Norfolk Public Schools
Science Learning in Place Plan: Biology Lessons

Week 10: May 18 – May 22, 2020 (Biochemistry, Cytology & Boundaries)

Monday	Tuesday	Wednesday	Thursday	Friday
Water and its Important Facts Assignments: • Read pages # 1-2 • Complete Activities: I- Water Characteristics II- Label	**Molecular Chains** Assignments: • Read page # 3 • Complete Activities: III- Create IV- Organic Molecules V- Enzymes	**What is the cell theory?** Assignments: • Read page # 5 • Complete Activities: VI- Scientists VII- Cell Theory VIII- Cell Types	**What is the cell theory?** Assignments: • Re-read page #-5 • Complete Activity: IX- Matching	**Cellular Boundaries** Assignments: • Read page # 7 • Complete Activity: X- Fill-In XI- Identify each Illustration

Week 9: May 25 – 29, 2020 (Cell Cycle & Bioenergetics)

Monday	Tuesday	Wednesday	Thursday	Friday
The Cell Cycle Assignments: • Read pages # 8-9 • Complete Activities: I- Matching II- Matching III- Cell Cycle Diagram	**How are diploid cells different from haploid cells?** Assignments: • Read pages # 10-11 • Complete Activity: IV- Analyze the Karyotype	**Meiosis Provides for Genetic Variation** Assignments: • Re-read page # 11 • Complete Activity: V- Mitosis vs. Meiosis	**Cell Energy** Assignments: • Read page # 12 • Complete Activity: VI- Analyze VII- Fill-In	**Photosynthesis** Assignments: • Read page # 13 • Complete Activity: VIII- Fill-In

Week 12: June 1 – 5, 2020 (Molecular DNA & Mendelian Genetics)

Monday	Tuesday	Wednesday	Thursday	Friday
Living Things Contain Proteins Assignments: • Read pages # 14-15 • Complete Activities: I- Label II- Analyze III- Create Sentences	**Genes & Proteins** Assignments: • Read pages # 16-17 • Complete Activities: IV- Analyze V- Circle the answer VI- Complete the chart	**Genetics** Assignments: • Read page # 18 • Complete Activities: VII- Chart VIII-Pedigree	**Genetics** Assignments: • Re-read page # 18 • Complete Activities: IX- Monohybrid Crosses X- Dihybrid Cross XI- Calculation	**Complex Patterns of Inheritance** Assignments: • Read page #20 • Complete Activities: XII- Analyze XIII- Identify

Biochemistry

Water and Its Important Facts Water is perhaps the most important compound in living organisms. In fact, water makes up 70 to 95 percent of most organisms.

When two atoms share electrons, the force that holds them together is called a covalent bond. This group of atoms held together by a covalent bond forms a molecule. Some molecules do not share the electrons equally and form a polar bond, a polar molecule. A polar molecule has a positive end and a negative end. For example, the electrons in a water molecule spend more time near the oxygen nucleus than they do near the hydrogen nuclei. This makes water a polar molecule.

Polar water molecules attract ions and ions are positively and negatively charged atoms. Because of this attraction, water can dissolve many ionic compounds such as salt along with many other polar molecules such as sugar. Water molecules also attract other water molecules. The positively charged hydrogen atoms of one water molecule attract the negatively charged oxygen atoms of another water molecule. When water molecules bond with other water molecules, they form a weak bond called a hydrogen bond. Hydrogen bonds are important because they hold molecules, such as proteins, together. Because water is a polar molecule, it is able to creep up thin tubes, such as those found in plants. This allows plants to get water from the ground. Water has a number of other special characteristics. Water resists temperature changes. It takes more heat to raise the temperature of water than it does to raise the temperature of most other liquids. Water also loses a lot of heat when it cools. Water expands when it freezes. As a result, ice is less dense than liquid water. This is why ice floats when it forms in water.

I. Water Characteristics: Use the following word bank to fill in the blanks.

hydrogen bonding	water	high	temperature
floats	polar	heat of vaporization	cool
heat	dissolve	homeostasis	adhesion
freezing	cohesion	surface tension	
capillary action	bases	universal solvent	

a) Water molecules have a slightly negative charge at one end and a slightly positive charge at the other end. This means that the molecule is _____.
b) _____ is the attraction between the positive end of one water molecule and the negative end of another water molecule.
c) Many of the 5 unique properties of water are caused by _____
   - _____ is the movement of water up thin plant tubes, caused by _____ which means that water molecules 'stick' to other things.
   - The property that helps bugs stand on water is _____.
   - Water expands when it freezes which makes ice _____.
   - Water has a _____, so it takes a lot of energy to change from a liquid to a gas. This helps organisms maintain the amount of water they have in their bodies.
   - Water resists temperature change so organisms maintain _____ and keep a constant _____
d) Because water is a polar molecule, it can dissolve many substances and is sometimes called "_____".
e) Cells are 95% _____, therefore 95% of your entire body is made of water.
f) Solid form floats, preventing lakes and oceans from _____ solid.
g) Water can absorb huge amounts of _____, which helps stabilize air temperatures around the globe.
h) Water absorbs heat when it evaporates, allowing organisms to _____ to release excess heat.
i) Water is able to _____ many substances (it is a good solvent) so the water inside and outside of cells is able to carry nutrients (solutes) into and around cells, and wastes (also solutes) away from cells.

j) What is the strongest acid listed in Figure 2–2? _____

k) What is the pH of the weakest acid listed in Figure 2-2? _____

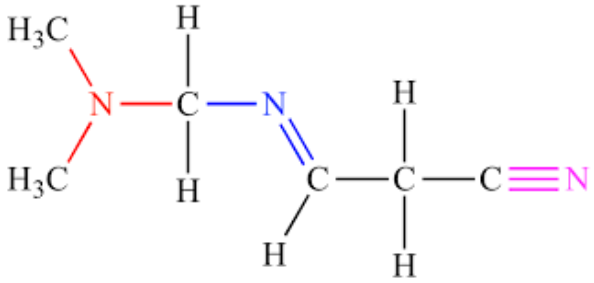
l) What is the pH of the strongest base listed in Figure 2-2? _____

pH Values of Some Common Substances	
Substance	**pH**
Hydrochloric acid	1.0
Sulfuric acid	1.2
Tomatoes	4.2
Rainwater	6.2
Pure water	7.0
Sea water	8.5
Ammonium chloride	11.1
Sodium hydroxide	13.0

Figure 2-2

The Role of Carbon in Organisms Carbon is one of the substances found in living organisms. Carbon atoms can form covalent bonds with other carbon atoms and with many other elements. When a carbon atom bonds by sharing one electron, it forms a single bond. When it bonds by sharing two electrons, it forms a double bond. When a carbon atom bonds by sharing three electrons, it forms a triple bond.

II. Label: Use the illustration to circle and label single, double and triple carbon bonds.



Molecular Chains As one carbon atom bonds to another and then that one bonds to another, they form straight chains, branched chains, or rings. These chains and rings can contain almost any number of carbon atoms and can include atoms of other elements as well. The chains and rings are called carbon compounds. Carbon compounds sometimes contain only one or two carbon atoms. But some carbon compounds contain tens, hundreds, or thousands of carbon atoms. These large compounds are called biomolecules.

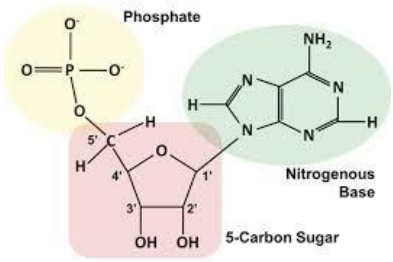
What are examples of biomolecules?

Carbohydrates are one type of biomolecule. Carbohydrates are organic compounds made of carbon, hydrogen, and oxygen. They are used by cells to store and release energy. Starch and sugars are examples of carbohydrates.

Lipids are another type of biomolecule. Lipids are large and are made mostly of carbon and hydrogen, with a small amount of oxygen. Fats, oils, waxes, and steroids are all lipids. Lipids do not dissolve in water because their molecules are not attracted by water molecules. Water molecules do not attract lipids because lipids are nonpolar molecules. Lipids are used by cells for energy storage, insulation, and protective coatings, such as in membranes.

Another type of biomolecule is protein. **Proteins** are necessary for all life because they provide structure for tissues and organs and carry out cell metabolism (you learned in Section 6.1 that metabolism is all of the chemical reactions that occur within an organism). They provide the body with the ability to move muscles. They also are needed to transport oxygen in the bloodstream. Proteins are large and complex and are made up of carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur. Enzymes are a particular type of protein. Enzymes change the speed of chemical reactions within the body. In some cases, enzymes speed up a reaction that would ordinarily take more time. For example, enzymes speed up the digestion of food.

III. Create: Write one sentence using the following 3 terms to show your understanding.
•biomolecules •carbon compounds •organic compounds



_____

_____

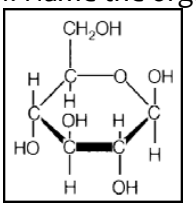
_____

Nucleic acids are biomolecules that stores cellular information in the form of a code. Nucleic acids are important compounds necessary for life. They are made of smaller units called nucleotides. Nucleotides consist of carbon, hydrogen, oxygen, nitrogen, and phosphorus atoms. These atoms are arranged into three groups: a nitrogenous base, a simple sugar, and a phosphate group. The figure above shows the structure of nucleotides. Two important nucleic acids are deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). DNA is an organism's master information code. DNA includes the instructions that determine how an organism looks and acts. RNA forms a copy of DNA to use in making proteins.

IV. Organic Molecules/Biomolecules: For each organic compound, write its monomer and characteristics in the appropriate box.

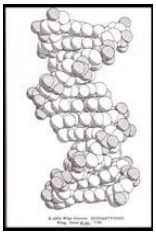
Monomers	Characteristics	
nucleotide	found in the nucleus of cells	DNA & RNA
monosaccharide	lots are found in muscle cells	enzymes, hemoglobin, & actin
fatty acid	waxes & phospholipids	glucose, fructose & sucrose sugars
amino acid	fats	made in the ribosome of the cell

1. Name the organic compound_____



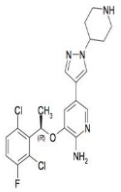
Monomer:

2. Name the organic compound _____



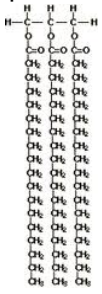
Monomer:

3. Name the organic compound _____



Monomer:

4. Name the organic compound _____



Monomer:

V. Enzymes: Fill in the blank using the following words.

substrate	denature	-ase	activation
active site	protein	catalyzes	

1. Special kind of _____ (macromolecule) that _____ (speeds up) chemical reactions.
2. _____ - when the shape of the enzyme is changed, making it unable to function properly.
3. Enzyme names usually end in _____.
4. _____ - the substance on which an enzyme acts.
5. _____ - the specific site on the enzyme that binds to the substrate (the "business" end)
6. Enzymes lower the _____ energy of a reaction, meaning they lower the amount of energy needed for a reaction to progress.

Cytology

What is the cell theory?.. The experiments of Schleiden, Schwann, and other scientists led to the development of what is called the cell theory. It is one of the fundamental ideas of the science of biology. The three main parts of the cell theory are summarized below: 1. All living things are made of one or more cells. 2. Cells are the basic units of structure and function in living things. 3. All cells come from other cells.

Two Basic Cell Type Using microscopes, scientists saw that all cells contain small structures called organelles. Each organelle has a specific function in the cell. Some cell organelles are held together by a membrane, but others are not. Scientists group cells into two categories—cells that have membrane-bound organelles (eukaryotes) and cells that do not (prokaryotes). Unicellular organisms, such as bacteria, are prokaryotes. Most cells you can think of are eukaryotic. Having membrane-bound organelles is an advantage for eukaryotic cells because chemical reactions in different parts of the cell can happen at the same time. Eukaryotic cells have a central organelle called a nucleus that controls all the cell's activities. Prokaryotes do not have an organized nucleus. Instead, they have loose strands of DNA.

VI. Scientists: Match the following scientists with their contributions

_____Redi
_____Pasteur
_____Schleiden
_____Schwann
_____Virchow
_____Hooke
_____Leeuwenhoek

a. all animals made of cells
b. all plants made of cells
c. all cells come from pre-existing cells
d. observed cork; named cells
e. invented microscope; observed "animalcules"
f. maggot/meat experiment to disprove spontaneous generation
g. disproved spontaneous generation once and for all...

VII. Cell Theory: Three (3) Main Points

1) All organisms are composed of 1 or more _____.
2) The cell is the basic unit of _____.
3) All cells come from _____ cells.

VIII. Cell Types: For each characteristic, indicate yes or no for Prokaryotes and Eukaryotes.

Characteristic	Prokaryote	Eukaryote	Characteristuc	Prokaryote	Eukaryote
Nucleus?			Mitosis?		
Membrane-bound organelles?			Plants and Animals?		
Genetic material?			Ribosomes?		
Complex?			Bacteria?		
Multicellular?			Unicellular?		

IX. Matching: Use the following organelles/structures to pair with their functions.

vacuole	cytoskeleton	cilia	chlorophyll
mitochondria	cell wall	chromatin	nucleolus
microfilament	microtubules	endoplasmic reticulum	flagella
plastid	ribosome	golgi apparatus	
cytoplasm	chloroplast	lysosomes	

a. _____ a plant organelle used for storage

b. _____ site where DNA makes protein

c. _____strands of DNA containing directions for making proteins

d. _____short, hair-like projections on a cell's surface, with an oar-like motion

e. _____clear, jelly-like fluid inside a cell

f. _____cell support structure within the cytoplasm

g. _____membrane-bound compartments for temporary storage of materials

h. _____site of cellular chemical reactions

i. _____longer projections on a cell's surface, with a whip-like motion

j. _____an organelle that sorts proteins into packages and packs them into vesicles

k. _____organelles that remove waste from the cell

l. _____rigid wall outside the plasma membrane for additional support & protection

m. _____green pigment that traps light energy and gives leaves and stems their green color

n. _____organelles that capture light energy and convert it to chemical energy

o. _____organelle within the nucleus that makes ribosomes

p. _____tiny, solid protein fibers that are part of the cytoskeleton

q. _____thin hollow cylinders made of protein that are part of the cytoskeleton

r. _____organelles in plants and animals that transform energy for the cell

Boundaries

Cellular Boundaries The plasma membrane (aka cell membrane) acts as the flexible boundary of the cell. In plant cells, fungi, bacteria, and some protists, there is an additional boundary—the cell wall. The cell wall is a rigid wall outside the plasma membrane. It gives extra support and protection to the cell.

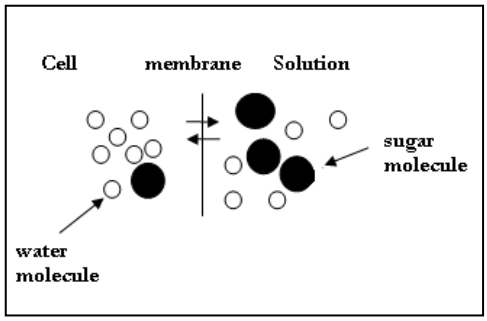
The plasma membrane of a cell is called a selectively permeable membrane. This means only certain particles, or molecules, are let in and out of a cell. Water is the only substance the plasma membrane always allows in or out. The movement of water from an area of higher concentration to an area of lower concentration, or diffusion, across the plasma membrane is called osmosis. This water flow through the membrane helps create homeostasis. Homeostasis is the regulation of the cell's internal environment.

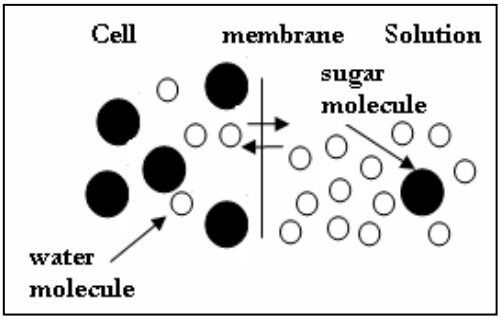
X. Fill-In: The Fluid Mosaic Model & Movement through the Cell Membrane

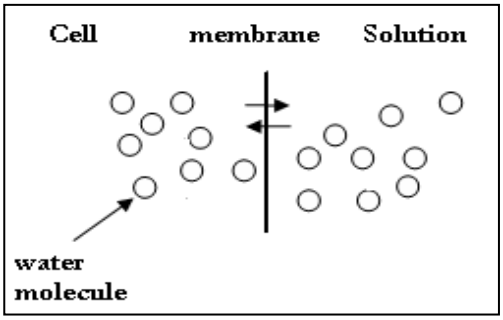
diffusion	energy	high
phospholipids	cell membrane	osmosis
proteins	low	active transport

The cell membrane is composed of _____ and _____. The Fluid Mosaic Model describes the _____. Passive transport is also called _____ and it doesn't require _____. Passive transport moves molecules from areas of _____ to _____ concentration. _____ is a type of diffusion involving only the movement of water molecules. A nonspecific type of movement that requires energy is _____ which moves molecules from low to high concentration.

XI. Identify each illustration as either an isotonic, a hypotonic, or a hypertonic solution inside the cell and describe how the movement of water molecules will affect the shape of the cell.







_____ _____ _____

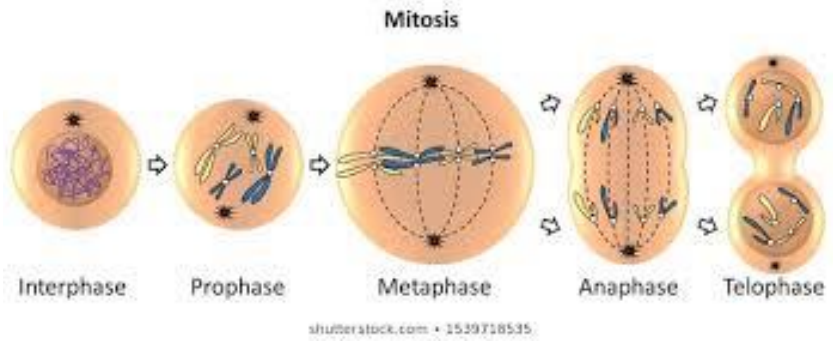
_____ _____ _____

Cell Cycle

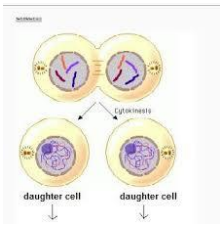
The cell cycle is the time of growth and division of a cell. A cell's life cycle is divided into two periods. There is a period of growth called interphase. There is also a period of nuclear division called mitosis.

What is interphase? During interphase a cell grows in size, carries on metabolism, duplicates chromosomes, and prepares for division. Interphase is the busiest phase of the cell cycle.

What is mitosis? Mitosis follows interphase. It is the process of nuclear division in which two daughter cells form. Each of these daughter cells contains a complete set of chromosomes that are identical to those of the parent cell. There are four phases of mitosis. Each phase merges into the next phase. The four phases are prophase, metaphase, anaphase, and telophase. **Prophase** is the first and longest phase. During prophase the chromatin coils up to form chromosomes. Each duplicated chromosome is made up of two identical halves, called sister chromatids. Centromeres hold the sister chromatids together. During **metaphase**, the second phase of mitosis, the doubled chromosomes are pulled to the center of the cell. **Anaphase** is the third phase of mitosis. During this phase, the centromeres of the sister chromatids split apart. This separates the sister chromatids from each other. In **telophase**, the last phase of mitosis, the chromatids move to opposite sides of the cell. Two nuclei are formed—one on each side of the cell. Finally, a new double membrane begins to form between the two new nuclei.



Immediately following telophase, the cell's cytoplasm divides and separates into two new identical cells. This is called cytokinesis.



I. Matching: Each letter may be used more than once.

A Prophase **B** Metaphase **C** Anaphase **D** Telophase

1. chromosomes move until they form two groups near the poles of the spindle _____
2. chromosomes become visible _____
3. a nuclear envelope re-forms around each cluster of chromosomes _____
4. centrioles take up positions on opposite sides of the nucleus _____
5. chromosomes line up across the center of the cell_____
6. nucleolus becomes visible in each daughter nucleus _____

Results of Mitosis When mitosis is complete, one-celled organisms remain as single cells. The organism simply multiplied into two organisms. These daughter cells eventually will repeat the same cell cycle as the parent cell and will grow and divide. In larger organisms, cell growth and reproduction result in groups of cells that work together as tissue to perform a certain function. Tissues organize in combinations to form organs. Organs perform specific complex tasks within the organism. Multiple organs that work together form an organ system, such as the digestive system. The stomach is one organ in the digestive system. It functions to digest food. It is important to remember that no matter how complex the organ system organism becomes; the cell is still the most basic unit of that or organization.

II. Matching: Pair the key terms with the appropriate definition.

cytokinesis	interphase	metaphase	mitosis
centromere	cell cycle	chromosomes	chromatin
organ	organ system	prophase	anaphase

a. _____cell growth period where a cell increases in size, carries on metabolism, and duplicates chromosomes prior to division
b. _____short second phase of mitosis where doubled chromosomes move to the center of the cell
c. _____period of nuclear cell division in which two daughter cells are formed, each containing a complete set of chromosomes
d. _____group of two or more tissues organized to perform complex activities within an organism
e. _____multiple organs that work together to perform a specific life function

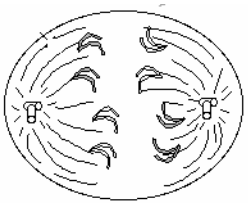
f. _____first and longest phase of mitosis where chromatin coils into visible chromosome
g. _____the third phase of mitosis in which the centromeres split, and the sister chromatids of each chromosome are pulled apart
h. _____continuous sequence of growth (interphase) and division (mitosis) in a cell

i. _____cell structure that joins two sister chromatids of a chromosome

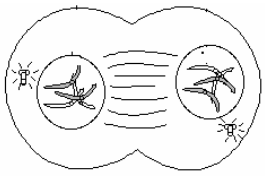
j. _____long strands of DNA found in the eukaryotic cell nucleus; coils up to form chromosomes
k. _____cell structures that contain DNA and carry the genetic material that is copied and passed from generation to generation of cells
l. _____cell process following mitosis in which the cell's cytoplasm divides and separates into new identical cells

III. Cell Cycle Diagrams:

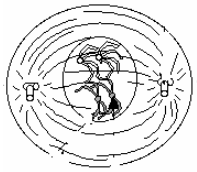
Identify the following stages of mitosis.



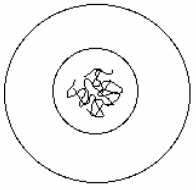
A. _____



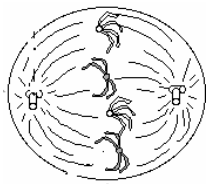
B. _____



C. _____



D._____



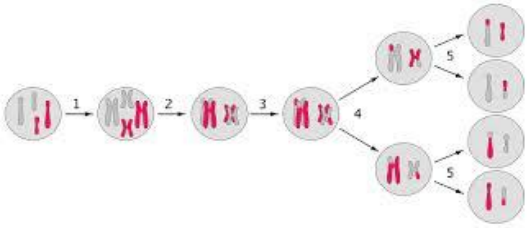
E. _____

F. What order should the phases above be in?

_____→ _____ → _____ → _____ → _____

How are diploid cells different from haploid cells? A **diploid** cell is a body cell, which goes through mitosis. Organisms also produce a different kind of cell called a **haploid cell**. This cell contains only one of each kind of chromosome. A **gamete** (sex cell), is a haploid cell. Remember, Mendel concluded that parents give one allele of each trait to their offspring. That happens because the gamete is a haploid cell containing half the number of chromosomes as a body cell (somatic cells). Every living thing has a set number of chromosomes. For example, every dog has 78 chromosomes, every human has 46 chromosomes (23 pairs), and every tomato plant has 24 chromosomes. As you can see, the number of chromosomes is not related to how complex an organism is.

When the organism reproduces during meiosis, it only passes on half the number of chromosomes. In a diploid cell the two chromosomes of each pair are called homologous chromosomes. Each chromosome of the pair has genes for the same traits in the same order. Because there are different alleles for the same gene, it is possible that two chromosomes of a homologous pair will not be identical to each other.

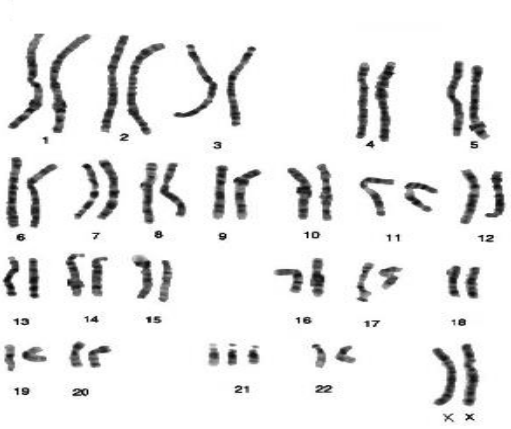


Meiosis Provides for Genetic Variation The cell division that happens during meiosis creates many possible gene combinations. When crossing over occurs during prophase I, even more variations are possible. The reassortment of genetic information that occurs during meiosis is called genetic recombination. It is a major source of variation among organisms. Meiosis also provides the physical basis for explaining Mendel's results. Mendel's laws and meiosis provide the foundation for heredity.

Nondisjunction ……..Meiosis usually happens without any problems, but sometimes chromosomes do not separate correctly. When this happens, the gametes that form will either have too many chromosomes or not enough chromosomes. The failure of chromosomes to separate correctly is called nondisjunction. An organism with extra chromosomes may survive, but an organism that is missing one or more chromosomes does not usually develop. Surprisingly, in plants, extra chromosomes can actually be helpful. Often the flowers and fruits are larger, and the plant is healthier. Because of this, plant breeders have learned to cause nondisjunction by using chemicals.

Sometimes there are an abnormal number in a set of chromosomes. To identify an abnormal number of chromosomes, a sample of cells is taken from an individual or a fetus (a developing mammal from nine weeks old to birth). The chromosomes are photographed and arranged in pairs by a computer. The pairs are arranged by length and location of the centromere. The chart showing the pairs is called a karyotype. It is very useful in identifying unusual chromosome numbers in cells.

IV. Analyze the karyotype:



1. Examine the last pair of chromosomes to determine the gender of the individual. Is the individual a female or male? _____

2. The normal number of chromosomes is _____ pairs. Does the individual karyotype have a normal or abnormal number of chromosomes? _____

3. Explain your response _____
_____
_____
_____

V. Mitosis vs. Meiosis

Complete the chart below by checking off which cell division has which characteristics.

Description	Mitosis	Meiosis	Neither
Cell division in body cells			
Cell division in gametes			
Eukaryotic Cells			
Produces haploid cells			
Produces diploid cells			
Produces 2 cells			
Produces 4 cells			
Used by bacteria to divide			

The Need for Energy

Cell Energy All living organisms need energy to live. Plants and other green organisms are able to make energy from sunlight and store it to use later. Some organisms, like animals, cannot make their own energy. They must eat other organisms to get the energy they need. Many of the things our bodies do, called cell processes, need energy. Some cell processes are muscles contracting during exercise, your heart pumping, and cell division. Your brain also needs energy to do its work.

How do our cells get energy? After exercising, your body needs a quick source of energy. Perhaps you eat a granola bar to satisfy the need. The cells in our bodies often need a quick source of energy. There is a molecule in your cells called **adenosine triphosphate**, or ATP for short which provides quick energy for cells when they need it.

Forming and Breaking Down ATP ATP has an adenosine molecule, a ribose sugar, and three phosphate groups held together by chemical bonds. When one of the chemical bonds is broken, one of the phosphate groups is released. Energy is also released. This quick release of energy is then available for a cell to use.

When one of the phosphate groups is released, ATP becomes adenosine diphosphate, or ADP. ADP has only two phosphate groups. ADP can add another phosphate group and become ATP again. The cycle of the formation and breakdown of ATP creates a source of energy.

How do cells get the energy they need from ATP? Many proteins have a special place where ATP can bind itself. When ATP releases its energy and becomes ADP by breaking the phosphate bond, the cell uses the energy. At this point ADP can bind with another phosphate group and form ATP again. This cycle is repeated, providing a renewable source of energy for the cell.

Uses of Cell Energy Cells use the energy they receive from ATP in many ways. Some cells make new molecules with the energy. Other cells use the energy to build membranes and cell organelles. Some cells use energy to maintain homeostasis, which is the regulation of their internal environment.

VI. Analyze: Select the correct answer.

A cell's internal environment is kept stable through (a)___ ATP (b)___ homeostasis (c)___ ADP

VII. Fill-In Write the missing number in the statements that describe the formation and breakdown of ATP.

ATP contains _____ phosphate group(s).

_____ phosphate group(s) is released.

ADP contains _____ phosphate group(s).

ADP adds _____ phosphate group(s) to become ATP.

Photosynthesis: Trapping the Sun's Energy

Plants and other green organisms must trap light energy from the sun to be able to use it. The energy must then be stored in a form that can be used by cells. That form is ATP. The process plants use to trap and make energy from sunlight is called **photosynthesis.** During photosynthesis, plants use the sun's energy to make simple sugars. These sugars are then made into complex carbohydrates, such as starch that store energy. There are two parts to photosynthesis: light-dependent reactions and light-independent reactions. The light-dependent reactions change light energy into chemical energy. This results in the splitting of water and the release of oxygen. The light-independent reactions produce simple sugars.

Where does photosynthesis take place? The chloroplast is the part of the plant's leaf where photosynthesis takes place. The chloroplast contains pigments, which are molecules that take in specific wavelengths of sunlight. Wavelengths of sunlight transfer energy. The most common pigment in the chloroplast is chlorophyll. Chlorophyll is a plant pigment that absorbs most wavelengths of sunlight except green. Because it cannot take in the green wavelength, it reflects the green. This is what makes leaves look green. In the fall, leaves stop producing chlorophyll, so other pigments become visible.

VIII. Fill-In: Use the words to fill in the blanks.

carbon dioxide	chloroplasts	respiration
heterotrophs	mitochondria	autotrophs
glucose	photosynthesis	solar
water	chemical	light

a) _____use organelles called _____in their leaves to collect _____ energy.

b) _____occurs so plants can make _____to use for energy.

c) Photosynthesis converts _____ energy into _____ energy.

d) Photosynthesis uses _____ and _____ energy to form _____.

e) Animals that can't make their own food are called _____.

f) Animals, plants, and fungi all use organelles called _____to perform a process called _____ which breaks down food molecules to produce ATP for energy.

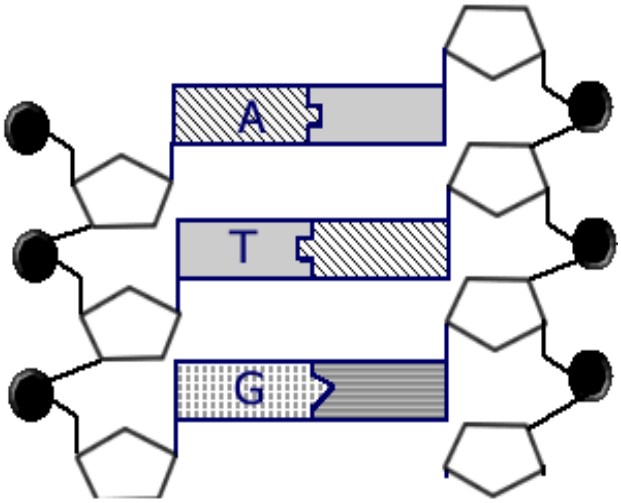
Molecular DNA

Living things contain proteins. Your skin, muscles, and bones contain protein. All the actions you perform such as eating, running, and thinking depend on proteins called enzymes. How is this related to DNA? Within DNA is the information for life. DNA contains the instructions to make all the different proteins an organism needs.

How can DNA hold all that information? DNA can contain amazing amounts of information because of its structure. In 1953, James Watson and Francis Crick describes DNA as a very long molecule made up of repeating units called nucleotides. Each nucleotide is made up of a simple sugar, a phosphate group, and a nitrogenous base. A nitrogenous base is a carbon ring structure that contains one or more atoms of nitrogen. In DNA, there are four of these bases: adenine (A), guanine (G), cytosine (C), and thymine (T). The bases always pair accordingly in DNA; A = T and C = G. Because each nucleotide contains just one of these nitrogenous bases, there are only four different nucleotides in DNA. Nucleotides join together to form long chains, or strands. The phosphate groups and the sugar form the backbone of the strand and the nitrogenous bases stick out like the teeth of a zipper. They also noted that DNA was twisted (helix) into a coil like a spring. DNA is made of two strands that are twisted into a coil, so it is called a double helix.

I. Label the following parts of the DNA molecule.

Adenine
Guanine
Thymine
Cytosine
Phosphate
Deoxyribose
Hydrogen Bond
Circle Backbone



How can DNA do so much with so little? If every organism is made up of the same four nucleotides, how can organisms be so different from one another? The key to variety in organisms is the sequence, or order, of the four nucleotides. For example, a nucleotide sequence of A-T-T-G-A-C carries different information than the sequence T-C-C-A-A-A. It is the sequence of nucleotides that forms the unique genetic information for every organism. In a similar way, words that have the same letters but in different order have different meanings. TEA is not the same as EAT or ATE.

Replication of DNA For most organisms to reproduce, a sperm cell and an egg cell, both produced through meiosis, must unite to form a fertilized egg. From one fertilized egg, an organism with millions of cells is produced through mitosis. Each cell in that organism has a copy of the DNA that was in the original fertilized egg. Remember, before a cell can divide, it must first make a copy of its chromosomes. The DNA in the chromosomes is copied in a process called DNA replication. If the DNA did not make a copy of itself, new cells would have only half the amount of DNA of their parents and could not grow and reproduce successfully. Species could not survive. All organisms replicate DNA.

How does DNA replicate? Remember that a DNA molecule is made of two strands of nucleotides joined together like a zipper at the nitrogenous bases. As you know, adenine on one strand always pairs with thymine on the other strand. In the same way, guanine on one strand always pairs with cytosine on the other strand. During replication, the DNA molecule unzips and separates.

As the DNA unzips, nucleotides that are floating free in the cell attach to the unzipped chains. On the unzipped strand where there is guanine, cytosine will attach. The original DNA molecule continues to unzip until every base has become a pair and a new DNA molecule is formed. In this way the original DNA strand serves as a pattern or template to make a new DNA molecule. Each new strand formed is a complement of one of the original strands. The result is two DNA molecules, each is the same as the parent molecule. When all of the DNA in all the chromosomes has been replicated, the cell can divide, passing on the genetic information to the new cell.

II. Analyze: When one DNA molecule replicates, how many new DNA molecules are formed? (Circle your choice.)

a. one b. two c. three d. four

III. Create Sentences: Use the key terms (DNA replication, double helix and nitrogen base) and write 3 sentences that shows your understanding of the terms.

a. _____

b. _____

c._____

Genes and Proteins

DNA contains information used to make proteins. Proteins have many uses. Some proteins become structures and some control cell functions. Since DNA has the information for making proteins, DNA controls cells. Remember that all this information is based on the sequence of nucleotides in the DNA molecule.

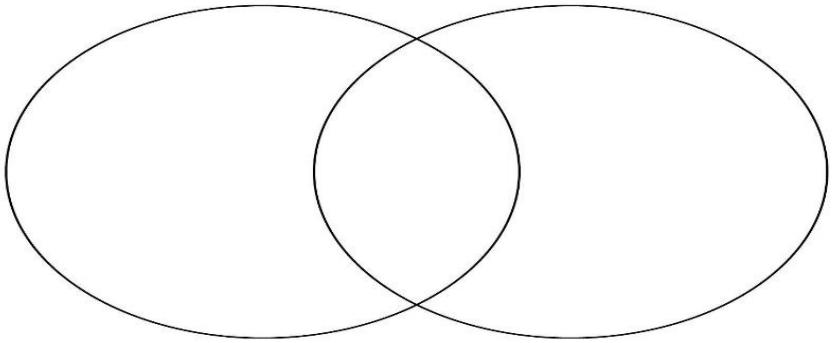
RNA What is the role of RNA in a cell? Just as in a typical factory, workers have specific tasks. So does RNA. There are three different kinds of RNA. One type is messenger RNA (mRNA). It brings instructions from DNA to the cytoplasm. A second type of RNA is called the ribosome, or ribosomal RNA (rRNA). It binds to the mRNA and uses the instructions to assemble the amino acids in the right order. The third type of RNA is transfer RNA (tRNA). It delivers amino acids to the ribosome to be made into a protein.

What does RNA look like? RNA, like DNA, is a nucleic acid. But the structure of RNA is quite different. RNA is a single strand. DNA is a double strand. The sugar (ribose) in RNA is different than the sugar (deoxyribose) in DNA. Finally, both RNA and DNA have four nitrogenous bases, but instead of thymine, RNA has uracil. Remember that in DNA, guanine binds with cytosine, and thymine binds with adenine. In RNA uracil (U) binds with adenine. The structure of RNA helps it do all the work of building proteins.

Transcription In order to get the information to the cytoplasm, first messenger RNA has to be made. In this process, called transcription, RNA is made from part of a DNA strand. First, a portion of the DNA molecule unzips. Free RNA nucleotides pair with the nucleotides on the DNA strand. The mRNA strand is complete when the RNA nucleotides form a strand by bonding together. The mRNA strand breaks away and the DNA strands rejoin. The mRNA strand leaves the nucleus and enters the cytoplasm. You can see that transcription is similar to replication with one important difference—a single strand RNA molecule is created rather than a double strand DNA molecule.

RNA Processing Not all of a DNA strand carries information to make proteins. There are long sequences of noncoding nucleotides on DNA strands. Enzymes cut out any noncoding sequences that may have been transcribed. In this way, the mRNA carries only information it needs to make protein. It takes two more kinds of RNA to actually make the protein. The process of changing the information in mRNA into an amino acid chain in protein is called **translation.**

IV. Analyze: Use the diagram to compare and contrast between transcription and translation.



What is the central dogma? If you were to summarize the process of replication, transcription, translation, and protein formation you might say it is the pathway of information flowing from DNA to mRNA to protein. This process is called the central dogma of biology. This means that the same process occurs in every living thing, from the simplest bacteria to the most complex animal.

V. *Circle the answer that best completes the sentence.*

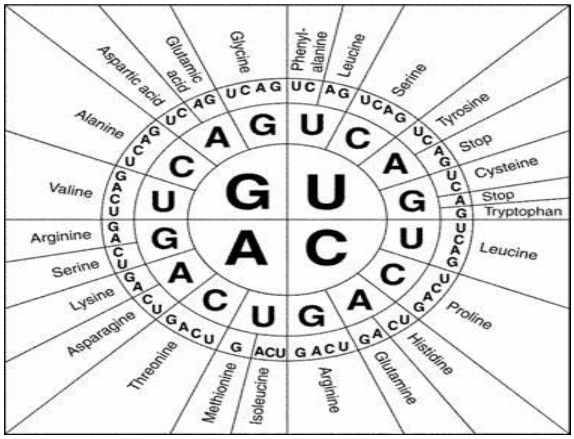
1. Protein Synthesis occurs on structures called **ribosomes/nuclei.**
2. mRNA is made in the **nucleus/cytoplasm**.
3. DNA Replication occurs in the **nucleus/cytoplasm.**
4. tRNA and Amino Acids are floating around in the **nucleus/cytoplasm**.
5. DNA is **double/single** stranded.
6. DNA contains **thymine/uracil**.
7. RNA contains the sugar **deoxyribose/ribose**.
8. Transcription produces **mRNA/tRNA**.
9. Translation produces **mRNA/tRNA**.
10. Replication produces **DNA/RNA**.

VI. Complete the following table

DNA (*master copy*)	**A**	**T**	**G**	**G**	**T**	**A**	**C**	**C**	**A**
DNA (Replication)									
mRNA (transcription									

VII. Chart: Use the genetic code chart to determine the correct amino acid.

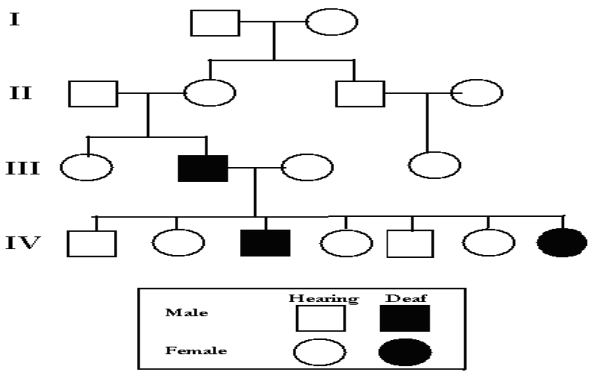
mRNA sequence	amino acid
UAC	
CAU	
GGU	
CCG	
AGC	



Mendelian Genetics

Geneticists are scientists who study how inherited or genetic traits pass from one generation to the next. Sometimes they use what is called a pedigree to study a family's genetic puzzle. A pedigree is a visual diagram of genetic inheritance used by geneticists to map genetic traits. A pedigree uses a set of symbols to identify males (squares) and females (circles) in a certain family that carry the genetic trait being studied.

VIII. Analyze: Answer the following questions **a-g** using the diagram.



****Identify by roman numeral and number per generation****

a) The chart, showing how a trait is passed from one generation to the next in a family, is called a(an) _____.
b) How many women are deaf? _____
c) How many women can hear? _____
d) How many men are deaf? _____
e) How many men can hear? _____
f) How many children does the couple in generation three have? _____
g) Identify all the carriers in the diagram. _____

A **Punnett** square is a square diagram that is used to predict the genotypes of a particular cross or breeding experiment. The diagram is used by biologists to determine the probability of an offspring having a particular genotype.

Simple Recessive Heredity Most genetic disorders are caused by recessive alleles. Diseases such as cystic fibrosis, Tay-Sachs disease, and phenylketonuria, also known as PKU, can be predicted by the use of a pedigree. For an offspring to inherit a recessive trait, both parents must have the recessive allele.

Simple Dominant Heredity Remember that to inherit a dominant trait, only one parent needs to have the dominant allele for that trait. A cleft chin, a widow's peak hairline, freely hanging earlobes, almond-shaped eyes, and thick lips are examples of dominant traits. Only one allele needs to be present for these traits to show up. Huntington's disease is caused by a rare dominant allele. There is no effective treatment for Huntington's disease, which causes a breakdown in certain parts of the brain. Because Huntington's disease doesn't occur until a person is between the ages of 30 and 50, many people have already had children before they develop the disease. A pedigree could help

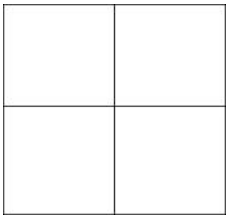
people with Huntington's disease in their family better understand their own risks for the disease and for passing it on to future generations.

IX. Monohybrid Crosses: Complete the following Punnett squares.

1. a. Fill-in the Punnett Square: Tt X TT

   b. How many offspring will be tall? _____

   c. What percentage will be short? _____

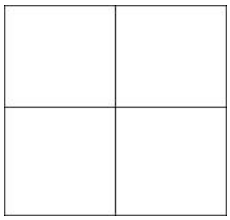


2. A heterozygous brown bear (B) was crossed with a black bear (b).

   a. Fill-in the Punnett Square.

   b. What are the possible genotypes of the offspring?

   c. What are the possible phenotypes of the offspring?

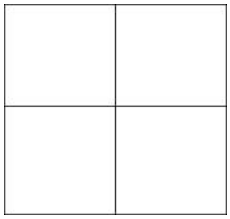


3. Homozygous brown bear is crossed with a homozygous brown bear.

   a. Fill-in the Punnett Square.

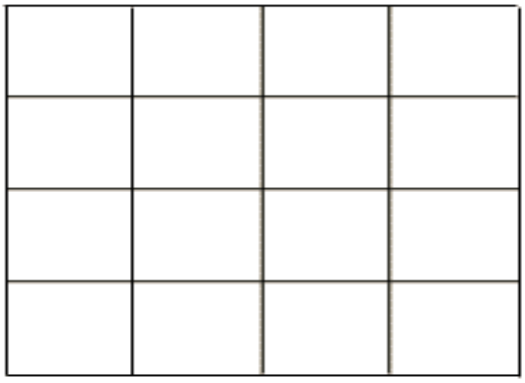
   b. What are the possible genotypes of the offspring?

   c. What are the possible phenotypes of the offspring?



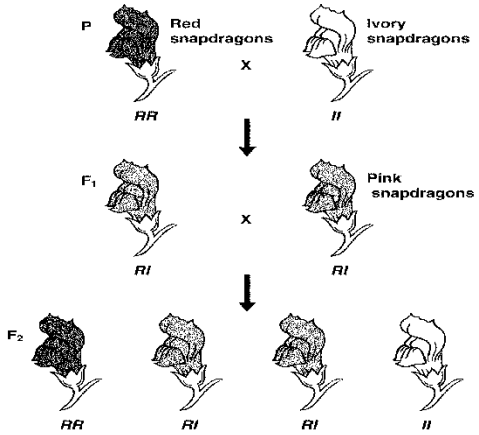
X. Dihybrid Cross: Complete the following cross ** **Di**hybrid cross - involves **2** traits at once.
(HINT: Use the FOIL method to get possible combinations)

TrRr X TtRr



XI. Calculation: What are the phenotypic results?

Complex Patterns of Inheritance Sometimes traits are not inherited through simple Mendelian genetics. Some traits are not simply dominant or recessive. When neither allele of the parents is completely dominant, the phenotype of the heterozygous offspring is a mix of the two parents. This pattern of inheritance is called **incomplete dominance**. For example, when a homozygous red snapdragon is crossed with a homozygous white snapdragon, the offspring's color will be a mix of the two. It will be pink. This follows Mendel's law of segregation.



XII. Analyze: Use the following colors and determine the inheritance pattern when applying the incomplete dominance.

a. blue X red = _____

b. yellow X red = _____

c. blue X yellow = _____

d. white X black = _____

What is codominant inheritance? In codominant inheritance, both alleles show up equally. **Codominant alleles** cause the phenotypes of both homozygote parents to be expressed equally in the heterozygote offspring. For example, when a certain variety of black chicken is crossed with a white chicken, all the offspring are checkered. Some of the feathers are black and some of the feathers are white.

XIII. Identify List 3 examples of organisms that express the codominance inheritance pattern.

a. _____ b. _____ c. _____