The Diversity of Animals 2
Chapter 23

Phylogeny of Animalia (overview)

Key features of Chordates

- Phylum Chordata (the Chordates) includes both invertebrates and vertebrates that share (at some point in their life):
  - Notochord
  - Dorsal, hollow nerve cord
  - Pharyngeal gill slits
  - Post-anal tail
Human embryo: chordate features

Invertebrate chordates

- Have a notochord, but not a true vertebral column
- Example: tunicates
  - Have all 4 chordate features as larvae
  - Lose
    - Post-anal tail
    - Notochord
    - Most of dorsal hollow nerve tube
  - Keep
    - Pharyngeal gill slits
    - Pharynx expands, used for filter-feeding

Tunicates

- Larvae
- Tunicate
Vertebrates 1: Jawless Vertebrates

- Example 1: Hagfish
  - Don't have a true vertebral column
  - Not really vertebrates, but usually grouped with them.
  - Secrete copious amounts of enzymatic slime to digest prey!

Vertebrates 1: Jawless vertebrates

- Example 2: Lampreys
  - These do have a vertebral column, and thus are true vertebrates
  - Parasites on other fish
    - Use sucker-like mouth with rasping teeth (inside mouth and on tongue) to latch on and suck blood and body fluids

Vertebrates 2: Cartilaginous fishes

- New (derived) features
  - Jaws
  - Paired appendages
  - Mineralized skeleton
    - But reduced in the cartilaginous fish... (do have mineralization in teeth, parts of skeleton)
    - Thought to have evolved from more mineralized fishes
- Many cartilaginous fish are predators
- Examples: Rays and sharks
Vertebrates 3: Bony fishes

- New (derived) feature: swim bladder
- Gives rise to lungs in land vertebrates!
- **NOTE:** Mineralized bone is not a new feature despite the fact that they are the bony fishes!

- Bony fish diversity

**Deep sea anglerfish:** reduced mineralization; reduced and attached males

**Seahorse:** Long snout for feeding on plankton, long and mobile tail for hanging onto coral and algae; male has pouch for brooding young
Vertebrates 4: Amphibians

- Amphibians live “double lives”
  - Aquatic as larvae
    - Gain oxygen with gills
    - Move with tail
  - Semi-terrestrial as adults
    - Gain oxygen with lungs and through skin
    - Move with legs
    - Still tied to water for reproduction; eggs will dry out without water; many with external fertilization

Frogs and salamanders

Vertebrates 5: Reptiles

- Reptiles, birds and many mammals are adapted for terrestrial life
  - Key feature: amniotic egg
    - Has shell that allows gas exchange without water loss (Nature’s Gortex!)
    - Internal membrane (amniotic sac) is fluid-filled and houses embryo
    - Reproduction is thus no longer tied to water
Vertebrates 5: Reptiles

- Other adaptations of reptiles and birds to terrestrial life
  - Tough, scaly skin resists water loss
  - Internal fertilization
  - More efficient lungs and circulatory system
    - Better adapted than amphibians for air-breathing
    - Birds have extremely efficient lungs!

Vertebrates 5: Reptiles (diversity)

- Turtles
- Tuataras
  - Only found on New Zealand
- Crocodiles and Alligators
  - Largest reptiles
  - Closely related to dinosaurs
- Snakes
- Lizards

Vertebrates 6: Birds

- Birds are closely related to reptiles ("feathered reptiles")
  - *Archaeopteryx* (and similar fossil "reptile-birds") show relationships between reptiles and birds
**Vertebrates 6: Birds**

- Birds are adapted for flight
  - Feathered wings (airfoils)
  - Light for flight!
    - Hollow spaces in bones
    - Reduction of organs (i.e. single ovary)
    - Absence of teeth
  - Endothermic
    - Higher metabolic rates needed for flight
- Acute visual systems
  - Coordination of flight
- Efficient respiration and circulation

**Vertebrates 6: Birds (Diversity)**

- **Hummingbird**
  - Tiny
  - 60 cycles/sec wingbeat
- **Frigatebird (juvenile)**
  - Type of seabird
  - Many seabirds are extraordinary long-distance travelers and fishers
- **Ostrich**
  - Largest bird (up to 300 pounds)
  - Flightless

**Vertebrates 7: Mammals**

- Key features
  - Hair
  - Provide milk to their offspring
    - Via mammary glands
Vertebrates 7: Mammals (Groups)

- Monotremes (Example: duck-billed platypus)
  - Egg-laying mammals
  - Have mammary gland but no nipples; young lick milk off fur.
- Marsupials (kangaroos and koalas; primarily in Australia)
  - Born early in development; completes development while nursing (usually in pouch)
- Placental mammals
  - Complete embryonic development within uterus
  - Extensive placenta where exchange of nutrients and gas between mother and offspring

Monotremes

Marsupials
Placentals