CHAPTER 22: DESCENT WITH MODIFICATION: A DARWINIAN VIEW OF LIFE
I. Evidence for evolution
   A. Fossil record
   B. Homologies
      1. Anatomic evidence
         a. homologous structures
         b. vestigial structures
      2. Molecular homologies
   C. Biogeography
      Your filled in biogeography question sheet from lecture will be helpful for studying this
   D. Artificial selection

II. How does evolution proceed
   A. Darwin - natural selection and 'fitness'
      1. Reproductive capacity exceeds resources
      2. Limited availability of resources puts limit on population growth
      3. Heritable variety within a species leads to some individuals better able to compete for resources
      4. Therefore differential reproductive success

CHAPTER 23: EVOLUTION OF POPULATIONS
I. Microevolution (changes in allele frequency within a population) and its causes
   A. Can sexual shuffling of alleles due to meiosis and random fertilization have an effect on allele frequency in a population over time? No according to: Hardy-Weinberg equilibrium $p + q = 1$ and $p^2 + 2pq + q^2 = 1$
   B. Be able to do Hardy-Weinberg problems e.g. if given frequency of homozygous recessive individuals in the population ($q^2$) be able to find all other frequencies or if given frequency of dominant allele ($p$) etc.
      I recommend working the sample problems linked from your lecture syllabus
      1. Factors that will cause microevolution and thus interfere with the Hardy-Weinberg equilibrium (Hardy-Weinberg Ditty will help you memorize these)
         a. Genetic drift - with small numbers chance plays bigger role
            i. Founder effect
            ii. Genetic bottleneck
b. **Gene flow**
   i. Emigration and immigration

c. **Nonrandom mating**
   i. Assortative mating
   ii. Sexual Selection
      Male-Male competition - intrasexual
      Female mate choice - intersexual

d. **Mutations**
   i. **Only** way to get new alleles

e. **Natural selection**
   i. Stabilizing selection
   ii. Directional selection
   iii. Disruptive selection
   iv. Balancing selection
      Heterozygote advantage
      Frequency-dependent selection

**Chapter 24: The Origin of Species**

I. Reproductive Isolating Mechanisms - how species (know the definition) are kept separate
   A. Prezygotic Isolating Mechanisms (a zygote is the cell formed when a sperm fertilizes an egg)
      1. Temporal
      2. Habitat
      3. Gametic
      4. Mechanical - shape or color
      5. Behavioral
   B. Postzygotic Isolating Mechanisms
      1. Hybrid inviability
      2. Hybrid infertility

II. Macroevolution - How new species develop
   A. Allopatric speciation
   B. Sympatric speciation
      1. Polyploidy

III. Macroevolutionary events above the species level
   A. Gradualism
   B. Punctuated equilibrium - Gould and Eldredge
      1. Long periods with little change and then extinction events followed by adaptive radiation (divergent evolution)

**Chapter 16 – The Molecular Basis of Inheritance**

Structure of nucleic acids
Differences between DNA and RNA

Structure of DNA
Double helix – two strands of DNA composed of five-carbon sugar and phosphate backbones with nitrogenous bases like the rungs of
a ladder in the center
The two strands held together by hydrogen bonding between the bases
Antiparallel strands – one runs 3' to 5' while the other runs 5' to 3'

Replication
DNA replication is semiconservative
Enzymes of replication – know functions of these

Leading strand replication
Helicase
Single-strand binding protein
Primase
DNA polymerase III

Lagging strand replication
Okazaki fragments produced first
Same enzymes as above plus two enzymes below
DNA polymerase I
Ligase

Chapter 17 – From Gene to Protein
Genetic code
Universal, redundant, unambiguous
Codon – three nucleotide bases code for one amino acid

Transcription
Initiation
RNA polymerase attaches to a promoter on the DNA
Elongation
Termination
RNA polymerase reaches terminator sequence on the DNA

RNA processing
Addition of 5' cap and poly A tail
Removal of introns - alternative splicing

Translation
Attachment of mRNA to ribosome
Initiation (start) codon
Transfer RNA (tRNA) contains an anticodon that matches the codon on mRNA
Stop codons

Mutations
What is a mutation?
Types of mutations
Base pair substitutions
Silent
Missense
Nonsense
Addition and deletion mutations
  In threes or multiples of threes
Frame shift mutations – not in threes or multiples of threes

Causes of mutations

Chapter 18 – Regulation of Gene Expression
I. Levels of gene regulation in eukaryotes
   A. Regulation of chromatin structure - epigenetics
      1. Histone acetylation – acetyl groups attach to histone proteins so nucleosomes are separated from each other and the DNA of a gene can be transcribed – like the unwinding of a scroll
      2. Methylation of genes - methyl groups attach to DNA – this prevents a gene from being transcribed – e.g. globin genes in all cells except red blood cells
   B. Transcription
      1. Transcription factors – proteins – help RNA polymerase to attach to the promoter
      2. Enhancers – DNA located up or downstream from gene also help RNA polymerase to attach to the promoter
      3. Activators – proteins – help enhancers attach to RNA polymerase
   C. RNA processing – necessary for eukaryotic RNA to leave the nucleus
      Addition of 5’ cap and poly A tail – know functions of these
      Alternative splicing - removal of introns (intervening sequences) and splicing of exons (expressed sequences) – the processed RNA leaves the nucleus
   D. Translation
      1. ‘Lifespan’ of mRNA
         a) MicroRNAs in plant kingdom decrease the ‘lifespan’ of messenger RNAs
      2. Initiation of translation by attachment of mRNA to ribosome
         a) MicroRNAs in animal kingdom inhibit movement of mRNAs on ribosomes so translation cannot occur
   D. Protein processing
      1. Cleavage – must remove a part of the protein to activate it – e.g. insulin
      2. Chemical modification – e.g. addition of sugar groups to make a glycoprotein
   E. Protein degradation
      1. Labeling protein with ubiquitin so proteasomes will hydrolyze the protein