Introduction to Cell & Molecular Biology
Fall 2007

Top Five Lists

Chapter 1 - *Lucas, Kelly B, Megan A, Eric*

1. The seven characteristics common to all forms of life (composed of cells, use energy, respond to environmental changes, regulate their internal conditions – homeostasis, grow and develop, reproduce, and evolve)
2. Living organisms can be viewed at different levels of complexity: atoms, molecules and macromolecules, cells, tissues, organs, organisms, populations, communities, ecosystems, and the biosphere. Entropy decreases as the level of organization increases.
3. Taxonomy involves grouping species according to their evolutionary relatedness to other species (from broad to narrow, each species is placed into a domain, kingdom, phylum, class, order, family, genus, and species)
4. The genome is the genetic composition of a species. It provides a blueprint for the traits of an organism; it is transmitted from parents to offspring, and acts as an instrument for evolutionary change. The proteome is the collection of proteins that a cell or organism can make.
5. The scientific method, also called hypothesis testing, is a series of steps to test the validity of a hypothesis. Experiments often involve a comparison between control and experimental groups.
6. The proteome is the complete complement of proteins and an organism or cell can make. Understanding genomes and proteomes helps us to understand the characteristics of individuals and how they survive in their native environments.
7. Vertical evolution is mutations in a lineage that change the characteristics of species over many generations. Natural selection results in the survival of individuals with greater reproductive success.
8. Biology is the study of life.
9. There are 3 domains consisting of Prokarya, Eukarya, and Archaea.
10. Evolution is the change in species over time and all of the evolution has a history or a story of what was.
11. Adaptation is different than evolution in the sense that adaptation is a feature that allows better survival the organism. A process or product that results for betterment of that particular organism.
12. Science seeks causes for natural phenomenon and gathers knowledge and evidence of the natural world in an organized manner to help support hypotheses.

Chapter 2 – *Shawn, Lo, Kayla, Shashika*

1. Bonding - including covalent, ionic and hydrogen bonds
2. Isotopes - this is when the number of neutrons in an atom is different and hence the mass number is also different.
3. Polar and Non-polar bonds - polar bonds occur between atoms with different electronegativity and occurs from covalent bonds while non-polar bonds occur from molecules of the same element and ionic bonds.

4. Water- what makes water so essential in the human body and ultimately the earth (hydrophobic and hydrophilic)
5. Acids and bases - the properties if each and the pH system.
6. Atoms are made up of protons and neutrons in the nucleus and electrons in an orbital
7. Oxygen, carbon, hydrogen, and nitrogen are the major elements that make up living organism
8. The properties of water
9. Acid vs. base
10. Carbon, Oxygen, Nitrogen, and Hydrogen are the main elements of life because they have stable covalent bonds, exist in the gaseous form, water and carbon both have unique properties, and other elements are unsuitable.
11. Atoms are composed of protons (positive charge, found in nucleus), neutrons (neutral charge, found in nucleus), and electrons (negative charge, found in orbital).
12. There are three main types of bonds that atoms can have: covalent (sharing of electrons), ionic (gaining and losing of electrons), and hydrogen (weak polar covalent bond).
13. Water is a polar molecule and is the basis of life. It has a high heat of vaporization, high specific heat, high heat of fusion, and surface tension. It is a universal solvent, transparent to light, and the basis of the pH system.
14. The pH of a solution refers to its hydrogen concentration. The pH of pure water is neutral at 7. Alkaline solutions have a pH of higher than 7 and acidic solutions have a pH lower than 7.
15. Atomic mass, atomic number and isotopes
16. orbitals in atoms and how they interact with each other to form molecules.
17. A bond is an attraction or a combination between atoms.
18. Water is very important to sustain life. The unique properties of water help to serve the above purpose.
19. CHO and N were favored as elements of life due to their unique properties.

Chapter 3 – *Mo, Lana, Anna, Corbin, Brett*

1. Functional Groups (amino, carbonyl [ketone/aldehyde], carboxyl, hydroxyl, methyl, phosphate, sulfate, sulfhydryl) See pg 43 for diagrams.
2. Carbon has the ability to form 4 covalent bonds with other elements, including itself.
3. Structural isomers contain the same atoms but in different bonding relationships; stereoisomers have identical bonding relationships but different spatial positioning of their atoms; enantiomers exist as mirror images of each other.
4. The four major classes of organic molecules are (1) carbohydrates [sugars] (2) lipids [fats, waxes, phospholipids, steroids] (3) proteins [amino acids] & (4) nucleic acids [RNA/DNA]
5. Four levels of protein structure are (1) Primary [a.a. sequence] (2) Secondary [bending/twisting into helicies or beta sheets] (3) Tertiary [folding/re-folding to assume 3D shape & (4) Quaternary [multimeric proteins that consist of more than one polypeptide chain]
6. Structure determines function
7. Carbon containing molecules are the basis for organic chemistry. Carbon is necessary in living organisms because it has the ability to bond with four

other atoms. It can also form both polar and non-polar bonds, bonds that are stable at many temperatures associate with life.

8. Carbohydrates (C-H-O) are broken down in the cell to form energy which is stored in ATP. Examples of carbohydrates are monosaccharide (glucose), disaccharides (sucrose) and polysaccharides (glycogen in animals, starch and cellulose in plants).
9. Lipids (usually C and H) are molecules that are insoluble in water and non-polar. Lipids include fats and phospholipids. Triglycerides are a common form of fat found in the body and are composed of a molecule of glycerol with 3 fatty acids attached to it. Fatty acids can be saturated, unsaturated and polyunsaturated.
10. Proteins contain C-H-O and nitrogen. Proteins play a major role in most life processes. They contain a side chain which consists of one of the 20 amino acids. Amino acids bind together to form peptides, and many polypeptides come together, they form a functional protein. Protein structure consists of primary (a. a sequence), secondary (twisting), tertiary (folding into 3-shape) and quaternary (many proteins together).
11. Nucleic Acids are found in two forms; DNA and RNA. They are are responsible for the storage, expression and passage of genetic information. DNA molecules forms a double helical structure and store genetic information that is coded into its monomers. RNA is responsible for decoding this information in order to form a specific polypeptide chain from the information. RNA consists of a single strand of nucleotides.
12. There are four kinds of organic molecules, carbohydrates, proteins, nucleic acids, and lipids.
13. Organic molecules have isomers. Isomers have the same chemical formula, but are formed into different structures. There are two kinds of isomers: structural isomers-have different bonding patterns; stereoisomers or geometric isomers(a type of structural isomers)- different spatial relationships enantiomer-mirror image

Chapter 4 – *Janae, Michaelen, Pa, Ben*

1. cell structures (organelles) of eukaryotes and prokaryotes
2. cytosol - synthesis and breakdown of molecules
3. Nucleus and endomembrane system
4. Semiautonomous organelles - mitochondria/chloroplasts
5. Cells theory - which consists of (1) organisms comprised of one or more cells, (2) cell basic unit of organization, and (3) cells derived from other cells.
6. Cells show unity and diversity/cell size
7. Cells consist of many organelles such as the nucleus, mitochondria, endoplasmic reticulum (rough and smooth ER), golgi apparatus, and the cytoplasm.
8. Comparison of Plant and Animal cells.
9. Comparison of Eukaryotic and Prokaryotic cells.
10. Cells have many ways of getting materials into/out of cells such as: exocytosis/endocytosis, diffusion/osmosis across membrane, phagocytosis, and pinocytosis. Cell structure of both Euk and Prokaryotic cells.
11. The Nucleus and endomembrane system.
12. Individual organelles and their functions in the cell.
13. Functions of the plasma membrane.
14. Synthesis and breakdown of molecules and where they occur

15. The Cell theory - All living things are composed of one or more cells, Cells are the smallest units of living organisms, New cells can only come from pre-existing cells by cell division
16. All life forms can be classified into two categories based on their cell structure: Prokaryotes and Eukaryotes.
17. Chromosomes containing DNA are located in the nucleus of eukaryotic cells.
18. Mitochondria produce most of a cell's ATP, which is utilized by many proteins to carry out their basic functions.
19. Metabolism is the sum of all chemical reactions by which cells produce the materials and energy that are necessary to sustain life.

Chapter 5 – *Tara, Kayleen, Greg*

1. Structure of Phospholipids: polar head= hydrophilic / non-polar tail= hydrophobic
2. Fluid Mosaic Model for the membrane
3. Membrane properties/permeability - allows passage of gases, soluble lipids, hydrophobic/non-polar, water (aquaporins).
4. Molecular Movements: bulk flow= mass movement, diffusion = net movement of individual molecules, osmosis= water's diffusion
5. Molecules from [hi energy or conc] to [lo energy or conc]
6. Water moves from high water potential to low water potential
7. Water potential is a measure of free energy of water
8. Transport - active= against gradient, requires ATP and Na/K pump; Passive= with gradient
9. Functions of cell membrane
10. Surface of cell membrane
11. Cells are surrounded by a phospholipid bilayer. The phospholipids are formed from a glycerol backbone (C3), two fatty acids and a phosphate group. Proteins are imbedded in this membrane—peripheral (outer or inner surface of membrane) and integral (interior of membrane) proteins.
12. The membrane has several functions including: regulating cellular traffic, separate internal and external environments, cell support, info processing/communication, and transport.
13. Membranes are semi-permeable. They only allow certain substances to pass through, for example, water, non-polar and lipid soluble substances. They are impermeable to large polymers and charged molecules.
14. Molecules move from one place to another through bulk flow-the mass movement of molecules due to a pressure gradient, diffusion-random movement of substances form hi to low following a concentration gradient, osmosis-diffusion of a solvent (water) across a membrane, and dialysis-the movement of a solute across a membrane.
15. There are two types of carrier mediated transport. One is facilitated diffusion which does not involve ATP, but instead uses transport proteins which act like a channel to move molecules faster than expected down the concentration gradient. The other is active transport which requires energy and other proteins to transport substances against a concentration gradient.

Chapter 6 – *Jillian, Jackie, Grace, Julie*

1. Genomes, functional molecules, and pre-existing organization
2. Molecular recognition
3. Eukaryotic system is made up of four interacting parts that work together: nucleus, cytosol, endomembrane system, and semiautonomous organelles.
4. Binary fission divides mitochondria and chloroplasts
5. Sequences of proteins that are destined for semiantonomous organelles
6. Within eukaryotic cells (which act much like a factory) there is a system composed of four parts that work together for the cell to function. The four parts are: the nucleus, cytosol, endomembrane system and the semiautonomous organelles.
7. The nucleus (the brain): double membrane bound organelle that has pores in the membrane and contains chromatin inside which is chromosomes that are made of DNA and proteins, nucleolus where RNA and ribosome production happen and nucleoplasm (matrix).
8. The cytosol: within the cytosol there is the cytoskeleton which provides organization and facilitates movement, it coordentates responses to the enviornment via signaling pathways (communication), and controls the levels of different types of molecules through pathways for the synthesis and breakdown of molecules.
9. Endomembrane system includes: the nuclear envelope, endoplasmic reticulum, Golgi apparatus, lysosomes, vacuoles, and plasma membrane. This system works with the cytosol to synthesize most lipids. Within the system, proteins are first inserted into the ER membrane and transported by vesicles to other parts of the system.
10. Semiautonomous organelles include mitochondria ("power house", site of cellular respiration) chloroplasts (where photosynthesis occurs) and peroxisomes which reproduce by binary fission. The endosymbiosis theory proposes that the mitochondria and chloroplasts origionated from bacteria that took up residence within a primordial eukaryotic cell.
11. The Endomembrane System is critical for lipid synthesis, protein synthesis and sorting, and the attachment of carbohydrates to lipids and proteins.
12. Lipid Synthesis occurs in the ER Membrane. In eukaryotic cells, the cytosol and the endomembrane system work together to synthesize most lipids in the ER membrane.
13. Mitochondria and chloroplasts contain their own genetic material and divide by binary fission.

Chapter 7 – *Emily F, Michael, Molly M, Ora*

1. Cell Respiration process
2. How glycolysis produces ATP
3. Which parts of cellular respiration produce ATP and how much
4. Differences between aerobic and anaerobic respiration
5. Forms and states of energy (kinetic, potential, kinetic; radiant, etc)
6. Structure and function of enzymes
7. Factors that control enzyme activity
8. Energy conservation is the first law of thermodynamics, and the second is that all systems tend to a state of entropy.
9. Free energy = amount of energy that is available to do work... free energy is symbolized by delta G, and a spontaneous reaction is symbolized by a negative change in free energy.

10. Enzymes (protein molecules that increase the rate of a reaction) bind to an substrate at the active site forming the enzyme-substrate complex (lock & key model). This process may be inhibited (or sometimes enhanced) by competitive and noncompetitive inhibitors.
11. Cellular respiration is the process by which cells obtain energy from organic molecules. When oxygen is used it is aerobic, vs. anaerobic without oxygen used. T
12. The following stages are involved in oxidizing glucose: glycolysis → breakdown of pyruvate to an acetyl group → citric acid cycle → oxidative phosphorylation
13. Laws of Thermodynamics; Law 1 – energy cannot be created or destroyed, Law 2 – transfer of energy or transformation from one state to another increases entropy (degree of disorder.
14. Exergonic reaction – free energy released, spontaneous, Endergonic reaction – requires energy, non-spontaneous
15. Catalyst – agent that speeds up a chemical reaction
16. Proteins – chains of amino acids linked by peptide bonds
17. Enzyme activity is influenced by: Enzyme concentration, Substrate concentration, Temperature, pH, inhibitors
18. Catabolism – breakdown of large molecules into smaller molecules, Anabolism – build molecules from smaller ones
19. Glycolysis - breakdown of glucose, with oxygen (aerobic) or without oxygen (anaerobic), starting materials are: glucose, 2 ATP, 2 NAD+, 4 ATP, end products are: 2 pyruvate, 2 ADP, 2 NADH, 4 ATP; occurs in the cytosol

Chapter 8 - *Molly M, Amy, Michaela, Robby S*

1. General facts of Photosynthesis (equation, endergonic, reduction rxn)
2. Overview of the process of Photosynthesis (who, what, when, where, why)
3. Light Dependent Reactions (Z-Scheme)
4. Light Independent Reactions (Calvin Cycle)
5. Wavelengths (length of certain colors, action spectrum, quality vs. quantity)
6. Structure of chloroplasts (membranes, where the reactions occur)
7. Electron Transport and ATP Synthesis
8. General equation: $CO_2 + H_2O$ + light → $(CH_2O)_n + O_2$; occurs in the chloroplasts
9. Black Box diagram; light reactions, z-scheme (light dependent), Calvin cycle (light independent)
10. Calvin Cycle; reduction, rearrangement, recharging, fixation
11. Structure of the leaf and functions of each part
12. Absorption spectrum vs. action spectrum

Chapter 10 – *Brian, Robb, Elena, Dustin F*

1. Extracellular matrix is a network of material secreted by plant/animal cells that forms a complex meshwork outside of cells
2. ECM in animals is made of proteins and polysaccharides involved in strength, structural support, organization, and cell signaling
3. Three types of cell junctions in animals are anchoring, tight, and gap junctions; for plants they are middle lamella and plasmodesmata
4. Cell Junctions are structures that adhere cells to each other and to the ECM

5. Tissues are groups of cells that have similar structure. (four general kinds in animals are epithelial, connective, muscle, and nervous)(in plants three general types dermal, ground and vascular)
6. Plants have a cell wall
7. Extracellular matrix (ECM) – a network of material that is secreted from cells and forms a complex meshwork outside of cells.
8. ECM in animals performs many important roles: strength, structural support, organization and cell signaling.
9. Plant cells are surrounded by an ECM which is called the cell wall, it is a protective layer.
10. Cell junction is a specialized structure in plants and animals that link cells within the organism resulting in what is called a multicellular organism. There are different types of cell junctions in plant as opposed to animal cells. Common animal cell junctions are; anchoring junctions, tight junctions and gap junctions. Common plant cell junctions are; middle lamella and plasmodesmata.
11. Tissue is a part of an animal or plant consisting of a group of cells having similar structure and function.

Chapter 11 – *Andrea S, Jessica, Maria, Andy K, Maria*

1. Experiments by Avery, MacLeod, and McCarty and by Hershey and Chase provided compelling evidence to support the role of DNA as the genetic material.
2. Hammerling, Steward and Gurdon determined where the DNA is located in the cell, the nucleus.
3. Meselson and Stahl proved the semi-conservative mechanism of replication.
4. Contributions by Watson and Crick, Wilkins and Franklin, and Chargaff contributed to the determination of DNA structure.
5. DNA is replicated by original DNA strands acting as templates for the synthesis of new DNA strands (semi-conservative).
6. DNA is a double helix with a sugar-phosphate backbone and many different combinations of nitrogenous bases.
7. The current model of DNA works because it accounts for storing information, transmitting messages, replication, variability/ diversity, and mutations.
8. Replication is the process of duplicating DNA to pass on to daughter cells.

Chapter 12 – *Russ, Lauren, Alex, Lindsey*

1. One gene/one enzyme theory proposed by Beadle and Tatum
2. Process of transcription and what the outcome of it is. Transcription is converting the message in DNA into RNA (occurs in the nucleus) or the production of RNA in the nucleus using a DNA template= RNA synthesis.
3. RNA processing in eukaryotes and prokaryotes, the similarities and differences.
4. Process and steps of translation and what it accomplishes (using the instructions in mRNA, a protein is created)
5. Genetic code and what it does.
6. Central Dogma- The idea that explains how DNA determines the phenotype.

7. Ways that RNA differs from DNA (single stranded vs. double stranded; nucleotides have a sugar ribose vs. deoxyribose; shorter vs. longer; uracil vs. thymine)
8. There are three kinds of RNA which are produced during transcription (rRNA- ribosomal RNA which makes up the ribosome and is the most abundant type; mRNA - Messenger RNA carries the genetic message to the ribosome to be translated into a protein, a short lived type of RNA, also heads out to the cytoplasm to find a ribosome; tRNA- Transfer RNA that shuttles amino acids to the ribosome for protein synthesis and also makes a beeline to the cytoplasm and becomes activated by linking to the appropriate amino acid. Activating enzymes join the tRNA and amino acids.
9. Transcription is the process by which RNA is synthesized.
10. Translation is the process by which mRNA is used to synthesize a protein.
11. There is a genetic code first discovered by Nirenberg for the formation of amino acids from nucleotide sequences.
12. RNA is processed in Eukaryotes.

Chapter 13 – *Bri, Megan W, Heather, Jordan*

1. Gene regulation is the ability of cells to control their level of gene expression.
2. Gene regulation ensures that proteins will be produced only when they are needed; this saves energy for the cell.
3. Recall the toad and carrot experiments that taught us not all genes are switched on at any one time and that there are mechanisms for regulating the expression of gene. These mechanisms are highly coordinated.
4. Operons are the most important means of gene regulation in prokaryotic cells.
5. Eukaryotic cells regulate gene via transcriptional control, mRNA, translation, and post-translation processing.
6. The tryptophan operon is a repressible operon.
7. The lac operon is an inducible operon and glucose is a catabolite repressor for the system.
8. Relationship between levels of lactose and glucose around an operon and how it affects the operon
9. differences in cell regulation between eukaryotes and prokaryotes
10. Lac operon and its function
11. trp operon and its function
12. Eukaryotes regulate genes in different ways by: Uncoiling chromosomes, RNA processing, DNA methylation, silencing
13. Eukaryotes regulate their genes differently than prokaryotes because of their different genomes.
14. Know the difference between inducible and repressible genes and how they can be turned on or off.
15. Know how the lac operon works and what it does.
16. Know how the trp operon works and what it does.
17. Know how eukaryotes regulate RNA transcription and translation

Chapter 14 – *Khris, Dustin, Amber W*

1. Cell mutation - sickle-cell anemia: caused by a mutation of the beta-globin gene
2. Mutations may be either spontaneous or induced

3. Mutagens alter DNA structure in different ways (chemical or physical)
4. DNA repair - one of the most common types of repair is nucleotide excision repair (NER): can fix UV-induced damage, chemically modified bases, missing bases, etc
5. Cancer - At least 80% of all human cancers are related to exposure to carcinogens (agents that increase the likelihood of developing cancer)
6. Mutations occur in a variety of ways
7. Examples of mutations include sickle cell anemia, thalassemia
8. Mutations are important for heredity, evolution; nonsense - changes to stop codon; frameshift - adds or deletes either one or two nucleotides

Chapter 15 – *Nick, Megan H, Kelsey*

1. The cell cycle consists of a series of stages needed for cell division. The G1 phase for growth and normal functions, the S phase for DNA replication, the G2 phase for preparation for mitosis, mitosis, and cytokinesis.
2. Mitosis consists of the following parts in order: Prophase, Premetaphase, Metaphase, Anaphase, and Telophase (directly followed by cytokinesis). Mitosis forms 2 diploid cells identical to that of their parent.
3. Meiosis has two phases: Meiosis I and Meiosis II. Meiosis I forms 2 haploid cells, whereas Meiosis II forms 4 haploid cells.
4. Meiosis allows for genetic variation.
5. Homologous chromosomes cross over and are separated in Metaphase I of meiosis in a random order. Deficiencies, inversions, duplications, and translocations are different ways to alter chromosome structure.
6. Cytokinesis is different in plant and animal cells. In animal cells, a cleavage furrow forms to split the two cells. In plants, a cell plate forms and separates the two newly formed cells.
7. Double Stranded DNA wraps around histone proteins to form nucleosomes (first way of compacting), forming a 30 nm fiber (2nd way of compacting). Eventually chromatin becomes so compact---called heterochromatin. It compacts even more to prepare for mitosis and meiosis.
8. Mitosis is for asexual production (2 identical daughter cells), carried out in multiple stages: interphase (prepares to divide by replicating DNA), prophase (nuclear membrane disappears, sister chromatids match up, spindle forms) metaphase (sister chromatids line along metaphase plate), anaphase (single chromosomes pulled to opposite poles), telophase (nuclear membrane re-forms and chromosomes decondense), and cytokinesis (two daughter cells form from division via cleavage furrow)
9. Meiosis is for sexual reproduction (4 daughter cells with half of each parents' DNA), formed when two gametes form a zygote via fertilization. Meiosis carried out in multiple stages: interphase (prepare to divide), prophase I (homologous chromosomes match up and form bivalents--crossing over occurs, spindle forms, nuclear membrane disappears), metaphase I (bivalents line along metaphase plate), anaphase I (homologous chromosomes separate toward opposite poloes) telophase I (nuclear membrane forms and cleavage furrow separates two cells--cytokinesis), prophase II (sister chromatids condense, spindle forms, nuclear membrane disappears), metaphase II (sister chromatids line along metaphase plate) anaphase II (chromatids pulled toward opposite poles), telophase II (nuclear membrane re-forms, separate to four cells via cleavage furrow---cytokinesis)

10. Bivalents are only during meiosis I, sister chromatids are only during mitosis and meiosis II. Crossing over usually occurs in meiosis I and not usually in mitosis or meiosis II. mitosis and meiosis II are haploid, while meiosis I is diploid. Animals are diploid-dominant species.
11. Mutations can occur on chromosomes and non-disjunctions can occur during meiosis I. Either can have serious consequences resulting in livable and non-livable creatures.
12. Heterochromatin: DNA wound so tightly that it is transcriptionally inactive; Euchromatin: less condensed DNA that can still be transcribed
13. Nondisjunction - chromosomes fail to separate properly during meiosis. Results in aneuploids such as Trisomy 21, Triple X Syndrome, Kleinfelter's, Jacob's, and Turner's Syndrome

Chapter 16 – *Stephany, Stephanie, Aaron*

1. Who is Mendel and what did he do?
2. What is the Law of Segregation?
3. What is the Law of Independent Assortment?
4. What are sex-linked traits?
5. What is the difference between between dominance, co-dominance and incomplete dominance?
12. Humans have 20 autosomes and 1 pair of sex-linked chromosomes. This is where all human genes are found.
13. The Law of Segregation states that one of each homologous chromosomes goes to daughter cells and the Law of Independent Assortment states that homologous chromosomes separate independently of each other.
14. The genotype is the genetic composition of an individual, the phenotype is the outward expression of the genetic make-up, and an allele is a variant form of a gene.
15. A Punnett square is used to predict the outcomes of genetic crosses.
16. Incomplete Dominance is when neither allele dominates and you get a blended phenotype. Ex: red and white alleles for a flower make a pink flower.
17. Co-dominance is when an individual expresses both alleles. Ex: blood types.

Chapter 17 – *Adam, Katie H, Meghan R*

1. Gene Interactions
2. Linkage/Non-linkage
3. Crossing Over
4. Mutations on Mitochondrial Genes
5. X Inactivation
6. Epistasis- When the alleles of one gene mask the effects of a different gene
7. Linked genes- When two different genes are on the same chromosome and inherited as a pair unless crossing-over occurs.
8. Barr-body- A highly condensed X chromosome when there is more than one X chromosome paired together
9. Crossing-Over- When a linked gene switches an allele with another to produce a variant of offspring including recombinants that would not have been made otherwise.
10. Polygenic- Many genes help the outcome of one trait
11. Map distance can be calculated between two genes = number of recombinant offspring/ total Number of offspring x 100
12. Barr body (Pg. 360)

Chapter 18 – *Megan K*

1. Hershey and Chase's experiments with *E. coli* and viruses
2. Structure of a virus
3. How viruses multiply through the takeover of host cells
4. Binary fission
5. Differences between bacterial and eukaryotic DNA