Review: Evolution by Natural Selection

1) Must exist for given trait
2) Results in differential survival and reproductive fitness
3) Must be heritable (genetically based)

DNA

- Trait variation is encoded in DNA
    - DNA is composed of bas pairs of nucleotides (A,T,C,G)
- If base pairs differ among individuals for a particular trait may lead to different trait expression of that particular trait

Chromosomes

- Composed of DNA
- Regions on chromosome that we characterize at genes
    - Represents variability of groups of base pairs
- Genes code for how a trait is going to be expressed
    - However, genes can have alternate forms based upon the base pairs they are composed of
        - Alternate forms = **alleles**→ forms of the same gene with different base pairs
- Different alleles can lead to different trait expressions
    - Lamarck's giraffe neck length
    - Imagine that giraffe neck length is coded by one gene

      Allele A= long neck

      Allele B= short neck

      Genotype- the underlying genetic code for a trait (the allele)

      Phenotype- the outward expression of a trait (whether the neck is long or short)
- Evolution: Change in living organisms over time
- Evolution: Change in allele frequency in a given population over time
- Individuals are selected for/against based on their traits
    - However, individuals do NOT evolve
- Populations Evolve!
    - Trait expression/allele frequency change with selective pressures
- Natural Selection- only mechanism that results in adaptive change
    - Is NOT random
        - Allele frequency= change in response to selective pressures
    - Does NOT generate new trait expressions. It can only act on existing variation for a particular trait
- Mutation
    - The ultimate source of all genetic variation→ new alleles are produces within an individual

1) Spontaneous
    a. During egg/sperm production, spontaneous changes occur in DNA
2) External forces
    a. "mutagens"
    b. Cause changes in underlying DNA of an individual
    c. Examples: chemicals/radiation

- Very rare
- Effect can be negative, positive, or neutral
- Model organism
    - Example: Fruit fly (Drosophila)
    - Increased mutation in environment can signal environment problems

Gene Flow

- Very common- populations can exchange alleles through dispersal- movement of genetic material that lead to new alleles in a particular population
- Can occur through organismal movement and pollination
- Usually not random, but it can be

Non-random Mating

- Inbreeding
    - Self-fertilization
        - Hermaphrodite- has both viable male and female reproductive parts
    - Mating by closely related organisms (siblings)
    - Often results in decrease in genetic (allelic) diversity within that population
    - Completely random process
    - Changes in allele frequency due to accidental events, random mating, separation of a population
    - Very common/problematic in small populations
    - Small gene pool
        - Represents all alleles in a population

Random Mating

- Some individuals don't mate

Founder Effect

- Allelic diversity (gene pool) is determined by individuals that move/are moved to a new population then breed

Bottleneck Effect

- Due to some event, only a small number of individuals survive and they then represent the population gene pool
- Example: Northern Elephant Seals
    - Through hunting they ended up with a single population
    - All allelic diversity now comes from one population
    - The seals recovered but they have a really small gene pool (genetic diversity)