**Phylum Chordata** (44,000 species)

- [OVERHEAD, not in book]
  - dorsal hollow nerve chord that forms spinal cord and brain
  - notochord at some stage of life cycle
  - gill slits at some point in life cycle

**VERTEBRATES** [OVERVIEW - OVERHEAD, not in book]:

I. Class Agnatha - jawless fish

- surprise - no jaws!

- eel like shape

- include lampreys and hagfish
  - lampreys are parasitic - like huge leeches. Wiped out fishing in the great lakes when the St. Lawrence canal was opened.

- toothed, sucker like mouth

- hagfish are mostly scavengers. Will bury into dead or sick fish and eat it out from the inside.

II. Class Chondrichthytes - sharks, rays, etc. (chondros = cartilage, ichthys = fish)

- skeleton is composed of cartilage rather than bone

- teeth are replaced continuously (that’s why shark’s teeth are so common).

- most sharks are carnivorous (!); the largest all feed on plankton

- rays and skates live along the bottom, feed on mollusks and other bottom dwellers.

- some have live birth (but not like mammals)

- areas in skin can detect electrical fields generated by muscle contraction (helps them zoom in on prey)!

III. Osteichthytes (osteon = bone)

- bony fish - skeleton composed of bone
- body covered with scales
- several pairs of gills, but all covered by one gill cover (= operculum)
- most have air sacs (swim bladders); lungs are derived from these
- about 18,000 species

Two main groups:
- lobe fin fish & lung fish
  - gave rise to amphibians (and rest of chordate groups)
- ray finned fish
  - fins are supported by bony rays
  - huge diversity - an incredibly successful group, found in almost any kind of aquatic habitat (your typical “fish”).
    - gold fish, bass, perch, flounder, trout, salmon, etc.

IV. Amphibians (about 4,000 species)
- first animals to live on land.
- all are tied to water at some point in their life
- eggs must be laid in areas with water, or at least a lot of moisture.
- skin is always moist, so water is lost through their skin.
- go through metamorphosis (i.e. tadpole - frog)
- many groups have poison glands (mention “toad licking”)
- Three orders: Frogs, Salamanders & Caecilians (a weird group with no legs, that looks like an earthworm with a mouth).

V. Reptiles
- first really successful group to invade land. How?
  - scaly skin is relatively impervious to water (skin is dry!)
  - an egg that can survive on land!
- are “cold-blooded” (better, ectothermic - get heat from their environment; incidentally, all groups discussed so far are essentially “cold-blooded”.)

- Four orders: turtles, lizards & snakes (same group!), crocodiles, & tuataras

V ½. Dinosaurs (reptiles? some folks put them into their own class)

- flourished during Mesozoic, about 225 mya to 65 mya.
- may have been quite advanced. There is evidence for:
  - endothermy (warm-bloodedness)- the book is very one-sided here
    - but there is very good evidence for this, including a possible four chambered heart with separate blood vessels just found recently
  - feathers in many groups
  - parental care
  - herd behavior
  - agility and speed - these were not typical “lizards”.
  - flying ability - pterosaurs are thought to have had powered flight!

- Best theory for extinction - meteor about 65 mya. The impact crater HAS been found.
  - but other changes were probably also taking place.

VI. Aves - birds, about 8,600 species

- some controversy about origin, but generally believed to have been dinosaurs (one way to look at it: dinosaurs did not die out!)

- lay eggs (the basic egg structure is very similar to reptiles)
- feathers - highly modified scales
- endothermic, high metabolism (flying can be energy intensive)
- completely developed four chambered heart (details in Biology 104).
- most have adaptations for weight loss:
  - frigate birds have a wingspan of 2 m and a skeleton that weighs 4 oz.
- divided into about 26-28 orders, some of which you should find familiar (Owls, ducks, penguins, birds of prey, perching birds, etc.

V. Mammalia - mammals (dogs, bats, mice, humans, etc.) about 4060 species.

- body covered with hair
- mammary glands (gives this group their name)
- endothermic
- on average, larger brain than other groups
- differentiated teeth (incisors, canines, pre-molars, molars)
- almost all have live birth (three living exceptions)

A. Subclass Prototheria - monotremes
- lay eggs, lack teeth
- three species - duck billed platypus, and two sorts of echidna (look like a porcupine), all in Australia or New Guinea.

B. Subclass Theria - all other living mammals
- do not lay eggs (live birth)

a. Infraclass Metatheria - marsupials
- don't have a real placenta - young is born in a very immature state, crawls into mothers pouch, attaches to nipple and finishes development.
- opossum is local example. More opossums exist in South America, but center for Marsupials is Australia:
  - Kangaroos, Tasmanian devils, etc.

b. Infraclass Eutheria - true placental mammals.
- Embryo completes most of it’s development in the mother
- about 18 orders. Most successful are rodents and bats (between them include about 2,500 species). Other orders include carnivores, primates, whales, ungulates, elephants, etc.
- A comment on marsupial radiation.
- Australia drifted away about 65mya.

- Marsupials thus adapted to niches (roles) filled by regular animals elsewhere.

- [OVERHEAD, not in book]