Animal diversity and basal lineages

1

Learning goals

- Describe common features of animals
- Describe the features of Porferia
- Describe the features of Cnidarians

2

General features of animals

- **Heterotrophic** – consumer
- Multicellularity
- **No cell walls**
- **Active movement**
- Diversity of form
- Diversity of habitat
- Sexual reproduction
- Specialized tissues

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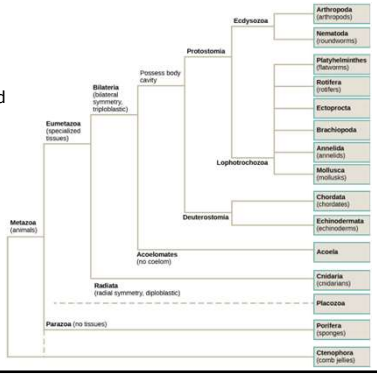
- **Parazoa**: lacking tissues and symmetry
  - Porifera
- **Eumetazoa**: definite shape, symmetry, tissue
  - Cnidaria
  - Ctenophora
  - Bilateria
  - Protostomes
  - Deuterostomes



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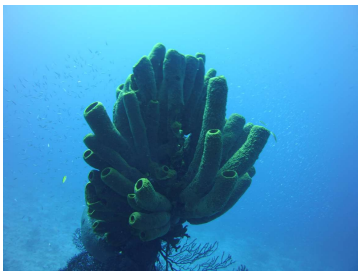
Phylum Porifera (Parazoa)

- Sponges
- 26,000 marine species; 150 freshwater species
- Among the most abundant animals in the deep ocean
- Lack symmetry
- Various growth forms
- Larval sponges free-swimming
- Adults remain attached (sessile)
- Specific cell types (multicellular)



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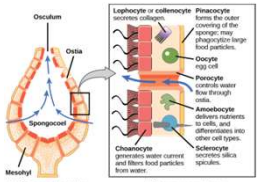
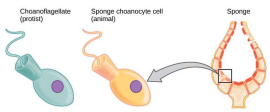
Sponge functional layers

- Outer epithelium
- Flattened cells
- Water through **osculum**
- Gelatinous matrix
- **Spicules** of calcium carbonate
- **Spongin**: reinforcing tough protein fibers
- Lining of the internal cavity
  - **Flagellated choanocytes** or **collar cells** engulf and digest food from passing water





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Sponge reproduction

- Asexual: **fragmentation**
- Sexual
  - Choanocytes transform into sperm
  - Sperm captured and passed to egg cell
  - Development may occur within mother or in open water
  - Larva is **planktonic**; zooplankton
  - Will settle and transform into adult

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Understanding check

What makes animals distinct from other forms of life that we have seen so far?

Why might sponges be mistaken for plants (or some other type of organism)

What protist group likely shares a common ancestor with all animals?

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Eumetazoa

Animals with **true embryonic tissues**

- **Endoderm** forms the gastrodermis (digestive tissue)
- **Ectoderm** forms the epidermis and nervous system
- **Mesoderm** (only in bilateral animals) forms the muscles

True body symmetry

- Radial symmetry
- Bilateral symmetry

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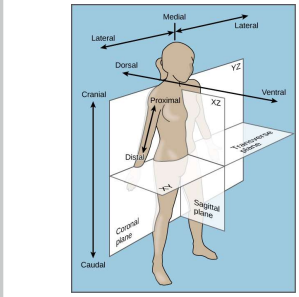

Symmetry

- All eumetazoans have symmetry defined along an imaginary axis drawn through the animal's body
- **Radial symmetry**
  - Body parts arranged around central axis
  - Can be divided into two equal halves by any plane that passes through the center
- **Bilateral symmetry**
  - Body has right and left halves that are mirror images
  - Only the sagittal plane bisects the animal into two equal halves

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Phylum Cnidaria ("cnidos": stinging)

- Most marine, few freshwater species
- Diploblastic
- Radially symmetric
- Bodies have distinct tissues, but no reproductive, circulatory, or excretory systems
- No concentrated nervous system
  - Latticework of nerve cells; touch, gravity, light receptors
- Capture prey with **nematocysts**

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Cnidarian body plan

- Single opening leading **to gastrovascular (GVC) cavity**, site of:
  - Digestion
  - Most gas exchange
  - Waste discharge
  - Formation of gametes
- Two layers of body wall
  - **Epidermis**
  - **Gastrodermis**
  - **Mesoglea** occurs between layers

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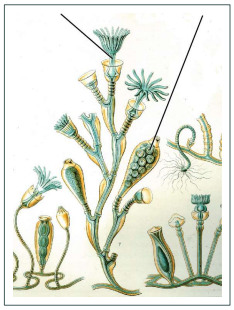
Gastrovascular space

- Serves as a hydrostatic skeleton
- Rigid structure against which muscles can operate
- Gives the animal shape



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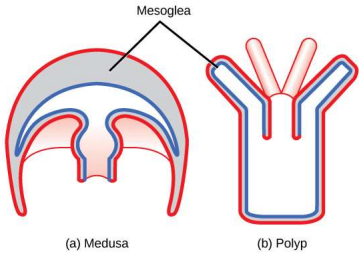
Cnidarian life cycle

- Highly variable
  - Some only as **polyps**
  - Some only as **medusae**
- When both polyp and medusa in life cycle, medusa forms gametes
- Sexes separate
- **Gonochorism** – individual is either sperm or egg producing
  - Zygote develops into planktonic **planula**
  - Metamorphosis into polyp
  - Plyp produces medusae or other polyps asexually



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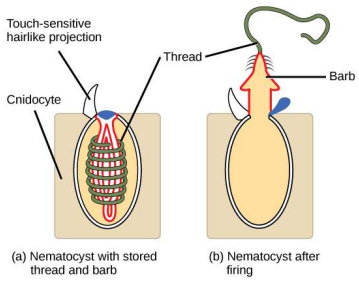
Digestion

- Extracellular digestion of food inside the animal
- In gastrovascular cavity
  - Cells engulf fragments by **phagocytosis**
- **Nematocysts** (cells with microscopic stinging capsules)
  - Capture prey and defense
  - Secreted from nematocyte
  - Mechanism of discharge unknown
  - Some carry venom



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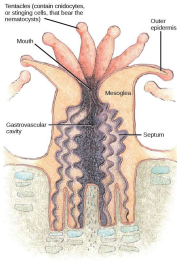
Anthozoa

- Largest class
- Sea anemones, most corals, sea fans
- Solitary and colonial polyps
- GVC is compartmentalized
- Hollow tentacles
- Symbiotic dinoflagellates photosynthesize and provide nutrients to reef coral



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Cubozoa and Hydrozoa

- **Cubozoa**
  - e.g., box jellies
  - Complex eyes
  - Strong swimmers, voracious fish predators
  - Stings may be fatal to humans
- **Hydrozoa**
  - e.g., *Hydra*, Portuguese man-of-war
  - Both polyp and medusa stages
  - Colonial polyp
  - Only class with freshwater members

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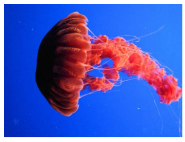
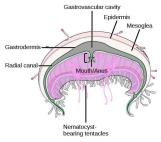
Scyphozoa

- **Scyphozoa**
  - e.g., jellyfish
  - Medusa most conspicuous and complex
  - Ring of muscle cells allows for rhythmic contractions for propulsion





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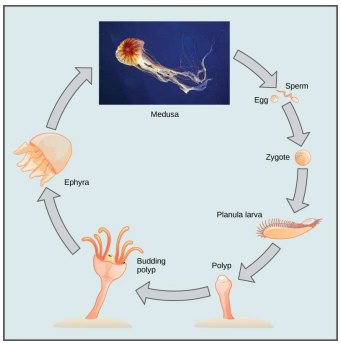
Jellyfish life cycle



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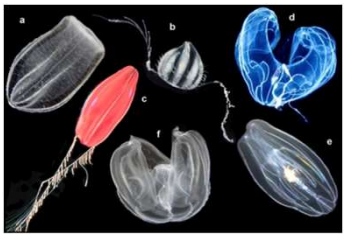
Phylum Ctenophora

- Comb jellies, sea walnuts
- Pelagic
- Transparent and small
- Propel via 8 rows of comb-like plates of fused cilia
- Many bioluminescent
- Two tentacles with **colloblasts** that discharge strong adhesive to capture prey



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Understanding check

What sort of symmetry do the early eumetazoans exhibit?

Are ctenophorans dangerous like some cnidarians are? Explain…

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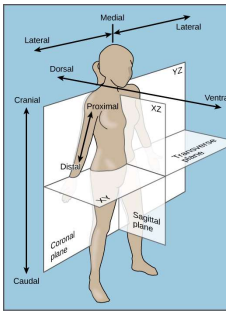
Bilateral symmetry

- Bilateral symmetry
  - Body is mirrored down the sagittal plane (down the middle
  - of the body)
  - **Cephalization**: evolution of a head brain area
    - Directional movement
    - Central nervous system (eventually)
  - Eventually gives rise to segmentation



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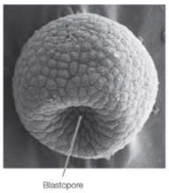
Basic bilaterian pattern of development

- Mitotic cell divisions (called **cleavage**) of the zygote forms a hollow ball of cells, called the **blastula**
- Blastula indents to form a two-layer-thick ball with:
  - **Blastopore**: opening to the outside
  - **Archenteron**: Primitive body cavity



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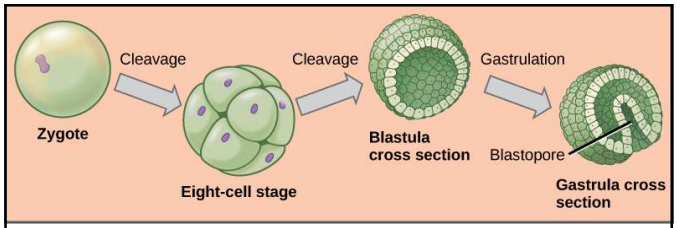

Formation of the blastula

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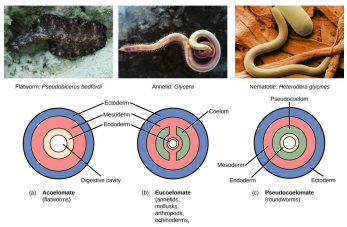
Types of body cavities

- **Coelom** (body cavity): space surrounded by mesoderm tissue that is formed during development
- **Acoelomates**: no body cavity
- **Pseudocoelomate**: cavity between mesoderm and endoderm (**pseudocoelom**)
- **Coelomates**: cavity entirely within mesoderm (**coelom**)



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The body cavity made possible advanced organ systems

- Coelomates developed a **circulatory system**: flow nutrients and remove wastes
  - **Open circulatory system**: blood passes from vessels into sinuses, mixes with body fluids, and reenters the vessels
  - **Closed circulatory system**: blood moves continuously through vessels that are separated from body fluids Patterns of development
- Cephalization allowed for the development of a central nervous system

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Understanding check

Why is bilateral symmetry so important in animal development?

What are the three types of body cavity configurations in bilateral animals?

Why is the development of a body cavity so important to the evolution of eumetazoans?

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Early Bilaterians

- **Acoelomates**
  - Acoela
  - **Lack a digestive cavity**
  - Primitive nervous system
  - Minor concentration of neurons in the anterior end of the body

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