

General Biology 1

BIO1201 RM 1021

Syllabus & Textbook:

<https://openlab.citytech.cuny.edu/oer-biology/lecture-schedule/>

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Grade Breakdown:

Lecture (60%)

Exams (4): 22.5% Each

Pop Quizzes (?): 10% Average

Lab (40%) – Lab Instructor

<u>Letter Grade</u>	<u>Numerical Ranges</u>
A	93-100
A-	90-92.9
B+	87-89.9
B	83-86.9
B-	80-82.9
C+	77-79.9
C	70-76.9
D	60-69.9
F	59.9 and below

Kingdom Animalia: Animal Diversity



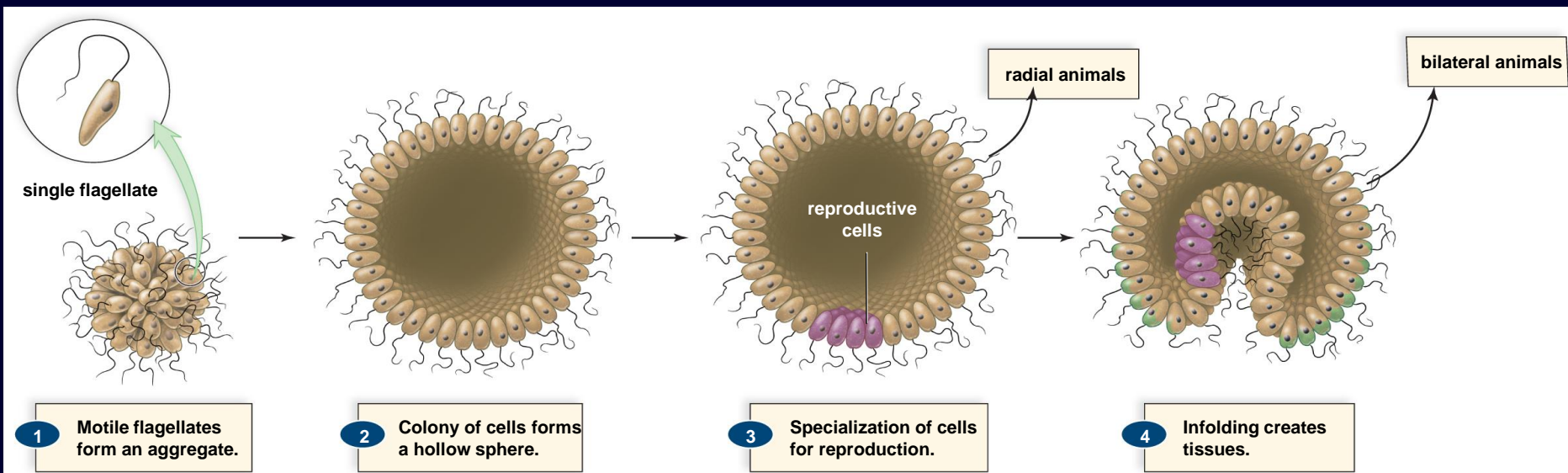
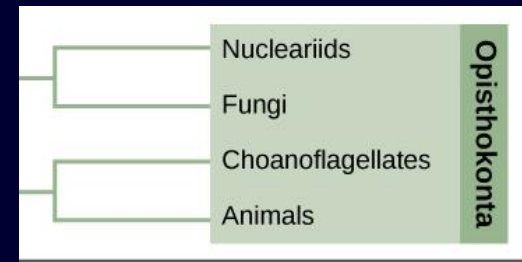
Chap. 28:
pp. 510-538

What are animals?

- All animals are...
 - Eukaryotes
 - Multicellular
 - **Heterotrophic** – must **ingest** other living things to acquire organic molecules and energy
- Animals do NOT have...
 - Cell walls – so they make extensive **Extracellular Matrix** to connect cells into tissues, organs, etc.
 - Chloroplasts or other means of photosynthesis
- Unique features of animals:
 - Nervous tissue and electrical impulse conduction
 - Muscle Tissue and excitation-contraction
 - Most animals have an advanced body plan that includes a central cavity (coelom)

Where do animals come from?

- Animals have the diploid life cycle
- Animals are monophyletic
 - Both invertebrates and vertebrates can trace their ancestry to the same ancestor



The Colonial Flagellate Hypothesis

Evolution of Animals: Classification Criteria

Each step in the evolution of the animal body plan is called a “grade”

–Level of organization

- Cellular, tissue, organ, organ system

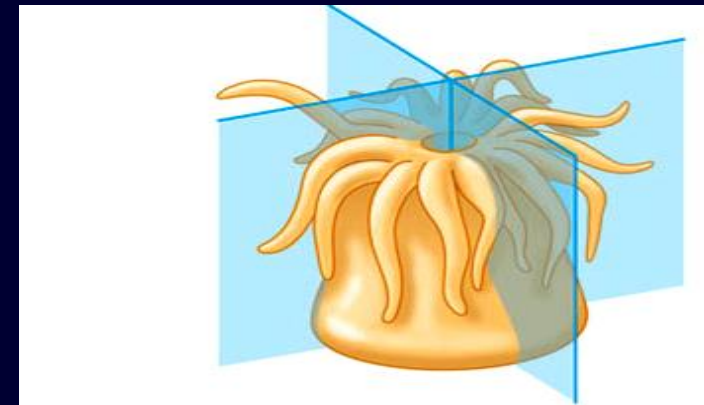
–Body Plan

- Sac plan - have an incomplete digestive system
 - Only one opening used for both entrance and exit (Jellyfish).
- Tube-within-a-tube plan - have a complete digestive system
 - Separate entrance and exit to the digestive system

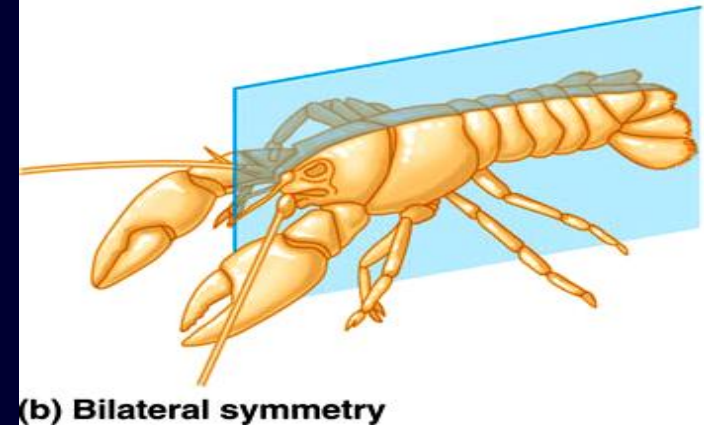
Evolution of Animals: Classification Criteria

– Symmetry

- **Asymmetry** means there is no particular body shape (e.g., sponge).
- **Radial** - Two identical halves (e.g., jelly fish)
 - Enables an animal to reach out in all directions
- **Bilateral** - Definite right and left halves
 - Animals tend to be active and to move forward at an anterior end
 - The development of a head to localize the brain and sensory organs at the anterior end is called cephalization



(a) Radial symmetry



(b) Bilateral symmetry

Evolution of Animals: Classification Criteria

– Type of Coelom (body cavity)

- **Acoelomate** – no body cavity
- **Pseudocoelom** - false body cavity
- **Coelom** – body cavity

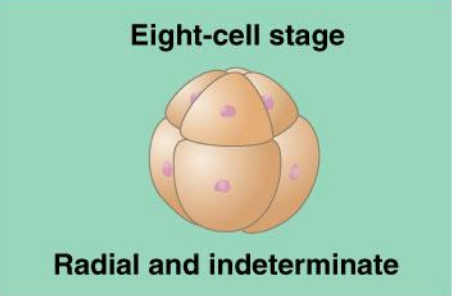
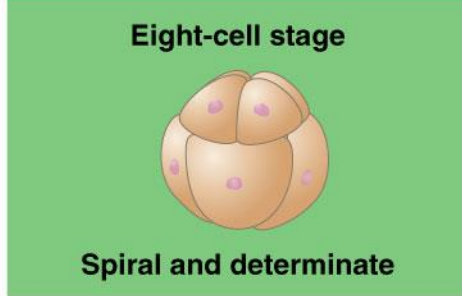
– Early Developmental Pattern

- **Protostome** - First embryonic opening becomes the mouth (mouth forms first)
- **Deuterostome** - Second embryonic opening becomes the mouth (mouth forms second)

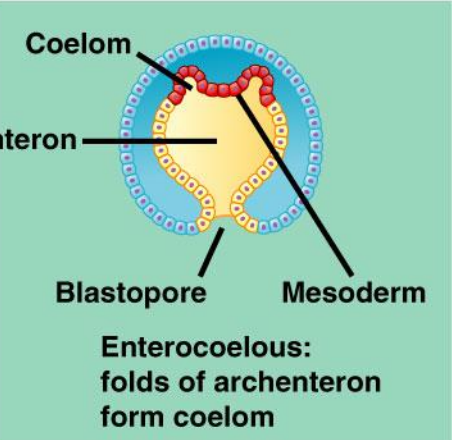
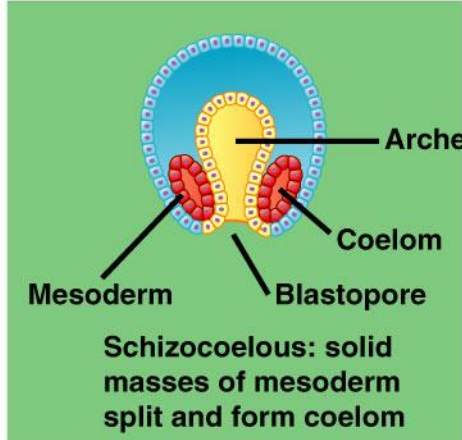
Protostomes & Deuterostomes

Protostome development
(examples: molluscs, annelids,
arthropods)

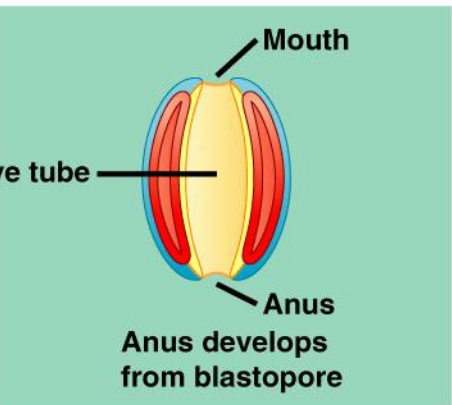
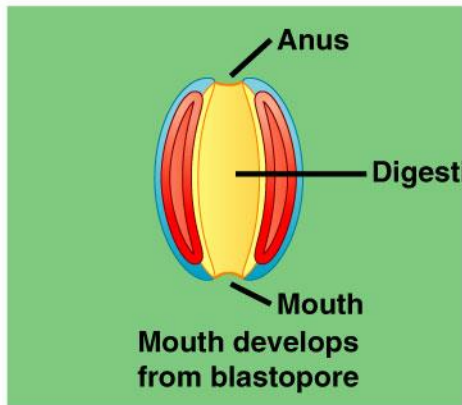
Deuterostome development
(examples: echinoderms,
chordates)



(a) Cleavage

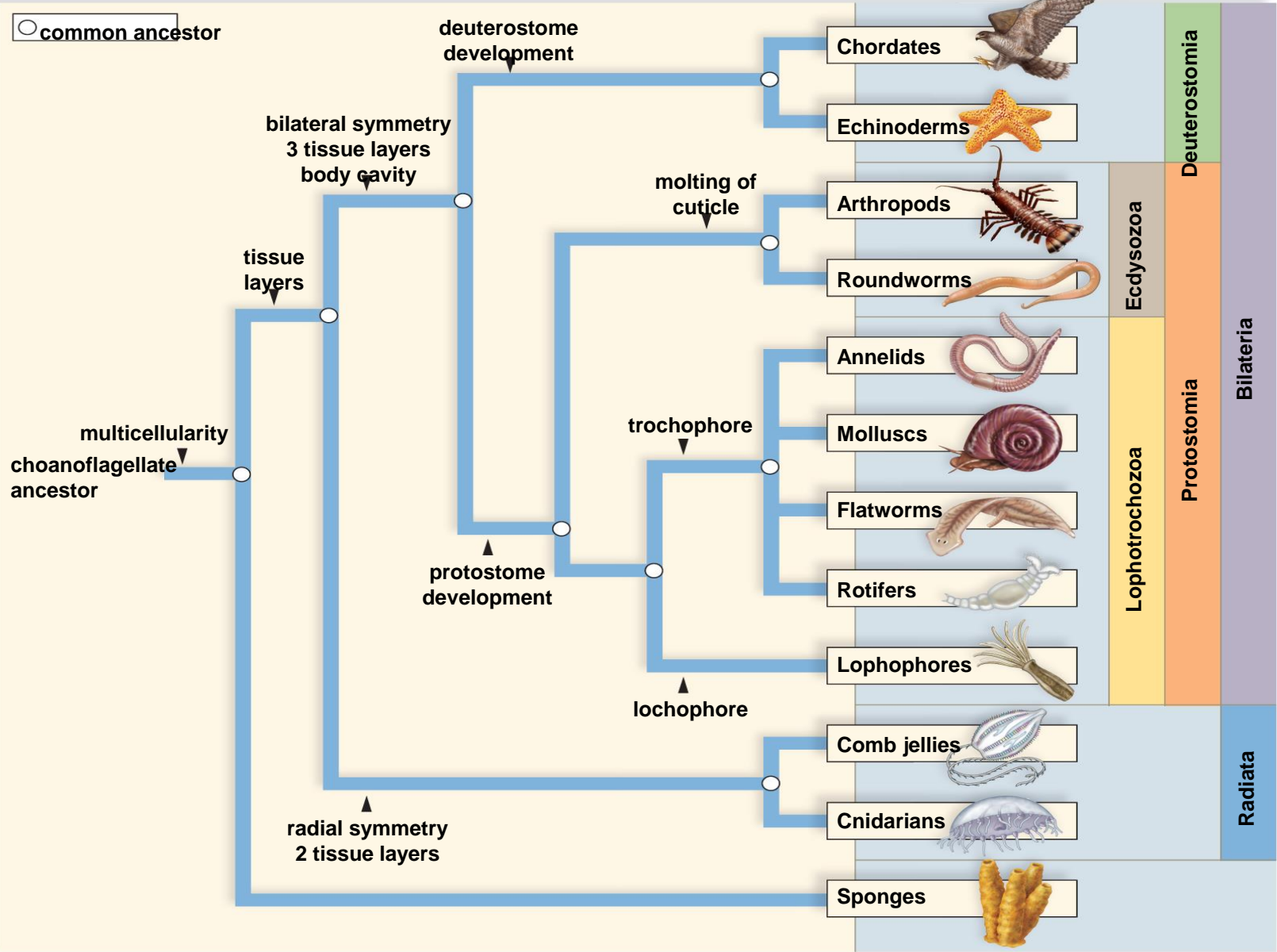


(b) Coelom formation



(c) Fate of the blastopore

Phylogenetic Tree of Animals



Multicellularity

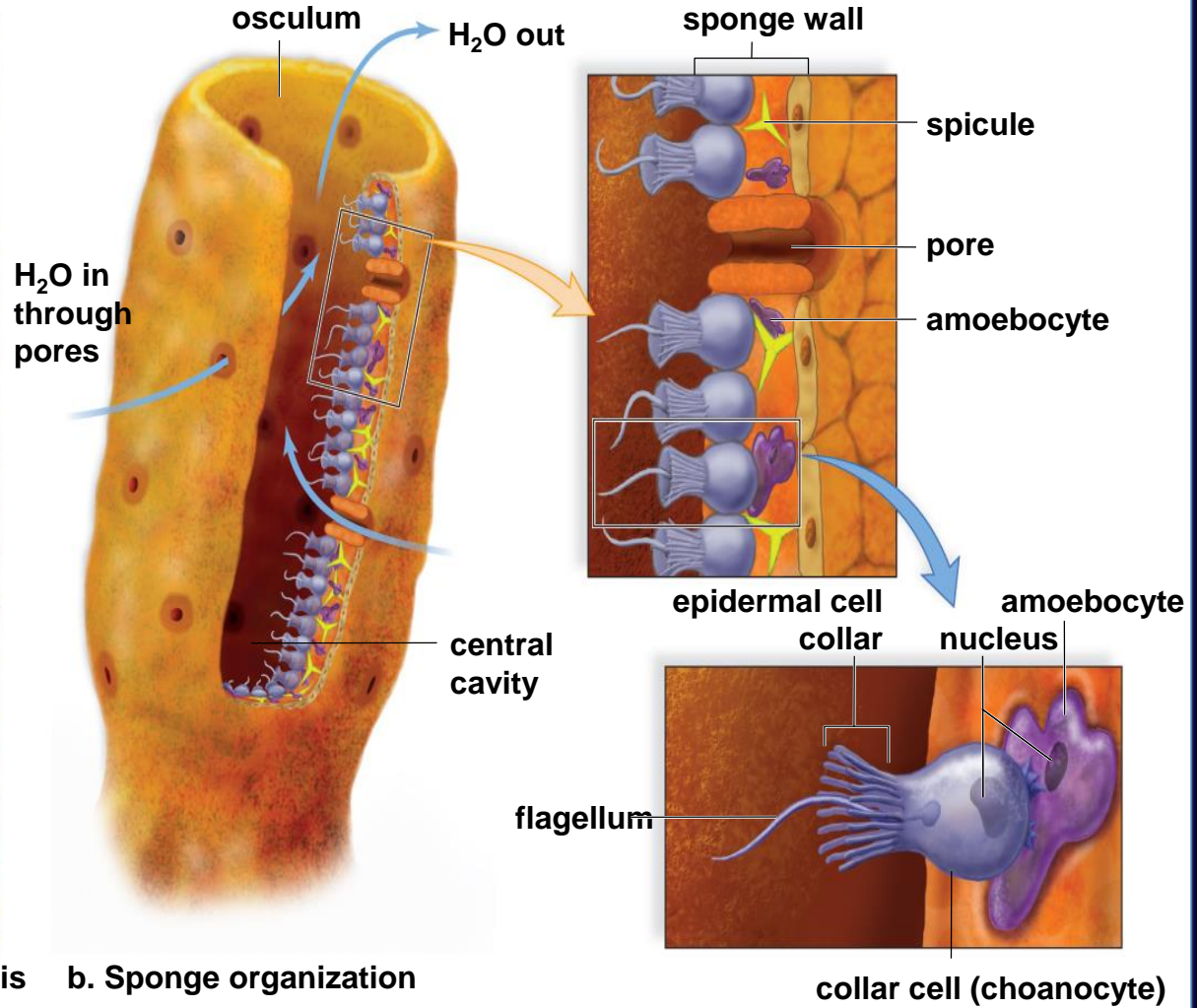
- **Sponges**

- Only level of animal to have **no true tissues** but cellular organization
- **Saclike bodies** perforated by many pores
- Beating of flagella produces water currents that flow through pores into central cavity and out **osculum**
- **Sessile filter feeders**
- **Asexual reproduction** by fragmentation or budding

Simple Sponge Anatomy



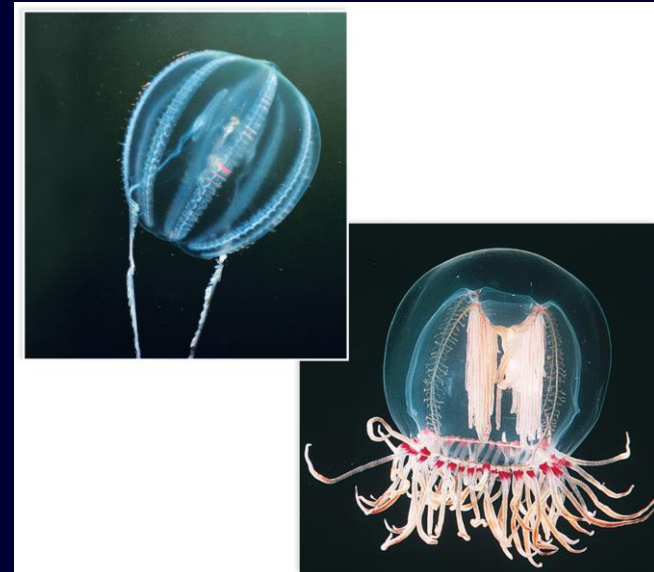
a. Yellow tube sponge, *Aplysina fistularis*



b. Sponge organization

True Tissue Layers

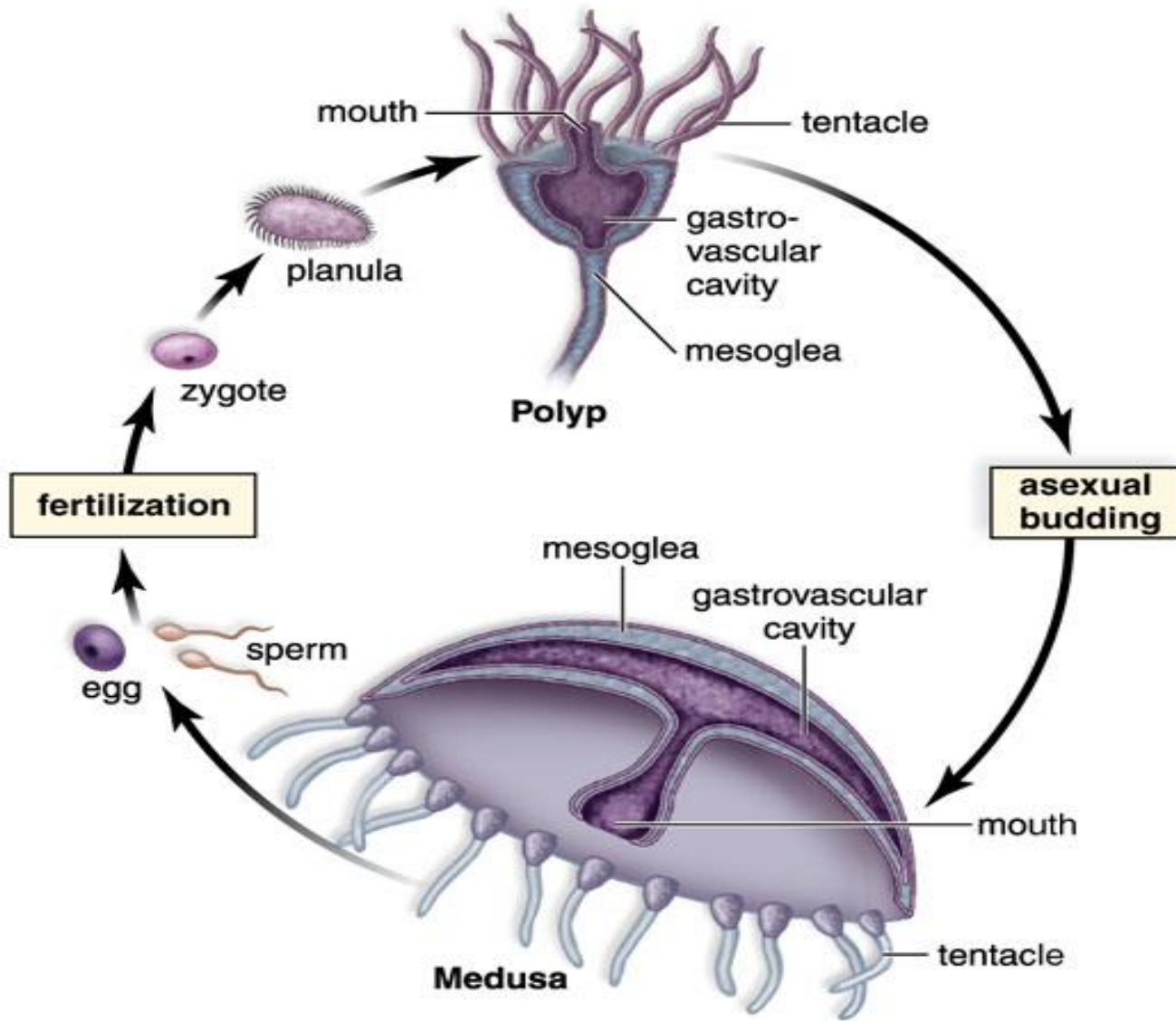
- Total of three possible germ layers
 - Ectoderm
 - Endoderm, and
 - Mesoderm
- phyla Ctenophora and Cnidaria develop only ectoderm and endoderm
 - **Diploblasts** (2 tissue layers)
 - **Radially symmetrical**



Radial Symmetry: Cnidarians

- Tubular animals with tissues and radial symmetry
 - most often reside in shallow marine waters
 - **Polyp and medusa** body forms
 - Specialized **stinging cells** (cnidocytes)
 - Fluid-filled capsule, nematocyst
 - Two-layered **body sac**
 - Outer layer - Protective epidermis
 - Inner layer - Gastrovascular cavity
 - **Nerve net** found throughout body





a.

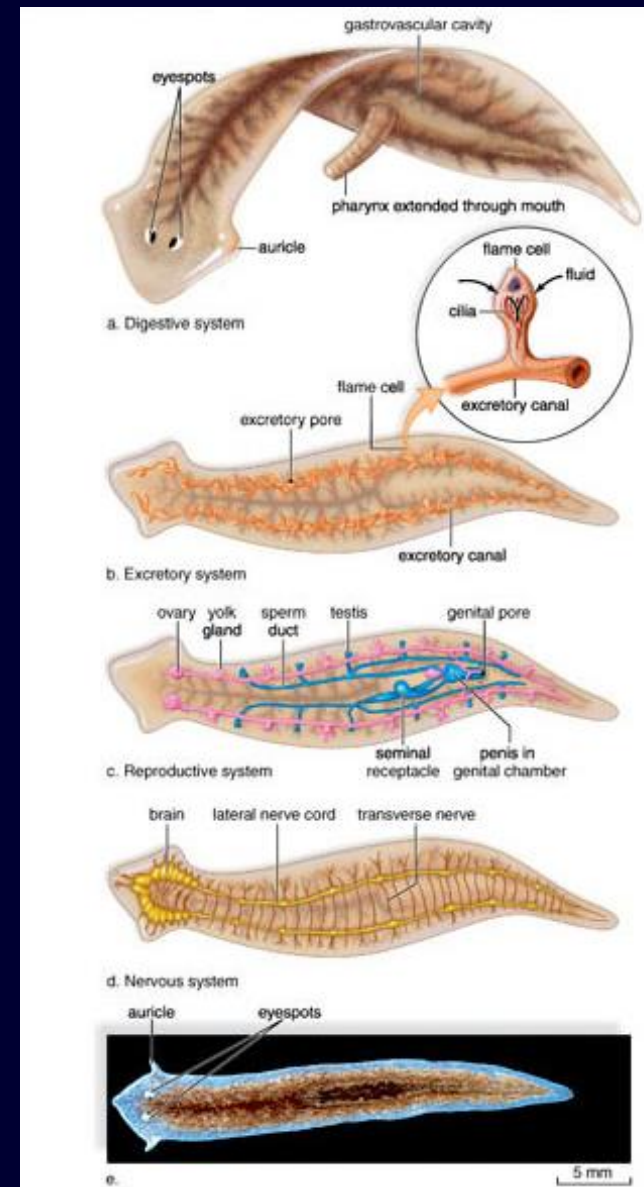
Bilateral Symmetry

- Ribbon worms (phylum Nemertea)
 - Have distinctive proboscis
- Flatworms (phylum Platyhelminthes)
 - Majority are parasitic
 - Organ-level organization
 - No specialized circulatory or respiratory structures
 - Have undergone **cephalization**
 - Ladder-type nervous system



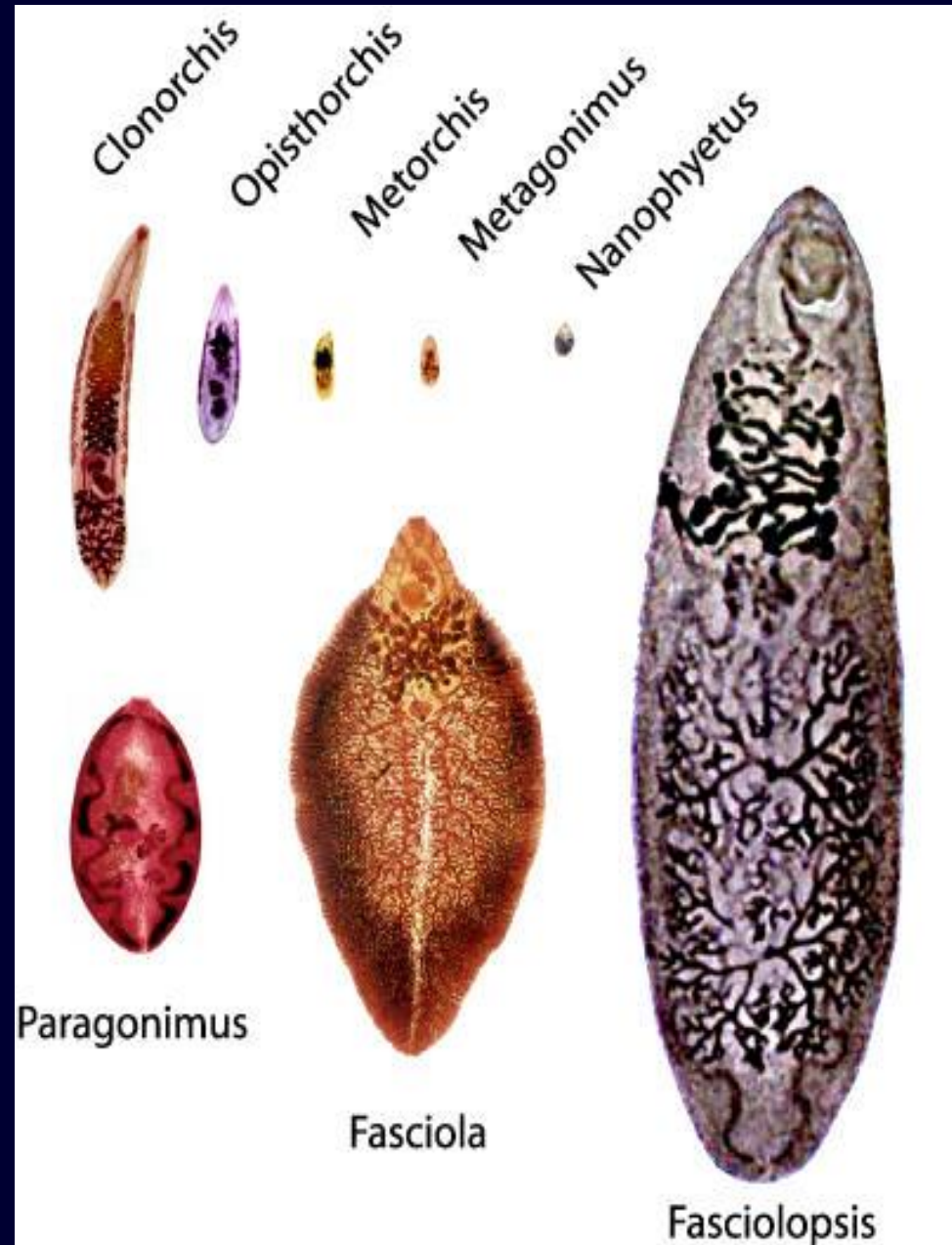
Free-living Flatworms

- **Planarians** (genus *Dugesia*)
 - Live in freshwater habitats
 - Head is bluntly arrow shaped
 - Auricles function as sense organs
 - Two light-sensitive eye spots
 - Three kinds of muscle layers:
 - Outer circular layer
 - Inner longitudinal layer
 - Diagonal layer
 - Excretory organ functions in osmotic regulation and water excretion
 - Can reproduce asexually
 - Hermaphroditic
 - Practice cross-fertilization

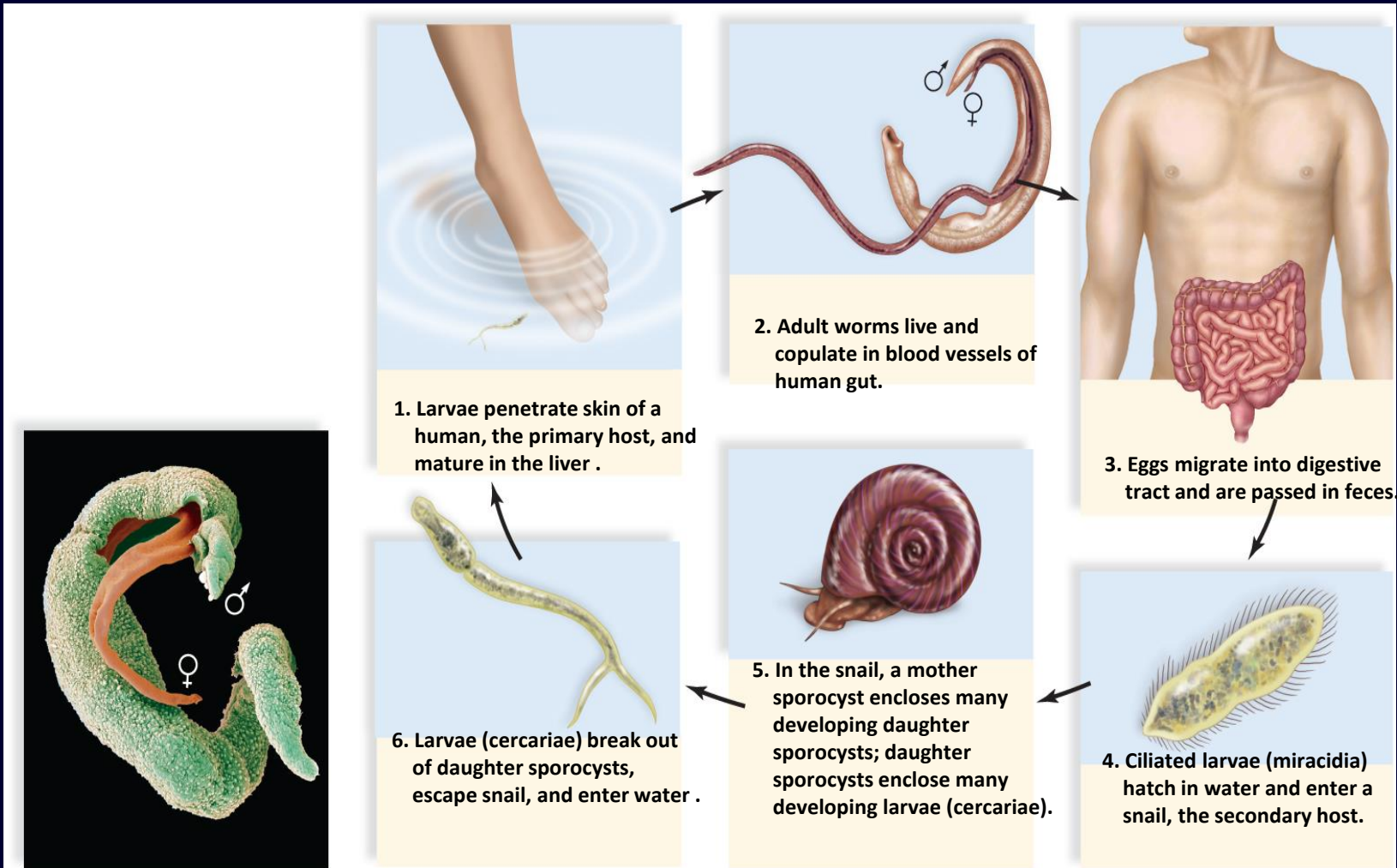


Parasitic Flatworms

- Parasitic flatworms are flukes (trematodes) and **tapeworms** (cestodes) and **flukes**
 - Well-developed nerves and gastrovascular cavity are unnecessary
 - Reproductive system well developed
 - Usually hermaphroditic



Life Cycle of Schistosomiasis (blood flukes)



Parasitic Flatworms

- Tapeworms
 - Have anterior region with modifications for attachment to intestinal wall of host
 - Behind head region, scolex, a long series of proglottids are found
 - Segments each containing a full set of both male and female sex organs
 - Complicated life cycles



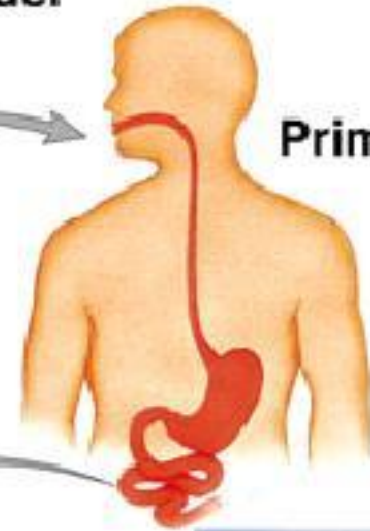
Each larva becomes a bladder worm encysted in muscle.

Meat contains many bladder worms.

Secondary host



Primary host



Bladder worm attaches to human intestine.

Feces contain many larvae-containing eggs.



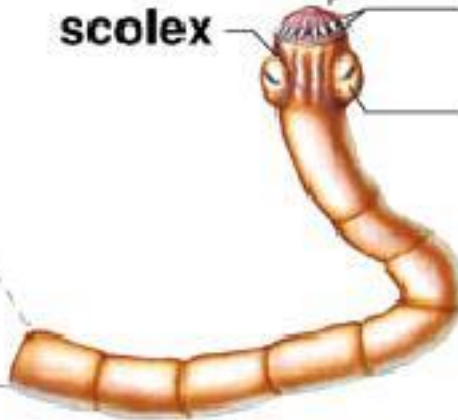
1.0 mm

Gravid proglottid has many larvae-containing eggs.

scolex

hooks

sucker



Tapeworm has proglottids that become more mature.



250 μ m

EAT! EAT! EAT!
& ALWAYS STAY THIN!

NO DANGER

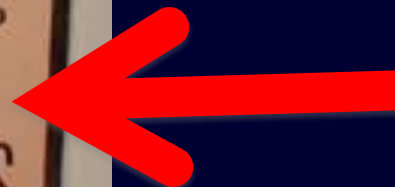
NO DIET - NO BATHS
NO EXERCISE!

FAT

the ENEMY that is shortening Your Life
BANISHED!



HOW?
with
SANITIZED
**TAPE
WORMS**
Jar Packed



FRIENDS FOR A
FAIR FORM!

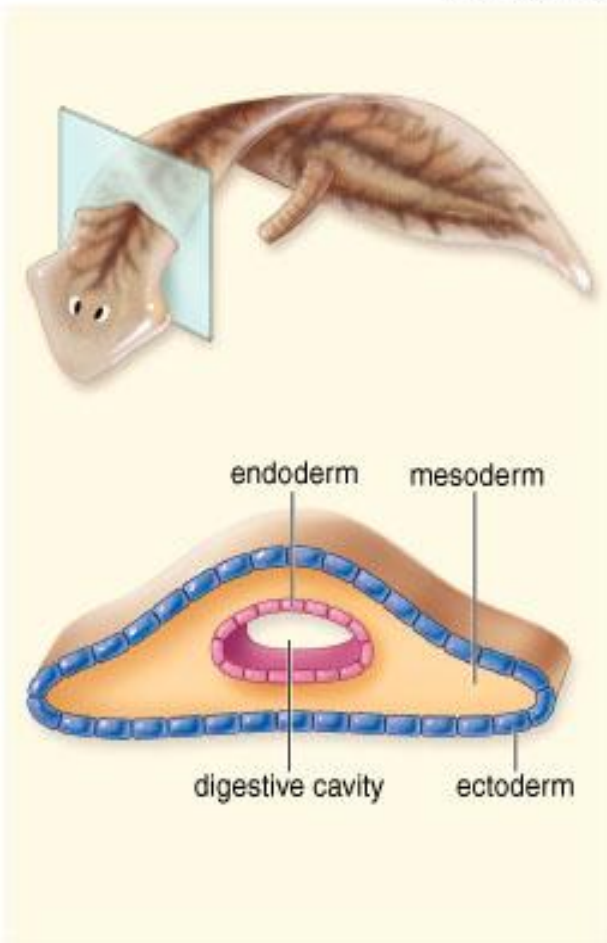
Easy To
Swallow!

No Ill
Effects!

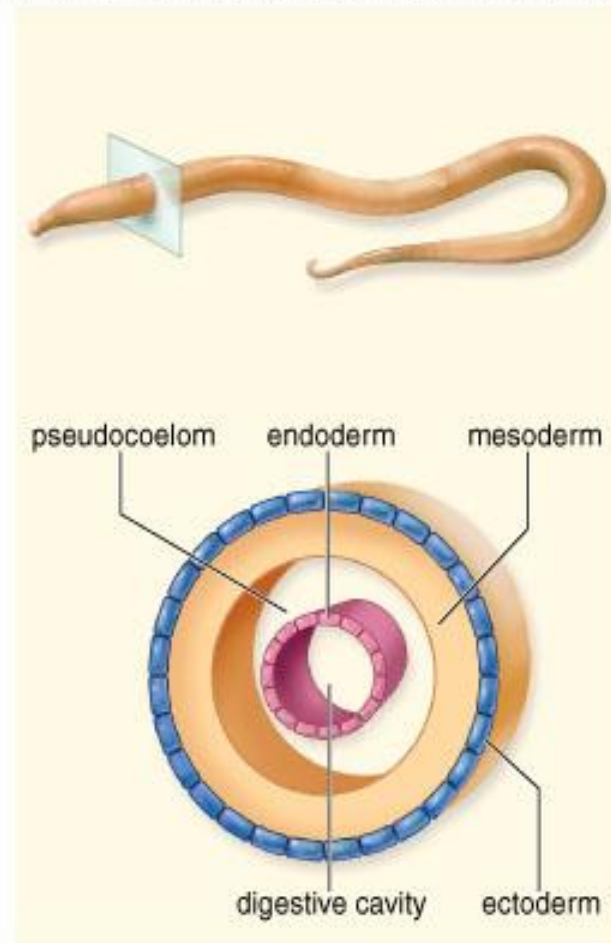
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W. T.
BRIDGE, Chicago
Ill. U.S.A.
SEND NO
MONEY
PARTICULARS
MAIL TO
FREE

Acoelomate, Pseudocoelomate and Coelomate animals

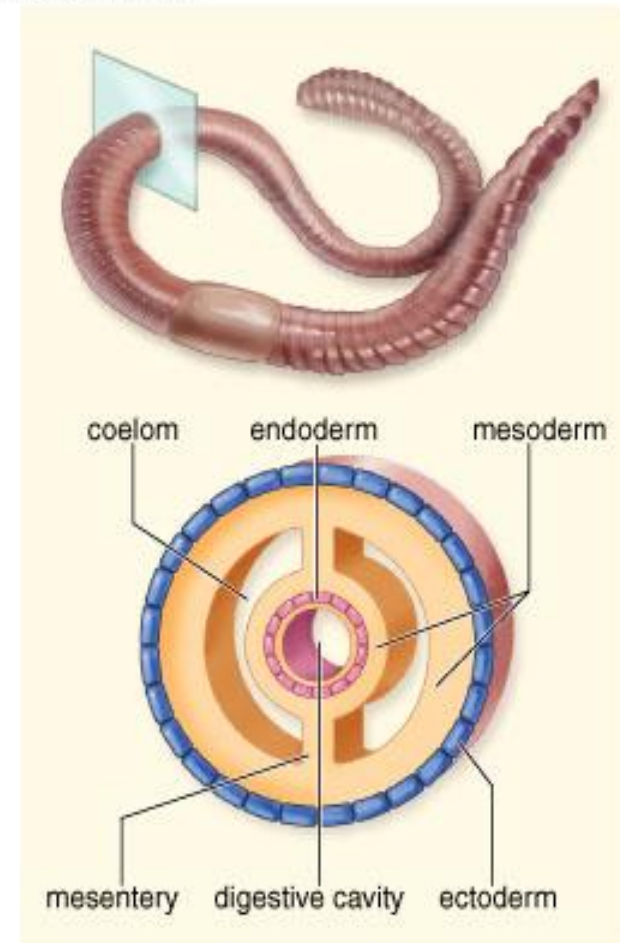
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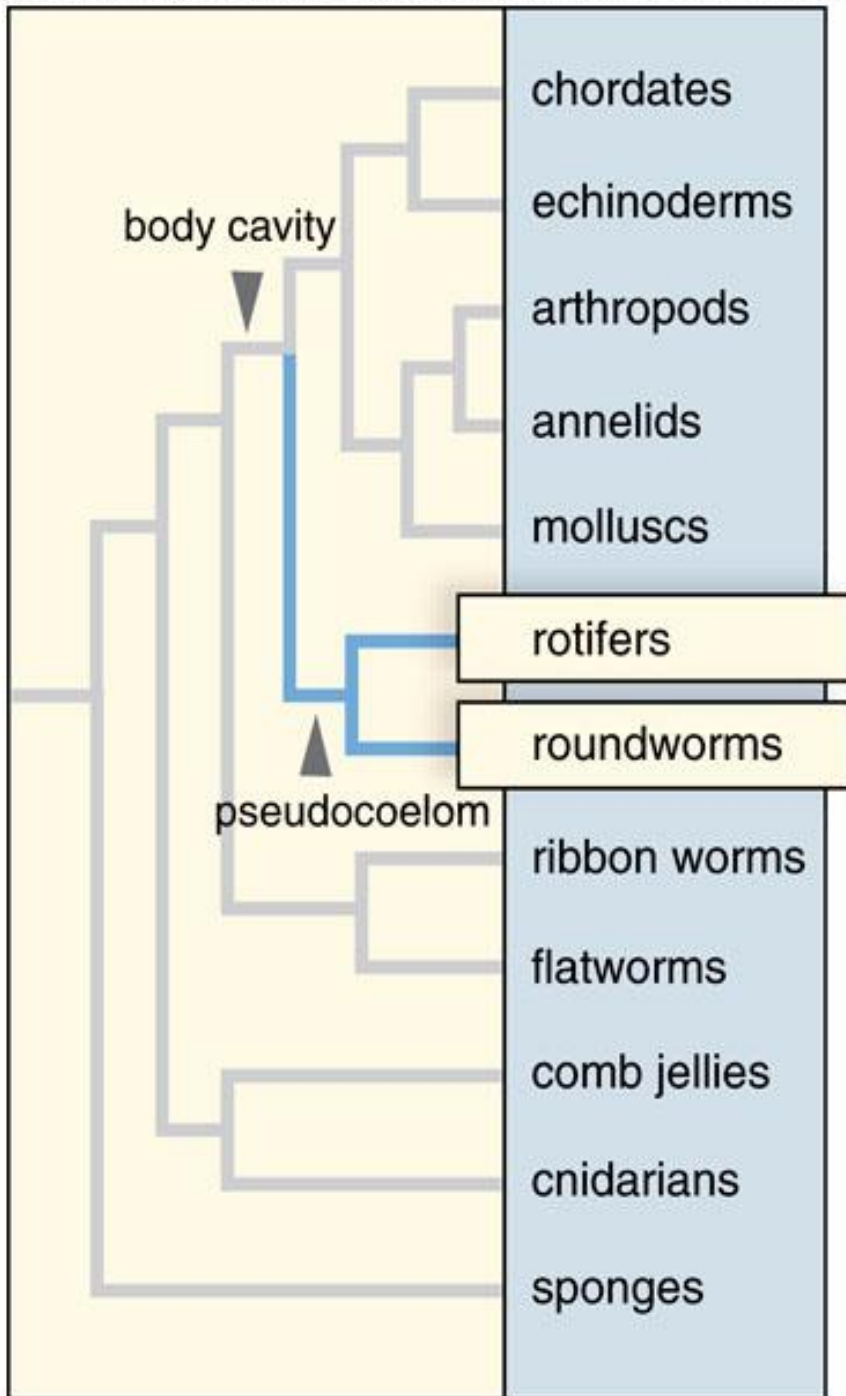
a. **Acoelomate** (flatworms)



b. **Pseudocoelomate** (roundworms)

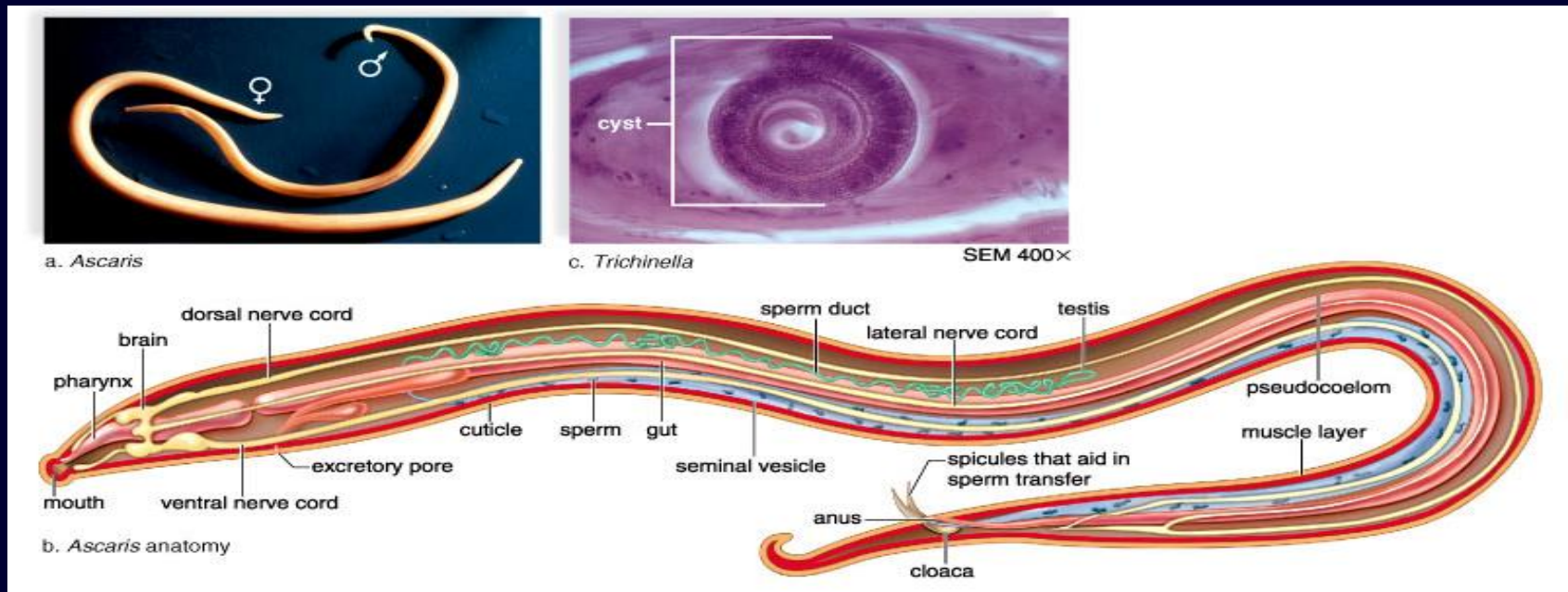


c. **Coelomate** (molluscs, annelids, arthropods, echinoderms, chordates)



Round worms: Nematoda

- Non-segmented, generally colorless worms
- Several parasitic roundworms infect humans
- **Pseudocoelomates**
 - A “false” body cavity that is incompletely lined by mesoderm
 - Provides a space for internal organs and can serve as hydrostatic skeleton



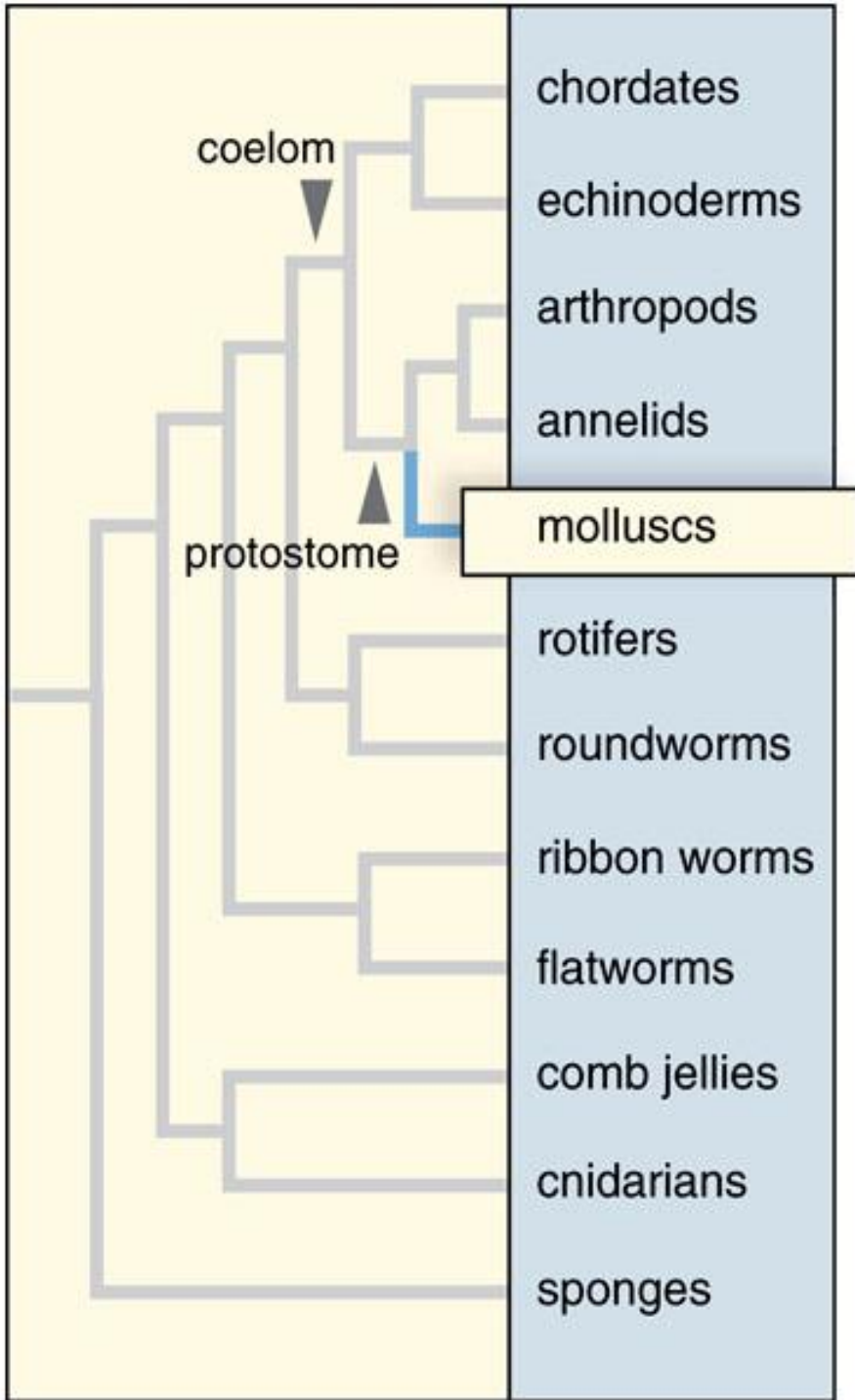
QUESTIONS

You are trying to identify an organism. It is an animal, but it does not have any distinguishable tissue. It is probably a...

- A. Flatworm
- B. Jelly fish
- C. Sponge
- D. Nematode (roundworm)

What would be the most effective method of reducing the incidence of blood flukes in a human population?

- A. Reduce the freshwater snail population
- B. Reduce the mosquito population
- C. Avoid contact with rodent droppings.



Molluscs (phylum Mollusca)



- Have three-part body plan
 - Visceral Mass
 - Contains internal organs
 - Mantle
 - May secrete shell and/or contribute to development of gills or lungs
 - Foot
 - Muscle adapted for locomotion, attachment, or food capture

Molluscs

(phylum Mollusca)



- Nervous system consists of several ganglia connected by nerve cords
- Coelom is reduced, and largely limited to the region around the heart
- Heart pumps hemolymph through vessels into hemocoel



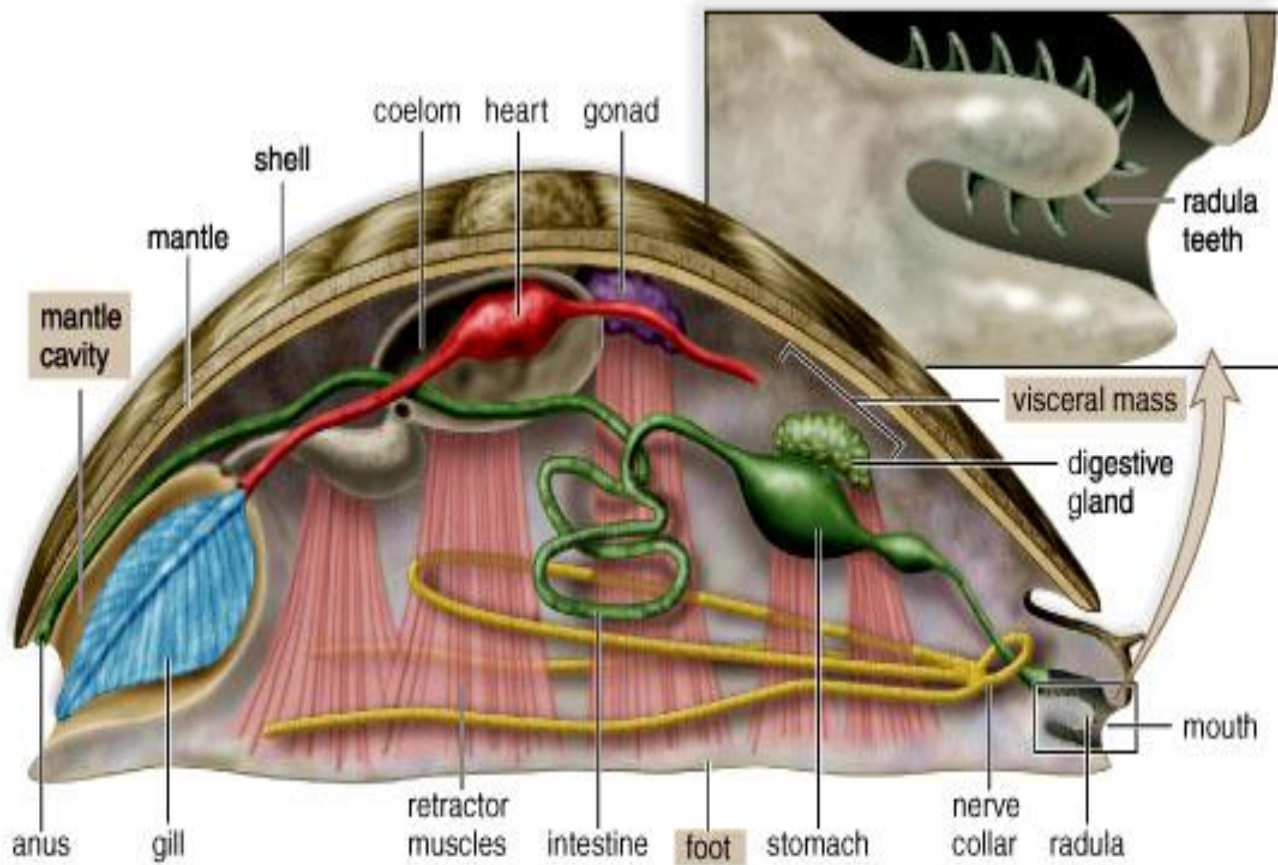
Phylum Mollusca (>150,000 species!)

- Gastropods (Snails, slugs), Bivalves (oysters, clams, scallops, mussels), Cephalopods (octopuses, squids)
- Most have hard shells, secreted by the “mantle” and a muscular foot
- They have a true coelom and complete, closed digestive tract
- Most still have an “open” circulatory system (no enclosed vessels), but molluscs are the first to evolve gills and a true heart for circulation



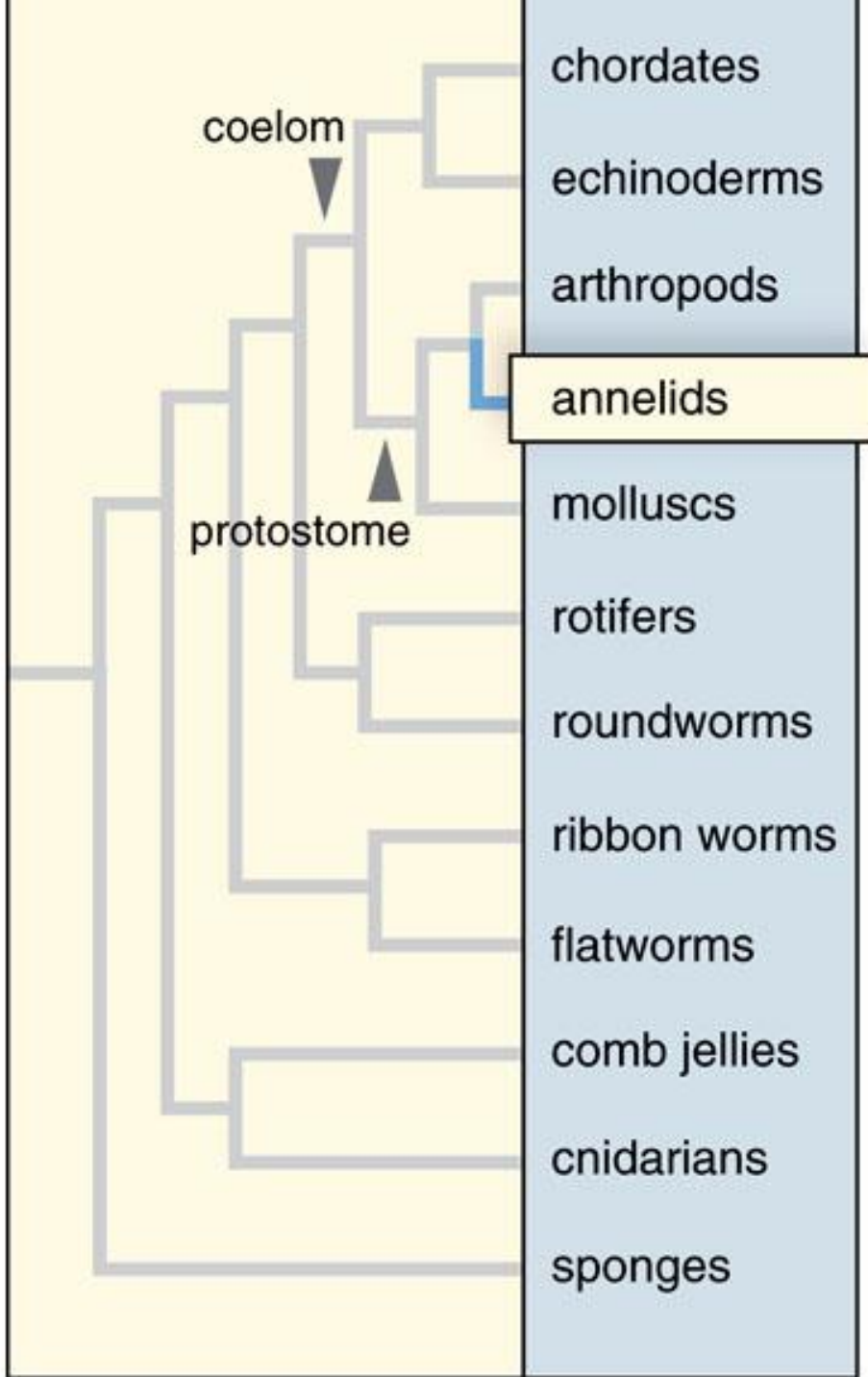
Body Plan of Molluscs

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a. Generalized molluscan anatomy

b. Radula



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Annelids (Phylum Annelida)

- segmented worms
- Segmented partitions (septa) divide the well-developed, fluid-filled coelom, which acts as hydrostatic skeleton
 - Specialized digestive tract
 - Closed circulatory system
 - Ventral solid nerve cord
 - Most are marine
 - Setae (bristles) help in movement

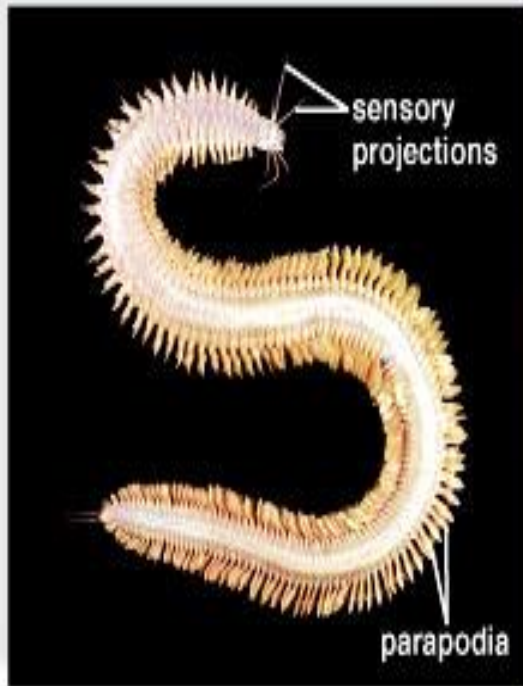


Annelids

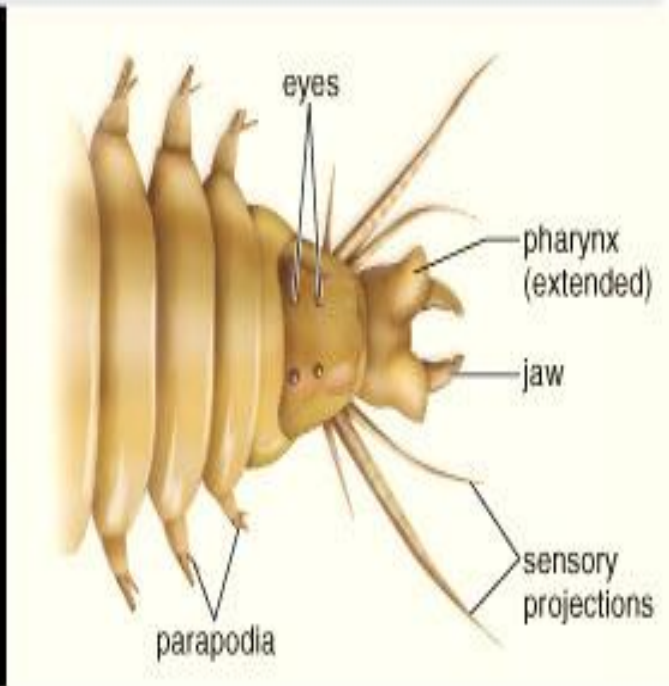
(Phylum Annelida)

A. Polychaetes (many setae)

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a. Ragworm, *Nereis diversicolor*



b. Christmas tree worms, *Spirobranchus giganteus*

Polychaetes Diversity

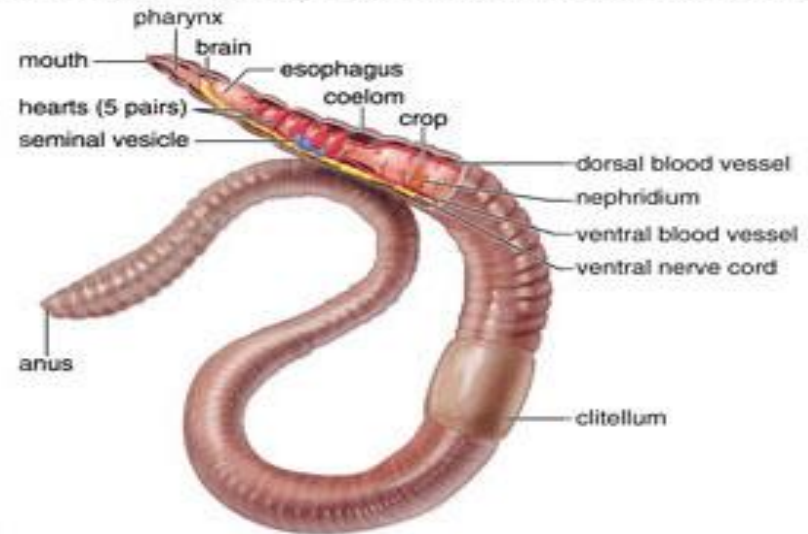
Annelids

(Phylum Annelida)

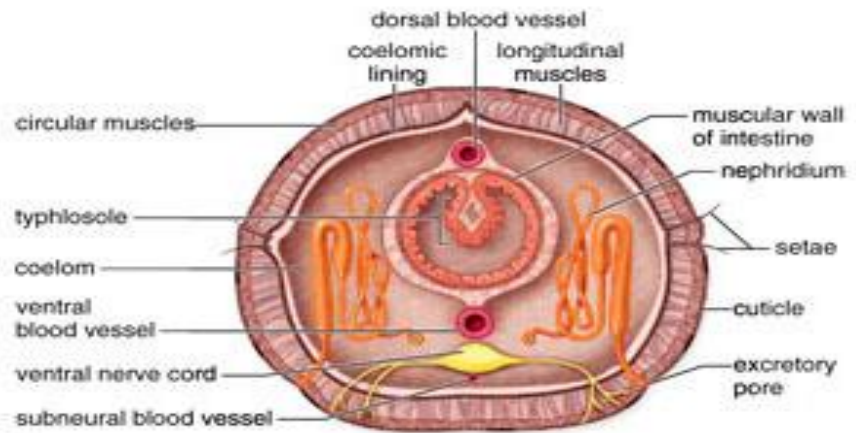
B. Earthworms: Oligochaetes (few setae)

- Do not have well-developed head or parapodia
- Setae protrude in pairs directly from surface of body
- Food drawn into mouth by action of muscular pharynx
 - Digestion and absorption occur in long internal intestine

Earthworm, *Lumbricus terrestris*



a.



b.



c.

Earthworms

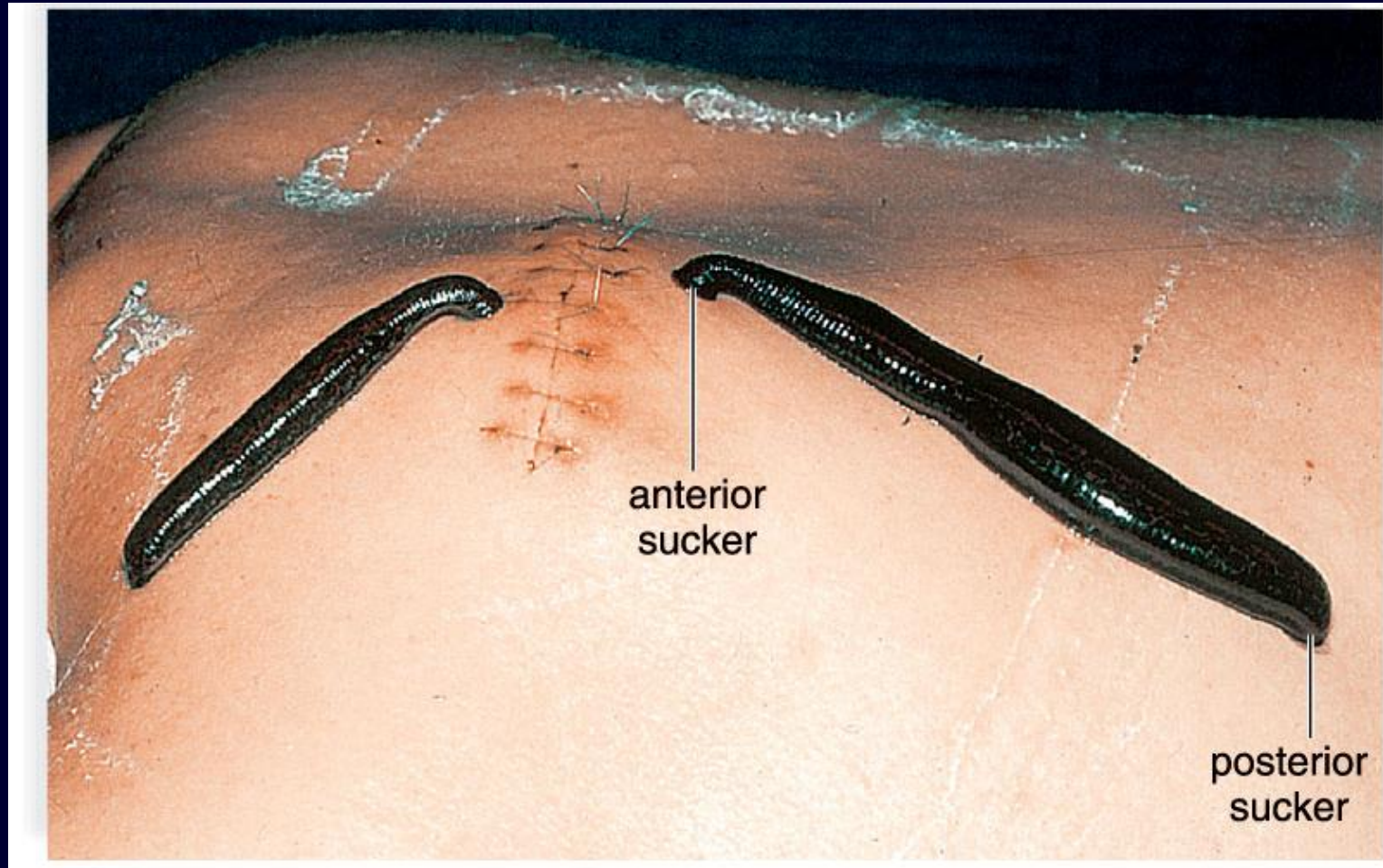
Segmentation evidenced by:

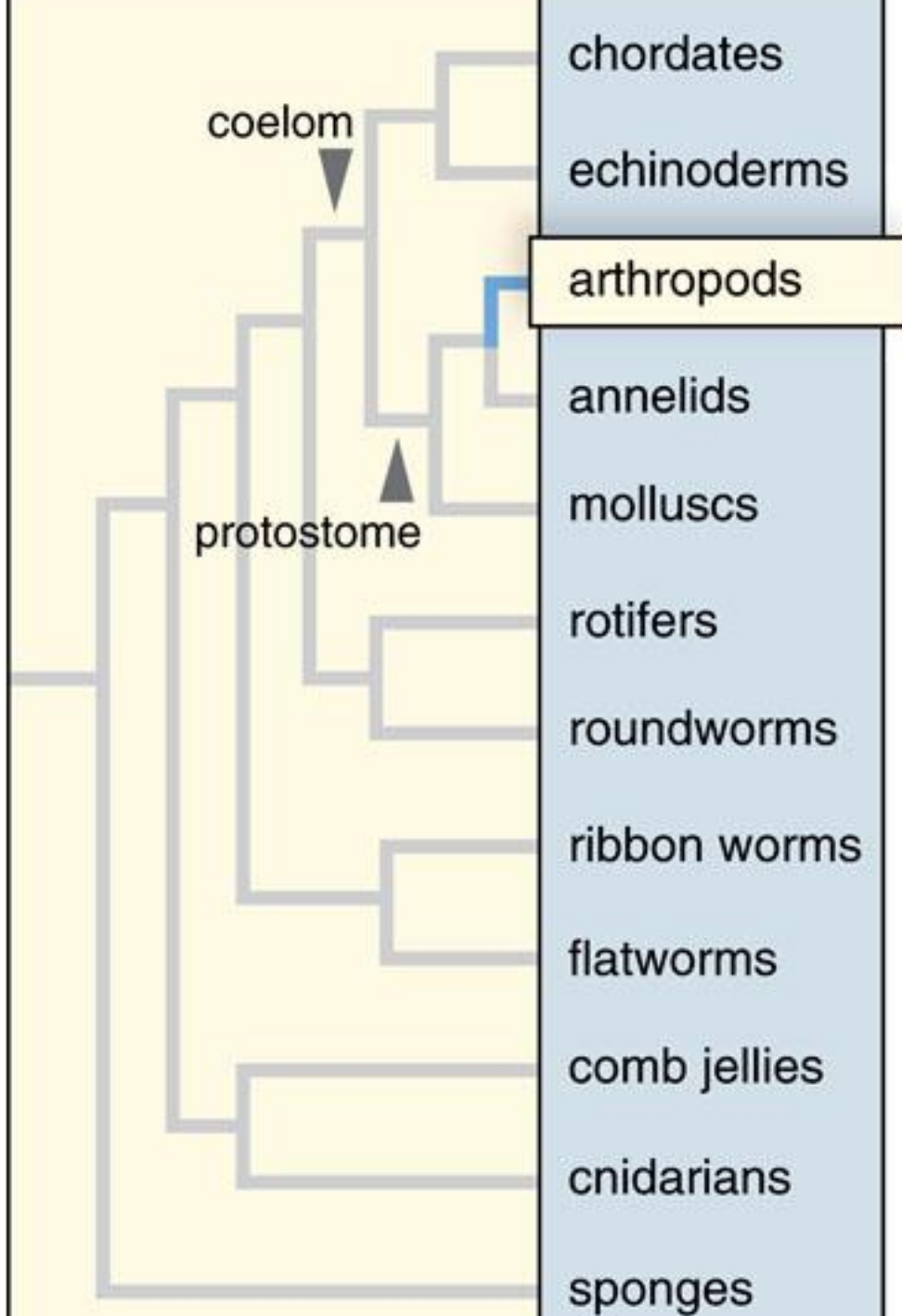
- Body rings
- Coelom divided by septa
- Setae on most segments
- Gangli and lateral nerves in each segment
- Nephridia in most segments
- Branch blood vessels in each segment
- **Reproduction**
 - Hermaphroditic
 - Two worms lie in parallel to each other facing in opposite directions
 - Fused midbody segment (clitellum) secretes mucus, protecting sperm from dessication



Annelids

(Phylum Annelida)
C. Leeches (no setae)

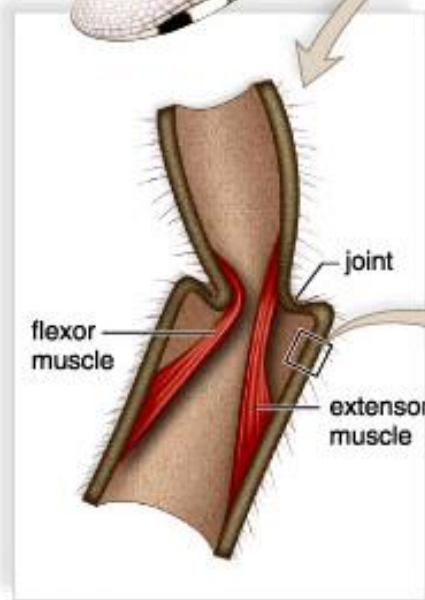




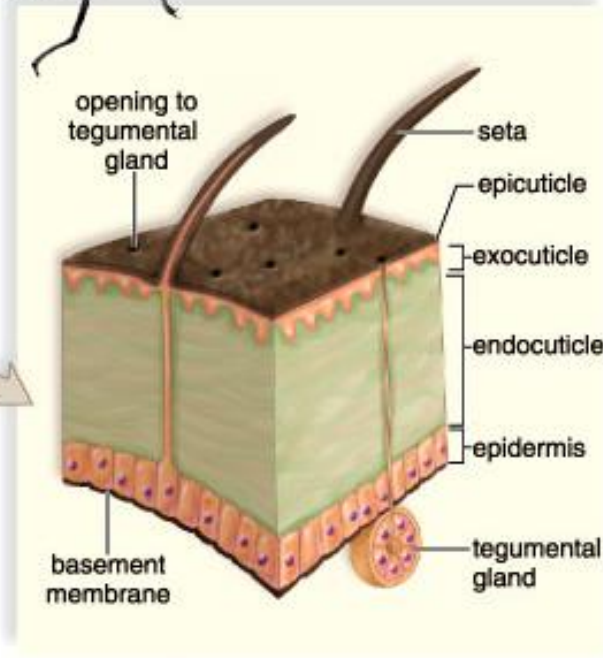
Arthropods

- Arthropods (phylum Arthropoda) have freely movable jointed appendages
- >1,000,000 species (2/3 of all known species!)
- Very successful due to many characteristics
 - Rigid, jointed hard cuticle exoskeleton
 - Must molt as they grow
 - Segmented, but some segments are fused into regions
 - Head, thorax, abdomen
 - Well-developed nervous system, open circulatory system, coelomates, protostomes

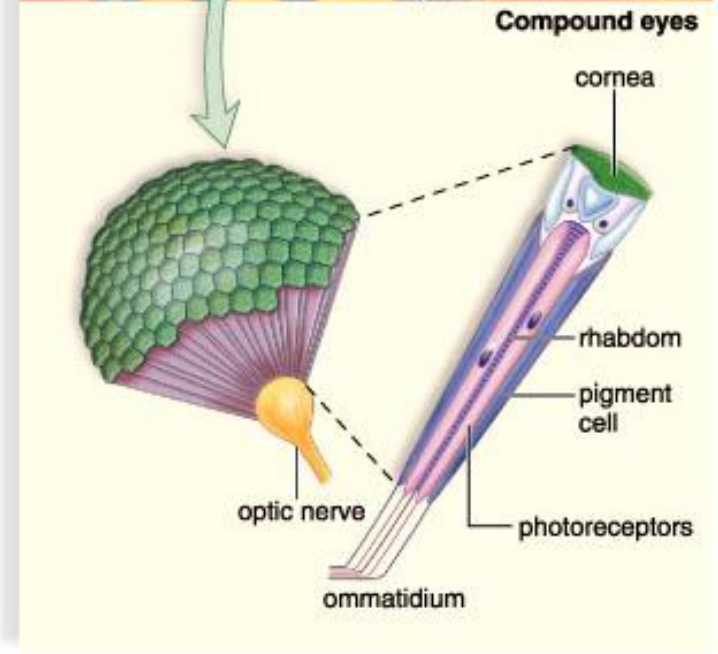
Arthropod Skeleton and Eye



a. Joint movement



b. Exoskeleton composition



c. Compound eye

Arthropods

- Variety of respiratory organs
- Occurrence of **metamorphosis**

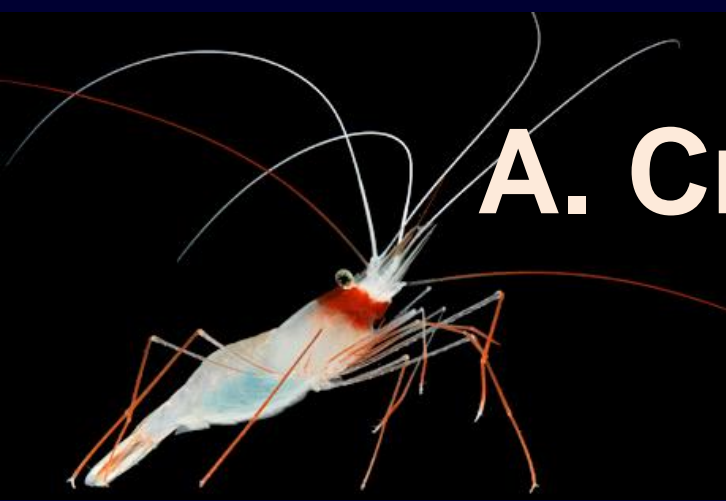


- **Three major arthropod subphyla**

- Crustaceans
- Uniramians
- Chelicerates



A. Crustaceans



- **Decapods** (10 legs) are the most familiar & numerous of crustaceans
- Shrimp, lobsters, crayfish, and crabs
 - Thorax bears five pairs of walking legs
 - Head and thorax fused into cephalothorax
 - Covered by nonsegmented carapace
 - Abdominal segments equipped with swimmerets
 - Respiratory system consists of gills

B. Uniramians

- Include **insects, millipedes, and centipedes**
- **Appendages** attached to the thorax and abdomen only have **one branch**
- Head appendages include:
 - Only one pair of antennae
 - One pair of mandibles, and
 - One or two pairs of maxillae
- Live on land and breathe by **tracheae**

Insect Diversity



Grasshopper, order *Orthoptera*

3 pairs of legs



Mealybug, order *Homoptera*



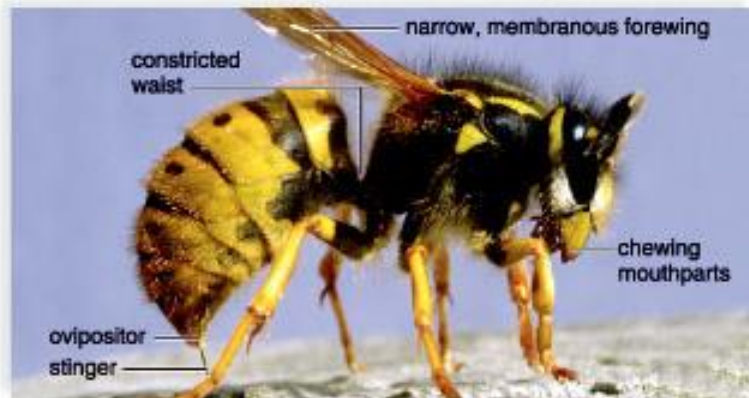
Beetle, order *Coleoptera*



Leafhopper, order *Homoptera*



Head louse, order *Anoplura*



Wasp, order *Hymenoptera*

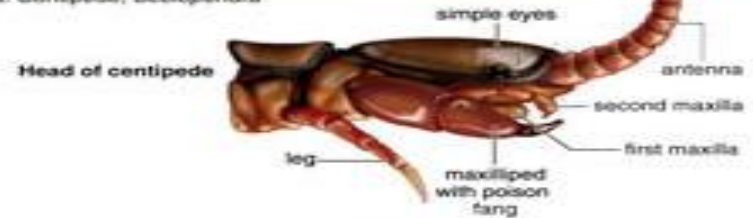


Dragonfly, order *Odonata*

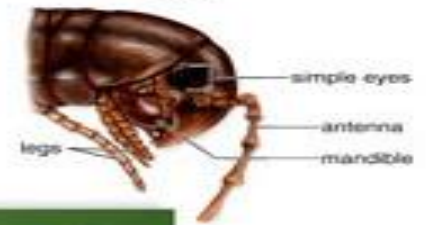
Centipede and Millipede



a. Centipede, *Scolopendra*



Head of centipede



Head of millipede

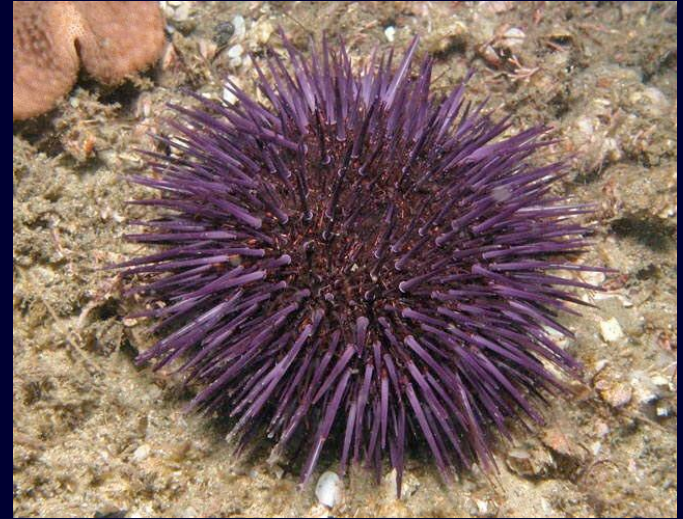
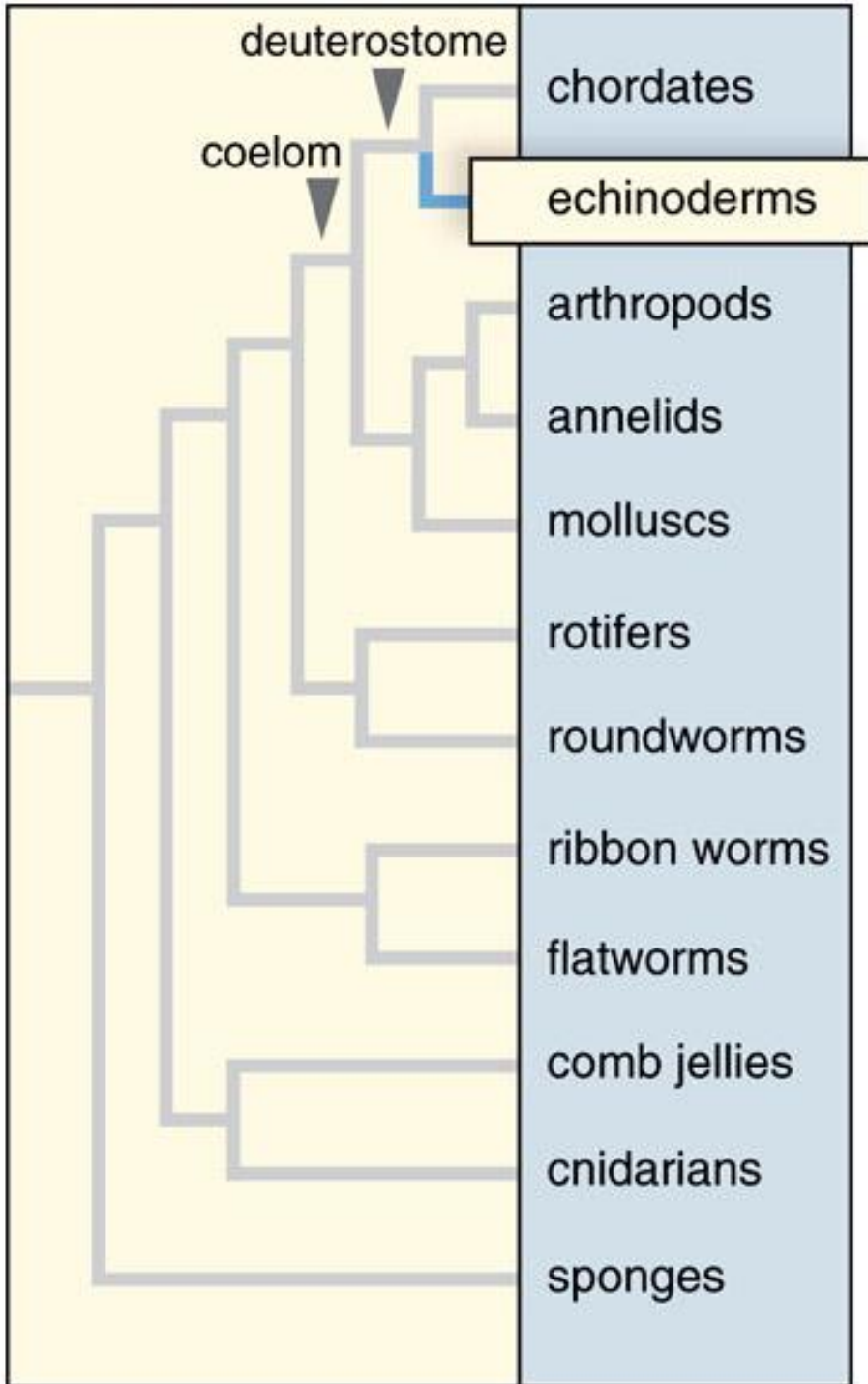


c. Millipede, *Tachypoda*



C. Chelicerates

- Include terrestrial spiders, scorpions, ticks, mites, horseshoe crabs and sea spiders
- All appendages attached to cephalothorax; none on head
 - First pair (chelicerae) are feeding organs
 - Second pair (pedipalps) function in feeding or sensory



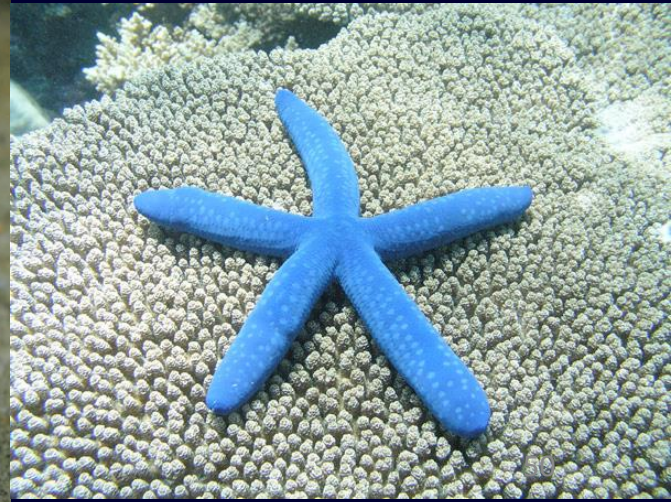
Phylum Echinodermata

- Seastars (starfish), sea urchins, sea cucumbers
 - mostly sessile or slow-moving
- This group represents a major change in animal embryonic development...
- **Deuterostomes** – during development the first opening (blastopore) becomes the anus, not the mouth

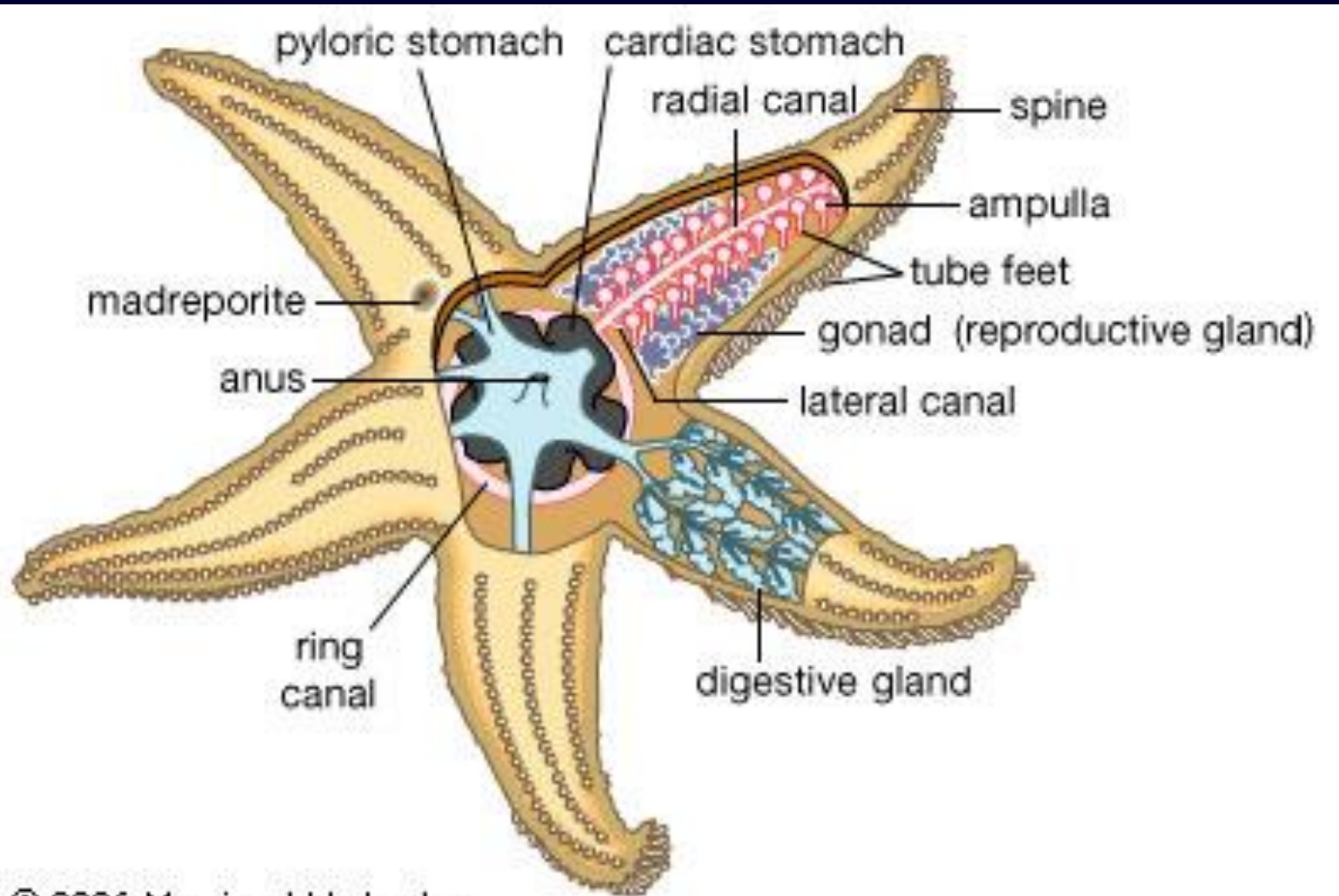


Phylum Echinodermata

- Adults APPEAR to have radial symmetry (larva do not), but they are true bilaterates
 - Because of this, and the sedentary lifestyle, they APPEAR similar to radiata, but actually...
 - Echinoderms are the closest relatives to vertebrates
- Posses endoskeletons and complete digestive tracks



Starfish Eating



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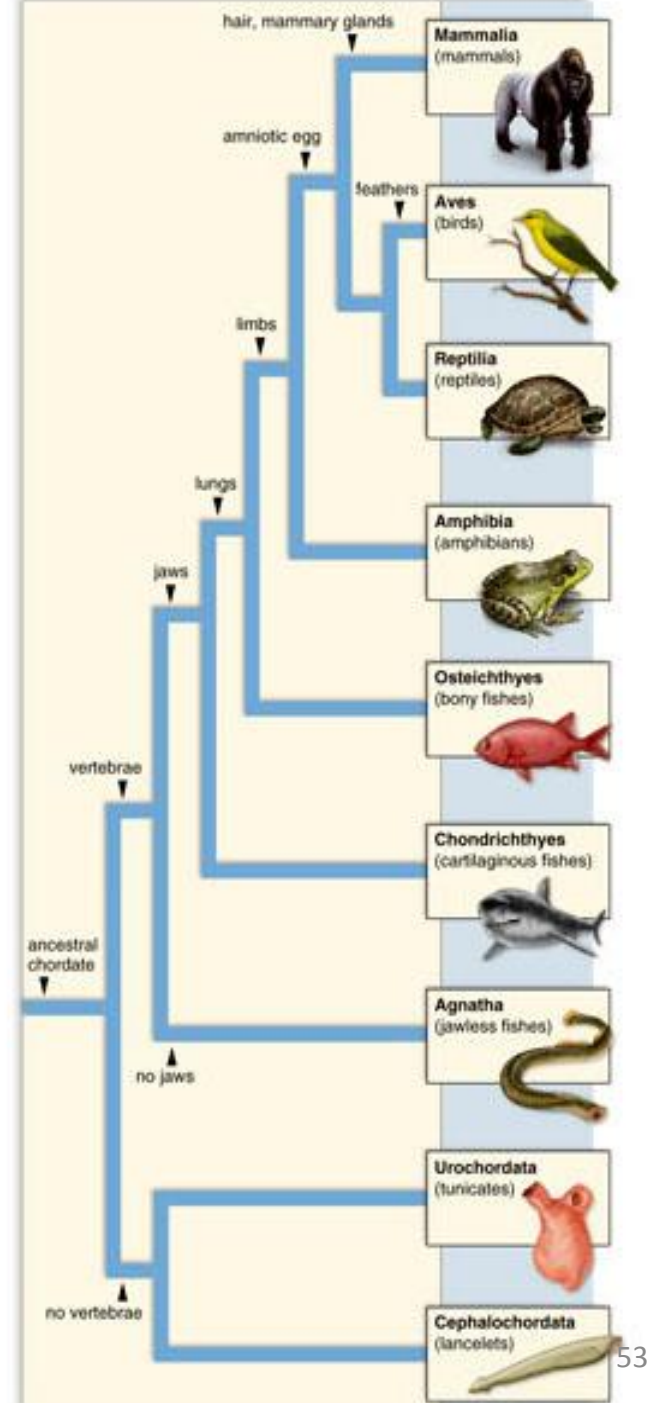
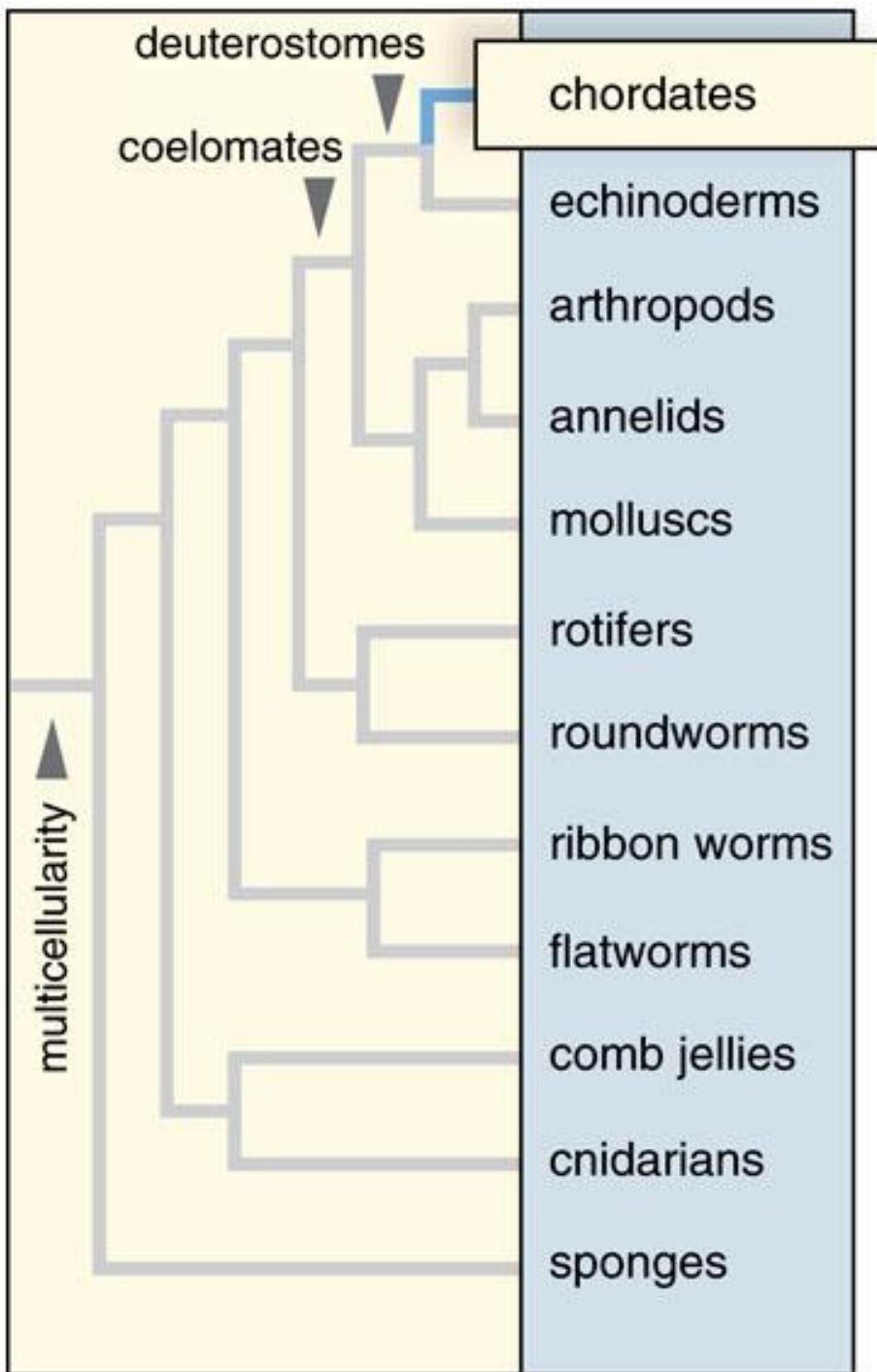
https://www.youtube.com/watch?v=HG17TsgV_qI

QUESTION

- A. Cnidaria
- B. Annelida
- C. Mollusca
- D. Arthropoda
- E. Echinodermata

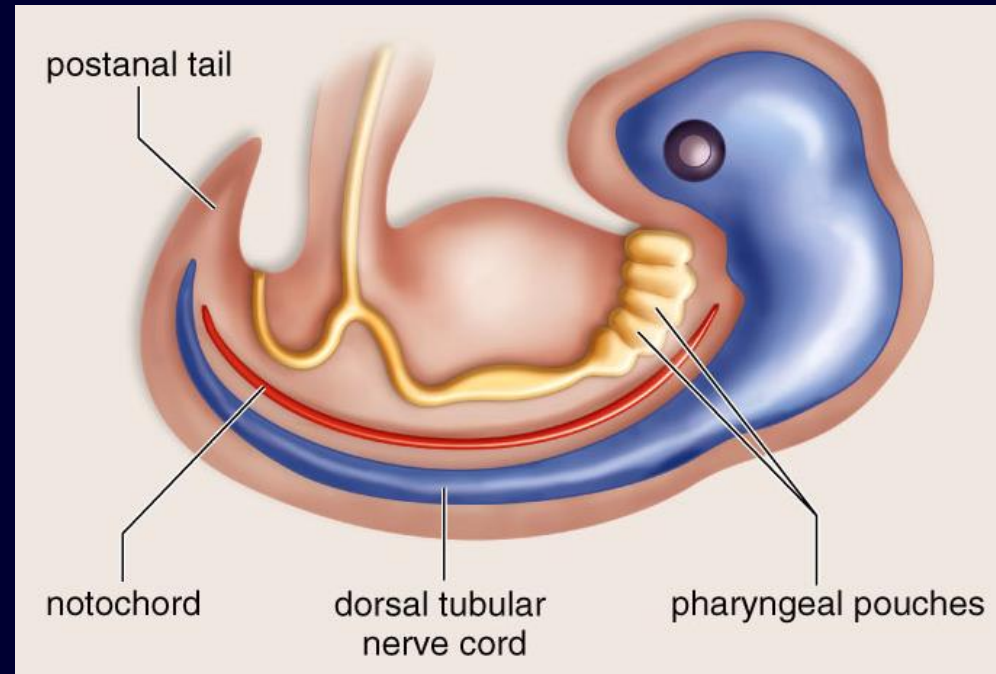
protostomes that have an open circulatory system and an exoskeleton of chitin

D



Chordates

- Phylum Chordata
 - Four Main Characteristics
 - Notochord
 - Nerve Cord
 - Pharyngeal Pouches
 - Tail



Invertebrate Chordates

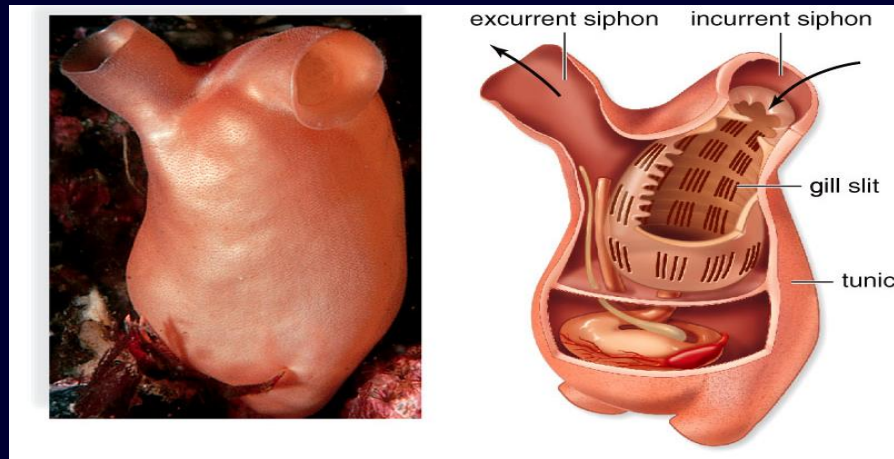
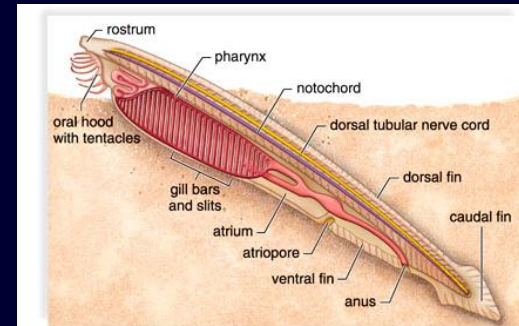
Notochord persists and is never replaced by a vertebral column

– Lancelets (Subphylum Cephalochordata)

• *Branchiostoma*

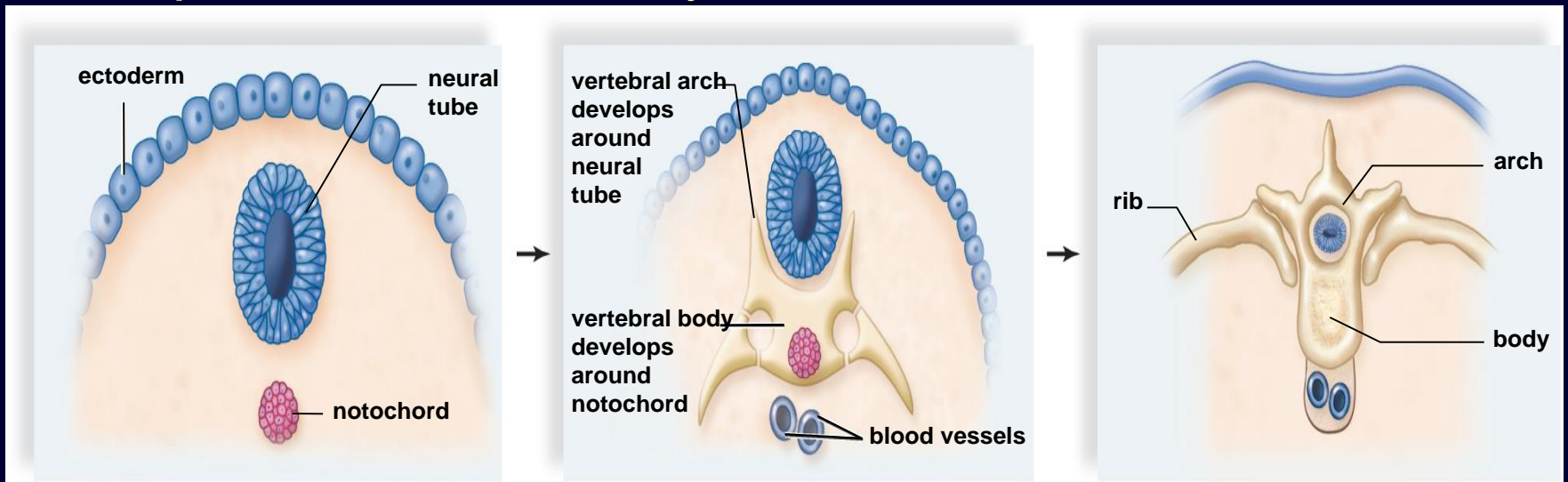
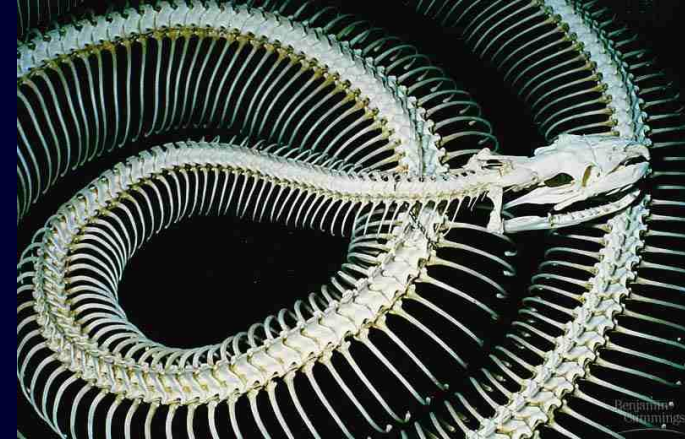
– Sea Squirts (Subphylum Urochordata)

• *Halocynthia*



Vertebrate Features

- Living endoskeleton with vertebral column
- Closed circulatory system
- Paired appendages
- Efficient respiration and excretion
- High degree of cephalization
- Adapted to active lifestyles



Replacement of Notochord by the Vertebrae

DOMAIN: Eukarya
KINGDOM: Animalia

CHARACTERISTICS

- Multicellular
- Well-developed tissues (except sponges)
- Usually motile
- Heterotrophic by ingestion or absorption, generally a digestive cavity
- Diploid life cycle



Invertebrates*

PHYLUM: Porifera	—————	sponges
PHYLUM: Cnidaria	—————	jellyfishes, sea anemones, corals
PHYLUM: Ctenophora	—————	comb jellies, sea walnuts
PHYLUM: Platyhelminthes	—————	flatworms (e.g., planarians, flukes, tapeworms)
PHYLUM: Nemertea	—————	ribbon worms
PHYLUM: Nematoda	—————	roundworms
PHYLUM: Rotifera	—————	rotifers
PHYLUM: Mollusca	—————	chitons, snails, slugs, clams, oysters, mussels, squids, octopuses
PHYLUM: Annelida	—————	segmented worms (e.g., clam worms, earthworms, leeches)
PHYLUM: Arthropoda	—————	spiders, scorpions, horseshoe crabs, lobsters, crayfish, shrimps, crabs, millipedes, centipedes, insects
PHYLUM: Echinodermata	—————	sea lilies, sea stars, brittle stars, sea urchins, sand dollars, sea cucumbers, sea daisies
PHYLUM: Chordata		
SUBPHYLUM: Urochordata	—————	sea squirts
SUBPHYLUM: Cephalochordata	—————	lancelets

Vertebrates*

SUBPHYLUM: Vertebrata

SUPERCLASS: Agnatha	—————	jawless fishes (e.g., lampreys, hagfishes)
SUPERCLASS: Gnathostomata	—————	jawed fishes; all tetrapods
CLASS: Chondrichthyes	—————	cartilaginous fishes (e.g., sharks, skates, rays)
CLASS: Osteichthyes	—————	bony fishes (e.g., herring, salmon, cod, eel, flounder)
CLASS: Amphibia	—————	frogs, toads, salamanders, newts, caecilians
CLASS: Reptilia	—————	snakes, lizards, turtles, crocodiles
CLASS: Aves	—————	birds (e.g., sparrows, penguins, ostriches)
CLASS: Mammalia	—————	mammals (e.g., cats, dogs, horses, rats, humans)

* Not in the classification of organisms, but added here for clarity