilia.

Group Includes:

- Flatworms
- Rotifers
- Annelids
- Molluscs



Animal Phylogeny Based on Mostly Molecular Data



Flatworms – Phylum Platyhelminthes

The simplest bilateral animals.

Acoelomate – no cavity

Includes forms that are:

-Free-living in marine, freshwater, or damp habitats

Some parasites

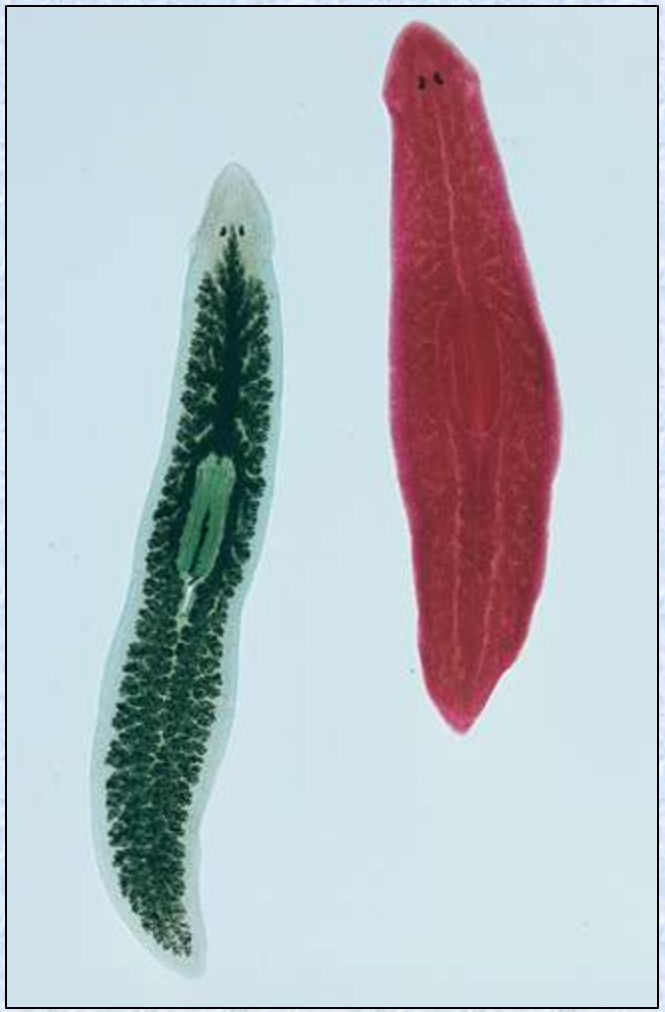
-Gastrovascular cavity – no anus

-Highly branched

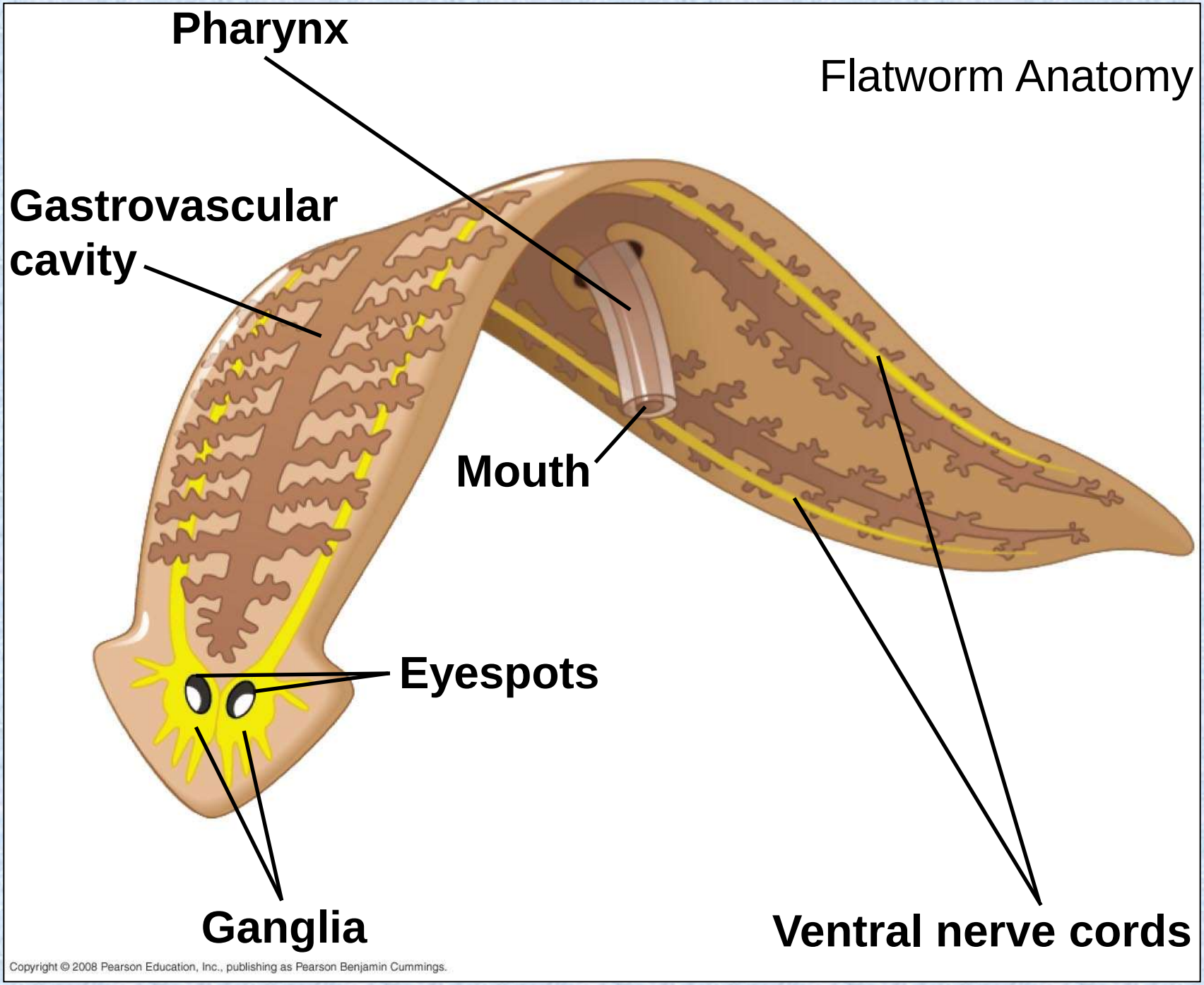
-Provides an extensive surface area for absorption of nutrients.

-Food is digested within the cavity, and waste exits the pharynx

Gas exchange takes place across the surface

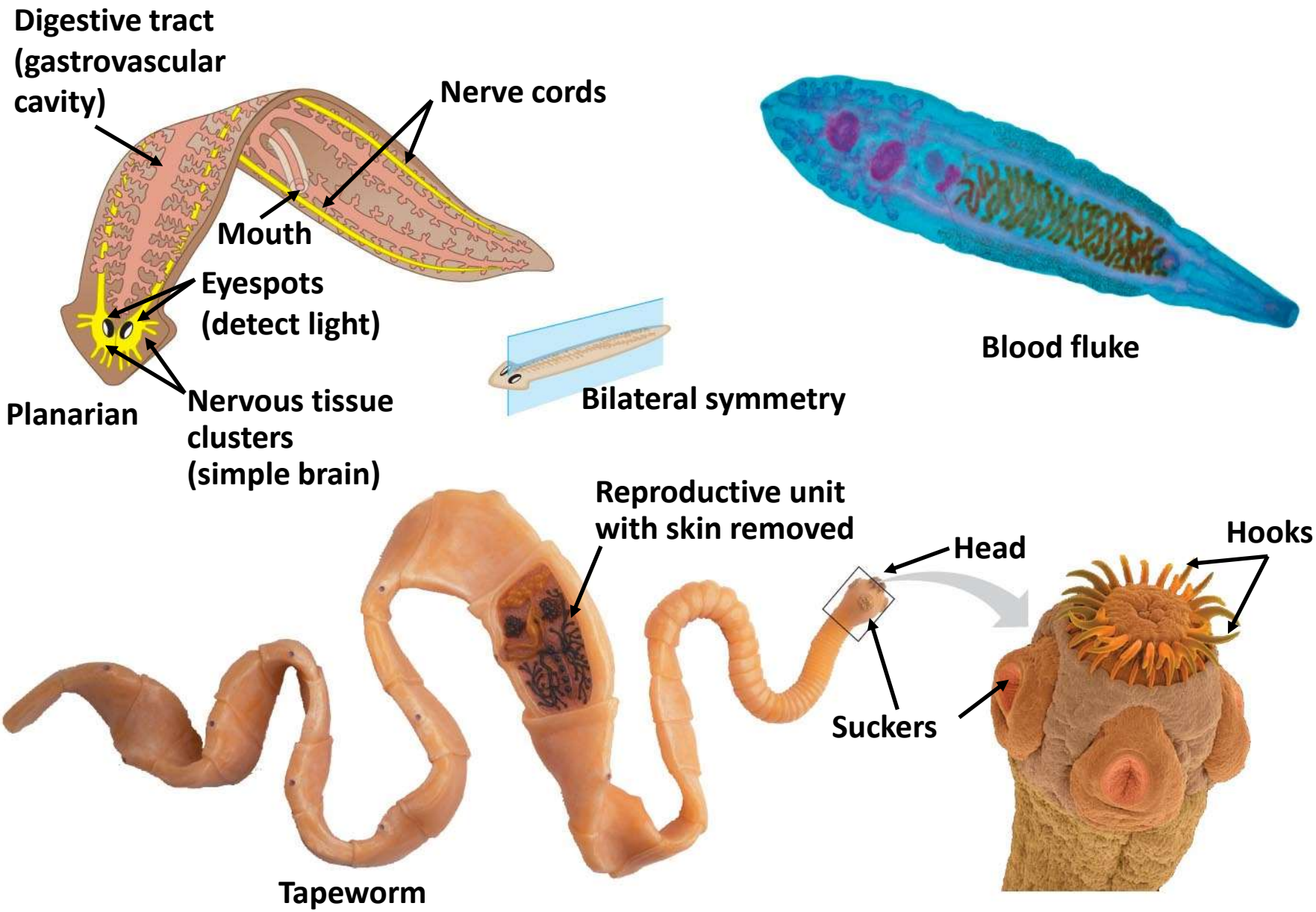


Flatworm Anatomy



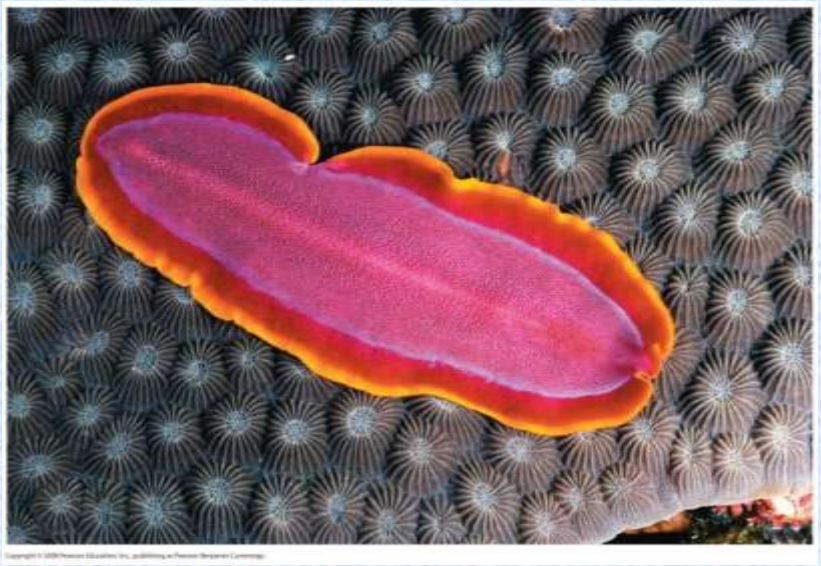
Flatworms are divided into four classes:

- Turbellaria (mostly free-living flatworms)
- Monogenea (monogeneans)
- Trematoda (trematodes, or flukes)
- Cestoda (tapeworms)

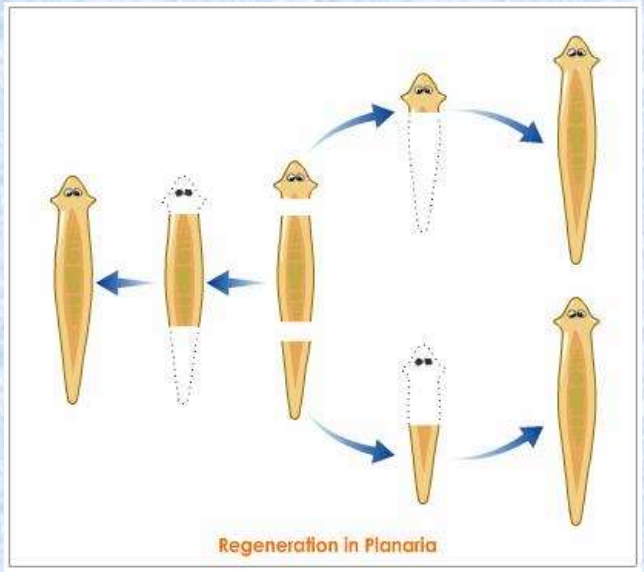


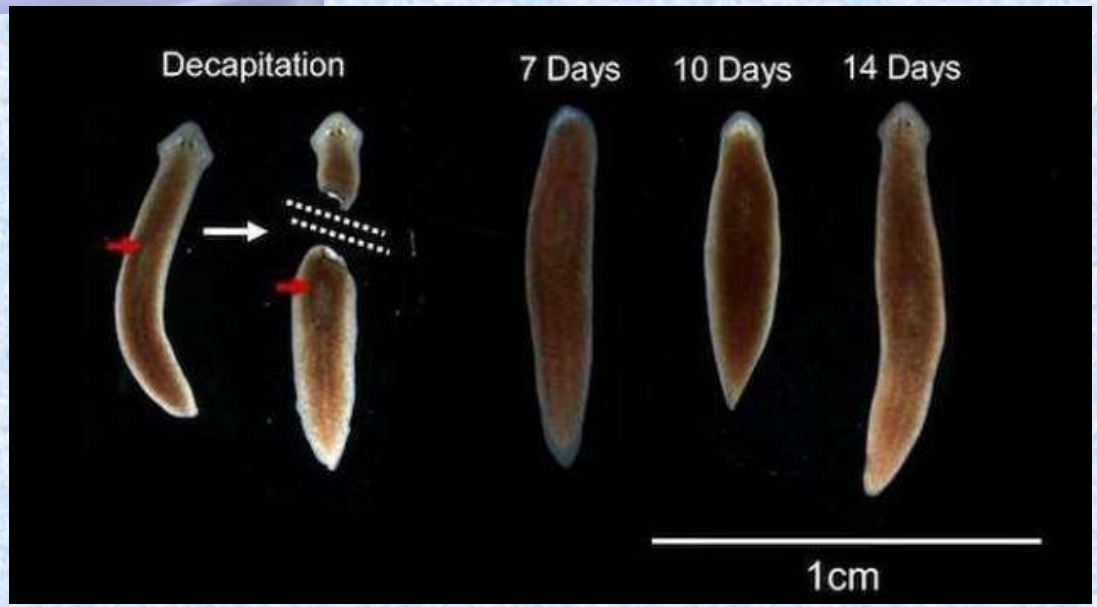
Turbellarians = Planarians

- Nearly all free-living and mostly marine
- The best-known turbellarians are commonly called **planarians**



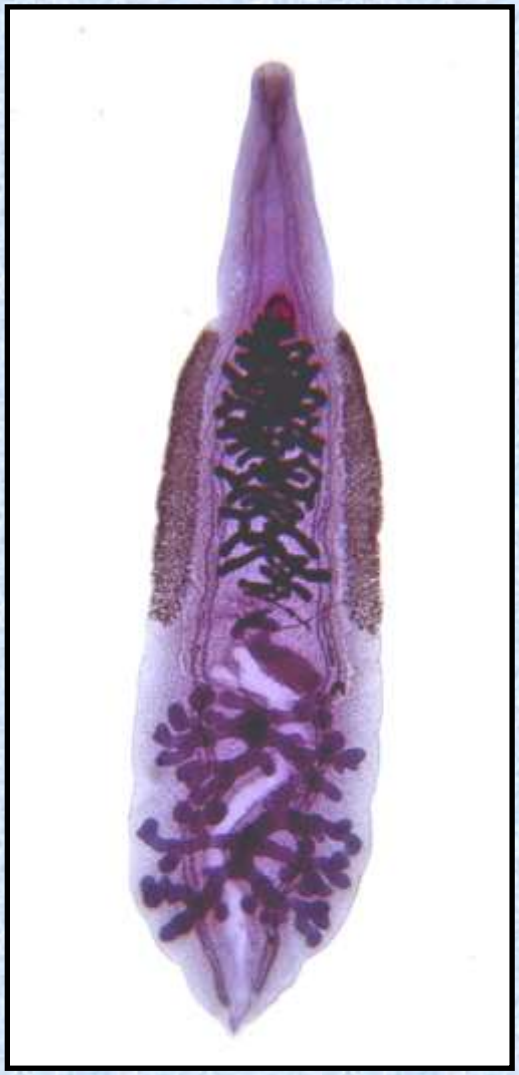
Planaria Regeneration





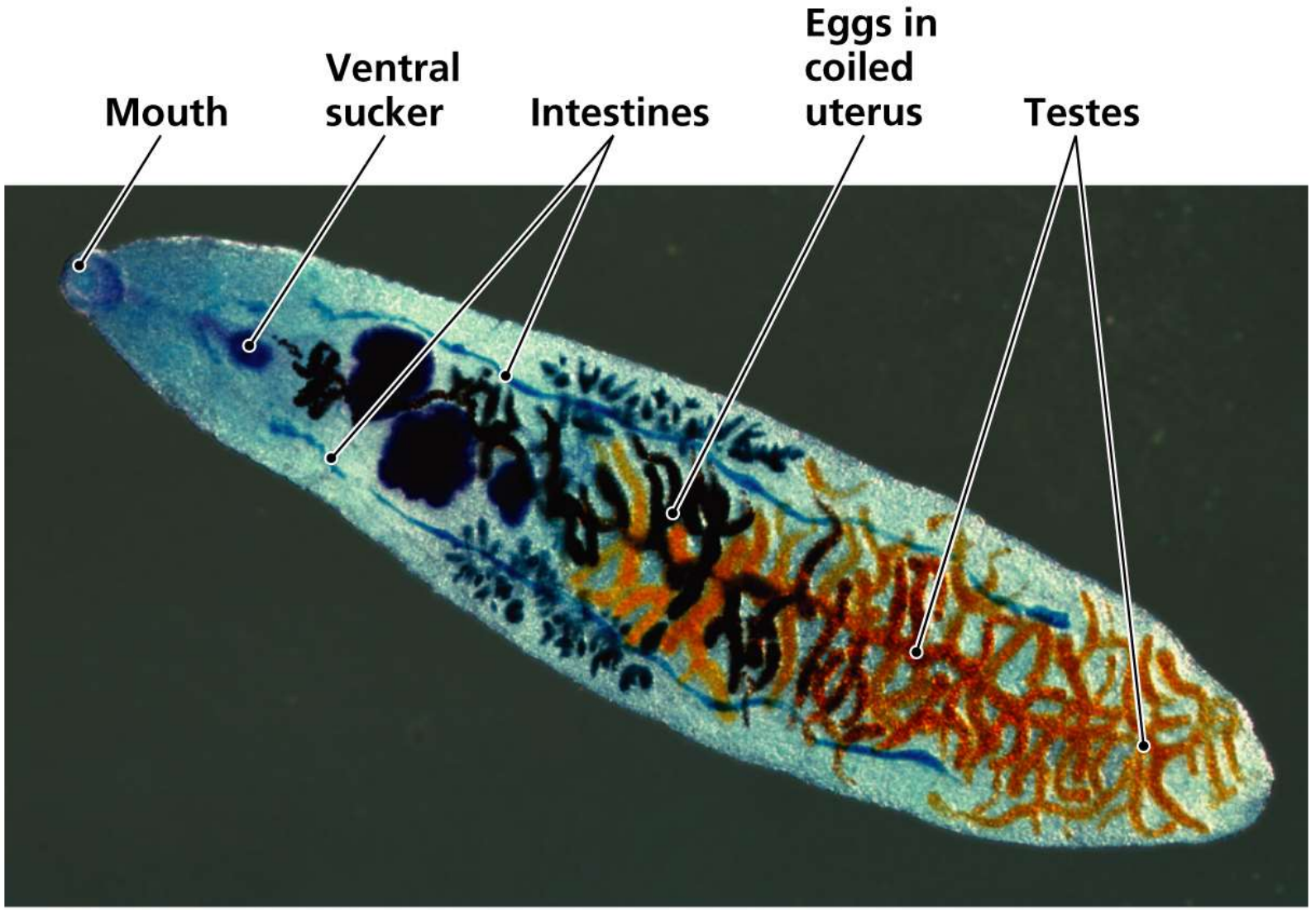
Flukes - Monogeneans and Trematodes

- Parasites in or on other animals
- Lost cephalization, don't hunt
- Complex life cycles with alternating sexual and asexual stages
- Trematodes that parasitize humans spend part of their lives in snail hosts. *Schistosoma*
- Monogeneans are external parasites of fish

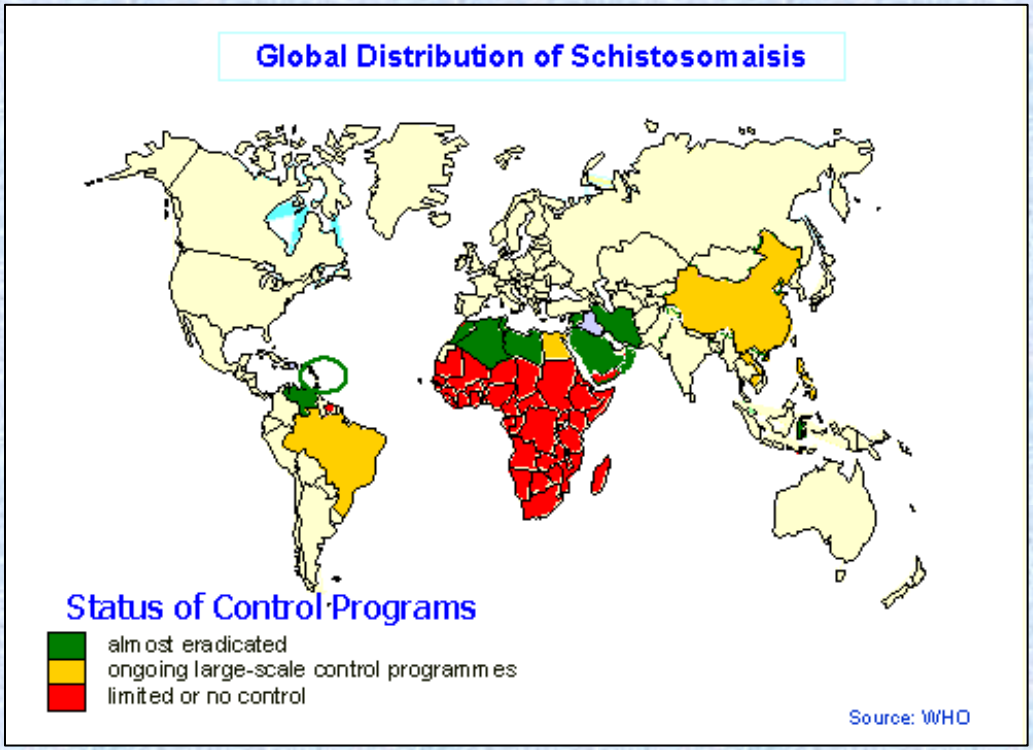


Clonorchis sinensis causes liver disease & jaundice, it is endemic to SE Asia.

Fluke Morphology

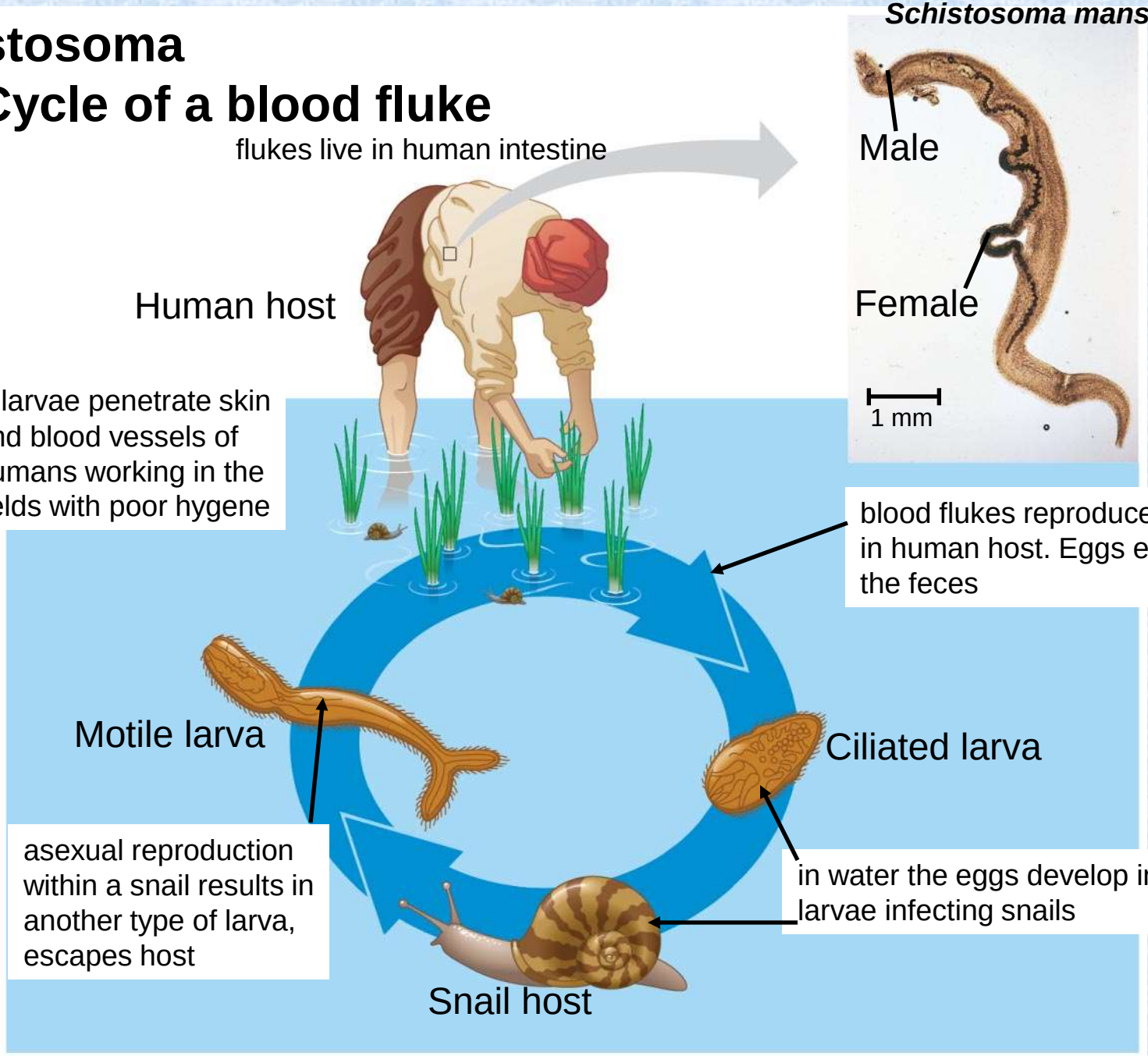


Schistosoma – a blood fluke



- Larvae mature in liver and blood vessels of small intestine
- Itching, anemia, inflamation of bladder, lymph node enlargement, enlarged liver or spleen, blood disorders etc.

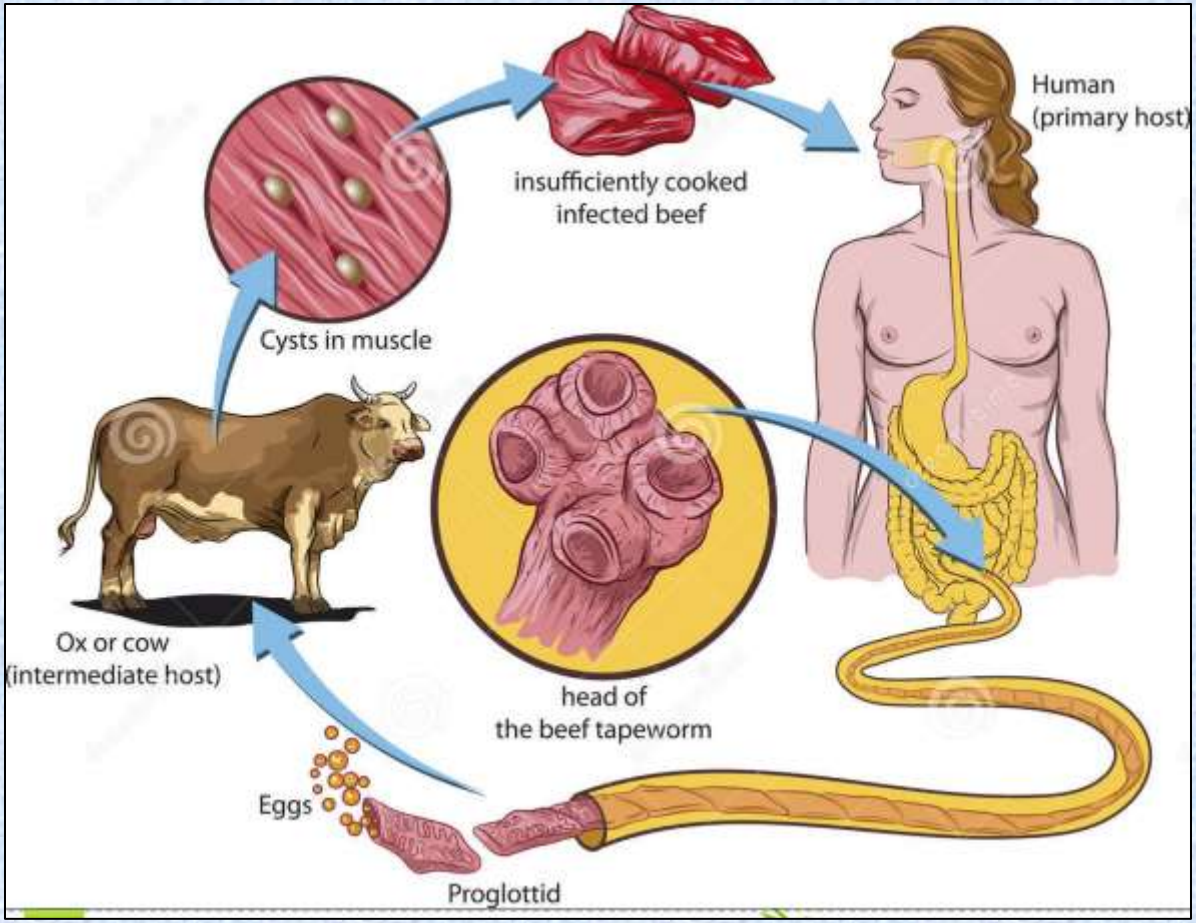
Schistosoma
Life Cycle of a blood fluke

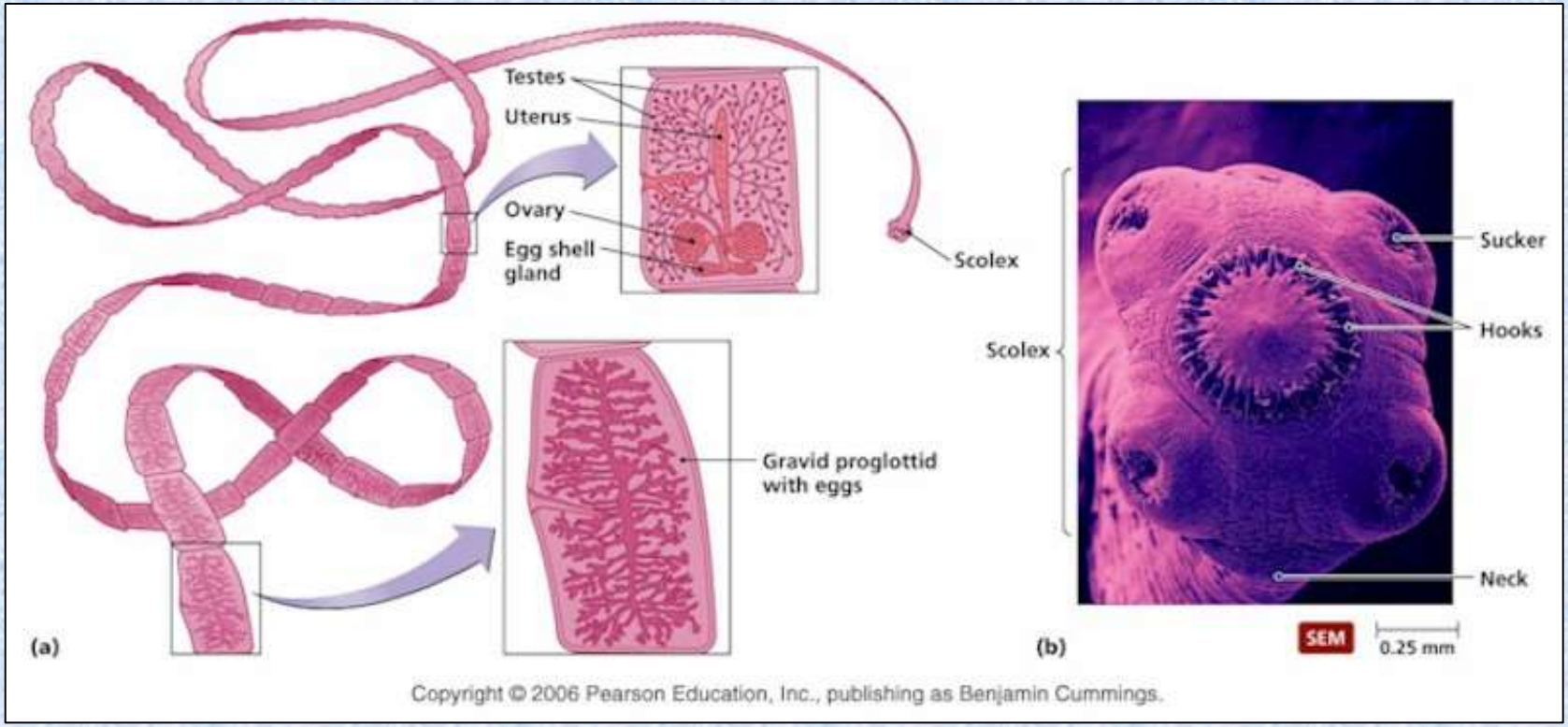


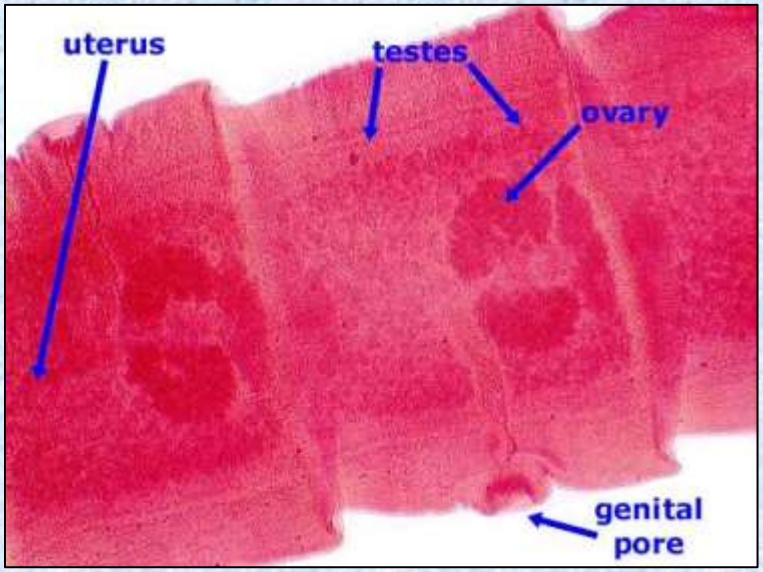
Tapeworms - Cestoda

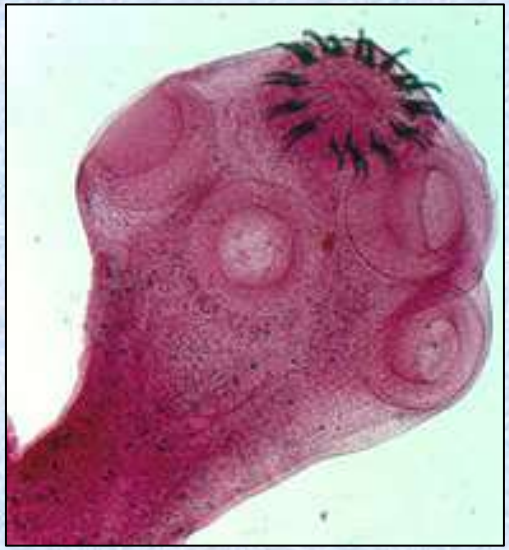
Tapeworms (Cestoda)

- Parasites of vertebrates, lack a digestive system
- Absorb nutrients from the host's intestine
- Fertilized eggs, produced by sexual reproduction, leave the host's body in feces. Eaten by cow, cysts in meat.



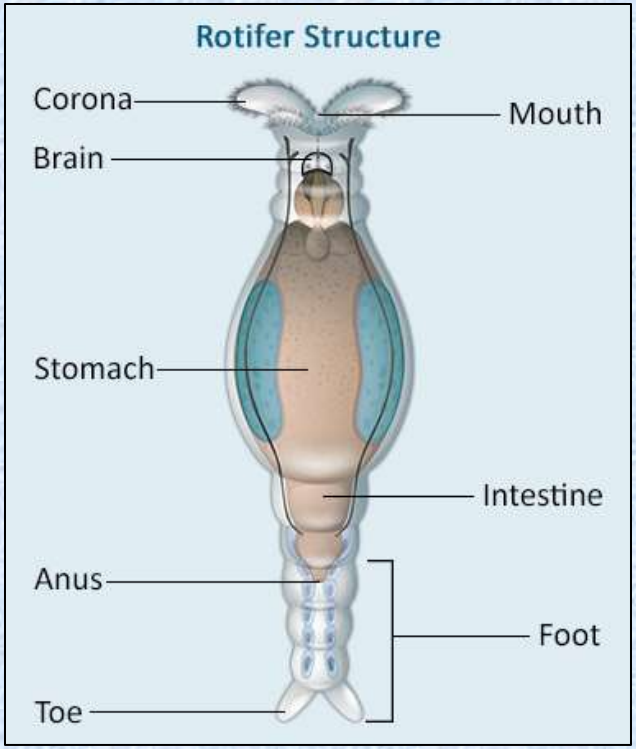






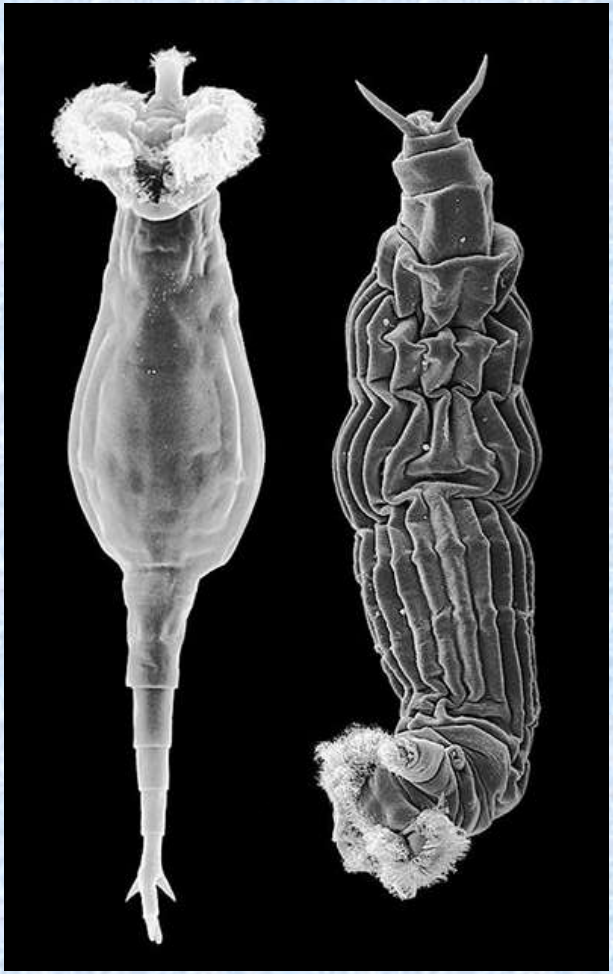
Rotifers

- Tiny animals that inhabit fresh water, the ocean, and damp soil
- Smaller than many protists but are truly multicellular and have specialized organ systems



Rotifers

- Ciliated corona, used for swimming and eating
- Muscular pharynx
- Have an **alimentary canal**, with separate mouth and anus
- Foot with toes
- Reproduce by **parthenogenesis**, females produce offspring from unfertilized eggs
- Some lack males entirely
- Can survive very harsh conditions



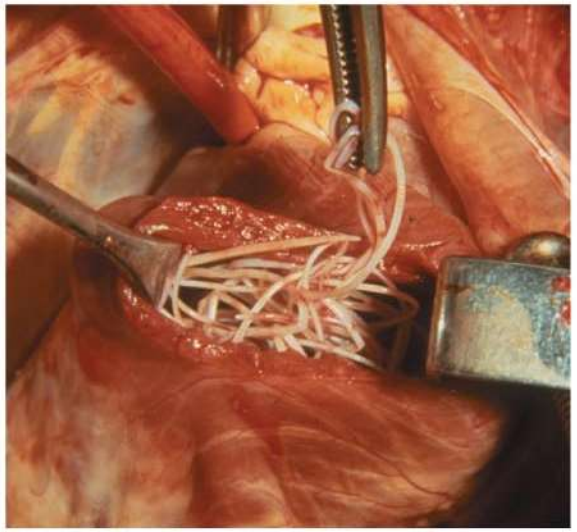
Roundworms - Phylum Nematoda

- Found in most aquatic habitats, soil, moist tissues of plants and animals
- Very successful - well adapted to every ecosystem; *500,000? species*
- Many are parasites

Roundworm Diversity

(a) A free-living roundworm

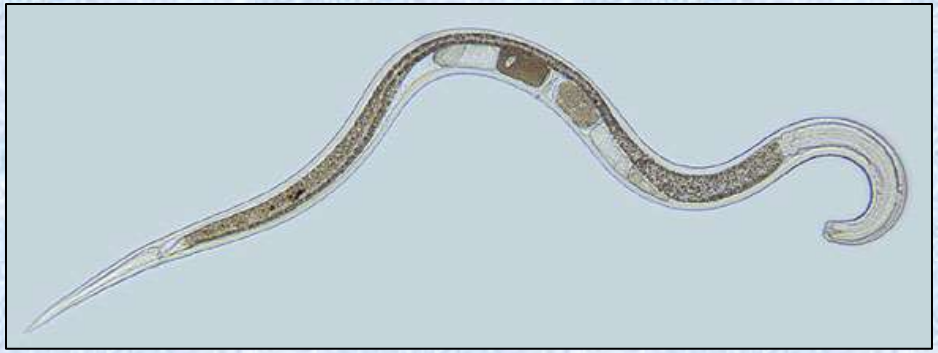
(b) Parasitic roundworms in pork

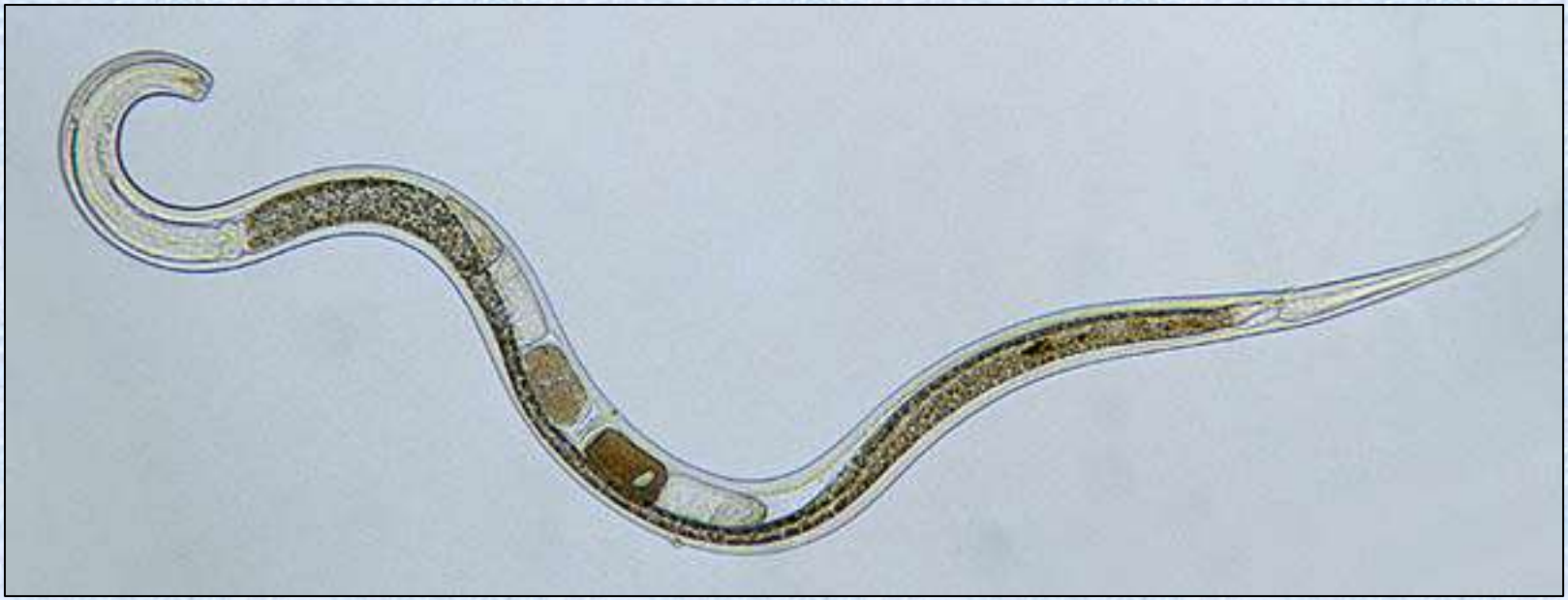


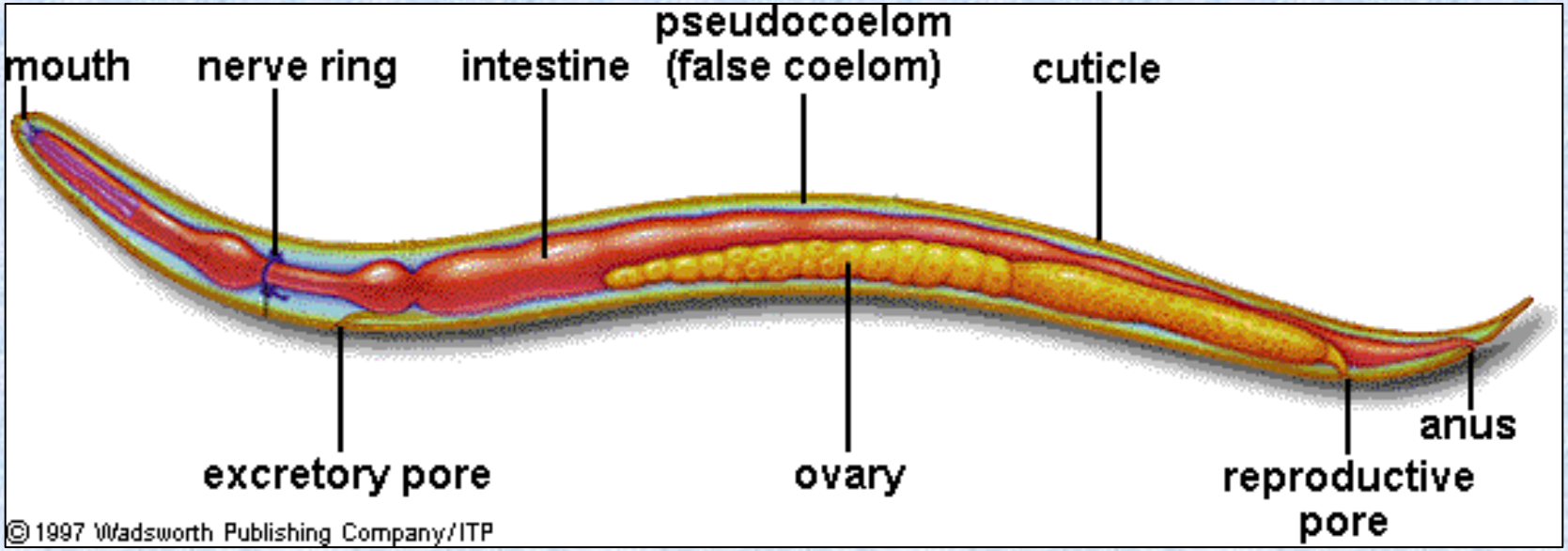
(c) Canine heart Infected with parasitic roundworms

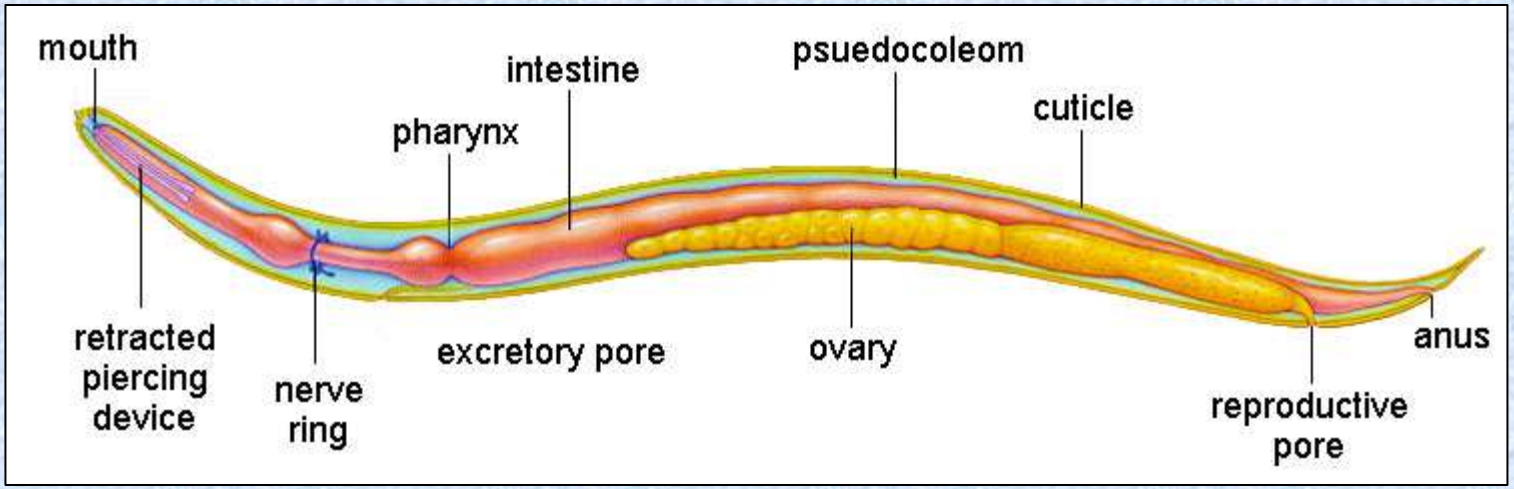
Roundworms - Phylum Nematoda

- Bilateral symmetry; round, no segments
- Tough outer cuticle, muscular layer
- Primitive body cavity
- Complete digestive tract, gut and anus
- No circulatory system
- Nervous system
- Reproduction sexual, by internal fertilization






mouth
nerve ring
intestine
pseudocoelom
(false coelom)
cuticle
excretory pore
ovary
anus
reproductive
pore
© 1997 Wadsworth Publishing Company/ITP


mouth
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nerve ring
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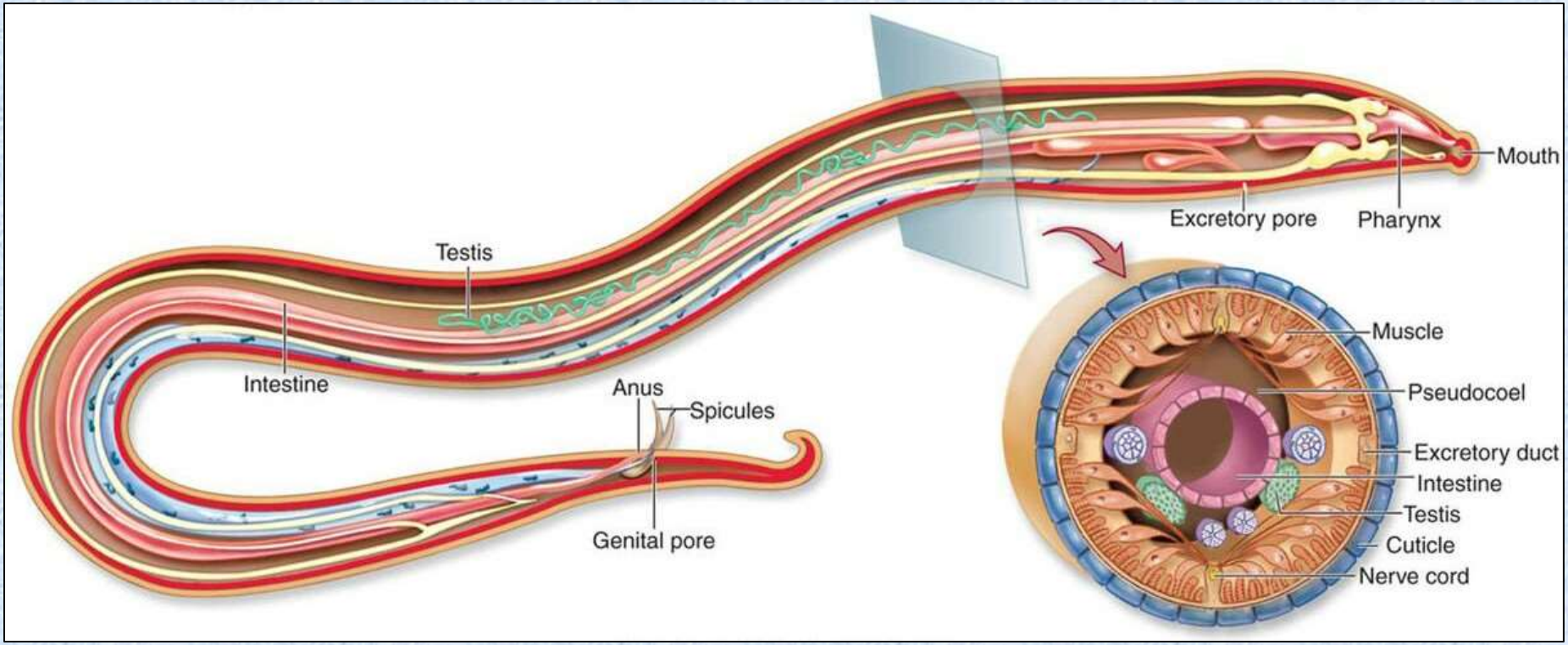
ovary
anus
reproductive pore


Mouth
Excretory pore
Pharynx
Testis
Intestine
Anus
Spicules
Genital pore
Muscle
Pseudocoel
Excretory duct
Intestine
Testis
Cuticle
Nerve cord

Some species of nematodes are important parasites of plants and animals

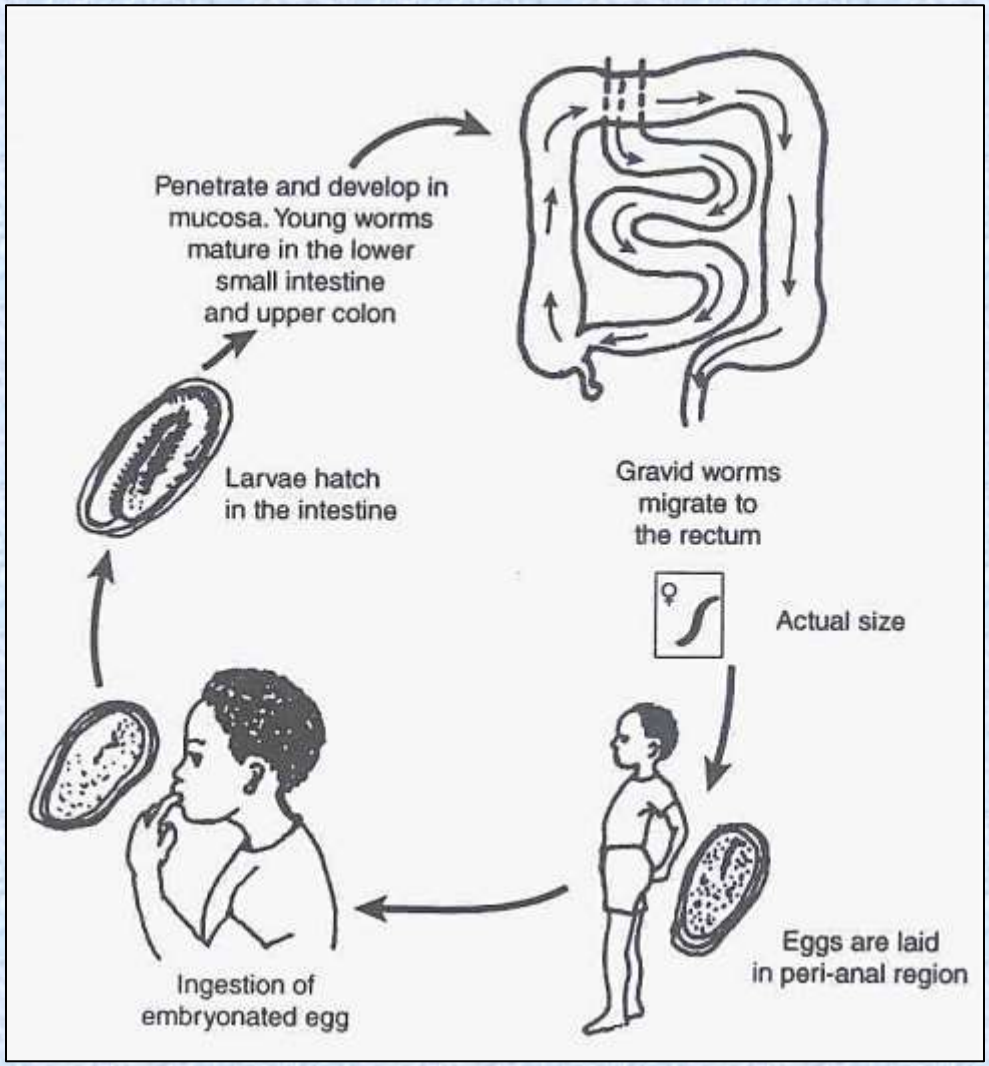
Ascaris, roundworm

Trichinella

Filariasis
Elephantiasis

Pinworms - *Enterobium vermicularis*

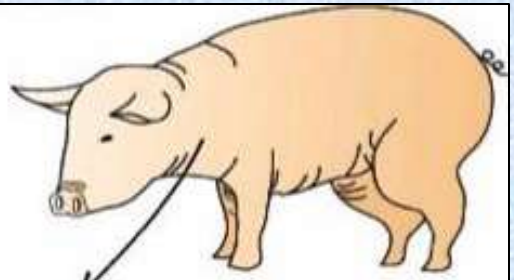
- Contagious intestinal parasite infestation that occurs commonly in children
- Spends its entire life in the large intestine of a human host.
- Adult female migrates to the anus to deposit eggs on the perianal skin.



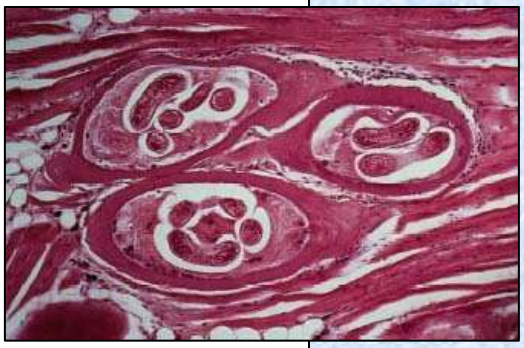
Trichinosis - *Trichinella spiralis*

- Caused by eating raw or undercooked pork and wild game infected with the cysts of a parasitic worm.
- Larvae released and grow in intestines.
- Worms can pass through the intestinal tract to invade other tissues, such as muscle, where they persist.
- Inflammatory response results in edema, muscle pain, fever, and weakness

Trichinella spiralis



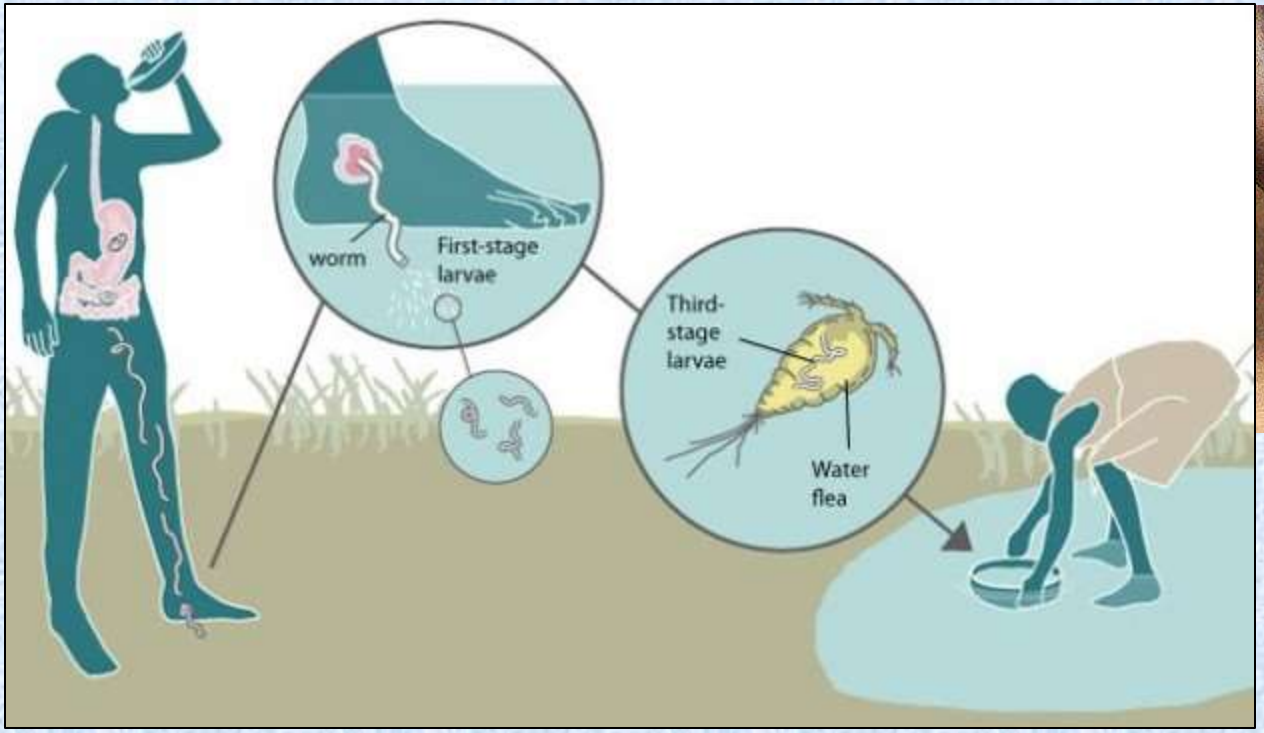
(a) Infested meat is ingested

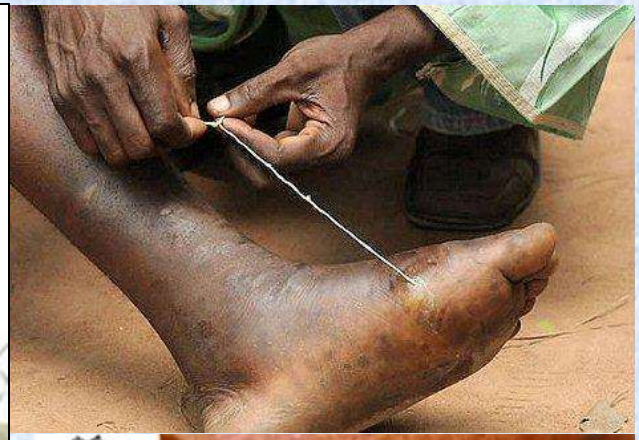


(b) Larvae deposited by adult worms into blood or lymph vessels

(c) Larvae lodge in muscle and encyst

Guinea Worm - *Dranunculus medinensis*





- Worm spends life feeding under skin
- Female lays eggs, juveniles emerge.
- Juveniles infect Copepod (water shrimp)
- Passed back to people in drinking water, grow, move to pelvic region to mate.
- Controlled by filtering out Copepods in drinking water

Filariasis – Elephantiasis
Wuchereria bancrofti and other filarial worms

- Adult worms release microfilarieae
- Passed by blood-sucking mosquitos and flies, which are also the second host
- Worms cause damage as they burrow through tissues, scar tissue develops
- Elephantiasis – swelling caused by blocking lymph nodes
- River Blindness – worms infect eyes

End