KINGDOM ANIMALIA: The Deuterostomes
Animal Diversity

Animals with a 3-layer embryo
- chordates
  - echinoderms
- arthropods
- tardigrades
- roundworms
- rotifers
- mollusks
- annelids
- flatworms

Animals with tissues
- cnidarians
- sponges
- placozoans

Animals
- Deuterostomes
- Ecdysozoa
- Protostomes
- Lophotrochozoa

Fig. 25-7b, p. 407
DEUTEROSTOME COELOMATES

- Phylum Echinodermata

- Phylum Chordata
DEUTEROSTOMES

- Phylum Echinodermata
- Echinoderm = “spiny skin”
- ~10,000 species (mostly marine)
- Examples
  - Sea star, sea urchin, sea cucumber, sand dollar
Echinoderms

- Characteristics
  - 5 part body plan
  - Symmetry (most)
    - Larvae → bilateral
    - Adult → “radial”
  - Water vascular system
    - Movement
Water Vascular System
Animal Diversity

Chordates
- Echinoderms

Deuterostomes

Protostomes
- Ecdysozoa
  - Arthropods
  - Tardigrades
  - Roundworms

- Lophotrochozoa
  - Rotifers
  - Mollusks
  - Annelids
  -Flatworms

Animals with a 3-layer embryo

Animals with tissues

- Cnidarians
- Sponges
- Placozoans
- Animals

Fig. 25-7b, p. 407
PHYLUM CHORDATA

- ~50,000 species

- 4 common features
  1. Notochord
  2. Dorsal hollow nerve cord
  3. Pharyngeal slits
  4. Post anal tail

- Other common characteristics
  - Bilateral
  - Coelomate
  - Cephalization
  - Complete digestive system
  - Closed circulatory system
Chordates

- **Vertebrates & invertebrate species**
  - Invertebrate chordates
    - No backbone
    - ~2,100 species
  - Vertebrate chordates
    - Backbone of cartilage or bone
    - Brain enclosed in skull
Chordate Phylogeny
Subphylum Cephalochordata

- Lancelets (Amphioxis)
  - Scaleless, fish-like
  - Notochord extends to front of head
Invertebrate Chordates

- **Subphylum Urochordata**
  - Tunicates (Sea Squirts)
    - Motile larvae, sessile adults
FISH

Jawless

Cartilage Skeleton

Bony Skeleton

Jawed

Ray-finned

Lobe-finned
Craniate Invertebrate

- Hagfish
  - Predators, scavengers
    - Predators, scavengers

- Characteristics
  - Jawless
  - Cartilage skeleton
  - Unpaired fins
  - No backbone!
Lampreys
- Predators
  (almost parasites)

Characteristics
- Jawless
- Cartilage skeleton
- Unpaired fins
- Have a backbone!
Class Chondrichthyes

“Cartilage fish”

Examples

- Sharks, skates, rays

Characteristics

- Jaws
  ➔ Teeth not fused to jaw
- Cartilage skeleton
  ➔ Calcified
- Gill slits separate & exposed
Chordate Phylogeny

- lancelets
- tunicates
- hagfishes
- lampreys
- cartilaginous fishes
- ray-finned fishes
- lobe-finned fishes
- lungfishes
- amphibians
- “reptiles”
- birds
- mammals
- amniotes
- tetrapods

Swim bladder or lungs
Jawed vertebrates
Vertebrates
Craniates
Ancestral chordates

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Bony fishes

- Ray-finned fish ("ray-wing")
  - Most fish species
- Examples
  - Trout, salmon, etc.
- Characteristics
  - Jaws
  - Skeleton of bone
  - Swim bladders (most)
  - Paired fins
  - Single gill opening (operculum)
Bony Fish Body Plan

Internal anatomy of perch

- Myomere (muscle segments)
- First dorsal fin
- Fin ray support
- Vertebra
- Spinal cord
- Efferent branchial artery
- Olfactory bulb
- Afferent branchial artery
- Bulbus arteriosus
- Ventricles
- Liver
- Pyloric ceca
- Spleen
- Intestine
- Ovary
- Stomach
- Anus
- Urinary bladder
- Anal fin
- Lateral line
- Caudal fin
- Swim bladder
- Kidney (opisthonephros)
- Second dorsal fin
- Pelvic fin
- Urogenital opening
Other bony fish

- **Lobed-finned fish ("flesh-wing")**
  - General characteristics like bony-fish
    - Ventral fins (paired) formed from fleshy body extensions
    - Example: coelacanth

- **Lungfish**
Chordate Phylogeny

- lancelets
- tunicates
- lampreys
- cartilaginous fishes
- ray-finned fishes
- lungfishes
- “reptiles”
  - tetrapods
  - amniotes
  - birds
  - mammals

- amphibia
- vertebrates
  - jawed vertebrates
  - swim bladder or lungs
  - craniates
  - ancestral chordates

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Class Amphibia

- “Double-life” ~5,700 species
- Examples
  - Frogs, toads, newts, salamanders
- Characteristics
  - Reproduction tied to water
  - Respiration: lungs, gills and/or skin
  - Moist glandular skin
  - 3-chambered heart
  - Ectotherms
PALEOZOIC ERA

CARBONIFEROUS

PERMIAN

TRIASSIC

JURASSIC

CRETACEOUS

MESOZOIC ERA

TERTIARY TO PRESENT

“stem” reptiles

ichthyosaurs

plesiosaurs

archosaurs

therapsids

anapsids

synapsids

snakes

lizards

tuataras

birds

therapod dinosaurs

other dinosaurs

pterosaurs

crocodilians

turtles

mammals

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Fig. 26-16c, p. 442
Class Reptilia

- “To creep”
- ~ 8,000 species
- Examples
  - Snakes, lizards, turtles, crocodiles & alligators
- Characteristics
  - Dry skin
  - Scales
  - Ectotherms
  - Amniotic egg
Chordate Phylogeny

- Lancelets
- Tunicates
- Hagfishes
- Lampreys
- Cartilaginous fishes
- Ray-finned fishes
- Lobe-finned fishes
- Lungfishes
- Amphibians
- “Reptiles”
- Birds
- Mammals

- Vertebrates
- Craniates
- Ancestral chordates

Swim bladder or lungs
Jawed vertebrates
Vertebrates
Amniotes
Tetrapods

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Class Aves

- **Examples**
  - Birds
- **~10,000 species**
- **Characteristics**
  - Feathers
  - Modified forelimbs (wings)
  - Leg scales
  - “Hollow” bones
  - Endotherms
  - Amniotic egg (calcareaous shell)
Kookaburra sits in the old gumtree…
Chordate Phylogeny

- lancelets
- tunicates
- lampreys
- cartilaginous fishes
- ray-finned fishes
- lobe-finned fishes
- lungfishes
- amphibians
- "reptiles"
- birds
- mammals

- craniates
- vertebrates
- swim bladder or lungs
- jawed vertebrates
- tetrapods
- amniotes
Class Mammalia

- ~4,500 species

- Characteristics
  - Hair
  - Mammary glands
  - Teeth
    - Specialized
  - Endotherms
Mammalian Teeth

- Heterodont dentition
Chordate Development

- **Oviparous**
  - Egg layed and young develop externally

- **Viviparous**
  - Eggs develop within mother’s body, young born live

- **Ovoviviparous**
  - Eggs retained and hatch within mother’s uterus
Mammalian Diversity

Oviparous

Viviparous

Pouched

Placental
Monotremes

- Order Monotremata
  - Oviparous mammals
  - Feed off milk after hatching
Marsupials

- Order Marsupialia
  - Viviparous pouched mammals
  - Nourished by yolk sac during early development
  - Non-placental
  - “Premature” birth; feed off milk in pouch
Placental Mammals

- **Viviparous placental mammals**
  - Embryo nourished through entire development within uterus