**AP Biology Summer Assignment**

The following documents are the required summer assignment for students taking AP Biology (no matter the teacher you have). The purpose of the assignment is to help you remember key terms and concepts from your Biology 1 class, so that all students are beginning the year with the same basic information. During the year, it will be assumed that you have this basic knowledge. For each unit that was covered in Biology 1 (total of 9 units) there is a set of notes with key terms and concepts as well as a link to a google form. Students will be required to read through the notes and fill out the corresponding google form for each unit. The following is a list of helpful information:

* You do not need a google account to complete the google forms, you will always be asked to enter your name and student ID as a way of identification
  + Please use your full legal name (as it would appear on a teacher’s roster)
* Once you begin a google form, you cannot pause it or save it partially completed, it must be finished in its entirety.
  + Each google form has approximately five questions and should take approximately 10-15 minutes to answer
* In addition to the notes provided to you, please feel free to use additional resources (from your Biology 1 class, textbooks, etc.) to complete the summer assignment; however plagiarism will not be tolerated (this includes copying and pasting answers from the internet or from other students).
* The following are suggested completion dates for the summer assignment:
  + Units 1-3 🡪 July 8th, 2016
  + Units 4-6 🡪 July 29th, 2016
  + Units 7-9 🡪 August 15th, 2016
  + *While these are not required due dates, the teachers will be checking responses on these days and you and/or your parents will receive communication that you are behind schedule on completing your summer assignment for AP Biology*
* This document, along with the notes and google form links will be posted on Mrs. Krouse’s, Ms. Glick’s and Mr. Burda’s webpage for access throughout the summer in case you misplace this hard copy.

If you have questions or concerns about the summer assignment please contact the AP Biology teachers at the following email addresses:

Ms. Glick – [GlickJM@pwcs.edu](mailto:GlickJM@pwcs.edu)

Mrs. Krouse – [OttoliKE@pwcs.edu](mailto:OttoliKE@pwcs.edu)

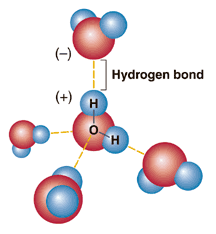
Mr. Burda - [BurdaDT@pwcs.edu](mailto:BurdaDT@pwcs.edu)

**AP Biology Summer Assignment Notes**

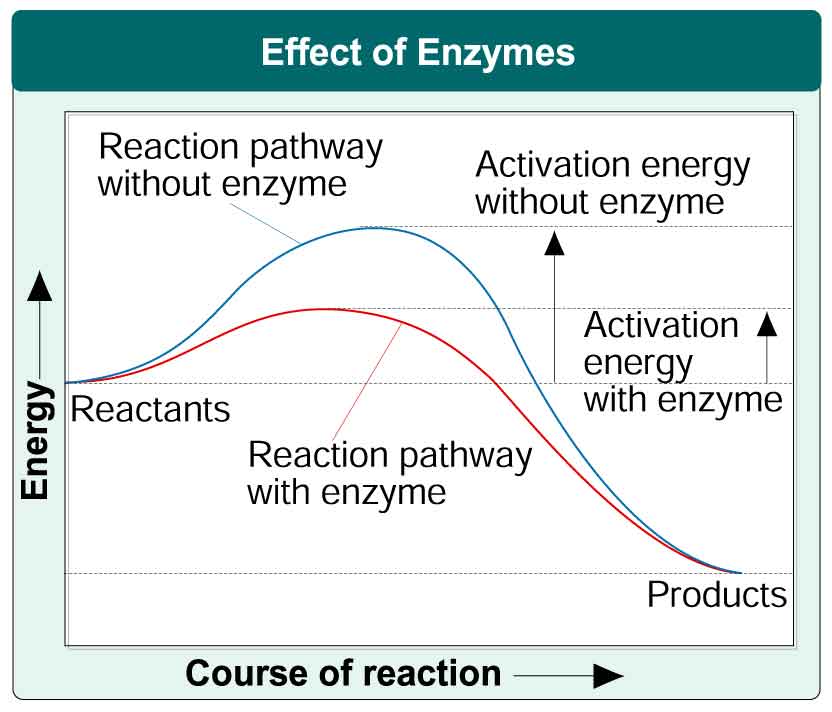
***Unit 1 – Introduction to Biology***

1. Characteristics of Life
   1. Basic Unit is the Cell
   2. They Reproduce (either asexually or sexually)
   3. All Based On Universal Genetic Code (DNA)
   4. Grow & Develop
   5. Obtain & Use Materials & Energy (autotrophs produce their own, heterotrophs obtain it through consumption of other materials)
   6. Respond To Their Environment
   7. Maintain A Stable Internal Environment (referred to as homeostasis)
   8. As a group, Living Things Evolve, That Is They Change Over Time
   9. Display Organization (atom, molecule, organelle, cell, tissue, organ, organ system, organism)
2. Scientific Method
   1. Types of data: Quantitative (numbers) and Qualitative (descriptions not involving numbers)
   2. Step 1: Formulate a question that can be answered through an experiment – it must be testable!
   3. Step 2: Develop a Hypothesis - a proposed scientific explanation for a set of observations
   4. Step 3: Come up with a procedure to test your hypothesis
      1. Must have a control group (a group used for comparison) and an Experimental Group (the group exposed to the factor being tested)
      2. Independent Variable = the variable the scientist changes
      3. Dependent Variable = the variable that changes as a result
      4. Constant = a factor/variable that remains fixed during an experiment
   5. Step 4: Carry out the experiment and collect data
   6. Step 5: Analyze Data through the use of charts and Graphs
   7. Step 6: Draw a conclusion and communicate results to the scientific community
3. Graphing Analysis
   1. X-axis should be your independent variable and the Y-axis should be the dependent variable
   2. DV vs. IV is a conventional way to name graphs; however it doesn’t always work
      1. Other ways to title graphs are DV in response to IV or by using an explanation of results (ex: rain fall increase over time)
   3. Generally use a line graph when the IV changes *amount* (day #, amount of fertilizer, etc)
   4. Generally use a bar graph when the IV changes *type* (person name, color of flower, etc.)

***Unit 2 – Biochemistry***

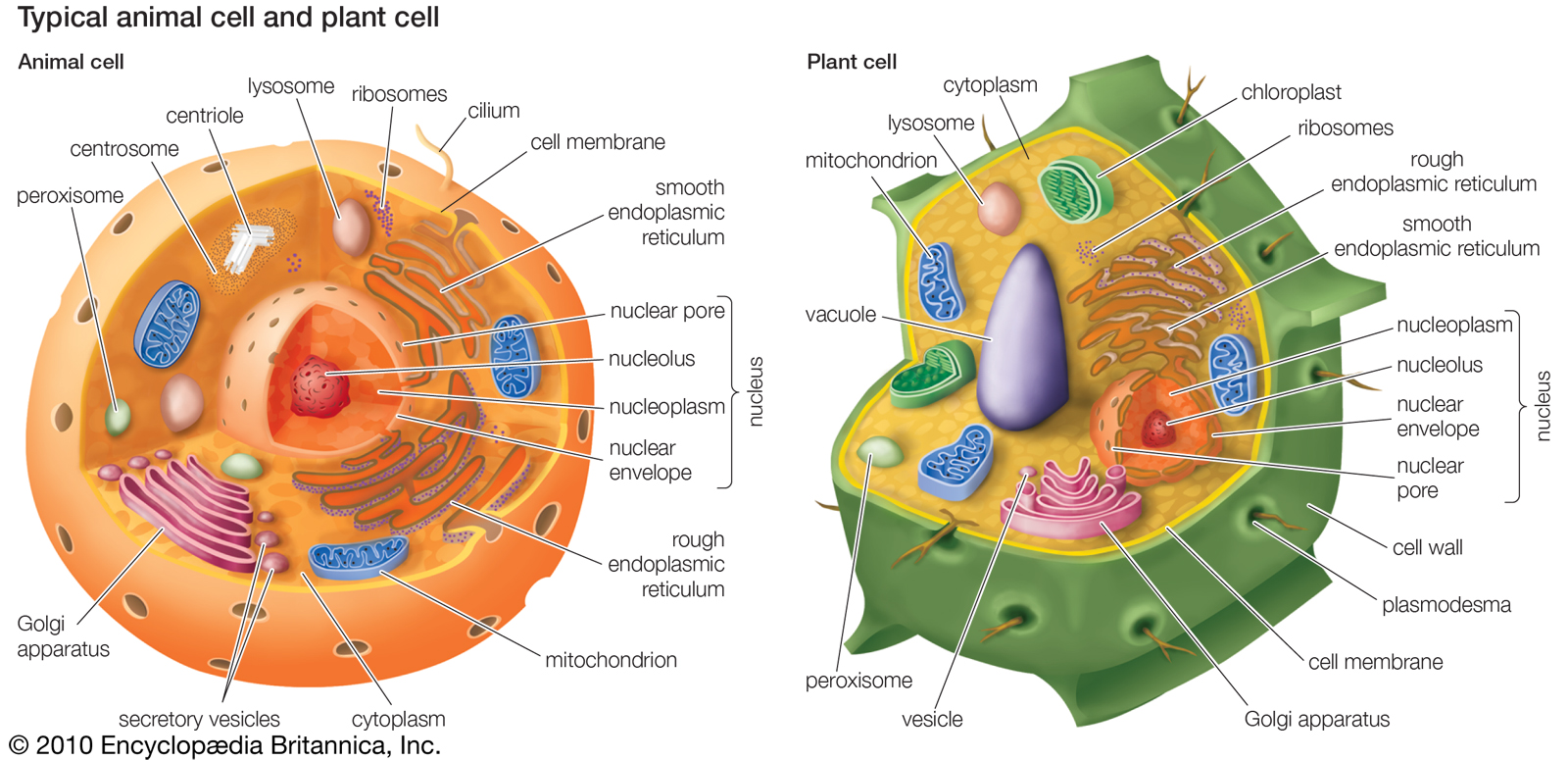
1. An element is a pure substance that is composed of only one type of atom; There are 92 natural elements
   1. An atom is the basic unit of matter; smallest particle of an element with all properties of that element
      1. Atoms are made up of three subatomic particles: proton (+), neutron (neutral) and electron (-)
   2. Isotopes are atom of same element with different number of neutrons (e.g., carbon-12, carbon-13, carbon-14)
   3. The atomic mass of an atom is composed of the number of protons + the number of neutrons
   4. The atomic number of an atom is the number of protons
      1. Neutrons can be calculated by taking the Atomic Mass – Atomic Number
      2. In a neutral atom, there is always the same number of protons and electrons
   5. A chemical compound is a substance formed by the chemical combination of two or more elements in definite proportions.
      1. The atoms in compounds are held together by chemical bonds and the electrons that are available to form bonds are called valence electrons.
      2. A covalent bond occurs when electrons are shared and an ionic bond occurs when electrons are transferred
2. Water is composed of 2 atoms of hydrogen linked by covalent bonds to 1 atom oxygen (H2O)
   1. It is considered a Polar Molecule: has positive hydrogen end and negative oxygen end because the electrons are unevenly distributed between the Oxygen and the two Hydrogen atoms.
   2. Because of the partial charges, the positive hydrogen of one water molecules is attracted to the negative oxygen of a different molecule, creating a hydrogen bond
   3. Due to hydrogen bonding, water has many unique properties
      1. **Cohesion:** Water molecules are drawn **tightly** together
      2. Water molecules on the surface of a lake or a pond, this forms a film, which is called **surface tension**
      3. Adhesion = Water adheres (sticks) to different surfaces
      4. Capillary Action= Water can flow up a tube, against gravity
      5. Water is the universal solvent (other substances easily dissolve in water)
      6. Water has a basic pH (7)
      7. Water is less dense in its solid form
      8. Water has a high heat capacity because it absorbs a lot of heat from the air without having a large temperature change
3. Macromolecules
   1. The most common elements in living things: Carbon, Hydrogen, Nitrogen, Oxygen, Phosphorus and Sulfur (CHNOPS)
   2. The four major macromolecules are all considered organic because they contain carbon
   3. Macromolecules are built from monomers (building blocks) through dehydration synthesis and the polymers are broken down through hydrolysis

|  |  |  |  |  |  |
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|  | Elements | Monomer | Polymer | Function | Examples |
| **Carbohydrate** | C, H, O | Monosaccharide (glucose or fructose) | Polysaccharide | Short term energy storage, structure in plants | Starch, Glycogen, Cellulose |
| **Lipid** | C, H, O | Most made from glycerol and fatty acid chains | Ex: Triglyceride | Long term energy storage, insulation | Fats, oils, waxes, steroids |
| **Nucleic Acid** | C, H, N, O, P | Nucleotide | Ex: DNA or RNA | Genetic Code | DNA and RNA |
| **Protein** | C, H, N, O, P, S | Amino Acid | Polypeptide | Structure,  Transport,  Movement,  Defense,  Regulating Cell Functions | Hemoglobin, lipase, protein channel |

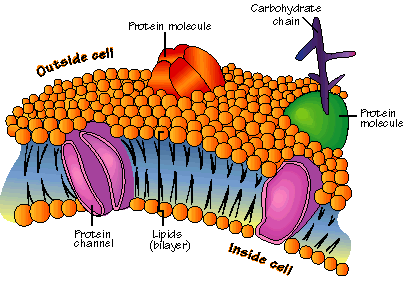
1. Chemical reactions always involve the breaking of bonds in reactants and forming of new bonds in products
   1. Some reactions release energy and others absorb energy
      1. Activation Energy: the energy required to start a reaction
   2. Some chemical reactions that make like possible are too slow or have activation energies that are too high - for this reason, cells make Catalysts, substances that speed up chemical reactions by lowering the activation energies
      1. Enzymes are catalysts that are protein molecules.
   3. Each enzyme has a specific shape and a specific portion called the active site, where substrates bind.
   4. Once the reaction is complete, the enzyme releases the products of the reaction.
   5. Enzymes can join or break substrates into products.
   6. Enzymes work best at a certain pH and temperature.

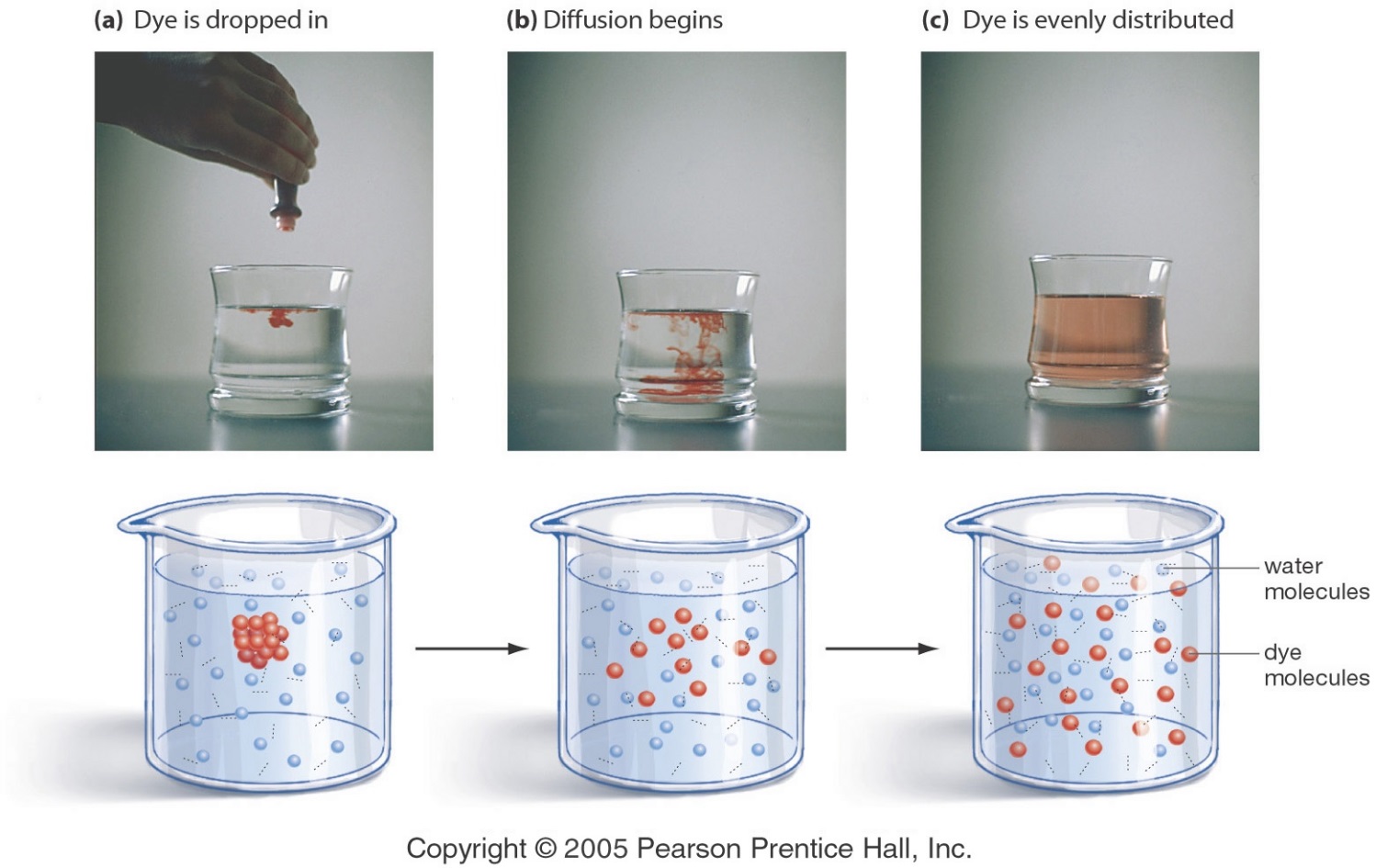
***Unit 3 – Cell Structure and Transport***

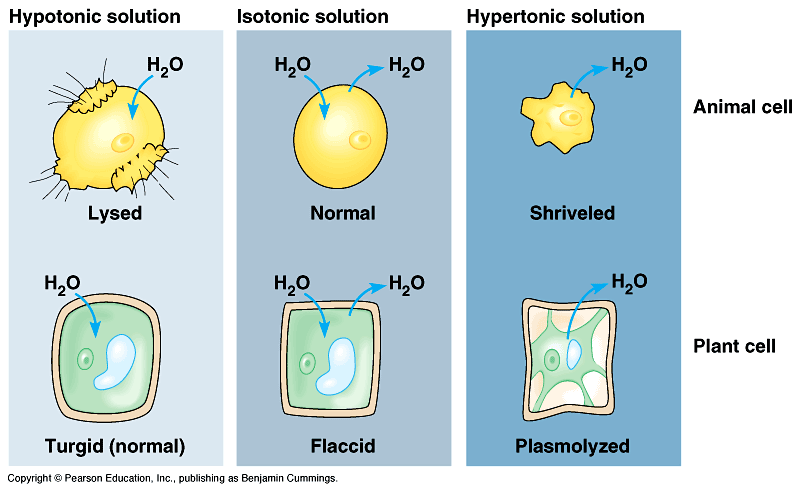
1. In 1665, Robert Hooke used an early microscope to look at a thin slice of cork, a plant material. Cork looked like thousands of tiny, empty chambers. Hooke called these chambers “cells.”
   1. Along with Hooke’s discover, several other scientists helped to develop the Cell Theory
      1. All living things are composed of cells
      2. Cells are the basic unit of structure and function in living things
      3. New cells are produced from existing cells
2. Cells come in a variety of shapes and sizes. There are two main types: Prokaryotic and Eukaryotic
   1. All cells: are surrounded by a barrier called a cell membrane and at some point contain DNA.
   2. Eukaryotes are cells that contain nuclei and Prokaryotes are cells that do not contain nuclei.
      1. The nucleus is a large membrane-enclosed structure that contains the cell's genetic material in the form of DNA.
      2. Prokaryotes do not have membrane-bound organelles (cell parts surrounded by membrane).
         1. Prokaryotic cells are generally smaller and simpler than eukaryotic cells.
         2. Example Organism: Bacteria
      3. Eukaryotic cells generally contain dozens of cell parts (organelles) and internal membranes
         1. Many eukaryotic cells are highly specialized (Ex: leaf cells in plants, nerve cells, muscle cells)
         2. Example Organisms: Plants, animals, fungi, and protists are eukaryotes.



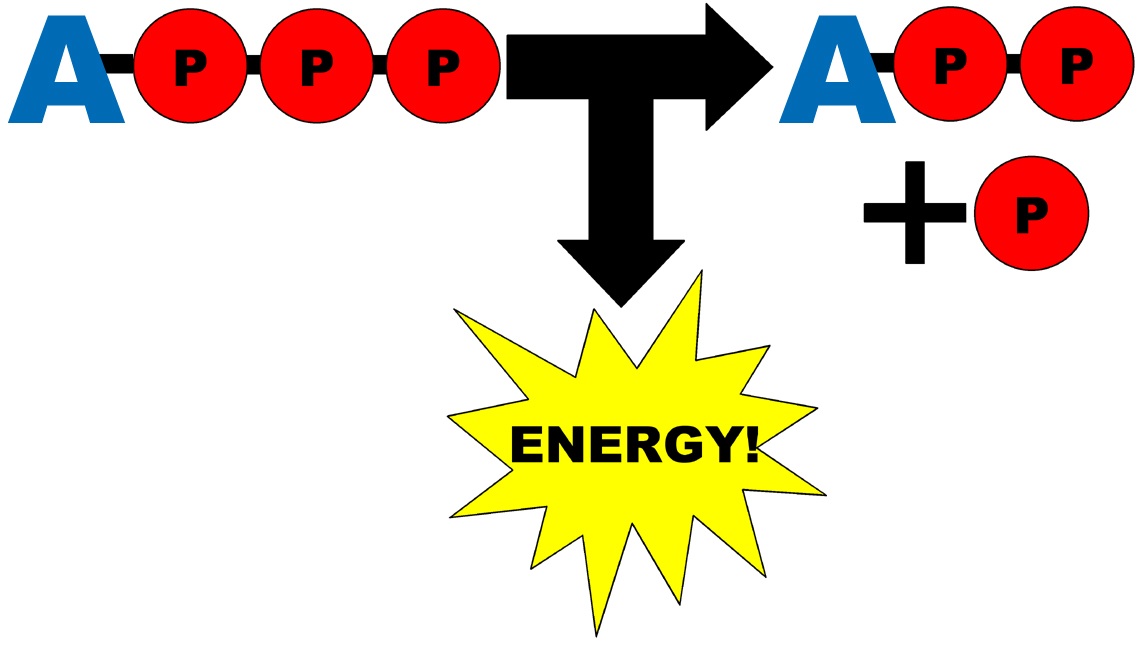
* 1. Some of the major organelles along with their function are listed below:
     1. Vacuole – storage for the cell (much larger in plants)
     2. Lysosome – breaks down waste
     3. Ribosome – produces proteins
     4. Golgi Apparatus/Complex – modifies and packages proteins
     5. Cytoplasm – jelly-like substance that suspends the organelles
     6. Nucleus – control center of the cell
     7. Nucleolous – produces the ribosomes
     8. Cell Membrane – control what enters and exits the cell
     9. Mitochondria – site of cellular respiration (energy production)
     10. Endoplasmic Reticulum (Smooth and Rough) – production and modification of proteins (rough) and lipids (smooth)
     11. Centriole – aides in animal cell division
     12. Cell Wall – present in plants and bacteria to provide structure
     13. Chloroplast – site of photosynthesis (glucose production)
     14. Cilia/Flagella – microtubules used for cell movement

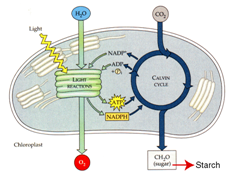
1. The cell membrane Regulates passage of materials into and out of the cell
   1. Parts of the membrane:
      1. Lipid bilayer (2 layers) - Made of 2 sheets of phospholipids, a type of lipid with a hydrophilic head and 2 hydrophobic tails
      2. Proteins - Act as channels for large particles to enter and leave the cell
      3. Cholesterol – helps to provide structure to the fluid membrane
      4. Carbohydrate chains - Recognize parts of molecules to determine what molecules can be brought into the cell
   2. Simple diffusion -Molecules move from area of high to low concentration
      1. This means they are going down the concentration gradient
      2. Passive Process (no energy required)



* 1. The membrane is selectively permeable, this means only certain solutes (typically small ones) can pass across by simple diffusion
  2. Facilitated Diffusion - Diffusion of certain molecules through a selectively permeable membrane, made possible by protein channels
     1. Passive Process
     2. Down gradient
  3. Osmosis - Diffusion of water across a selectively permeable membrane
     1. Passive process
     2. Down gradient (that is, water moves down its gradient)
     3. Types of solutions:
        1. Isotonic - Solution outside the cell has the same solute (and water) concentration as the cell itself
        2. Hypotonic - Solution outside the cell has a lower solute (higher water) concentration than the cell itself
        3. Hypertonic - Solution outside the cell has a higher solute (lower water) concentration than the cell itself
  4. Active Transport - Movement of materials from low to high concentration
     1. Active process (uses energy)
     2. Up Concentration Gradient
     3. Molecular pumps are membrane proteins that use energy from ATP to molecules across cell membranes.
     4. Exocytosis: sending large amounts of material out of the cell
     5. Endocytosis: taking large amounts of material into the cell
        1. Phagocytosis: The membrane folds to enclose solid particle (cell eating)
        2. Pinocytosis: The membrane folds to enclose liquid with dissolved materials (cell drinking)

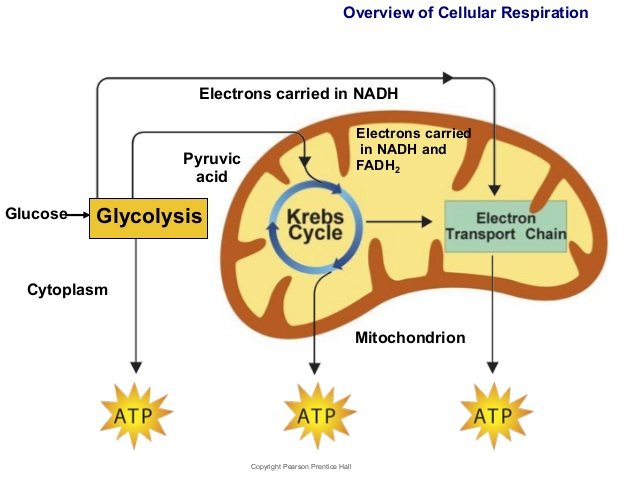
***Unit 4 – Cell Energy***

1. Energy is the ability to do work.
   1. Solar Energy: the ultimate source of energy available to Earth
   2. Chemical Energy refers to energy that is stored in molecular bonds (forces that hold molecules together)
   3. ATP is one of the most important energy storing compounds - An ATP molecule releases chemical energy when a bond holding a phosphate group to the molecule is broken
   4. The photosynthesis equation is 6CO2 + 6H2O + light energy 🡪 C6H12O6 + 6O2



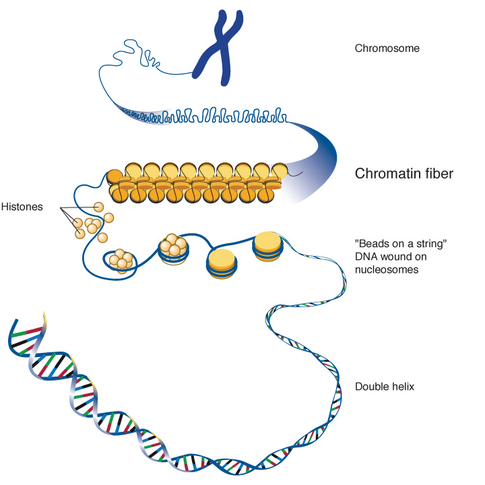
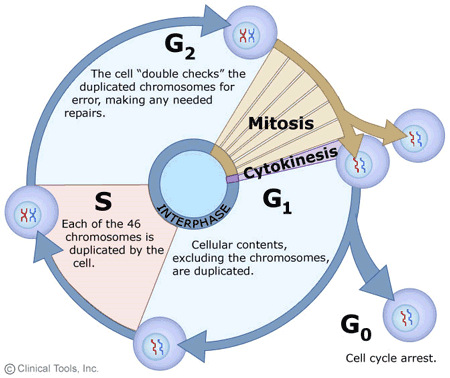
* + 1. Takes place in the chloroplast and is composed to two processes
    2. In the light reactions, light energy is transformed to ATP and NADPH, and water is used and oxygen is released.
       1. This process takes place on the thylakoid membrane. Light energy is absorbed by chlorophyll and the electrons (which came from the splitting of water) use this energy to move down an electron transport chain. This creates a proton gradient which powers ATP synthase to create ATP
    3. The ATP and NADPH made in the Light Dependent portion are used to power the Calvin Cycle which takes place in the stroma of the chloroplast
       1. In this process, 6CO2 are used to make a 6 carbon sugar called glucose

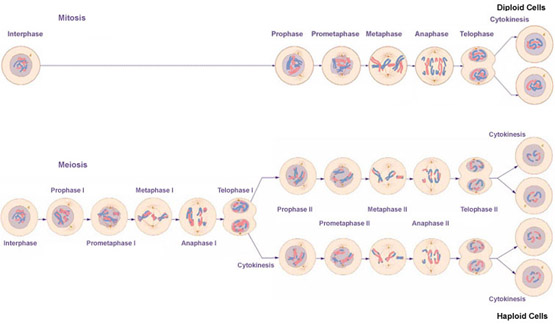
1. Living things get most of the energy they need from glucose.
   1. Autrotrophs make glucose using photosynthesis
2. Heterotrophs get glucose from food they eat



* 1. Aerobic Cellular Respiration is the process that releases energy by breaking down glucose and other food molecules in the presence of oxygen.
     1. Cellular Respiration Overall Equation is 6O2 + C6H12O6 → 6CO2 + 6H2O + Energy
     2. Three Stages occurring in the cytoplasm and mitochondria
        1. Glycolysis - Occurs in the cytoplasm of the cell and molecules of glucose are broken down into 2 molecules of Pyruvate (2ATP and 2 NADH made)
        2. Kreb’s Cycle - further break apart the pyruvate molecules in the matrix of the mitochondria (2ATP, 6 NADH, 2 FADH2 and 6 CO2 produced)
        3. Electron Transport Chain - Energy carrier molecules produced during Glycolysis and the Kreb’s Cycle enter the ETC in the inner membrane of the mitochondria
           1. The electrons are passed down a chain of proteins until they reach the final electron acceptor…..oxygen.
           2. Creates 32-34 ATP and water
  2. Anaerobic Cellular Respiration occurs when oxygen isn’t present (also called fermentation)
     1. A series of reactions that convert NADH (from glycolysis) back into NAD+ allowing glycolysis to keep producing a small amount of ATP
     2. Lactic Acid Fermentation – happens in animals
     3. Alcoholic Fermentation – happens in yeast

***Unit 5 – Cell Division***

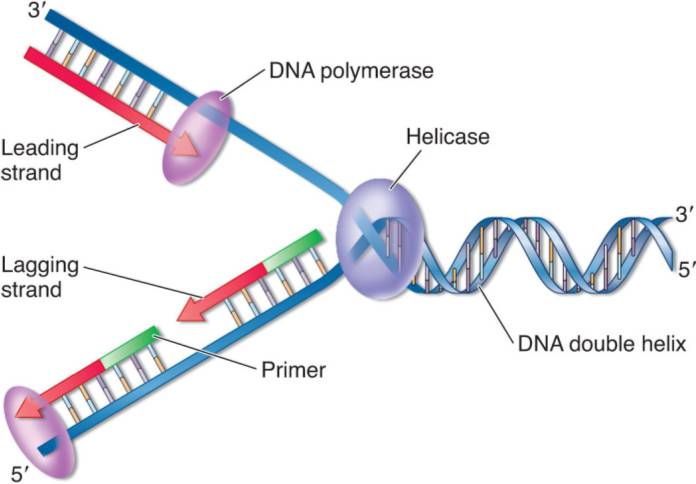
1. Eukaryotic chromosomes consist of **chromatin**, a complex of DNA and protein that condenses during cell division
   1. Every eukaryotic species has a characteristic number of chromosomes in each cell nucleus
   2. Nonreproductive cells have two sets of chromosomes
   3. In preparation for cell division, DNA is replicated and the chromosomes condense
   4. Each duplicated chromosome has two sister chromatids which separate during cell division
   5. The centromere is where the two chromatids are most closely attached
   6. Why can’t cells grow forever?
      1. Reason #1: Not enough DNA! As the cell increases in size, it keeps the same amount of DNA. Eventually the cell will grow too much for the DNA to control all its activities
      2. Reason #2: Surface area of membrane doesn’t increase as quickly as cell volume
         1. Too little membrane 🡪 not enough exchange of materials in and out of the cell
   7. Cell division is an integral part of the cell cycle, the life of a cell from formation to its own division
2. Prokaryotes (bacteria and archaea) reproduce by a type of cell division called binary fission
   1. In binary fission, the DNA replicates and the two daughter chromosomes actively move apart
   2. The plasma membrane pinches inward, dividing the cell into two
   3. Produces genetically identical daughter cells
3. Stages of the Cell Cycle are Interphase, Mitosis and Cytokenesis
   1. Before the cell divides, the DNA and organelles must replicate during Interphase so that after division each cell has the proper number of chromosomes and organelles
   2. Mitosis is the division of the nucleus and occurs in four stages
      1. Prophase - Nuclear membrane is broken down, Chromosomes first appear and centrioles migrate
      2. Metaphase - chromosomes align on the equatorial plane and spindle fibers attach to chromosomes
      3. Anaphase - chromatids move to opposite ends of the cell with the help of spindle fibers
      4. Telophase - chromosomes stop moving and the nuclear membrane reforms
   3. Cytokenesis and Telophase overlap; however cytokensis is the division of the cytoplasm and the actual cell
      1. This differs in plants and animals because of the presence of the cell wall in plants
4. Meiosis takes a cell with two copies of every chromosome (diploid) and makes cells with a single copy of every chromosome (haploid).



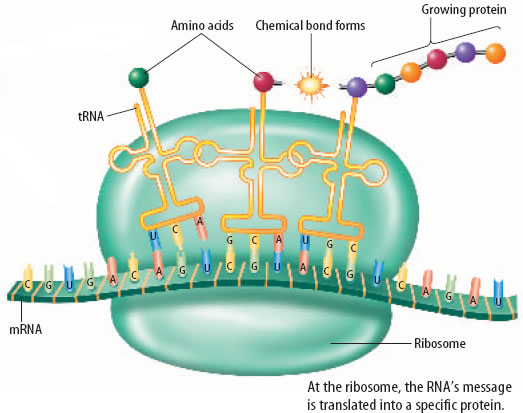
* 1. At fertilization the male and female sex cells will provide ½ of the chromosomes each – so the offspring has genes from both parents
  2. Meiosis scrambles the specific forms of each gene that each sex cell (egg or sperm) receives.
  3. In Meiosis there are two divisions (Meiosis I and Meiosis II)
     1. Interphase (only occurs once, before the first division) and DNA replicates
     2. Prophase I - During this phase each pair of chromatids don’t move to the equator alone, they match up with their homologous pair and fasten together (synapsis) in a group of four called a tetrad.
        1. It is during this phase that crossing over can occur.
        2. Crossing Over is the exchange of segments during synapsis.
     3. Metaphase I - The chromosomes line up at the equator attached by their centromeres to spindle fibers from centrioles.
        1. Still in homologous pairs
     4. Anaphase I - The homologous chromosome moves toward the opposite pole
        1. Sister chromatids remain attached and move as a unit towards the same pole
     5. Telophase I - Each of the newly formed cells has half the number of the parent cell’s chromosomes, but each chromosome is already replicated ready for the second meiotic cell division
     6. Prophase II - Each of the daughter cells forms a spindle, and the double stranded chromosomes move toward the equator
        1. No interphase before this!
     7. Metaphase II - The chromosomes are positioned on the metaphase plate in a mitosis-like fashion
     8. Anaphase II - The centromeres of sister chromatids finally separate
        1. The sister chromatids of each pair move toward opposite poles and are now individual chromosomes
     9. Telophase II and Cytokenesis - Nuclei form at opposite poles of the cell and cytokinesis occurs
        1. After completion of cytokinesis there are four daughter cells and all are haploid (n)
  4. Nondisjunction occurs when chromosomes fail to separate.
     1. Can occur during Anaphase I or Anaphase II of Meiosis
     2. Result: eggs or sperm with incorrect number of chromosomes
     3. If the mutated egg or sperm is fertilized, the child will have abnormalities.
  5. Karyotypes can detect chromosomal abnormalities
     1. Chromosomes are photographed, cut, and matched based on size

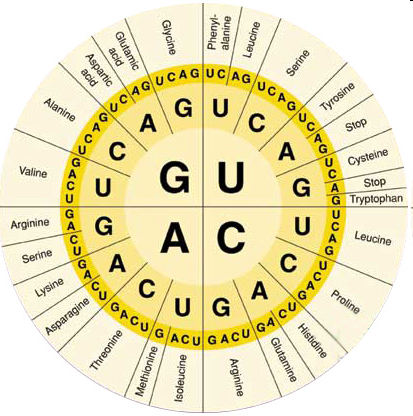
***Unit 6 – DNA and Protein Synthesis***

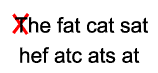
1. Rosalind Franklin took diffraction x-ray photographs of DNA crystals
   1. In the 1950’s, Watson & Crick built the first model (double helix) of DNA using Franklin’s x-rays
   2. DNA is a type of Nucleic Acid (Deoxyribonucleic Acid)
   3. Made of monomers called nucleotides
      1. Phosphate group
      2. 5-carbon sugar
      3. Nitrogenous base
   4. Sides made of a sugar Deoxyribose bonded to phosphate (PO4) groups
      1. The part of a strand that ends with a phosphate group is called the 5 prime (5’) end
      2. The part of a strand that ends with a sugar is called the 3 prime (3’) end
   5. Center made of nitrogen bases bonded together by weak hydrogen bonds
      1. Adenine bonds to Thymine and Cytosine bonds to Guanine
   6. Function: to store genetic information
2. DNA has to be copied before a cell divides and is copied during the S or synthesis phase of interphase
   1. Step 1: Enzyme Helicase unwinds and separates the 2 DNA strands by breaking the weak hydrogen bonds
   2. Step 2: Primase gathers nucleotides and brings them into the replication fork.
      1. A “primer” is created to start the new strand.
   3. Step 3: The enzyme DNA Polymerase matches free nucleotides with the correct base pairs on the template (parent) strands.
   4. Step 4: The enzyme ligase connects any “breaks” in the new strands and the 2 new strands rewind back together.
      1. Why are there breaks? DNA polymerase can only add nucleotides to the 3’ end of the DNA , This causes the new strand to be built in a 5’ to 3’ direction (DNA must be anti-parallel)
   5. The leading strand is built into the splitting fork and the lagging strand is built outwards



1. DNA is found inside the nucleus, but proteins are made in ribosomes
   1. A molecule called RNA carries the message from the nucleus to the cytoplasm! Unlike DNA, RNA is small enough to fit through the pores in the nuclear membrane (RNA also have U instead of T and has a Ribose sugar instead of Deoxyribose)
      1. There are three main types of RNA
         1. Messenger RNA (mRNA) copies DNA’s code & carries it to the ribosome
         2. Transfer RNA (tRNA) takes amino acids to the ribosomes
         3. Ribosomal RNA (rRNA) makes up the ribosomes



* 1. The process of making proteins occurs in two stages: Transcription and Translation
     1. Transcription: mRNA picks up the code from the DNA template strand and takes it from the nucleus to ribosomes in the cytoplasm
        1. Main goal: make a copy of the code and get it out of the nucleus!
     2. Translation: The instructions (mRNA) are read by tRNA, and tRNA joins amino acids in the right order in the ribosome. The following are more specific steps to get to the main goal: make a polypeptide
        1. mRNA goes to the ribosome
        2. tRNA brings amino acids to the ribosome
        3. tRNA “reads” the mRNA instructions and puts the amino acids in the right order
        4. Amino acids link together by peptide bonds to make a polypeptide (protein)
  2. tRNA is the “reader” of the message
     1. 3 bases on the mRNA strand = codon, complementary 3 bases on tRNA are the anti-codon
     2. Scientists can use the codon wheel or chart to read the mRNA and predict the amino acid sequence

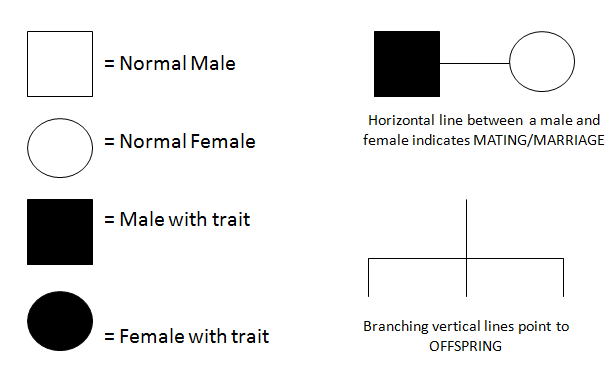
1. A mutation is a change in the sequence of nitrogen bases (A,T,C, and G’s) in the DNA code.
   1. Two types of gene mutations – point mutations and frameshift mutations
      1. Point mutations are caused by a substitution of one base for another in the DNA sequence
         1. Silent Mutation – DNA change results in an mRNA codon that codes for the same amino acid
         2. Missense Mutation – DNA change results in an mRNA codon that codes for a different amino acid
         3. Nonsense Mutation – DNA change results in an mRNA “stop” codon (polypeptide ends early)
      2. ****Frameshift mutations are caused by insertions or deletions of bases in the DNA sequence
         1. Mutations caused by an insertion or deletion of bases in the DNA sequence 🡪 different DNA triplets for the rest of the sequence 🡪 different mRNA codons 🡪 rest of the polypeptide is different
   2. Types of Mutations – Large Chromosomal Mutations
      1. Duplication – Large section of the chromosome is copied
      2. Inversion – Large section of the chromosome is flipped around
      3. Insertion – A large section from one chromosome is “stuck” into another
      4. Translocation – Large sections from two chromosomes are switched

***Unit 7 – Genetics***

1. Using peas as the basis for his genetics experiments, Mendel concluded that inheritance is determined by factors passed on from one generation to another (although he didn’t know yet that this was DNA)
   1. The ‘factors” that Mendel mentioned were the genes and each gene has different forms called alleles
   2. Mendel developed three laws
      1. Dominance – one version of a gene can hide the other version of the gene
      2. Segregation – only one gene of each pair is given to the offspring from each parent
      3. Independent Assortment – the inheritance of one gene doesn’t affect the inheritance of other genes
   3. Punnett Squares are used to show the probability of a certain trait being passed from one generation to another.
      1. Gametes are placed above and to the left of the square
      2. Offspring are placed in the square.
      3. Capital letters (A) represent dominant alleles.
      4. Lower case letters (a) represent recessive alleles.

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| **GENOTYPE** | **PHENOTYPE** |
| The genetic makeup | Physical appearance |
| Symbolized with letters | Expression of trait |
| Tt or TT | Short, tall, yellow or smooth |

* 1. There are different types of genotypes
     1. Homozygous = when an organism possesses two identical alleles (YY or yy)
     2. Heterozygous = when an organism possesses different alleles (Yy)

1. Mendel’s rule of dominance was complete dominance (Homozygous dominant organisms have the dominant phenotype and Heterozygous organisms have the dominant phenotype)
   1. Incomplete dominance = **Offspring** have an appearance somewhat **in between** **the** **phenotypes** of the two parents (“Mixed” or Blended)
      1. Neither allele is completely dominant over the other
   2. Codominance = Offspring have an appearance where both phenotypes are present
      1. Codominance occurs when two or more alleles influence the phenotype
      2. Both alleles are dominant
   3. Sex-linked traits - Traits (genes) located on the sex chromosomes (Many sex-linked traits carried on X chromosomes)
   4. Polygenic Traits are when many genes affect one trait whereas Pleitropy is one gene affects many different traits
   5. Multiple Alleles is when 3 or more alleles of the same gene that code for a single trait
      1. In humans, blood type is determined by 3 alleles – A, B, and O: however each human can only inherit 2 alleles
2. Scientists use pedigree charts to track the inheritance of a trait through multiple generations.
   1. Below is a summary of the symbols used in a pedigree chart.
   2. Autosomal dominant traits are controlled by a dominant allele on an autosome (a non-sex chromosome). For these traits, we use the following alleles, which result in the following genotypes and phenotypes.

|  |  |  |  |
| --- | --- | --- | --- |
| **Alleles** | **Genotype** | **Phenotype** | |
| A = trait  a = normal | AA | Trait |
| Aa |
| aa | Normal |

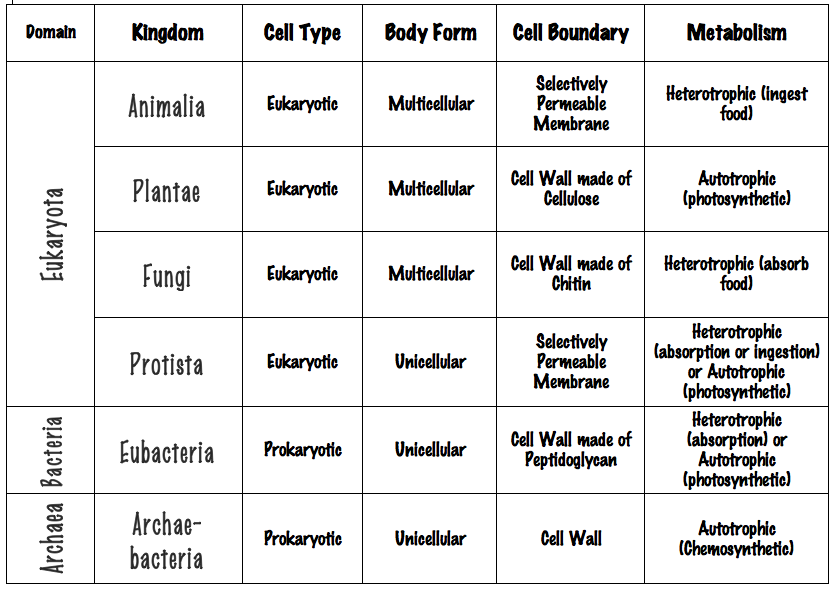
* 1. Autosomal recessive traits are controlled by a recessive allele on an autosome. For these traits, we use the following alleles, which result in the following genotypes and phenotypes.

|  |  |  |
| --- | --- | --- |
| **Alleles** | **Genotype** | **Phenotype** |
| A = normal  a = trait | AA | Normal |
| Aa |
| aa | Trait |

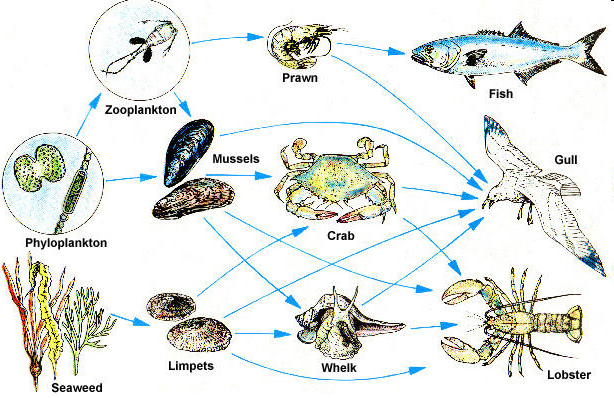
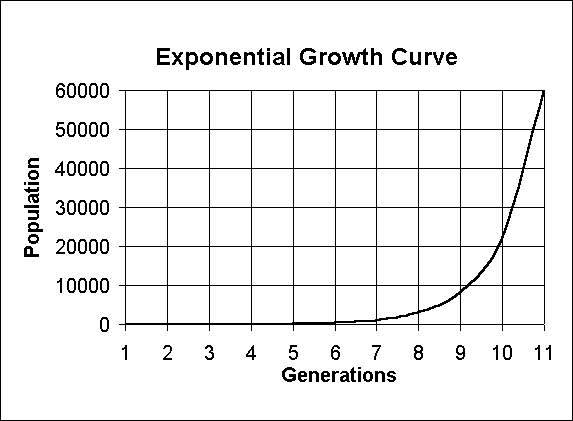
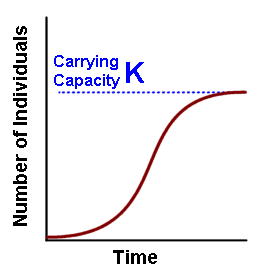
* 1. Sex-linked recessive traits are controlled by a recessive allele (usually on the X chromosome). Pedigrees that follow this method of inheritance will show more males with the trait than females. This is because males only need to receive one copy of the recessive allele to show the trait (because they only have one X chromosome). In contrast, females must receive two copies of the recessive allele to show the trait. For these traits, we use the following alleles, which result in the following genotypes and phenotypes.

|  |  |  |
| --- | --- | --- |
| **Alleles** | **Genotype** | **Phenotype** |
| XA = normal  Xa = trait | XAXA or XAXa | Female, Normal |
| XaXa | Female, Trait |
| XAY | Male, Normal |
| XaY | Male, Trait |

***Unit 8 – Evolution and Classification***

1. The History of Life on Earth
   1. Formation of the Earth, Synthesis of Organic Molecules, Unicellular Life, Blue-Green Algae add oxygen to atmosphere, Eukaryotic Cells, Vertebrates and Plants move to land
   2. There are many different forms of evidence for evolution
      1. **Fossil** = a trace of a long-dead organism, found in layers of sedimentary rock; hard minerals replace tissues of organism
      2. Comparative Anatomy – compare structures found in modern organisms with those from ancient times
         1. Homologous Structures: inherited from a common ancestor, changed due to different environments (Ex: Limb bones of whale, bat, human, etc.)
         2. Analogous Structures: similar in purpose, but not inherited from a common ancestor (Ex: Wings of insects vs. bird)
         3. Vestigial Structures: Features/structures that were useful to an ancestor but are no longer useful (Ex: Whale pelvis, Human tailbone + appendix)
      3. Comparative Embryology - Finding similarities in embryos ; organisms sharing a recent ancestor have more similar embryos
      4. Comparative Biochemistry - Finding similarities in protein and DNA sequences to look for relatedness
   3. Darwin and his Theory of Natural Selection:
      1. There is variation in every population
      2. Some variations are favorable
         1. Mutations in the DNA create different gene forms (variations)
      3. More young are produced in each generation than can survive
      4. There is competition for resources
      5. Those that are successful go on to reproduce
      6. Overtime, small changes accumulate in a population because the best traits continue to be passed on
   4. Individuals can’t evolve…they are born with all the genes they are ever going to have! Populations can evolve as the % of favorable mutations increases over time
   5. Types of Natural Selection:
      1. Stabilizing Selection = individuals with the average form of a trait have the highest fitness
      2. Directional Selection = one extreme form of trait is more successful
      3. Disruptive Selection = BOTH extreme forms are more successful than the average
      4. Sexual Selection =Females choose mates based on certain traits and males with these traits have higher fitness (reproductive success)
      5. Artificial Selection = humans “select” certain characteristics in plants, dogs, etc., that they find favorable
   6. Patterns of Evolution:
      1. Coevolution = change of two or more species in response to one another
      2. Convergent Evolution = organisms with different ancestors become very similar due to environment (Ex: sharks and dolphins)
2. Divergent Evolution = two or more related populations/species become different
3. Adaptive Radiation = an extreme form of divergent evolution where many related species evolve from a single ancestor species
4. Classification is Putting organisms into groups based on their similarities
   1. The science of classifying organisms is called taxonomy
   2. First scientist to use modern system of taxonomy = Carolus Linnaeus
      1. Today, scientists use Linnaeus’s system – the binomial system of nomenclature (These names include the genus and the species)
   3. Linnaeus developed a hierarchical system to classify organisms:
      1. Kingdom, Phylum, Class, Order, Family, Genus and Species
   4. Overview of the Three Domain, Five Kingdom System
   5. Cladograms help scientists understand how one lineage branched from another in the course of evolution.
   6. A dichotomous key is a tool that allows the user to determine the identity of items in the natural world, such as trees, wildflowers, mammals, reptiles, rocks, and fish.

***Unit 9 – Ecology***

1. Ecology = the study of the interactions between organisms and the living and nonliving components of their environment
   1. Levels of organization in Ecology
      1. Biosphere = the thin volume of earth and its atmosphere that supports life
      2. Biome = major habitat areas, either terrestrial (on land) or aquatic (in water)
      3. Ecosystems = all the organisms and non-living things in a particular place
      4. Communities = all the interacting populations in an area (only living things)
      5. Populations = all the members of a single species that live in one place at one time (ex: all the salmon in a stream)
      6. Organisms = An individual living thing
   2. Environmental factors - Biotic factors are living and abiotic factors are non-living
   3. Niche = the role an organism plays in its environment (includes habitat, ways of obtaining nutrients, etc.)
      1. Fundamental Niche = the range of conditions and resources a species could use/tolerate
      2. Realized Niche = the range of conditions and resources a species actually does use/tolerate
   4. Ecological Succession = a series of changes in an ecosystem in which new populations of organisms gradually replace existing ones
      1. Succession that begins in an area where there is no existing community is called primary succession
         1. The first organisms to occupy an area going through primary succession are a pioneer species
      2. Succession that has occurred in an area where an existing community has been partially destroyed is called secondary succession
         1. Eventually succession slows down and a stable community is established. This is called a climax community
2. The ultimate source of all energy on earth is the sun
   1. Role of Organisms in Energy Transfer:
      1. Producers: capture energy from the sun and use it to make simple energy-rich molecules (ex: glucose). Another name for a producer is an autotroph
      2. Consumers = cannot make their own food, must obtain nutrients by eating othe organisms. Another name for a consumer is a heterotroph
         1. Three Types: carnivores (meat only), omnivores (meat and plants), and herbivores (plants only)
      3. Decomposers: organisms that break down dead organic matter as a food source; help recycle nutrients throughout the ecosystem
   2. There are different “trophic levels” that represent the different levels of energy transfer.
      1. organism that eats a producer: primary consumer
      2. organism that eats a primary consumer: secondary consumer
   3. The total mass of organic matter (living stuff) at each trophic level is called the biomass
      1. Only 10% of the energy/biomass from one level can be transferred to the next level.
3. Symbiosis = close relationships between members of different species
   1. Predation - One organism kills another organism for food (the 2nd organism dies)
   2. Parasitism - One organism benefits and the other organism is harmed (t2nd organism doesn’t die)
   3. Competition - Both organisms are harmed by the interaction when they try to use the same resources
   4. Mutualism - Both organisms benefit from each other
   5. Commensalism - One organism benefits and the other is neutral (not helped or harmed)
4. Population Growth = (increasing the density of a population) usually cannot continue forever. When a population can no longer grow it has reached its carrying capacity.
   1. Limiting Factors = components of the environment that limit the growth of a population
      1. **Density Dependent =** limits the size of a population when the population reaches a certain density (number of organism per area)
      2. **Density Independent =** limits the size of a population no matter what the density is
   2. **Exponential Growth =** population increases quickly in size (can only happen for short periods of time when there are no limiting factors)
   3. **Logistic Growth =** population grows quickly for some time and then stops growing once it reaches its carrying capacity, the total number of individuals the environment can support

**AP Biology Summer Assignment – Google Form Links**

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