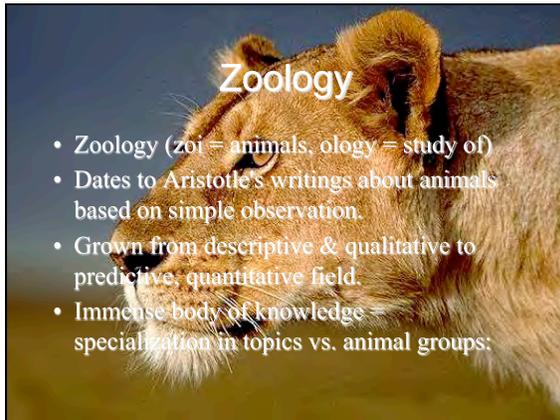


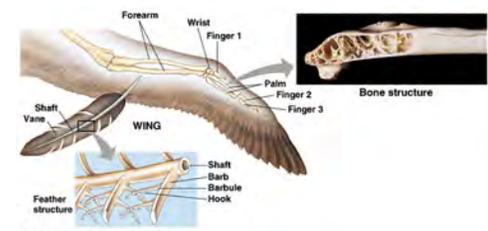
Animals

Zoology

- Zoology (zoi = animals, ology = study of)
- Dates to Aristotle's writings about animals based on simple observation.
- Grown from descriptive & qualitative to predictive, quantitative field.
- Immense body of knowledge – specialization in topics vs. animal groups:

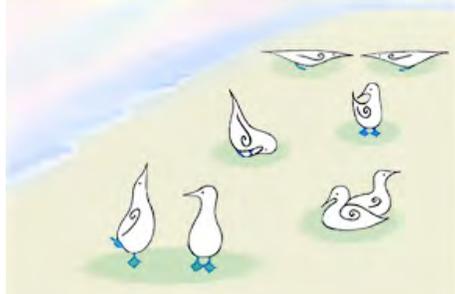


Animal Form & Function



By far, most diversity of bauplane (body forms).
And most variations within bauplane.

Animals are Animated — Fascinating Behaviors

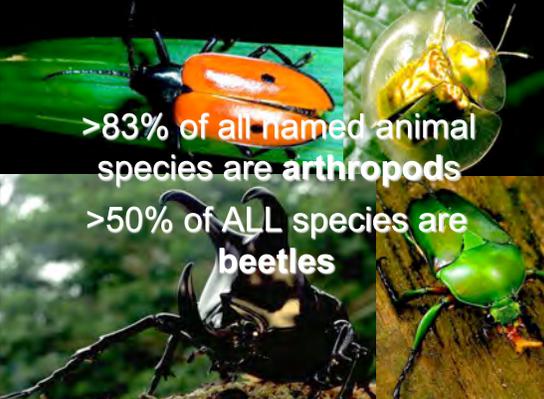


“ANIMAL” ≠ MAMMAL

>95% of animal species are invertebrates
Most diversity of animal body forms are marine invertebrates



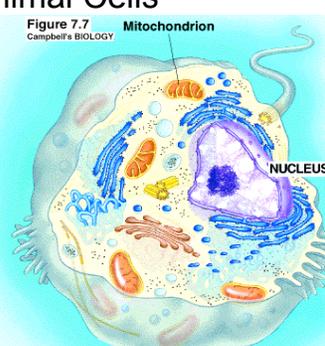
>83% of all named animal species are arthropods
>50% of ALL species are beetles



Animal Cells

Figure 7.7
Campbell's BIOLOGY

- Eukaryotic
- No cell wall
- No plastids
- No central vacuole
- Multicellular:
 - extensive specialization & differentiation
 - unique cell-cell junctions



Animals



Animals

- Motile
- Highly differentiated tissues
- Intercellular junctions
 - tissue-specific **cadherins**
- Extracellular protein fibers
 - **collagen**
- Diploid life cycle
- **Blastula/gastrula** embryo

Blastulation & Gastrulation

- Early embryonic development in animals

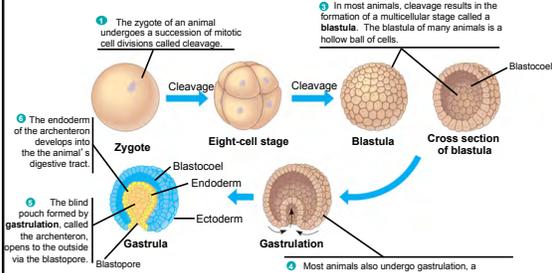


Figure 32.2

① The zygote of an animal undergoes a succession of mitotic cell divisions called cleavage.

② In most animals, cleavage results in the formation of a multicellular stage called a **blastula**. The blastula of many animals is a hollow ball of cells.

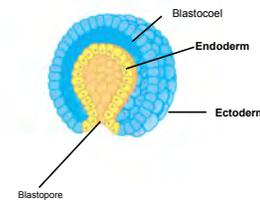
③ The endoderm of the archenteron develops into the animal's digestive tract.

④ The blind pouch formed by **gastrulation**, called the archenteron, opens to the outside via the blastopore.

⑤ Most animals also undergo gastrulation, a rearrangement of the embryo in which one end of the embryo folds inward, expands, and eventually fills the blastocoel, producing layers of embryonic tissues: the **ectoderm** (outer layer) and the **endoderm** (inner layer).

Primary embryonic germ layers

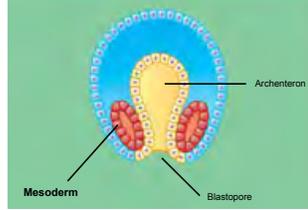
- **Diploblastic**: two germ layers
 - **Ectoderm**: develops into epidermal & neural tissues
 - **Endoderm**: develops into feeding tissues
 - Blastocoel: becomes filled with acellular **mesogleia**



Examples: Porifera & Cnidaria

Primary embryonic germ layers

- **Triploblastic**: three germ layers
 - **Ectoderm**: develops into epidermal & neural tissues
 - **Endoderm**: develops into gut & accessory organs
 - **Mesoderm** — displaces blastocoel: develops into muscle, endoskeleton, & connective tissues



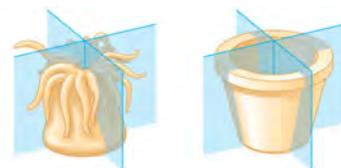
Examples: everything else

Figure 32.9b

Body Symmetry

- **Asymmetry**
 - Determined by environmental constraints — Encrusting
- **Radial symmetry**

Radial symmetry. The parts of a radial animal, such as a sea anemone (phylum Cnidaria), radiate from the center. Any imaginary slice through the central axis divides the animal into mirror images.



- Body orientation has two recognizable sides: **oral** (with mouth) & **aboral** (opposite side from mouth)

Body Symmetry

- **Asymmetry**
 - Determined by environmental constraints — Encrusting
- **Radial symmetry**
- **Bilateral symmetry**

Bilateral symmetry. A bilateral animal, such as a lobster (phylum Arthropoda), has a left side and a right side. Only one imaginary cut divides the animal into mirror-image halves.

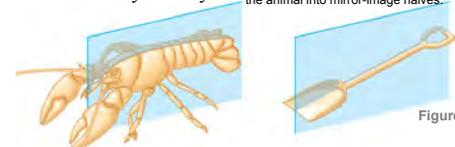


Figure 32.7b

- Body orientation has two recognizable **lateral** sides (right/left); **anterior** (front); **posterior** (rear); **dorsal** (back); & **ventral** (belly) dimensions.
- Generally accompanied by **cephalization**: localization of sensory and central nervous centers to the anterior (head)

Animals

Variations in Gastrulation: Digestive tract

- **Gastrovascular cavity** (blind gut)
 - Blastopore remains only orifice to gut
- **Protostome** ("mouth first") development
 - The blastopore becomes the mouth
 - Secondary invagination to form anus
- **Deuterostome** ("mouth second") development
 - The blastopore becomes the anus
 - Secondary invagination to form mouth

	Protostome development (examples: molluscs, annelids)	Deuterostome development (examples: echinoderms, chordates)
(a) Cleavage	Eight-cell stage Spiral and determinate	Eight-cell stage Radial and indeterminate
(b) Coelom formation	Archenteron Coelom Mesoderm Blastopore Solid masses of mesoderm split and form coelom.	Archenteron Coelom Blastopore Mesoderm Folds of archenteron form coelom.
(c) Fate of the blastopore	Anus Digestive tube Mouth Mouth develops from blastopore.	Mouth Digestive tube Anus Anus develops from blastopore.

Key
 ■ Ectoderm
 ■ Mesoderm
 ■ Endoderm

Figure 32.10

Organ Systems

External environment: Mouth, Food, CO₂, O₂

Animal body: Heart, Circulatory system, Respiratory system, Excretory system, Digestive system

0.5 cm, 50 μm, 10 μm

The lining of the small intestine, a digestive organ, is elaborated with fingerlike projections that expand the surface area for nutrient absorption (cross-section, SEM).

Unabsorbed matter (feces), Metabolic waste products (urine)

Figure 40.4

Circulatory & Respiratory Systems

Mouth, Gastrovascular cavity, Diffusion

(b) Two cell layers

Figure 40.3b

Circulatory Systems

- Ciliated Body Cavity
- Open Circulatory System
- Closed Circulatory System

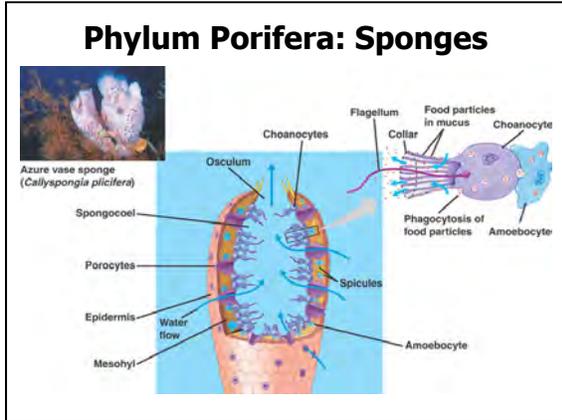
Gastrovascular cavity, Tubular heart, Dorsal blood vessel, Pharynx, Mouth, Hemocoel, Lateral hearts, Ventral blood vessel

Uncertain Systematics

Figure 32.10: Cladogram based on certain morphological and developmental characters

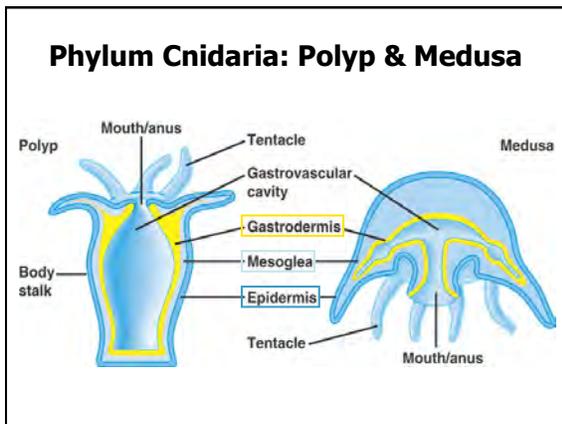
Figure 32.11: Cladogram based on certain molecular and other developmental characters

- No fossil record — all phyla appear simultaneously ("Cambrian explosion")
- Morphological, embryological, and molecular characters all yield contradictory patterns



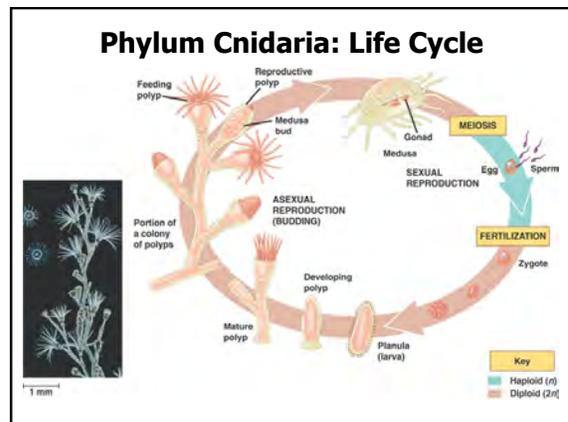
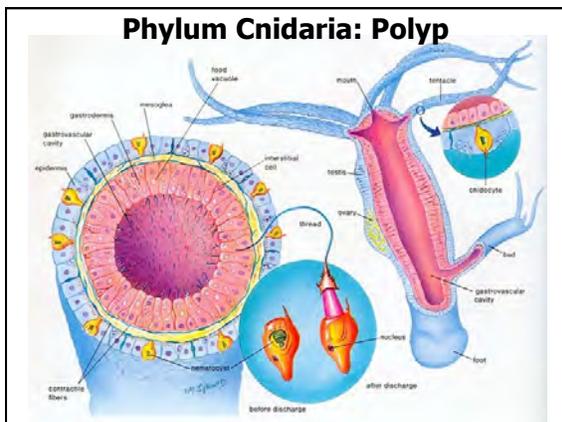
Phylum Porifera: Sponges

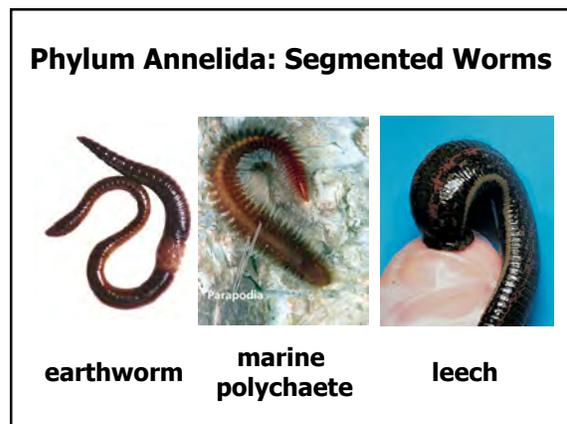
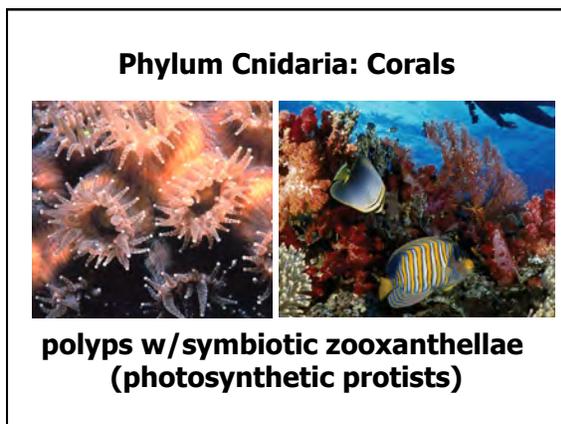
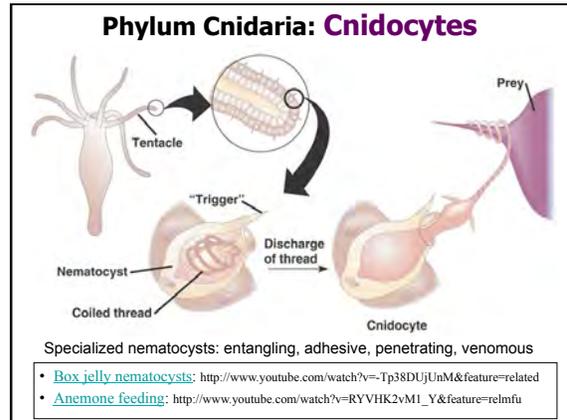
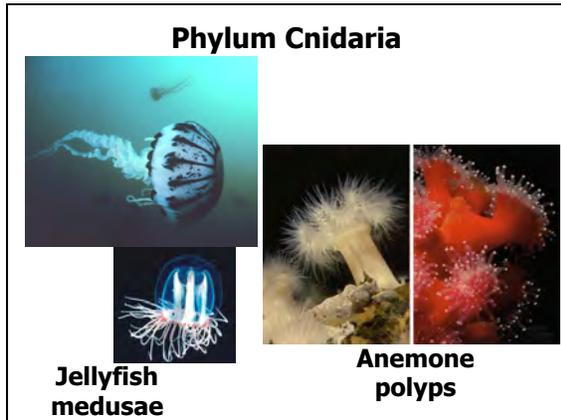
- Embryonic development:
 - Diploblastic
 - Radial symmetry → may become asymmetrical
 - No coelom
 - acellular mesogleia between endoderm and ectoderm
 - Gut → filter chamber (**spongocoel**)
 - intracellular digestion
 - Flagellated larvae
- Circulatory systems:
 - Flagellated* spongocoel
 - Cell-mediated: amoebocytes
- Special features:
 - Choanocytes
 - Amoebocytes
 - Spicules
 - *Flagellated tissue



Phylum Cnidaria: Polyp & Medusa

- Embryonic development:
 - Diploblastic
 - Radial symmetry
 - No coelom
 - acellular mesogleia
 - Ciliated / contractile gastrovascular cavity
 - Ciliated **planula** larvae
- Special features:
 - Polyps & medusas
 - Ciliated myoepithelia
 - Cnidocytes w/ nematocysts





Phylum Annelida: Segmented Worms

- Embryonic development:
 - Triploblastic
 - Bilateral symmetry w/ cephalization
 - Closed vascular circulatory system
 - Protostome
 - Eucoelomate
 - Lophotrochozoa
- Special features:
 - Segmentation
 - Hydrostatic skeleton

