Kingdom: Animals
Domain Eukarya

Click the "Slide Show" button at the lower right of the window to start the show. Then hit the SPACEBAR to advance.
Animal Characteristics

- **Heterotrophs**
  - must ingest others for nutrients
- **Multicellular**
  - complex bodies
- **No cell walls**
  - allows active movement
- **Sexual reproduction**
  - no alternation of generations
  - no haploid gametophyte
Animal Evolution

- Porifera: sponges
- Cnidaria: jellyfish, flatworms
- Platyhelminthes: roundworms, mollusks
- Nematoda: segmented worms
- Mollusca: mollusks
- Annelida: segmented worms, insects, spiders
- Arthropoda: starfish, vertebrates (with backbone)
- Echinodermata: radial symmetry
- Chordata: bilateral symmetry, coelom, endoskeleton

Key Features:
- Multicellularity
- Specialization & ↑ body complexity
- Redundancy, specialization, ↑ mobility
- Segmentation
- Body cavity: ↑ body complexity, ↑ digestive & repro sys
- Body size: ↑ mobility, ↑ body & brain size, ↑ mobility
- Tissues: specialized structure & function, muscle & nerve tissue
- Distinct body plan; cephalization
- Specialization & ↑ body complexity
Body Cavity

- **Space for organ system development**
  - increase digestive & reproductive systems
    - increase food capacity & digestion
    - increase gamete production

- **Coelem**
  - mesoderm & endoderm interact during development
  - allows complex structures to develop in digestive system
    - ex. stomach

**acoelomate**
- ectoderm
- mesoderm
- endoderm

**pseudocoelomate**
- ectoderm
- mesoderm
- endoderm
- pseudocoel

**coelomate**
- ectoderm
- mesoderm
- endoderm
- coelom cavity

protostome vs. deuterostome
Invertebrate: Porifera

- Sponges
  - no distinct tissues or organs
    - do have specialized cells
  - no symmetry
  - sessile (as adults)

food taken into each cell by endocytosis
Invertebrate: Cnidaria

- Jellyfish, hydra, sea anemone, coral
  - tissues, but no organs
  - two cell layers
  - radial symmetry
  - predators
    - tentacles surround gut opening
    - extracellular digestion
      - release enzymes into gut cavity
      - absorption by cells lining gut

(a) Sea anemone: a polyp
(b) Jelly: a medusa
Stinging cells of Cnidarians

- **Hydra**
- **Tentacles**
- **Sensory cell**
- **Stinging cell**
- **Trigger**
- **Undischarged nematocyst**
- **Discharged nematocyst**
Invertebrate: Platyhelminthes

- Flatworms
  - tapeworm, planaria
  - mostly parasitic
  - bilaterally symmetrical
    - have right & left & then have head (anterior) end & posterior end
    - cephalization = development of brain
    - concentration of sense organs in head
    - increase specialization in body plan

Animals now face the world head on!

acoelomate

- ectoderm
- mesoderm
- endoderm
Invertebrate: Nematoda

- **Roundworms**
  - bilaterally symmetrical
  - body cavity
    - pseudocoelom = simple body cavity
    - digestive system
      - tube running through length of body (mouth to anus)
  - many are parasitic
    - hookworm
Invertebrate: Mollusca

- Mollusks
  - slugs, snails, clams, squid
  - bilaterally symmetrical (with exceptions)
  - soft bodies, mostly protected by hard shells
  - true coelem
    - increases complexity & specialization of internal organs
Invertebrate: Annelida

- Segmented worms
  - earthworms, leeches
  - segments
    - increase mobility
    - redundancy in body sections
  - bilaterally symmetrical
  - true coelem
Invertebrate: Arthropoda

- Spiders, insects, crustaceans
  - most successful animal phylum
  - bilaterally symmetrical
  - segmented
    - specialized segments
    - allows jointed appendages
  - exoskeleton
    - chitin + protein
Arthropod groups

arachnids
8 legs, 2 body parts
spiders, ticks, scorpions

crustaceans
gills, 2 pairs antennae
crab, lobster, barnacles, shrimp

insects
6 legs, 3 body parts
Invertebrate: Echinodermata

- Starfish, sea urchins, sea cucumber
  - radially symmetrical as adults
  - spiny endoskeleton
  - deuterostome

loss of bilateral symmetry?
Invertebrate quick check…

- Which group includes snails, clams, and squid?
- Which group is the sponges?
- Which are the flatworms?
  - ...segmented worms?
  - ...roundworms?
- Which group has jointed appendages & an exoskeleton?
- Which two groups have radial symmetry?
- What is the adaptive advantage of bilateral symmetry?
- Which group has no symmetry?
Chordata

- **Vertebrates**
  - fish, amphibians, reptiles, birds, mammals
  - internal bony skeleton
    - backbone encasing spinal column
    - skull-encased brain
  - deuterostome

Oh, look... your first baby picture!
Vertebrates: Fish

- **Characteristics**
  - **body structure**
    - bony & cartilaginous skeleton
    - jaws & paired appendages (fins)
    - scales
  - **body function**
    - gills for gas exchange
    - two-chambered heart; single loop blood circulation
    - ectotherms
  - **reproduction**
    - external fertilization
    - external development in aquatic egg

- salmon, trout, sharks

450 mya
Transition to Land
Evolution of tetrapods

Lobe-finned fish

Early amphibian
Vertebrates: Amphibian

- **Characteristics**
  - **body structure**
    - legs (tetrapods)
    - moist skin
  - **body function**
    - lungs (positive pressure) & diffusion through skin for gas exchange
    - three-chambered heart; veins from lungs back to heart
    - ectotherms
  - **reproduction**
    - external fertilization
    - external development in aquatic egg
    - metamorphosis (tadpole to adult)

350 mya

- frogs
- salamanders
- toads
Vertebrates: Reptiles

- Characteristics
  - body structure
    - dry skin, scales, armor
  - body function
    - lungs for gas exchange
    - thoracic breathing; negative pressure
    - three-chambered heart
    - ectotherms
  - reproduction
    - internal fertilization
    - external development in amniotic egg

250 mya

- dinosaurs, turtles
- lizards, snakes
- alligators, crocodile

Diagram of reptile development:
- leathery shell
- embryo
- chorion
- amnion
- allantois
- yolk sac
Vertebrates: Birds (Aves)

- Characteristics
  - body structure
    - feathers & wings
    - thin, hollow bone; flight skeleton
  - body function
    - very efficient lungs & air sacs
    - four-chambered heart
    - endotherms
  - reproduction
    - internal fertilization
    - external development in amniotic egg

150 mya

finches, hawk
ostrich, turkey

AP Biology
Vertebrates: Mammals

- **Characteristics**
  - **body structure**
    - hair
    - specialized teeth
  - **body function**
    - lungs, diaphragm; negative pressure
    - four-chambered heart
    - endotherms
  - **reproduction**
    - internal fertilization
    - internal development in uterus
      - nourishment through placenta
    - birth live young
    - mammary glands make milk

- 220 mya / 65 mya
- mice, ferret, elephants, bats, whales, humans
Vertebrates: Mammals

- **Sub-groups**
  - **monotremes**
    - egg-laying mammals
    - lack placenta & true nipples
    - duckbilled platypus, echidna
  - **marsupials**
    - pouched mammals
      - offspring feed from nipples in pouch
    - short-lived placenta
    - koala, kangaroo, opossum
  - **placental**
    - true placenta
      - nutrient & waste filter
    - shrews, bats, whales, humans
Vertebrate quick check…

- Which vertebrates lay eggs with shells?
- Which vertebrates are covered with scales?
- What adaptations do birds have for flying?
- What kind of symmetry do all vertebrates have?
- Which vertebrates are ectothermic and which are endothermic?
- Why must amphibians live near water?
- What reproductive adaptations made mammals very successful?
- What characteristics distinguish the 3 sub-groups of mammals?
That’s the buzz!
Any Questions?