

Taxonomy and Sponges

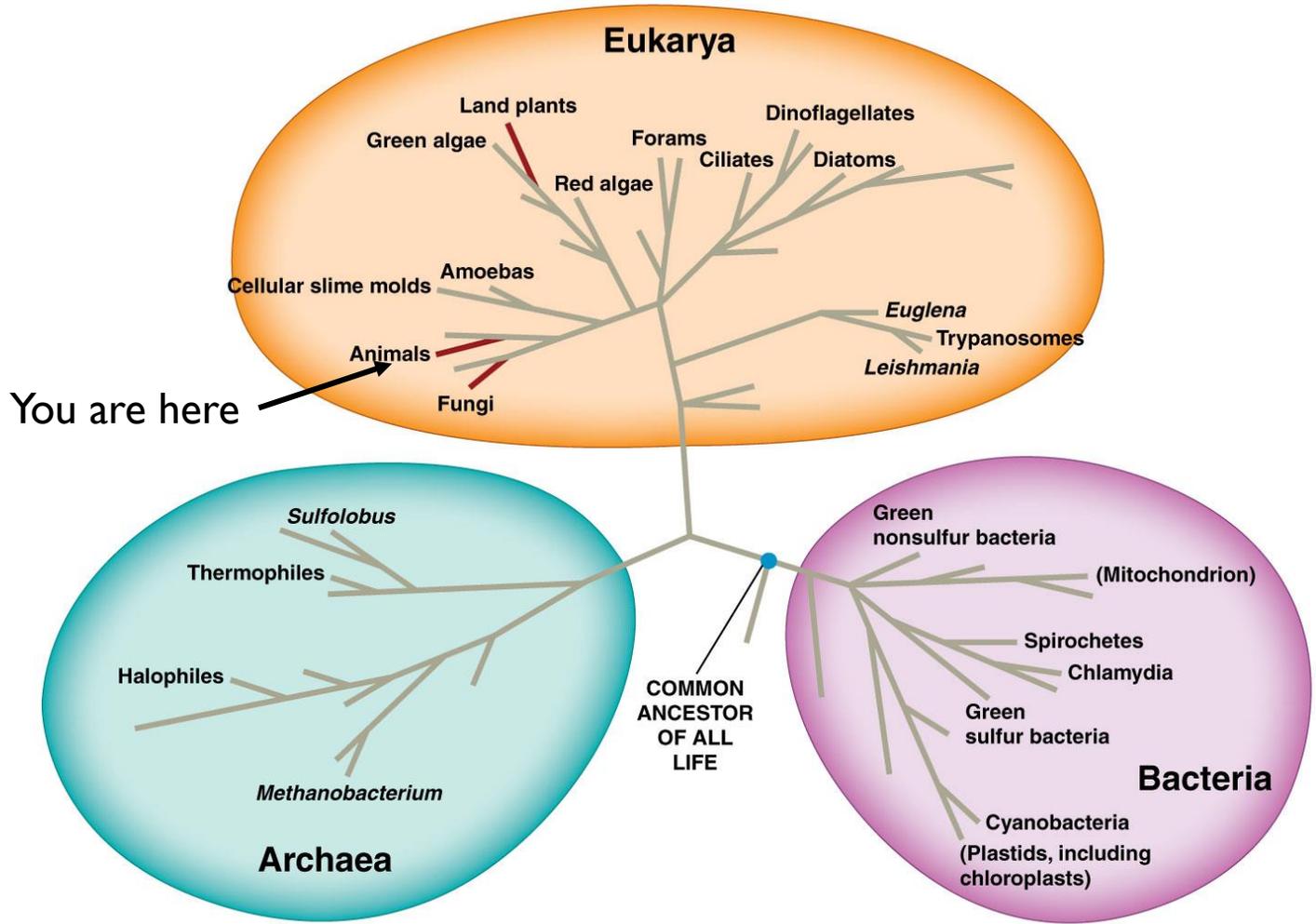
Lab 3

Domains of Life

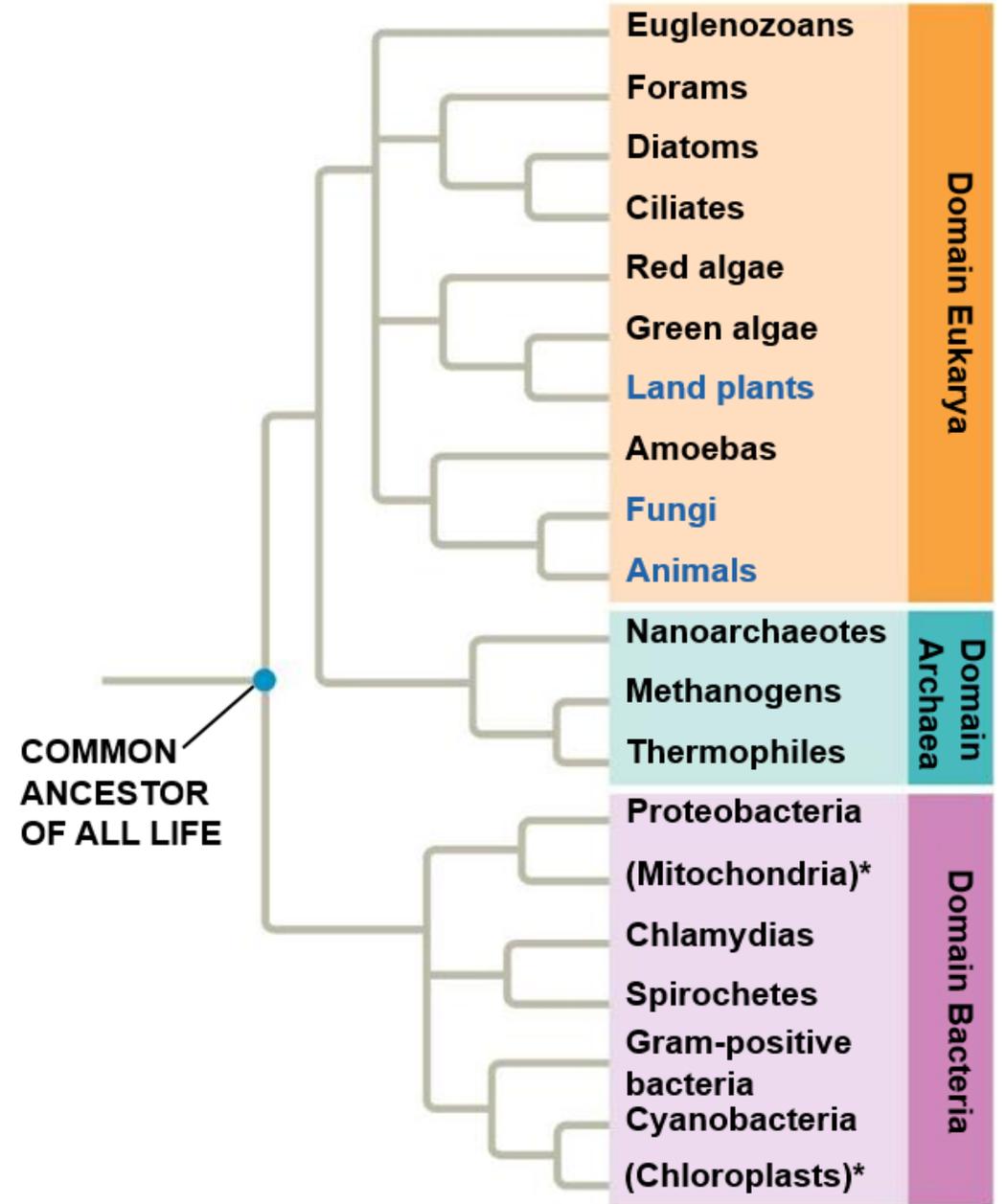
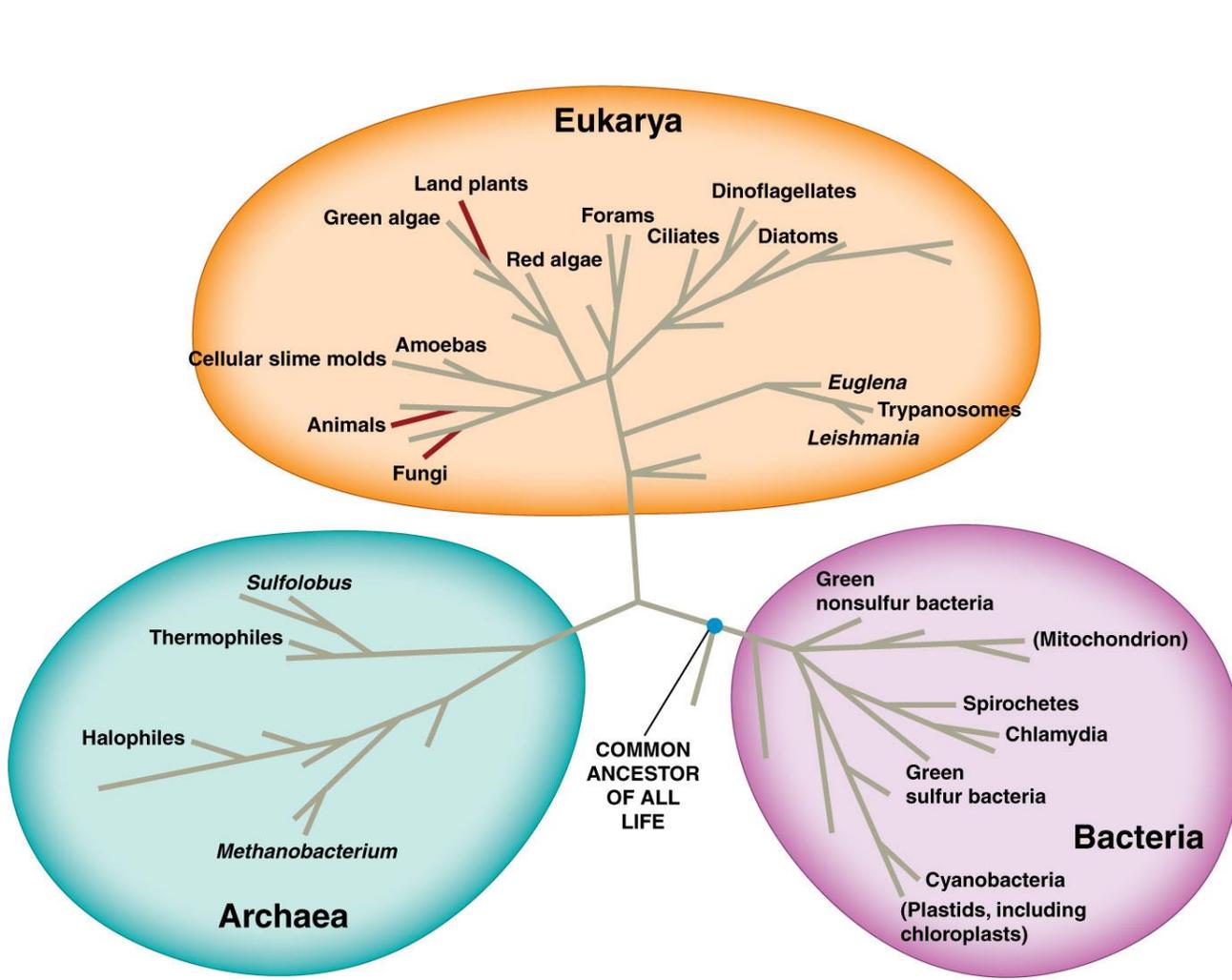
- ▶ **Bacteria**
 - ▶ Unicellular prokaryotes

- ▶ **Archaea**
 - ▶ Unicellular prokaryotes
 - ▶ Extremophiles

- ▶ **Eukarya**
 - ▶ Unicellular and multicellular eukaryotes
 - ▶ Protists
 - ▶ Fungi
 - ▶ Plants
 - ▶ Animals



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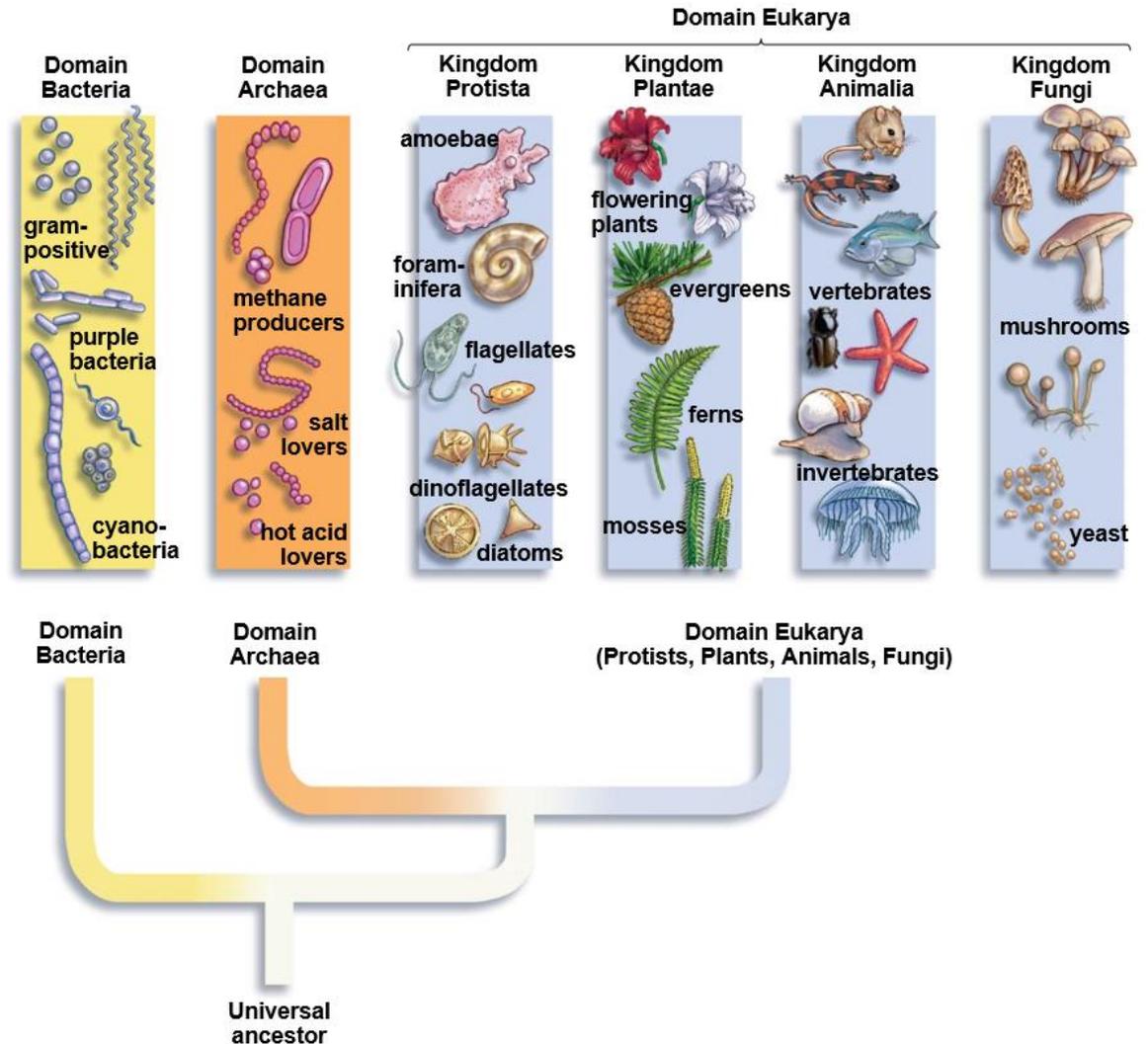


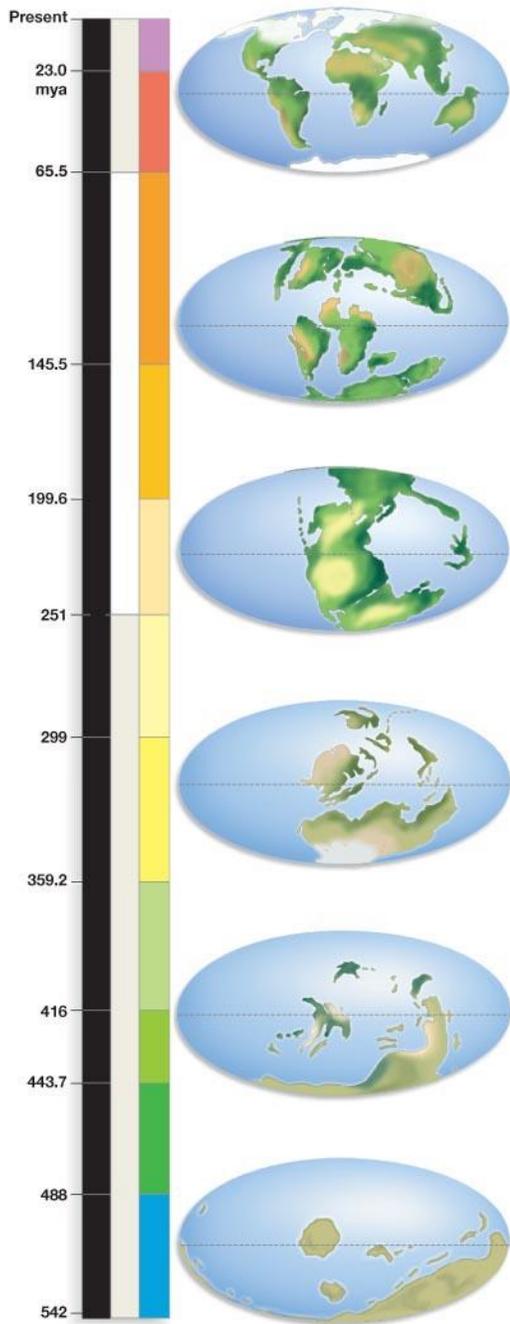
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Domains and Kingdoms of Life

- ▶ Earth – 4.6 BYA
- ▶ Prokaryotes – 3.8 BYA
- ▶ Eukaryotes – 2.0 BYA
- ▶ First Animals – 635 MYA





Era	Period	(Mya)	Notable events	Representative organisms	Mass extinction events
Quaternary		0.01	Historic time		
		1.80	Extinction of many large mammals; modern humans		
Cenozoic	Tertiary	5	Early humans emerge (genus <i>Homo</i>)		
		23	Grasses replace forests in drier areas		
		35	Rise of several modern mammals		
		56	Earliest whale fossils; first horses		
		65	First primate fossils Extinction of dinosaurs		Cretaceous Extinction
		65	Angiosperms replace gymnosperms in many areas		
Mesozoic	Jurassic	146	First bird fossil (<i>Archaeopteryx</i>) First flowering plants (Angiosperms)		
	Triassic	200	First dinosaurs and mammals		Triassic Extinction
	251	First mammal-like reptiles		Permian Extinction	
Paleozoic	Permian	251	First mammal-like reptiles		
	Carboniferous	299	First reptiles First gymnosperms		
	359	First seed-bearing plants Fish-to-tetrapod transition		Devonian Extinction	
	416	Early jawed fishes First fossils of land animals			
	444	First plant fossils First fungus fossils		Ordovician Extinction	
	488	First fossil of chordate (ancestors of vertebrates) Cambrian Explosion			
Precambrian		542	First animal fossils		
		635	First multicellular life		
		1,200	First eukaryotic fossils		
		2,000	First substantial oxygen in atmosphere		
		2,400	Evidence of abundant bacterial and archaeal life		
		3,400	Possible evidence of earliest life on Earth		
		3,800	Earth is formed		

Taxonomy

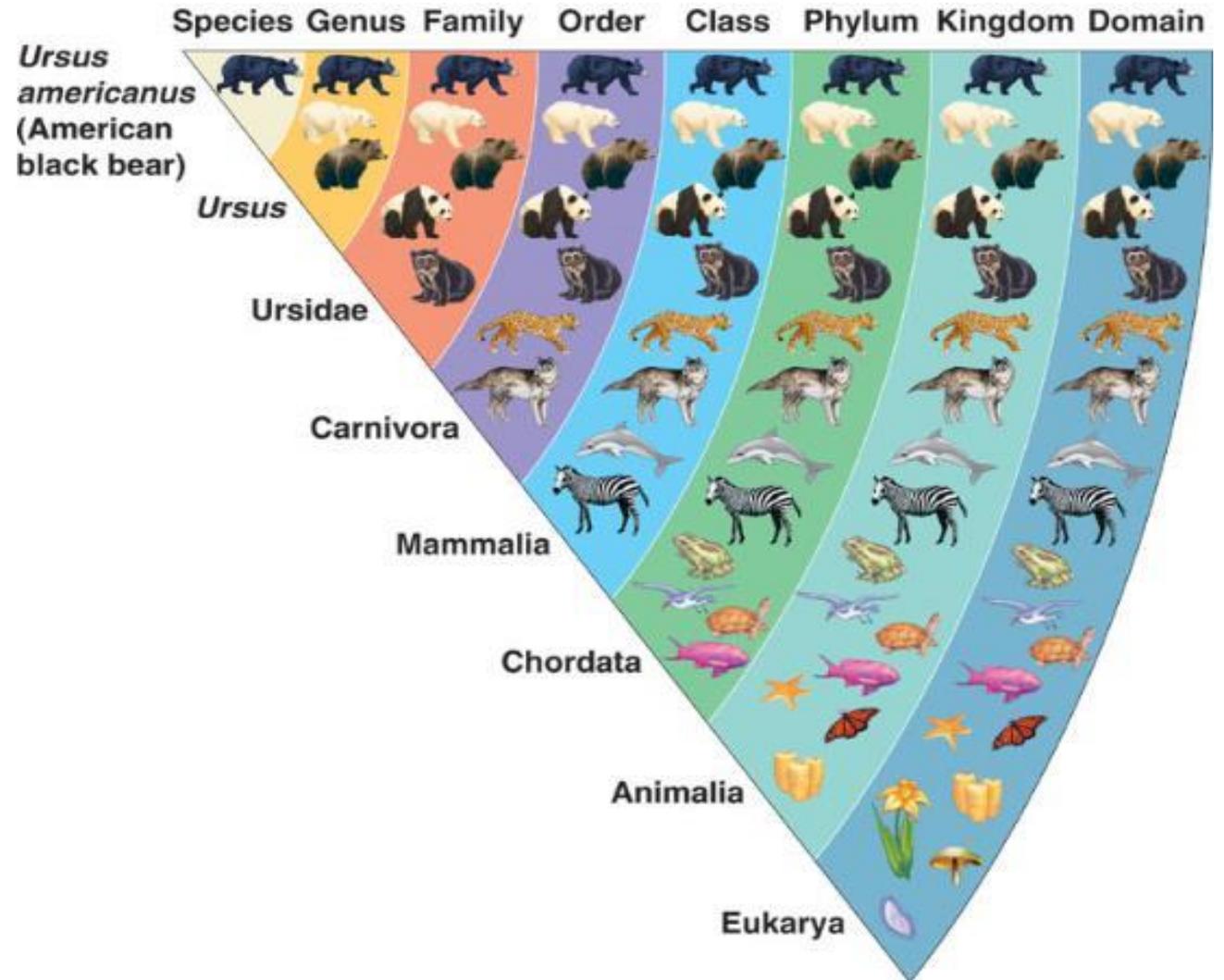
Taxonomy: the science of naming and classifying organisms

- ▶ Carl Linnaeus (1707 – 1778)
 - ▶ Swedish botanist, zoologist, and physician
- ▶ Father of taxonomy (classifying organisms)
 - ▶ **Binomial nomenclature:** species are identified by two names (*Genus species*)
 - ▶ Ex. *Homo sapiens*



Classifying Organisms: Taxonomy

- ▶ Domain
- ▶ Kingdom
- ▶ Phylum (plural, *phyla*)
- ▶ Class
- ▶ Order
- ▶ Family
- ▶ Genus (plural, *genera*)
- ▶ Species (no specie!)



Domain: Archaea, Bacteria, or Eukarya

Kingdom: Animalia, Plantae, Fungi, Protista, Archaea, Bacteria

Phylum: A group of similar classes

Class: A group of similar orders

Order: A group of families

Family: A group of similar genera

Genus: A group of similar species

Species: A group of interbreeding organisms that are reproductively isolated from other organisms



Taxonomy of a Grizzly Bear

Taxonomic Group	Number of Species	Examples
Domain Eukarya	About 4–10 million	
Kingdom Animalia	About 2 million	
Phylum Chordata	About 50,000	
Class Mammalia	About 5,000	
Order Carnivora	About 270	
Family Ursidae	8	
Genus <i>Ursus</i>	4	
Species <i>Ursus arctos</i>	1	



Grizzly bear Black bear Giant panda Red fox Abert squirrel Coral snake Sea star



KINGDOM Animalia

Multicellular, eukaryotic organisms.
Heterotrophic



PHYLUM Chordata

Dorsal hollow nerve cord, notochord,
pharyngeal gill slits, post-anal tail



CLASS Mammalia

Mammary glands, three-inner ear bones, hair or fur, mandible



ORDER Carnivora

Flesh-eaters, modified teeth (carnassial pair), four to five clawed toes on all feet



FAMILY Ursidae

Plantigrade paws with five non-retractable claws,
heavy bodied with short legs, short tail



GENUS Ursus

Humped shoulders, long curved claws



SPECIES *Ursus arctos*

Large bear, broad head, brown fur, dark claws



Taxonomy

Domain: Eukarya
Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Carnivora
Family: Ursidae
Genus: Ursus
Species: Arctos



Domain: Eukarya
Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Carnivora
Family: Ursidae
Genus: Ursus
Species: Maritimus



Taxonomy

Why use binomial nomenclature?

Mahi mahi = Dorado = Dolphinfish

or

Coryphaena hippurus



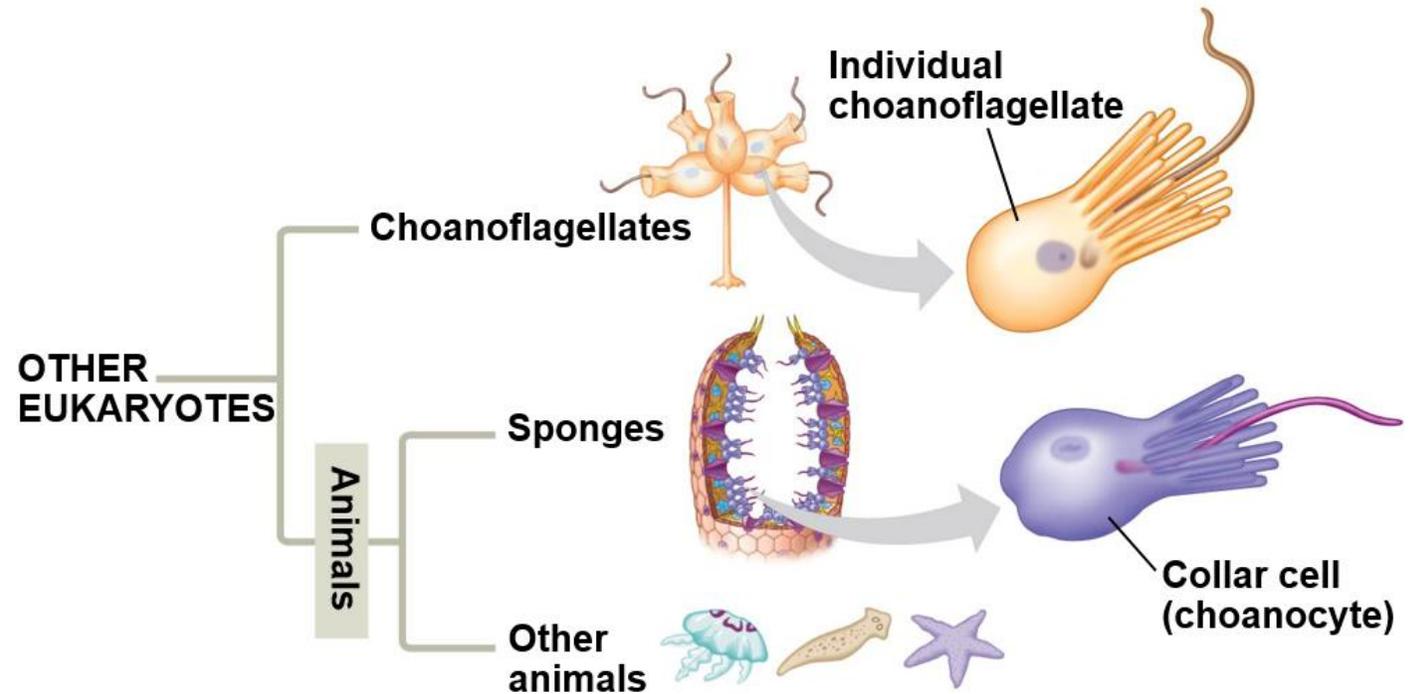
What is an Animal?

- ▶ Multicellular, heterotrophic, eukaryotes
- ▶ Lack cell walls
 - ▶ **Collagen**: structural protein in connective tissue
- ▶ Contain muscle and nervous tissue
 - ▶ Allow for movement and nerve impulses
- ▶ Most reproduce sexually
- ▶ First animals appeared ~ 700mya



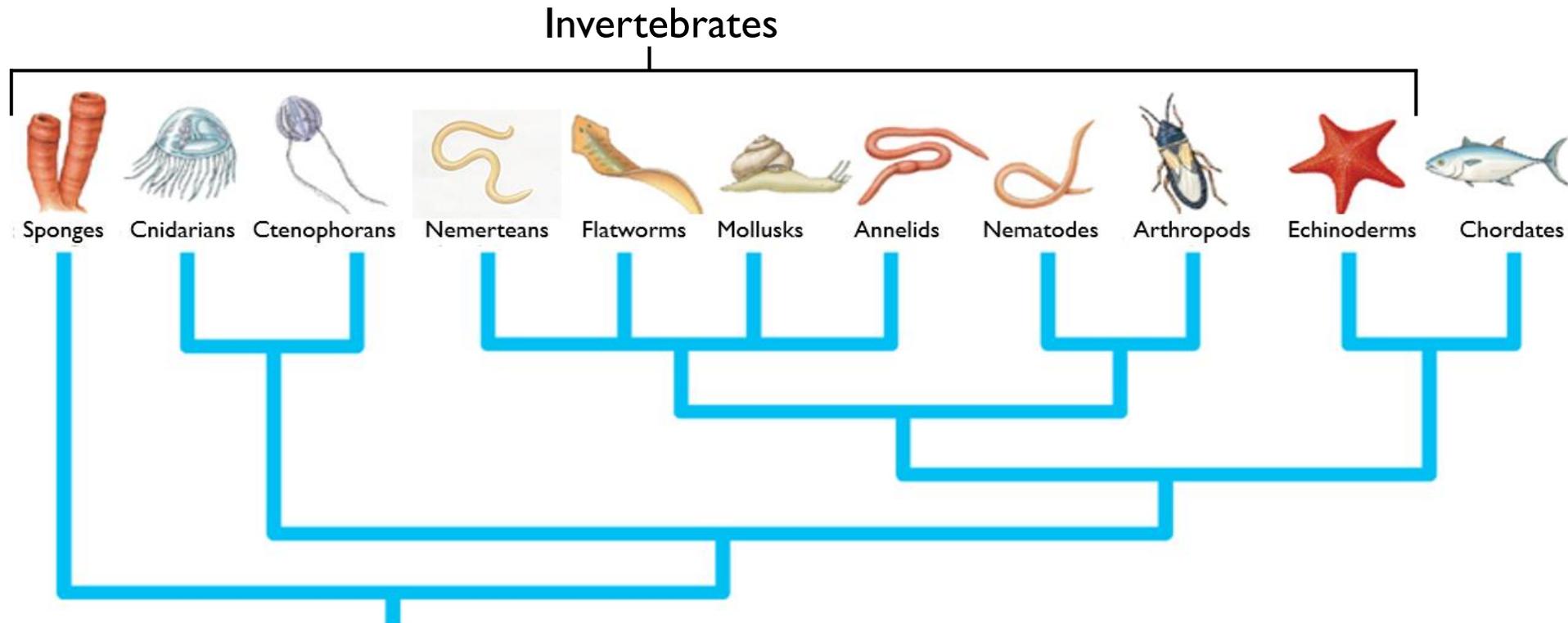
Origin of Animals

1. DNA sequence data supports Choanoflagellates as sister group
2. Choanoflagellate cells and collar cells of sponges are nearly identical
3. Similar collar cells have been observed in other animals



Invertebrates and Vertebrates

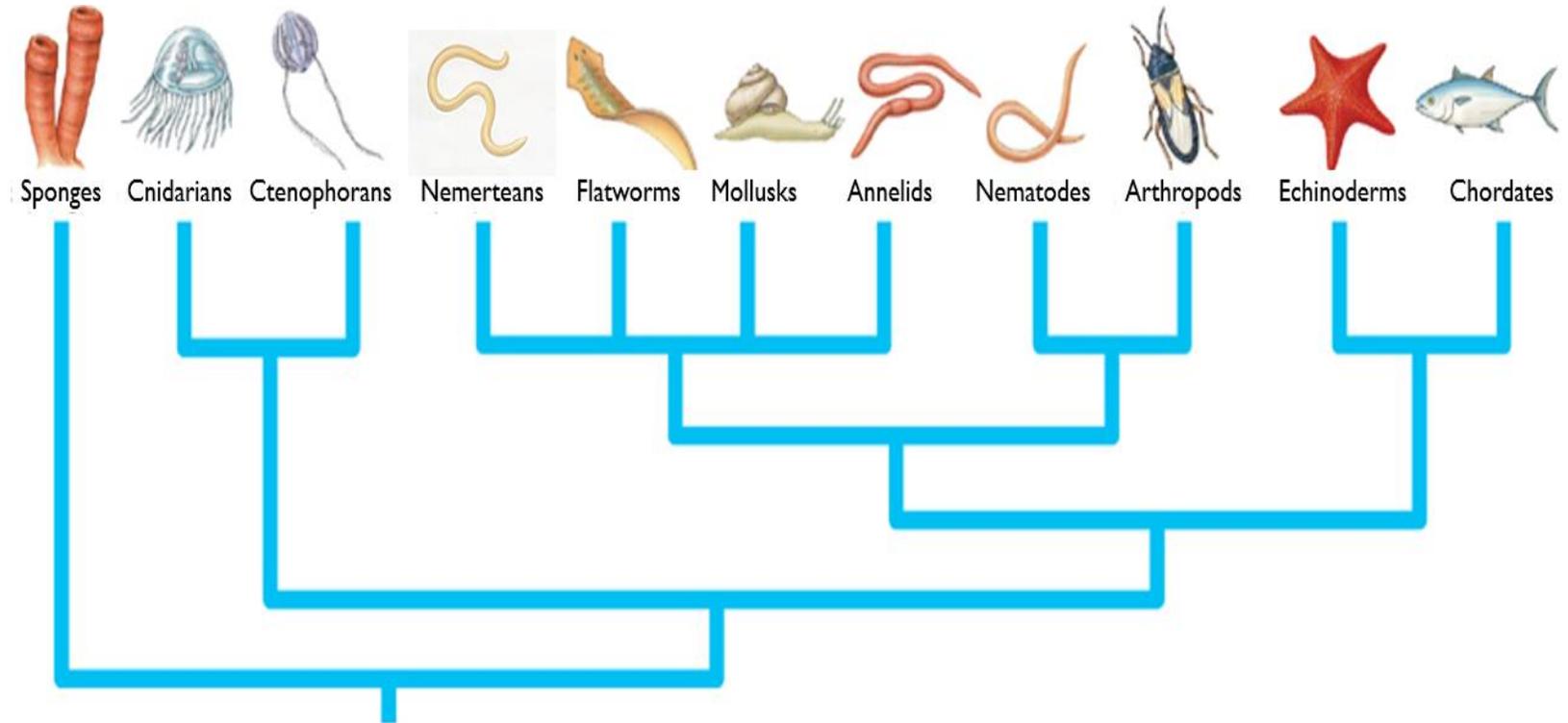
- ▶ **Invertebrates:** animals without a backbone
 - ▶ 99% of all animals
- ▶ **Vertebrates:** animals with a backbone



Animal Classification

Animals Classified by:

- ▶ Development
- ▶ Symmetry
- ▶ Organization level
- ▶ Body cavities
- ▶ Skeletal Systems
- ▶ Circulatory systems
- ▶ Segmentation
- ▶ Molecular data



Symmetry

Asymmetry: no symmetry

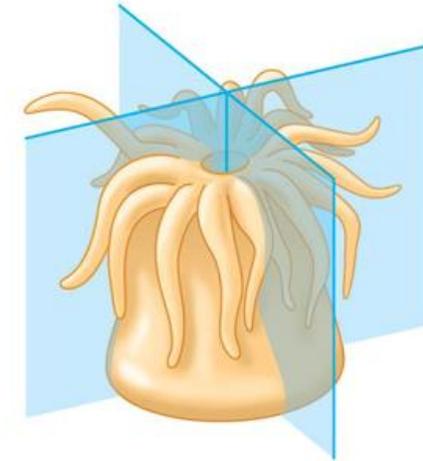
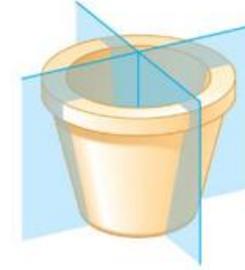
- ▶ Some sponges

Radial symmetry: Identical morphology along multiple planes through the center

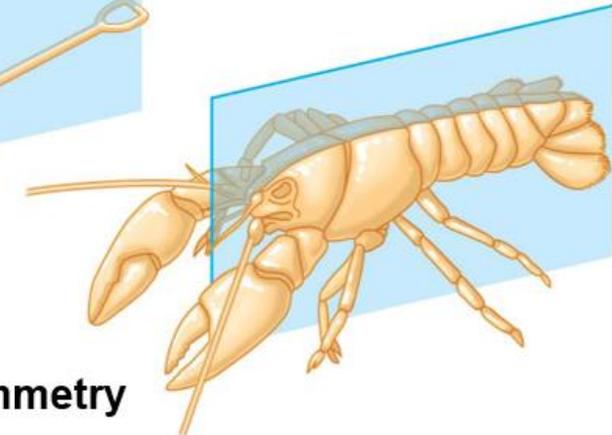
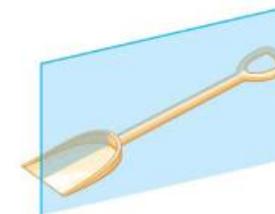
- ▶ Echinoderms (adult), sea jellies, and some sponges

Bilateral symmetry: Identical morphology along a single plane, yielding a left and right side

- ▶ Dorsal (top), ventral (bottom), anterior (front), posterior (back)
- ▶ Most animals



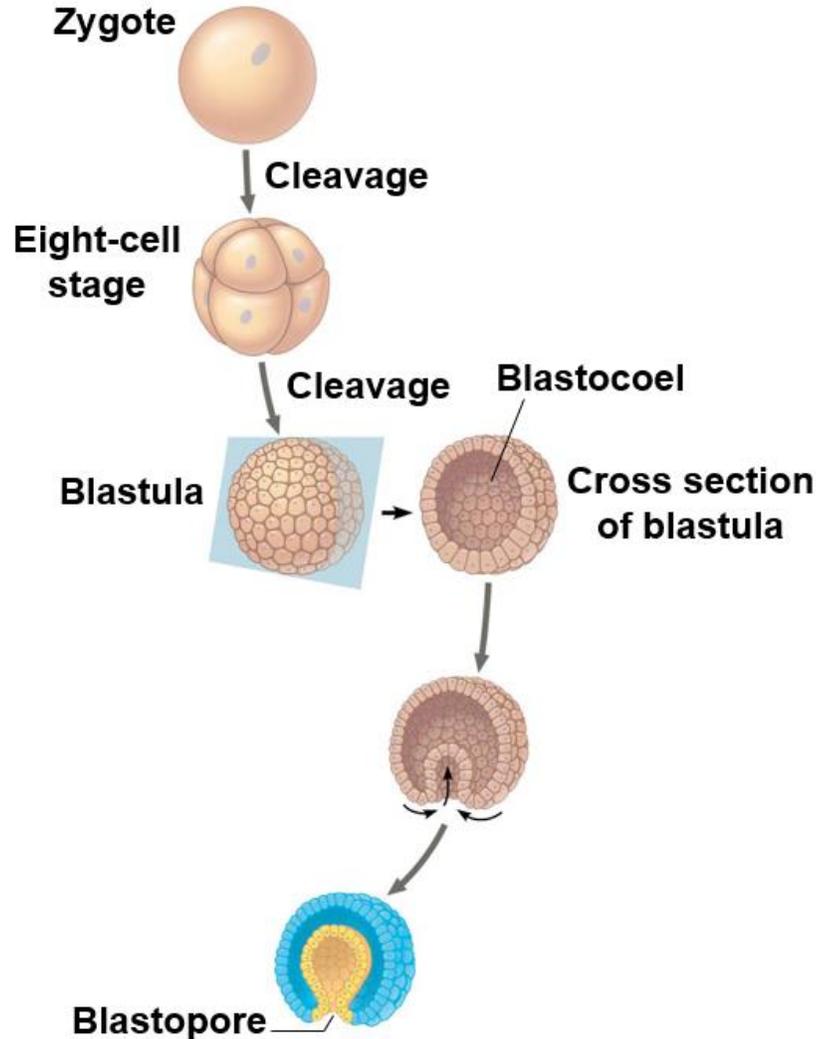
(a) Radial symmetry



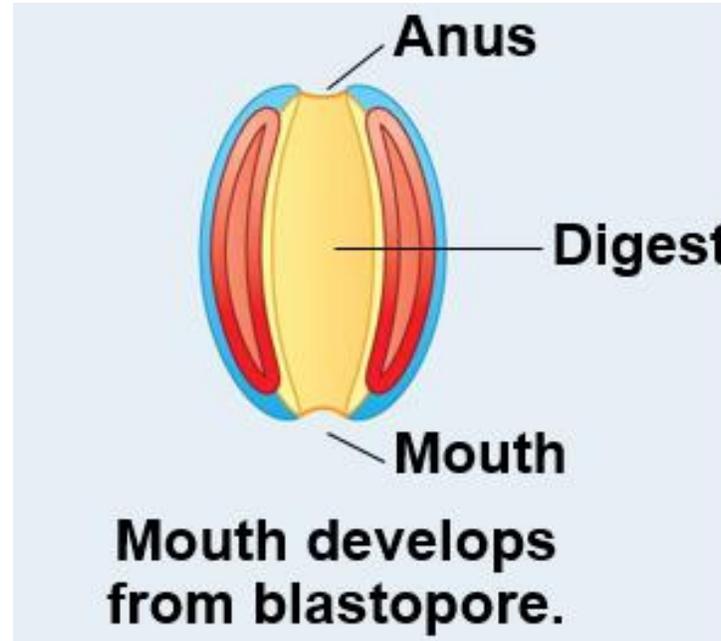
(b) Bilateral symmetry



Animal Development

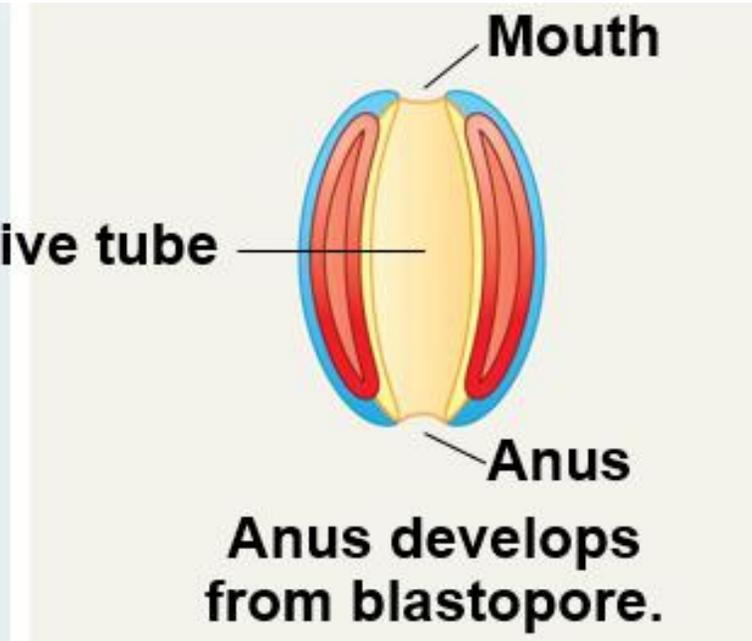


Protostome



Mouth develops first

Deuterostome



Anus develops first

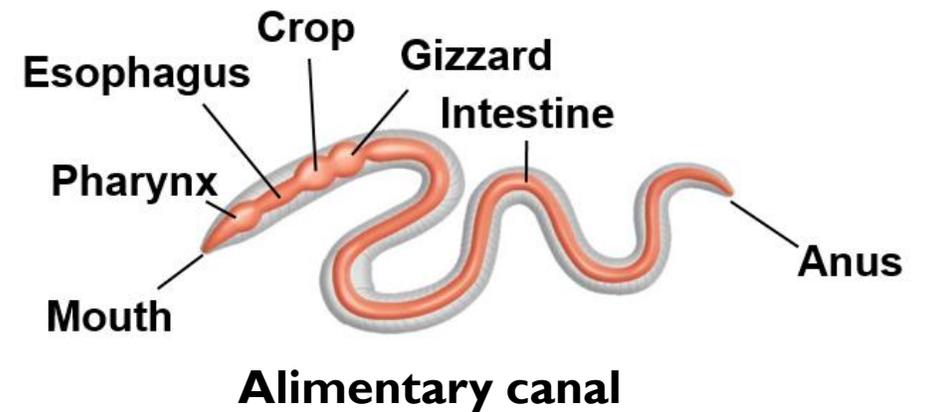
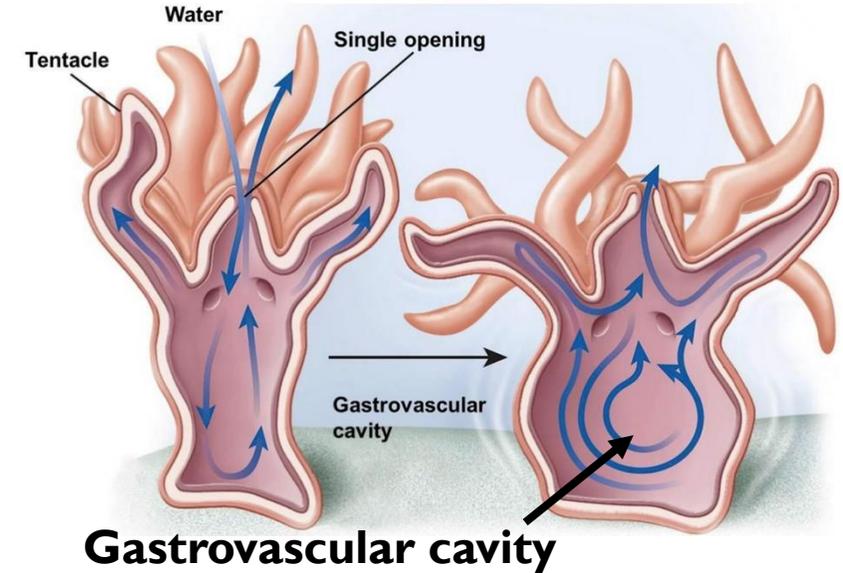
Digestive System

- ▶ Animals have diverse nutritional requirements and feeding strategies

Intracellular digestion: digestion inside cells

Gastrovascular cavity: central cavity with single opening that functions in both digestion and distribution of nutrients

Alimentary canal: digestive tract with two separate openings (mouth and anus)

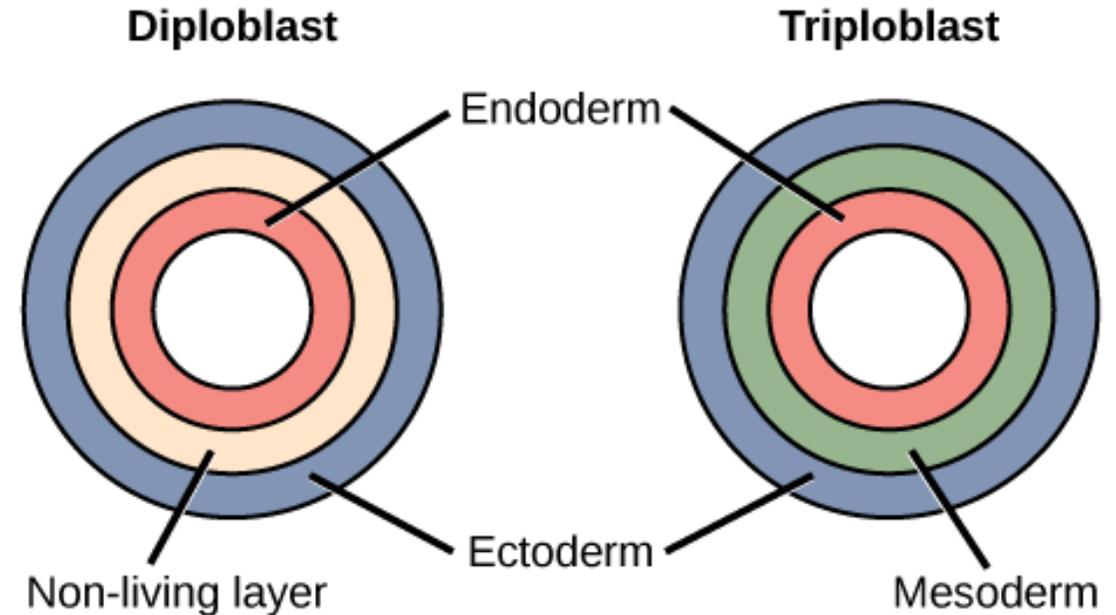


Germ Layers

- ▶ **Endoderm:** gives rise to lining of digestive tract and some organs
- ▶ **Mesoderm:** lines the coelom and gives rise to muscle, bone, blood
- ▶ **Ectoderm:** gives rise to outer covering and nervous system

Diploblastic: Two germ layers
(endoderm and ectoderm)

Triploblastic: Three germ layers
(endoderm, mesoderm, and ectoderm)



Skeletal Systems

Hydrostatic skeleton: fluid held under pressure within a closed body compartment

- ▶ Cnidarians, Platyhelminthes, Nematodes, Annelids



Exoskeleton: hard covering deposited on the animals surface that provides protection and points for muscle attachment

- ▶ Arthropods, Molluscs

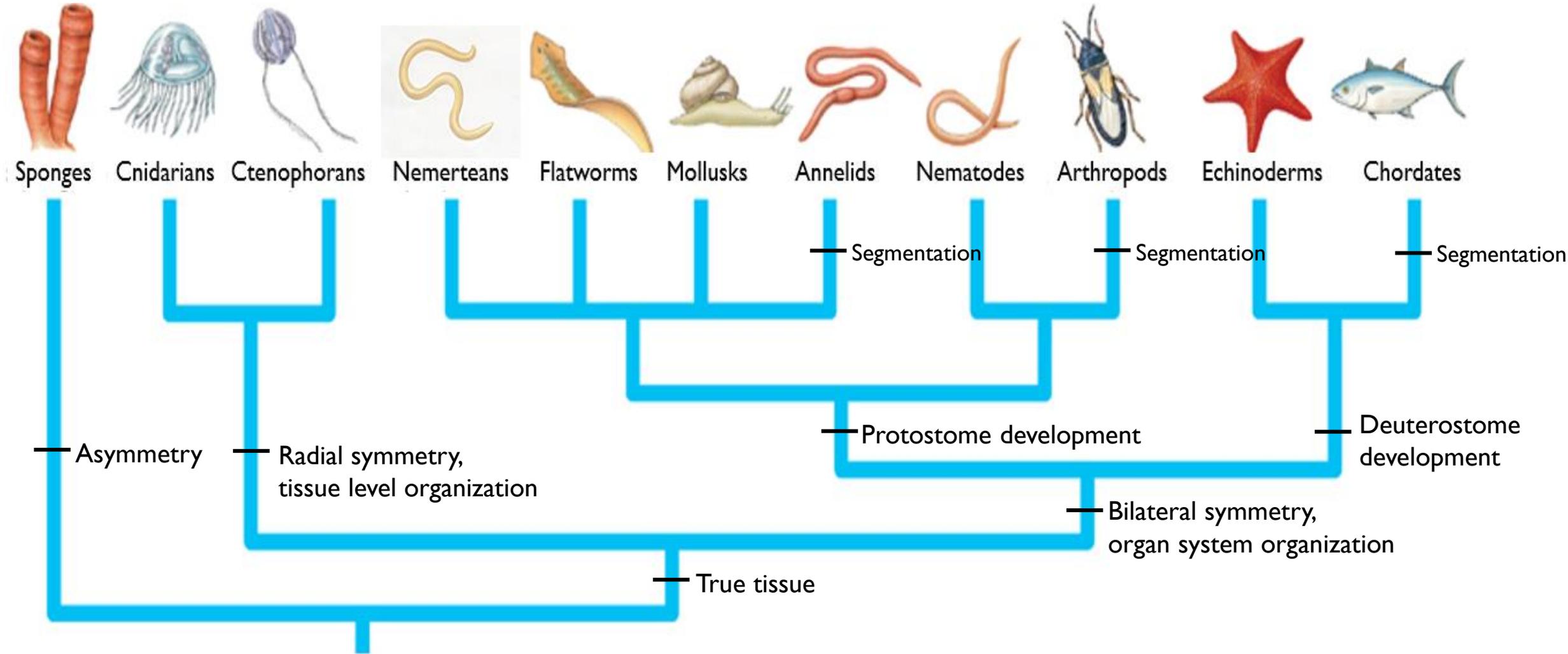


Endoskeleton: hard internal skeleton buried within soft tissue

- ▶ Porifera, Echinodermata, Chordata



Animal Phylogeny



DOES THE ANIMAL HAVE SPECIALIZED CELLS THAT FORM DEFINED TISSUES?

No

Yes

DOES THE ANIMAL DEVELOP WITH RADIAL SYMMETRY OR BILATERAL SYMMETRY?

Radial symmetry

Bilateral symmetry

DURING DEVELOPMENT, DOES THE ANIMAL'S GUT DEVELOP FROM FRONT TO BACK OR BACK TO FRONT?

Protostomes

Deuterostomes

DOES GROWTH OCCUR BY ADDING TO THE BODY CONTINUOUSLY OR BY MOLTING?

Growth by adding continuously to the body

Growth by molting



Sponges



Cnidarians



Flatworms



Annelids



Mollusks



Roundworms



Arthropods

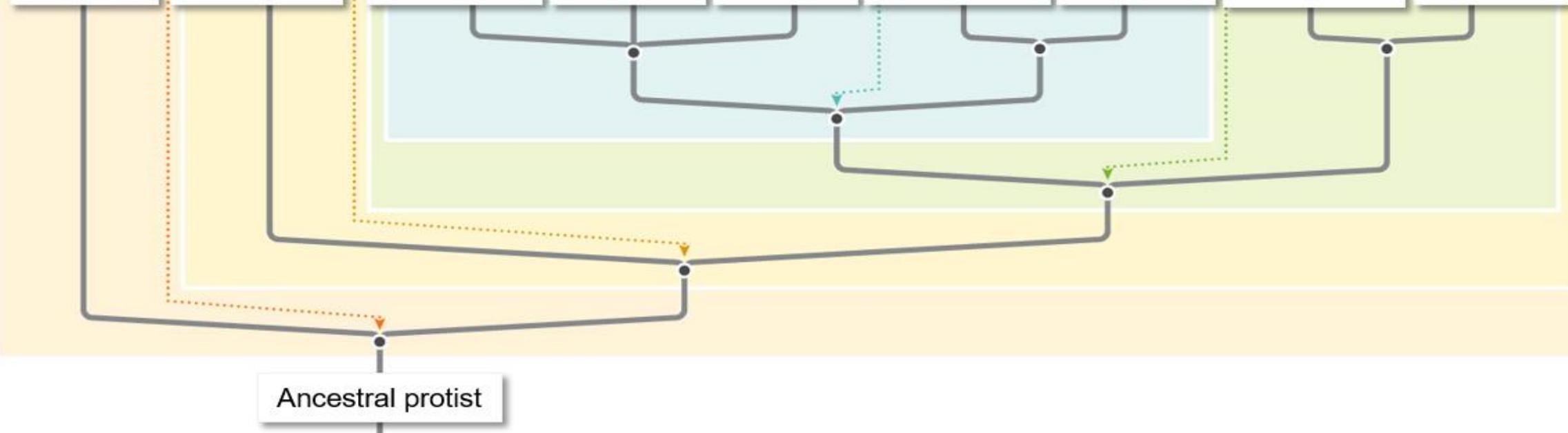


Echinoderms



Chordates

Ancestral protist



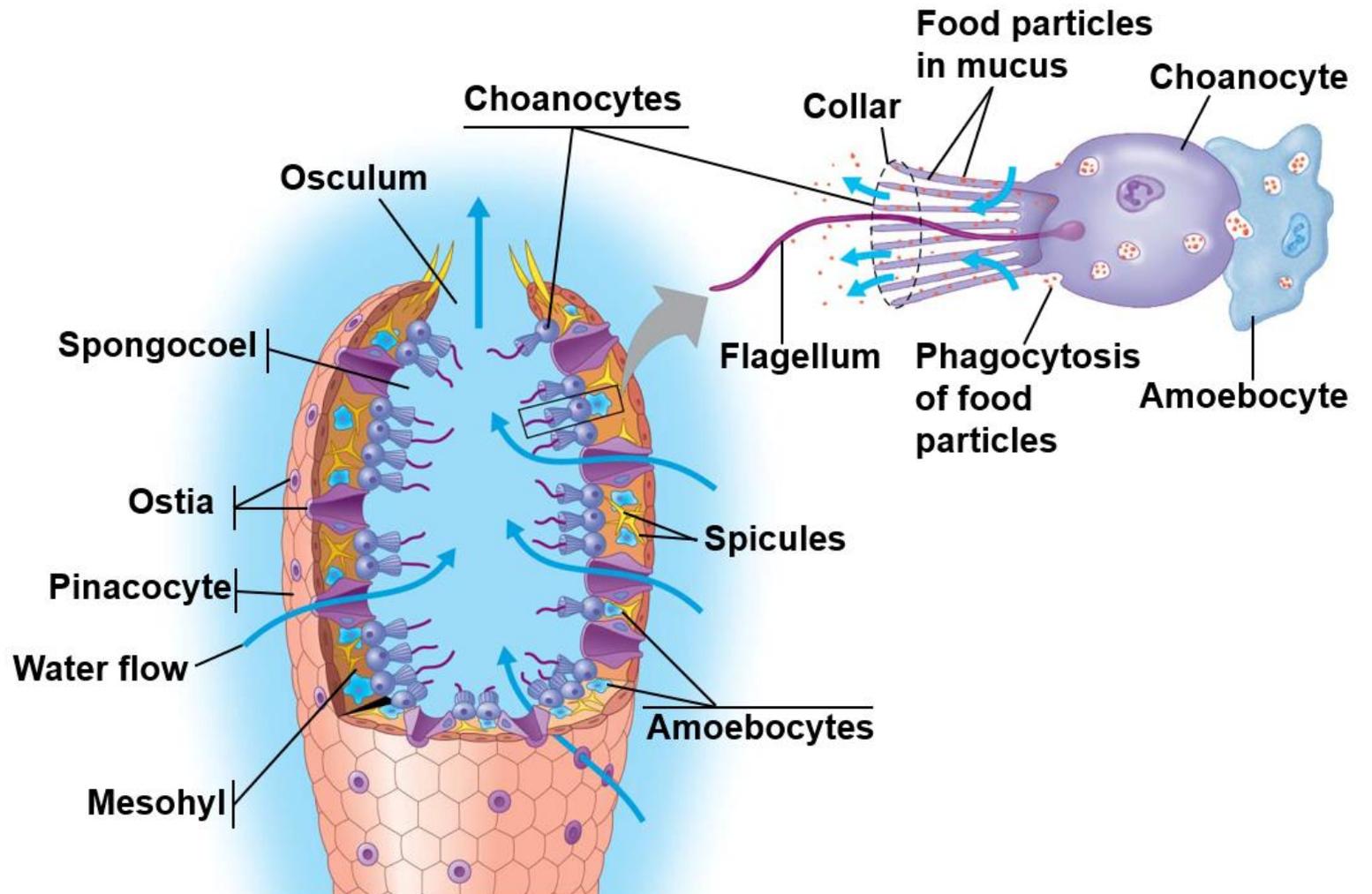
Phylum: Porifera

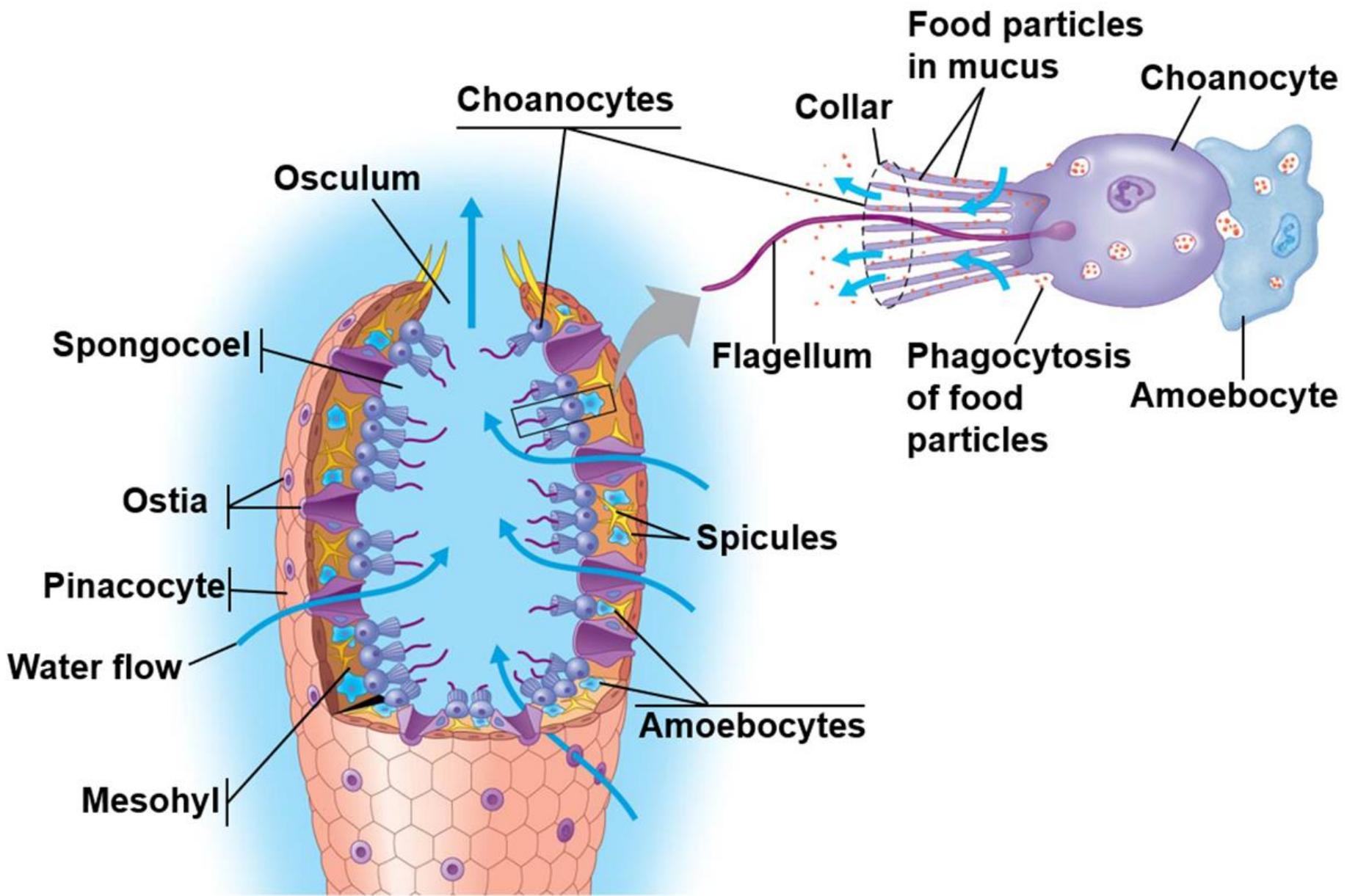
- ▶ Sponges
- ▶ Cellular level of organization
 - ▶ No tissues or organs
- ▶ All Aquatic / Mostly marine
 - ▶ 5,500 species (only 100 are freshwater)
- ▶ Radial or Asymmetrical
- ▶ Sessile as adults
- ▶ Hermaphrodites
 - ▶ Swimming larvae



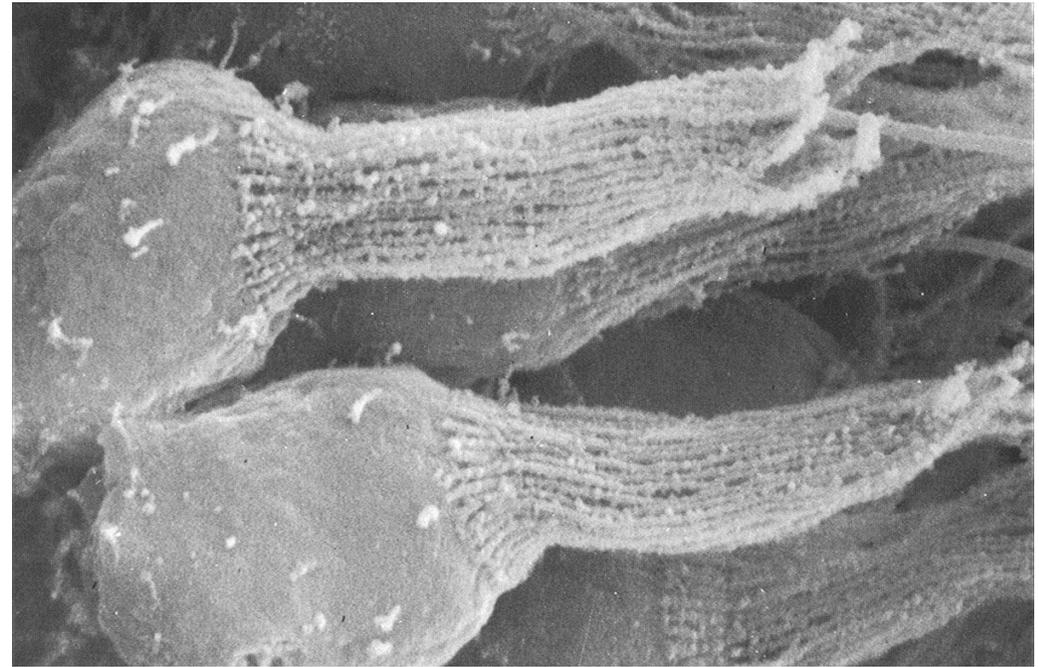
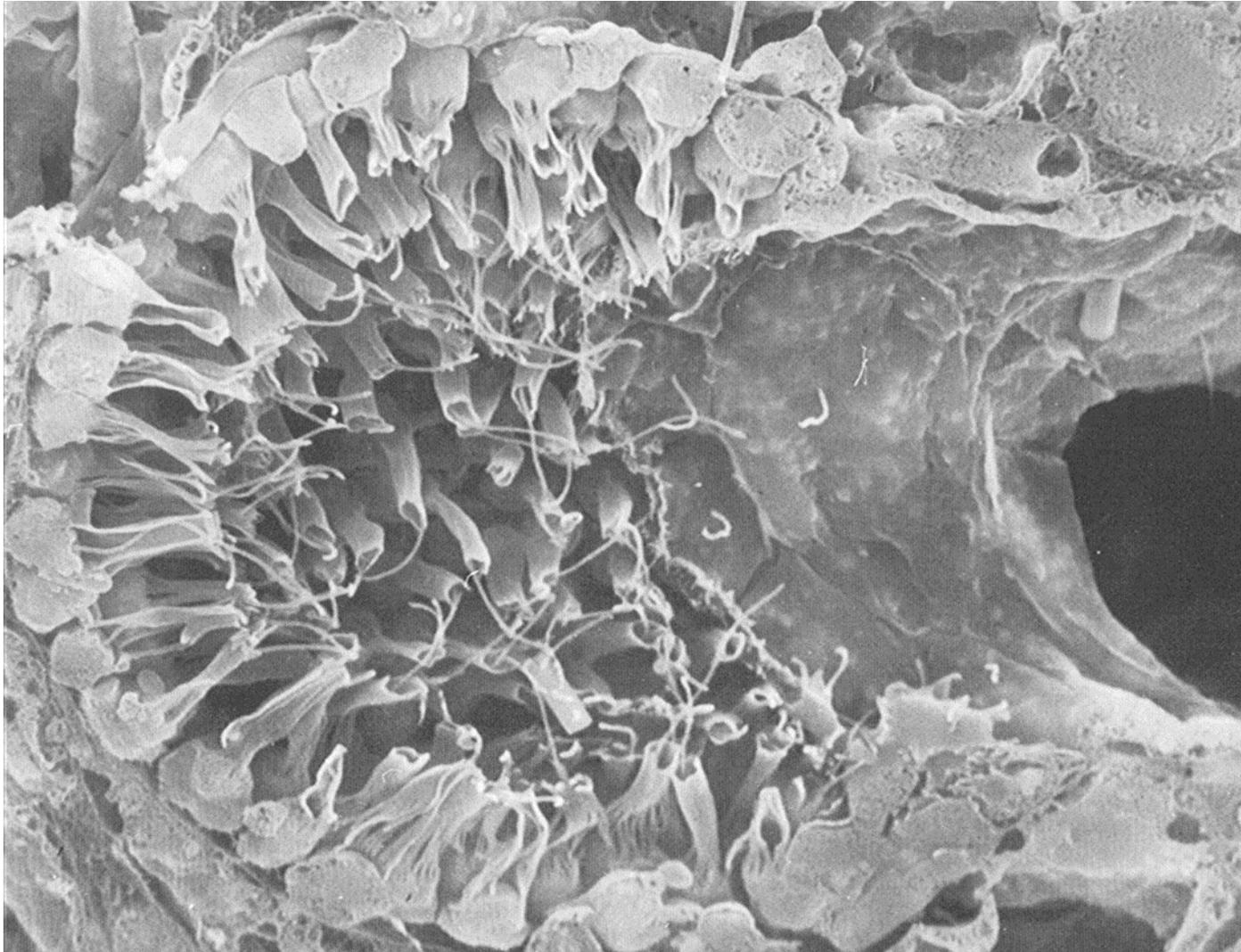
Phylum: Porifera

- ▶ **Choanocytes** (collar cells): flagellated cells used in filter feeding
- ▶ **Osculum**: opening at the top of the sponge
- ▶ **Ostia**: pores in the sponge exterior where water enters
- ▶ **Spongocoel**: central cavity
- ▶ **Amoebocytes**: motile cells that can turn into other cells
- ▶ **Mesohyl**: gelatinous matrix in the sponge
- ▶ **Pinaocytes**: cells covering the surface of the sponge

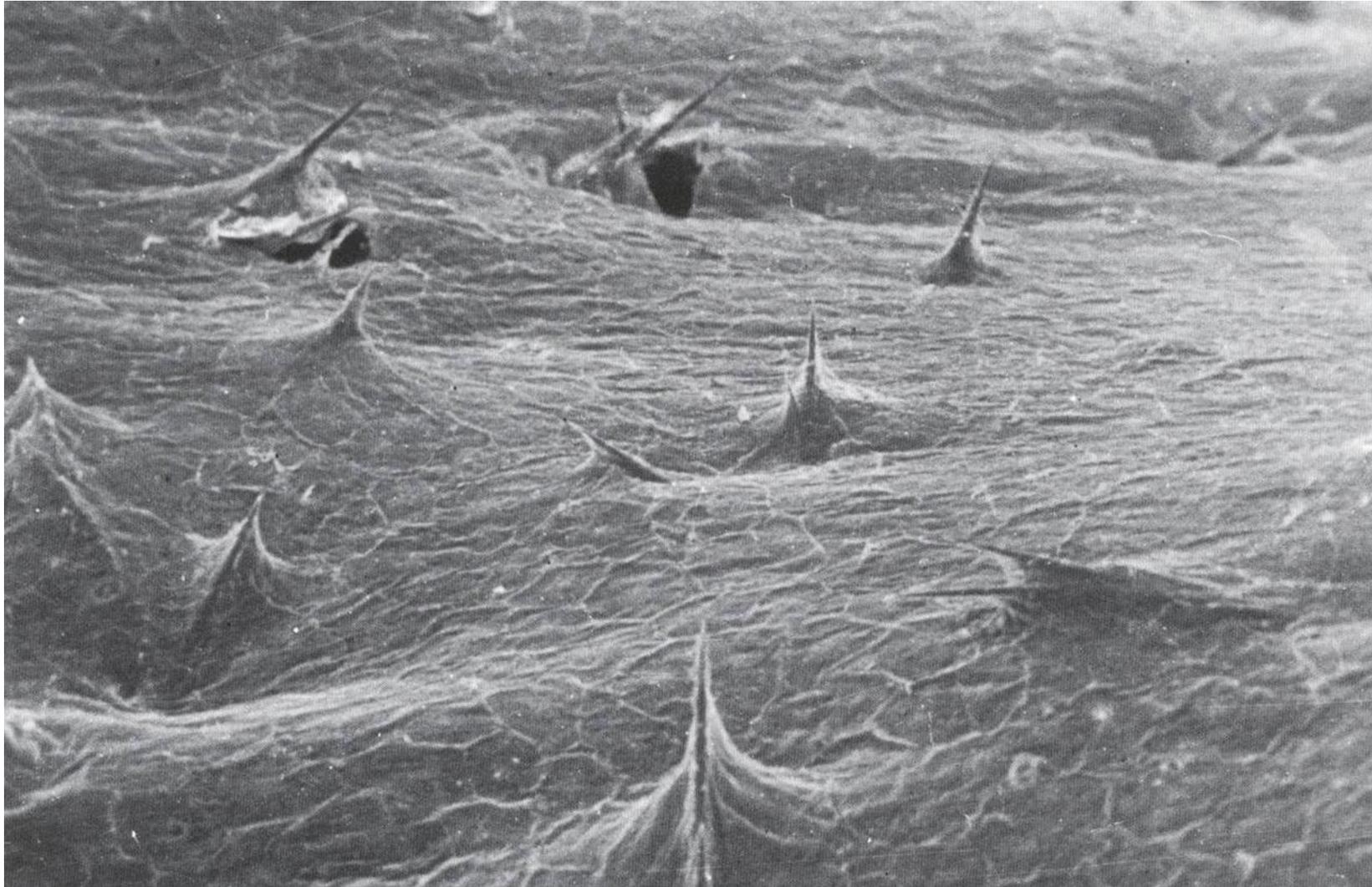




Phylum: Porifera



Phylum: Porifera



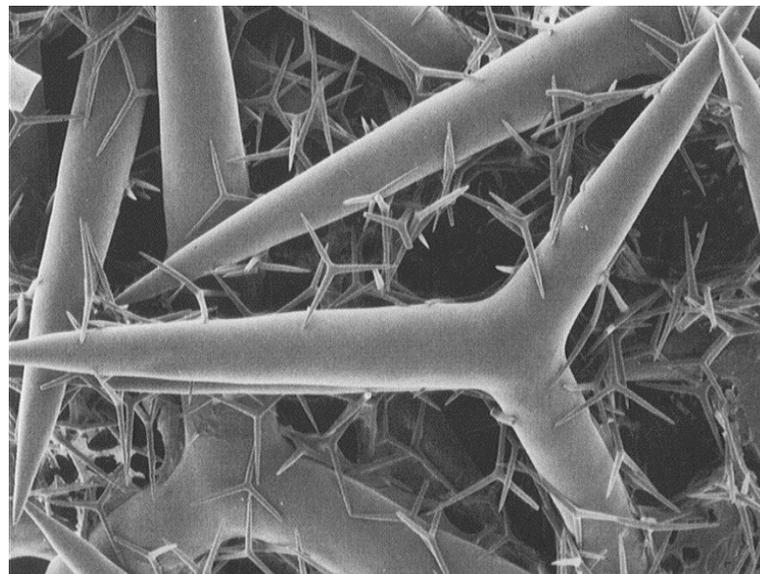
Phylum: Porifera

Skeleton

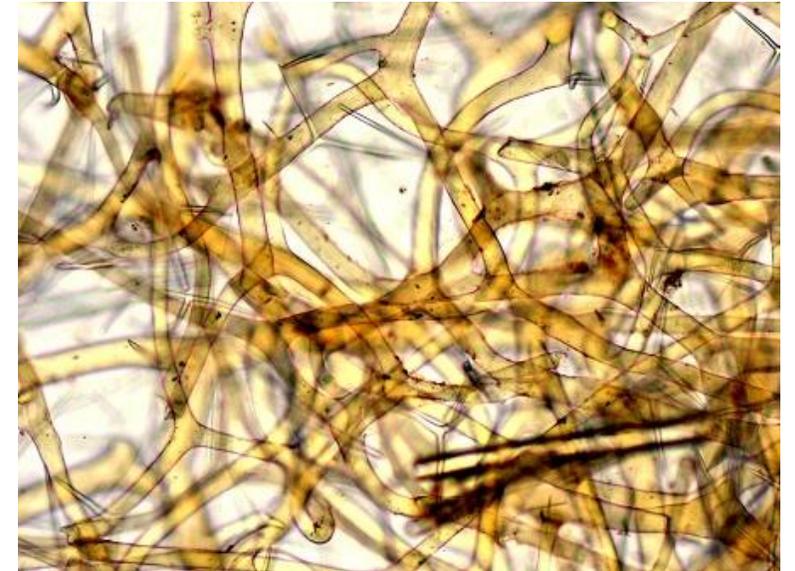
- ▶ **Spicules** (calcium carbonate or silica): support and protection
- ▶ **Spongin** (protein): support and flexibility



Silica Spicules



Calcareous Spicules

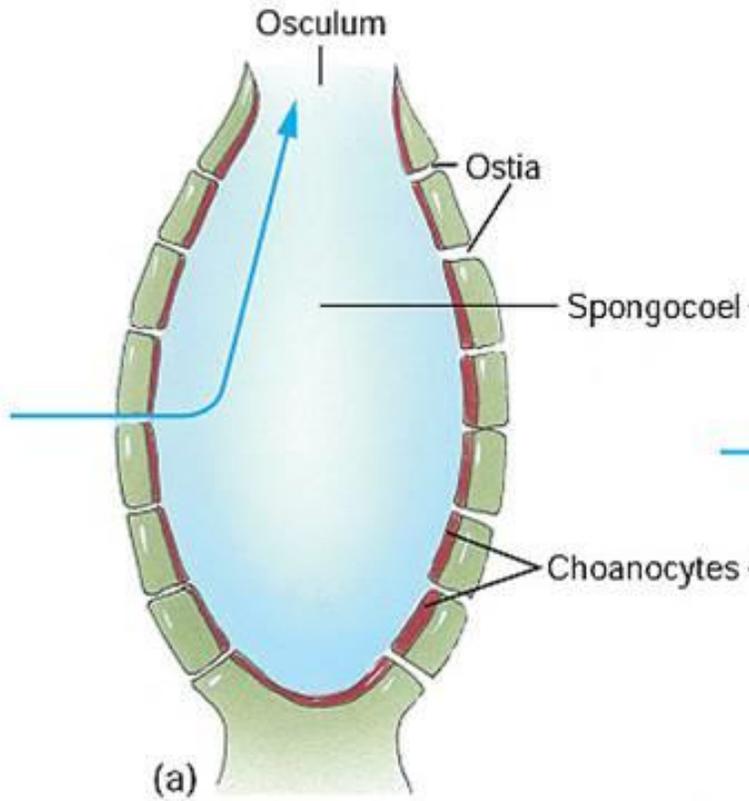


Spongin

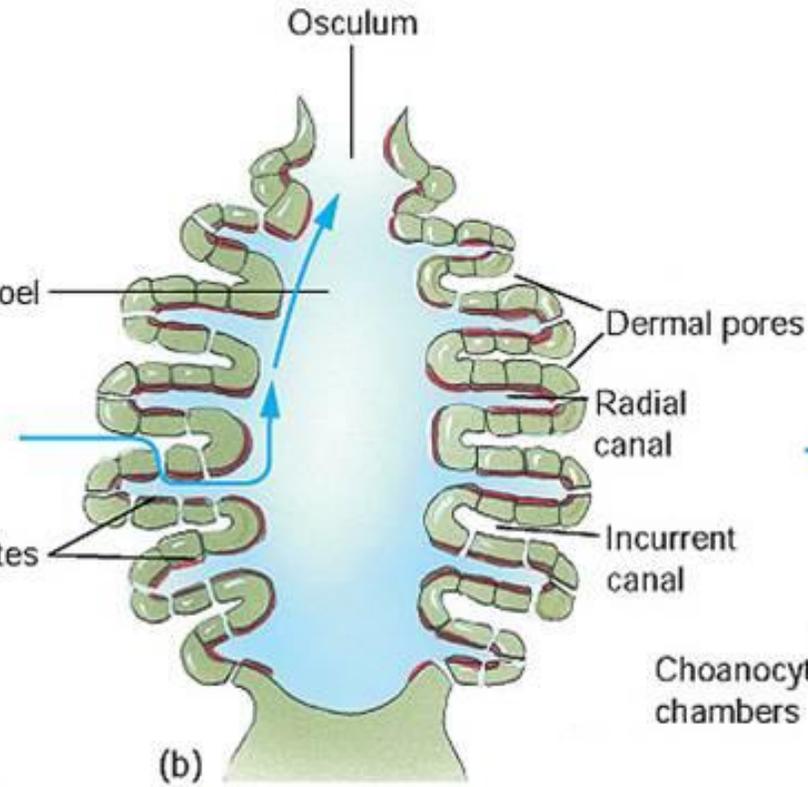


Porifera Body Forms

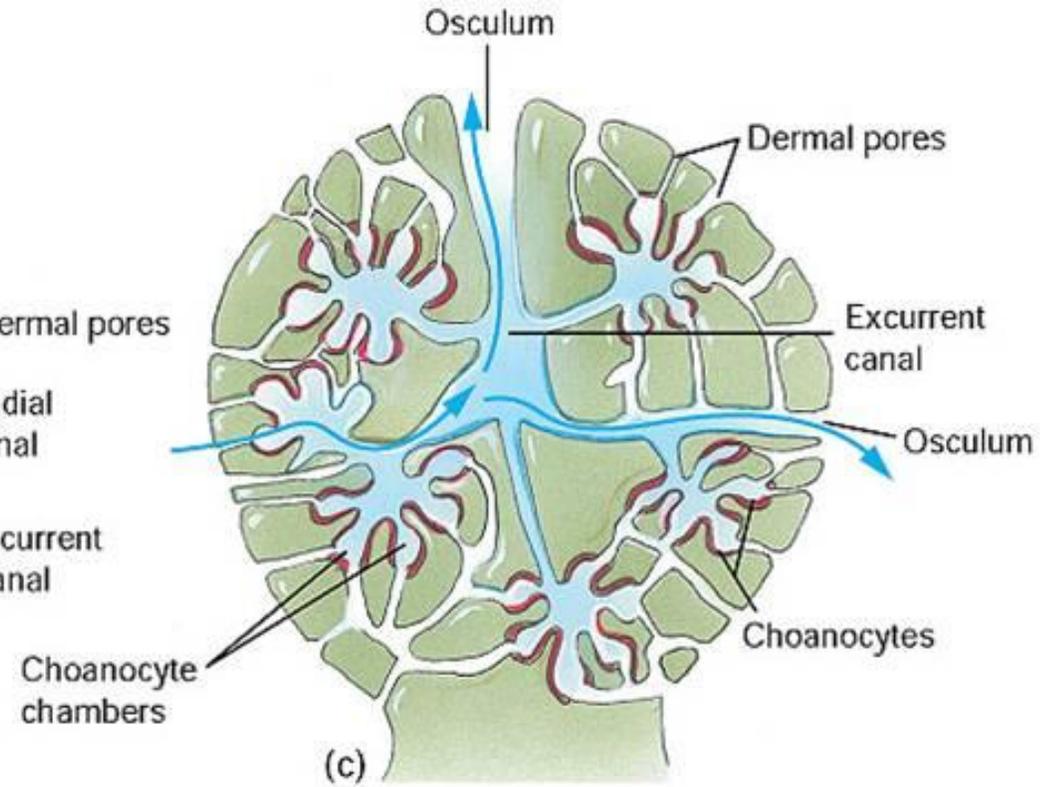
Asconoid



Syconoid



Leuconoid



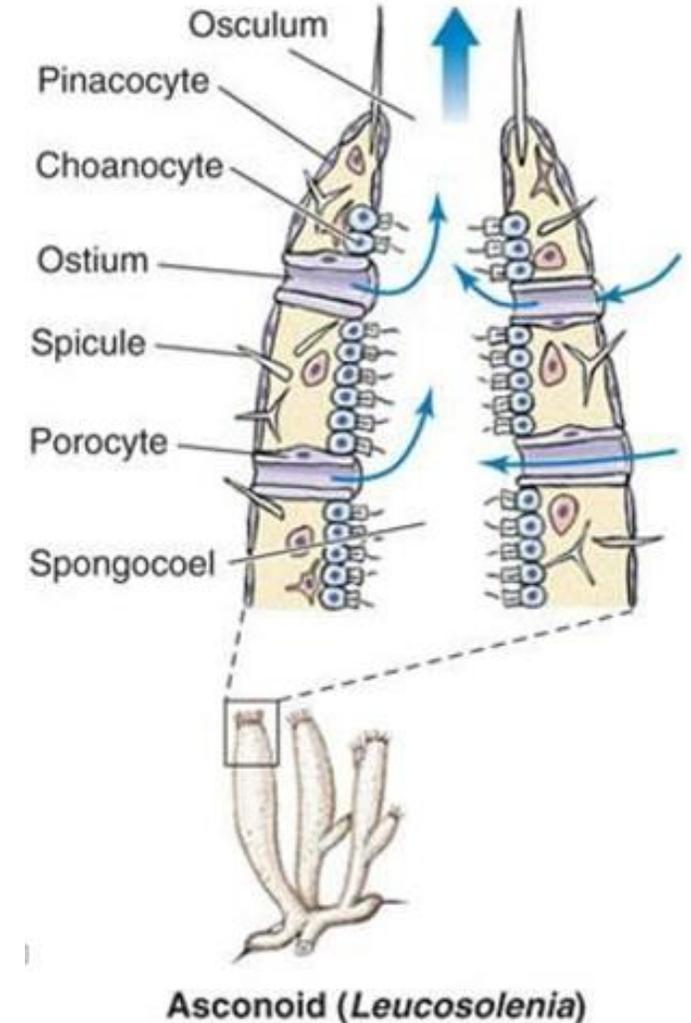
Porifera Body Forms

Asconoid

- ▶ Flagellated spongocoel

Water movement

- ▶ Ostia - Spongocoel- Osculum



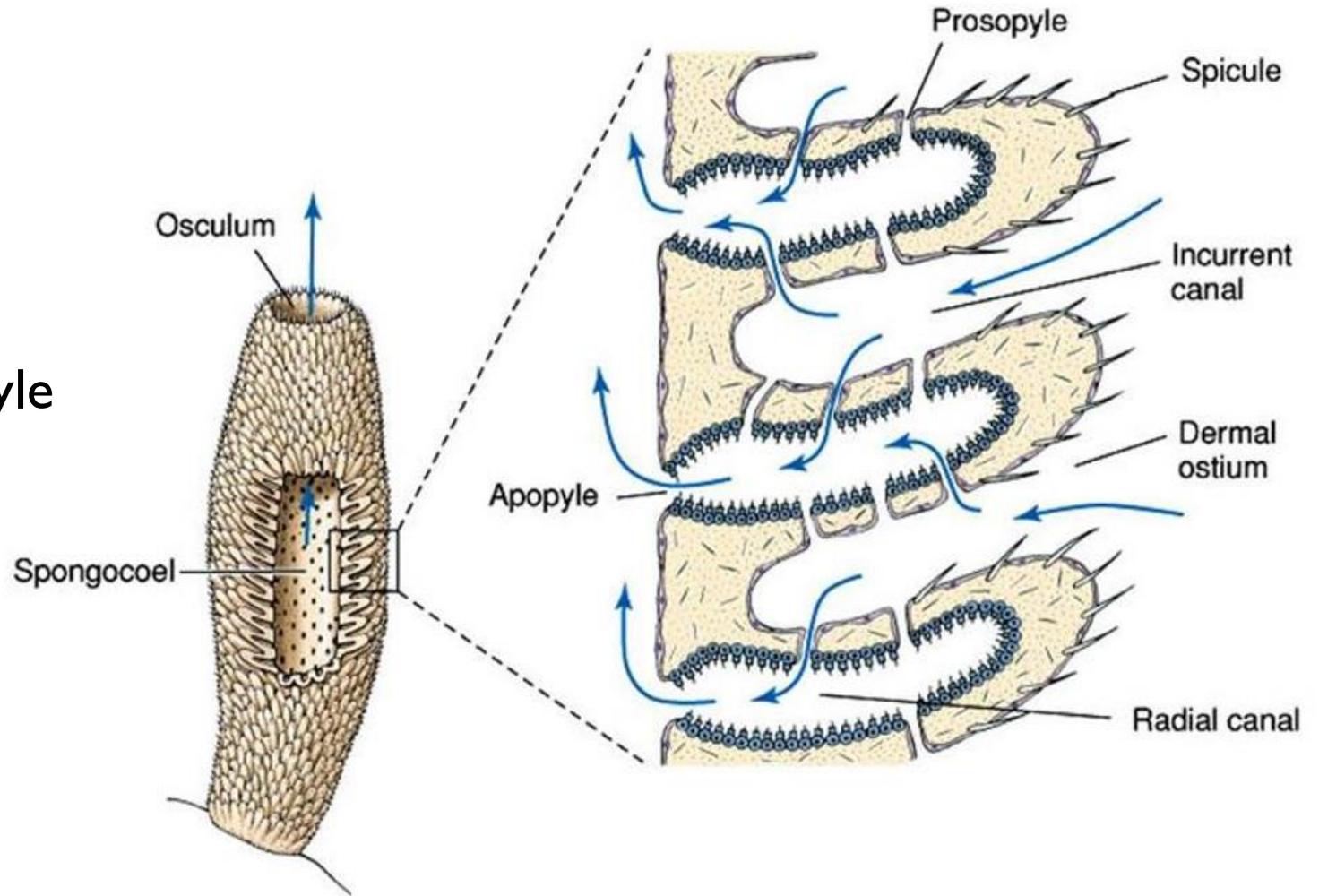
Porifera Body Forms

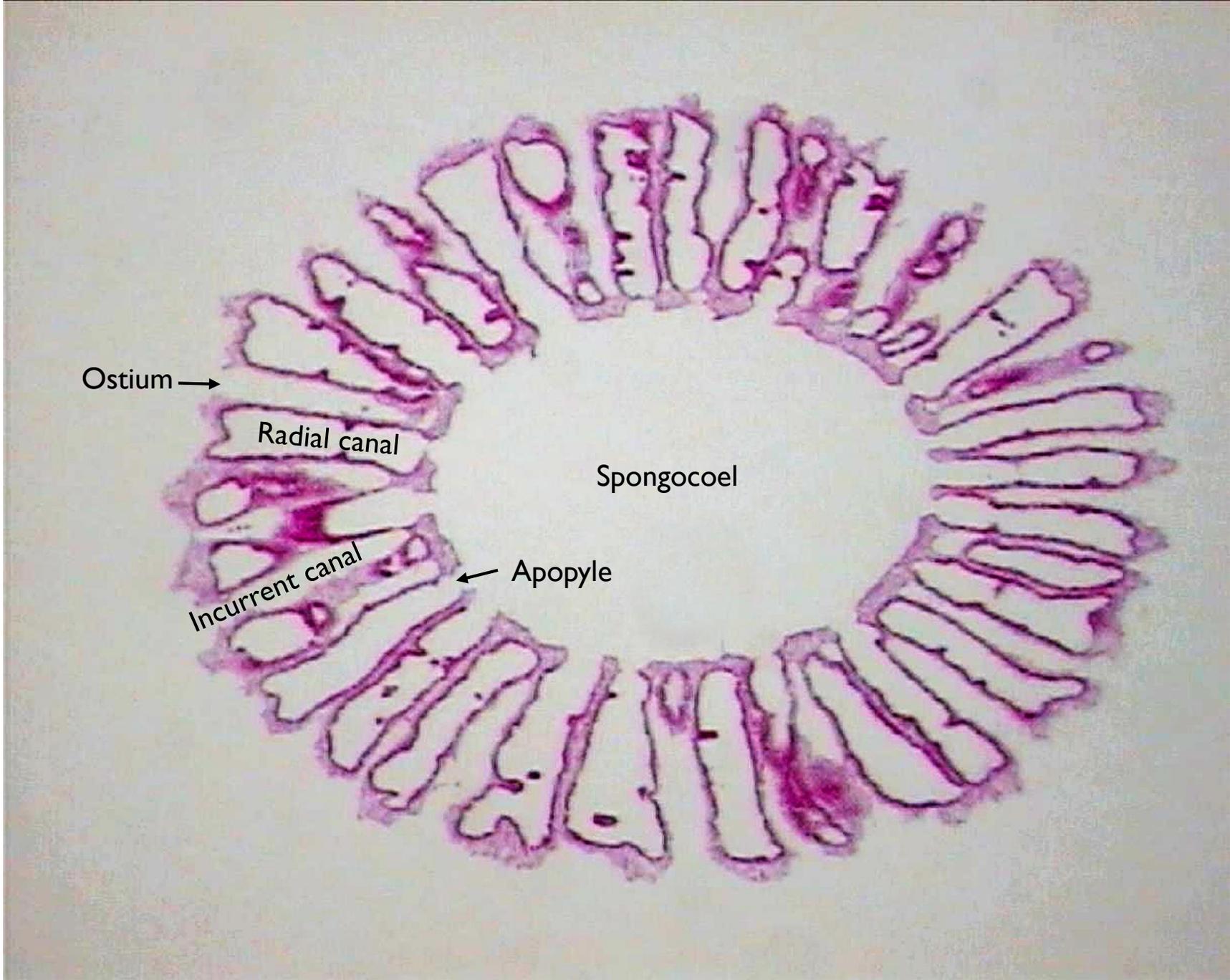
Syconoid

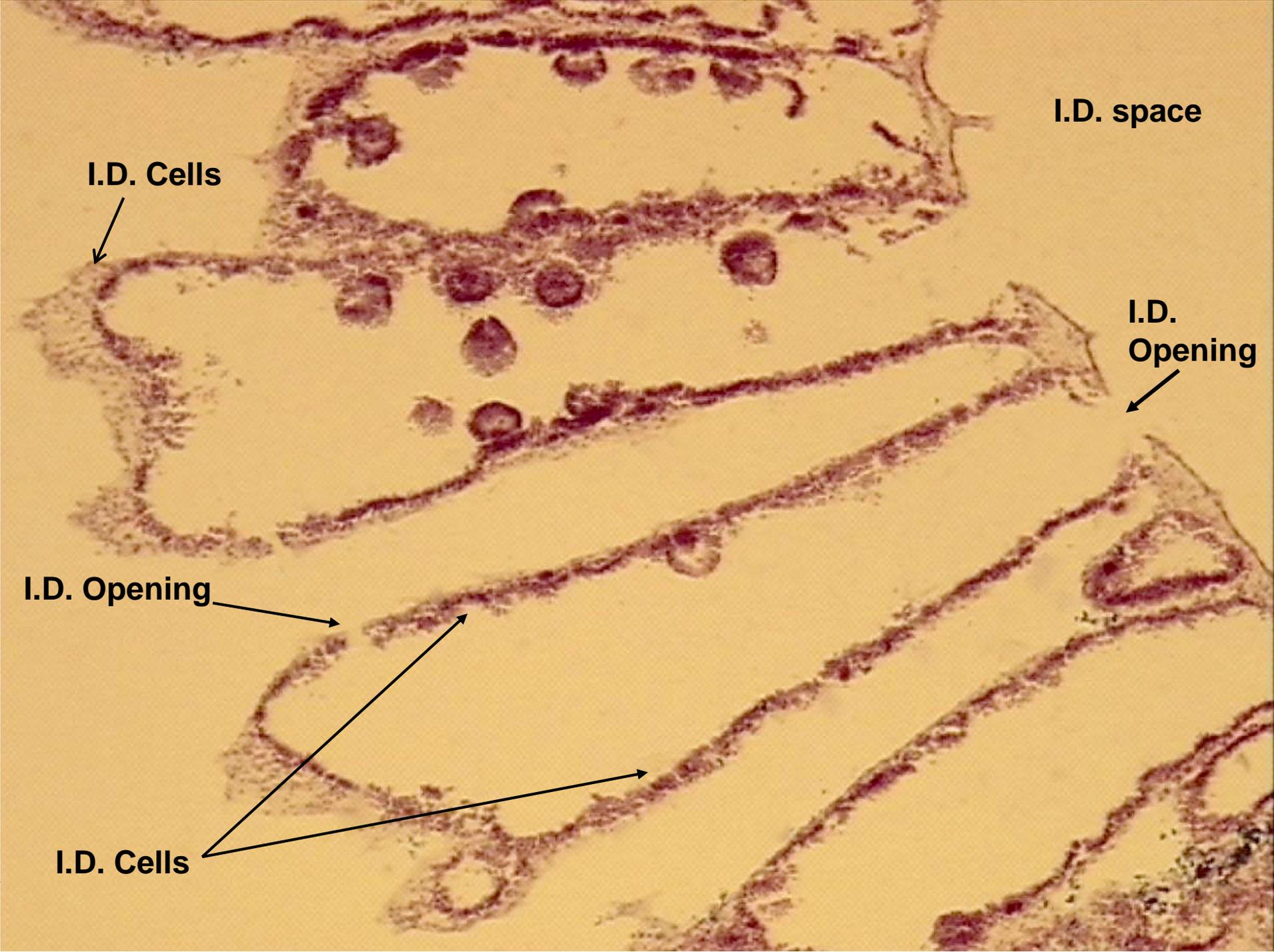
- ▶ Flagellated radial canals

Water movement

- ▶ Ostia - Incurrent canal – Prosopyle
- Radial canal - Apopyle - Spongocoel - Osculum







I.D. space

I.D. Cells

I.D. Opening

I.D. Opening

I.D. Cells



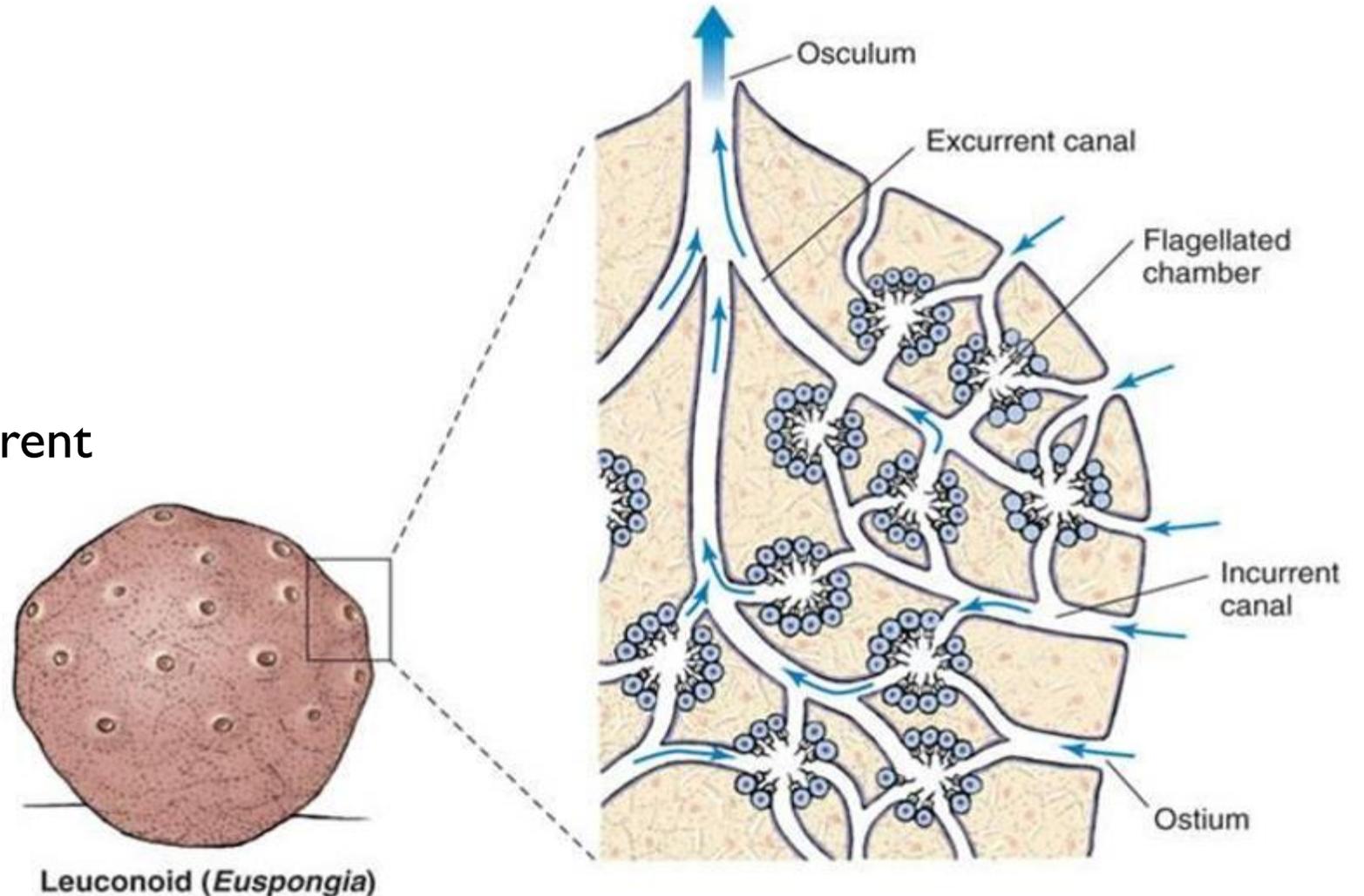
Porifera Body Forms

Leuconoid

- ▶ Flagellated chambers

Water movement

- ▶ Ostia - Incurrent canal - Flagellated chamber - Excurrent canal - Osculum



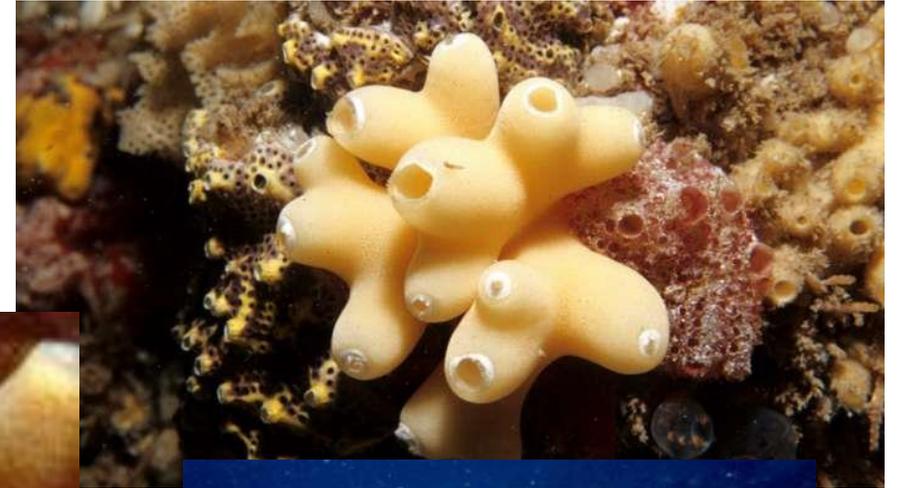
Porifera Classification

Class Calcarea

- ▶ Calcium carbonate spicules

Body forms:

- ▶ Asconoid
- ▶ Syconoid
- ▶ Leuconoid



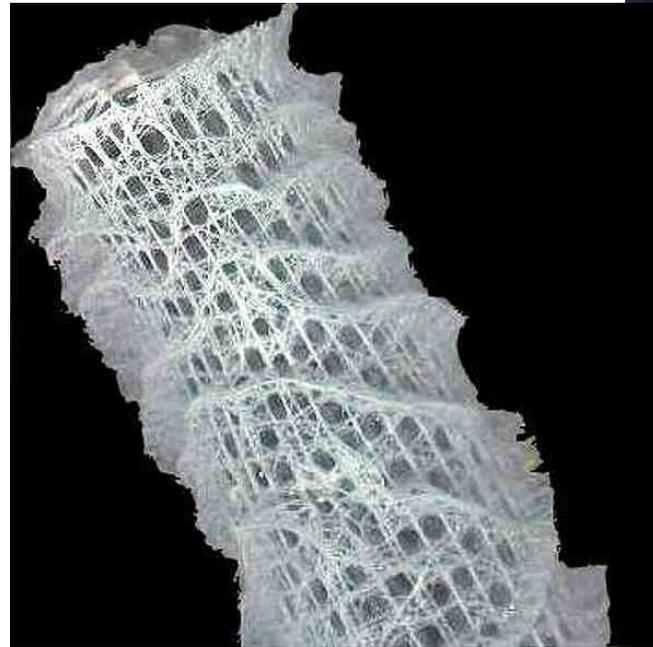
Porifera Classification

Class Hexactinellida

- ▶ Silica spicules

Body forms:

- ▶ Syconoid
- ▶ Leuconoid



Porifera Classification

Class Demospongia

- ▶ Silica spicules and/or spongin

Body forms:

- ▶ Leuconoid

