

Animal Complexity and Body Plans

- 34 different phyla of multicellular animals
- About 100 phyla generated during “Cambrian explosion”
- Animal body plans well-defined and established early in evolutionary history
- Many animals share a common architecture

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Organization of Animal Complexity

- **Unicellular organisms**
 - Protozoa = single-celled organisms
 - Not classified as Animals, but “animal-like”
 - High levels of organization within the cell
 - Perform all basic functions of life
- **Multicellular organisms**
 - Metazoa = multi-celled organisms
 - True animals
 - Cells organized into larger units, individual cells cannot survive alone

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Organization of Animal Complexity

Grades of Organization

Unicellular (Protozoans)

1. **Protoplasmic**
 - All functions occur within cell

Multicellular (Metazoans)

2. **Cellular**
 - Group of cells with different functions
3. **Tissue**
 - Aggregation of similar cells into layers
4. **Organ**
 - Organization of tissues into organs
5. **System**
 - Organs working together to perform function

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Organization of Animal Complexity

Body size

- ❖ Complex organization promotes evolution of large body size

Some advantages of large body size

- Able to tolerate environmental variation
- Predator avoidance
 - Morphology
 - BehaviorSee Figures 3.16 and 3.17 in ebook
- Food acquisition
- Metabolically efficient
 - Absolute energy demands higher for large animals but,
 - RELATIVE energy demands (per unit body weight) are LOWER

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Organization of Animal Complexity

Body size

- ❖ Disadvantages of large body size

Problem: surface area increases, but at a slower rate than body volume

- Surface area > as (body length)²
- Volume > as (body length)³

Why is it a problem?

- Physiological processes of nutrient, gas, and waste exchange often occur across surfaces

Solutions:

1. Folds in body surface
2. Development of internal transport systems

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Types of Tissues

1. Epithelial tissue

- Sheet of cells covering a surface
- Provides protective covering on the outside
- Lines organs, cavities, and ducts inside

2. Connective tissue

- Large group with several functions
- Loose vs. Dense connective tissue
- Fibrous tissue composed of collagen
- Blood, cartilage, and bone are all connective tissues

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Types of Tissues

3. Muscular tissue

- Most abundant tissue
- Striated vs. Smooth muscle

4. Nervous tissue

- Receives and conducts impulses (contains neurons)

See Figures 3.10 thru 3.15 in ebook

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Body Plans

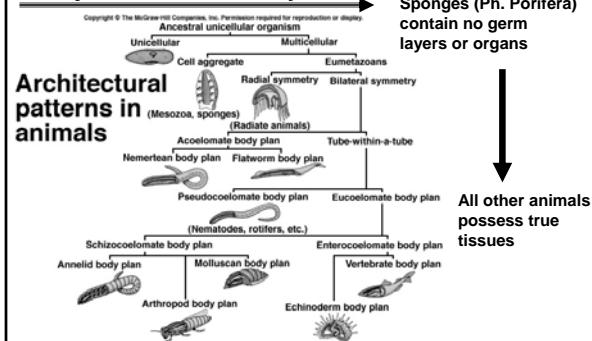
❖ Number of animal body plans is limited

Basic characteristics that have evolved

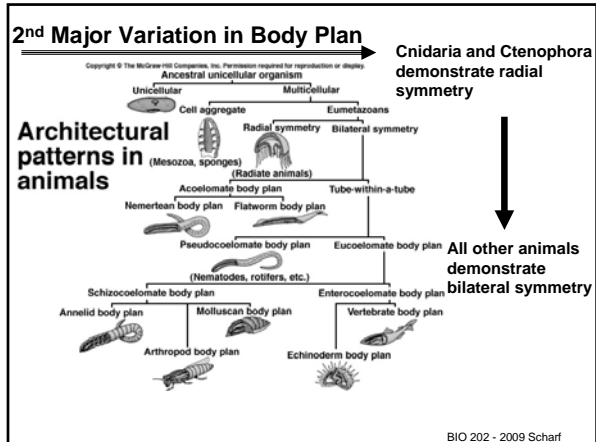
- Multicellular organization
- Symmetry
- Body cavity
- True coelom
- Segmentation
- Cephalization

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1st Major Variation in Body Plan



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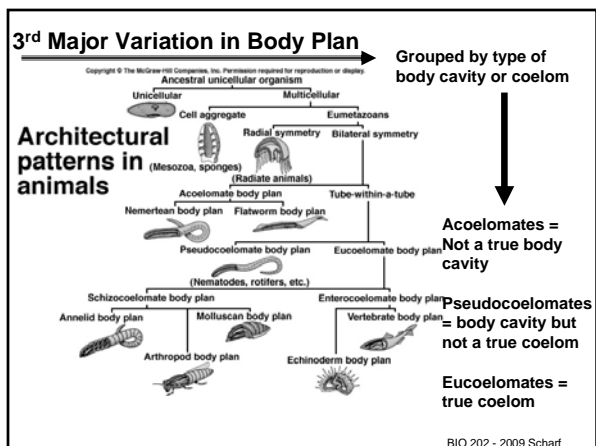
Animal Symmetry

Correspondence in size or shape on two sides of a plane

1. **Radial**
 - Cnidarians, Ctenophors, some sponges, and sea urchins
 - Usually sessile, free floating animals
 - Can interact with environment from all sides
2. **Bilateral**
 - Major evolutionary advance
 - Well suited for forward movement

See Figures 3.1 and 3.2 in ebook

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Why is the evolution of a body cavity important?

- ❖ Tube-within-a-tube allows greater flexibility
- ❖ Space for organs
- ❖ Exposes more cells to surface exchange

What are the differences?

1. **Acoelomates**
 - No true body cavity – space filled with parenchyma
2. **Pseudocoelomates**
 - Have body cavity but not a true coelom
 - Not derived from mesoderm
3. **Eucoelomates** See Figure 3.9 in ebook
 - Possess true coelom
 - Arises from mesoderm from one of two methods:
 - Schizocoelous or Enterocoelous development

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Coelom formation

- In Eucoelomates the coelom forms by:
 - ❖ **Schizocoelous development**
 - Splitting of mesodermal bands
 - Mesodermal cells originate in blastopore region
 - Annelids, arthropods, and molluscs
 - Or by:
 - ❖ **Enterocoelous development**
 - Mesoderm arises from pouches of the gut
 - Pouches separate from gut, then enlarge
 - Echinoderms and chordates
 - Although vertebrates undergo a modified schizocoelous development

See Figures 3.5 and 3.6 in ebook

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Body plans

Two major body plans:

- 1) **Deuterostome (“2nd mouth”) animals**
 - Radial cleavage
 - Blastopore becomes anus
 - Echinoderms, Hemichordates, and Chordates
- 2) **Protostome (“1st mouth”) animals**
 - Spiral cleavage
 - Blastopore becomes mouth
 - Includes acoelomates, pseudocoelomates, and eucoelomates
 - Two major subgroups: Ecdysozoa and Lophotrochozoa

See Figure 3.8 in ebook

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