BIOL 300 – Foundations of Biology
Summer 2017 – Telleen
Exam #2 Study Guide

Disclaimer: This outline is designed to help you organize the major topics that we have covered since the last exam and help you study. However, you need to be familiar with all of the material covered in class, not just the general topics listed here. This study guide is meant to be used in conjunction with the lecture outlines and your own notes, not as a substitute for them.

I. Energy, Enzymes, and ATP

A. Be able to define energy and describe how chemical energy is stored for use by cells
B. Know the two laws of thermodynamics
C. Understand the general form of chemical reactions (including which are products and which are reactants)
D. Know the difference between endergonic and exergonic reactions
E. Be able to define activation energy and how it relates to chemical reactions
F. Know what is meant by catalysis and how this relates to enzymes
G. Understand what an enzyme is and know what is meant by active site and binding site
H. Be able to describe in general terms how enzymes can be regulated
I. Know the general structure and function of ATP
J. Understand the terms oxidation and reduction and how they relate to electrons

II. Energy Conversion

Glycolysis, Fermentation, and Cellular Respiration

A. Be able to explain what role cellular respiration plays in living cells
B. Know the differences between aerobic respiration and anaerobic respiration
C. Know the overall equation for cellular respiration
D. Be able to describe in general terms the two stages of cellular respiration and explain which one is common to all known cells
E. Be able to explain what happens during glycolysis (in general terms, not each specific step) including the starting materials/reactants and the products (including electron and energy carrying molecules)
F. Understand how organisms can regenerate NAD^+ without oxygen (i.e. anaerobic respiration)
G. Be able to explain what is meant by fermentation and describe the two types we discussed in class
H. Understand generally what occurs during the Kreb's Cycle (including the starting materials, products, and electron and energy carriers)
I. Be familiar with the general idea of electron transport and the electron transport chain and how this is used to make ATP by chemiosmosis
J. Know how many ATP are generated from each part of cellular respiration during the breakdown of each glucose molecule and be able to compare the amounts of ATP made from aerobic versus anaerobic respiration
K. Understand how cellular respiration is linked to the biosynthesis of other biological molecules (like amino acids, lipids, and nucleic acids)

Photosynthesis

A. Know where all the energy that supports life comes from
B. Understand in general terms what photosynthesis is and know the overall equation (reactants → products) that represents it
C. Know the three general stages of photosynthesis and the locations that they occur in plant cells
D. Be able to describe the general structure and location of chloroplasts in plants (including the various internal compartments/membranes/etc)

E. Be able to explain what pigments are (including how this relates to light/photons) and which pigments are involved in photosynthesis
F. Understand the major stages of the light-dependent reactions and how this relates to photosystems, pigments, electrons (and electron carriers), and ATP.
G. Know the products (and by-products) of the light-dependent reactions
H. Be able to describe what occurs during the Calvin Cycle and know what enzyme is responsible for the initial fixing of carbon from carbon dioxide
I. Understand the difference between C_3, C_4, and CAM plants and how this relates to temperature

III. The Cell Cycle, Mitosis, and Cytokinesis

Understand the basic cell cycle and its regulation:

A. Interphase – Make sure you know what each of the phases are and what happens during each one.
B. Be able to explain how cancer relates to the cell cycle
C. Know what mitosis and cytokinesis are (more below).

Chromosome structure

A. Be able to draw a chromosome (both replicated and unreplicated) and label the following parts and explain what they are: Centromeres, Telomeres, Arms, Chromatids, Sister Chromatids
B. Know what n (and 2n) represent in terms of chromosome number and how this relates to ploidy (e.g. haploid and diploid)
C. Understand how chromosomes are packaged and what chromatin is. Also, what chromosomes are made up of.

Mitosis and Cytokinesis

A. Be able to explain what mitosis is and why it is important.
B. Be able to list the four phases of mitosis and explain what happens in each one, especially how the chromosomes are arranged.
C. Be prepared to draw a cell in mitosis with the correct number and arrangement of chromosomes if you are given n (or 2n) and the particular phase (e.g. anaphase).
D. Be able to explain how cytokinesis differs from mitosis and when it usually occurs relative to the phases of mitosis
E. Be able to explain the role of mitosis in multicellular organisms

IV. Meiosis and Sexual Reproduction

A. Be able to explain the purpose of sexual reproduction in terms of combinations of alleles
B. Be able to explain how meiosis is similar to mitosis and how the two processes differ. Also, how meiosis I differs from meiosis II.
C. Be able to draw/explain the phases of meiosis I and meiosis II.
D. Know which two phases in meiosis I are critical for the scrambling of alleles and be able to describe how it is accomplished in each one.
E. Know what is meant by a 'reductional division' and to part(s) of mitosis/meiosis this applies to. Understand how ploidy level changes.
F. Know how gametogenesis in humans differs from the generalized process of meiosis that we discussed in class (i.e. how oogenesis is different from spermatogenesis).

V. Mendelian Genetics

A. Know who Gregor Mendel was (also, where and approximately when)
B. Be able to describe Mendel's experiments, including what he was working on, what types of experiments where performed, and what sort of data was analyzed. Particularly his general crossing scheme (i.e. P_1, F_1, and F_2 generations and how they relate to each other). Also, explain the difference between a monohybrid and a dihybrid cross.
C. Be able to define the following terms: allele, homozygous, heterozygous, hemizygous, dominant, recessive, genotype, phenotype, and gamete

D. Be able to explain both of Mendel's laws and how they represent the behavior of chromosomes during meiosis.
E. Be able to diagram a cross of up to two genes using a Punnett Square (and possibly other methods) to predict the potential outcome.
F. Know the basic ratios from such crosses and how to derive more complex ratios from the basic ones (e.g. 3:1, 1:2:1, 1:1 and how these can get you to 9:3:3:1, 1:2:1:2:4:2:1:2:1, etc.)
G. Be able to solve simple genetics problems using your knowledge of Mendel's work and meiosis (see Genetics Practice Problems).
H. Be able to draw a diagram of meiosis and superimpose alleles on the diagram to illustrate how Mendel's Laws describe chromosome behavior.

VI. Extensions of Mendelian Inheritance

A. Know how sex is determined in humans and how the sex chromosomes relate to this
B. Understand why it is more difficult to follow Mendelian inheritance in humans than other organisms (like peas or fruit flies) even though genes in humans are still subject to Mendel's Laws
C. Be able to describe what a pedigree chart is and why they are important for the study of human genetics.
D. Be able to explain what is meant by sex linkage
E. Understand how some traits/alleles violate Mendel's Laws even though their inheritance is still Mendelian.
F. Be able to describe incomplete dominance and co-dominance. Know how they differ from each other. Know how the symbols used to represent these types of alleles differ from the normal uppercase=dominant, lowercase=recessive.
G. Understand what is meant by multiple alleles, lethal alleles, environmental influence, and hormonal/sex influence.
H. Be familiar with the examples described in class, particularly ABO bloodgroups.