ANIM3362 EVOLUTIONARY PROCESSES

Week One: Introduction & Genetic Variation

Week Two: Basic Models & Natural Selection

Week Three: Complex Types of Selection & Genetic Drift

Week Four: Mutation & Inbreeding

Week Five: Population Subdivision & Multilocus Population Genetics

Week Six: Species Concepts & Speciation

Week Seven: Basic Quantitative Genetics & Quantitative Genetic Methods

Week Eight: Selection on Phenotypes & Quantitative Genetic Applications

Week Nine: Maintenance of Genetic Variation & Correlations Between Traits

Week Ten: Experimental Evolution & Fluctuating Asymmetry

Week Eleven: Molecular Evolution & Advances in Molecular Techniques

Week Twelve: Phylogenomics & Applications of Phylogeny

Week Thirteen: Recap/Revision Only

<u>Evolution</u>
- = Change between generations within a series of populations that are descended from one another
- Darwin = "decent with modification"

Evolution before Darwin
- Ancient Greece: different kinds of organism could be transformed into each other
- Middle ages: animals could arise from inorganic matter or plants
- 17th to 18th Centuries: species are special creations with fixed form
- **Jean-Baptiste de Lamarck**:
    o Viewed species as variable populations
    o Progression towards complexity – complex organisms evolved from simpler ones
    o Individually acquired modifications are inherited
    o Lamarck's giraffe: neck increased in length as giraffe reached higher and higher for leaves

Darwin's theory
- Published theory of natural selection simultaneously with Alfred Wallace in 1858
- = Some individuals contribute more offspring to the next generation than do others – composition of the population will change automatically

Reception of Darwin's ideas
- Many accepted evolution, but rejected natural selection:
- Lacked a theory of inheritance
- Misinterpreted as evolution by chance
- Gaps between forms in nature
- Rediscovery of Mendel's laws in 1900's allowed revival of Darwin's theory, but initial effect was the opposite

Modern Synthesis
- Reconciliation between Mendelian theory and biometricians led by three theoreticians:
    o **RA Fisher**: showed that continuous characters could be explained by Mendelian inheritance of several genes, developed a theorem of natural selection
    o **JBS Haldane**: published a mathematical theory of natural selection and its interaction with other processes
    o **Sewell Wright**: published on the effects of inbreeding and selection on the genetic composition of populations

- **Theodosius Dobzhansky**: carried out investigations of evolution in populations of fruit flies and proposed that changes studied by population geneticists could lead to speciation

Inheritance and DNA
- DNA provides the physical mechanisms of heredity in most organisms
- Carries information used to build body's proteins
- Exists in most cells of the body and all reproductive cells
- Large amounts of DNA is non-coding in some specie
    - Most non-coding DNA is repetitive and has an unknown function

Structure of DNA
- Series of units (nucleotides) = sugar + phosphate + base
    - Base = cytosine & thymine (pyrimidines) and adenine & guanine (purines)
- A binds to T and G to C
    - This pairing contributes to the double helix
    - E.g. strand 1: …AGGCT… - compliment: …TCCGA…

DNA and Proteins
- Proteins are made up of chains of amino acids
- There are 20 amino acids and each is coded by a triplet of bases (codon)
- Amino acid sequence is read from nucleotide sequence in two stages:
    - Transcription: mRNA is transcribed from the DNA in the nucleus
    - Translation: amino acid sequence is read off the mRNA sequence in the ribosomes
- Genetic code = expressed for mRNA (in mRNA U is used instead of T)

Gene Inheritance and Variation
- Genes are inherited in Mendelian ratios
- Parents are usually diploidy = meaning they have two sets of chromosomes
- Recombination during meiosis allows alleles at different loci to assort independently
- When DNA is replicated, repaired of recombines – mutations are introduced
    - These different versions of each gene are carried around in different individuals at a given locus

DNA sequence variation
- Modern techniques allow variation to be assessed at the DNA level – either by direct or indirect methods

Direct methods
- Provides the most information, but is time consuming and expensive