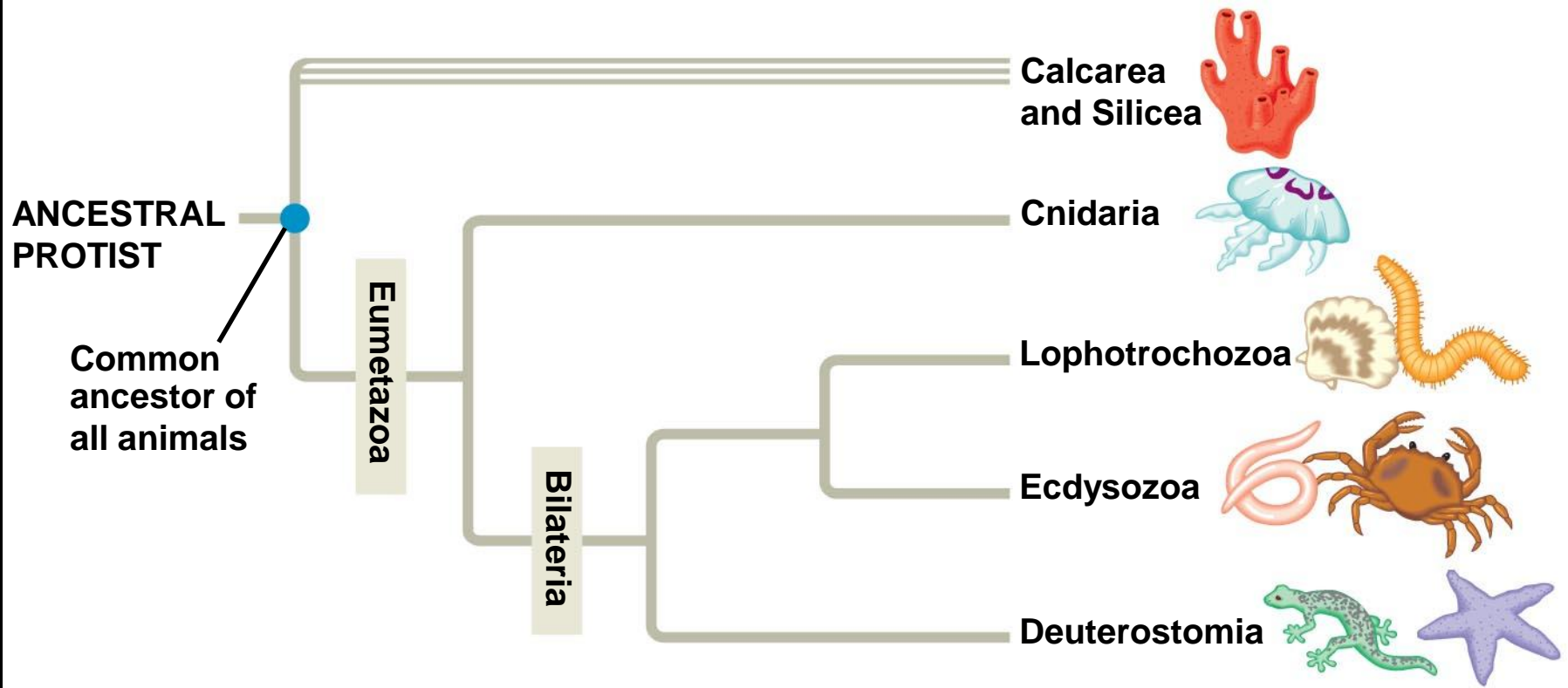




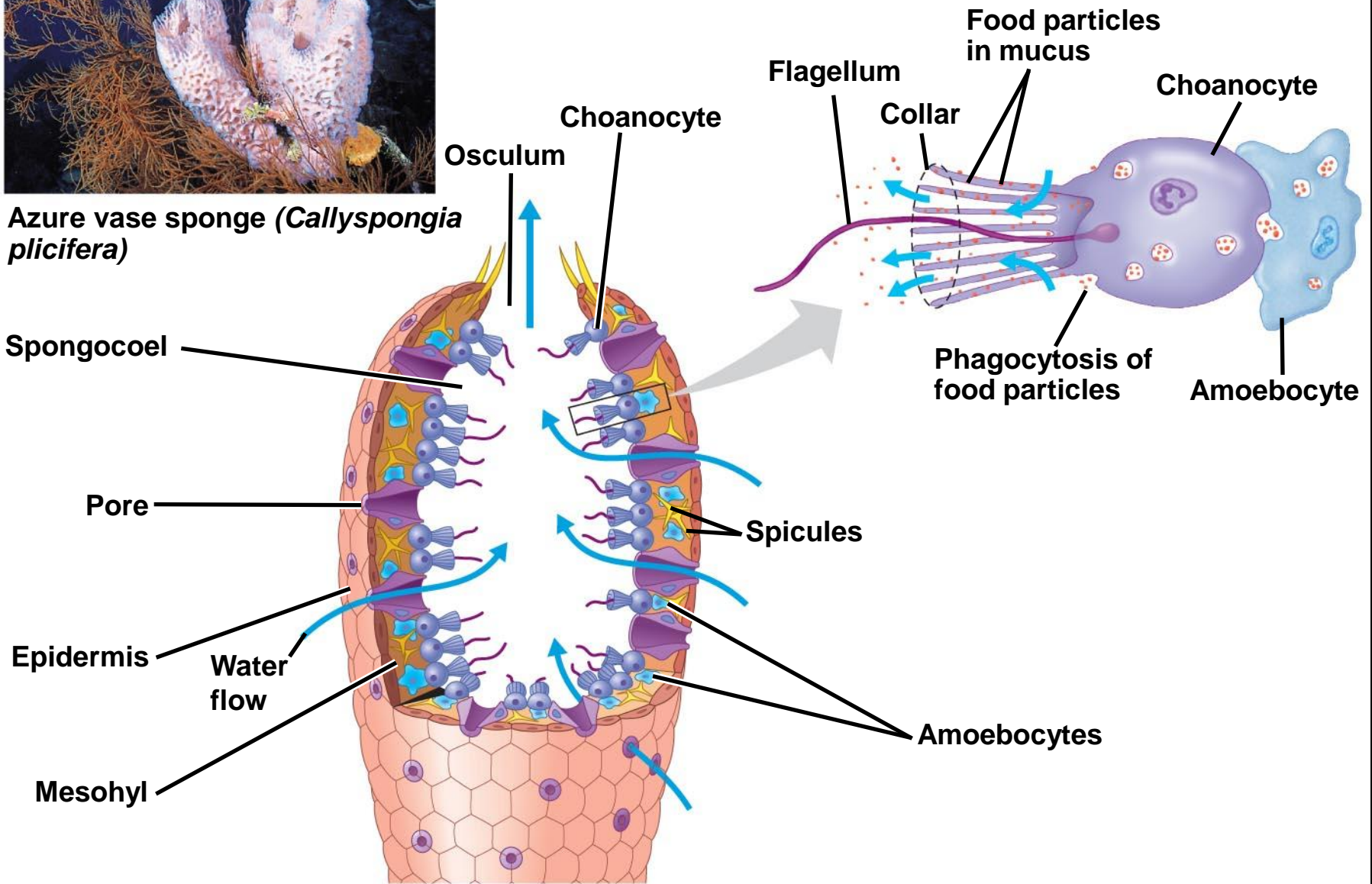
Overview: Life Without a Backbone

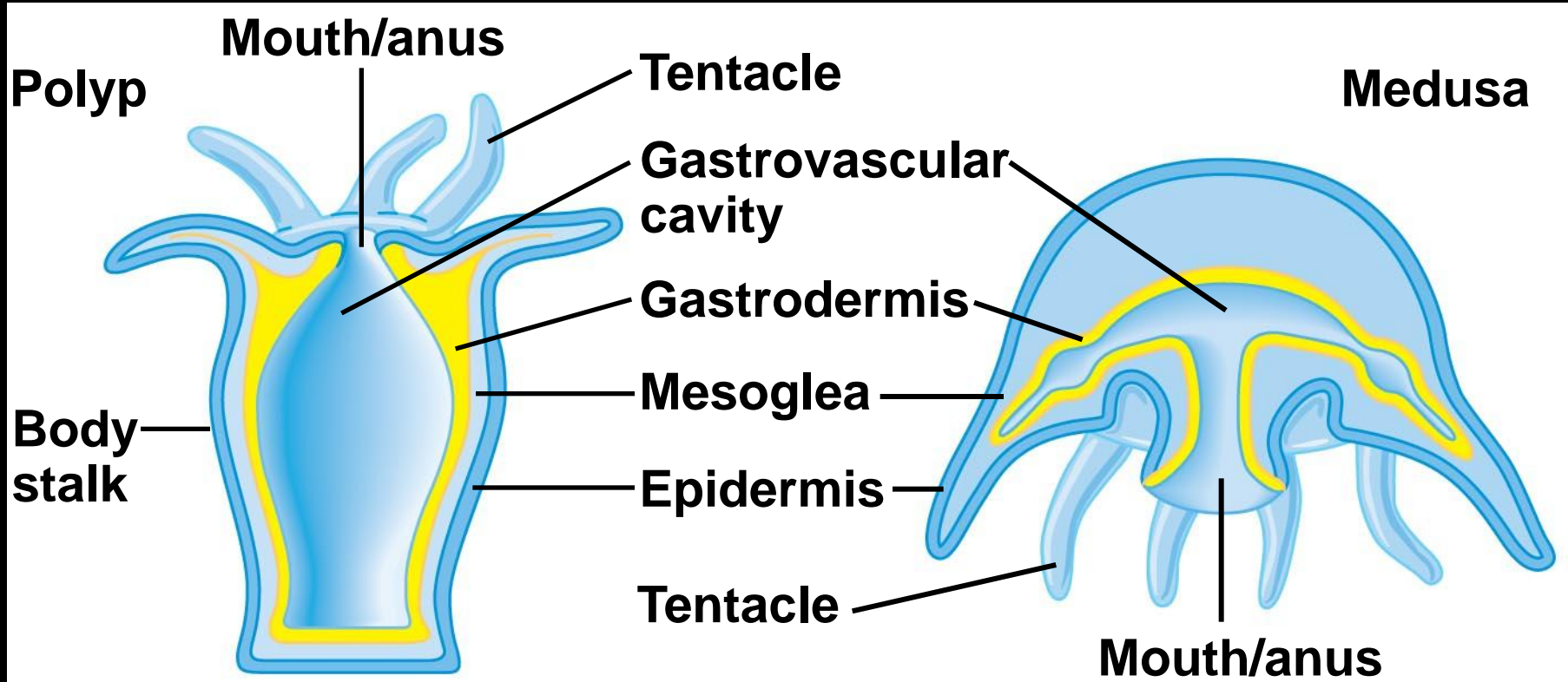
- **Invertebrates** are animals that lack a backbone
- They account for 95% of known animal species

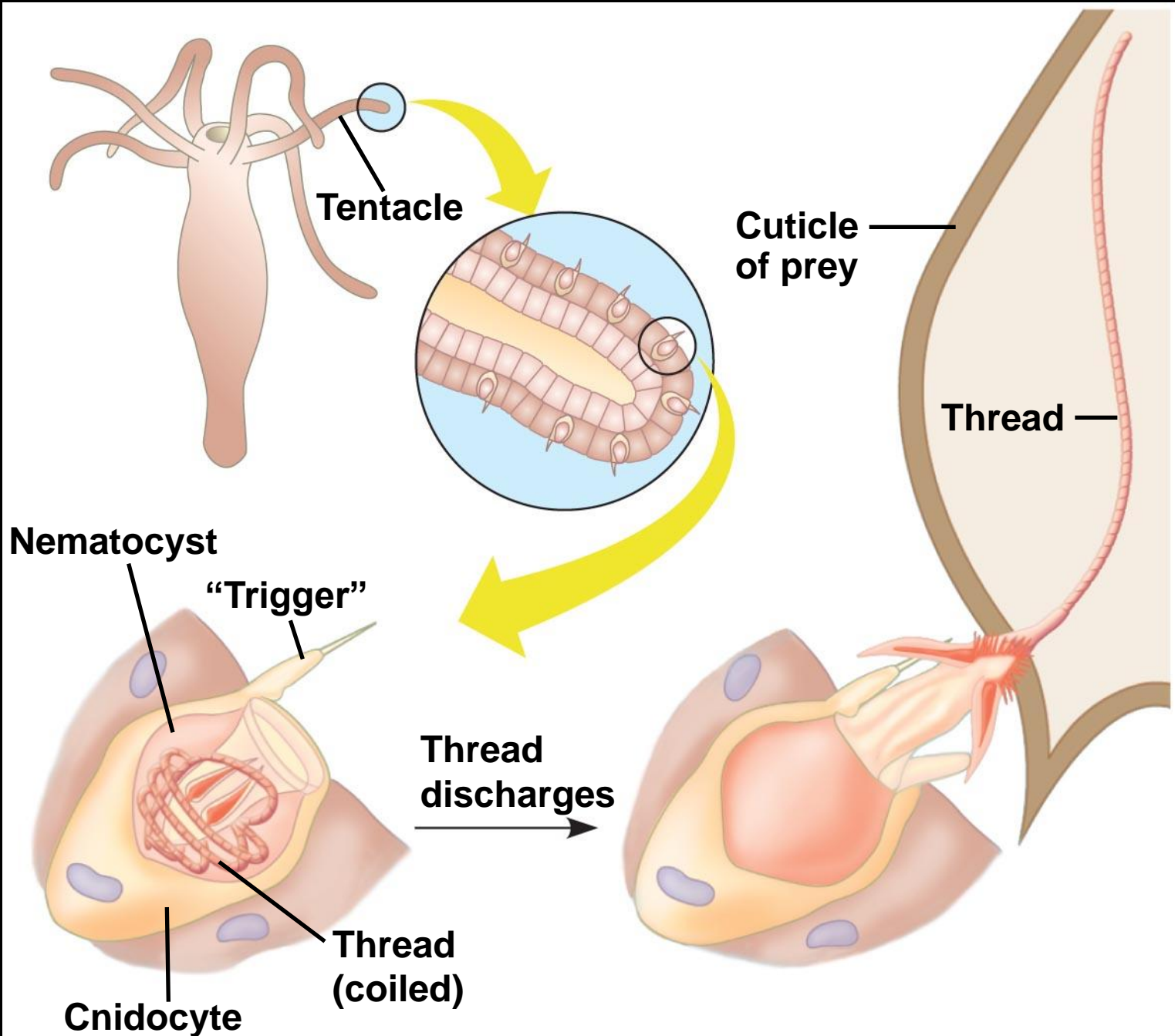




Azure vase sponge (*Callyspongia plicifera*)

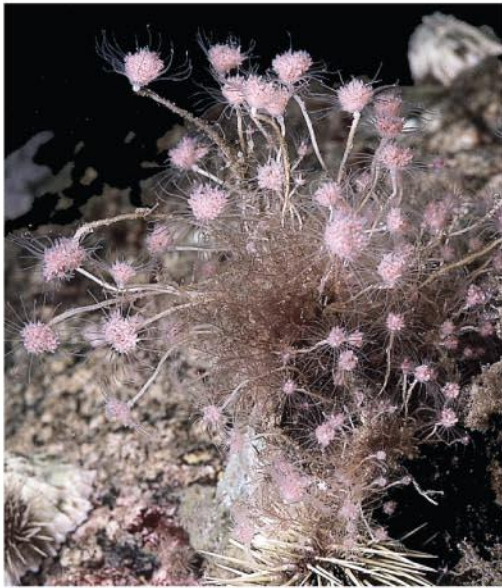












(a) Colonial polyps (class Hydrozoa)



(b) Jellies (class Scyphozoa)



(c) Sea wasp (class Cubozoa)



(d) Sea anemone (class Anthozoa)

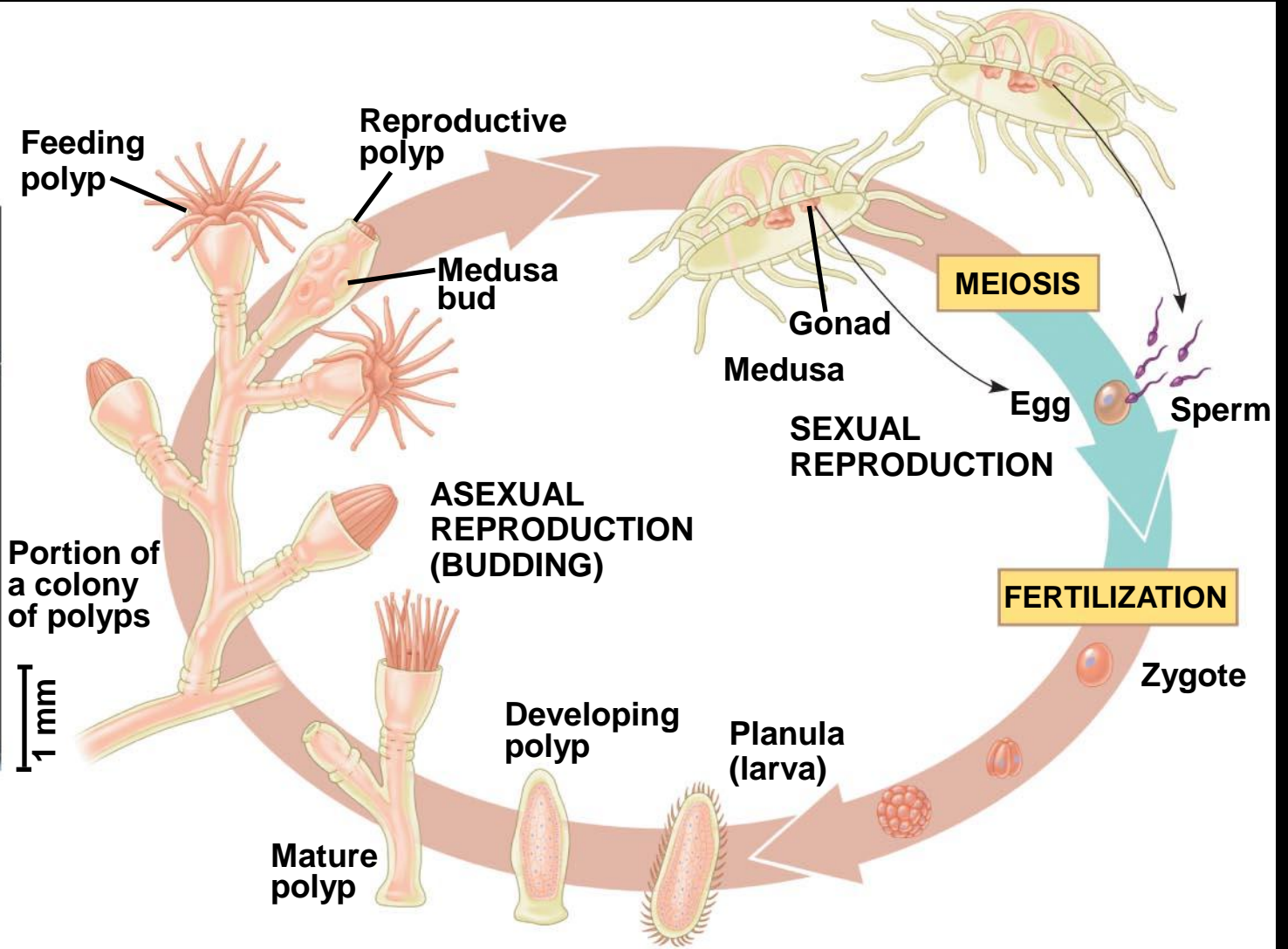
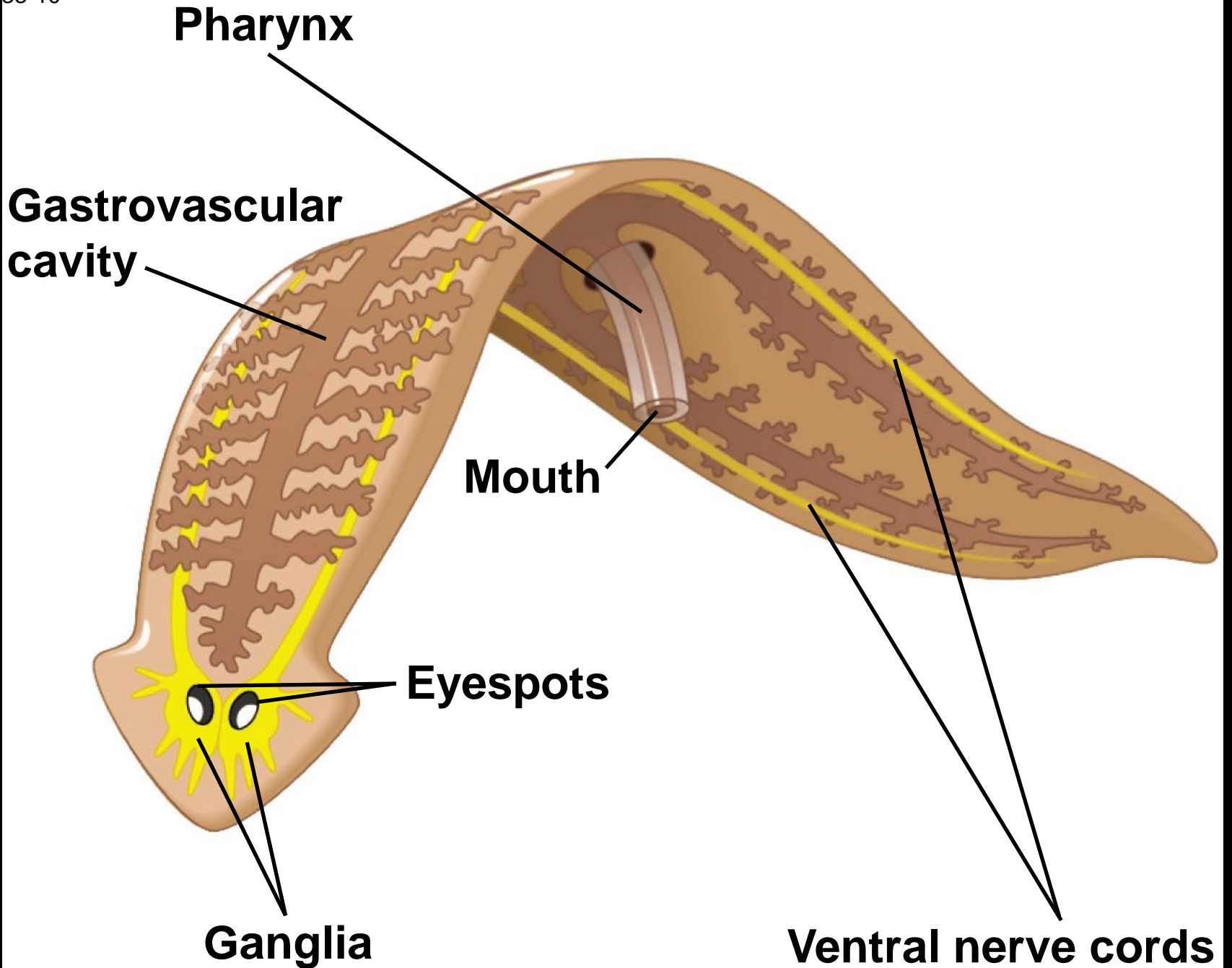


Table 33.2 Classes of Phylum Platyhelminthes

Class and Examples	Main Characteristics
Turbellaria (mostly free-living flatworms, such as <i>Dugesia</i>)	Most marine, some freshwater, a few terrestrial; predators and scavengers; body surface ciliated
Monogenea (monogeneans)	Marine and freshwater parasites; most infect external surfaces of fishes; life history simple; ciliated larva starts infection on host
Trematoda (trematodes, also called flukes)	Parasites, mostly of vertebrates; two suckers attach to host; most life cycles include intermediate and final hosts
Cestoda (tapeworms)	Parasites of vertebrates; scolex attaches to host; proglottids produce eggs and break off after fertilization; no head or digestive system; life cycle with one or more intermediate hosts





Monogeneans and Trematodes

- Monogeneans and trematodes live as parasites in or on other animals
- They parasitize a wide range of hosts, and most have complex life cycles with alternating sexual and asexual stages
- Trematodes that parasitize humans spend part of their lives in snail hosts
- Most monogeneans are parasites of fish

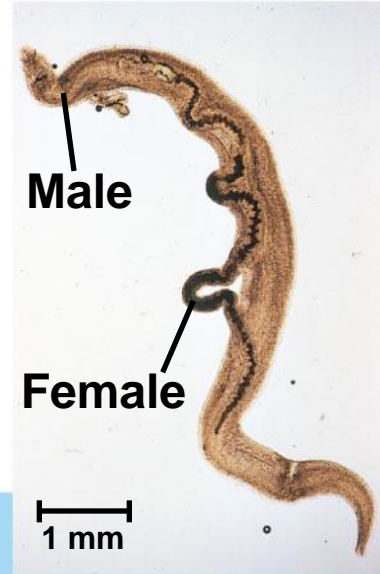
Human host



Male

Female

1 mm



Motile larva



Ciliated larva

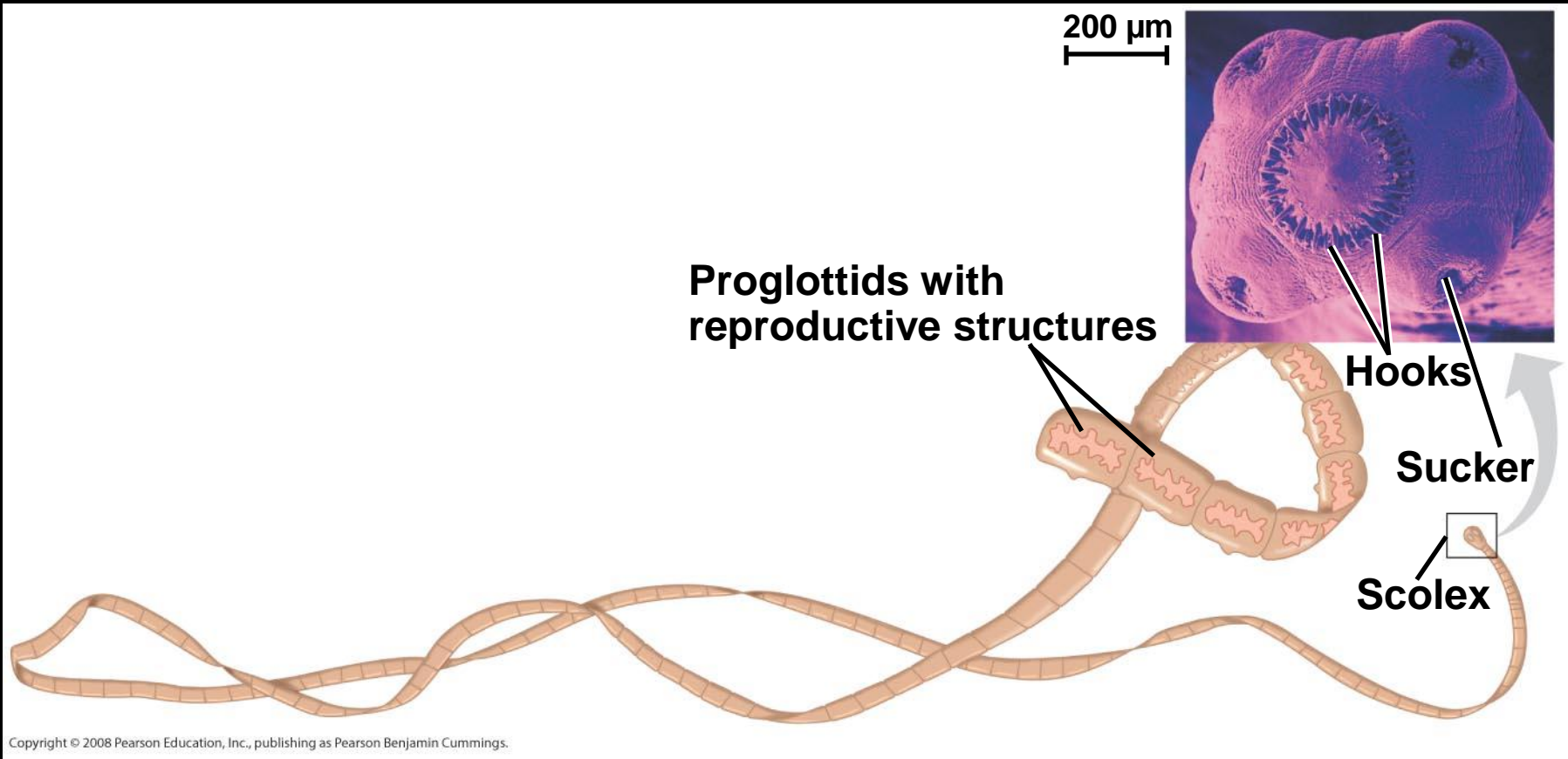


Snail host



Tapeworms

- Tapeworms are parasites of vertebrates and lack a digestive system
- Tapeworms absorb nutrients from the host's intestine
- Fertilized eggs, produced by sexual reproduction, leave the host's body in feces



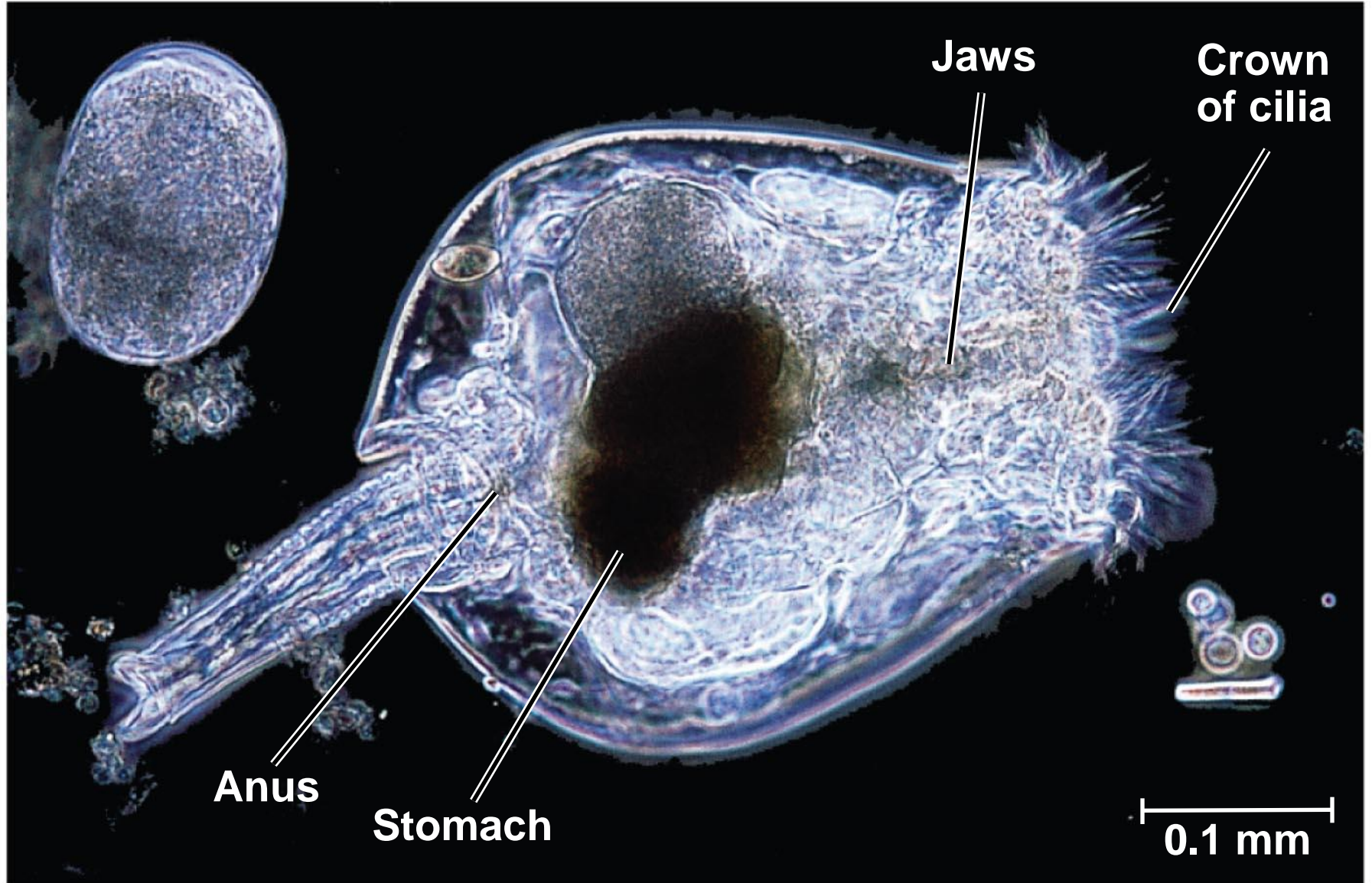
Rotifers

- Rotifers, phylum Rotifera, are tiny animals that inhabit fresh water, the ocean, and damp soil
- Rotifers are smaller than many protists but are truly multicellular and have specialized organ systems

PLAY

Video: Rotifer

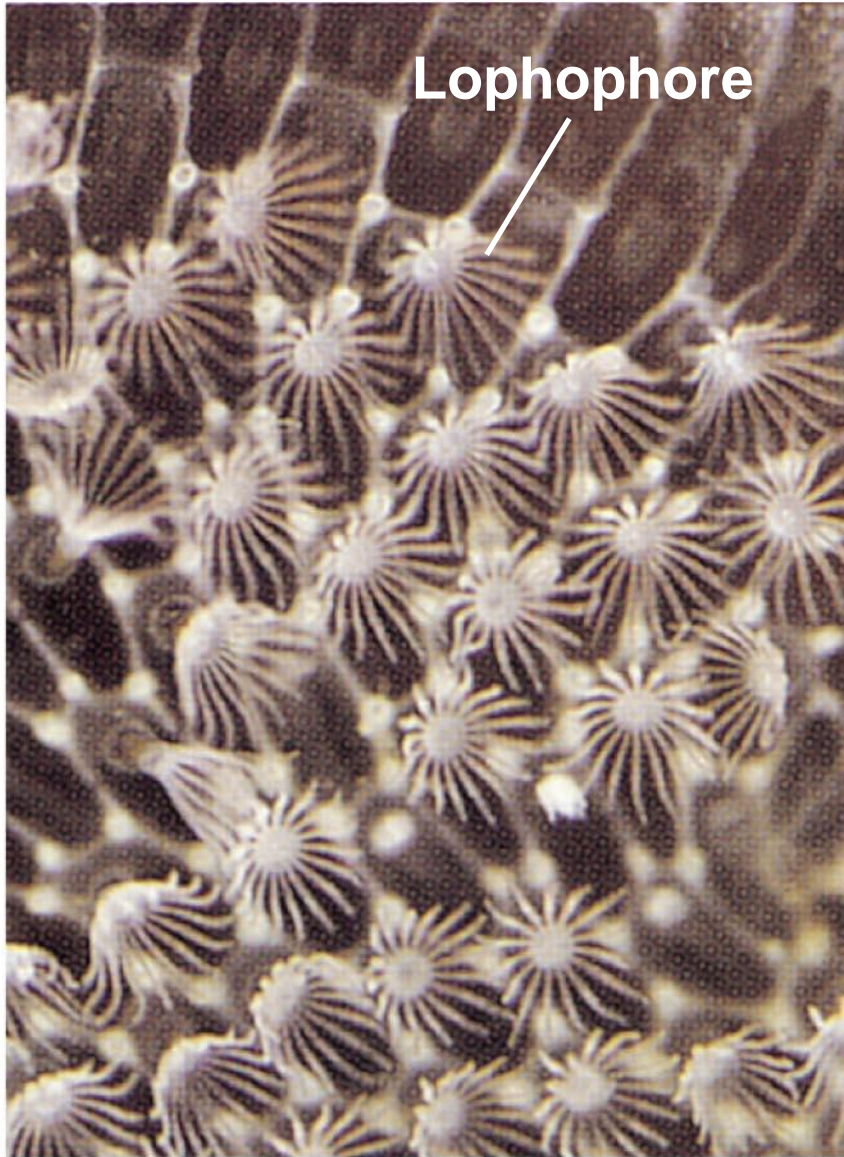
Fig. 33-13



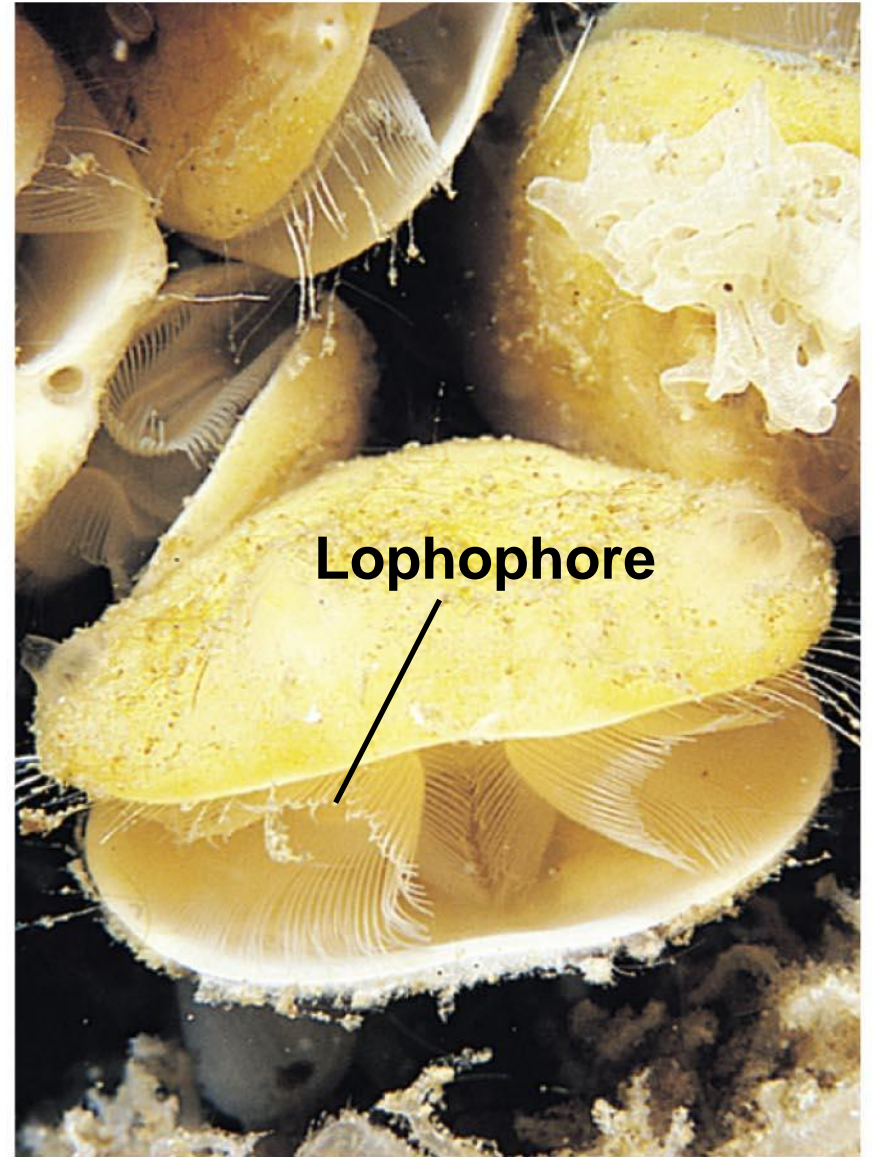
- Rotifers have an **alimentary canal**, a digestive tube with a separate mouth and anus that lies within a fluid-filled pseudocoelom
- Rotifers reproduce by **parthenogenesis**, in which females produce offspring from unfertilized eggs
- Some species are unusual in that they lack males entirely

Lophophorates: Ectoprocts and Brachiopods

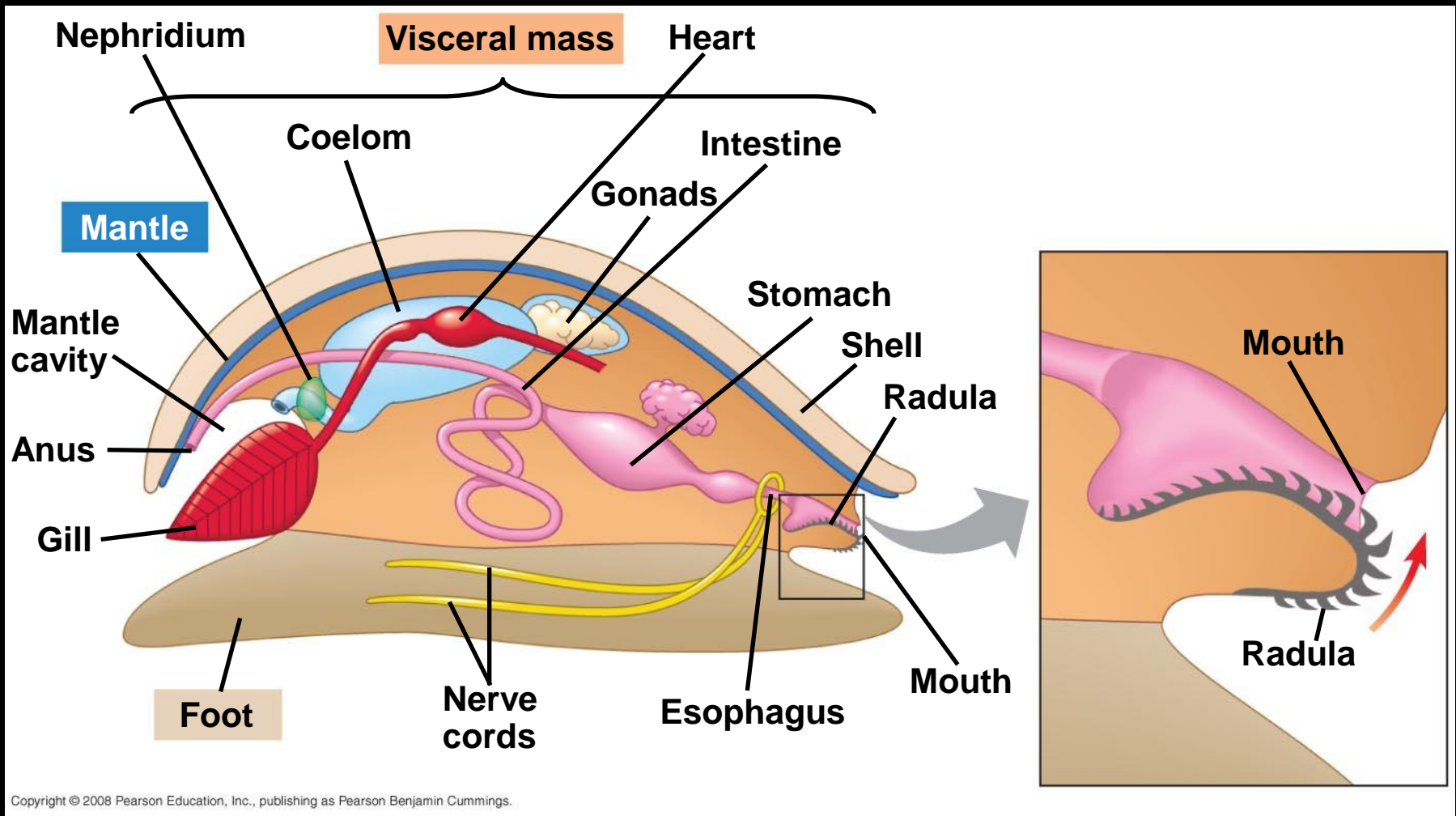
- Lophophorates have a *lophophore*, a horseshoe-shaped, suspension-feeding organ with ciliated tentacles
- Lophophorates include two phyla: Ectoprocta and Brachiopoda
- **Ectoprocts** (also called bryozoans) are colonial animals that superficially resemble plants
- A hard **exoskeleton** encases the colony, and some species are reef builders



(a) Ectoproct (sea mat)



(b) Brachiopods



- Most molluscs have separate sexes with gonads located in the visceral mass
- The life cycle of many molluscs includes a ciliated larval stage called a trochophore

- There are four major classes of molluscs:
 - Polyplacophora (chitons)
 - Gastropoda (snails and slugs)
 - Bivalvia (clams, oysters, and other bivalves)
 - Cephalopoda (squids, octopuses, cuttlefish, and chambered nautilus)



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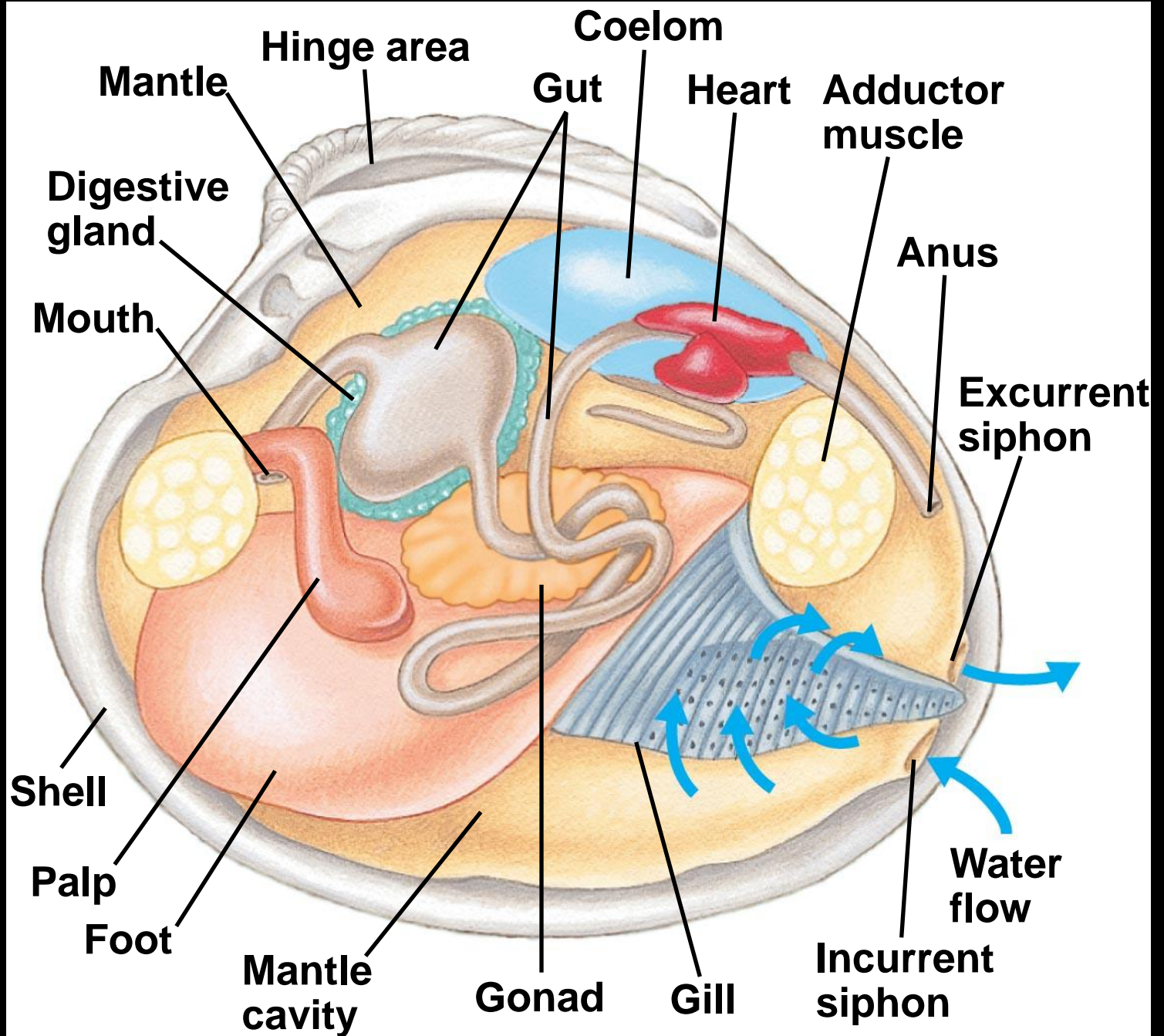


(a) A land snail



(b) A sea slug

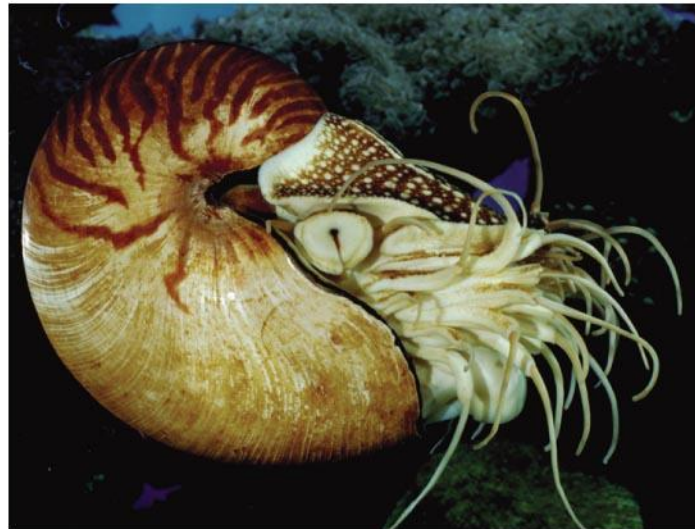




▶ **Octopus**



▼ **Squid**

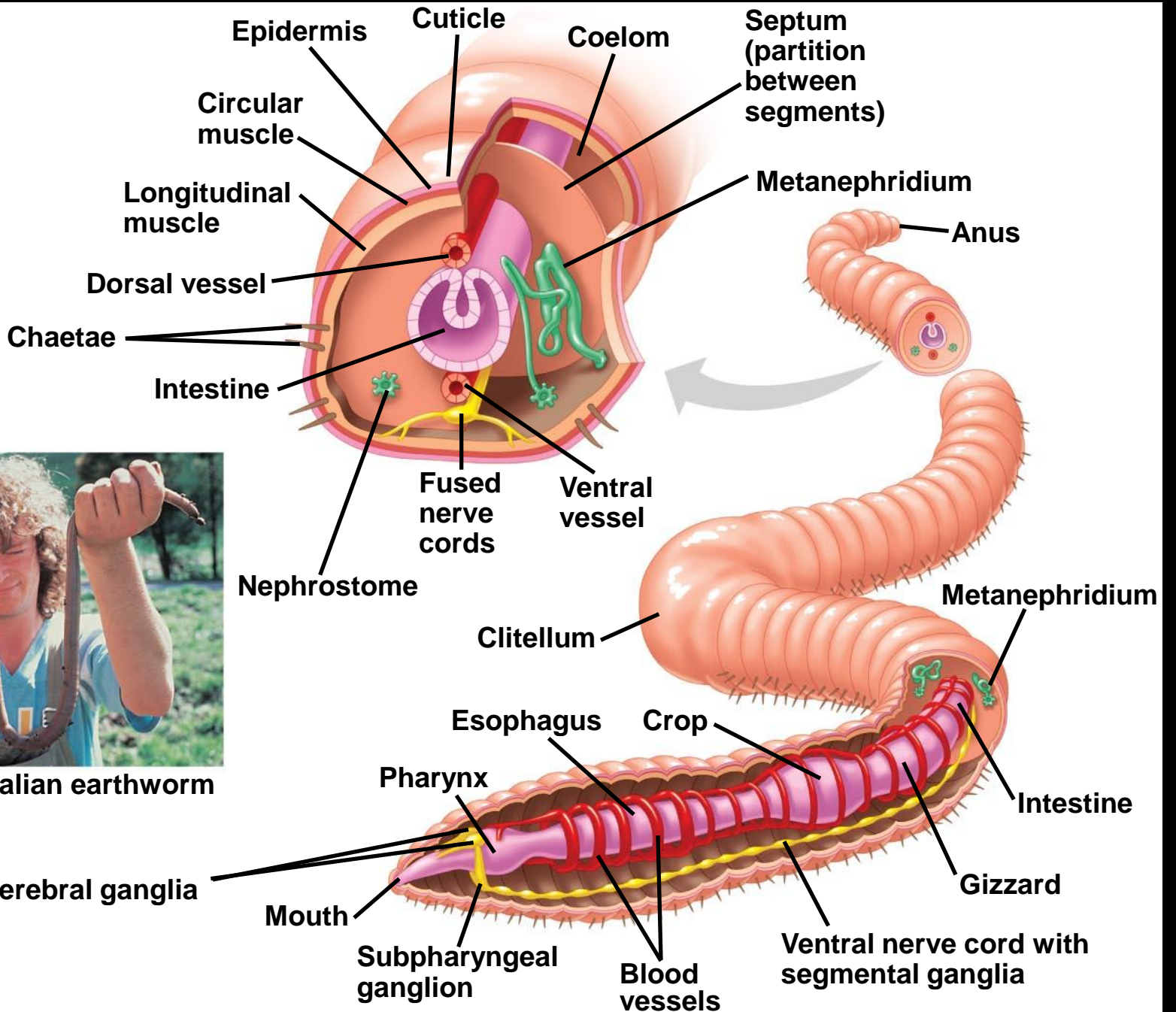


◀ **Chambered nautilus**

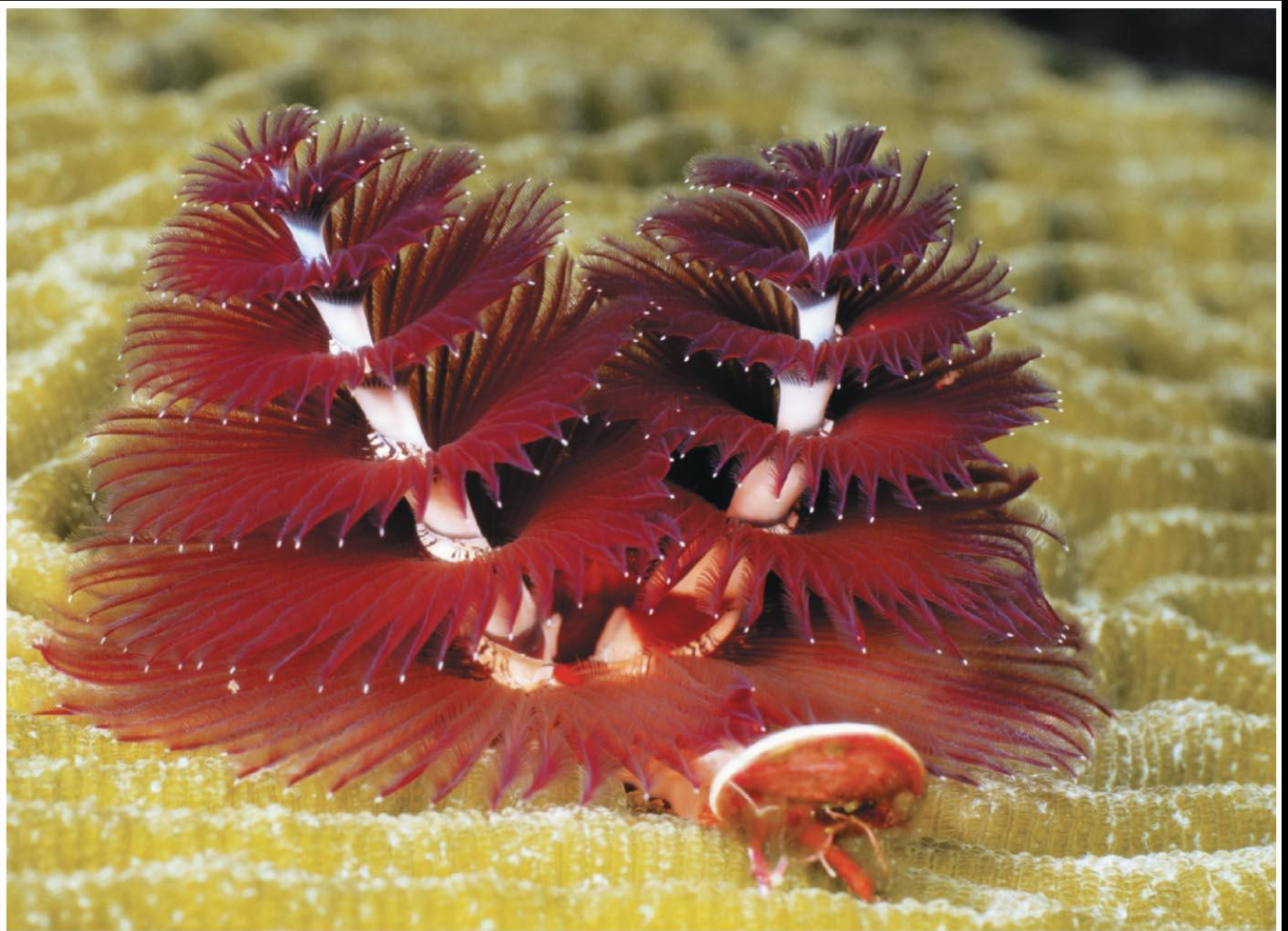
- Cephalopods have a closed circulatory system, well-developed sense organs, and a complex brain
- Shelled cephalopods called **ammonites** were common but went extinct at the end of the Cretaceous

Annelids

- Annelids have bodies composed of a series of fused rings
- The phylum Annelida is divided into three classes:
 - Oligochaeta (earthworms and their relatives)
 - Polychaeta (polychaetes)
 - Hirudinea (leeches)



Giant Australian earthworm

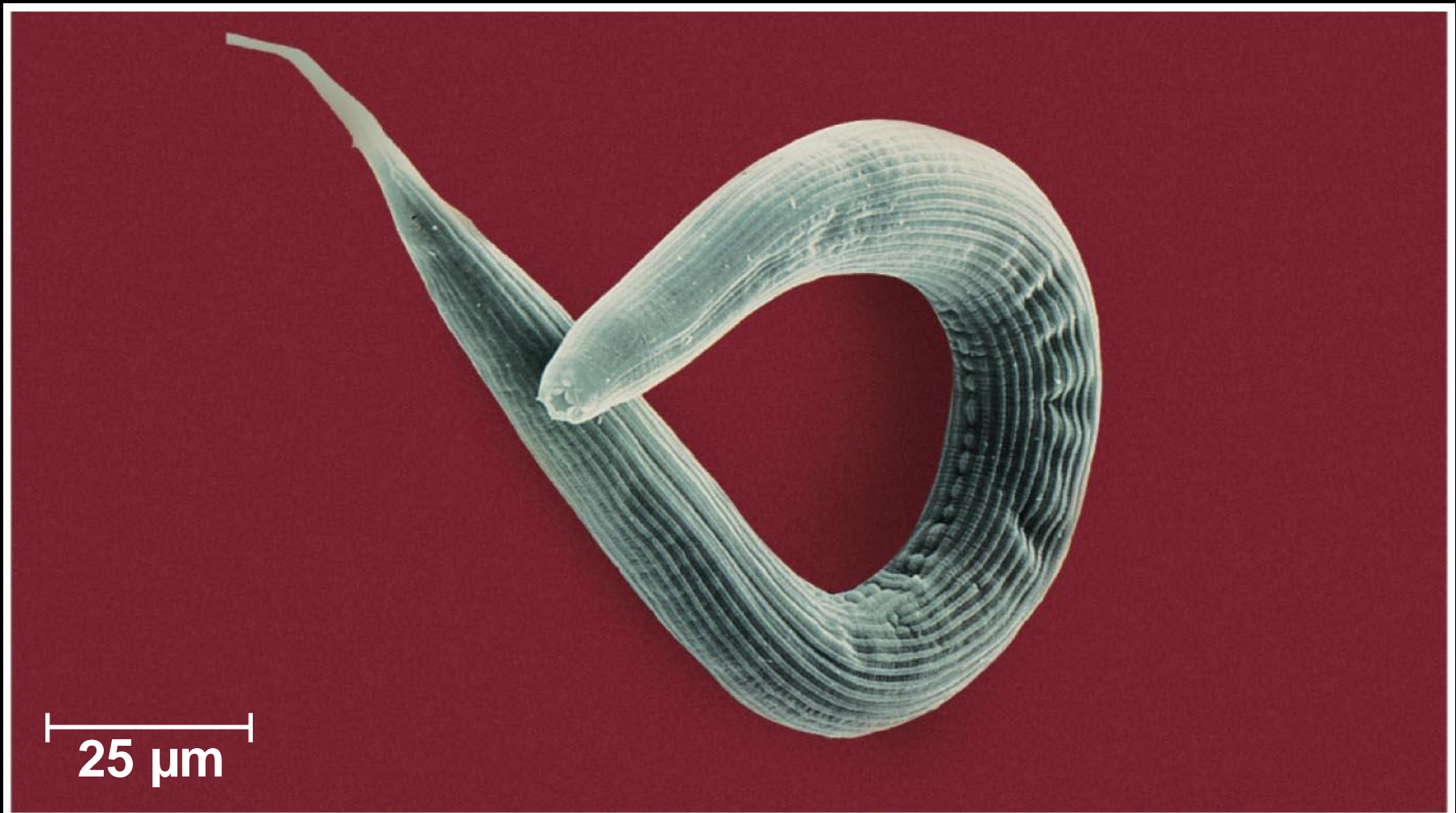




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Concept 33.4: Ecdysozoans are the most species-rich animal group

- Ecdysozoans are covered by a tough coat called a **cuticle**
- The cuticle is shed or **molted** through a process called ecdysis
- The two largest phyla are nematodes and arthropods

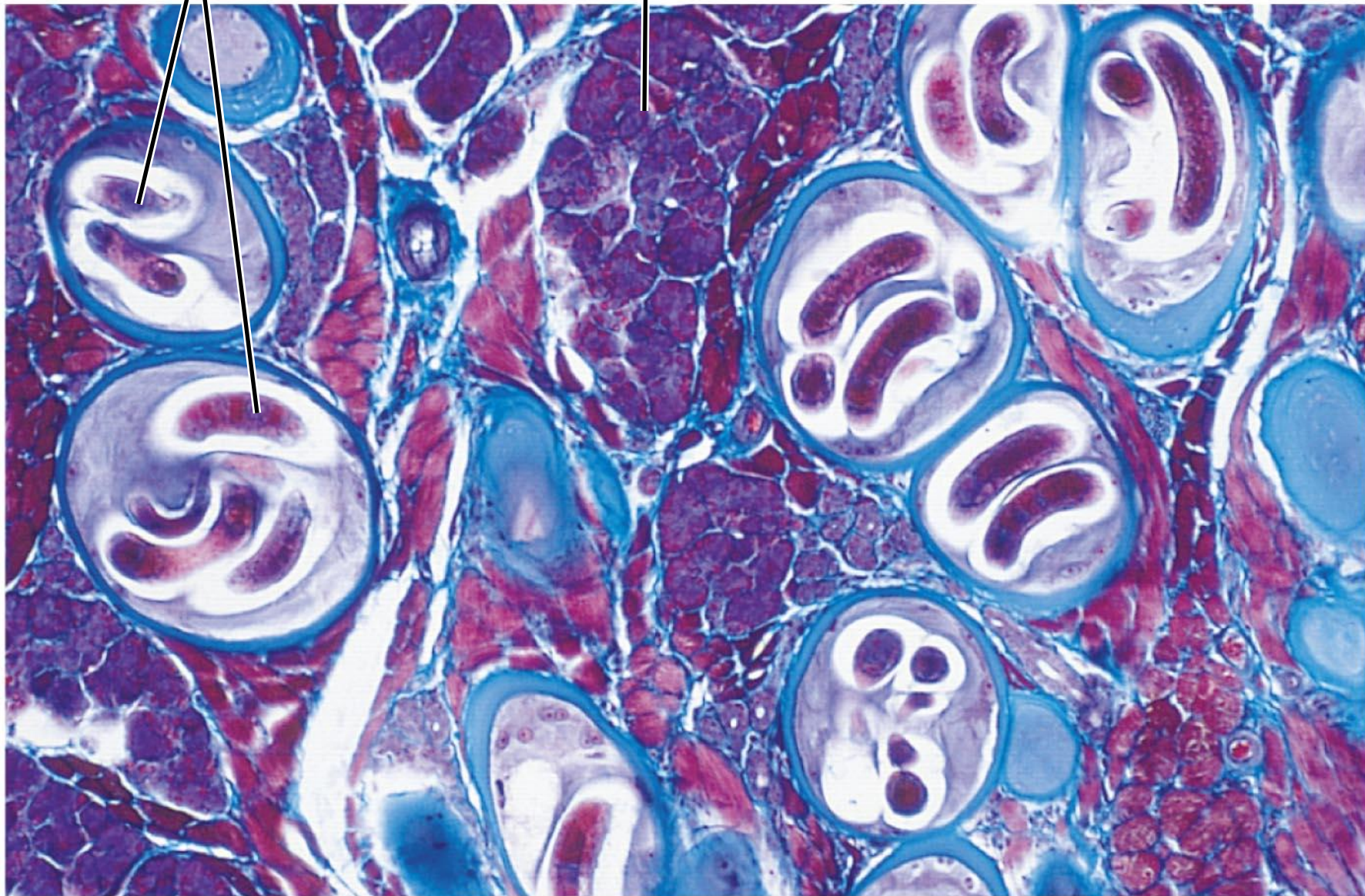


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Encysted juveniles

Muscle tissue

50 μ m



Arthropod Origins

- The **arthropod** body plan consists of a segmented body, hard exoskeleton, and jointed appendages, and dates to the Cambrian explosion (535–525 million years ago)
- Early arthropods show little variation from segment to segment

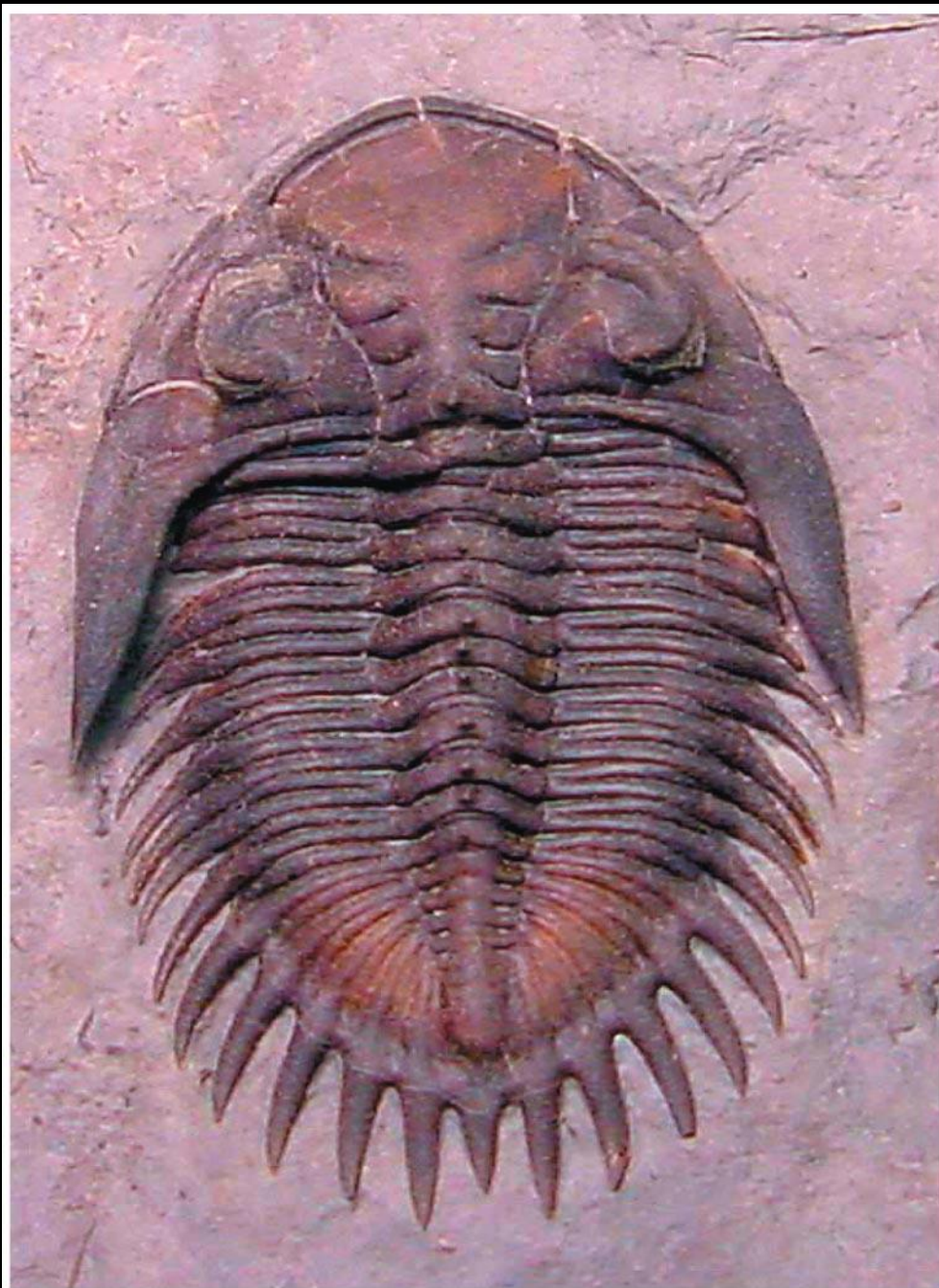
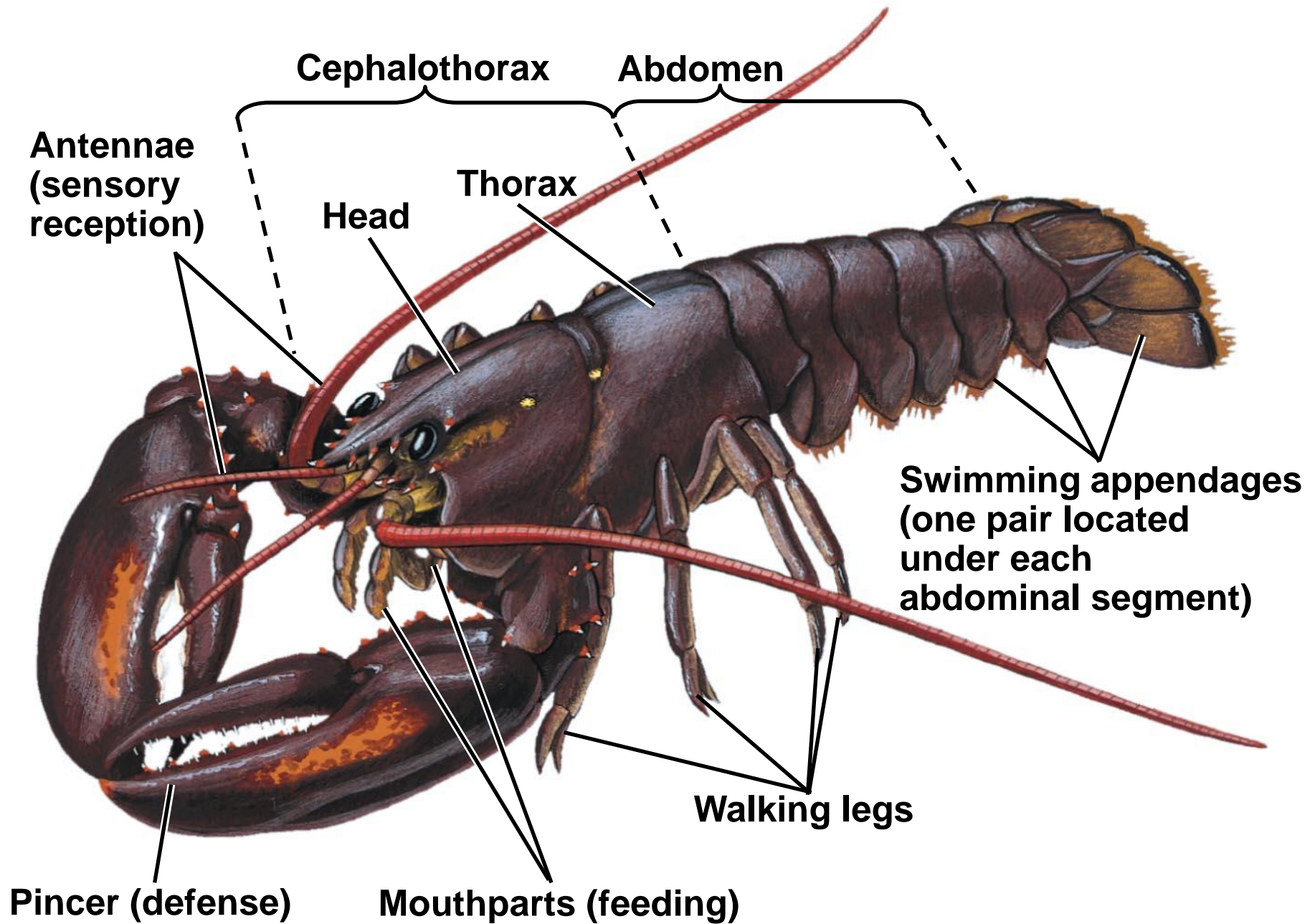


Fig. 33-29

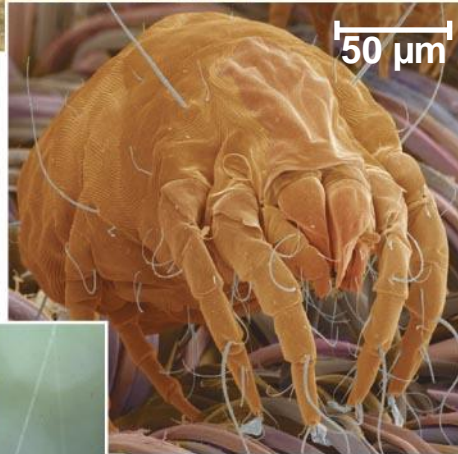


- Molecular evidence suggests that living arthropods consist of four major lineages that diverged early in the phylum's evolution:
 - **Cheliceriforms** (sea spiders, horseshoe crabs, scorpions, ticks, mites, and spiders)
 - **Myriapods** (centipedes and millipedes)
 - **Hexapods** (insects and relatives)
 - **Crustaceans** (crabs, lobsters, shrimps, barnacles, and many others)





▲ Scorpion

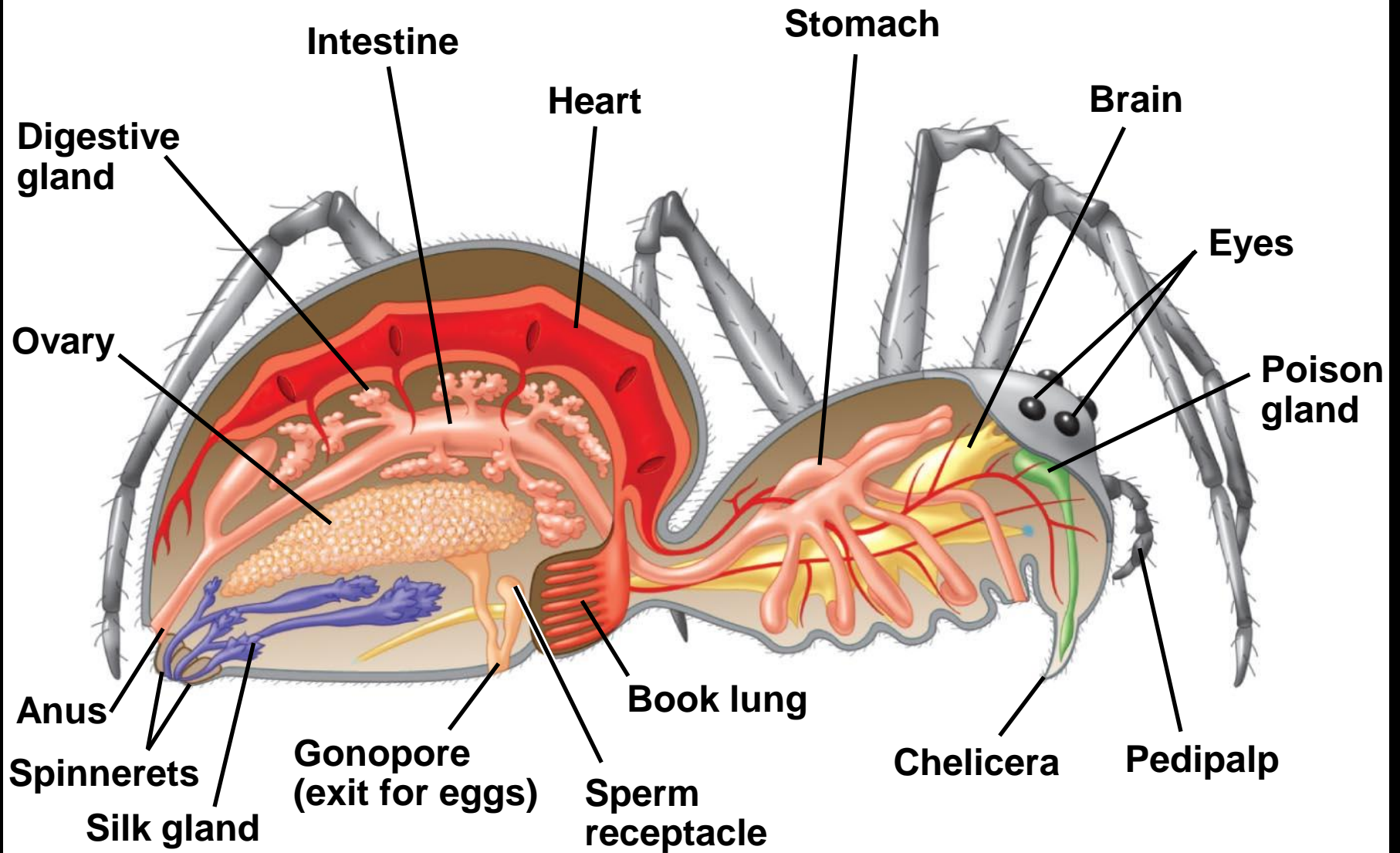


▲ Dust mite



◀ Web-building spider

- Arachnids have an abdomen and a cephalothorax, which has six pairs of appendages, the most anterior of which are the chelicerae
- Gas exchange in spiders occurs in respiratory organs called **book lungs**
- Many spiders produce silk, a liquid protein, from specialized abdominal glands



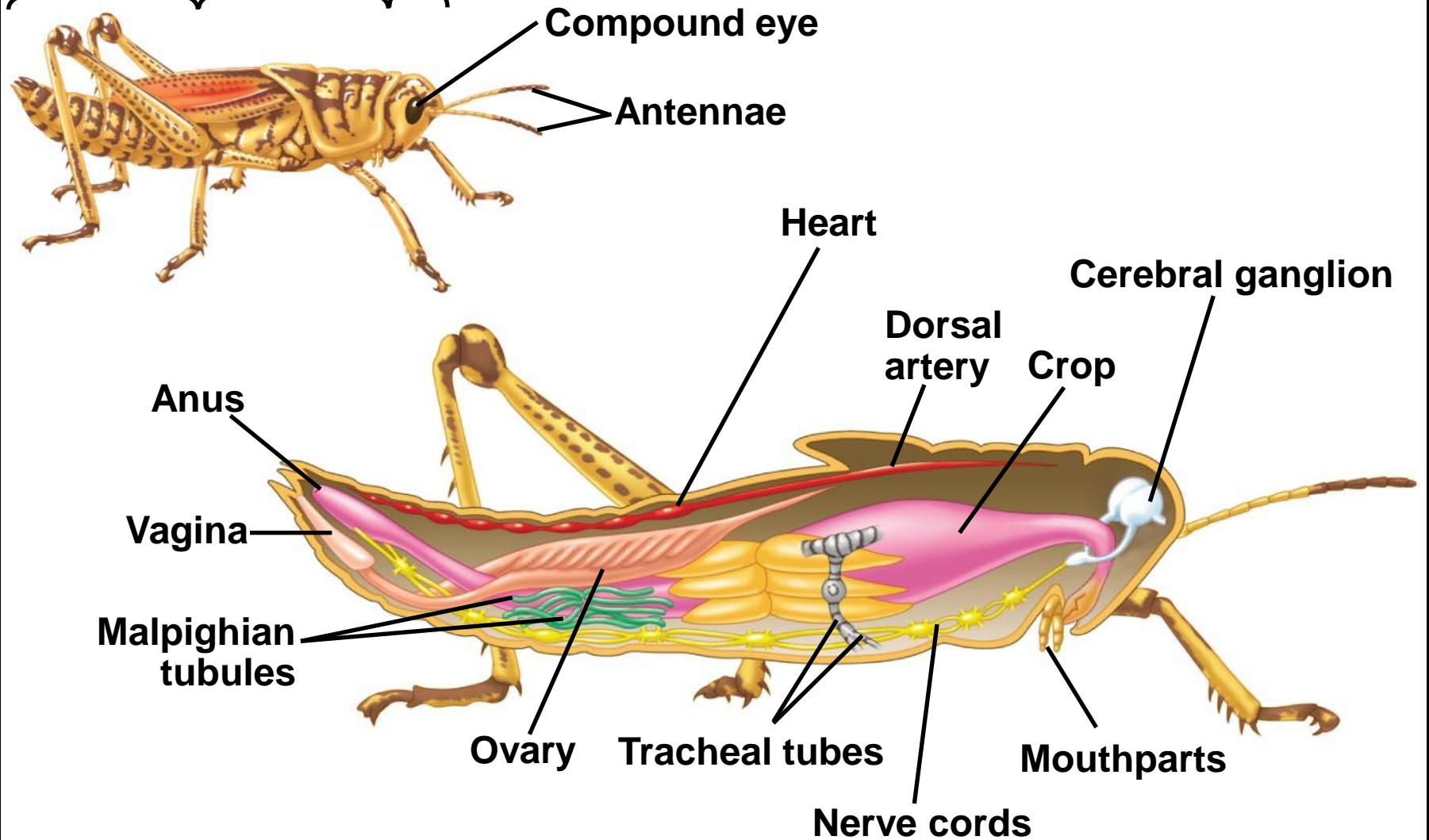
Myriapods

- Subphylum Myriapoda includes millipedes and centipedes
 - Myriapods are terrestrial, and have jaw-like **mandibles**
- Millipedes, class Diplopoda, have many legs
 - Each trunk segment has two pairs of legs





Abdomen Thorax Head





(a) Larva (caterpillar)



(b) Pupa



(c) Later-stage pupa



(d) Emerging adult



(e) Adult

Crustaceans

- While arachnids and insects thrive on land, crustaceans, for the most part, have remained in marine and freshwater environments
- Crustaceans, subphylum Crustacea, typically have branched appendages that are extensively specialized for feeding and locomotion
- Most crustaceans have separate males and females

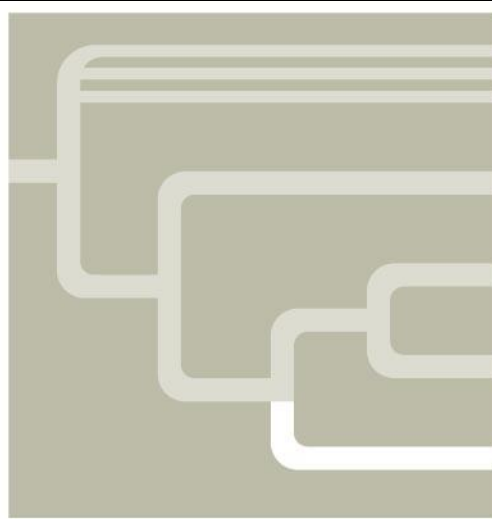
- **Isopods** include terrestrial, freshwater, and marine species
 - Pill bugs are a well known group of terrestrial isopods
- **Decapods** are all relatively large crustaceans and include lobsters, crabs, crayfish, and shrimp



(a) Ghost crab

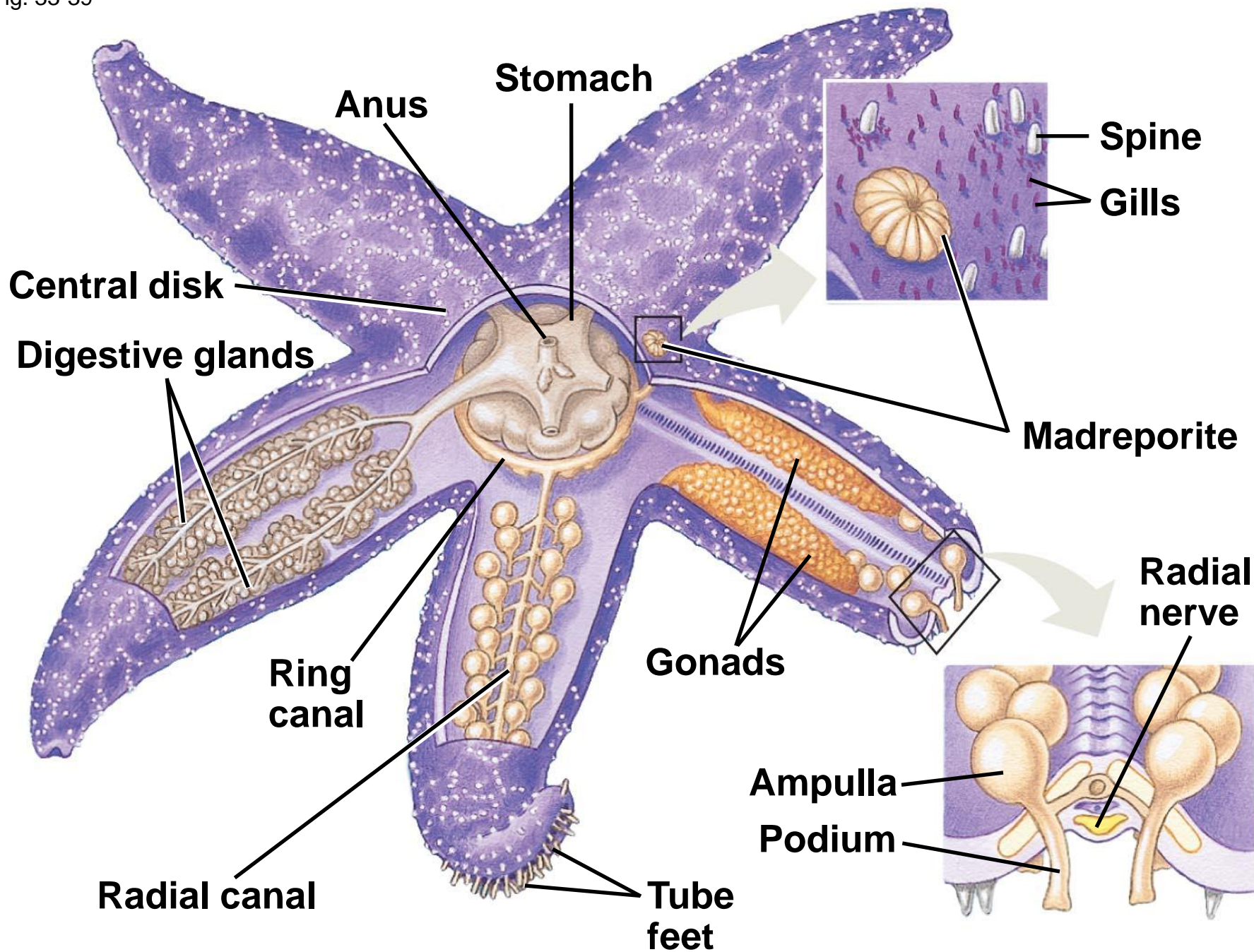


(c) Barnacles



Calcarea and Silicea
Cnidaria
Lophotrochozoa
Ecdysozoa
Deuterostomia

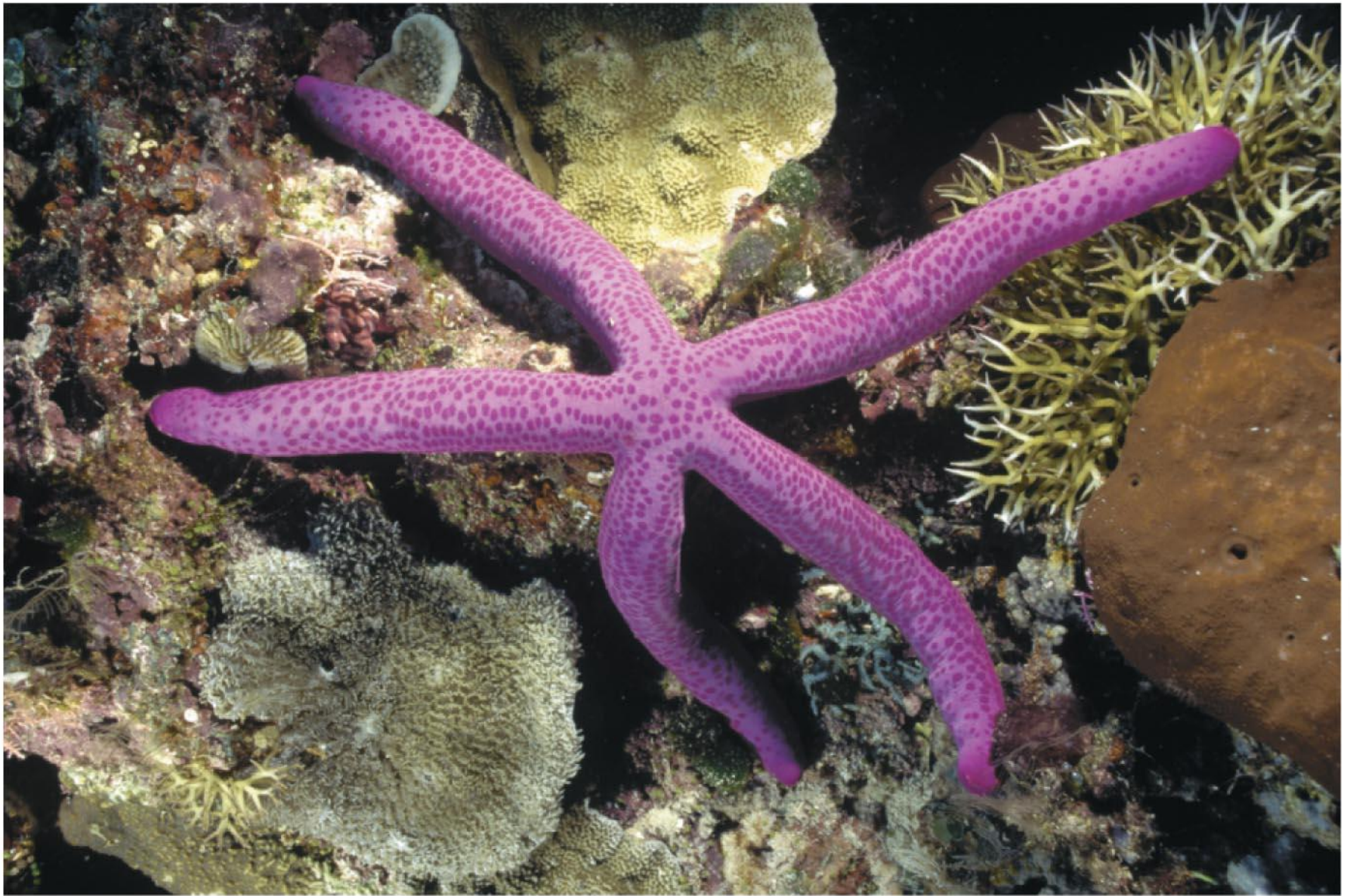
Fig. 33-39



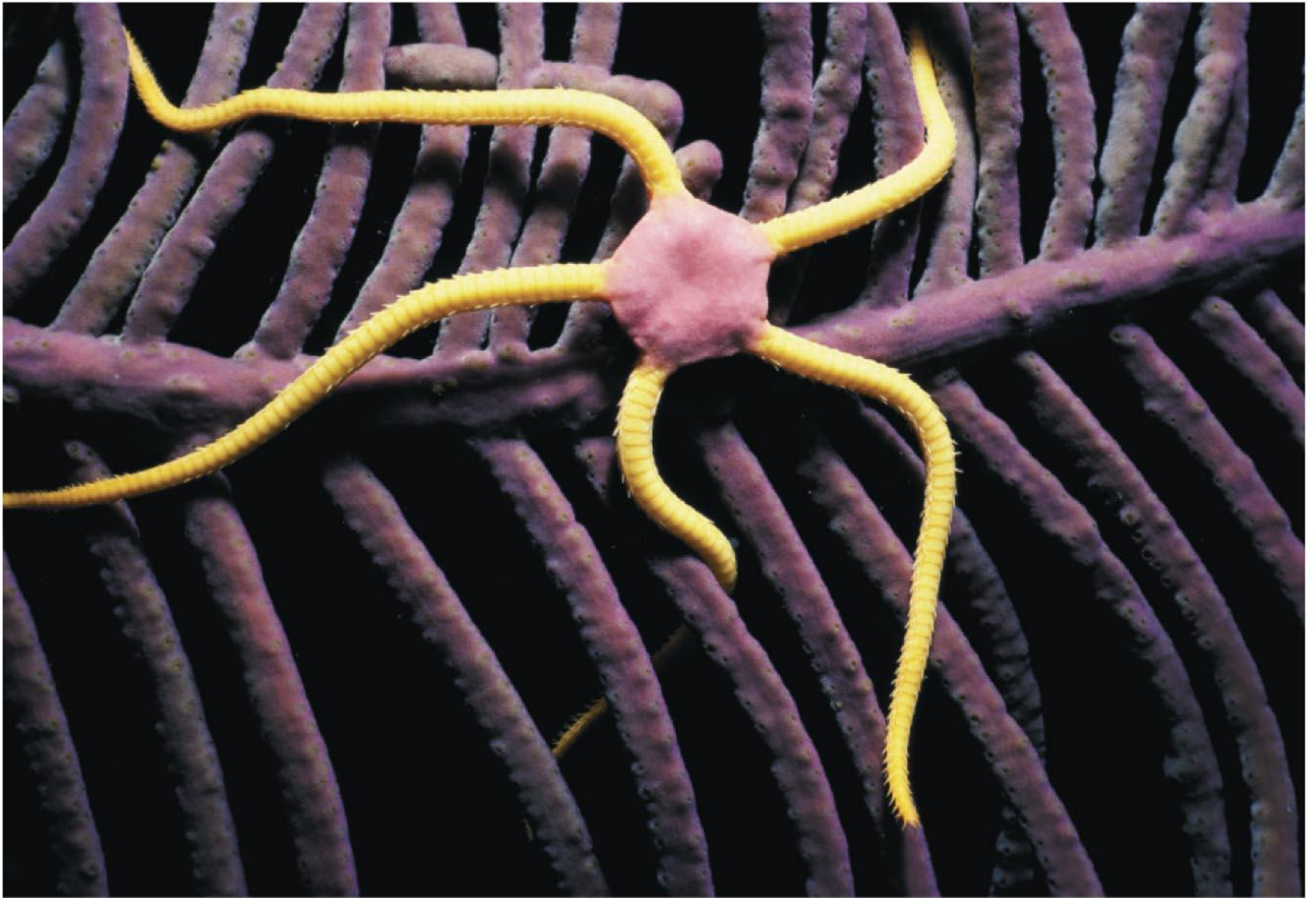
- Living echinoderms are divided into six classes:
 - Asterozoa (sea stars)
 - Ophiurozoa (brittle stars)
 - Echinozoa (sea urchins and sand dollars)
 - Crinozoa (sea lilies and feather stars)
 - Holothurozoa (sea cucumbers)
 - Concentricyclozoa (sea daisies)

PLAY

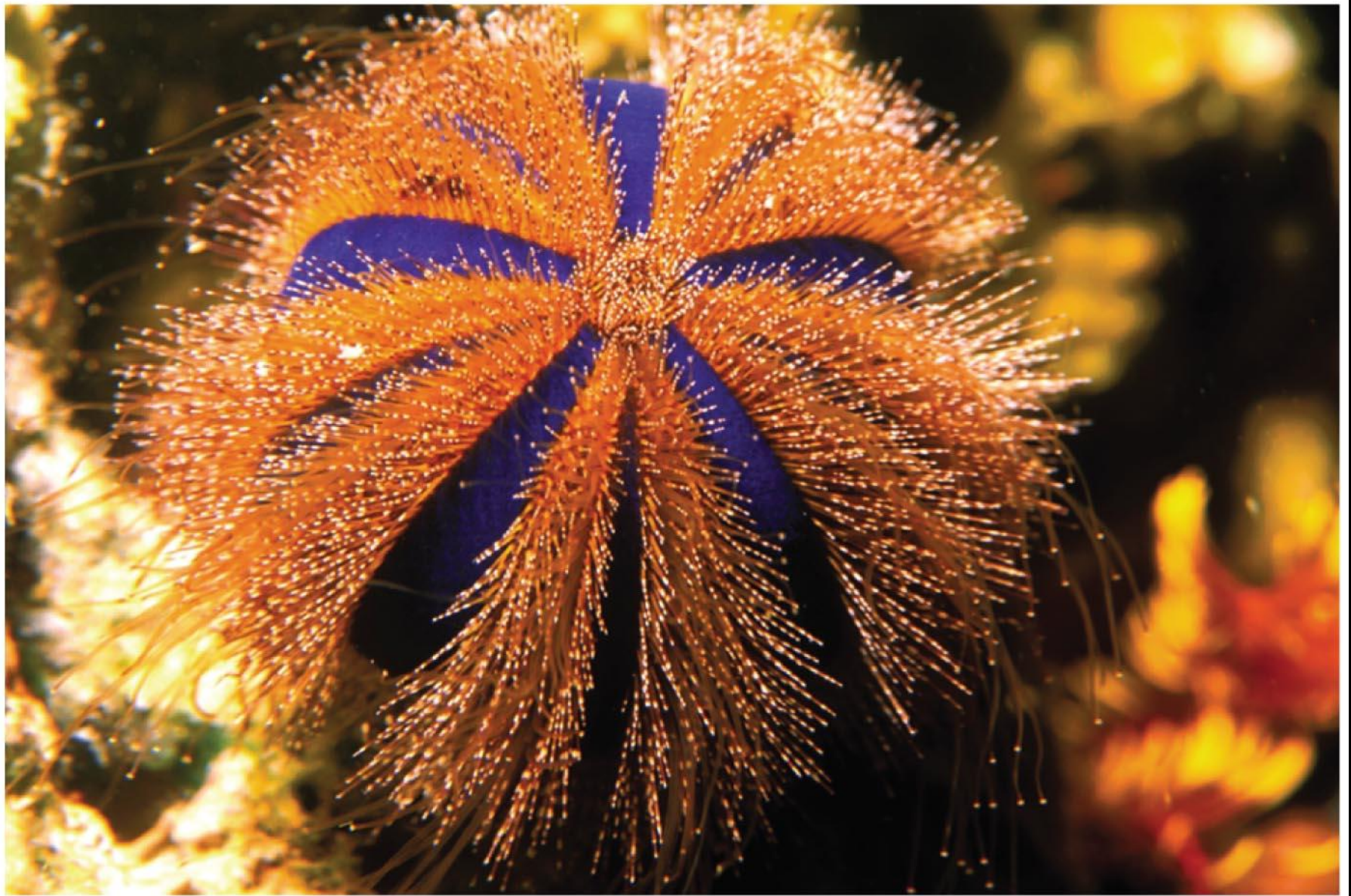
Video: Echinoderm Tube Feet



(a) A sea star (class Asteroidea)



(b) A brittle star (class Ophiuroidea)



(c) A sea urchin (class Echinoidea)



(d) A feather star (class Crinoidea)



(e) A sea cucumber (class Holothuroidea)

Sea Daisies

- Sea daisies were discovered in 1986, and only three species are known



(f) A sea daisy (class Concentricycloidea)

You should now be able to:

1. Describe how a sponge feeds and digests its food
2. List the characteristics of the phylum Cnidaria that distinguish it from other animal phyla
3. List the four classes of Cnidaria and distinguish among them based on life cycle morphology
4. List the characteristics of Platyhelminthes and distinguish among the four classes

5. Describe a lophophore and name two lophophorate phyla
6. Describe the features of molluscs and distinguish among the four classes
7. Describe the features of annelids and distinguish among the three classes
8. List the characteristics of nematodes that distinguish them from other wormlike animals

9. List three features that account for the success of arthropods
10. Define and distinguish among the four major arthropod lineages
11. Describe the developmental similarities between echinoderms and chordates
12. Distinguish among the six classes of echinoderms