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**Topic:** Animal Diversity II: Vertebrates

**Reading:** Chapter 24

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**Main concepts:**

- The vertebrates belong to subphylum Vertebrata in phylum Chordata.
- All chordates have a notochord, a flexible rod of protein that supports the spinal cord. In vertebrates, the notochord is replaced by the vertebrae during embryonic development. The urochordates (“sea squirts”) also lose their notochord as they reach adult form.
- Vertebrates are distinguished by their vertebral column: a spinal cord supported by a vertebral column made up of cartilage or bony vertebrae.
- Major groups of chordates:
  - Subphylum Urochordata: tunicates or “sea squirts,” small filter-feeders that have a notochord as juveniles.
  - Subphylum Cephalochordata: lancelets, fish-like animals that retain a notochord throughout their lives.
  - Subphylum Vertebrata:
    - Class Myxini: hagfishes, jawless fish with a few rudimentary cartilaginous skeletal parts. Some classification systems do not place the hagfishes with the vertebrates.
    - Class Petromyxontiformes: lampreys, jawless fish with multiple gill openings and some cartilaginous supporting structures for the spinal cord. Most lampreys parasitize bony fish.
    - Class Chondrichthyes: Sharks, skates, rays. These true fish have skeletons of cartilage, well-developed jaws, multiple gill openings, and rough, tooth-like scales. These fish reproduce by laying eggs that are externally fertilized.
    - Class Osteichthyes: Bony fish, also called the ray-finned fish. These fish have true bone as well as cartilage in their skeletons. Bony fish have a single gill flap, flat scales, a two-chambered heart, and a wide diversity of forms and habitats. Fish reproduce by laying eggs that are externally fertilized.
    - Class Amphibia: The amphibians, including frogs, salamanders, newts. Amphibians have soft, moist skin that acts as a respiratory surface, and most also have lungs (a few salamanders are lungless). Adult amphibians live on land in moist environments, but lay their eggs in the water. Eggs are fertilized externally. Amphibians have a three-chambered heart.
    - Class Reptilia: Land vertebrates with dry, scaly skin, including lizards, snakes, crocodilians, turtles, tortoises. These animals lay an egg with an amnion (a protective membrane) and a leathery shell. Reptiles rely on internal fertilization for reproduction. Most have a three-chambered heart, though crocodilians have a partially-divided ventricle.
    - Class Aves: Birds, sometimes lumped with the reptiles. Birds also lay an amniotic egg and rely on external fertilization. Feathers appear to have evolved from frayed scales, and first were used for insulation in warm-blooded ancient reptiles. Modern birds have a four-chambered heart and are homeothermic (maintain an internal temperature, or “warm-blooded”).
    - Class Mammalia: Mammals. Like birds and reptiles, mammals have an external covering made of keratin protein, but in mammals it forms hair or fur. Mammals use internal fertilization for reproduction, and placental mammals gestate the embryo inside their bodies (monotremes lay leathery eggs, while marsupials give birth to very young embryos which finish developing in an external pouch). All mammals have mammary glands, specialized sweat glands that secrete milk.

**Common misconceptions:**

- Most people think of mammals when they think of “animals.” In scientific taxonomy, Kingdom Animalia includes all motile, multicellular, heterotrophic organisms that lack cell walls.
  - Students frequently confuse the reptiles and amphibians, referring to frogs as “reptiles” or turtles as “amphibians.” Turtles can be especially confusing because most students associate “amphibian” with “water dweller.” Turtles are reptiles, however, because they have scaly skin, rely on internal fertilization, and lay a leathery amniotic egg.
  - Some students believe only mammals are “warm-blooded” (homeothermic), and believe birds are more “primitive” and so must be “cold-blooded” (heterothermic). Birds are, in fact, as complex as mammals, and their brain structure allows for a high degree of intelligence. How birds do as much as they do with
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proportionately smaller brains is currently a subject of study. Some parrots, in fact, have been trained to perform cognitive tasks that would challenge a human preschooler.

- Many people believe that amphibians were the first organisms to live on land. However, arthropods colonized land before the amphibians did, which provided early amphibians with an abundant food source. Plants colonized land before the arthropods, and bacteria most likely lived on land long before any other living organism.

### Reading notes:

- List the characteristics of chordates and of vertebrates.
- Make a table of the vertebrates. List the classes of vertebrates down the side and the characteristics along the top, including: number of chambers in the heart, body covering (scales, feathers, hair, etc.), fertilization, reproduction (i.e. soft egg, leathery egg, placenta, etc.), jaws, respiratory structures, and any other interesting features from these notes and your text.
- Describe the types of environmental challenges that a land-based habitat presents, and what kinds of adaptations allowed some groups of vertebrates to succeed on the land.

### Useful websites:

- "[The Phyla of Kingdom Animalia](http://www.abdn.ac.uk/~nhi708/classify/animalia/index.html)" (<http://www.abdn.ac.uk/~nhi708/classify/animalia/index.html>) lists all of the current phyla in this kingdom, and includes links with pictures and information on each.
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