General Biology 2: Lecture 3

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- History of Life
  - Adaptive Radiation
    - Post-Mass Extinction
    - Surviving species quickly diversif
  - Precambrian Time
    - Hadean, Archaean, Proterozoic Eons
      - Little to no atmospheric oxygen
      - Lack of ozone shield allowed radiation to bombard Earth
      - First cells come into existence in aquatic environments
      - Procaryotes (3.5 billion years ago)
        Cyanobacteria left many ancient stromatolite fossils
        Cyanobacteria added first oxygen to the atmosphere
        Evolution of abiotic species
      - Eukaryotes (2.5 billion years ago) - (Endosymbiotic Hypothesis: eukaryotes evolved from prokaryotes)
      - Multicellularity Arises (1.5 billion years ago)
      - Glycolysis as first aerobic process
      - Union of bacteria and archaean potentially led to the first Eukaryotic cell (membranes)
      - Ediacaran Fossils (end of Proterozoic) 600-540 million years ago
        Multicelluar animals appear including sponges
        Shallow marine mudflat animals, unusual forms, no interal organs, no shell or bones (all invertibrates)

Possesed collagen (all animals have the collagen protein)
Ended with a Mass Extinction event
Cylindrical / segmented fossils from Ediacaran period show signs of animals being more elaborate, but most fossils are not discovered

- Phanerozoic Eon
  - Paleozoic Era ("Ancient Life") 540-248 million years ago
    - Cambrian Explosion
      Warm, wet climate, O_2, no ice at poles
      All existing phyla appear in the fossil record
      No new animal body plans have developed since the Cambrian Explosion
      Many marine invertibrates with shells
      First vertibrates (520 million years ago)
    - High diversity of the Cambrian due to:
      Favorable environment - Oxygen, (Calcium Carbonate for shells)
      Evolution of Hox genes (regulatory genes)
      Predator/prey "Arms Race" - shells, reef-building
    - Burgess Shale organisms
      British Columbia, Canada
      Rapid burying of animals in mudslide led to rapid fossilization of many species
      Continuous new discoveries e.g. massive new species of arthropod (radiodonts)
    - Ordovician Period (490-443 million years ago)
      Warm temperatures and atmosphere very moist, lots of CO_2 in atmosphere
      Diverse marine invertibrates: trilobites, brachiopods, byozoans, etc.
      Primitive plants and arthopods first invade land
      First invertibrates (fish-like)
      Abrupt climate change (glaciers) led to mass extinction
    - Dilurian Period (443-417 million years ago)
      Stable climate, glaciers melted, sea levels rose
      Significant vertibrates (fish), plants, coral reefs

Large colonization by terrestrial plants (seedless) and arthropods

- Devonian Period (417-354 million years ago)
  "Age of Fishes"
  Rapid diversification of fishes
  North is dry, south is wet (oceans)
  Jawed and unjawed fishes gain dominance of cephalopods
- Carboniferous Period (354-290 million years ago)
  Rich coal deposits formed from plant material
  Cooler with land covered by forests and swamps
  Plants and animals further diversified
  Very large plants and trees present
  Flying Insects
  Animals developed in isolation tend to be bigger
  Amphibians prevalent
  Amniotic egg evolved in reptiles (leathery egg shell)
  Amphibians lay eggs in water, reptiles eggs protected by a shell and can be layed on land, provides internal fluid for embryo
- Permian Period (290-248 million years ago)
  Continental drift formed supercontinent Pangaea
  Forest shift to gymnosperms (conifers)
  Amphibians prevalent, but reptiles begin to dominate
  First mammal-like animals appeared // Ended with the largest known mass extinction event ("The Great Dying")

* Mesozoic Era ("Middle Life") 248-65 million years ago
  "Age of Reptiles", Consistantly hot climate, dry terrestrial environments, little-to-no ice at poles
  - Triassic Period (248-201 million years ago)
    Gymnosperms dominant plants
    Reptiles abundant (first dinosaurs)
    First true mammals - internal temperature regulation
  - Jurassic Period (201-145 million years ago)
    Dinosaurs achieved enormous success
    Malls remained small and insignificant
    First birds (feathers, hollow bones, endothermic)

Sauropods
Pangaea started to break apart

- Cretaceous Period (145-64 million years ago)
  Dinosaurs began precipitous decline
  K-T Extinction Event, K-Ph (Cretaceous-Paleogene) extinction - possibly meteor + volcanic activity
  Mammals begin adaptive radiation
  Mammals move into habitats left vacated by dinosaurs
  K-T Extinction kills non-avian dinosaurs
  Surviving reptiles: turtles, crocodiles/alligators
  Birds survive due to internal maintenance of body temperature

* Cenozoic Era ("Recent Life") 65 million years ago - present
  "Age of Mammals"

  - Paleogene, Neogene (Tertiary), Quaternary Periods (current period)
  - Tropical conditions replaced by colder, drier, climate
  - Mammals continued adaptive radiation (birds, fish, and insects also diversified)
  - Flowering plants diverse and plentiful
  - Primate evolution began (Quaternary Period) - 1.8 millions years ago through present
    Lemurs, tarsiers, monkeys, apes, humans
    Descended from tree-dweller ancestors
    <u>All</u> adapted for climbing trees
    1. Rotation shoulder joint (Brachiation)
    2. Big toe and thumb widely separated from other digits
    3. Stereoscopic vision (overlapping FoV, depth perception)
    Larger brain, 1 offspring at a time, upright body
    Human (*Homo*):
    - Bipedalism
    - Increased brain size
    - Fully opposable thumb
    Ancestral Humans
    - *australopithicus*

- *H. habilus*
- *H. erectus*

Non-Ancestral Humans

- Neanderthals
- Denosovans

Closest ancestor - Chimpanzees/Bonobos (genus *Pan*)