General Biology 2: Lecture 4

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- 6th Mass Extinction - "Worst state of species die off since loss of dinosaurs"
  - Humans: "Global superpredators"
  - Previous: 100% wildlife; Now: 3% wildlife
  - CO_2: Permian: $2 - 3000$ppm; Now: 414ppm (rising)
  - Human activities have caused atmospheric CO_2 to rise 150% since 1750
- Since dawn of human civilization
  - Loss of
    - 83% of wild mammals
    - 80% of marine mammals
    - 50% of plants
    - 15% of fish
  - Large cats estimated to be extinct in the wild in 10-15 years
  - Rhinos, pangolins, giraffes, etc. are all close to being extinct
- Living Planet Report
  - Average 69% decline in monitored population sof mammals, birds, amphibians, reptiles, fish (vertibrates only)
  - Most significant declines in Americas and Africa
  - Freshwater biodiversity declining faster than terrestrial or oceanic

  - Megafauna (large animals) are particularly vulnerable
  - Plants dying at same rate as mammals, higher than birds
  - 20% of wild species at risk of extinction this century
  - Many primates are on the brink of extinction
    * Political instability
    * Hunting
    * Habitat loss
    * e.g. Graver's gorilla, Aye-ayes, Northern sportive lemur, Pygmy tarsier, Rondo dwarf galago, Slow loris, etc.

- Evolution: Heritable change in one or more characteristics of a population or specie from one generation to the next
  - Micro-evolution: single gene in a population
  - Macro-evolution: formation of new species or groups of species through accumulation of micro-evolutionary changes
  - Species:
    * Group of related organisms that share a distinctive form
    * Among sexually reprodutive species, able to interbreed
  - Population: a localized group of individuals from a species which are more likely to interbreed

- History of Evolutionary Thought
  - Predarwinian - Theology, Myths, Superstition
  - Anaximander - Plato, Aristotle: *Scala Naturae* ("Scale of Life")
    * Estabilishes man as the dominant/perfect form of Life
    * Set man above and apart from nature
    * Incorporated into religious belief that the Earth and its creatures were the result of creation
    * "Great Chain of Being"
  - Creationism: A God is the absolute creator of heaven and Earth out of nothing (Christianity, Islam, Judaism)
  - Spontaneous Generation: Life arises from non-living matter

    - Sweaty rages with grain prduces mice → sweat transformed grain into rice
- Taxonomy - 17th Century to mid-18th Century
    - Jon Ray - first thorough study of natural world
    - Carolus Linnaeus - binomial nomenclature, fixity of species (ideal structure and function, species do not change)
    - Count George Buffon - 44 volume catalog of all known plants and animals, suggested life forms change over time
    - Erasmus Darwin - Charles Darwin's grandfather, suggested all living things descended from a common ancestor, evidence in developmental patters, artificial selection, and vestigial organs
- Evolutionary Thought - late 18th Century
    - Curvier
        - First to use comparative anatomy to develope a system of classification
        - Founded Paleoentology - fossils
        - Proposed Catastrohpism - after catastrophies new species emerge
    - Lamarck
        - Propose evolution and life diversity with environmental adaption
        - More complex organisms are descended from less complex organisms
        - Use and disuse - body parts used extensively become larger and stronger, while those not used deteriorate
        - Inheritance of acquired characteristics - modifications acquired during lifetime can be passed on to offspring
        - Giraffes - long necks from stretching to reach leaves
        - Generally rejected by scientists, however some recent evidence suggests that some acquired characteristics can be inherited - traumatic experiences led to epigenetic changes
    - Charles Lyell - "Principals of Geology"
        - Earth is subject to slow but continuous cycle of erosion and uplift

        - Proposed Uniformitarianism
        - Important writings that influenced Darwin
    * Charles Darwin
        - HMS Beagle - 1831 at age 22
        - Naturalist
        - 5 years seasick
    * Darwin's Theory of Evolution
        - Biogeographical observations
        - Study o fthe geographic distribution of life forms on Earth
        - Saw similar species in similar habitats
        - Reasoned related species could be modified according to the environment
- Galapagos Islands
    * Tortoises
        - Darwin observed tortoise neck length varied from island to island
        - Proposed that speciation on islands correlated with a difference in vegetation
    * Finches
        - Darwin observed many difference species of finches (13) on various islands
        - Speculated they could have desceded from a single pair of mainland finches
- *On the Origin of Species by Means of Natural Selection* - Darwin
    * Rev. Thomas Malthus - "Essay on the Principle of Population"
        - Struggle for existance: generations have same reproductive potential as previous generations, but resources are limited
        - Reproductive potential is greater than environment can support
        - Death, disease, and famine are inevitable if population is to have stability

* Darwin's Explanatory Model of Evolution by Natural Selection
  - Observations
    1. Organisms have great potential fetility, which permits exponential growth of population
    2. Natual populations do not normally increase exponentially, but remain fairly consistent in size
    3. Natural resources are limited
    4. Variation occurs among organisms within populations
    5. Variation is heritable
  - Inferences
    1. A struggle for existence occurs among organisms in a population
    2. Varying organisms show differential survival and reproduction, favoring advantageous traits (natural selection)
    3. Natural selection, acting over many generations, gradually produces new adaptions and new species