Chapter 8

- Evolution is an ongoing process
- Evolution: result of inherited adaptations that enhance survival and reproduction of the organism is a particular environment
- Two unexpected patterns:
    - Different species resembled closely the mainland finches
    - Similarity between the fossils of extinct species and the living species in that same area
- Four mechanisms can give rise to evolution
    - Evolution occurs when the allele frequencies in a population change
    - Individuals do not evolve but populations evolve
    - Microevolution: slight changes in gene pool over one or few generations
        - Agents of microevolution
            - Mutations
            - Gene flow
            - Genetic drift
            - Natural selection
            - Human culture
    - Macroevolution: cumulative effect over a long period of time
- Natural Selection
    - Efficient mechanism of evolution
    - Helps in adapting populations to their environment
    - Evolution and natural selection are not the same thing
    - Steps in natural selection:
        - Variation for a trait
        - Heritability
        - Differential reproductive success
    - "Survival of the fittest": reproductive success
    - Does not lead to perfect organisms
        - Environments change quickly
        - Natural selection can work only on existing traits
        - There may be multiple different alleles for a trait, each causing an individual to have the same fitness
- Mutations
    - New alleles arise
    - Ultimate source of all genetic variation
    - Can happen in not only the gene sequence but also in junk DNA (regulatory)
- Gene Flow
    - Occurs when individuals immigrate and emigrate between populations
- Genetic Drift
    - Caused solely by chance
    - A random change in allele frequencies
    - Impact is greater in smaller populations
    - Founder effect: colonization of a new location.
    - Bottleneck effect: due to a catastrophic event

- Other types of selection
    - Artificial: humans bring about differential reproduction
    - Directional
    - Stabilizing: individuals with intermediate phenotypes are most fit
    - Disruptive: individuals with extreme phenotypes experience the highest fitness, and those with intermediate phenotypes have the lowest
    - Sexual: ability to successfully obtain a mate
- Sexual dimorphism: differences in form between sexes of the same species

Evolution

- Evidence for evolution
    - Fossil record: evidence for ancient life
        - Learn about the age and features of extinct animals
        - Date layers of rock; age of organisms by radiocarbon dating
        - Incomplete record:
            - No fossils for many species
            - Environment can lead to variations
    - Biogeography: the study of the geographical distribution of living things
        - Changes in the land, oceans, and atmosphere affected the evolution of life
        - Distribution of certain fossils provide evidence that the continents have moved
    - Comparative anatomy and embryology: reveal common evolutionary origins
        - Anatomical similarities can be signs of common ancestry
        - Homologous structures divergent evolution
        - Analogous structures all developed from different original structures
        - Analogous features: evolved separately as adaptations to similar environments
        - Homologous traits: features that are inherited from a recent common ancestor
        - Analogous traits: features that are produces by convergent evolution
        - Vestigial structures: had value once upon a time; evolutionary leftovers
            - Genes for yolk protein
            - Genes for making vitamin C
            - Olfactory receptor genes
    - Molecular biology
        - Darwins boldest hypothesis: all forms of life are related to some extent
        - Compare DNA, RNA, proteins, even lipids of different organisms
        - Universal genetic code: UUA = leucine
        - Reveals that common genetic sequences link all life forms
        - Recency of common ancestry
            - "molecular clocks"
            - The longer two species have been evolving on their own, the greater the number of genetic differences that accumulate
            - More similar sequences = more recent common ancestor

- Lab and field experiments: enable us to watch evolution in progress
  - From observations of multigenerational experiments
  - Difference organisms are distantly related to one another
  - Evolution, explains the unity and diversity of life