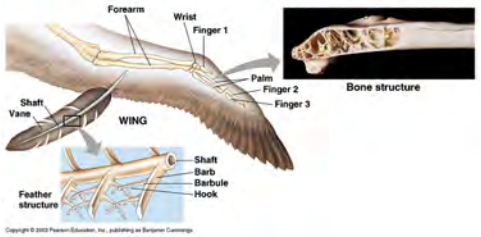
Zoology

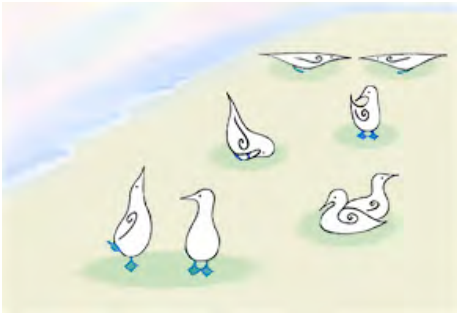
- Zoology (zoi = animals, ology = study of)
- Dates to Aristotle's writings about animals based on simple observation.
- Grown from descriptive & qualitative to predictive, quantitative field.
- Immense body of knowledge = specialization in topics vs. animal groups:

Animal Form & Function

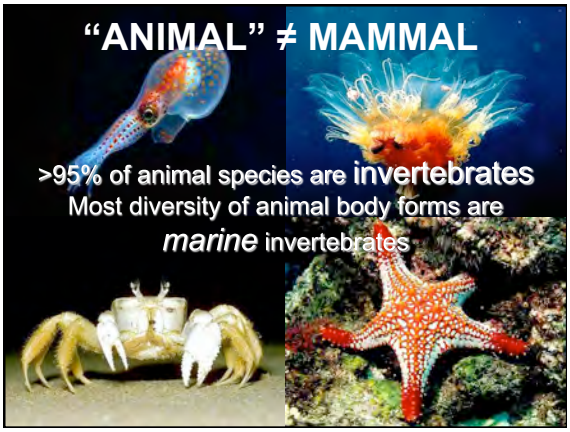


By far, most diversity of bauplane (body forms).
And most variations within bauplane.

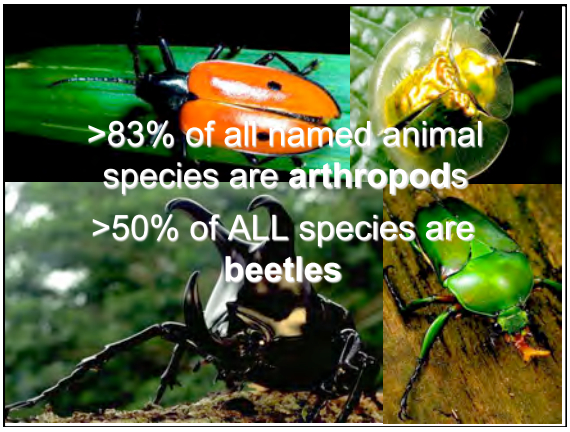
Animals are Animated — Fascinating Behaviors



"ANIMAL" ≠ MAMMAL



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

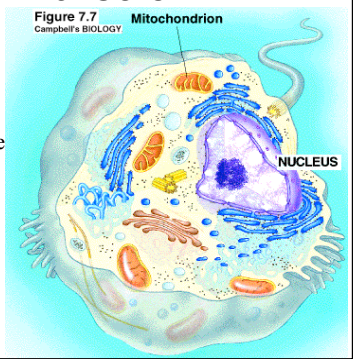


>83% of all named animal species are **arthropods**

>50% of ALL species are **beetles**

Animal Cells

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



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

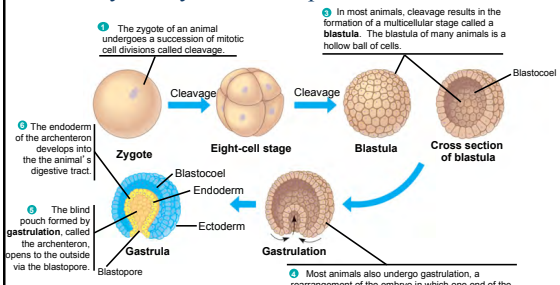
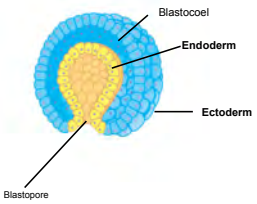


Figure 32.2

Primary embryonic germ layers

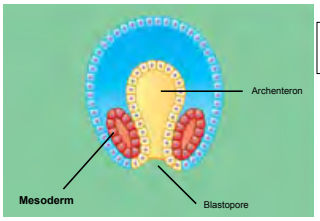
- **Diploblastic**: two germ layers
  - **Ectoderm**: develops into epidermal & neural tissues
  - **Endoderm**: develops into feeding tissues
  - Blastocoel: becomes filled with acellular **mesoglia**



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.

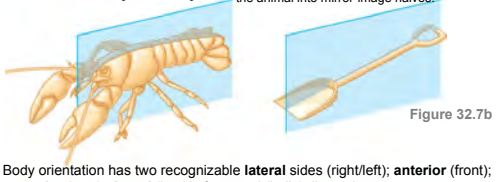
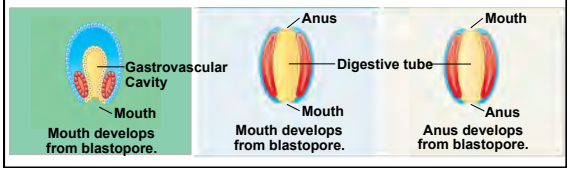


Figure 32.7b

- 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)

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



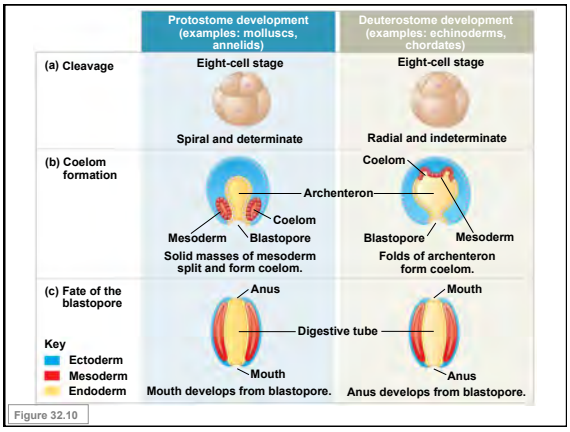


Figure 32.10

Organ Systems

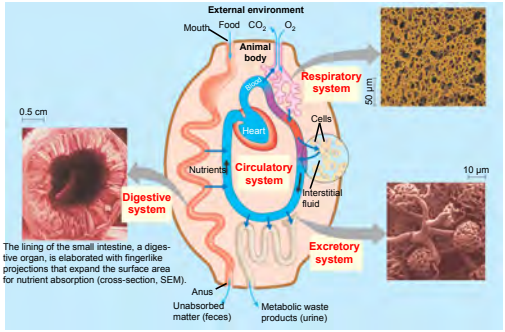


Figure 40.4

Circulatory & Respiratory Systems

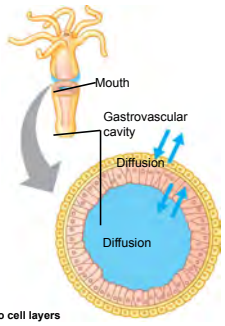
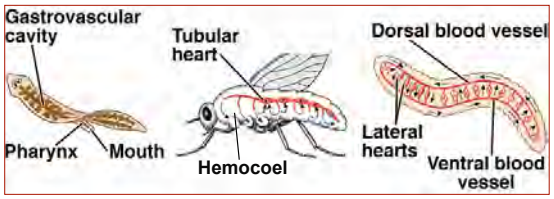


Figure 40.3b (b) Two cell layers

Circulatory Systems

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



Uncertain Systematics

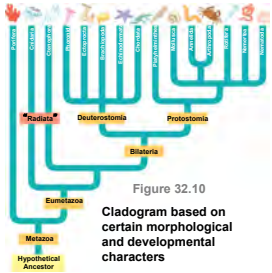


Figure 32.10
Cladogram based on certain morphological and developmental characters

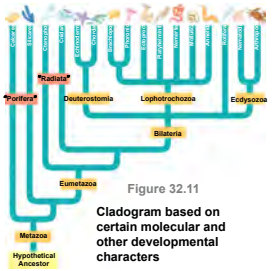
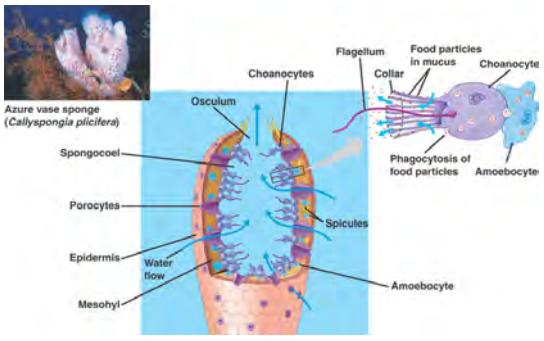


Figure 32.11
Cladogram based on certain molecular and other developmental characters

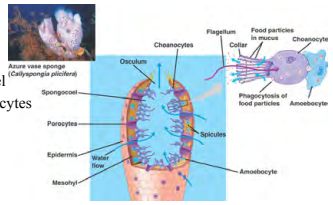
- No fossil record — all phyla appear simultaneously ("Cambrian explosion")
- Morphological, embryological, and molecular characters all yield contradictory patterns

Phylum Porifera: Sponges

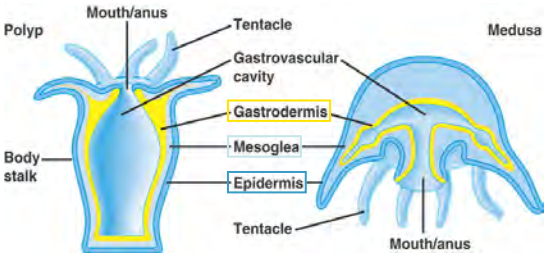


Phylum Porifera: Sponges

- Embryonic development:
  - Diploblastic
  - Radial symmetry → may become asymmetrical
  - No coelom
    - acellular mesoglia 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

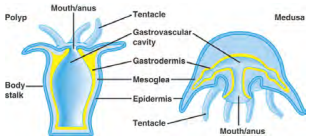


Phylum Cnidaria: Polyp & Medusa

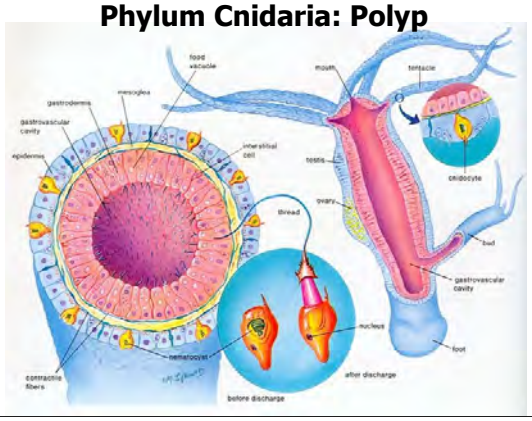


Phylum Cnidaria: Polyp & Medusa

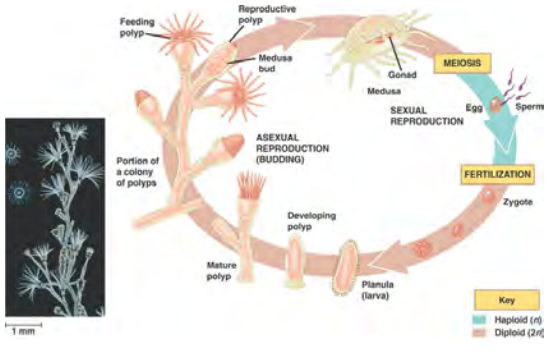
- Embryonic development:
  - Diploblastic
  - Radial symmetry
  - No coelom
    - acellular mesoglia
  - Ciliated / contractile gastrovascular cavity
  - Ciliated **planula** larvae
- Special features:
  - Polyps & medusas
  - Ciliated myoepithelia
  - Cnidocytes w/ nematocysts



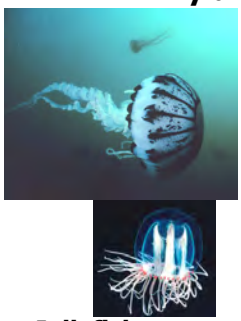
Phylum Cnidaria: Polyp



Phylum Cnidaria: Life Cycle



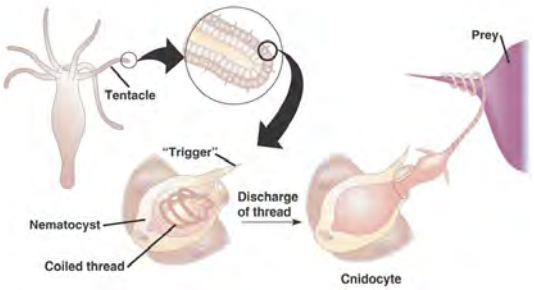
Phylum Cnidaria



Jellyfish medusae

Anemone polyps

Phylum Cnidaria: Cnidocytes



Specialized nematocysts: entangling, adhesive, penetrating, venomous

- Box jelly nematocysts: http://www.youtube.com/watch?v=-Tp38DUjUnM&feature=related
- Anemone feeding: http://www.youtube.com/watch?v=RYVHK2vM1_Y&feature=relmfu

Phylum Cnidaria: Corals

polyps w/symbiotic zooxanthellae (photosynthetic protists)

Phylum Annelida: Segmented Worms

earthworm

marine polychaete

leech

Phylum Annelida: Segmented Worms

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