Biology STAAR EOC Review

Reporting Category 1: Cell Structure and Function

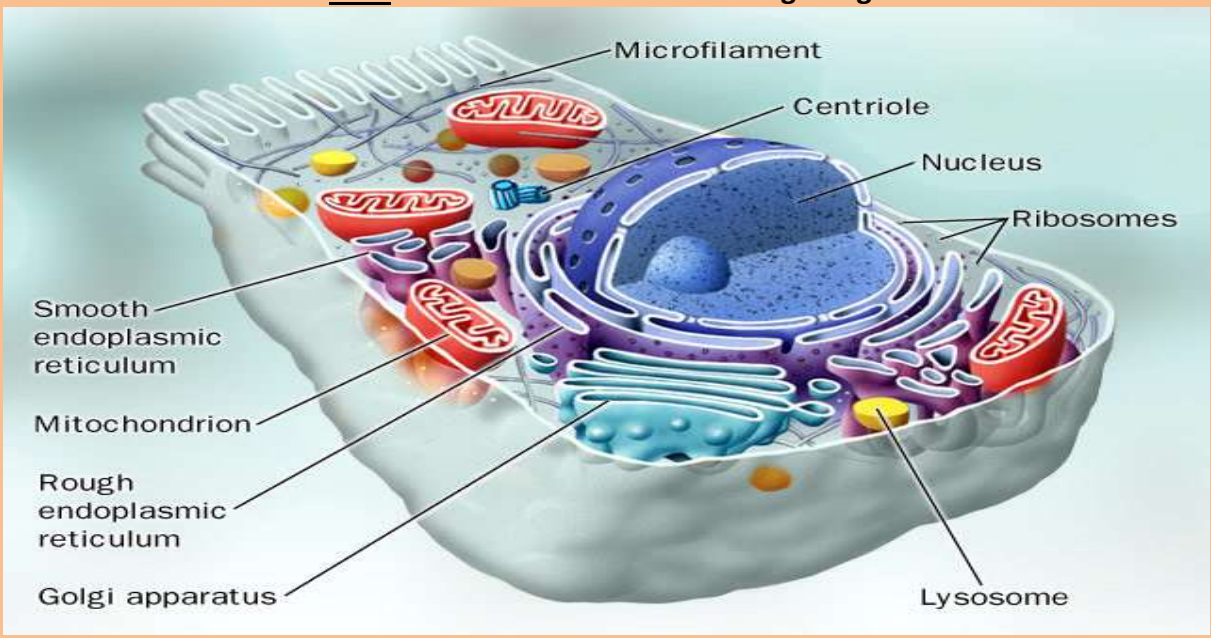
STAAR -11 Questions STAAR M-9 Questions 4 Readiness Stds 5 Supporting Stds

- **Biology** is the study of life and living organisms.
- An **organism** is a complete, individual, living thing.
- All organisms are formed from the same basic building block – **cells**.

TEKS
(RS)- will be tested (65%)
(SS)- may be tested (35%)

Key Ideas

<u>Cells</u> are the smallest units of living things



Simple cells are called <u>prokaryotic</u>; Complex cells are called <u>eukaryotic</u>

Cell Parts or Organelles

Cell membrane	**Surrounds the cell; controls what enters/leaves the cell; recognizes other cells; maintains homeostasis**
Cytoplasm	**Suspends organelles in a eukaryotic cell; enclosed within the cell membrane**
Nucleus	**Controls the cell's activities; contains chromosomes made of DNA**
Mitochondria	**Breaks down food to release energy**
Endoplasmic reticulum (smooth or rough)	**Moves substances within the cell (pipe-like structures)**
Ribosome	**Makes proteins; round structures located in rough endoplasmic reticulum**
Golgi body or complex	**Changes and packages cell products**
Lysosome	**Contains enzymes (proteins that speed up digestion and chemical reactions)**
vacuole	**Holds material like water; large in a plant cell**
	Plant cells only
Cell wall	**Surrounds the cell membrane; supports and protects plant cell**
chloroplast	**Contains <u>chlorophyll</u> (green pigment) for photosynthesis**

4B
Investigate and explain cellular processes, including homeostasis, energy conversions, transport of molecules, and synthesis of new materials (RS)

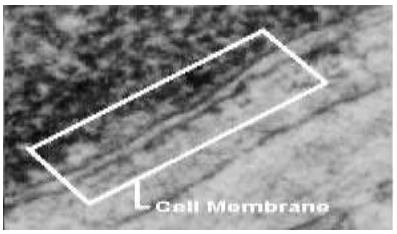
Cellular Processes

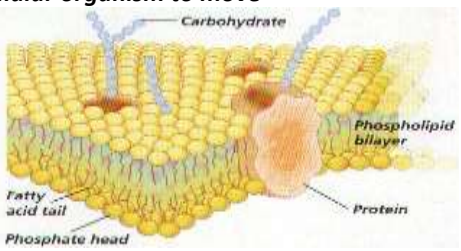
I. Homeostasis is a process by which organisms keep internal conditions relatively stable regardless of changes in the external environment. It is important because the processes that keep the cell alive can only take place under certain internal conditions.

- **Balanced internal condition of cells**
- **Homeostasis** is also called **equilibrium**
- **Maintained by plasma membrane controlling what enters & leaves the cell**

Plasma or Cell Membrane

The cell membrane is flexible and allows a unicellular organism to move



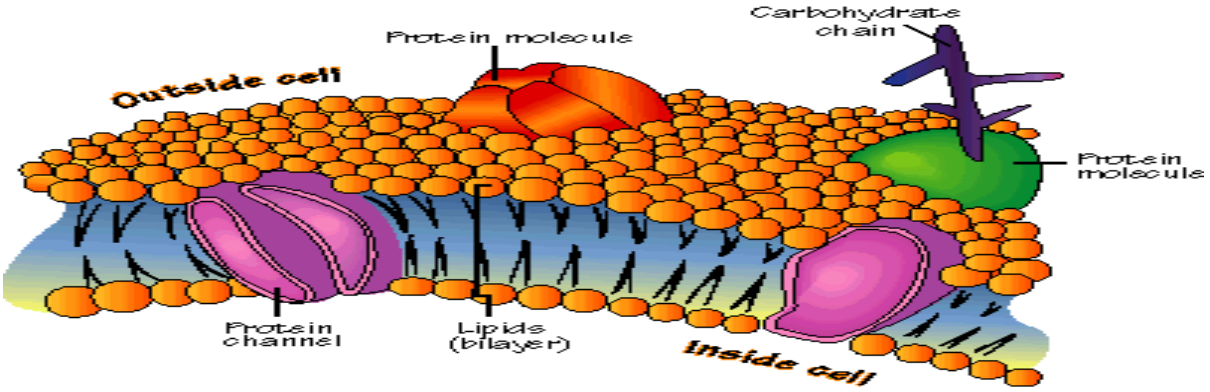


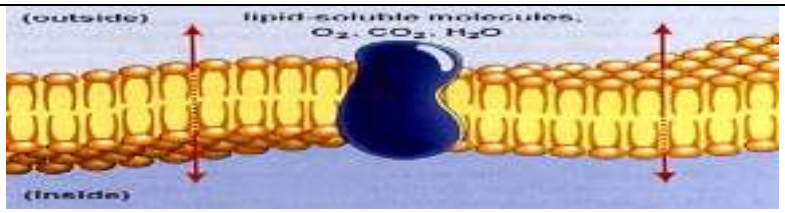
When you **transpor**t something, you move it from one place to another. Cells transport materials across the cell membrane.

Functions (what they do) of Plasma or Cell Membrane

- ✓ Protective barrier
- ✓ Regulate transport in & out of cell (**selectively permeable**- only lets some things and out of the cell like a club bouncer; Specifically, small molecules and larger hydrophobic molecules move through easily. e.g. O_2, CO_2, H_2O; Ions, hydrophilic molecules larger than water, and large molecules such as proteins do not move through the membrane on their own.
- ✓ Allow cell recognition
- ✓ Provide anchoring sites for filaments of cytoskeleton
- ✓ Provide a binding site for enzymes
- ✓ Interlocking surfaces bind cells together (junctions)
- ✓ Contains the cytoplasm (fluid in cell)

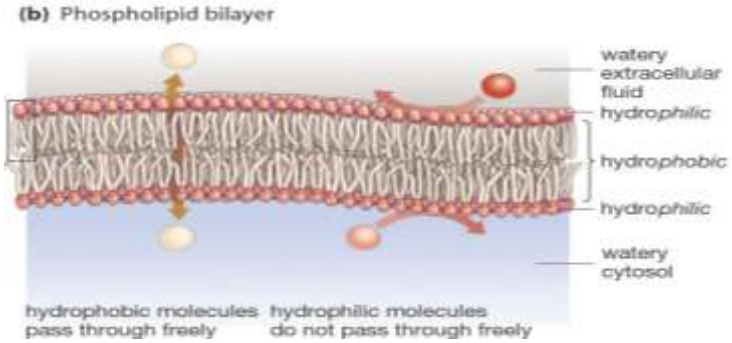
Structure of the Cell Membrane





Cell Membrane

- **<u>Polar heads</u> are hydrophilic "water loving"**
- **<u>Nonpolar tails</u> are hydrophobic "water fearing"**
  Makes membrane "Selective" in what crosses - "Selectively permeable"

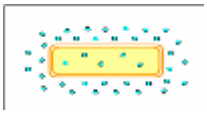


II. Types of Transport Across Cell Membranes

Simple Diffusion

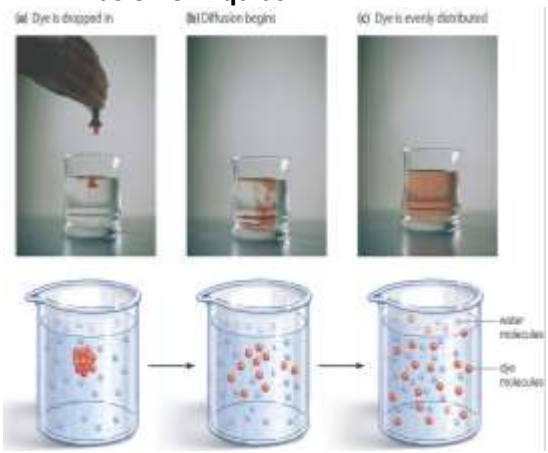
Requires <u>NO energy</u>; Molecules move from area of <u>HIGH to LOW concentration</u>

DIFFUSION

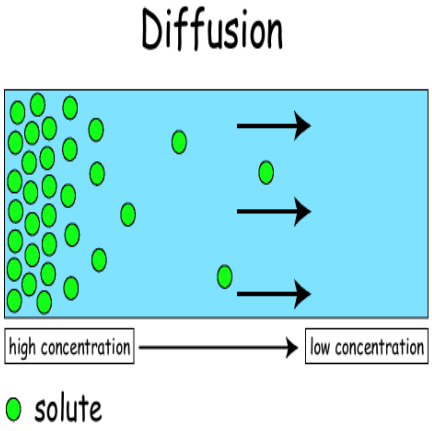


Diffusion is a **PASSIVE process** which means **no energy** is used to make the molecules move**, they have a natural KINETIC ENERGY**

Ex: Diffusion of Liquids



Diffusion through a Membrane

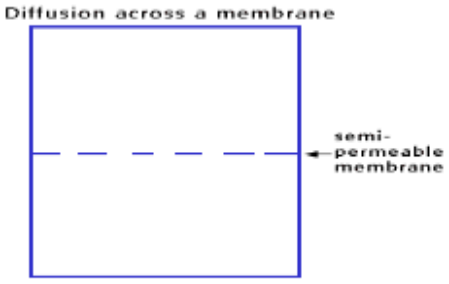


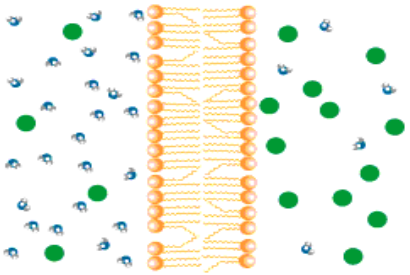
Solute moves DOWN concentration gradient (HIGH to LOW)

Osmosis- **Diffusion of water across a membrane**

Moves from HIGH water potential (low solute) to LOW water potential (high solute)

Diffusion of H_2O Across A Membrane

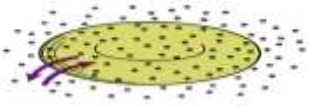




Cells in Different Solutions (Think of a pimple)

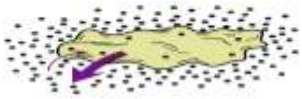
TABLE 5-1 *Direction of Osmosis*

Condition	Net movement of water	
External solution is hypotonic to cytosol	into the cell	H_2O → ← H_2O
External solution is hypertonic to cytosol	out of the cell	H_2O ← → H_2O
External solution is isotonic to cytosol	none	H_2O ⇄ ⇄ H_2O



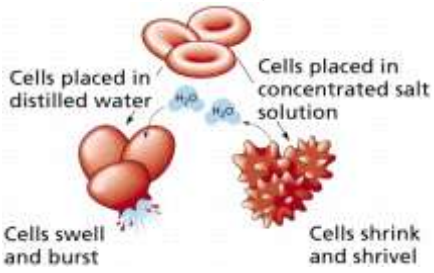
Isotonic (Balance flow)
NO NET MOVEMENT OF H_2O
(equal amounts entering & leaving)

Hypotonic Solution
CYTOLYSIS (Cell Swells)



Hypertonic Solution
PLASMOLYSIS (Cell bursts)

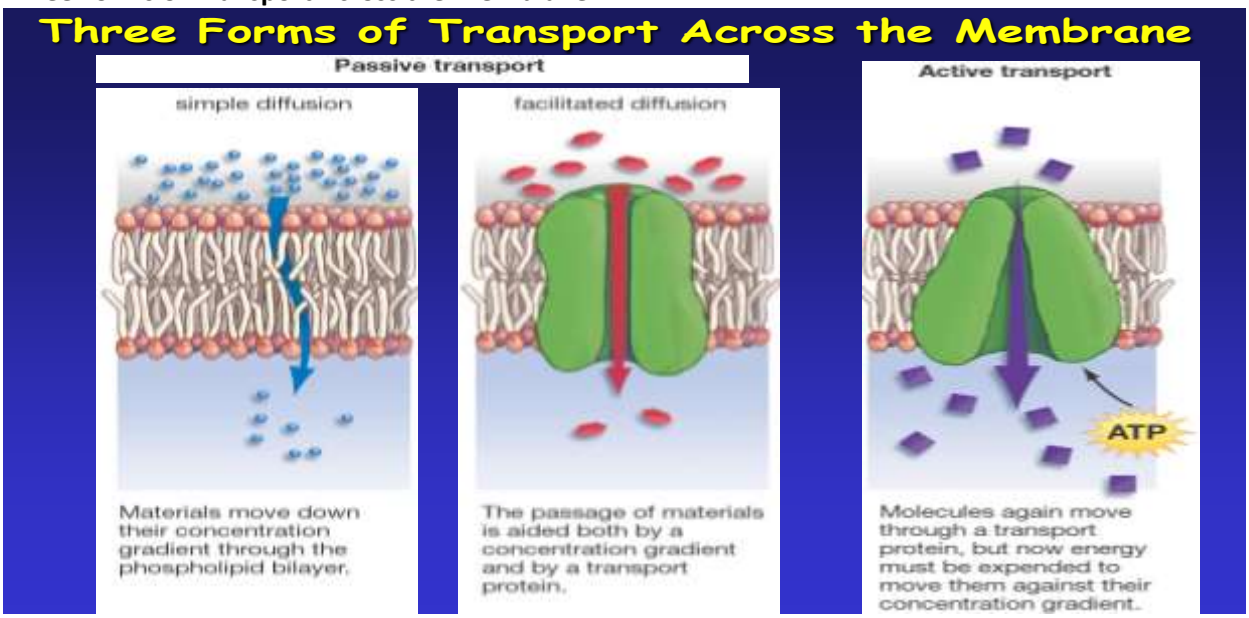
(Isotonic)



(Hypotonic) **(Hypertonic)**

III. Energy Conversions

Three Forms of Transport Across the Membrane



A. Passive Diffusion- Simple Diffusion

- Doesn't require energy
- Moves high to low concentration
- Example: Oxygen or water diffusing into a cell and carbon dioxide diffusing out.

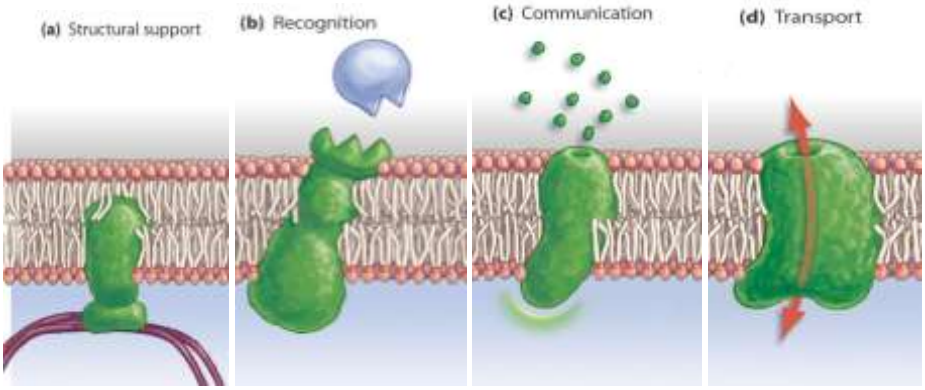
B. Facilitated diffusion

- Doesn't require energy
- Uses transport proteins to move high to low concentration
- Examples: Glucose or amino acids moving from blood into a cell.

C. Active Transport

- Requires energy or ATP
- Moves materials from LOW to HIGH concentration
- AGAINST concentration gradient
- Examples: Pumping Na^+ (sodium ions) out and K^+ (potassium ions) in against strong concentration gradients.
- Called Na+-K+ Pump

Proteins Are Critical to Membrane Function

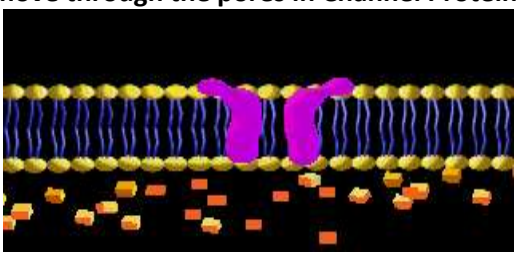


Types of Transport Proteins

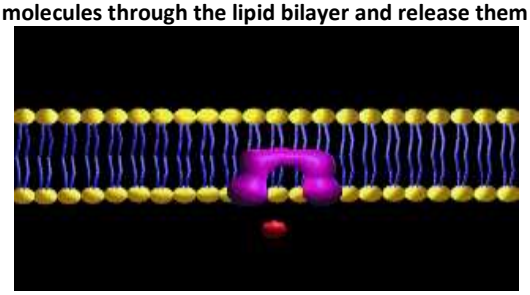
- Channel proteins are embedded in the cell membrane & have a pore for materials to cross

- **Carrier proteins can change shape to move material from one side of the membrane to the other**

Facilitated Diffusion
Molecules will randomly move through the pores in Channel Proteins.



- **Some Carrier proteins do not extend through the membrane.**
- **They bond and drag molecules through the lipid bilayer and release them on the opposite side.**



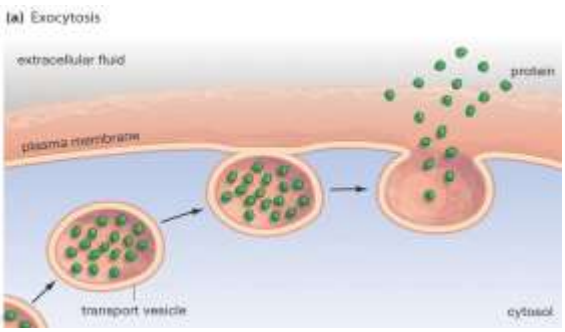
Carrier Proteins

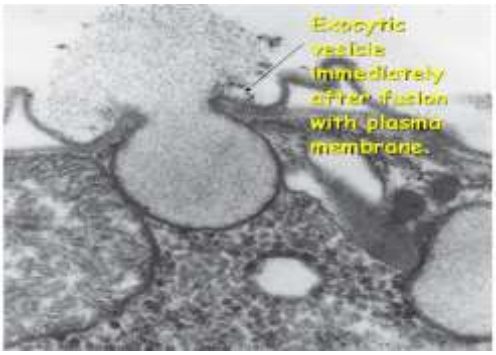
- **Other carrier proteins change shape to move materials across the cell membrane**

Exocytosis - **moving things out of the cell**

- **Molecules are moved out of the cell by vesicles that fuse with the plasma membrane.**
- **This is how many hormones are secreted and how nerve cells communicate with one another**

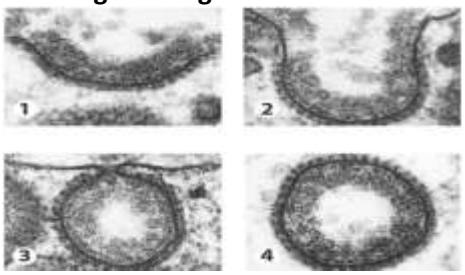
Moving the "Big Stuff" Out in the Cell





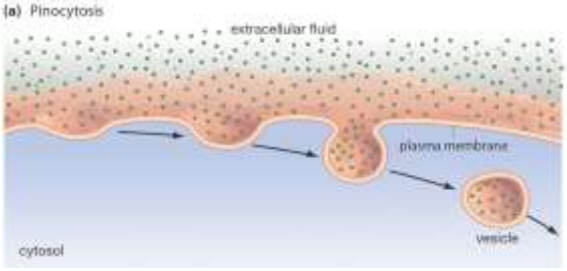
Endocytosis- Large molecules move materials into the cell by one of three forms of **endocytosis.**

Moving the "Big Stuff" in the cell



3 Types of Endocytosis

A. **Pinocytosis- Most common form of endocytosis; Takes in dissolved molecules as a vesicle**

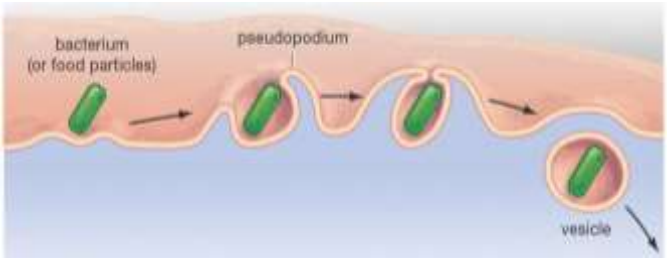


Cell form an invagination

***Materials dissolve in water to be brought into cell**

B. **Phagocytosis Used to engulf large particles such as food, bacteria, etc. into vesicles;**

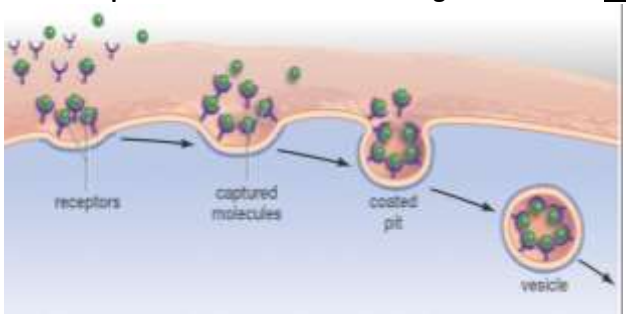
Called "Cell Drinking"



Phagocytosis about to occur

C. **Receptor-Mediated Endocytosis**

Some integral proteins have receptors on their surface to recognize & take in hormones, cholesterol, etc.



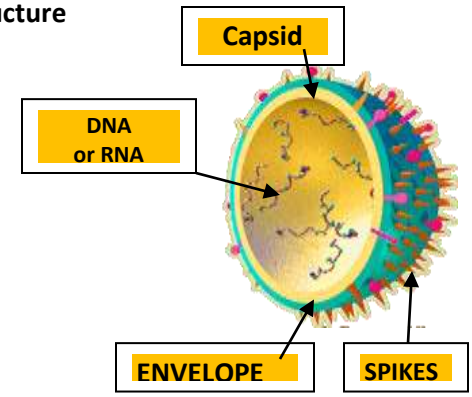
Summary of Cellular Processes

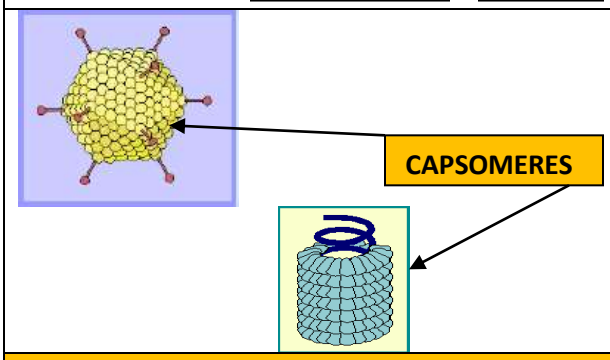
• **Homeostasis**	Regulation of conditions (like pH or temperature) within a cell which allows for stable, "normal" internal equilibrium (balance)
• **Energy Conversions**	During photosynthesis, plant cells use energy from the sun to make sugar called glucose; during aerobic cellular respiration, mitochondria release energy from molecules like glucose
• **Molecule transportation**	Molecules move in and out of cells across the cell membrane by various means; active transport (like transport proteins) requires energy, but passive energy (like diffusion) does not
• **Synthesis of New Molecules**	Cells can create new molecule from simpler molecules, like when proteins are made from amino acids

4C
Compare the structures of viruses to cells, describe viral reproduction, and describe the role of viruses in causing diseases such as human immunodeficiency virus (HIV) and influenza (RS)

Structure of Viruses

Virus Structure





Outside View of a Virus

Viruses and Cells

Characteristic	Virus	Cell
Structure	DNA or RNA in capsid, some with envelope	Cell membrane, cytoplasm, eukaryotes also contain nucleus and many organelles
Reproduction	Only within a host cell	Independent cell division, either asexually or sexually
Genetic Code	DNA or RNA	DNA
Growth and Development	No	Yes; in multicellular organisms, cells increase in number and differentiate
Obtain and use energy	No	Yes—Eukaryotic ell
Response to Environment	No	Yes
Change over time	Yes	Yes

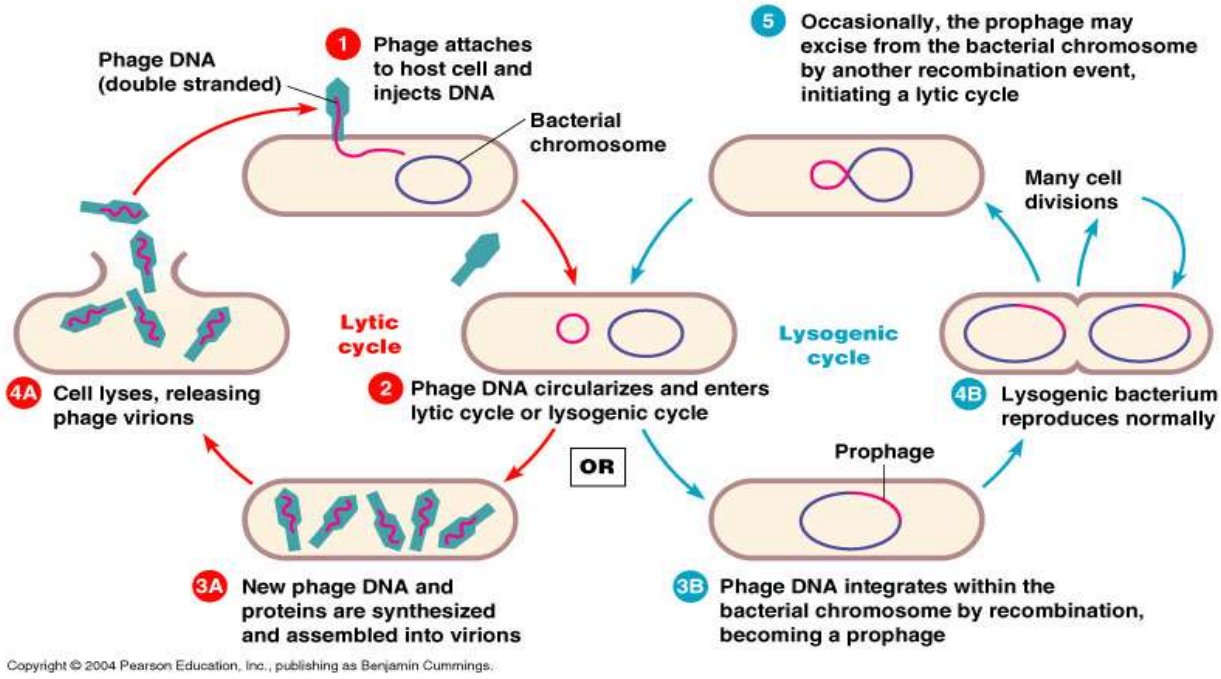
- **A virus** is a nonliving particle made up of proteins, nucleic acids, and sometimes lipids.

- **Viruses can reproduce only by infecting living cells**. **A virus consists of a core of DNA or RNA** surrounded by a protein coat called a **capsid**.
- Unlike a cell, a virus lacks structures to take in food, break apart food for energy, or synthesize molecules.
- Because **viruses are noncellular** and cannot perform most functions of life, scientists classify viruses as nonliving particles. However, viruses are able to perform one life function- reproduction- with the aid of a **host** organism.
- Hosts can be **prokaryotes or eukaryotes**.
- Viruses that use prokaryotes as host cells are called **bacteriophage**s or **phages.**

Viral Reproduction

Viruses reproduce by taking over the host cell. The process begins when a virus attaches to the outside of a cell. The virus then injects its genetic material into the cell. After the viral genetic material enters a host cell, one of two processes may occur.

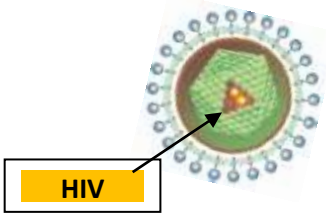
A. Steps of Lytic Cycle and Lysogenic cycle



Stages of the Lytic Cycle	Stages of the Lysogenic Cycle
The host cell starts making messenger RNA from the viral DNA.	

Role of Viruses in Causing Diseases Such as HIV and Influenza

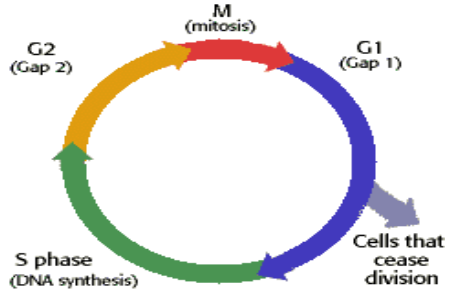
Viruses can cause disease in humans through the lytic cycle such as HIV and Influenza.

HIV	and	Influenza
 HIV		 **Influenza or the "flu"**

Human immunodeficiency Virus or HIV	Influenza or the flu
Causes AIDS or Acquired immunodeficiency Syndrome; currently there is no cure for AIDS because HIV mutates and evolves rapidly;	RNA virus
HIV infects and destroys immune system cells called helper T cells; Helper T cells play a role in keeping the body free from disease	Infects the respiratory tract of humans as well as other animals
When HIV attacks a helper T cell, it binds to the cell membrane and enters the cell. Once the virus is inside the cell, it uses the cell's structures to make new viruses. Then the virus destroys the cell and the new viruses are released into the bloodstream. They travel throughout the blood, infecting and destroying other helper T cells.	The death of the infected cells and a person's immune system response causes inflammation which leads to sore throat and mucus secretions
As an HIV infection progresses, more helper T cells are destroyed. Doctors determine the number of helper T cells in the blood of people with HIV infections to monitor how far their infections have progressed. The fewer the T-cells in the blood, the more advanced the infection.	Infection causes mild to severe illness, including fever, cough, headache, and a general feeling of tiredness
As the immune system becomes increasingly compromised by HIV, the body becomes more susceptible to diseases that seldom show up in people with a healthy immune system; People who have AIDS die from other diseases because their immune system is too weak to fight off infections (opportunistic diseases)	Infection lasts for 1 to 2 weeks and can cause a more severe illness

5A
Describe the stages of the cell cycle, including deoxyribonucleic acid replication and mitosis, and the importance of cell cycle to the growth of the organism (Readiness Standard)

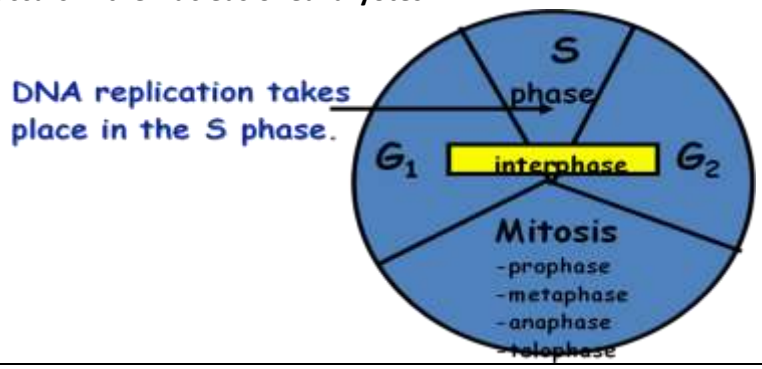
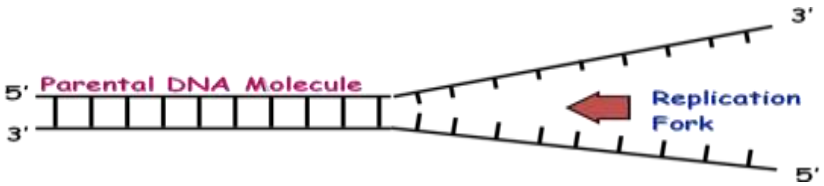
The Cell Cycle: *Stages in growth & division*

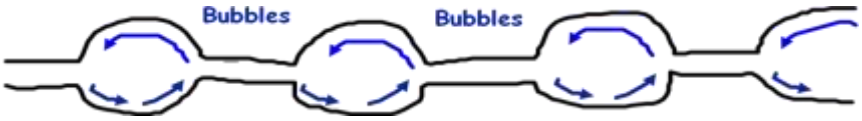


G1 Phase	*S Phase*	*G2 Phase*	*M Phase* (Mitosis)	*Cytokinesis* (Cell plate forming between the two cells)
First growth stage	**Copying of all of DNA's instructions**	**Time between DNA synthesis & mitosis**	**Cell growth & protein production stop**	**Occurs after chromosomes separate**
Cell increases in size	**Chromosomes duplicated**	**Cell continues growing**	**Cell's energy used to make 2 daughter cells**	**Forms two, identical daughter cells**
Cell prepares to copy its DNA		**Needed proteins produced**	**Called mitosis or karyokinesis (nuclear division)**	

I. DNA Replication

A process that transforms one DNA molecule into 2 identical copies; enzyme help DNA strands unwind and separates; each DNA strand serves as a template (pattern) for a new, complementary strand to form by matching (pairing) nitrogen bases. As a result, each new DNA molecule contains half of the original molecule

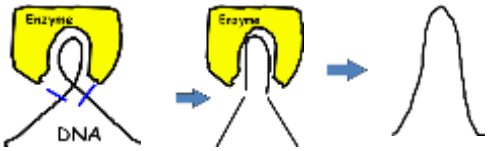
Replication Facts	• DNA has to be copied before a cell divides • DNA is copied during the S or synthesis phase of interphase • New cells will need identical DNA strands
Synthesis Phase (S phase)	**S phase during interphase of the cell cycle** **Occurs in the Nucleus of eukaryotes** 
DNA Replication (in a nut shell)  **the process used by cells to copy DNA – enzyme unzips DNA and each side of the ladder acts as a template for the building of the new half. Use the N-base paring rules : A-T ; C-G** **Example)** **TACGGAC (old strand)** **ATGCCTG (new strand**	**Begins at Origins of Replication** **Two strands open forming Replication Forks (Y-shaped region)** **New strands grow at the forks** 
	As the 2 DNA strands open at the origin, Replication Bubbles form • Prokaryotes (bacteria) have a single bubble • Eukaryotic chromosomes have MANY bubbles



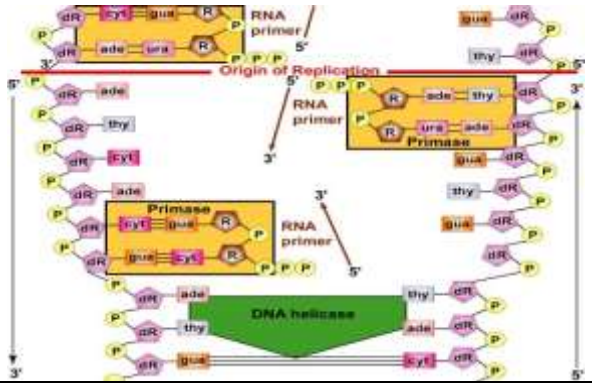
Enzyme Helicase unwinds and separates the 2 DNA strands by breaking the weak hydrogen bonds

- Single-Strand Binding Proteins attach and keep the 2 DNA strands separated and untwisted

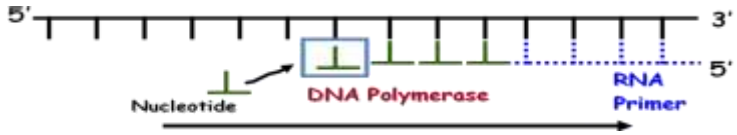
Enzyme Topoisomerase attaches to the 2 forks of the bubble to relieve stress on the DNA molecule as it separates



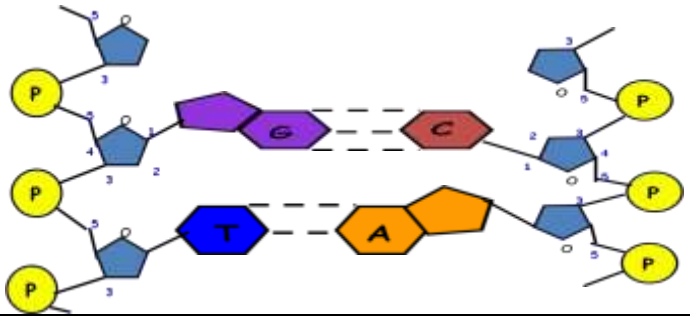
Before new DNA strands can form, there must be RNA primers present to start the addition of new nucleotides;
Primase is the enzyme that synthesizes the RNA Primer;
DNA polymerase can then add the new nucleotides



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

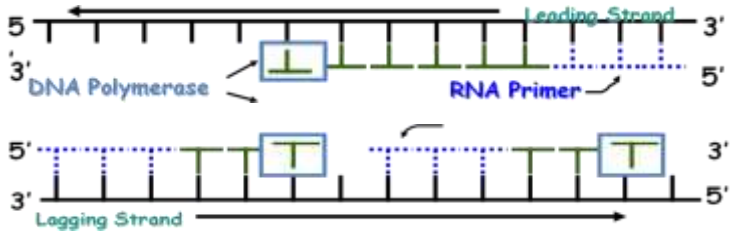
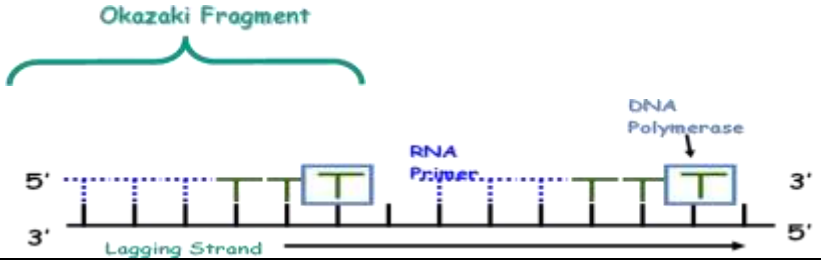
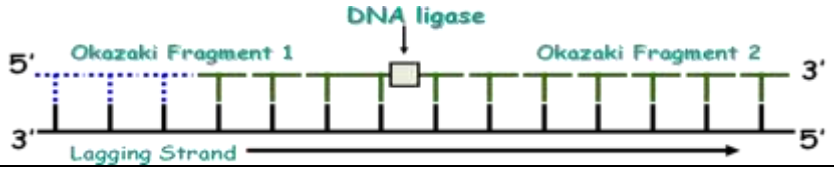
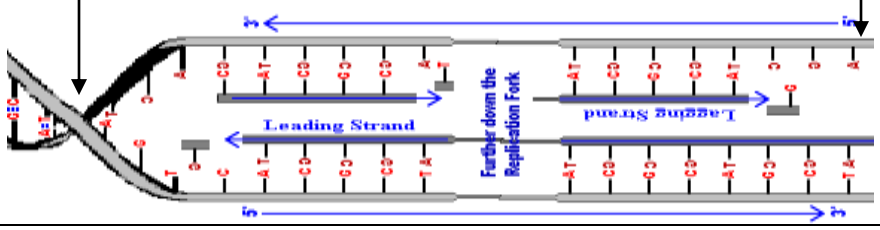


Direction of Replication



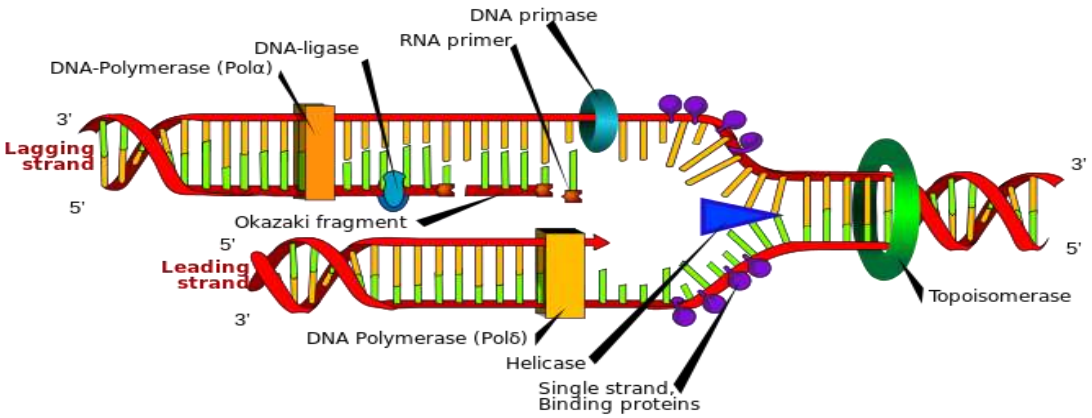
DNA replication:

The **Leading Strand** is synthesized as a single strand from the point of origin toward the

		Synthesis of the New DNA Strands	**opening replication fork** 
			The Lagging Strand is synthesized discontinuously against overall direction of replication **This strand is made in MANY short segments.** **It is replicated from the replication fork toward the origin** 
		Lagging Strand Segments	**Okazaki Fragments** - series of short segments on the **lagging strand** **Must be joined together by an enzyme** 
		Joining of Okazaki Fragments	**The enzyme Ligase joins the Okazaki fragments together to make one strand** 
		Replication of Strands	**Replication Fork** **Point of Origin** 
		Semiconservative Model of Replication (Watson & Crick)	**The two strands of the parental molecule separate, and each acts as a template for a new complementary strand** **New DNA consists of 1 PARENTAL (original) and 1 NEW strand of DNA** 

Parental DNA

Summarize DNA Replication- Explain what happens using the diagram below:

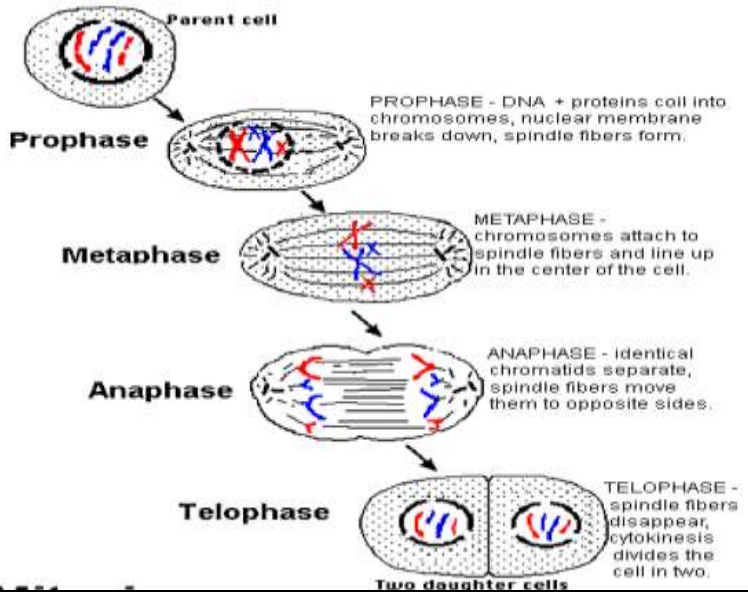
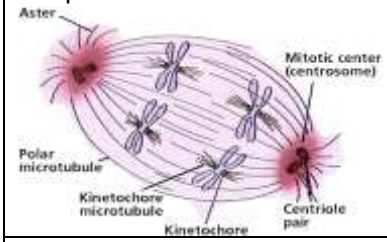


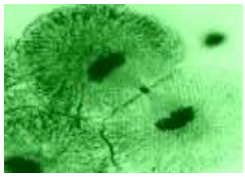
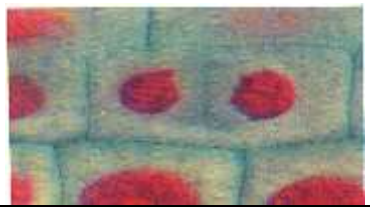
II. **Mitosis-** Life Cycle of a Cell

- **Mitosis is a cycle with n*o* beginning or end;**
- **Mitosis creates diploid cells and is for the purpose of tissue repair and growth in animals] DNA coils to form chromosomes during cell division**

Interphase – Resting Stage

- **Cells carrying on normal activities**
- **Chromosomes aren't visible**
- **Cell metabolism is occurring**
- **Occurs before mitosis**

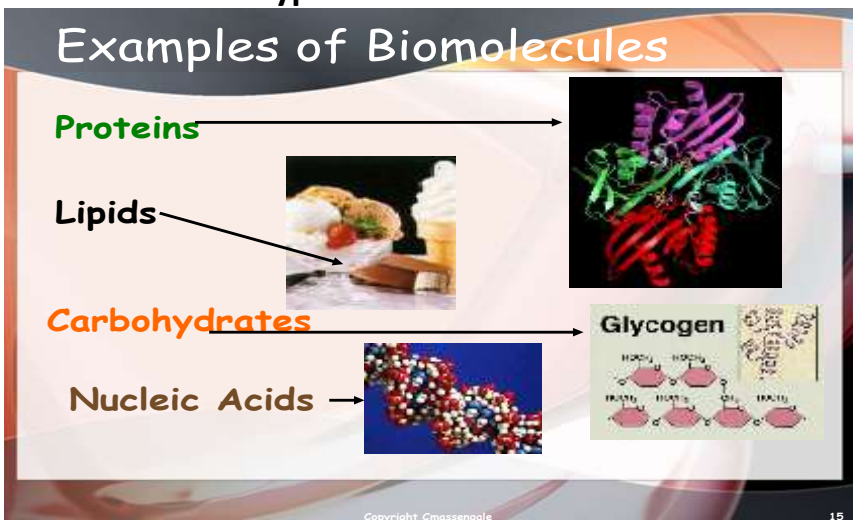
	Stages of Mitosis (PMAT) ***Prophase*** ***Metaphase*** ***Anaphase*** ***Telophase***	**Cells Undergoing Mitosis**  	
	Prophase 	➢ **DNA coils tightly & becomes visible as chromosomes** ➢ **Nuclear membrane disappears** ➢ **Nuceolus disappears** ➢ **Centrioles migrate to poles** ➢ **Spindle begins to form**	
	Metaphase	➢ **Spindle fibers from centrioles attach to each chromosome** ➢ **Cell preparing to separate its chromosomes** ➢ **Cell aligns its chromosomes in the middle of the cell**	
	Anaphase 	➢ **Cell chromosomes are separated** ➢ **Spindle fibers shorten so chromosomes pulled to ends of cell**	
	Telophase	➢ **Separation of chromosomes completed** ➢ **Cell Plate forms (plants)** ➢ **Cleavage furrow forms(animals)** ➢ **Nucleus & nucleolus reform**	

		➢ **Chromosomes uncoil** 
	Cytokinesis **(Cell plate forming between the two cells)**	➢ **Occurs after chromosomes separate** ➢ **Forms two, identical daughter cells** 

III. Importance of the cell cycle to the growth of the organism

9A
Compare the structures and functions of different types of biomolecules, including carbohydrates, lipids, proteins, and nucleic acids (***Readiness Standard)***

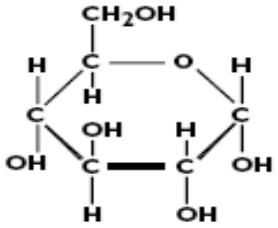
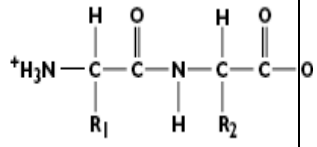
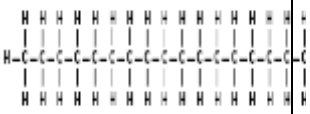
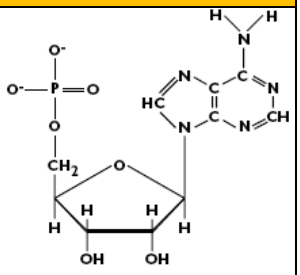
Types of Biomolecules



Biomolecule	Structure	Function
Protein (enzyme, hormone) Example: Nuts	**Contains carbon (C), nitrogen (N), oxygen (O), hydrogen (H), and possibly sulfur (S) atoms; made of amino acids; large and complex** Example: Muscle	***Used to build cells;*** ***Structural molecule (like keratin in fingernails); enzyme, hormone, transport molecule (like hemoglobin in blood); contractions***
Lipids (fats, steroid, wax, oil, fatty acid) Example: Crisco	***Contains carbon(C), oxygen (O), hydrogen (H), and possibly other atoms: ratio of hydrogen (H) atoms to oxygen (O) atoms is high; insoluble (does not dissolve) in water*** Example: oils	***Source of energy; cell membrane component; protective coating (like wax); chemical messenger (like cholesterol)*** Example: butter
Carbohydrates (Sugar, starch) Example: Sugar in Coke	**Contains carbon (C), nitrogen (N), and hydrogen (H) atoms; ratio of hydrogen to oxygen atoms is 2:1** Example: Starch in pasta	***Source of energy (like glucose); structural molecule (cellulose)*** Ex: Orange (fruits are carbohydrates because they have sugar)
Nucleic Acids ***(****DNA & RNA)* 	**Contains a carbohydrate (sugar) group, phosphate group (PO_4^{-3}), and a nitrogen base (adenine, thymine (in DNA only) or uracil (in RNA only), cytosine, and guanine; very large and complex**	**Carrier of genetic information and instructions of protein synthesis**

Cells Use ATP from Biochemical energy for: Active transport, Movement, Photosynthesis, Protein Synthesis, Cellular respiration, and all other cellular reactions

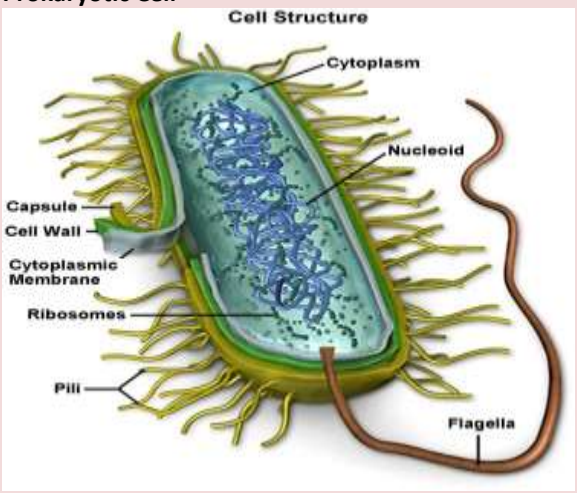
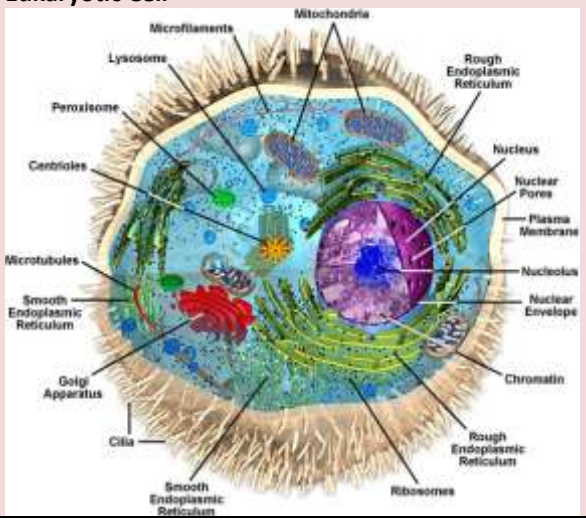
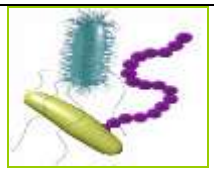
Structure of Biomolecules

CARBOHYDRATE (Sugar – Glucose)	PROTEIN (One Amino Acid)	LIPID (Fat)	NUCLEIC ACID (One Nucleotide)
			

4A
Compare and contrast prokaryotic and eukaryotic cells (Supporting Standard)

DIFFERENCES IN CELLS

Cells can be grouped according to their similarities and differences. All cells can be divided into two categories – prokaryotes and eukaryotes.

Prokaryotic Cell	Eukaryotic Cell
	
lacks a true nucleus	Has a well-defined nucleus surrounded by a nuclear membrane
does not have membrane bound organelles	DNA is in the form of complex chromosomes
DNA in a prokaryote is a single circular molecule	More complex
have no mitochondria, chloroplasts, Golgi bodies, lysosomes, vacuoles, or endoplasmic reticulum	cells are found in plants, animals, fungi, and protists.
have a cell wall and a cell membrane	Example:
Example: **bacteria cell (below) and blue green algae**	**Animal cell** **Plant cell**
	 

Eukaryotic cells also differ between plants and animals. Plant cells contain three structures not found in animal cells – cell walls, large central vacuoles, and plastids. Centrioles are found in some, but not all types of plant cells. They are found in all animal cells.

Summary

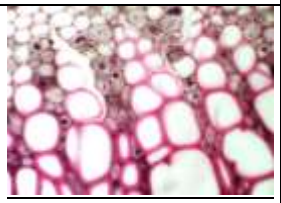
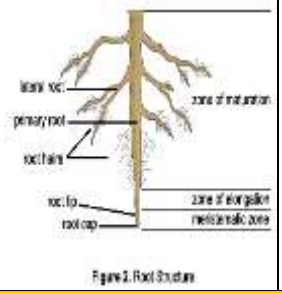
Characteristic	Prokaryote (Bacteria and Blue green algae)	Eukaryote (Plant and animal cell)
Cell membrane	Yes	Yes
Cytoplasm	Yes	Yes
Ribosomes	Smaller	Larger
Nucleus	No	Yes
Organelles	No	Yes

5B
Examine specialized cells, including roots, stems, and leaves of plants; and animal cells such as blood, muscle, and epithelium (SS)

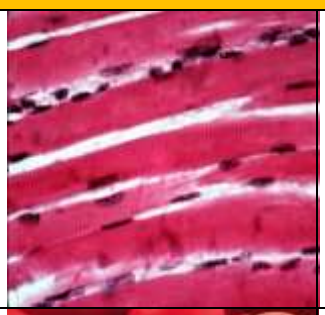
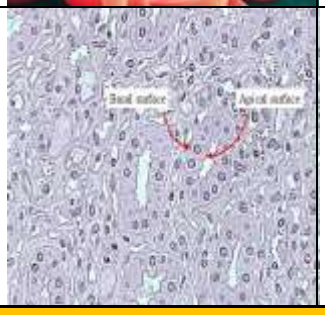
Specialized Cells

DNA holds the genetic information that controls what the cell can do and what molecules it makes.
Ex: White blood cells in animals are specialized to attack pathogens (disease causing agents) like viruses or bacteria

Plant Cells

Plant part		Examples of specialized plant cells and functions
Leaf	 Guard Cell	Cells containing chloroplasts (green coloring) for photosynth Guard cells control size of stomates (pores) allowing gas tra
Stem	 Xylem Cell	Xylem cells move water and minerals; Phloem cells move nutrients like glucose throughout the plant using pipe like structures (this provides support for leaves, branches, and flowers)
Root		Epidermis cells on root hairs increase surface area to allow for the absorption of water and mineral nutrients

Animal Cells

Muscle Cell		• Muscle cells are individual cells that comprise the muscle tissue of the body and execute muscle contraction. • There are three types of muscle cells: skeletal, cardiac, and smooth. Each of these types differ in cellular structure, specific function, and location within the body • Together, the three muscle cell types play specific roles in supporting the skeletal structure and posture of the body, assisting in the flow of blood through blood vessels, aiding in digestion, and driving the heartbeat.
Blood Cell		Mammals have 3 types of blood cells (they make up 45% of blood tissue): (Pictured here are the red blood cells) 1. red blood cells — Erythrocytes (carrying oxygen and son carbon dioxide through the use of hemoglobin) 2. white blood cells — Leukocytes (cells of the immune system involved in defending the body against both infectious disease and foreign materials 3. platelets — Thrombocytes- (clear, small and a natural source of growth in the body; it helps to form clots.
Epithelium Cell		• Epithelial tissue covers external surfaces and internal cavities and organs. • Epithelia forms boundaries- it lines the intestines and the esophagus.. Most substances that move into or out of the body must pass through epithelial tissue. • One surface of the tissue is free and the other adheres to a basement membrane

5C
Describe the roles of DNA, ribonucleic acid (RNA), and environmental factors in cell differentiation

What is Cell Differentiation?

A multicellular organism such as a human begins as a single cell. Through the cell cycle and mitosis, the cell divides into 2 daughter cells which are continually divided by mitosis. Daughter cells are not necessarily identical or the same as their parent cells in the early stages. The process of cell differentiation produces specialized cells that have certain structures that allow them to perform a specific function.

Cell differentiation occurs in **stem cells**, which are unspecialized cells that can differentiate into other cells. Stem cells can produce other stem cells or specialized cells such as nerve, muscles, or blood cells. Not all stem cells have the same differentiation potential.

Types of Stem Cells (Specialized Cells)

- **Totipotent cells**- can produce any cell in an organism and can produce the cells of tissues surrounding an embryo. These cells are often found in the umbilical cord of mother's.

- **Pluripotent cells** form totipotent cells. In am embryo (blastocycst stage), these cells develop into three layers- germ layers: ectoderm, endoderm, and mesoderm. Each layer gives rise to a specific set of tissues and organs in the developing embryo.

- **Multipotent cells**, found in adults, can develop into a few cells such as stem cells in bone marrow which can develop into several types of blood cells , but not that of other tissues.

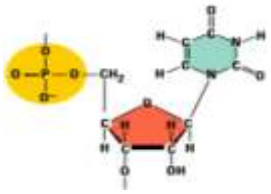
Roles of DNA and RNA in Cell Differentiation

DNA (Deoxyribonucleic Acid): genetic material that carries inherited information from parent to offspring. With a few exceptions, all the cells in an organism have the same DNA in their nuclei. During a normal cell cycle, the cells DNA is copied and passed to daughter cells. This **process of copying is called DNA replication.**

IMPORTANT!!!

***** ALL DNA is copied during replication, but only certain genes are transcribed and translated into proteins!!! The other genes are present in the cell, but they are dormant (not active)!**

Role of RNA



RNA (Ribonucleic Acid)

Ribose sugar has an extra –OH or hydroxyl group
It has the base uracil (U) instead of thymine (T)

RNA is a nucleic acid that uses genetic material from DNA to produce proteins in the cytoplasm
• RNA molecules play an active role in cells by speeding up or catalyzing biological reactions, controlling gene expression, or sensing and communicating responses to cellular signals.
• **Gene expression (active transcription and translation)** of a gene. For example, chemicals in cells called transcription factors influence which genes are transcribed and when they are transcribed. • **Transciption factors are involved in the differentiation of stem cells** into many types of speciifc tissues from the time of embryonic development.
• **After a gene is transcribed, its translation may be prevented by a process called RNA interference (RNAi).** • **RNA i involves small molecules of RNA called microRNA that bind to mRNA.** • **Once mRNA is bound by microRNA, the mRNA is cut into fragments and can no longer be translated into a protein.**

Environmental Factors in Cell Differentiation

Many factors in a cells internal or external environment affect which genes are expressed. **Gene expression** affects how a cell differentiates.

A. Internal Conditions that Affect Cell Differentiation:

Proteins and hormones that are made within the organism. Certain protein within cells transmit information and trigger (start or activate) hormones (enzymes) that carry forward the information for cell growth/differentiation.

B. External Conditions that Affect Cell Differentiation:

The release of these hormones is affected by environmental factors, such as **temperature changes** , the **supply of oxygen, and available nutrients**--- affect **gene expressions.**

Pollution can also influence gene expression because they can mock or mimic chemical signals sent by cells. This may cause some genes to be expressed that normally wouldn't be expressed**.**

Climate factors often affect gene expression. Ex: The length of day or night may trigger when plants may bloom flowers, drop their leaves, etc.

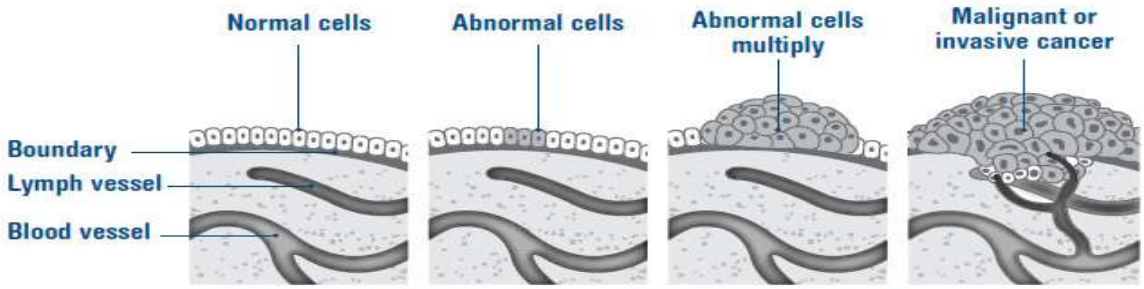
5D
Recognize that disruptions of the cell cycle lead to diseases such as cancer

What can happen when the cell cycle is disrupted?

The cell cycle is the process in which cells grow, replicate DNA, and divide to form daughter cells. During the embryonic stage of life, cells divide frequently to form the body of the organism. But later, the cell cycle is tightly regulated and controlled. This control allows the body to maintain its size and keep tissues healthy. When old cells die, controlled cell division allows new cells to replace them.

- ✓ **Disruption of the cell cycle- loss of control of the cell cycle (when it does not stop at all) can lead to cancer.**

Like other functions of cells, the cell cycle depends on DNA. When DNA is damaged or altered, it can undergo a mutation, which is a permanent change to the information it carries. In some cases, the mutation can cause an abnormal pattern of growth and division. The cell may divide quickly and may stop being useful to the body.



Some benign tumours are precancerous and may progress to cancer if left untreated. Other benign tumours do not develop into cancer

- ✓ **Cancer is the uncontrolled growth of cells (mitosis). It ultimately kills the organism.**
  Ex: oncogenes cause uncontrollable cell division, resulting in the spread of cancerous tumors.

A mass of rapidly growing cells is called a **tumor.**

Some tumors are benign, or harmless because they do not grow beyond the tumor. **Ex: moles on the body. Benign tumors are noncancerous.**

Other tumors, called malignant or cancerous tumors have cells that spread to other parts of the body. Often malignant cells spread by entering blood or lymph, another type of body fluid. The spread of malignant cells is called **metastasis.**

Cancer can occur in almost any organ including the liver, skin, lungs, brain, reproductive organs, and endocrine glands. Blood and lymph can also be cancerous. It is not a single disease, but is a group of diseases that grow abnormally and spread to other parts of the body. It is treated by **chemotherapy** (chemicals used to kill or slow the growth of cancer cells; may affect healthy cells), **radiation therapy** (damages the DNA of cancer cells using X rays or gamma rays), **surgery** (remove tumors), **or other**

treatments (drugs that target cancer cells and block the supply of blood to the tumor)

5 Major Types of Cancer		
Types	**Characteristics**	**Examples**
Carcinomas	Involves cells that cover external or internal body parts	Cancers of the lung, breast, colon, skin cancers
Sarcomas	Involves cells in bones, muscles, fat, or connective tissue	Bone cancers, Kaposi's sarcoma
Lymphomas	Begins in the lymph tissues in the immune system	Hodgkins disease, non- Hodgkins disease
Leukemias	Begin in the bone marrow and spread through the blood, do not involve tumors	Many types of acute and chronic leukemia
Adenomas		Cancers of the thyroid, pancreas, and pituitary gland involves tumors of the endocrine cells

9D
Analyze and evaluate the evidence regarding formation of simple organic molecules and their organization into long complex molecules having information such as the DNA molecule for self-replicating life

What evidence supports the formation of simple organic molecules on early Earth?

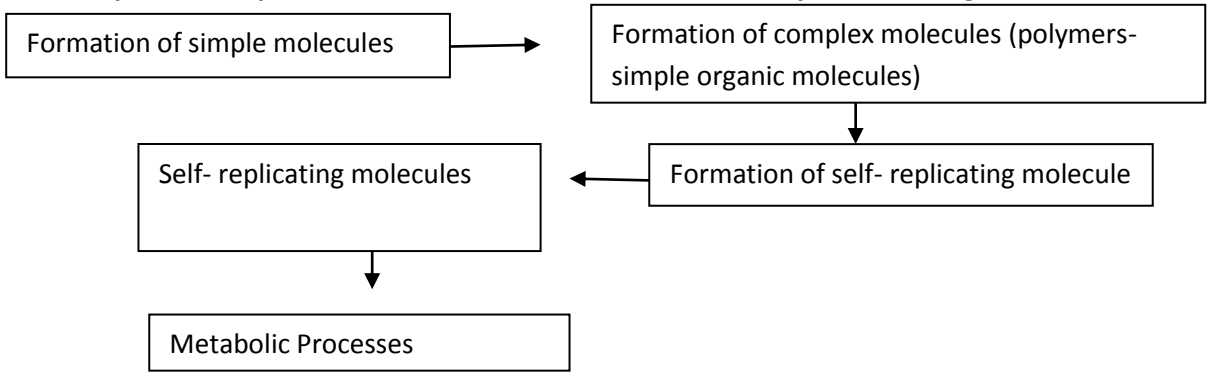
- **Organic molecules** are molecules that contain certain bonds between carbon atoms. Living things are made from organic molecules. Ex: nucleic acids, ATP, amino acids, and proteins.

- Scientists have hypothesized about the conditions on early Earth. Evidence suggest that Earth formed 4 to 5 billion years ago and for millions of years, volcanic activity and meteor strikes and comets kept the Earth's crust unstable. About 3.9 billion years ago, the strikes slowed down and oceans formed. The atmosphere developed from gases emitted from volcanoes.

- Organic molecules is hypothesized to have formed from an external energy source such as lightning, geothermal heat, or ultraviolet radiation. This idea was tested in 1953 by Miller and Urey using electricity in a cloud chamber and supported from evidence today from space- Murchison meteorite found in Australia in 1969 is said to be 4 billion years old and contain many organic molecules. Once the simple organic molecules were formed, the accumulated in oceans in a "soup." Eventually more complex molecules formed from the simple ones., followed by systems of molecules. Over time, anaerobic heterotrophs developed from these molecular systems.

How might complex molecules and cells have formed?

- **Steps from simple molecule to life is said to have evolved by the following flow chart:**



There is evidence in 3.8 billion year old rocks of chemical reactions that take place in living things.

	How did DNA become the molecule that directs cell activity? 1968- Carl Woese hypothesized that DNA arose from RNA which is known as the "**RNA World" Hypothesis** • Inorganic matter split into simple organic molecules • RNA nucleotides form and • RNA is able to replicate itself, synthesize proteins, and function in information retrieval • RNA then falls into 3 roles 1. Proteins build cell structures and catalyze chemical reactions 2. RNA helps in protein synthesis 3. DNA functions in information storage and retrieval.

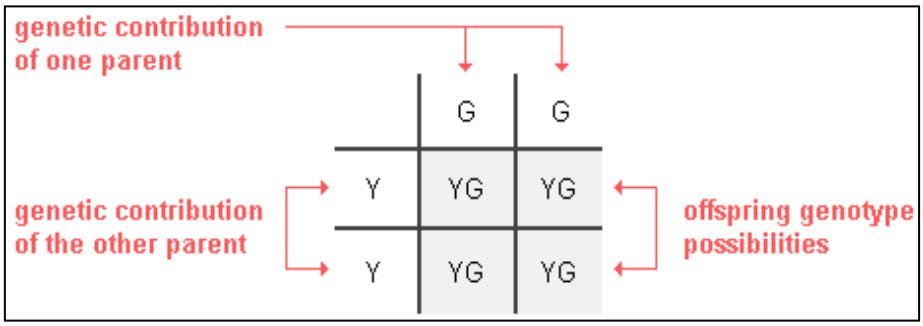
Reporting Category 2: Mechanisms of Genetics

11 Questions on STAAR; 8 Questions on STAAR M

3 Readiness Standards; 5 Supporting Standards

TEK (RS)- will be tested (65%) (SS)- may be tested (35%)	Key Ideas
6A identify components of DNA, and describe how information for specifying the traits of an organism is carried in the DNA; *Readiness Standard*	 **DNA** **DNA (Deoxyribonucelic acid)** carries genetic information from parent cell (via mitosis) or egg and sperm cells (vis meiosis) to offspring; it is coiled inside the nucleus of eukaryotic cells; controls a cell's activities (determines which proteins a cell makes) and specifies the organism's traits; structure is 2 strands twisted into a double helix with ladder- like connections between complementary nitrogen bases. **Components of DNA** • DNA is a polymer which is made of repeating units. • The units are called nucleotides • Nucleotides contain 3 parts: a phosphate group, a 5 carbon sugar called deoxyribose, and a nitrogenous base. • The phosphate and the sugar make up the backbone of the DNA molecule. • Nitrogenous bases are **A**denine, **G**uanine, **C**ytosine, and **T**hymine • **A** always binds to **T** with 2 hydrogen bonds; **C** always binds to **G** with 3 hydrogen bonds 4 Nitrogenous bases in DNA **Adenine (A) = Thymine (T)** **Cytosine (C) = Guanine (G)** • It has a twisted ladder shape called a **double helix** DNA is packaged in structures called **chromosomes**. Within chromosomes, DNA is organized into units called genes at are found at specific places on a chromosome. Genes hold the information for traits such as blood type, eye color, hair color, etc **How is information for specifying traits carried in DNA?**

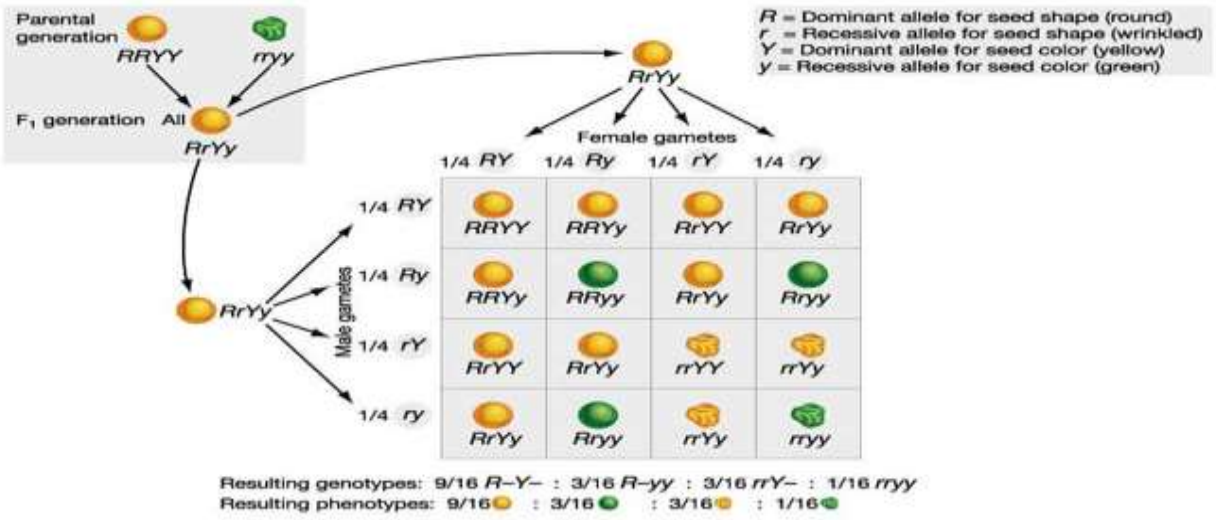
	• DNA carries genetic information in a sort of code based on the order of the 4 nitrogenous bases. The order of the bases within a gene determines the product of the gene. The differences in the base order of one organism are different from another organism. • For cells to use the information in DNA, it must be decoded. • DNA is decoded in a 2 step process. 1. **Transcription**- a strand of DNA is used as a template to make a strand of RNA, a single stranded nucleic acid (in the nucleus of the cell) 2. **Translation**-the order of the nucleotides in RNA is decoded in a sequence of amino acids, the building blocks of proteins. The amino acids are assembled into proteins in the cytoplasm. **Proteins** have a role in shaping the traits of organisms. I.e. they may form structures in cells, act as catalyst in reactions (enzymes), transmits signals throughout the body (hormones) or help an organism fight invaders (antibodies)
6E identify and illustrate changes in DNA and evaluate the significance of these changes; *Readiness Standard*	**Changes in DNA- mutations** **Mutation- A change to the structure or organization of DNA;** most likely to occur during DNA replication prior to mitosis; involves little or no effect on the organism, but can affect the cell and form cancer when mitosis does not stop. It can also be beneficial or helpful where it helps the organism to better survive within an environment. Only mutations that occur during meiosis can be passed on to offspring. **A gene mutation** involves a change in a single gene. **A chromosomal mutation** involves changes to the structure or organization of a chromosome. **I. What are the effects of gene mutations?** A gene mutation that changes one base pair if a gene is called a **point mutation**. There are 3 types: substitutions, insertions, and deletions. 1. **Substitutions**- one base pair is substituted or replaced with another base pair. Ex: CU**U** changes to CU**A** 2. **Insertion**- a base pair is added to the gene. Ex: TACGCATGGAAA→ TAC**A**GCATGGAAA 3. **Deletion-** a base pair is removed from the gene Ex: TA**C**GTTT→ TAGTTT (C has disappeared) **The result is a useless protein.** Insertion and deletion mutations are known as **frameshift mutations** because they change the "reading frame" of codons. **II. What are the effects of chromosomal mutations?** Chromosomal mutations may change the structure of the chromosomes. A **deletion** is the removal of part of a chromosome. Ex: ABC DEF → AC DEF A **duplication** is the addition of an extra copy of a section. Ex: ABC DEF → ABBC DEF

	Other chromosomal mutations change the position of genes along one or more chromosomes. In an **inversion**, a set of genes reverses its position on the chromosome. Ex: ABC DEF → AED CBF In a **translocation**, sets of genes exchange positions on 2 nonhomologous chromosomes. Ex: ABC DEF → ABC JKLDEF They may be lethal to offspring that inherit them.
6F predict possible outcomes of various genetic combinations such as monohybrid crosses, dihybrid crosses and non-Mendelian inheritance; *Readiness Standard*	**Outcomes of Genetic Combinations** • **Gregor Mendel** worked with **pea plants** in the mid 1800s **to learn the basic patterns of inheritance.** He proposed the idea that **units he called factors controlled traits.** Today, these factors are known as **genes.** • Many organisms that reproduce sexually have 2 versions of every gene. One copy is included in each of the 2 gametes (sperm and egg cells). The two versions may not be the same or identical. Different forms of the gene are called **alleles**. • Mendel concluded that when an organism has 2 different alleles for the same trait, only the **dominant allele** is expressed (**Principle of Dominance**). The allele that is not expressed is called recessive. Ex: In the gene Tt The T= dominant; t= recessive **Phenotype –** what the organism looks like **Genotype –** the gene combination – either Homozygous (TT or tt) or Heterozygous (Tt) How are genes inherited in Monohybrid crosses? (Punnett Square)  **Monohybrid Cross** – a cross of 2 organisms that are heterozygous for one trait. 4 Results are possible because of the **law of segregation**- 2 alleles separate or segregate during gamete formation. ½ will be dominant (Y) and ½ will be recessive (y) Y y Y **YY** **Yy** y **Yy** **yy (recessive)**

Genotypic Ratio: 1 YY, 2 Yy, 1 yy or 1:2:1

Phenotypic ratio: 3 plants will be yellow peas to one plant with green peas
It is predicted that 75% of the pea plants will be yellow. 25% of the pea plants in this punnett square will be green.

- **Dihybrid cross –** is the cross of 2 organisms that are hybrids for 2 traits. Notice **there are 16 possible combinations of genotypes** for the offspring**. The phenotypic ratio is 9:3:3:1.**



The 16 genotypes are equally likely because the way one pair of genes separate does not influence how the other pair separates. The law of independent assortment states that the alleles for 2 traits such as pea color and pea shape, segregate independently of one another. The law applies to many pairs of traits. However, some traits are linked, meaning their alleles do not segregate independently.

What are some Patterns of Inheritance?

Many traits are expressed or inherited in ways that differ, at least partially from Mendel's view.

- **Incomplete dominance-** some alleles are only partially dominant over recessive alleles. In snapdragon flowers, the allele for red flowers ® is partly dominant over the allele for white flowers (r). The heterozygous genotype (Rr) has pink flowers.

- **Codominance-**sometimes 2 alleles are expressed in heterozygous genotype. In chickens, the alleles for black feathers and white feathers are both expressed in the heterozygous genotype. These chickens have mixed black and white feathers.

- **Multiple alleles-** many genes have more than one allele. Human blood, for example, is affected by 3 alleles for the same gene. The alleles for type A and type B are codominant. The allele for type O blood is recessive to the alleles for Type A and Type B blood**.**

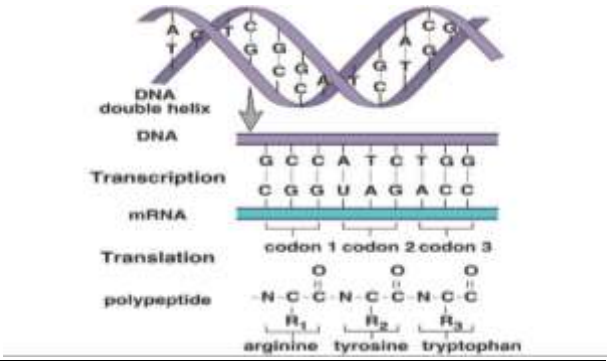
- **Polygenic traits-**many traits are determined by multiple genes. Height and skin color in humans are examples of polygenic traits.

	• **Maternal inheritance-** chloroplasts and mitochondria both contain genes that are passed from generation to another only in egg cells. Your mitochondrial genes are the same genes found in your mother's mitochondria**.**
6B recognize that components that make up the genetic code are common to all organisms; *Supporting Standard*	**Parts of the Genetic Code** **How organisms inherit traits is one of the greatest achievements of modern biology.** Biologists know that the **directions for inheritance are carried by a molecule called DNA or deoxyribonucleic acid. This genetic code,** with a few minor variations, determines the inherited traits if every organism on Earth. **What are the components of the Genetic Code?** DNA has 3 components- deoxyribose, one or more phosphate groups, and one of 4 nitrogenous bases- A, T, C, G Proteins are made by the joining of amino acids into long chains called polypeptides. Each polypeptide contains a combination of any or all of the 20 different amino acids. The properties of proteins are determined by the order in which different amino acids join together as polypeptides. A **codon** consists of 3 consecutive bases that specify a single amino acid which is added to the polypeptide. ▪ DNA contains a triplet code ▪ Every three bases on DNA stands for ONE amino acid ▪ The genetic code is the "language' of codons that is common to nearly all organisms. It is the "language" of mRNA instructions. Each three-letter unit on mRNA is called a codon. ▪ Most amino acids have more than one codon! ▪ There are 20 amino acids with a possible 64 different triplets ▪ The code is nearly universal among living organisms

First Base	Second Base U	Second Base C	Second Base A	Second Base G	Third Base
U	UUU phenylalanine	UCU serine	UAU tyrosine	UGU cysteine	U
	UUC phenylalanine	UCC serine	UAC tyrosine	UGC cysteine	C
	UUA leucine	UCA serine	UAA stop	UGA *stop*	A
	UUG leucine	UCG serine	UAG stop	UGG tryptophan	G
C	CUU leucine	CCU proline	CAU histidine	CGU arginine	U
	CUC leucine	CCC proline	CAC histidine	CGC arginine	C
	CUA leucine	CCA proline	CAA glutamine	CGA arginine	A
	CUG leucine	CCG proline	CAG glutamine	CGG arginine	G
A	AUU isoleucine	ACU threonine	AAU asparagine	AGU serine	U
	AUC isoleucine	ACC threonine	AAC asparagine	AGC serine	C
	AUA isoleucine	ACA threonine	AAA lysine	AGA arginine	A
	AUG (*start*) methionine	ACG threonine	AAG lysine	AGG arginine	G
G	GUU valine	GCU alanine	GAU aspartate	GGU glycine	U
	GUC valine	GCC alanine	GAC aspartate	GGC glycine	C
	GUA valine	GCA alanine	GAA glutamate	GGA glycine	A
	GUG valine	GCG alanine	GAG glutamate	GGG glycine	G

6C explain the purpose and process of transcription and translation using models of DNA and RNA; ***Supporting Standard***

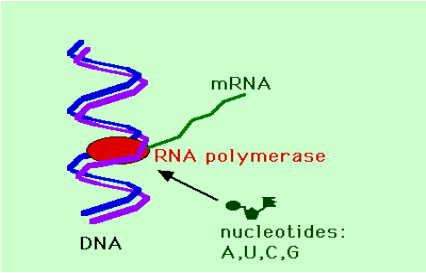
Transcription and Translation



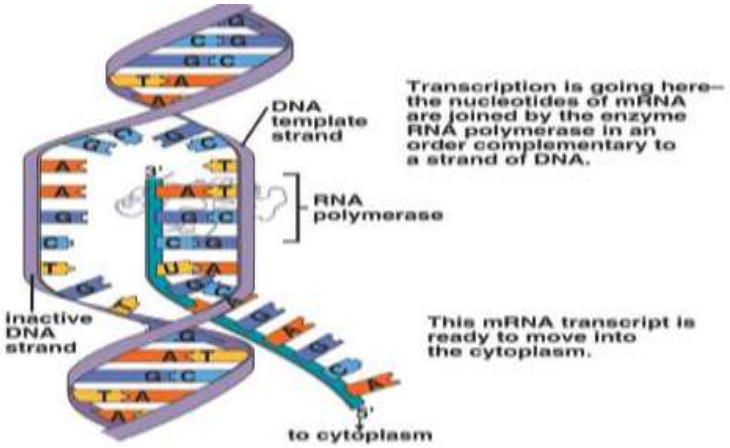
Explain what is happening in the diagram above and each labled part's purpose

Transcription

Transcription **– the process of making RNA from DNA; Purpose: To copy DNA's genetic information into messenger RNA; Occurs in the nucleus of the cell**



A much closer look:

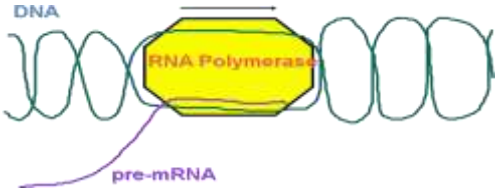


How does the transcription process occur:

1. **DNA strands temporarily unwind**
2. **Complementary RNA nucleotides pair up with one strand of DNA nucleotides**
3. **Messenger RNA (mRNA) carries specific protein synthesis instructions to ribosomes**

What enzyme plays a role in transcription? The enzyme RNA polymerase;

- The RNA polymerase enzyme is found in the nucleus and separates the two DNA strands by breaking the hydrogen bonds between the bases;
- It then moves along one of the DNA strands and links RNA nucleotides together



Example) TACGGAC (template DNA strand)
AUGCCUG (RNA built)

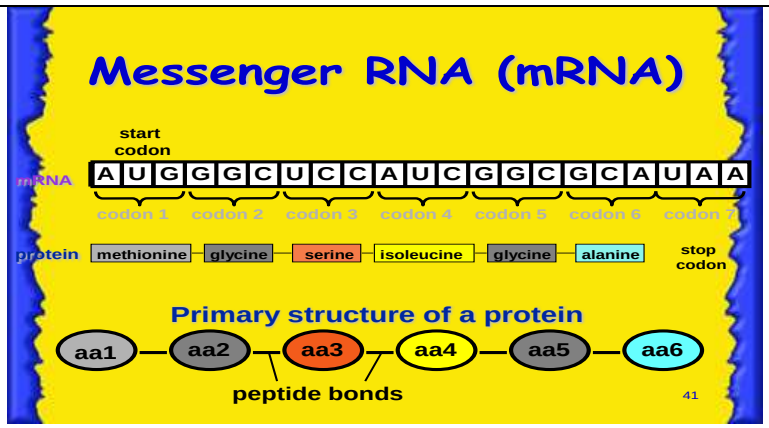
Question:

- What would be the complementary RNA strand for the following DNA sequence?
  DNA 5'-GCGTATG-3'

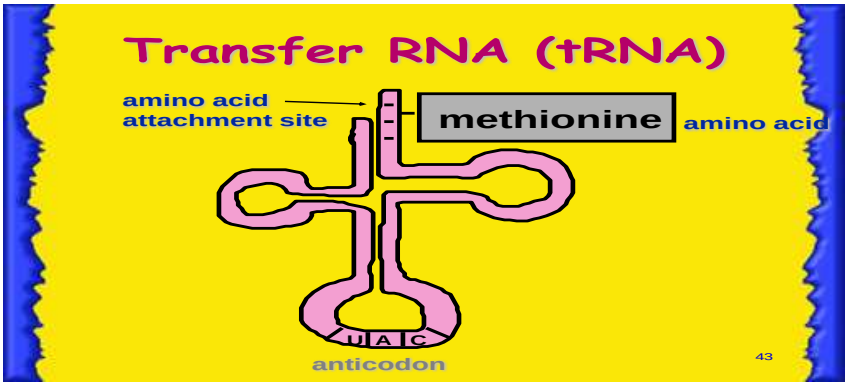
RNA plays an important part in making protein

3 Types of RNA have a role in protein synthesis

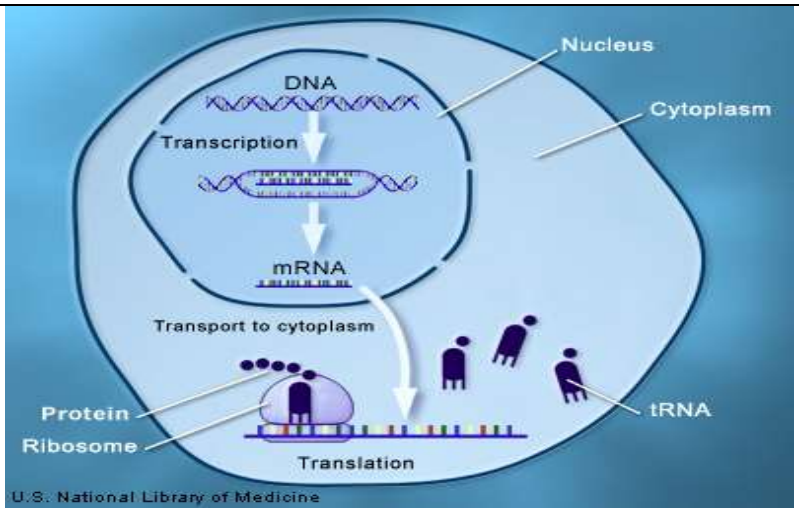
1) mRNA – messenger-blueprint for how to build protein; Carries the information for a specific protein; Made up of 500 to 1000 nucleotides long; Sequence of 3 bases called codon; AUG – methionine or start codon; UAA, UAG, or UGA – stop codons



2) <u>tRNA</u> – transfer RNA- carries amino acids to ribosome; Made up of 75 to 80 nucleotides long; Picks up the appropriate amino acid floating in the cytoplasm; Transports amino acids to the mRNA; Have anticodons that are complementary to mRNA codons; Recognizes the appropriate codons on the mRNA and bonds to them with H-bonds



3) <u>rRNA</u> – ribosomal – makes up a ribosome; Made up of rRNA is 100 to 3000 nucleotides long; Made inside the nucleus of a cell; Associates with proteins to form ribosomes



- **Translation –** the process of building a protein by matching codons in mRNA to anticodons of tRNA (use codon chart); Occurs within a cell's ribosomes in the cytoplasm

Synthesis of proteins in the cytoplasm

- Involves the following: mRNA (codons), tRNA (anticodons), ribosomes, and amino acids

How Translation (How a protein is made from mRNA) occurs:

1. **tRNA (transfer RNA) matches codons to amino acids which then join together to form a protein chain.**
Stop codon- codon that terminates the translation process; releases amino acids

6D Recognize that gene expression is a regulated process; *Supporting Standard*

Gene Expression as a Regulated Process

What is Gene Expression?

- During transcription, an active gene is transcribed into mRNA. Then, during translation, mRNA is translated into a protein. All of these steps- from the start of transcription to the assembly of a protein are controlled and regulated by the process of **gene expression.**
- When cells divide during mitosis or binary fission, each daughter cell receives a complete copy of the organism's DNA.
- In multicellular organisms, cells have the same genetic information regardless of their location or function. If all cells have the same DNA, why do muscle cells function differently from skin cells? This is because of **gene expression.**
- **Regulation of gene expression** (or **gene regulation**) includes the processes that cells and viruses use to regulate the way that the information in genes is turned into gene products

 **(a gene)**

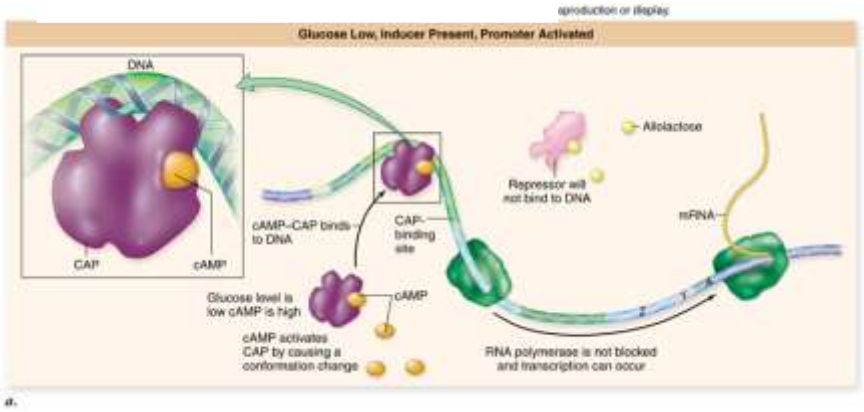
How is Gene expression controlled?

How is gene expression regulated in prokaryotes?

Prokaryotic DNA contains **operons**, groups of genes that are regulated together. Operons are located next to two regulatory regions of DNA- a promoter and an operator.

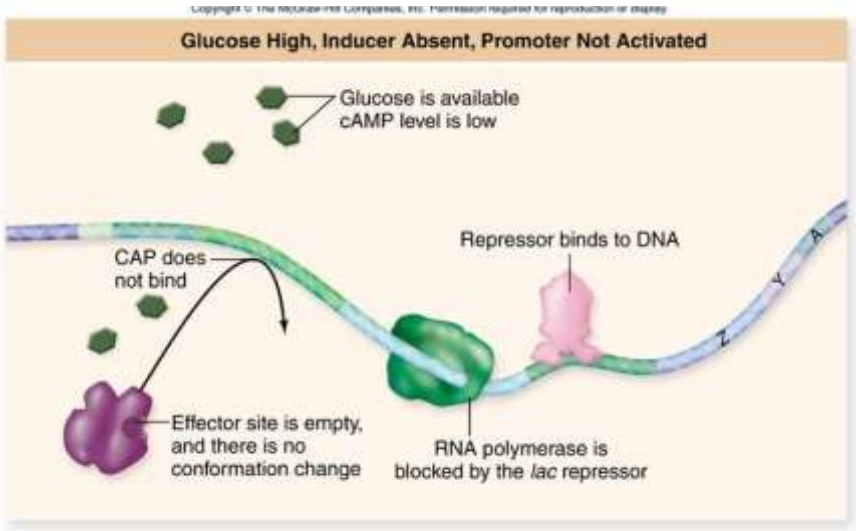
- **RNA polymerase** binds to the promoter, which is a signal that shows RNA polymerase where to **begin transcription**.
- The **operator** is next to the promoter and it **controls the rate of transcription.**
- A protein called a **repressor** can bind to the operator. If the repressor binds to the operator, then RNA polymerase cannot access the operon and transcription does not occur**.**

An example of an operon is the *lac* operon in the bacterium E. coli. This group of three genes must be turned on before the bacterium can use lactose as food.



(Transcription can occur- operator present)

(**Repressor is present so transcription does not occur**)

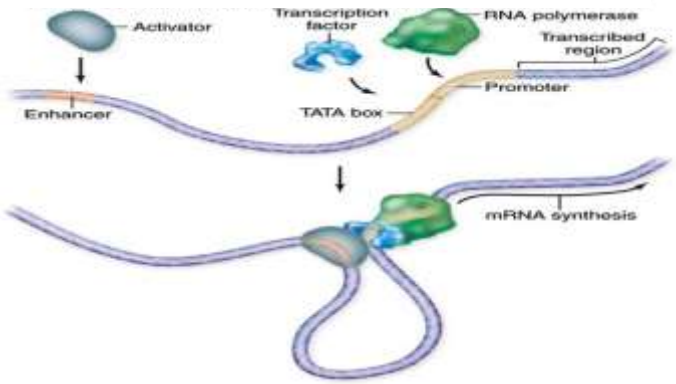


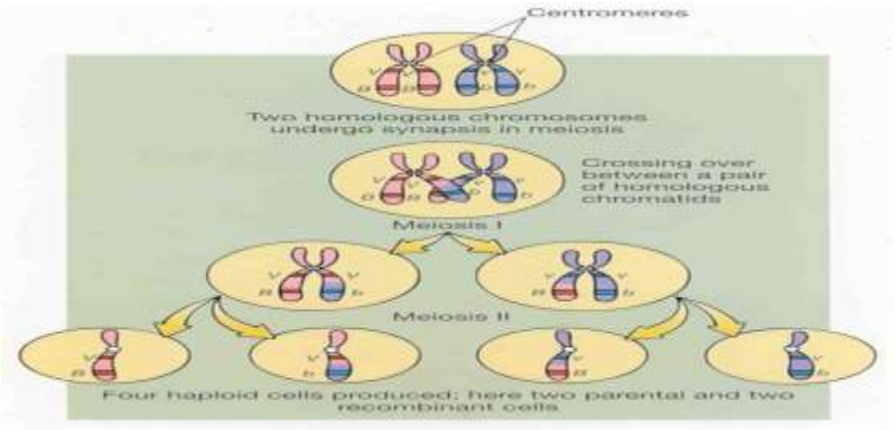
b.

How is gene expression regulated in eukaryotes?

Controlling the expression of eukaryotic genes requires transcription factors.

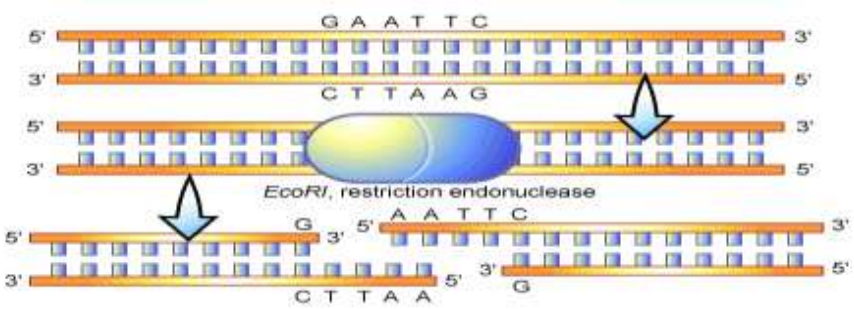
- In eukaryotes, genes are rarely found in clusters that are activated by the same promoter.
- Many eukaryotic genes are preceded by a **short region of DNA** called the **TATA box** that **positions RNA polymerase.**
- Cells also regulate gene expression with DNA binding proteins called **transcription factors.**
- Each types of transcription factor affect gene expression in different ways. Some roles of **transcription factors** include **opening tightly packed chromatin (which enhances transcription), attracting RNA polymerase, or blocking access to certain genes.**
- **In many cases, a group of specific factors must be present for RNA polymerase to attach to a binding site.**
- **After transcription is finalized,** other mechanisms could **stop gene expression. For example, mRNA may be prevented from leaving the nucleus, or its stability could be affected. Without mRNA, translation cannot occur.**



6G recognize the significance of meiosis to sexual reproduction; and *Supporting Standard*	**Significance of Meoisis to Sexual Reproduction**  • **Meiosis –** cell division that creates 4 haploid cells called gametes – aka –reduction division • **Meiosis involves 2 divisions – Meiosis I and Meiosis II** **Meiosis I has some special events:** • In Prophase I homologous chromosomes pair up and crossing over occurs. This recombination increases genetic variation for the species • Metaphase I – Pairs line up • Anaphase I – pairs are separated **Meiosis II is similar to mitosis**
6H describe how techniques such as DNA fingerprinting, genetic modifications, and chromosomal analysis are used to study the genomes of organisms. *Supporting Standard*	**DNA Technology to study the genomes of organisms** **Genomes-** is the set of genetic information that an organism carries in its DNA. **How can DNA fingerprinting be used to study a genome?** **DNA fingerprinting** is a technique that compares specific sections of 2 or more DNA samples. The technique is used for a wide variety of purposes including forensics, studying the migration of animals and determining evolutionary relationships. • Useful in determining if a particular person was at a crime scene. Every person's genome contains sections of repeated DNA sequences between genes. What varies from person to person is the number of times these sequences are repeated. When the sections are compared, the results can show, with a high level of certainty whether DNA samples came from the same person. **A. DNA Extraction- the** opening of cells to separate/isolate DNA from other cell parts • Chemical treatments (some type of detergent with an enzyme) cause cells and nuclei to burst • The DNA is inherently sticky, and can be pulled out of the mixture • This is called "spooling" DNA

B. DNA Cutting- large DNA molecules are cut into smaller fragments using restriction enzymes. These enzymes recognize and cut DNA at specific sequences.

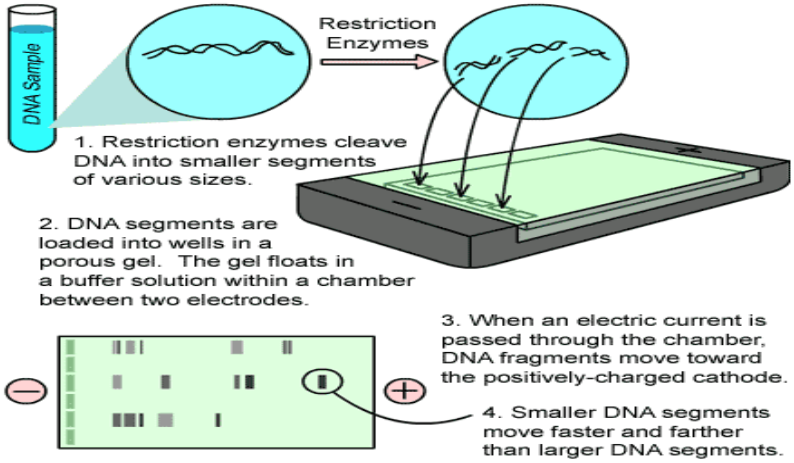
- ***Restriction enzymes*** cut DNA at specific sequences; Useful to divide DNA into manageable fragments



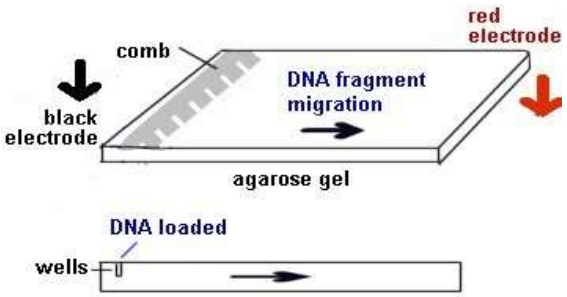
C. Separating DNA – DNA fragments can be separated and analyzed using gel electrophoresis. This process allows scientists to compare genomes of different organisms, separate genes, and create DNA "fingerprints"

A. Electrophoresis- how the DNA is analyzed

- DNA can be separated based on size and charge
- The phosphate groups are negatively charged
- DNA is placed in a gel and electricity is run through
- Negative DNA moves toward the positive end
- Smaller fragments move farther and faster



4) **Sequencing DNA** – this process allows scientists to determine the sequence of N-bases in DNA.



5) Recombinant DNA – scientists can cut DNA from two sources with the same restriction enzyme and combine them. This is used in genetic engineering. This process has been used to create human proteins used to treat disease, create pest-resistant crops, and for many other purposes.

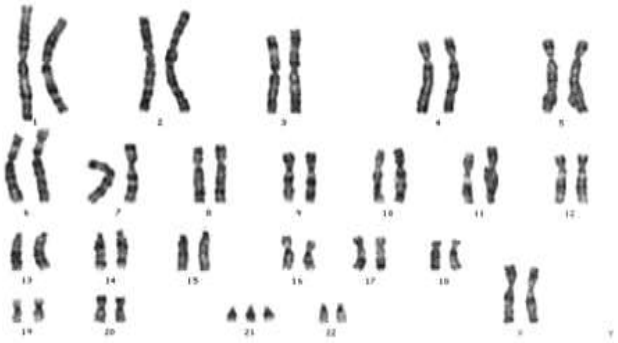
6) Copying DNA – polymerase chain reaction (PCR) has been developed that makes many copies of a small amount of DNA**.**

How Can a Chromosomal Analysis be used to Study a Genome?

Chromosomal analysis is the detailed study of all of the chromosomes of a cell. It can identify some genetic abnormalities and predict the likelihood of diseases.

Karyotyping- a visual display of all of the chromosomes in an organism's genome, arranged by decreasing size. To produce a karyotype, a researcher photographs chromosomes in a cell during mitosis and then arranges the photographs by size. Karyotypes can reveal genetic abnormalities in an individual, such as an extra chromosome or a chromosome that is missing.

Ex: A Human Karyotype



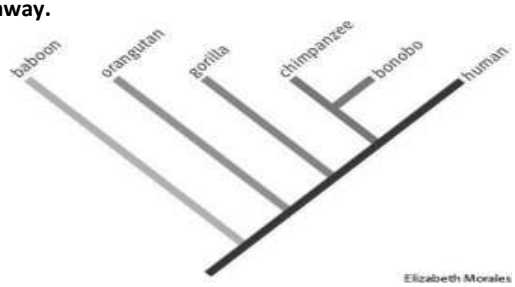
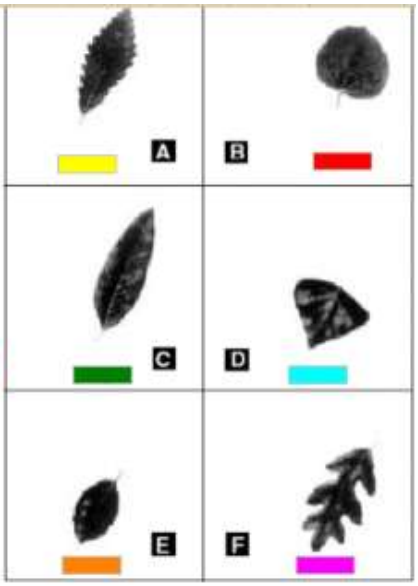
Karyotypes are pictures taken of the chromosomes at metaphase. They are cut out and matched with their identical chromosome. Two copies of each chromosome should be present. This karyotype shows a mutation. One of the sex chromosomes is missing. Also #21 has 3 chromosomes. This person most likely has **Trisonomy 21 or Down's Syndrome**.

Reporting Category 3: Biological Evolution and Classification

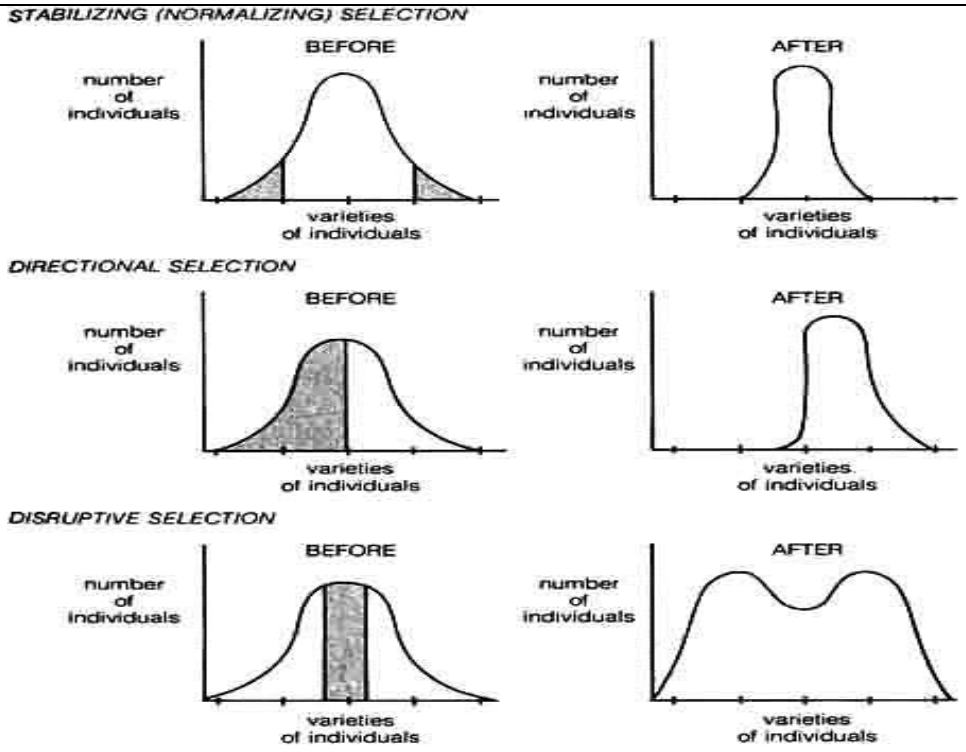
***10 Questions on STAAR; 8 questions on STAAR M**

***3 readiness standards; 7 supporting standards**

TEK (RS)- will be tested (65%) (SS)- may be tested (35%)	Key Ideas
7A **analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental**	**Evidence of Common Ancestry Among Groups** **(Theory that all organisms are descended from the same ancestor)** **I. Fossil record** **A variety of organisms that have existed at different times, including very simple, ancient species and the eventual arrival of more varied and complex species** **II. Biogeography** **Geographic distribution of organisms (species that live in the same area are more closely related, but related species can also be found living far apart)** **III. Homologies** **A. Anatomical Homologies** **Structural similarities (like bones in a bird's wing and the human arm) that serve a different purpose for each species.** **B. Molecular Homologies** **Molecular similarities among organisms (the genomes for humans and chimpanzees are about 99% identical)** **C. Developmental Homologies** **Embryonic similarities among certain organisms show how some organisms develop in common ways (vertebrate embryos have gill pouches that later develop into gills or Eustachian tubes)**
B.7.E analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species	**Evolution is the process through which species change over time.** • **Natural Selection is a theory proposed by Charles Darwin that explains how evolution occurs. It proposes that those individuals in a population that are better adapted to their environment are more likely to survive and reproduce.** • **Inherited variations are differences in traits of individuals of the same species.** • **Adaptation is a trait that increases an organism's chances of survival in its environment, such as white fur increasing an organism's chances of survival in a snow- covered environment.**
B.8.B categorize organisms using a hierarchical classification system based on similarities and differences shared	**How do scientists categorize organisms?** **Scientists may use several ways to categorize organisms. It depends if they are looking at a group of organisms or an individual organism. They may use the following:** • **Cladogram- a diagram that shows relationships among groups of organisms** • **Dichotomous key- determine the identity of a single organism** **What is a cladogram?** • **A cladogram is used to show the evolutionary relationships among species. They show how members of a group change over time, giving rise to new groups.**

among groups	• **In a cladogram, more closely related groups are appear closer together while more distantly related groups are farther away.**  Elizabeth Morales **Cladogram** **What is a dichotomous key?** **Dichotomous Key - a tool that allows the user to determine the identity of items by their characteristics, such as insects, leaves, trees, mammals, reptiles and others.** **Follow the clues in a dichotomous key to identify the organism!**  **Dichotomous Key for Leaves** **Key to Common Leaves** **1a.** If the edge of the leaf has no teeth, waves, or lobes, go to 2. **1b.** If the edge of the leaf has teeth, waves, or lobes, go to 3. **2a.** If the leaf has a single bristle at its tip, it is a shingle oak. **2b.** If the leaf has no single bristle at its tip, go to 4. **3a.** If the leaf edge is toothed, it is a lombardy poplar. **3b.** If the leaf edge has waves or lobes, go to 5. **4a.** If the leaf is a heart-shaped leaf with veins branching from the base, it is a redbud. **4b.** If the leaf is not heart shaped, it is a live oak. **5a.** If the leaf edge has lobes, it is an English oak. **5b.** If the leaf edge has waves, it is a chestnut oak. 

7B **analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record**	**Scientists established a fossil record that reveals that evolution can proceed slowly with gradual changes in spurts with sudden changes. Organisms represent living fossils because they look very much like their ancestors that lived long ago.** • **The fossil record is a timeline that shows how life has evolved in Earth. It is organized according to the age of the fossil and their similarities.** • **Gradualism is the process of evolution in which a species changes very slowly over a very long period** • **Punctuated equilibrium is the process of evolution where a species experiences little or no change for long periods, followed by sudden change** **A living fossil is a species that shows little or no change since its ancestor first appeared on Earth**
7C **analyze and evaluate how natural selection produces change in populations, not individuals**	**What is Natural Selection?** **A population is a group of individuals of the same species who interbreed. Individuals in a population have varying traits. For ex: some dogs may have a sharper sense of smell than other dogs and can hunt better than other dogs (ex: blood hounds vs. poodles)** **A variation that makes an organism more successful in its environment is called adaptation.** **Meiosis creates variation among individuals which causes consequences at the population level** **Individuals with adaptations that help them survive and reproduce in their environment have high fitness. Fitness refers to an organism's ability to survive and reproduce in its environment.** **Although individual variation is the root of natural selection, populations evolve by natural selection.** **Natural selection is a process in which organisms with adaptations best suited to their environment leave more offspring than other organisms. Because these organisms produce more offspring, their genetic variations become more prevalent in a population and the population changes or evolves.** **How does natural selection produce changes in populations and not individuals?** **Natural selection can occur in a variety of ways. Natural selection on trait controlled by a single gene with two alleles can cause one allele to increase and the other to decrease. Polygenic traits are more complicated. Natural selection on polygenic traits that can occur as directional selection, stabilizing selection, or disruptive selection. Each of these ways causes a distinct change to a population.**



Natural Selection on Polygenic traits	
Directional selection	**Occurs when individuals with a particular phenotype (physical feature you see) have an advantage in their environment.** **Often a single gene controls the trait.** **Ex: A birds with larger beak sizes are more successful at surviving ihan birds with small or medium sized beaks.**
Stabilizing selection	**Occurs when extremes in phenotypes gives individuals in the population a disadvantage. Often these traits are polygenic- controlled by multiple genes.** **Ex: Body size of an organism. For most organisms, extremely large or extremely small body types are not favorable for survival.**
Disruptive selection	**Occurs when extreme phenotypes for a trait are adaptive.** **Ex: If bird beaks of an intermediate size are a disadvantage for survival, birds with small or large beaks are more likely to survive.** **If the pressure in natural selection lasts long enough, birds will have beaks that are large or small.**

B.7.D analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success

What causes inherited variation among individuals in a population?

- Inherited variation refers to the genetic differences among individuals in a population, such as a body size or fur color. Can be caused by mutations in DNA that affect the way genes are expressed. Other causes include crossing- over and the independent assortment of chromosomes that occur during meiosis. Variations can be introduced when individuals migrate from one population to another and mate.
- 2 components of inherited variation are genotype and phenotype.
- Knowing the frequency of alleles and phenotypes in a population is important for understanding how natural selection could affect the evolution of a population.

What contributions to differential reproductive success?

Natural selection is caused by an environmental stressor for which specific phenotypes have a fitness advantage. Over time, the individuals with those adaptive phenotypes survive and reproduce, which makes the allele responsible for the phenotype more common in the population.

Environmental resources

The environment may pose many challenges. Resources are scarce and predators and competitors are numerous. Many organisms will die before they reproduce.

However, certain phenotypes can give some individuals a fitness advantage. Fitness refers to an organism's ability to survive, attract a mate, and reproduce within a particular environment.

The difference in the number of offspring produced by 2 phenotypes is called differential reproductive success. Natural selection is the process by which traits become more or less common in a population due to differential reproductive success. There are several elements of natural selection.

Inherited variation	<u>Inherited traits that are favored</u> – ie. Black mice that survive in an environment because they can camouflage better than brown mice- continues while the least favored trait declines. Mice with the black fur will have a better chance of surviving and passing on their alleles. If the environment changes, the relative fitness of individuals can change.
Producing more offspring than can survive	Most populations produce far more offspring than can survive in any given environment due to resource constraints. When populations produce many more offspring than can survive, the likelihood increases that some offspring will reach reproductive age. The ones that do reproduce likely have phenotypes gave them an advantage within that environment over those that did not survive or reproduce.

	Limited supply of environmental resources	**In any environment, organisms compete for limited resources- space, food, and shelter.** **When resources become scarce, such as a drought, then <u>competition increases</u>.** **Populations often decline, and the individuals with advantageous traits for survival are most likely to live and reproduce.**

7.F analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination

Other Evolutionary Mechanisms

Genetic drift	**Change in the gene pool caused by chance; tends to decrease a species' genetic variation** **Example: Flood kills 95% of a worm population**
Gene flow	**Change in gene pool caused by movement of organisms into (increase genetic variation) or out of (decrease genetic variation) the population**
Mutation	**Change in the genetic pool caused by insertion, deletion, or substitution in DNA sequence of gamete cell; tends to increase genetic variation**
Recombination	**Sexually reproducing species have increased genetic variation because of gene crossover events during meiosis**

B.7.G analyze and evaluate scientific explanations concerning the complexity of the cell

Complexity of the Cell

What do scientists think ancient cells were like?

- **No one knows when the first cells lived on Earth. Microscopic fossils that look like bacteria may have been on rock for 3.5 billion year. These ancient fossils may have been ancestors of prokaryotes.**
- **The first cells lived on Earth when its atmosphere lacked oxygen. They were similar to prokaryotes who live in extreme environments.**
- **Over time, cellular processes such as photosynthesis and cellular respiration developed. Photosynthetic bacteria were the first organisms to perform photosynthesis about 2.2 billion years ago.**

What are some scientific explanations for how the complexity of cells changed over time?

The oldest known fossils of eukaryotes are 2.1 billion years old and resemble green algae. Theories were proposed to explain this phenomenon.

Endosymbiotic theory- some organelles in eukaryotic cells formed from symbiotic relationships between early prokaryotes and eukaryotes.

Endosymbiosis- is a process in which one organism lives inside another organism to the benefit of

	both. According to the endosymbiotic theory, free- living aerobic bacteria became endosymbionts inside larger, anaerobic cells. Over time, they evolved into the organelles that are now observed as mitochondria. In another endosymbiotic process, free- living photosynthetic bacteria become chloroplasts. Lynn Margolis proposed this theory.
B.8.A define taxonomy and recognize the importance of a standardized taxonomic system to the scientific community	**Taxonomy** **Taxonomy is the study of the classification of organisms, enables the international scientific community to use a common system to identify, organize, and classify new and existing organisms or groups of organisms. Carolus Linneaus developed this system.** **Binomial nomenclature- "two word naming system"; The first word is the organism's genus or the group at which it and other species belong. The second word is a species' name. A species is a group of organisms that can breed or reproduce with one another and produce fertile offspring. Ex: Humans are called *Homo sapiens;* Binomial nomenclature: system of naming an organism using its genus and species; write in italics and capitalize only the genus** **LEVELS OF CLASSIFICATION:** **Kingdom Phylum Class Order Family Genus Species** **(Largest) (Smallest)** **To help you remember: Think of the following: (King Philip came Over For Grape Soda)** **CLASSIFICATION OF HUMANS:** • **Kingdom *Animalia* (multicellular organisms that eat food)** • **Phylum *Chordata* (dorsal hollow nerve cord, notochord, pharyngeal slits)** • **Class *Mammalia* (hair, mammary glands, endothermy, four-chambered heart)** • **Order *Primates* (nails, clavicle, orbits encircled with bone, enlarged cerebrum, opposable digits)** • **Family *Homidae* (bipedal – walk erect on two feet, advanced tool use)** • **Genus *Homo* ("human" like)** • **Species *Homo sapiens*** **Why is a standardized taxonomic system important to the scientific community?** **It allows scientists to communicate precisely about a species they are studying. The use of common names causes far too much confusion. 2 names are much more precise by using only the genus and species. We immediately know the group and their characteristics.** **Ex: camel - there are many species of camels.** **A scientific name such as *Camelus bactrianus* is recognized all around the world as only one type of camel.** **Before Linneau's taxonomic naming system, scientists would use scientific names in as many as seven words and a species had more than one scientific name. Ex: a wild rose would be labeled as *Rosa sylvestris inodora seu canina*** **45**

B.8.C compare characteristics of taxonomic groups, including archaea, bacteria, protists, fungi, plants, and animals

6 Kingdoms of Classification

Taxonomy is the study of the classification of organisms, enables the international scientific community to use a common system to identify, organize, and classify new and existing organisms or groups of organisms
Autotroph: organism that makes its own food Ex: plants
Heterotroph: organisms that depends on other organisms for food

3 Domains are used to classify or group all organisms

Domain	Description
Archae	Primitive unicellular eukaryotes; some autotrophs and some heterotrophs ; some live in harsh or extreme conditions

Kingdom	Archaebacteria
Cell type	Prokaryote
Cell structures	Cell walls without peptidoglycan
# of cells	Unicellular
Nutrition	Autotroph or heterotrophy
Reproduction	Asexual by binary fission
Metabolism	Asexual
Examples	Methanogens (gas loving bacteria), halophiles (salt loving bacteria- Ex: Dead Sea)

Bacteria — Unicellular prokaryotes; some autotrophs, but most are heterotrophs; typically bacteria

Kingdom	Eubacteria
Cell type	Prokaryote
Cell structures	Cell walls with peptidoglycan
# of cells	Unicellular
Nutrition	Autotroph or heterotrophy
Reproduction	Animal
Metabolism	Aerobic or anaerobic
Examples	Streptococcus, Escherichia coli (E. coli)

Eukarya — Eukaryotes; wide variety

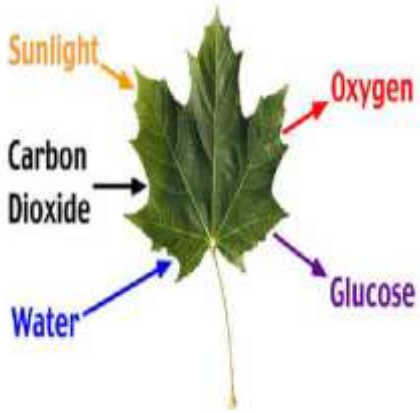
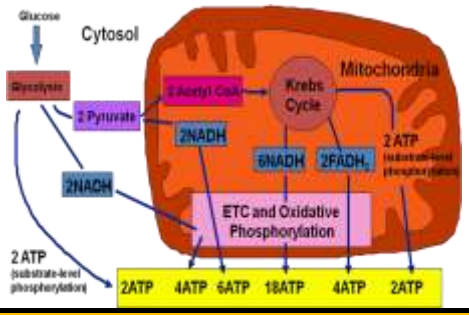
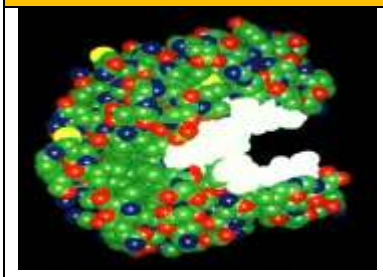
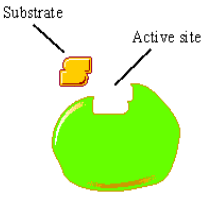
Kingdom	Protista	Fungi	Plantae	Animalia
Cell type	EUKARYOTE	EUKARYOTE	EUKARYOTE	EUKARYOTE
Cell structures	Some: cell walls of cellulose; Some: cilia	Cell walls of chitin	Cell walls of cellulose; chloroplasts	No cell walls or chloroplasts
# of cells	Most unicellular; some colonial; some multicellular	Most multicellular; some unicellular	Most multicellular; some green algae unicellular	multicellular
Nutrition	Autotroph or heterotroph	heterotroph	Autotroph	Heterotroph
Reproduction	Asexual or sexual	Asexual or sexual	Asexual or sexual	Usually sexual
Metabolism	Most are aerobic	Anaerobic or aerobic	Aerobic	Aerobic
Examples	Amoeba, paramecium,	Mushrooms, yeast - *Candida*	Mosses, ferns, flowering plants	Sponges, worms, insects, fishes,

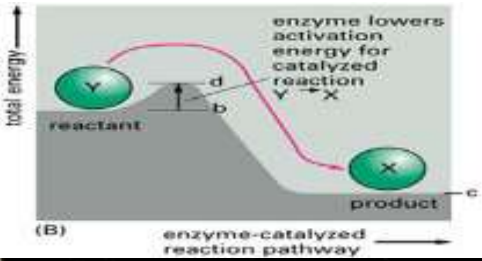
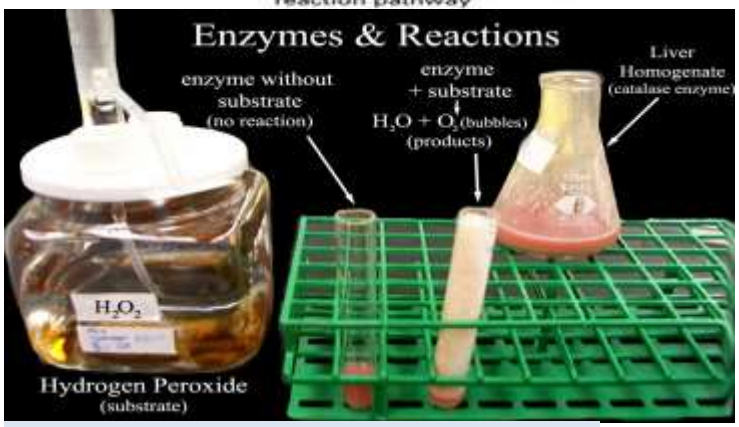
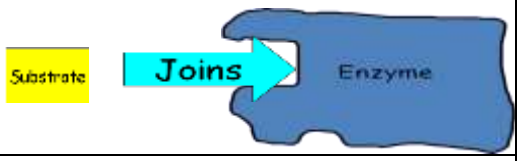
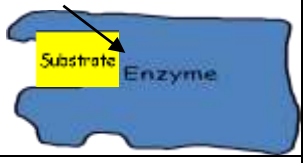
				slime, molds, giant kelp	*albicans* (yeast infection); *Tinea pedis* (athlete's foot)		mammals	

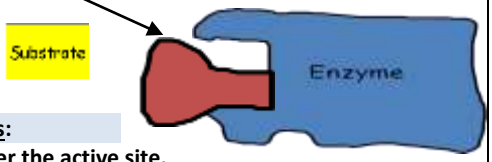
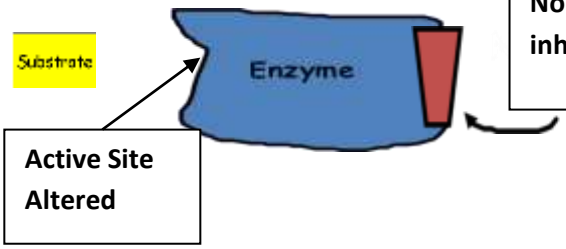
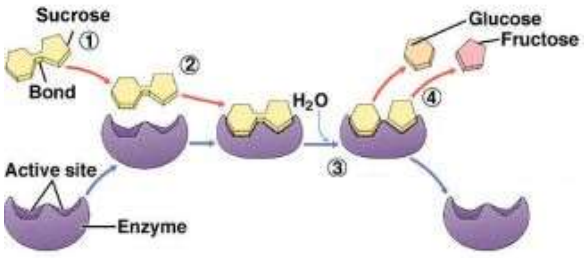
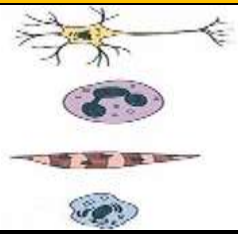
Reporting Category 4: Biological Processes and Systems

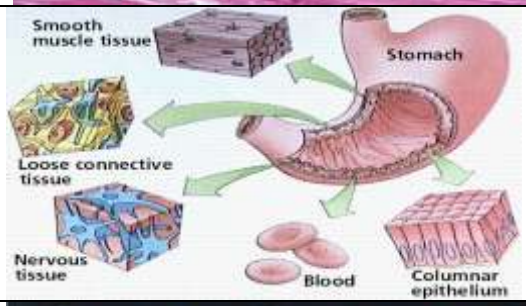
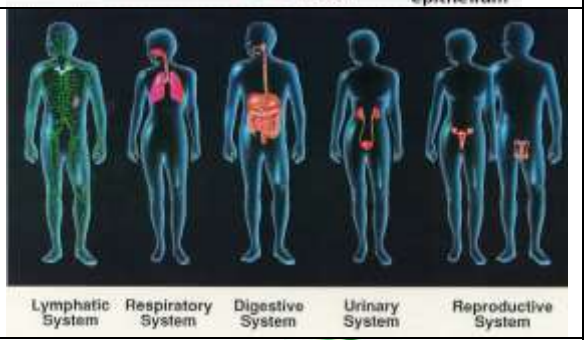
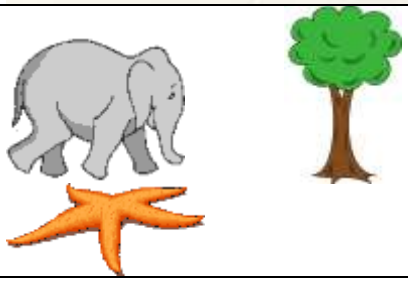
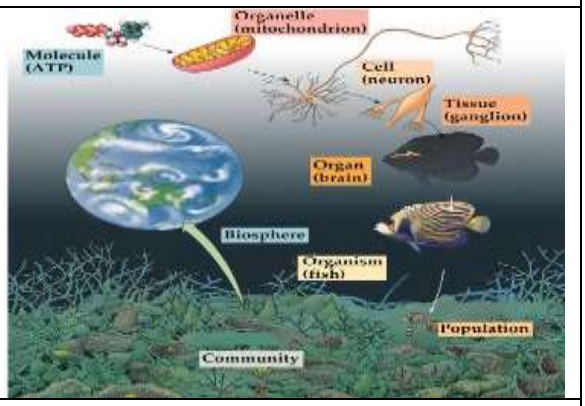
- 11 Questions on STAAR; 9 STAAR M
- 2 Readiness Standards; 4 Supporting Standards

<table>
<tr><th>TEK
(RS)- will be tested (65%)
(SS)- may be tested (35%)</th><th>Key Ideas</th></tr>
<tr><td>10.A describe the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals</td><td>An animal's organ systems interact to perform many functions.
<table>
<tr><td>Regulation</td><td>The endocrine system makes certain hormones. Blood in the circulatory system carries them to the skeletal system to control the amount of calcium released from bones.</td></tr>
<tr><td>Nutrient Absorption</td><td>Food is broken down in the stomach mechanically by the muscular system (churns food) and chemically by water, acid, and enzymes in the digestive system; nutrients are then absorbed by blood in the circulatory system</td></tr>
<tr><td>Reproduction</td><td>Certain hormones produced in the endocrine system control ovulation in a female's reproductive system</td></tr>
<tr><td>Defense</td><td>Mucus in the lungs traps a virus in the respiratory system. T-cells in the immune system destroy virus- infected cells. Nerves in the nervous system sense pain from a fire on the skin</td></tr>
</table></td></tr>
<tr><td>10.B describe the interactions that occur among systems that perform the functions of transport, reproduction, and response in plants</td><td>A plant's organ system and parts interact to perform many functions.
<table>
<tr><th>Function</th><th>Example of interactions</th></tr>
<tr><td>Transport</td><td>• The root system uptakes water.
• Xylem vessels transport water to the leaves in the shoot system.
• Phloem vessels transport sugars and nutrients throughout the plant.</td></tr>
<tr><td>Reproduction</td><td>• The reproductive organs in a flower are the pistil (female) and the stamen (male).
• A seed is a mature, pollinated ovule (fertilized egg).
• Hormones in a plant's root system help trigger the growth of a seed in the shoot system.</td></tr>
<tr><td>Response</td><td>When one side of a plant does not receive enough light, a hormone that causes growth is produced in the shoot system's leaves. It is transported to the darker side. As the dark side grows, the plant bends toward the light.</td></tr>
</table></td></tr>
<tr><td>9.B compare the reactants and products of photosynthesis and cellular respiration in terms of energy and matter</td><td>
<table>
<tr><th>Photosynthesis</th><th>Cellular respiration</th></tr>
<tr><td>Process by which green plants and some other organisms make sugars (like glucose) and release oxygen using light energy, carbon dioxide and water</td><td>Energy releasing process that occurs in the mitochondria of eukaryotic cells and requires oxygen; energy is produced in the form of the molecule adenosine triphosphate (ATP) which is then used for the organism's metabolic processes (like growth or maintenance)</td></tr>
<tr><td>$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
Carbon dioxide + water makes (with light energy added from the sun) glucose and oxygen</td><td>$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO2 + 6H_2O$ + energy
(glucose) (ATP)
Glucose (sugar) + oxygen gas makes water and carbon dioxide and energy</td></tr>
<tr><td>Reactants: $6CO_2 + 6H_2O$ (with light energy from the sun)</td><td>Reactants: $C_6H_{12}O_6 + 6O_2$</td></tr>
</table></td></tr>
</table>

	Products: $C_6H_{12}O_6$ + $6O_2$	**Products: $6CO2 + 6H_2O$ + energy (ATP)**
		**Total ATP (Energy) Yield - Eukaryotes** **02 ATP - glycolysis (substrate-level phosphorylation)** **04 ATP - converted from 2 NADH - glycolysis** **06 ATP - converted from 2 NADH - grooming phase** **02 ATP - Krebs cycle (substrate-level phosphorylation)** **18 ATP - converted from 6 NADH - Krebs cycle** **<u>04 ATP</u> - converted from 2 $FADH_2$ - Krebs cycle** **36 ATP - TOTAL** 
9.C identify and investigate the role of enzymes	**Enzymes**	**Enzymes** **Enzymes control the rate of chemical reactions by weakening bonds, thus lowering the amount of activation energy needed for the reaction** • **Also known as proteins** • **Are catalysts (speed up reactions chemical reactions)** • **They do not change during reaction** • **Often named by the affected substrate, ending in "-ase"** **Example: Lactase (enzyme) speeds up the following reaction of lactose** **Lactase (catalyst)** **Lactose → glucose + galactose**
		• **Most enzymes are Proteins (tertiary and quaternary structures)** • **Act as Catalyst to accelerates a reaction** • **Not permanently changed in the process** • **Are specific for what they will catalyze** • **Are Reusable** • **End in *–ase*** ***Examples: -Sucrase -Lactase -Maltase*** 

	How Enzymes Work	**Enzymes work by weakening bonds which lowers activation energy**   **Liver Enzyme Lab (Can work also as a Potato Lab)**
		The substance (reactant) an enzyme acts on is the substrate. 
		A restricted region of an enzyme molecule which binds to the substrate **Active Site** 
	Induced Fit	**A change in the shape of an enzyme's active site Induced by the substrate**  **A change in the configuration of an enzyme's active site (H+ and ionic bonds are involved).** **<u>Induced by the substrate.</u>** **substrate** **induced fit** 

	What Affects Enzyme Activity?	Three factors: 1. Environmental Conditions Extreme Temperature are the most dangerous - high temps may denature (unfold) the enzyme. pH (most like 6 - 8 pH near neutral) Ionic concentration (salt ions) 2. Cofactors and Coenzymes Inorganic substances (zinc, iron) and vitamins (respectively) are sometimes need for proper enzymatic activity. • Example: Iron must be present in the quaternary structure - hemoglobin in order for it to pick up oxygen. 3. Enzyme Inhibitors Competitive inhibitors: are chemicals that resemble an enzyme's normal substrate and compete with it for the active site.  Noncompetitive inhibitors: Inhibitors that do not enter the active site, but bind to another part of the enzyme causing the enzyme to change its shape, which in turn alters the active site. 
	Assessment Point Using the diagram on the right, Identify the role of enzymes and list ways you investigated enzymes in lab. →	
10.C analyze the levels of organization in biological systems and relate the levels to each other and to the whole system	**LEVELS of ORGANIZATION** Biological systems are organized into levels which directly relate to other levels and to the whole system. Example: groups of organs (heart, etc) form the circulatory system in a human organism. **Living Levels:** CELL — makes up ALL organisms 	

TISSUE	**Similar cells working together**	
ORGAN	**heart, brain, stomach …**	
ORGAN SYSTEMS	**respiratory, circulatory, excretory, digestive, urinary, reproductive, integumentary, etc …**	
ORGANISM		
POPULATION	**one species in an area**	
COMMUNITY	**several populations in an area**	
ECOSYSTEM	**forest, prairie …**	
BIOME	**Tundra, Tropical Rain forest…**	
BIOSPHERE	**all living and nonliving things on Earth**	

11.A describe the role of internal feedback mechanisms in the maintenance of homeostasis

Homeostasis is the process by which cells and organisms maintain a constant balance in their internal environment.

An internal feedback mechanism is a self-regulating process, like a chemical reaction, that can help maintain homeostasis.

It is a system that operates to keep the internal conditions of an organism within a certain range despite changes that occur in its external environment.

Mechanism	Response to Stimulus	Example
Negative feedback	Decreases effect	A human that becomes too hot will cool himself by dilating vessels and sweating
Positive feedback	Increases effect	Ethylene is produced when apples ripen, which stimulates production of more ethylene, causing more apples to ripen

Reporting Category 5: Interdependence within Environmental Systems

- 11 Questions on STAAR; 9 Questions on STAAR M
- 4 Readiness Standards; 5 Supporting Standards

TEK (RS)- will be tested (65%) (SS)- may be tested (35%)	Key Ideas
11.D describe how events and processes that occur during ecological succession can change populations and species diversity (Readiness Standard)	**Ecological Succession** Succession is natural, gradual changes in the types of species that live in an area; can be primary or secondary; The gradual replacement of one plant community by another through natural processes over time **Primary Succession** Primary succession is the development of a community in an area where no living things previously existed. I. Begins in a place without any soil – Sides of volcanoes – Landslides – Flooding II. Starts with the arrival of living things such as lichens that do not need soil to survive Called PIONEER SPECIES   Lichens • Soil starts to form as lichens and the forces of weather and erosion help break down rocks into smaller pieces • When lichens die, they decompose, adding small amounts of organic matter to the rock to make soil  Soil • Simple plants like mosses and ferns can grow in the new soil  Ferns  Mosses • The simple plants die, adding more organic material (nutrients to the soil) • The soil layer thickens, and grasses, wildflowers, and other plants begin to take over • Insects, small birds, and mammals have begun to move into the area • What was once bare rock, now supports a variety of life • These plants die, and they add more nutrients to the soil • Shrubs and trees can survive now **Secondary Succession** Secondary succession is the replacement of one type of community by another in an area where an existing community was destroyed or removed • Begins in a place that already has soil and was once the home of living organisms • Occurs faster and has different pioneer species than primary succession

- **Example: after forest fires**

Climax Community
A stable group of plants and animals that is the end result of the succession process

- **Does not always mean big trees**
  - **Grasses in prairies**

  -Cacti in deserts

B.12.A interpret relationships, including predation, parasitism, commensalism, mutualism, and competition among organisms (RS)

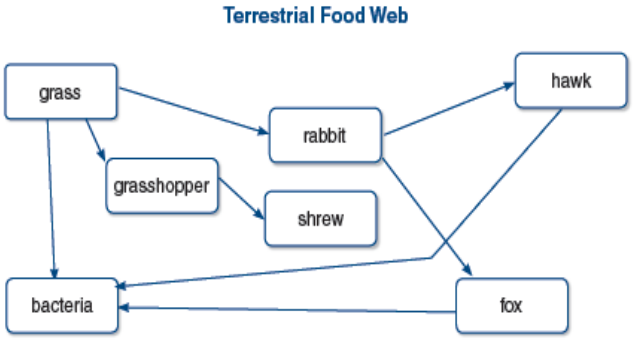
Relationships

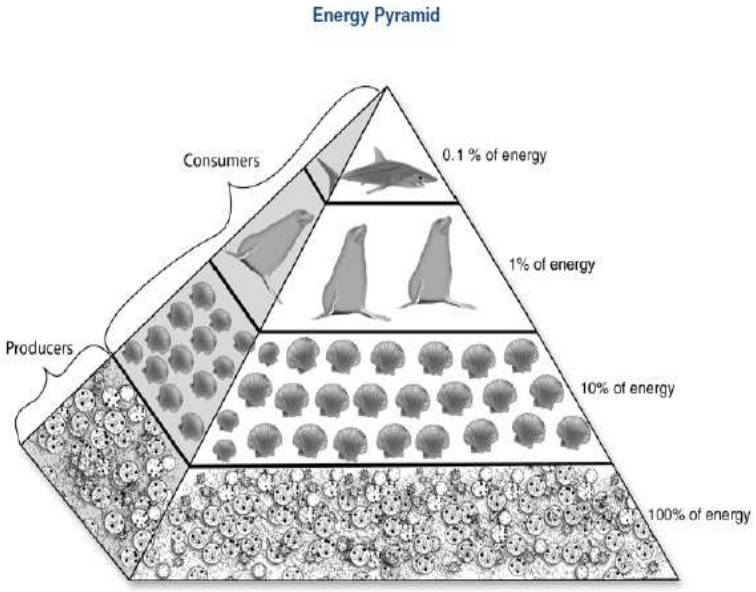
- **Symbiosis is a relationship in which two different organisms have a close association with each other.**
- **Mutualism is a symbiotic relationship in which both organisms benefit.**
- **Commensalism is a symbiotic relationship in which one organism benefits while the other organism is not affected in any way.**
- **Parasitism is symbolic relationship in which one organism benefits while the other is harmed**
- **Predation involves an organism known as a predator that eats part or all of another organism known as its prey.**
- **Competition occurs when two or more individuals or populations compete for the same resource, such as shelter or food**
- **A pathogen is a virus, bacterium, or any organism that causes a disease.**

B.12.C analyze the flow of matter and energy through trophic levels using various models, including food chains, food webs, and ecological pyramids (RS)

Flow of Matter and Energy through Trophic Levels

Trophic level – the level at which energy is flowing through an ecosystem





12.F describe how environmental change can impact ecosystem stability (RS)

Environmental Change Impacting Ecosystem Stability

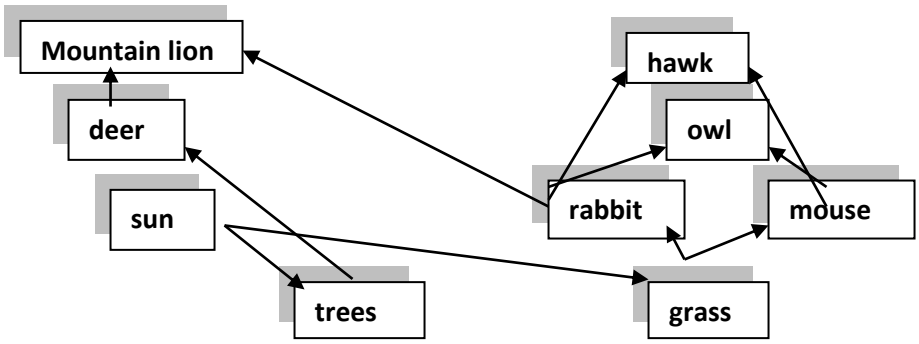
Change in the environment, caused by nature or humans, can affect the stability of an ecosystem in positive or negative ways. Environmental changes can help sustain diverse and abundant populations over a long period of time or they can diminish or destroy populations.

Example A	Example B
A volcanic eruption kills a community's populations of organisms. The area's ecosystem is destroyed.	Leaking sewage systems release sewage into a river, causing excessive weed and algae growth and reducing fish populations. Humans repair leaks and reintroduce fish species. As a result, the ecosystem recovers.

11.B investigate and analyze how organisms, populations, and communities respond to external factors (Supporting Standard)

Response to External Factors

Organisms, populations, and communities must respond to external factors like changes in the environment or other organisms. If an entire species is unable to respond to change, it could face extinction.
Example: A fire destroys all of the grass in a food chain



1. **Many mice switch to tree berries and seeds as alternative food sources. The population survives.**
2. **The rabbits are unable to find new food sources. They leave to look for grass in a new community. If they are unsuccessful then the population of rabbits will die.**

11.C summarize the role of microorganisms in both maintaining and disrupting the health of both organisms and ecosystems

Role of Microorganisms

Microorganisms:

Tiny organisms (like bacteria or protists) that can only be seen in a microscope. They play a critical role in the maintenance and disruption of the health of both individual organisms and entire ecosystems.

Example: The bacteria E. coli is critical for the digestive process in many warm- blooded organisms. Outside of the intestines, E.coli can sicken or kill certain organisms

Beneficial Roles of Bacteria	Harmful Roles of Bacteria
Decompose organic material	Spoil food
Change nitrogen from one form to another in the nitrogen cycle	Produce harmful or damaging toxins
Have role in making drugs(like penicillin), foods(like yogurt and cheese), and vitamins	Cause of shortage of oxygen in lakes where blooms occur
Help absorb nutrients in the human digestive system	Cause diseases

12.B compare variations and adaptations of organisms in different ecosystems

What is genetic variation?

Within a population, individuals differ from one another. Many of these differences are genetically based. Environmental factors can also lead to individual differences because they influence how genes are expressed.

Genetic variation is the difference in the genotypes within a population. Ex: Humans have different eye and hair color, skin color, shape of faces, certain health disorders, etc.

Genetic variation helps species survive because if all organisms within a population were genetically identical, then all of them would be equally vulnerable to a change in the environment or disease. The entire population could die off due to a predator, a new competitor, or the arrival of a new disease which would put the species in danger.

What are adaptations?

An adaptation is a heritable trait that helps an organism survive in its environment. It may be a physical trait such as a beak size or shape or a behavioral trait such as how to protect itself or find food.

Some adaptations are specific to certain ecosystems. Ex: some insects camouflage themselves to fit in the environment. Ex: chameleon

How do variations and adaptations of organisms compare in different ecosystems?

Genetic variations tend to increase with the size of a population and the rate at which the species reproduces.

- **Certain patterns in the genetic variation and adaptations in populations exist.**
- **Bacteria, the most numerous groups of species on Earth are also most genetically varied. In contrast, large mammals, like elephants, that have small populations that have much less genetic variations.**

	• **Some organisms in different ecosystems have similar adaptations. Ex: animals that graze grasslands such as zebras, buffalos, and llamas. They all have flat teeth for grinding grass, a long and complex digestive system to break down grass, and sturdy hooves for walking and running.** • **Deciduous forest-** This biome has a wide range of temperatures and precipitation. The organisms that adapted to survive the seasonal weather changes. **To survive the winters, these animals often do not move much and some may hibernate or sleep. Other animals migrate to other places until warm weather returns to the forest.** • **Desert-** In this biome, plants and animals have adaptations that help them conserve water. Ex: Leaves of a cacti **Also many animals are nocturnal animals and move only during the night because it is so hot in the desert. They also may have physical adaptations to keep cool. Ex: the long ears of rabbits and foxes.** • **Coral reef-** In this biome, the reef is formed from the skeletons of coral animals. These are found in shallow, tropical waters. A healthy coral reef is home to a large variety of animals including corals, anemones, fish, and shellfish. These organisms are adapted to warm, relatively shallow salt water.
12.D recognize that long-term survival of species is dependent on changing resource bases that are limited	**How is the long term survival of species affected by their resource base?** **The long term survival of organisms** depends on the resources supplied by their environment. **Resources are necessities for sustaining life-** food, water, air, space**. These help organisms survive and reproduce.** **In any environment, most resources are limited and their availability can change over time. Without enough resources, the species may die out or become extinct.** **Population size is influenced by the following factors-** • Competition • Predation • Parasitism and disease • Drought and other climate extremes • Human disturbances **What can change the resource bases of an environment?** A sudden change to the environment can cause a rapid extinction of many species. **Ex: dinosaurs** **During a mass extinction, large numbers of species become extinct and whole ecosystems collapse.**

What currently affects the resource bases of species?

Resource bases have been changing drastically since the Industrial Revolution. All over the world, land that was once used for wildlife is now used for farms, ranches, cities, and houses**.**

Fresh water is diverted from wildlife habitats to areas where people grow cops and for homes and factories.

As these resources are used for other purposes, fewer resources are available for wildlife.

Pollution affects resource bases. Ex: BP Horizon Oil Spill in the Gulf of Mexico in 2010. Oil residue will remain in the wetlands and coastline of the south for many years to come and will impact species that live there.

Many species are now endangered- soon to be extinct. Ex: Florida panther of the Everglades in Florida and the giant panda of bamboo forests in China.

12.E describe the flow of matter through the carbon and nitrogen cycles and explain the consequences of disrupting these cycles

Flow of Matter Through Cycles

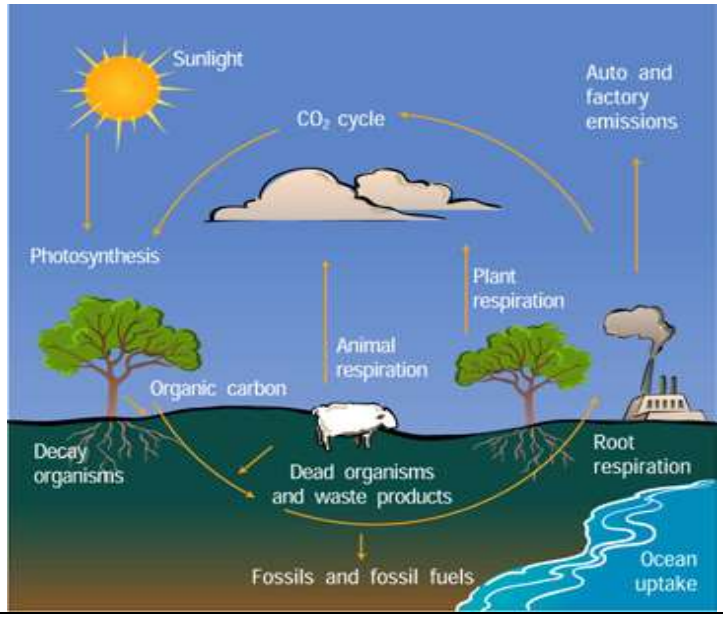
How does matter flow through the carbon cycle?

Carbon makes up less than 1% of the Earth's crust and atmosphere,but all living thingsdepend on carbon compounds.

The carbon cycle is a process that moves carbon between the atmosphere, the Earth's surface, and living things. Carbon is recycled through respiration, photosynthesis, fuel combustion, decomposition; carbon can be atmospheric or dissolved, or can be found in organic compounds within the body.

How does the carbon cycle works?

- In the atmosphere, carbon exists mostly as carbon dioxide. **Carbon dioxide leaves the atmosphere when it dissolves in water or is taken up by plants for photosynthesis.**
- **It is released in the atmosphere during cellular respiration, geologic processes such as volcanic eruptions, and when fossil fuels or forests are burned.**



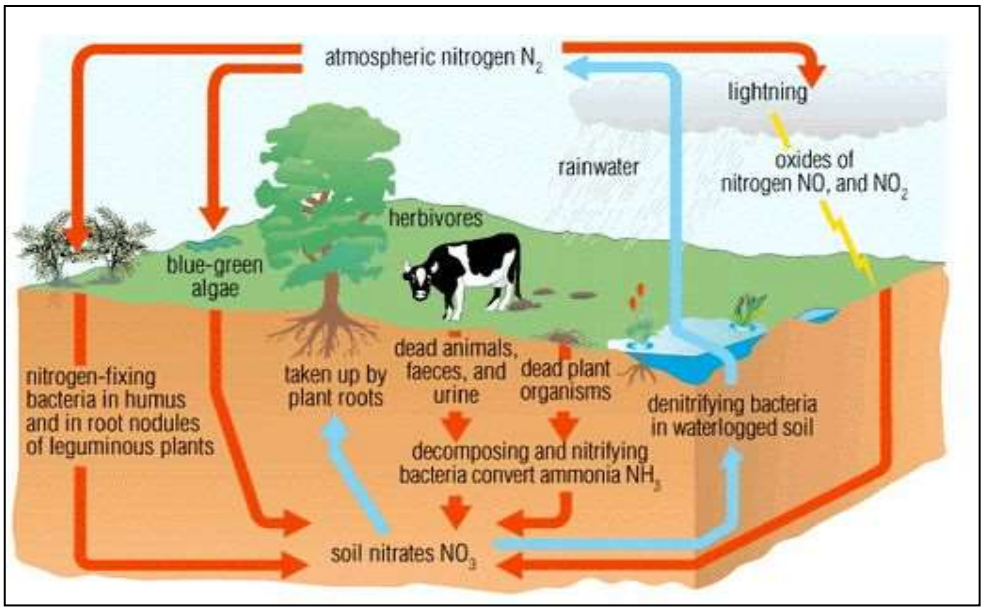
What are some consequences of disruptions of the carbon cycle?

- **Over the past 100 years, the levels of carbon dioxide in Earth's atmosphere have increased. Human activities such as the burning fossil fuels and forests are releasing carbon dioxide into the atmosphere at alarming rates and it is being released faster than it can be removed by natural processes.**

- **Increasing levels of carbon dioxide is a major contributing factor to the global climate change. Scientists say that increasing carbon dioxide which is a greenhouse gas that helps keep heat from leaving the atmosphere. The higher carbon dioxide levels are causing rising temperatures and climate change.**

- **The Greenhouse effect also affects the oceans. When CO_2 or carbon dioxide dissolves in water, carbonic acid forms which causes the water to become more acidic (acidification). This negatively affects marine organisms that have a low tolerance for changing pH levels.**

How does the flow of matter flow through the nitrogen cycle?



Nitrogen gas makes up 78% of Earth's atmosphere. In the nitrogen cycle, nitrogen moves between the atmosphere, Earth's surface, and living things.

Nitrogen Cycle – producers take in nitrogen compounds in soil and pass to consumers that consume the producers; decomposers (bacteria) break down nitrogen compounds and release nitrogen gas to air or usable nitrogen so the soil. The nitrogen cycle involves the exchange of nitrogen between living things and their environment.

- **Nitrogen gas** is removed from the atmosphere by a process called nitrogen fixation**. Nitrogen fixation** is the process by which bacteria change nitrogen gas into a form that plants can use.

- **Certain bacteria in the soil and water are able to fix nitrogen. Some of these bacteria live in the roots of certain plants. Lightning also fixes nitrogen.**

- **In the soil, a variety of bacteria convert fixed nitrogen from one form to another. The result is a mixture of nitrogen compounds, including nitrates, nitrites, and ammonia compounds. Plants take ammonia and make amino acids.**

- **Bacteria** in the soil break down the remains of dead plants and animals, providing more fixed nitrogen to the soil. **The actions of denitrifying bacteria return nitrogen to the atmosphere.**

What are some consequences of disruptions to the nitrogen cycle?

One problem

- To increase plant growth, farmers and gardeners mix nitrogen containing fertilizer into the soil. The fertilizer runoff can affect the balance of nitrogen in bodies of water.
- In a process called **eutrophication**, nitrogen dissolves in the body of water and stimulates the growth of plants and algae.
- **When plants and algae die, the bacterial populations that feed on dead matter boom. These bacteria consume so much oxygen from water that fish and other aquatic animals cannot survive.**

Another problem

- **Acid precipitation** can also disrupt the nitrogen cycle. Acid precipitation can lead to the death of plants and animals by altering the pH levels of soil and water. It can also cause harmful metals from pipes to enter drinking water.

Process Standards (Underlying Processes and Mathematical Tools)
B.1.A demonstrate safe practices during laboratory and field investigations
B.1.B demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials
B.2.A know the definition of science and understand that it has limitations, as specified in chapter 112.34, subsection (b)(2) of 19 TAC
B.2.B know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories
B.2.C know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;
B.2.D distinguish between scientific hypotheses and scientific theories
B.2.E plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology
B.2.F collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, gel electrophoresis apparatuses, micropipettors, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, cameras, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams, or samples of biological specimens or structures
B.2.G analyze, evaluate, make inferences, and predict trends from data
B.2.H communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports
B.3.A in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student
B.3.B communicate and apply scientific information extracted from various sources such as current events,

Process Standards (Underlying Processes and Mathematical Tools)
news reports, published journal articles, and marketing materials
B.3.C draw inferences based on data related to promotional materials for products and services
B.3.D evaluate the impact of scientific research on society and the environment
B.3.E evaluate models according to their limitations in representing biological objects or events
B.3.F research and describe the history of biology and contributions of scientists