Review for Exam 1

Chapters 1 and 2

Key Concepts

1. There are two main types of cells, prokaryotes and eukaryotes.
2. Viruses are different, neither prokaryotes nor eukaryotes
3. Prokaryotes and eukaryotes have both similarities and differences.
4. To determine how cells function, model systems are studied by a variety of techniques.
5. 70% of the cell is water, a polar molecule.
6. Cells are composed of 4 main types of carbon-based molecules - Nucleic Acids, Carbohydrates, Proteins, and Lipids.
7. Nucleic Acids, Carbohydrates and Proteins are polymers made up of hundreds or thousands of low molecular weight subunits (monomers). Dehydration-Condensation reactions.
8. Polymers are synthesized directionally. Nucleic acids are from 5'to 3'and proteins are from the N-Terminus to the C-terminus.
9. Lipids form a water impermeable bilayer, allowing for the cell to be isolated from the surrounding environment and even for the partitioning of organelle components from the rest of the cell.

Terms
Prokaryote
Eukaryote
Virues
Model systems - *E. coli*, yeast - *S. cerivisiae, S. pombe, D. discoideum, C. elegans, Drosophila melanogaster, Arabidopsis,* Mice
Organelles
Nucleus
Mitrochondria
Chloroplasts
Lysomes
Peroxisomes
Endoplasmic Reticulum
Golgi
Cytoskeleton
DNA
Light microscopy - Brightfield Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Confocal Microscopy.
Electron Microscopy - Transmission Electron Microscopy, Scanning Electron Microscopy
Subcellular Fractionation - Centrifugation -Differential Centrifugation, Density Centrifugation - Velocity Centrifugation, Equilibrium Centrifugation
Tissue Culture - Plant, Animal

Polar
Hydrogen Bonds
Carbohydrates
Simple sugars
Monosaccharide $(CH_2O)_n$
Polysaccharides - linear and branched (amylose) forms
Glycosidic Bonds - alpha 1-4 linkage - glycogen, starch, Beta 1-4 linkage - cellulose, 1-6 linkages result in branched oligosaccharides
Lipids
Fatty acids - 16-18 carbon chain
Unsaturated/saturated fatty acids
Triglycerides - 3 fatty acid chain linked to glycerol
Phospholipids- major constituents of membrane - 2 fatty acids bound to glycerol - more than one type of phospholipid
Glycolipids - 2 fatty acids linked to polar head group containing carbohydrate ("glyco" refers to carbohydrate)
Cholesterol - also in membranes - 4 ring structure
Proteins
20 common (essential) amino acids
4 groups of amino acids - Polar, Nonpolar, Basic and Acidic
Polypeptides
N (amino) terminus
C (carboxy) terminus
Peptide bond
Primary protein structure - sequence
Secondary protein structure - 3 types - alpha helix, beta strand, random coil
Enzymes - always a protein - can be made of more than 1 polypeptide chain, they lower the activation energy of a reaction, acting as catalysts
Active site - where the substrate is bound
Coenzymes
Membrane Structure - bilayer, fluid mosaic
Membrane proteins - 2 classes - Peripheral - can be removed by high salt or high pH
Integral - can be removed with detergent, *e.g.*, channels or pores.

Chapter 3
Key Concepts

1. Nucleic acids are the genetic material
2. G always pairs with C, A always pairs with T in DNA.
3. DNA and RNA are assembled from nucleotides with phosphodiester bonds. The phosphate group on the 5' end (of the ribose or deoxyribose) of one nucleotide binds to the hydroxyl group on the 3' end (of the ribose or deoxyribose) of the last nucleotide in the DNA or RNA chain.
4. DNA and RNA are assembled in the 5' to 3' direction
5. DNA is double stranded (with a deoxyribose) and RNA is single stranded (with a ribose).

6. DNA is replicated in a semi-conservative manner.
7. The DNA sequence and the protein sequence for a gene are colinear.
8. The genetic code is preserved between all cells and viruses.

Terms
Nucleic Acids
Purines - adenine, guanine - 2 rings
Pyrimidine - thymine, cytosine, uracil - 1 ring
Nuclosides
Nucleotides
Pentose
Deoxyribose
Ribose
Oligonucliotide
Adenosine 5'monphosphate
Guanosine 5'monphosphate
Thymidine 5'monphosphate
Cytodine5'monphosphate
Uridine 5'monphosphate
Transcription (Transcribe)
Translation (Translate)
Replication (Replicate)
Adenosine 5'triphosphate (ATP)
GTP
Cyclic AMP (cAMP)
Semi-conservative replication
Bacteriophage
Genes
Colinear
Genetic code
Codon
Stop codon
Frame, frame shift mutation
cDNA - Complementary DNA made by reverse transcription of mRNA
Know the handout on Molecular Biology Tools

Chapter 4
Key Concepts

1. The genome of eukaryotic cells contain a lot of DNA that does not code for a gene product (protein, rRNa or tRNA). In higher eukaryotes only about 3% of the genome codes for proteins.
2. Genes often contain introns which must be removed (spliced out) of the RNA before its product - protein, rRNA, or tRNA - can be made (protein) or is functional (rRNA, tRNA).

3. Introns may be the evolutionary remains of formerly important sequences or from retroviruses.
4. During evolution genes are sometimes copied. This is one way of getting more of a protein expressed at a single time. The copied genes accumulate mutations with time (evolutionary time scale) and may result in the copied genes encoding related proteins which have a different function, activity or time of expression (see the example in the text of globin genes). These copied, related genes are called "gene families".
5. DNA is contained in structures called chromosomes.
6. In non-dividing cells (Interphase), DNAis packed by histone particles in to 10 nm filaments, 30 nm filaments, or heterochromatin.
7. In dividing cells (Mitotic), DNA is tightly wound (condensed) into chromosomes (~10,000X more tightly wound) so they can be transferred to daughter cells.
8. The folding of chromosomes is highly ordered and reproducible
9. Centromeres are specialized regions of the chromosome critical in making sure that each daughter cell gets one of each chromosome during mitosis.
10. Teleomers are important structures for chromosome replication and maintenance.
11. Because of advances in molecular biology, it is now possible to map complete genomes using RFLP, Microsatellite sequences, and FISH.
12. Because of advances in molecular biology, it is now possible to map and sequence complete genomes.

Terms

Bioinformatics - a new field of biology endeavoring to identify genes and protein structures from DNA sequences.
Allele
Diploid
Haploid
Noncoding DNA
Spacer sequences
Introns
RNA splicng/spliceosome
Exons
Gene families
Pseudogenes
Repetititve DNA sequences
Satellite DNA
Chromosomes (Eukaryotic and Prokaryotic)
Chromatin
Histones H1, H2A, H2B, H3, H4
Nucleosome
Euchromatin
Heterochromatin
Telomeres
Centromeres
Mitosis

In situ hybridization - a technique that is used to locate genes to specific bands/location on a chromosome. The probe is RNA or DNA --FISH
Centromeres
Kinetochore
S. cerivisiae vs. S. pombe centromeres
Teleomers
YAC - yeast artificial chromosome - a minichromosome with its own telomere and centromere for cloning large pieces of genomic DNA from other organisms, *e.g.*, humans.
RNAi (interference RNA)
Lipid Rafts as modification of the fluid mosaic membrane model

Review Sheet 1 Modifications

Chapter 4

Key Concepts

11. Because of advances in molecular biology, it is now possible to map and sequence complete genomes.

Additional Terms

RNAi (interference RNA)

Lipid Rafts as modification of the fluid mosaic membrane model