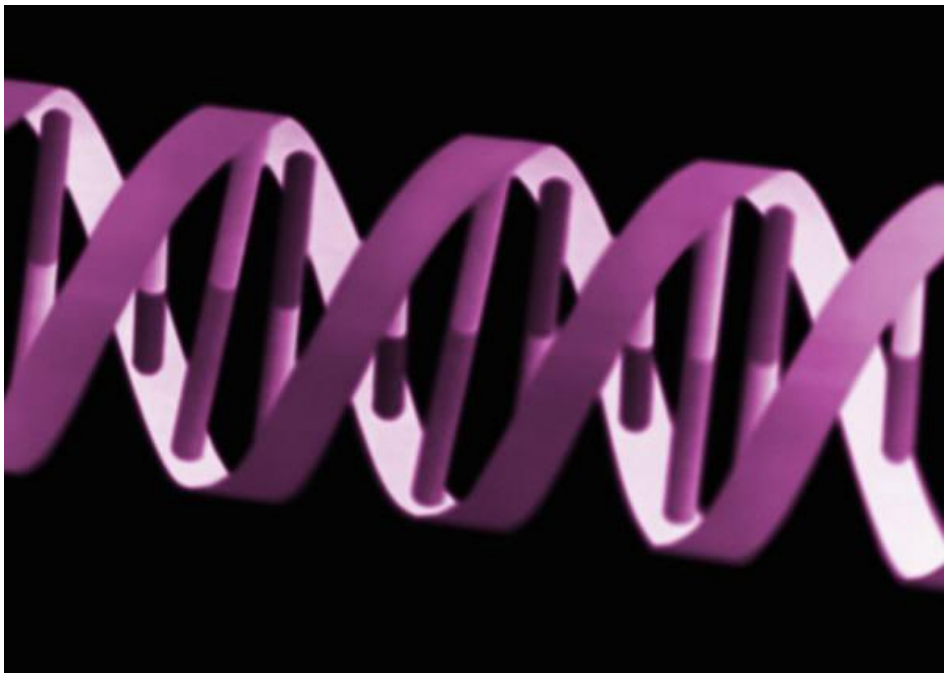
Biology Benchmark Review

Written in coordination with the Biology teachers at Lee High School and district staff



Notes:

1. All Biology (standard) benchmarks are included in this review.
    a. Annually assessed are shown by "AA." Daughter benchmarks do not have any notations.

SC.912.L.14.1 **AA**	Describe the scientific theory of cells (cell theory) and relate the history of its discovery to the process of science.	Moderate

2. Each benchmark has a reading and an activity. The activity section all follows the same format:
    a. Starting out by using an activity to review the applicable vocabulary,
    b. Bringing the student up to compare and contrast (if applicable) and/ or application level
    c. Finally, to the equivalent experience level, in which students will practice multiple choice questions at the DOK complexity level of the benchmark.

3. The last page is a "Student Reference Sheet" which summarizes the strategies which will be used throughout the review. This page streamlines the redundancy of the directions for the students.

4. Each benchmark activity is two pages- meant to be printed front and back.

5. This activity packet is not meant to take place of experiential lab review, it is meant to be a supplement.

6. All of the readings are sourced from Holt McDougal Biology, 2012 Test Prep, unless otherwise noted.

SC.912.L.14.1 AA	Describe the scientific theory of cells (cell theory) and relate the history of its discovery to the process of science.	Moderate

In Biology, the cell theory is a scientific theory that describes the properties of cells, the basic unit of structure in every living thing. The initial development of the theory, during the mid-17th century, was made possible by advances in microscopy, the study of cells is called cell biology. Cell theory is one of the foundations of biology.
(source: http://en.wikipedia.org/wiki/Cell_theory)

The three parts to the cell theory are as described below:

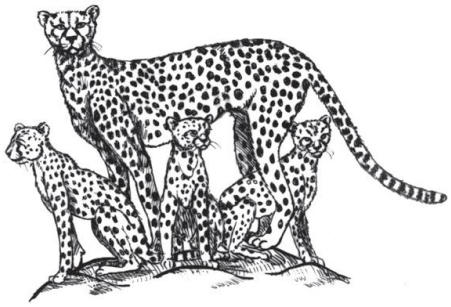
1. All living things are made of one or more cells.

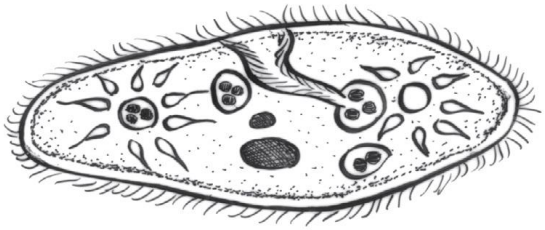
2. Cells are the basic units of structure and function in organisms
3. All cells arise from existing cells.
(source: http://en.wikipedia.org/wiki/Cell_theory)

SC.912.L.14.1 AA	Describe the scientific theory of cells (cell theory) and relate the history of its discovery to the process of science.	Moderate

1. Write the tenets of the cell theory in your own words.
2. Make a Venn diagram comparing the terms "law" and " theory."
3. Can the cell theory ever become a cell law? Why or why not?

1) A cheetah, like those shown below at left, and a paramecium, like the one shown below at right, are both living things.





According to the cell theory, what can you conclude about these two very different organisms?

A. They are made of many cells.
B. They are made of one or more cells.
C. They come from the same kind of cell.
D. They come from noncellular structures.

Statement	
Reason	
Evidence	

2) In science, a theory is an explanation for some phenomenon that is based on observation, experimentation, and reasoning. One important theory in biology is the cell theory. What kinds of observations led to the development of the cell theory?

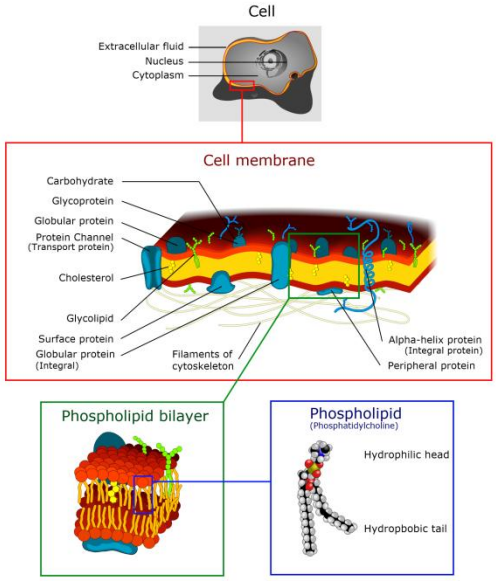
F. testing of first vaccines
G. discoveries of fossil bacteria
H. isolations of DNA and RNA
I. microscopic views of plants and animals

Statement	
Reason	
Evidence	

SC.912.L.14.2 AA	Relate structure to function for the components of plant and animal cells. Explain the role of cell membranes as a highly selective barrier (passive and active transport).	Moderate

The cell membrane or plasma membrane surrounds the cytoplasm of living cells, physically separating the intracellular components from the extracellular environment. Fungi, bacteria and plants also have the cell wall which provides a mechanical support for the cell and precludes the passage of larger molecules. The cell membrane also plays a role in anchoring the cytoskeleton to provide shape to the cell, and in attaching to the extracellular matrix and other cells to help group cells together to form tissues.

The membrane is selectively permeable and able to regulate what enters and exits the cell, thus facilitating the transport of materials needed for survival. The movement of substances across the membrane can be either "passive", occurring without the input of cellular energy, or active, requiring the cell to expend energy in transporting it. The membrane also maintains the cell potential. The cell membrane thus works as a selective filter that allows only certain things to come inside or go outside the cell. The cell employs a number of transport mechanisms that involve biological membranes:



1. Passive diffusion and osmosis: Some substances (small molecules, ions) such as carbon dioxide (CO_2), oxygen (O_2), and water, can move across the plasma membrane by diffusion, which is a passive transport process. Because the membrane acts as a barrier for certain molecules and ions, they can occur in different concentrations on the two sides of the membrane. Such a concentration gradient across a semipermeable membrane sets up an osmotic flow for the water.

2. Transmembrane protein channels and transporters: Nutrients, such as sugars or amino acids, must enter the cell, and certain products of metabolism must leave the cell. Such molecules are pumped across the membrane by transmembrane transporters or diffuse through protein channels. These proteins, also called permeases, are usually quite specific, recognizing and transporting only a limited food group of chemical substances, often even only a single substance.

3. Endocytosis: Endocytosis is the process in which cells absorb molecules by engulfing them. Endocytosis requires energy and is thus a form of active transport.

4. Exocytosis: Just as material can be brought into the cell by invagination and formation of a vesicle, the membrane of a vesicle can be fused with the plasma membrane, extruding its contents to the surrounding medium. A passage is formed in the fused membrane and the vesicles discharges its contents outside the cell
(Source: www.wikipedia.com).

SC.912.L.14.2 AA	Relate structure to function for the components of plant and animal cells. Explain the role of cell membranes as a highly selective barrier (passive and active transport).	Moderate

1. Complete a Vocabulary Burrito for the following organelles in plant and animals cells. However, instead of using the word in a sentence, **create an analogy** for its function. For instance: The nucleus manages and directs the cell, so it is like a principal managing a school.

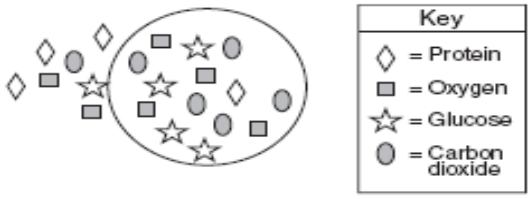
Nucleus
Ribosome
Endoplasmic reticulum
Mitochondiron
Chloroplast
Golgi Complex
Large Central Vacuole
Lysosome
Nuclear Envelope
Nucleolus
Chromatin
Microtubules
Microfilaments
Cilia
Flagella

2. Create a Y Diagram using the terms "Passive Transport" and "Active Transport."
3. There are three main types of passive transport… Define and tell the difference between the three.

Diffusion	Facilitated Diffusion	Osmosis
_____	_____	_____
_____	_____	_____

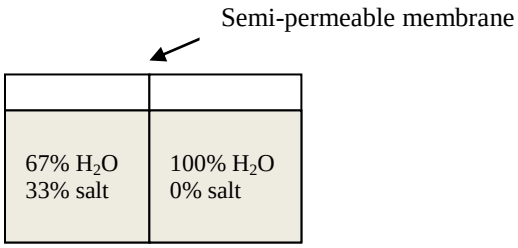
4. In the following diagram, how would each substance diffuse (into or out of the cell)?

Protein:
Oxygen:
Glucose:
Carbon Dioxide:



5. In the following diagram…

   How would the water move? How would the water levels change? Why?
   Which passive transport process is this? How do you know?



SC.912.L.14.3 AA	Compare and contrast the general structures of plant and animal cells. Compare and contrast the general structures of prokaryotic and eukaryotic cells.	Moderate

Prokaryotic cells

The prokaryote cell is simpler, and therefore smaller, than a eukaryote cell, lacking a nucleus and most of the other organelles of eukaryotes. There are two kinds of prokaryotes: bacteria and archaea; these share a similar structure.

The nuclear material of a prokaryotic cell consists of a single chromosome that is in direct contact with the cytoplasm. Here, the undefined nuclear region in the cytoplasm is called the nucleoid.

A prokaryotic cell has three architectural regions:

- On the outside, flagella and pili project from the cell's surface. These are structures (not present in all prokaryotes) made of proteins that facilitate movement and communication between cells.
- Enclosing the cell is the cell envelope – generally consisting of a cell wall covering a plasma membrane though some bacteria also have a further covering layer called a capsule. The envelope gives rigidity to the cell and separates the interior of the cell from its environment, serving as a protective filter. Though most prokaryotes have a cell wall, there are exceptions such as *Mycoplasma* (bacteria) and *Thermoplasma* (archaea). The cell wall consists of *peptidoglycan* in bacteria, and acts as an additional barrier against exterior forces. It also prevents the cell from expanding and finally bursting (cytolysis) from osmotic pressure against a hypotonic environment. Some eukaryote cells (plant cells and fungal cells) also have a cell wall.
- Inside the cell is the cytoplasmic region that contains the cell genome (DNA) and ribosomes and various sorts of inclusions. A prokaryotic chromosome is usually a circular molecule (an exception is that of the bacterium *Borrelia burgdorferi*, which causes Lyme disease).[8] Though not forming a *nucleus*, the DNA is condensed in a *nucleoid*. Prokaryotes can carry extrachromosomal DNA elements called *plasmids*, which are usually circular. Plasmids enable additional functions, such as antibiotic resistance.

Eukaryotic cells

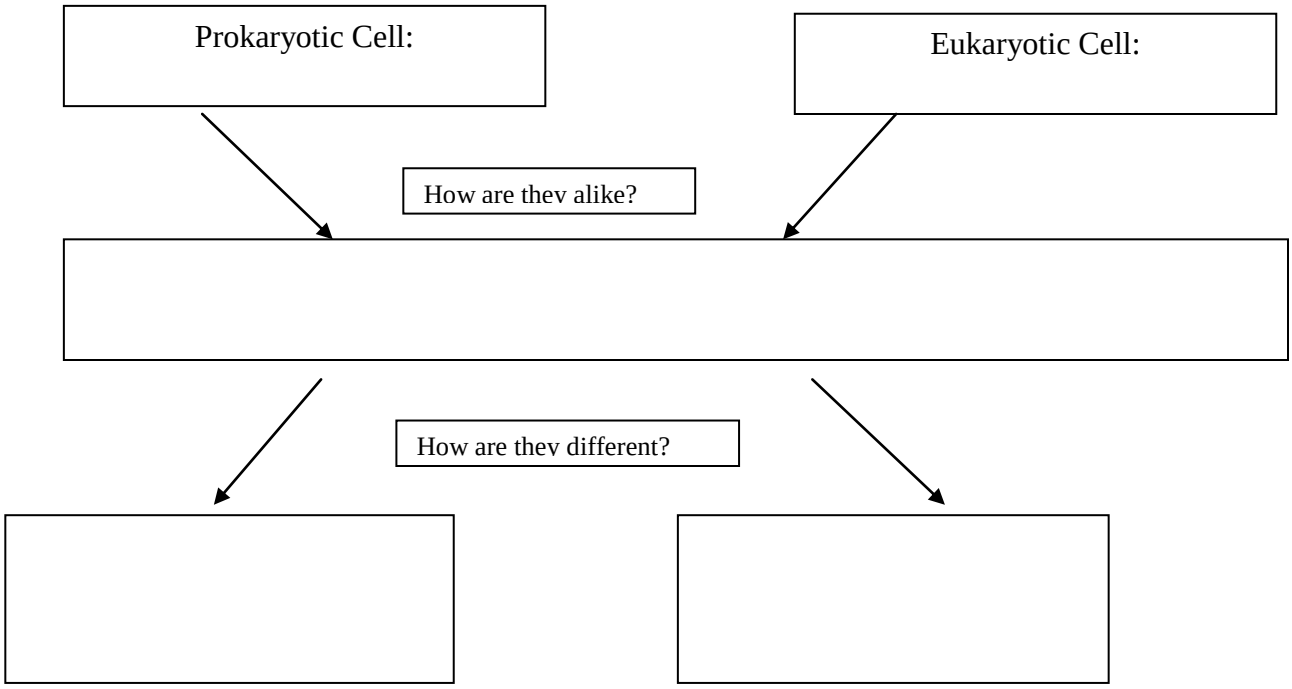
Plants, animals, fungi, slime moulds, protozoa, and algae are all eukaryotic. These cells are about 15 times wider than a typical prokaryote and can be as much as 1000 times greater in volume. The major difference between prokaryotes and eukaryotes is that eukaryotic cells contain membrane-bound compartments in which specific metabolic activities take place. Most important among these is a cell nucleus, a membrane-delineated compartment that houses the eukaryotic cell's DNA. This nucleus gives the eukaryote its name, which means "true nucleus." Other differences include:

- The plasma membrane resembles that of prokaryotes in function, with minor differences in the setup. Cell walls may or may not be present.
- The eukaryotic DNA is organized in one or more linear molecules, called chromosomes, which are associated with histone proteins. All chromosomal DNA is stored in the *cell nucleus*, separated from the cytoplasm by a membrane. Some eukaryotic organelles such as mitochondria also contain some DNA.
- Many eukaryotic cells are ciliated with *primary cilia*. Primary cilia play important roles in chemosensation, mechanosensation, and thermosensation. Cilia may thus be "viewed as sensory cellular antennae that coordinate a large number of cellular signaling pathways, sometimes coupling the signaling to ciliary motility or alternatively to cell division and differentiation."[9]
- Eukaryotes can move using *motile cilia* or *flagella*. The flagella are more complex than those of prokaryotes.

(Source: www.wikipedia.com).

SC.912.L.14.3 AA	Compare and contrast the general structures of plant and animal cells. Compare and contrast the general structures of prokaryotic and eukaryotic cells.	Moderate

1. Complete a Compare/Contrast Chart with the terms "Prokaryotic Cell" and "Eukaryotic Cell."



2. Suppose a certain antibiotic kills eukaryotic cells by blocking pores in the nuclear membrane. Explain why it would not be effective on prokaryotic cells.

3. Fill out the following table in the following format….

	State the Function	Animal Cell	Plant Cell
Cytoplasm			
Cytoskeleton			
Nucleus			
Endoplasmic Reticulum			
Ribosome			
Golgi Apparatus			
Vesicle			
Mitochondrion			
Vacuole			
Lysosome			
Centriole			
Cell Wall			
Chloroplast			

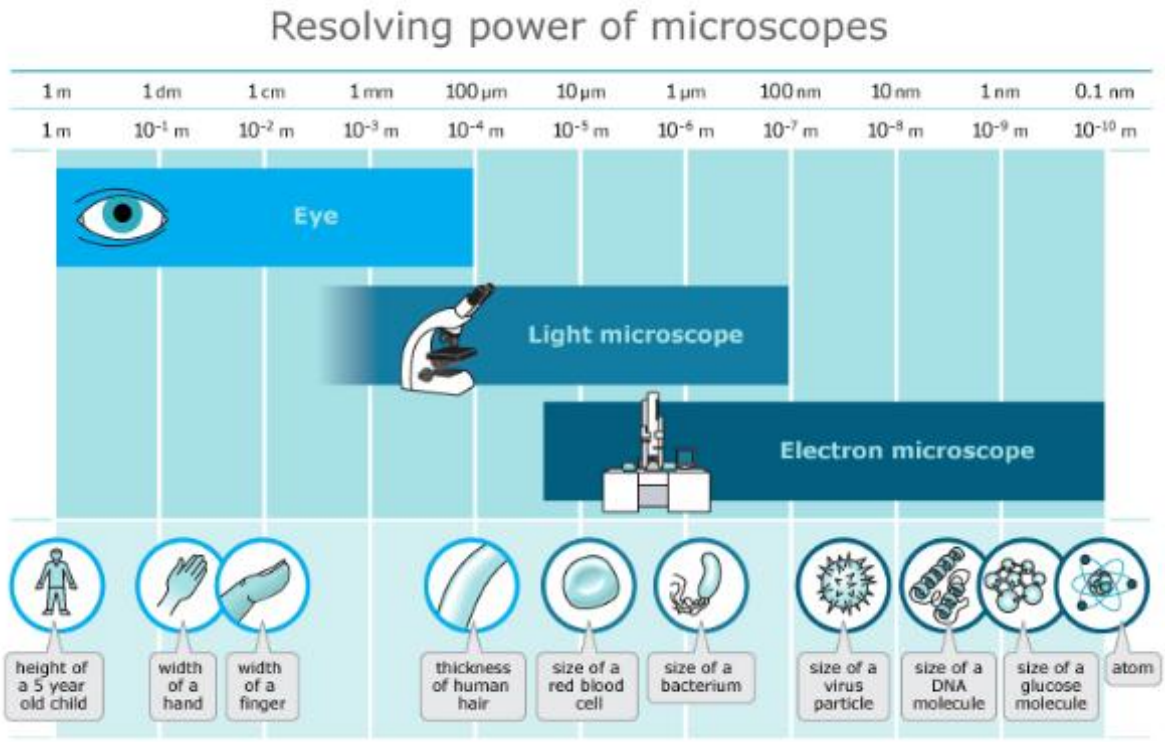
4. Explain why there are differences between animal and plant cells?

5. Which statement correctly explains a difference between the cells of prokaryotes and the cells of eukaryotes?
   a. Eukaryotic cells reproduce using DNA; prokaryotic cells use RNA only to reproduce.
   b. Eukaryotic cells have fewer distinct parts than prokaryotic cells because they are less evolved.
   c. Eukaryotic cells do not have cell walls or vacuoles; prokaryotic cells have both of these features.
   d. Eukaryotic cells have a nucleus and membrane-bound organelles; prokaryotic cells lack these features.

SC.912.L.14.4	Compare and contrast structure and function of various types of microscopes.	Moderate

Different types of microscopes have different qualities and uses. It was not until the 1660s and 1670s that the microscope was used extensively for research in Italy, The Netherlands and England. Marcelo Malpighi in Italy began the analysis of biological structures beginning with the lungs. Robert Hooke's *Micrographia* had a huge impact, largely because of its impressive illustrations. The greatest contribution came from Antonie van Leeuwenhoek who discovered red blood cells and spermatozoa and helped popular rise of microscopy as a technique. On 9 October 1676, Van Leeuwenhoek reported the discovery of micro-organisms.[3]

In 1893 August Köhler developed a key technique for sample illumination, Köhler illumination, which is central to modern light microscopy. This method of sample illumination gives rise to extremely even lighting and overcomes many limitations of older techniques of sample illumination. Further developments in sample illumination came from Fritz Zernike in 1953 and George Nomarski 1955 for their development of phase contrast and differential interference contrast illumination which allow imaging of transparent samples.
(Source: www.wikipedia.com).

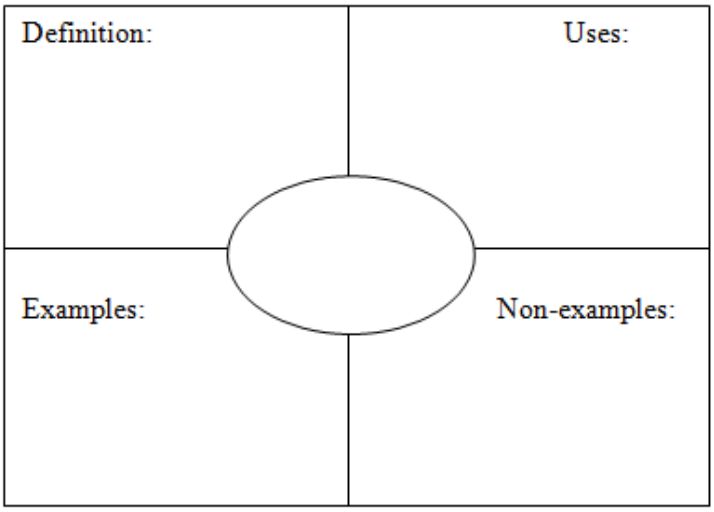


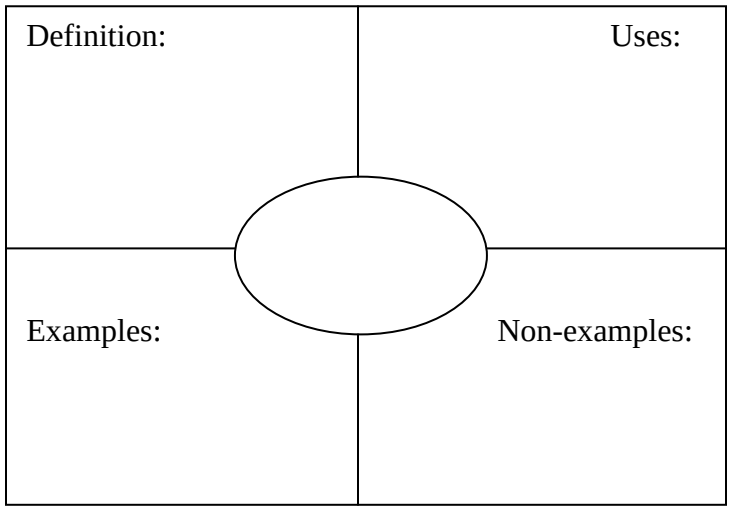
http://www.sciencelearn.org.nz

The traditional light microscope utilizes light and magnification to reveal images. The electron microscope uses electrons rather than light to find images. In 1931, the transmission electron microscope works on the same principle as an optical microscope but uses electrons in the place of light and electromagnets in the place of glass lenses. Use of electrons instead of light allows a much higher resolution The most recent developments in light microscope largely centre on the rise of fluorescence microscopy in biology. During the last decades of the 20th century, particularly in the post-genomic era, many techniques for fluorescent labeling of cellular structures were developed.
(Source: www.wikipedia.com).

SC.912.L.14.4	Compare and contrast structure and function of various types of microscopes.	Moderate

1. Complete two separate Frayer Model for a "Light Microscope" and an "Electron Microscope."





2. Answer the following: What is the driving force for the change of microscopes over time? Justify your reasoning.

3. A scientist is examining a sample of tissue using the instrument below.

What kind of instrument is she using?

A. light microscope
B. Sterco microscope
C. **C.** scanning electron microscope
D. **D.** transmission electron microscope

4. Sometimes scientists use dyes on the samples they study under the microscope. Why might a scientist use colored dyes when viewing items under a compound light microscope?
   a. to make them more visible
   b. to make them more attractive
   c. to make them appear more realistic
   d. to make them appear more three-dimensional

SC.912.L.14.6	Explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspectives of both individual and public health.	High

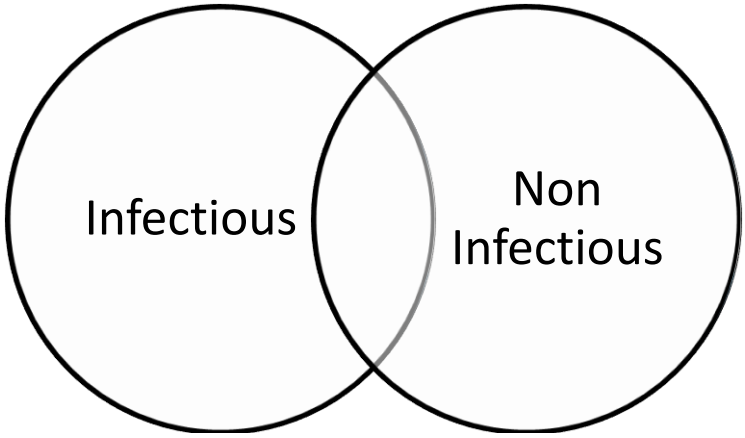
Public health is "the science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private, communities and individuals" (1920, C.E.A. Winslow).[1] It is concerned with threats to health based on population health analysis. The population in question can be as small as a handful of people or as large as all the inhabitants of several continents (for instance, in the case of a pandemic). The dimensions of health can encompass "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity", as defined by the United Nations' World Health Organization.[2] Public health incorporates the interdisciplinary approaches of epidemiology, biostatistics and health services. Environmental health, community health, behavioral health, health economics, public policy, insurance medicine and occupational health (respectively occupational medicine) are other important subfields.

The focus of public health intervention is to improve health and quality of life through the prevention and treatment of disease and other physical and mental health conditions, through surveillance of cases and the promotion of healthy behaviors. Promotion of hand washing and breastfeeding, delivery of vaccinations, and distribution of condoms to control the spread of sexually transmitted diseases are examples of common public health measures.

Modern public health practice requires multidisciplinary teams of professionals including physicians specializing in public health/community medicine/infectious disease, epidemiologists, biostatisticians, public health nurses, medical microbiologists, environmental health officers / public health inspectors, dental hygienists, dietitians and nutritionists, veterinarians, public health engineers, public health lawyers, sociologists, community development workers, communications experts, and others.
(Source: www.wikipedia.com).

SC.912.L.14.6	Explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspectives of both individual and public health.	High

1. Draw a Venn Diagram comparing " infectious diseases" and "non infectious diseases."



Use an SRE for the following questions:
(S) – Statement – Restate the correct answer in a complete sentence.
(R) – Reason – Explain why you think your statement is true. Use the stem, "This statement is true because…"
(E) – Evidence – Cite evidence that supports your reasons. Examples: data from labs, facts, quotes, rules, examples

2. Although many types of bacteria are helpful and do not cause disease, nearly half of all human diseases are bacterial. How have better sanitation and the use of antibiotics over the last century affected death rates from bacterial infections?

A. death rates have increased
B. death rates have decreased
C. death rates have remained the same
D. death rates have increased and then decreased

Statement	
Reason	
Evidence	

3. In the 1800s, many people living in cities in the United States died of infectious diseases such as cholera; a disease caused by a bacterium that pollutes water. Cholera is no longer a major problem in the United States. What is the **most likely** reason for the elimination of cholera as a major disease?
A. Advances in medicine have led to cures for cholera.
B. People have learned the importance of washing their hands.
C. Sewage treatment plants have eliminated such pathogens from drinking water.
D. Regulations have prevented factories from dumping pollution into lakes and rivers.

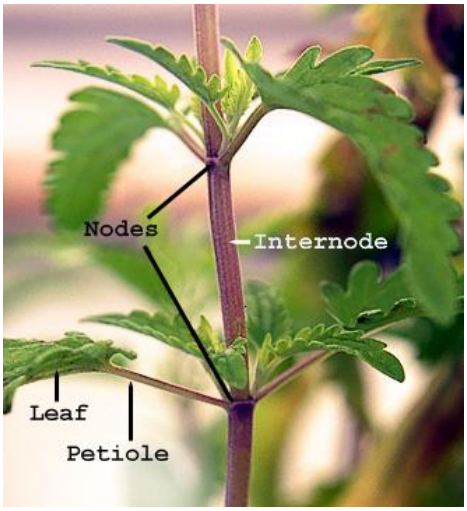
Statement	
Reason	
Evidence	

SC.912.L.14.7 AA	Relate the structure of each of the major plant organs and tissues to physiological processes.	Moderate

A stem is one of two main structural axes of a vascular plant. The stem is normally divided into nodes and internodes, the nodes hold buds which grow into one or more leaves, inflorescence (flowers), conifer cones, roots, other stems etc. The internodes distance one node from another. The term shoots is often confused with stems; shoots generally refer to new fresh plant growth and does include stems but also to other structures like leaves or flowers. The other main structural axis of plants is the root. In most plants stems are located above the soil surface but some plants have underground stems. A stem develops buds and shoots and usually grows above the ground. Inside the stem, materials move up and down the tissues of the transport system.

Stems have four main functions which are:[1]

- Support for and the elevation of leaves, flowers and fruits. The stems keep the leaves in the light and provide a place for the plant to keep its flowers and fruits.
- Transport of fluids between the roots and the shoots in the xylem and phloem.
- Storage of nutrients.
- The production of new living tissue. The normal life span of plant cells is one to three years. Stems have cells called meristems that annually generate new living tissue.



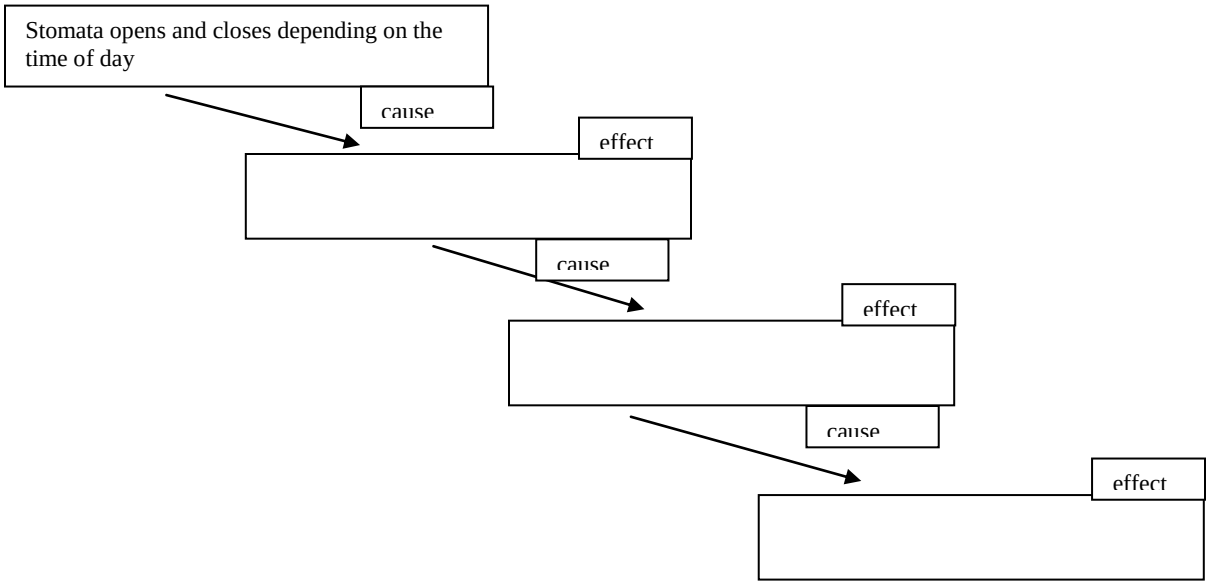
In vascular plants, the root is the organ of a plant that typically lies below the surface of the soil. However, this is not always the case, a root can also be aerial (growing above the ground) or aerating (growing up above the ground or especially above water). Furthermore, a stem normally occurring below ground is not exceptional either (see rhizome). So, it is better to define *root* as a part of a plant body that bears no leaves, and therefore also lacks nodes. There are also important internal structural differences between stems and roots.

The first root that comes from a plant is called the radicle. The four major functions of roots are 1) absorption of water and inorganic nutrients, 2) anchoring of the plant body to the ground, and supporting it, 3) storage of food and nutrients, 4) vegetative reproduction. In response to the concentration of nutrients, roots also synthesise cytokinin, which acts as a signal as to how fast the shoots can grow. Roots often function in storage of food and nutrients. The roots of most vascular plant species enter into symbiosis with certain fungi to form mycorrhizas, and a large range of other organisms including bacteria also closely associate with roots.
(Source: www.wikipedia.com).

SC.912.L.14.7 AA	Relate the structure of each of the major plant organs and tissues to physiological processes.	Moderate

Term	Make a sketch of the plant part	Define what it does for the plant (in your own words)	Physiological Process it is involved in (ie. transpiration, photosynthesis, cellular respiration, reproduction)	Type of plant tissue	Are there other plant parts needed for this one to do its job? If so which ones?
Shoot					
Root					
Meristems					
Xylem					
Phloem					
Cuticle					
Stomata (stoma)					
Guard Cells					
Seed					
Fruit					

1. Create a Cause and Effect Chain



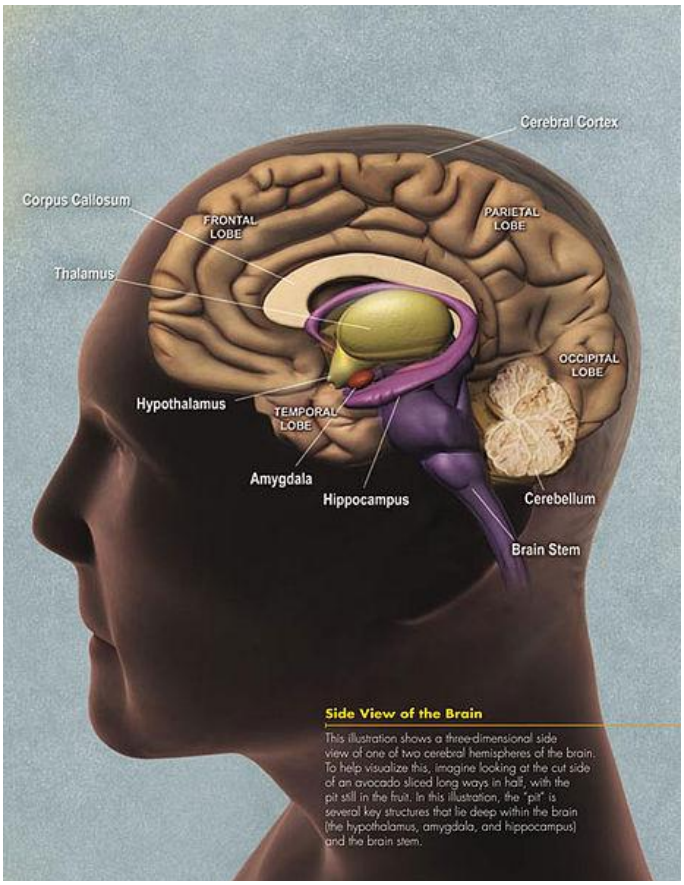
2. The stomata on a saguaro cactus must open to let in carbon dioxide from the atmosphere. When each stoma opens, however, water can escape from the plant. How does the saguaro minimize the loss of water when stomata open?

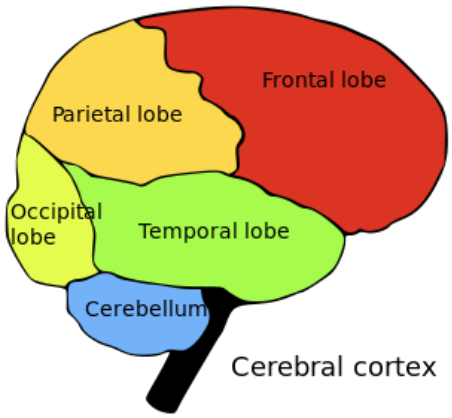
A. Guard cells open and close the stomata rapidly during the day to let as little water as possible escape.
B. Guard cells open the stomata only at night, when the air temperature is cooler and the humidity somewhat higher.
C. Guard cells always keep the stomata open slightly, so that carbon dioxide can flow in but very little water can flow out.
D. The saguaro has fewer stomata than any other plant, an adaptation that prevents water loss through transpiration.

SC.912.L.14.26 AA	Identify the major parts of the brain on diagrams or models.	Low

The human brain has many properties that are common to all vertebrate brains, including a basic division into three parts called the forebrain, midbrain, and hindbrain, each with fluid-filled ventricles at their core, and a set of generic vertebrate brain structures including the medulla oblongata, pons, cerebellum, optic tectum, thalamus, hypothalamus, basal ganglia, olfactory bulb, and many others.

As a mammalian brain, the human brain has special features that are common to all mammalian brains, most notably a six-layered cerebral cortex and a set of structures associated with it, including the hippocampus and amygdala. All vertebrates have a forebrain whose upper surface is covered with a layer of neural tissue called the pallium, but in all except mammals the pallium has a relatively simple three-layered cell structure. In mammals it has a much more complex six-layered cell structure, and is given a different name, the cerebral cortex. The hippocampus and amygdala also originate from the pallium, but are much more complex in mammals than in other vertebrates.



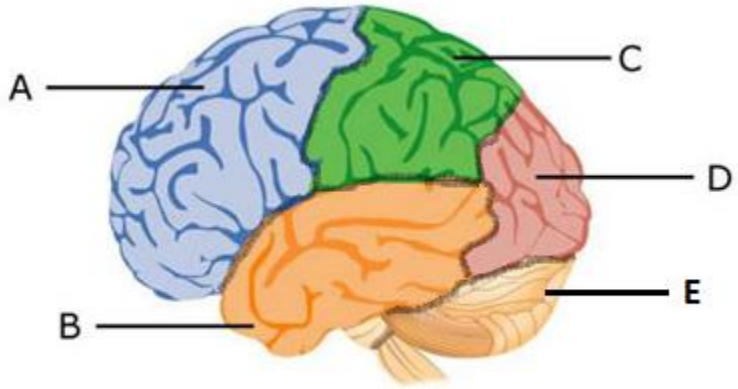


(Source: www.wikipedia.com).

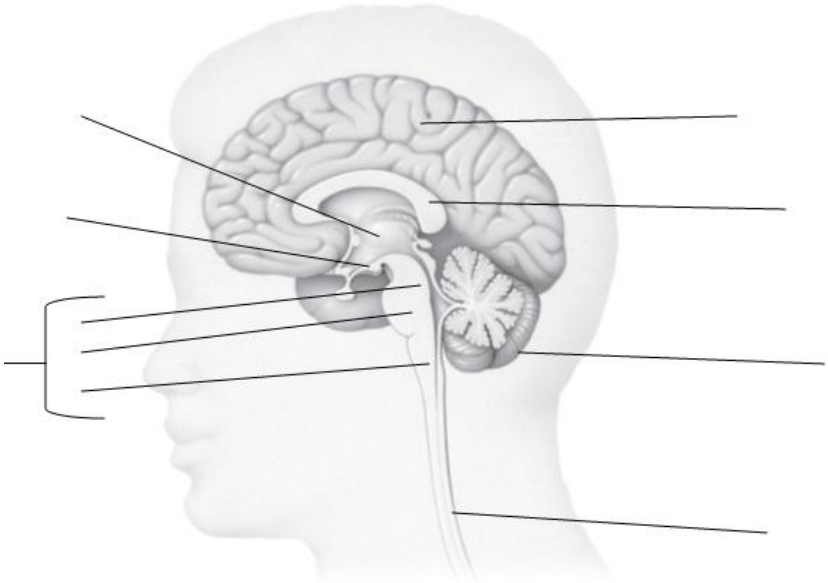
SC.912.L.14.26 AA	Identify the major parts of the brain on diagrams or models.	Low

Content Limits: Cerebrum, Cerebellum, Pons, Medulla Oblongata, Brain Stem, Frontal Lobe, Parietal Lobe, Occipital Lobe, and Temporal lobe.

1. Label each part of the picture: Lateral view using with only lobes.



2. Label each part of the picture (some terms will be used again)



3. For each of the terms listed above come up with a mnemonic device that will help you remember each word's location in the brain.

SC.912.L.14.36 AA	Describe the factors affecting blood flow through the cardiovascular system.	Moderate

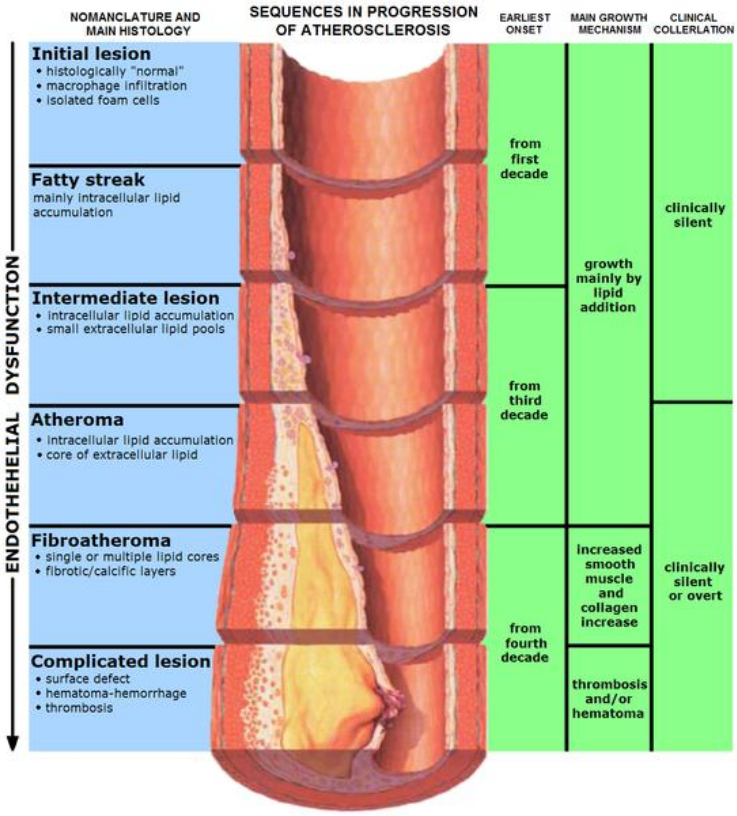
Blood flow is the continuous running of blood in the cardiovascular system. The human body is made up of several processes all carrying out various functions. We have the gastrointestinal system which aids the digestion and the absorption of food. We also have the respiratory system which is responsible for the absorption of O_2 and elimination of CO_2 .The urinary system removes waste from the body. The cardiovascular system helps to distribute food, O_2 and other product of metabolism. The reproductive system is responsible for perpetuating the species. The nervous and endocrine system is responsible for coordinating the integration and function of other system.

Cell →Tissue → Organ →System.

The cell is the basic structure in the human body. These cells that makes up the bodies of all living things exist in an 'internal sea' of extracellular fluid (ECF) enclosed within the integument of the animal. From this fluid, the cell takes up O_2 and nutrients into it, they discharge metabolic waste products. In animals with a closed vascular system, the ECF is divided into two components, the interstitial fluid and the circulating blood plasma. The plasma and the cellular elements of the blood, principally red blood cells, fill the vascular system and together they constitute the total blood volume.[1]

Cardiovascular disease is a class of diseases that involve the heart or blood vessels (arteries, capillaries and veins). Cardiovascular disease refers to any disease that affects the cardiovascular system, principally cardiac disease, vascular diseases of the brain and kidney, and peripheral arterial disease. The causes of cardiovascular disease are diverse but atherosclerosis and/or hypertension are the most common. Additionally, with aging come a number of physiological and morphological changes that alter cardiovascular function and lead to subsequently increased risk of cardiovascular disease, even in healthy asymptomatic individuals.

Cardiovascular disease is the leading cause of deaths worldwide, though since the 1970s, cardiovascular mortality rates have declined in many high-income countries. [4] At the same time, cardiovascular deaths and disease have increased at a fast rate in low- and middle-income countries.[5] Although cardiovascular disease usually affects older adults, the antecedents of cardiovascular disease, notably atherosclerosis, begin in early life, making primary prevention efforts necessary from childhood.[6] There is therefore increased emphasis on preventing atherosclerosis by modifying risk factors, such as healthy eating, exercise, and avoidance of smoking.



(Source: www.wikiipedia.com)

SC.912.L.14.36 AA	Describe the factors affecting blood flow through the cardiovascular system.	Moderate

1. Explain the basic components of cardiovascular system and how it works. Use drawings to assist your answer.

2. What is blood's function in the body?

Read the following scenarios and respond to them in the table format.

	How would this affect the blood pressure?	**What is the affect on the blood flow?**
Cholesterol causes narrowing of the arteries.		
As you are exercising and your heart rate increases.		
Smokers are filling their lungs with many poisonous gases causing the hardening of their arteries as well as slowing the heart rate.		
Survivors of heart attacks generally will lose a portion of their heart muscle. Sometimes as small as 10% can die, but in others up to half the heart muscle can die.		
A runner in a marathon does not drink enough liquids and he becomes severely dehydrated.		

4. Heart rate, or the rate at which the muscles in the heart contract, is controlled by the sinoatrial node, a group of cells in the cardiac muscle of the right atrium. Heart rate decreases when you are asleep and increases when you are awake. Some people require an artificial pacemaker to regulate their heart rate if it is too slow. Which hypothesis explains how the body might be affected by a dangerously slow heart rate?

F. The body might have trouble falling asleep or feeling rested after a full night of sleep.
G. Cells in the body might not receive enough oxygen, which could cause the person to faint.
H. The adrenal gland might not produce enough hormones to prepare the body for a quick reaction.
I. Breathing might become shallow, which could cause the person to retain too much carbon dioxide.

SC.912.L.14.52 AA	Explain the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics.	Moderate

The immune system is a system of biological structures and processes within an organism that protects against disease. To function properly, an immune system must detect a wide variety of agents, from viruses to parasitic worms, and distinguish them from the organism's own healthy tissue.

Pathogens can rapidly evolve and adapt to avoid detection and neutralization by the immune system. As a result, multiple defense mechanisms have also evolved to recognize and neutralize pathogens. Even simple unicellular organisms such as bacteria possess a rudimentary immune system, in the form of enzymes that protect against bacteriophage infections.

Other basic immune mechanisms evolved in ancient eukaryotes and remain in their modern descendants, such as plants and insects. These mechanisms include phagocytosis, antimicrobial peptides called defensins, and the complement system. Jawed vertebrates, including humans, have even more sophisticated defense mechanisms, including the ability to adapt over time to recognize specific pathogens more efficiently. Adaptive (or acquired) immunity creates immunological memory after an initial response to a specific pathogen, leading to an enhanced response to subsequent encounters with that same pathogen. This process of acquired immunity is the basis of vaccination.

A vaccine is a biological preparation that improves immunity to a particular disease. A vaccine typically contains an agent that resembles a disease-causing microorganism, and is often made from weakened or killed forms of the microbe, its toxins or one of its surface proteins. The agent stimulates the body's immune system to recognize the agent as foreign, destroy it, and "remember" it, so that the immune system can more easily recognize and destroy any of these microorganisms that it later encounters.

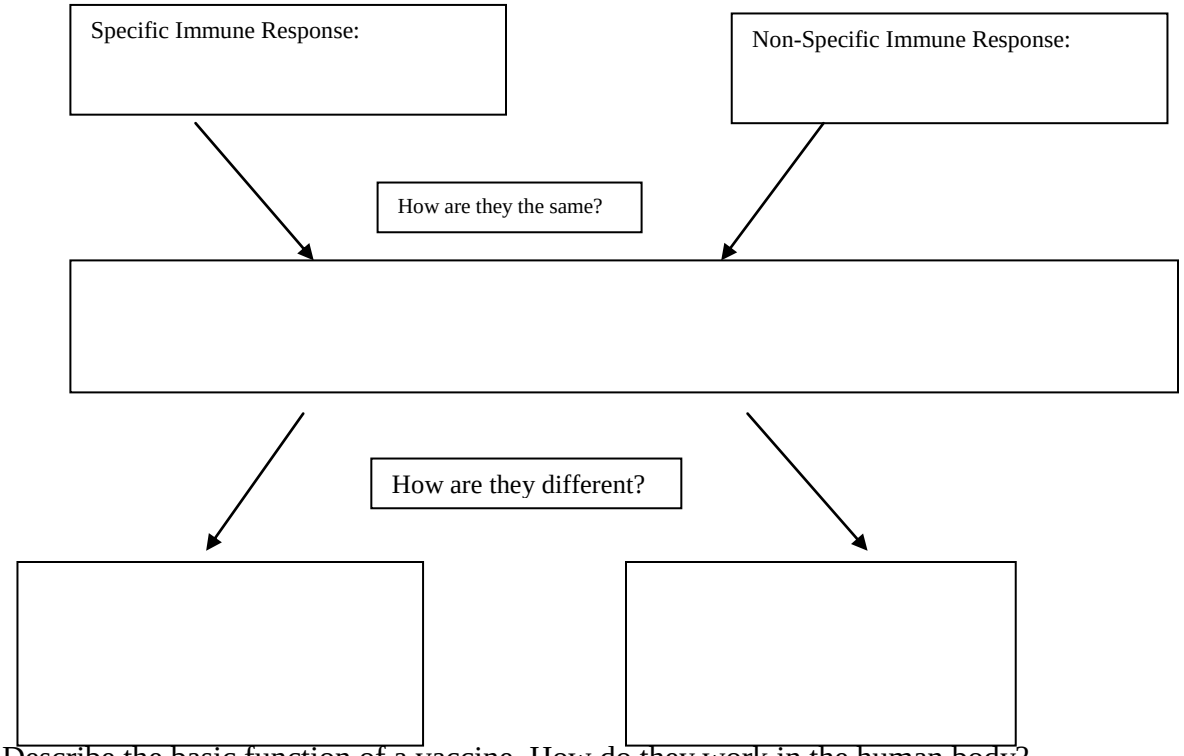
An antibacterial is an agent that inhibits bacterial growth or kills bacteria. The term is often used synonymously with the term *antibiotic(s)*. Today, however, with increased knowledge of the causative agents of various infectious diseases, *antibiotic(s)* has come to denote a broader range of antimicrobial compounds, including anti-fungal and other compounds.
(Source: www.wikipedia.com).

SC.912. L.14.52 AA	Explain the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics.	Moderate

1. What is the function of the human immune system?
2. What is the first line of defense against pathogens? Explain how this works.
3. The 3rd line of defense in the human immune system kills and removes pathogens. It consists of six types of white blood cells found in our blood system. In each box describe each type of white blood cell and their function.

White Blood Cell					

4. Make a compare contrast chart for "Specific Immune Response" and "Non Specific Immune Response." Remember to define the terms at the top in your own words.



5. Describe the basic function of a vaccine. How do they work in the human body?

6. What are antibiotics? How do they work in the human body? What is antibiotic resistance?

7. In the immune system's specific response, white blood cells can target specific types of disease-causing microbes. How do white blood cells recognize invading microbes?

A. Receptor proteins on their surfaces bind to specific antigens.
B. Helper T cells release antibodies that bind with the antigens.
C. Natural killer cells puncture and destroy the infected body cells.
D. Plasma cells bind to the viral antigens and mark them for destruction.

SC.912.L.15.1 AA	Explain how the scientific theory of evolution is supported by the fossil record, comparative anatomy, comparative embryology, biogeography, molecular biology, and observed evolutionary change.	High

Evidence of common descent of living things has been discovered by scientists working in a variety of fields over many years. This evidence has demonstrated and verified the occurrence of evolution and provided a wealth of information on the natural processes by which the variety and diversity of life on Earth developed. This evidence supports the modern evolutionary synthesis, the current scientific theory that explains how and why life changes over time. Evolutionary biologists document the fact of common descent: making testable predictions, testing hypotheses, and developing theories that illustrate and describe its causes.

Comparison of the DNA genetic sequences of organisms has revealed that organisms that are phylogenetically close have a higher degree of DNA sequence similarity than organisms that are phylogenetically distant. Further evidence for common descent comes from genetic detritus such as pseudogenes, regions of DNA that are orthologous to a gene in a related organism, but are no longer active and appear to be undergoing a steady process of degeneration from cumulative mutations.

Fossils are important for estimating when various lineages developed in geologic time. As fossilization is an uncommon occurrence, usually requiring hard body parts and death near a site where sediments are being deposited, the fossil record only provides sparse and intermittent information about the evolution of life. Evidence of organisms prior to the development of hard body parts such as shells, bones and teeth is especially scarce, but exists in the form of ancient microfossils, as well as impressions of various soft-bodied organisms. The comparative study of the anatomy of groups of animals shows structural features that are fundamentally similar or homologous, demonstrating phylogenetic and ancestral relationships with other organisms, most especially when compared with fossils of ancient extinct organisms. Vestigial structures and comparisons in embryonic development are largely a contributing factor in anatomical resemblance in concordance with common descent. Since metabolic processes do not leave fossils, research into the evolution of the basic cellular processes is done largely by comparison of existing organisms' physiology and biochemistry. Many lineages diverged at different stages of development, so it is possible to determine when certain metabolic processes appeared by comparing the traits of the descendants of a common ancestor. Universal biochemical organization and molecular variance patterns in all organisms also show a direct correlation with common descent.

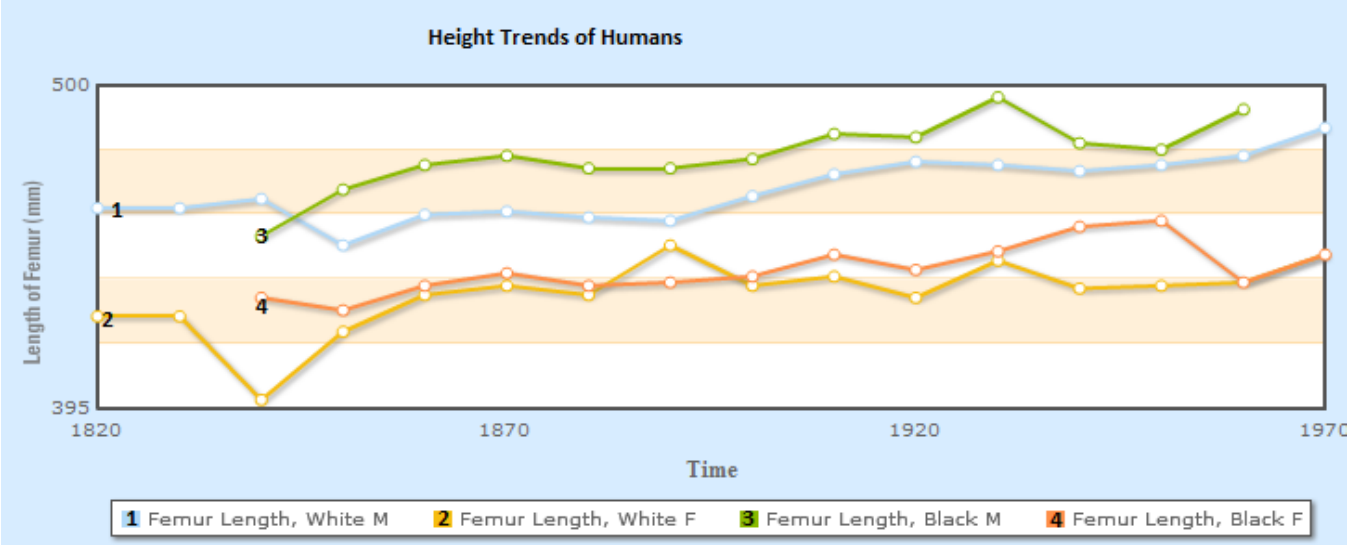
Further evidence comes from the field of biogeography because evolution with common descent provides the best and most thorough explanation for a variety of facts concerning the geographical distribution of plants and animals across the world. This is especially obvious in the field of island biogeography. Combined with the theory of plate tectonics common descent provides a way to combine facts about the current distribution of species with evidence from the fossil record to provide a logically consistent explanation of how the distribution of living organisms has changed over time.

The development and spread of antibiotic resistant bacteria, like the spread of pesticide resistant forms of plants and insects provides evidence that evolution due to natural selection is an ongoing process in the natural world. Alongside this, are observed instances of the separation of populations of species into sets of new species (speciation). Speciation has been observed directly and indirectly in the lab and in nature. Multiple forms of such have been described and documented as examples for individual modes of speciation. Furthermore, evidence of common descent extends from direct laboratory experimentation with the artificial selection of organisms—historically and currently—and other controlled experiments involving many of the topics in the article. This article explains the different types of evidence for evolution with common descent along with many specialized examples of each.
(Source: www.wikipedia.com).

SC.912.L.15.1 AA	Explain how the scientific theory of evolution is supported by the fossil record, comparative anatomy, comparative embryology, biogeography, molecular biology, and observed evolutionary change.	High

1. Make a vocabulary burrito with the following terms: adaptation, comparative anatomy, embryology, homologous structure, vestigial organ, biogeography, molecular biology, geologic time, adaptive radiation, convergent evolution, punctuated equilibrium, genetic drift.
2. What is the difference between a theory, law and hypothesis? How do scientists use these terms, and does usage of these terms change?

3. The human population of the United States has grown taller over the past 150 years. Scientists can use the femur bones, or the thigh bones to estimate average height since records have not been kept. By measuring the length of the femur, scientist can track height trends over long periods of time.



a) Which groups had the greatest increase in femur length? Which group had the least?
b) What might explain the increase in height for all four groups over the past 150 years?
c) Do you think that these femur trends are sufficient evidence for evolution? Why or why not?

4. The pictures below show similarities among the forelimbs of three mammals.

These similarities provide evidence for which of the following hypotheses?

A. Legs and wings may have evolved from flippers.
B. All mammals have evolved from an ancestor that was a bat.
C. A cat's leg, a dolphin's flipper, and a bat's wing have identical functions.
D. Cats, dolphins, and bats may have had the same ancestor millions of years ago.

5. In 2008, the remains of a Saber Tooth Tiger was found in the coastal areas of the United Kingdom. Scientists were able to capture intact DNA sequences and found it was similar to the African lion. Which of the following conclusions can the scientists formulate about the Saber Tooth tiger and the African lion?

A. African lions and Saber Tooth tigers have a mutual ancestor.
B. African lions outcompeted Saber Tooth tigers causing their extinction.
C. African ions and Saber Tooth tigers should be classified as the same species.
D. African lions and Saber Tooth tigers have the same number of chromosomes.

SC.912.L.15.4	Describe how and why organisms are hierarchically classified and based on evolutionary relationships.	High

Taxonomy (from ancient Greek τάξις taxis, arrangement, and νομία *nomia*, method)[1] is the academic discipline of defining groups of biological organisms on the basis of shared characteristics and giving names to those groups. Each group is given a rank and groups of a given rank can be aggregated to form a super group of higher rank and thus create a hierarchical classification.[2][3] The groups created through this process are referred to as taxa (singular taxon). An example of a modern classification is the one published in 2009 by the Angiosperm Phylogeny Group for all living flowering plant families (the APG III system).

Biological classification is a critical step in the taxonomic process, as it informs the user as to what the relatives of the taxon are hypothesized to be. Although the discipline of taxonomy itself does not deal with the investigations of how taxa are related to one another, it does serve to communicate these results to the user. To do this, it uses taxonomic ranks, including, among others (in order from most inclusive to least inclusive): Domain, Kingdom, Phylum, Class, Order, Family, Genus, and Species.

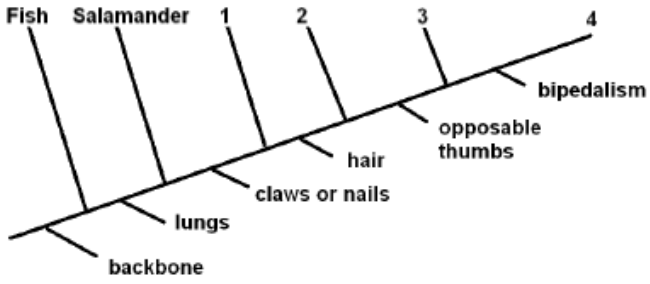
Phylogenetics

Today, traditional rank-based biological classifications persist in a structure largely unchanged since the 1700s; however, how the relationships of these taxa are investigated has changed drastically in recent decades. It is now common for biologists to devise a classification based on the results of phylogenetic analysis using DNA sequence data. Although phylogenetics itself is fundamental to modern-day systematics, its use for the description of new taxa, and placement within a classification scheme, is unrequired. As a result, phylogenetics tends to have a direct impact on taxonomic classifications, even though it is not a part of taxonomy.
(Source: www.wikipedia.com).

SC.912.L.15.4	Describe how and why organisms are hierarchically classified and based on evolutionary relationships.	High

1. Describe how organisms are named and classified.

2. A cladogram is a diagram which shows how organisms are related to each other through common ancestors. Fill in the following missing areas with **any** animal which would possess the needed traits.



3. The table below shows the common and scientific names of common vertebrates found in the United States.

Vertebrate	Common Name	Scientific Name
A	white perch	*Morone americana*
B	grass pickerel	*Esox americanus*
C	varying hare	*Lepus americanus*
D	American toad	*Bufo americanus*
E	muskellunge	*Esox masquinongy*

Which two vertebrates are most closely related?

A) A and B C) C and D

B) B and E D) A and D

4. Below is part of a field guide that several students have been using to identify trees in a local park.

A Dichotomous Key to Common Trees of the Northeastern United States

1. a. Leaves are thin and needlelike (coniferous) . . . . . Go to 2
   b. Leaves are broad and fanlike (deciduous) . . . . . Go to 6

2. a. Needles are over 2.5 cm long and are clustered . . . . Go to 3
   b. Needles are 1.25 cm long or less . . . . . Go to 4

3. a. Needles occur in clusters of 3 . . . . . Pitch pine *(Pinus rigida)*
   b. Needles occur in clusters of 5 . . . . . Eastern white pine *(Pinus strobus)*

The students notice that one plant has thin 1.2 cm needles that occur in clusters. Which of the following inferences can be made?

A. The plant is deciduous.
B. The plant is a *Pinus rigida*.
C. The plant is an Eastern white pine.
D The plant cannot be identified from the information provided.

SC.912.L.15.5	Explain the reasons for changes in how organisms are classified.	High

Early taxonomists

Taxonomy has been called "the world's oldest profession", and naming and classifying our surroundings has likely been taking place as long as mankind has been able to communicate. It would always have been important to know the names of poisonous and edible plants and animals in order to communicate this information to other members of the family or group.

In the East, one of the earliest recorded pharmacopoeias was written by Shen Nung, Emperor of China (c. 3000 BC). He wanted to spread information related to agriculture and medicine, and is said to have tasted hundreds of plants with the goal of learning their medicinal value. Records after this are difficult to interpret for some time, but medicinal plant illustrations show up in Egyptian wall paintings from c. 1500 BC. The paintings clearly show that these societies valued and communicated the uses of different species, and therefore had a basic taxonomy in place.

Aristotle to Pliny the Elder

Historical records show that informally classifying organisms took place at least back to the days of Aristotle (Greece, 384-322 BC), who was the first to begin to classify all living things. Some of the terms he gave to animals, such as "invertebrates" and "vertebrates" are still commonly used today. His student Theophrastus (Greece, 370-285 BC) carried on this tradition, and wrote a classification of 480 plants called *Historia Plantarum*. Again, several plant groups currently still recognized can be traced back to Theophrastus, such as *Cornus*, *Crocus*, and *Narcissus*. The next major turn-of-the-millennia era taxonomist came in the form of Pliny the Elder (Rome, 23-79 AD). His elaborate 160-volume work Naturalis Historia described many plants, and even gave many of them Latin binomial names.

Pre-Linnaean taxonomists

Title page of *Systema Naturae*, Leiden, 1735

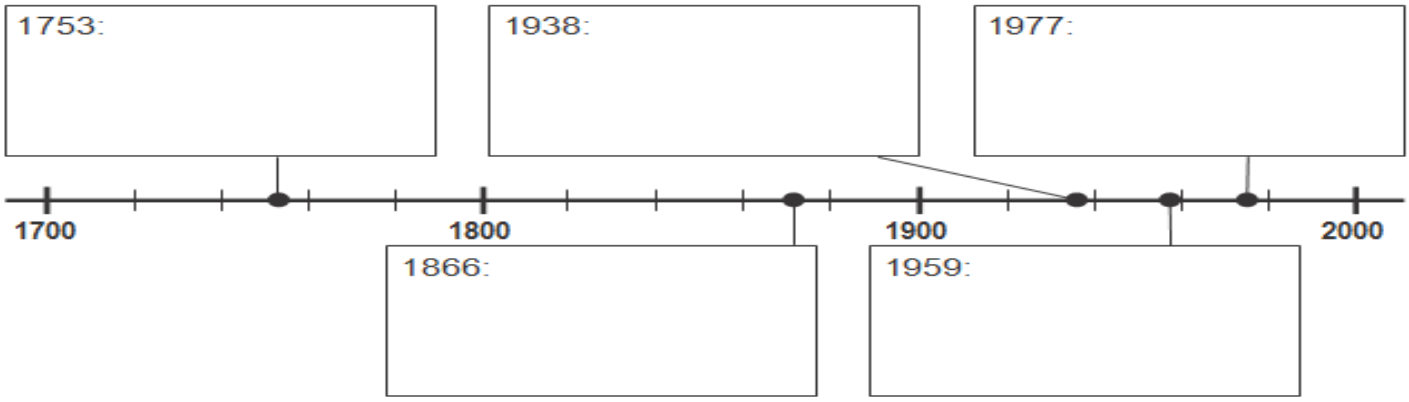
It was not until c. 1500 years later that taxonomic works became ambitious enough to replace the ancient texts. This is often credited to the development of sophisticated optic lenses, which allowed for the morphology of organisms to be studied in much greater detail. One of the earliest authors to take advantage of this leap in technology was Andrea Cesalpino (Italy, 1519–1603), who is often referred to as "the first taxonomist". His magnum opus De Plantis came out in 1583, and described over 1500 plant species. Two large plant families that he first recognized are still in use today: the Asteraceae and Brassicaceae. Then in the seventeenth century John Ray (England, 1627–1705) wrote many important taxonomic works. Arguably his greatest accomplishment was Methodus Plantarum Nova (1682), where he published over 18,000 plant species. At the time his classifications were perhaps the most complex yet produced by any taxonomist, as he based his taxa on many combined characters. The next major taxonomic works were produced by Joseph Pitton de Tournefort (France, 1656–1708). His work from 1700, Institutiones Rei Herbariae, included over 9000 species in 698 genera, and directly influenced Linnaeus as it was the text he used as a young student.[9]

The Linnaean era

The Swedish botanist Carl Linnaeus (1707-1778) ushered in a new era of taxonomy. With his major works *Systema Naturae* 1st Edition in 1735*Species Plantarum* in 1753 and *Systema Naturae* 10th Edition he revolutionized modern taxonomy. His works implemented a standardized binomial naming system for animal and plant species, which proved to be an elegant solution to a chaotic and disorganized taxonomic literature. As a result the Linnaean system was born, and is still used in essentially the same way today as it was in the eighteenth century. Currently, plant and animal taxonomists regard Linnaeus' work as the "starting point" for valid names (at 1753 and 1758 respectively).Names published before these dates are referred to as "pre-Linnaean", and not considered valid (with the exception of spiders published in *Svenska Spindlar*). Even taxonomic names published by Linnaeus himself before these dates are considered pre-Linnaean.
(Source: www.wikipedia.com).

SC.912.L.15.5	Explain the reasons for changes in how organisms are classified.	High

On the timeline below, fill in the major changes to the kingdom system that have occurred over the past three hundred years.



2. The ancient Greeks grouped plants and animals according to their structural similarities. What are modern classification systems based on?

a. solely on structural characteristics of organisms
b. on similar behaviors as well as similar characteristics
c. solely on evolutionary relationships between organisms
d. on evolutionary relationships as well as similar characteristics

3. **Respond with an SRE.**
The current classification system is extremely dynamic. In 1753, Linnaeus started this system by classifying all organisms into two kingdoms. It wasn't until nearly a century later that another scientist modified the two-kingdom system, and created a three-kingdom system. Currently, we use a six-kingdom system for classification. Why does the classification system keep changing?

a. The classification system changes because evolution continually produces new, unique organisms.
b. Scientific studies show new evolutionary relationships between organisms, which lead to modifications in the classification system.
c. The advancement of computer technology allows scientists to more accurately classify species, therefore the classification system continually changes.
d. Scientists re-classify organisms each year based on the opinions of the current preeminent scientists in the taxonomic field.

Statement	
Reason	
Evidence	

SC.912.L.15.6 AA	Discuss distinguishing characteristics of the domains and kingdoms of living organisms.	Moderate

Well before Linnaeus, plants and animals were considered separate Kingdoms. Linnaeus used this as the top rank, dividing the physical world into the plant, animal and mineral kingdoms. As advances in microscopy made classification of microorganisms possible, the number of kingdoms increased, five and six-kingdom systems being the most common.

Domains are a relatively new grouping. The three-domain system was first proposed in 1990, but not generally accepted until later. One main characteristic of the three-domain method is the separation of Archaea and Bacteria, previously grouped into the single kingdom Bacteria (a kingdom also sometimes called Monera). Consequently, the three domains of life are conceptualized as Archaea, Bacteria, and Eukaryota (comprising the nuclei-bearing eukaryotes).[12] A small minority of scientists add Archaea as a sixth kingdom, but do not accept the domain method.
(Source: www.wikipedia.com).

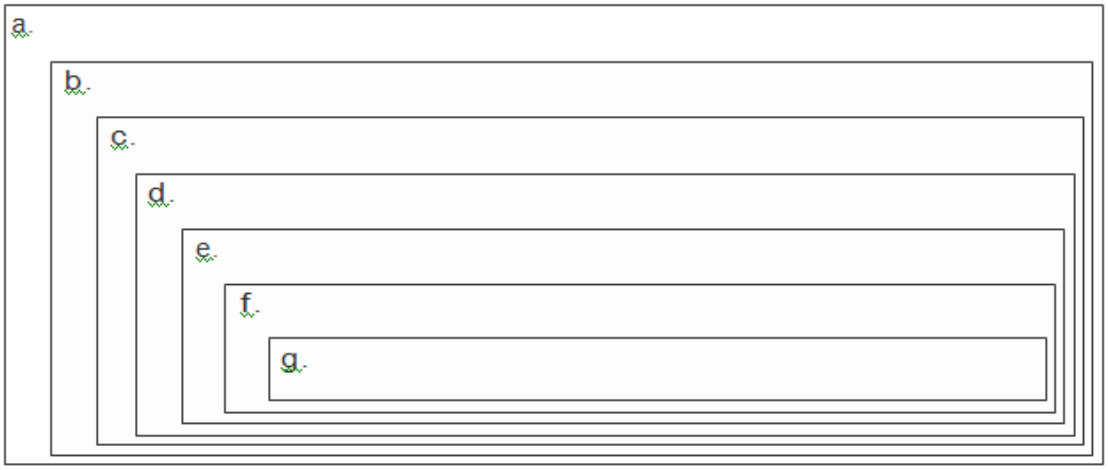
Domain and Kingdom Characteristics

Domain	Kingdom	Characteristics				
		Cell type	Cell structure	Body type	Nutrition	Example
Bacteria	Eubacteria	Prokaryotic	Cell wall, peptidoglycan	Unicellular	Autotrophic and heterotrophic	Enterobac-teria Spirochetes
Archaea	Archae-bacteria	Prokaryotic	Cell wall, no peptidoglycan	Unicellular	Autotrophic and heterotrophic	Methanogens
Eukarya	Protista	Eukaryotic	Mixed	Unicellular and multi-cellular	Autotrophic and heterotrophic	Amoebas Euglenas Kelps
Eukarya	Fungi	Eukaryotic	Cell wall, chitin	Unicellular and multi-cellular	Heterotrophic	Yeasts Mushrooms
Eukarya	Plantae	Eukaryotic	Cell wall, cellulose	Multicel-lular	Autotrophic	Ferns Pine trees
Eukarya	Animalia	Eukaryotic	No cell wall	Multicel-lular	Heterotrophic	Birds Earthworms

(Source: Holt McDougal Biology 2012 Test Prep)

SC.912.L.15.6 AA	Discuss distinguishing characteristics of the domains and kingdoms of living organisms.	Moderate

1. Describe in the 7 taxa of the Linnaean classification system in the boxes below.



2.

MAIN IDEA: **The three domains in the tree of life are Bacteria, Archaea, and Eukarya.**
Fill in the table below with notes about the three-domain system.

Domain	Characteristics	Kingdoms Included
Bacteria		
Archaea		
Eukarya		

3. Justify your answer with an SRE. A scientist collected a sample of microorganisms from an extremely hot, thermal deep-sea vent. With a microscope, the scientist observed that the microorganisms were single-celled prokaryotes. Under which domain would you classify these microorganisms?

a) Archea c) Eukarya
b) Bacteria d) Fungi

Statement	
Reason	
Evidence	

SC.912.L.15.8 AA	Describe the scientific explanations of the origin of life on Earth	Moderate

Scientist who study the origins of life think that the path to the development of living things began when molecules of nonliving matter reacted chemically during the first billion years of Earth's history. These chemical reactions produced many different simple, organic molecules. Energized by the sun and volcanic heat, these simple, organic molecules formed more-complex molecules that eventually became the building blocks of the first cells.

In the 1920s, the Russian scientist A. I. Oparin and the British scientist J.B.S. Haldane both suggested that the early Earth's oceans contained large amounts of organic molecules. This hypothesis became known as the primordial soup model. Earth's vast oceans were thought to be filled with many different organic molecules. Oparin and Haldane hypothesized that these molecules formed spontaneously in chemical reactions activated by energy from solar radiation, volcanic eruptions, and lightning.

In 1953, the primordial soup model was tested by Stanley Miller and Harold Urey. Miller placed the gases that he and Urey proposed had existed on early Earth into a device made up of glass tubes and vessels. To simulate lightning, he provided electrical sparks. After a few days, Miller found a complex collection of organic molecules, including some of life's basic building blocks: amino acids, fatty acids, and other hydrocarbons. These results support the hypothesis that some basic chemicals of life could have formed spontaneously under conditions like those in the experiment. Scientists have reevaluated the Miller-Urey experiment in light of the fact that we now know that four billion years ago, Earth did not have a protective layer of ozone gas, O3.Without ozone, ultraviolet radiation would have destroyed any ammonia and methane present in the atmosphere.

In 1986, the geophysicist Louis Lerman suggested that the key processes that formed the chemicals needed for life took place within bubbles beneath the ocean's surface. In this bubble model, he proposed that ammonia, methane, and other gases resulting from the numerous eruptions of undersea volcanoes were trapped in underwater bubbles. Inside the bubbles, these gases might have been protected from damaging ultraviolet radiation and could have undergone chemical reactions. Eventually, the bubbles rose to the surface and burst, releasing simple organic molecules into the air. In the air, the simple organic molecules were exposed to ultraviolet radiation and lightning, which provided energy for further reactions. The more-complex organic molecules that formed fell into the ocean with rain, starting another cycle.

SC.912.L.15.8 AA	Describe the scientific explanations of the origin of life on Earth	Moderate

1. Create a vocabulary burrito for the following terms: Nebula, ribozyme, cyanobacteria, endosymbiosis, Paleozoic, Cambrian explosion, Mesozoic, Cenozoic

2. Reciprocal Q & A on the Origins of Life: Using your notes or book make the following questions about the origins of life. You may use the readings on the back of the paper and the text in chapter 12.3-12.5. See student reference sheet for question stems.

Depth of Knowledge Level	**Number of questions you must create**
DOK 1	1
DOK 2	2
DOK 3	1

After writing on the paper, exchange with a classmate, and let allow them answer the questions. Check their answers. If wrong, explain to them why. Your papers should have two different handwritings and two different pen/pencil colors on it. Write the author's name and student's name on the paper.

3.

Scientist Name	***Summarize how their contribution aided in the explanation of the origin of life.***
Pasteur	
Oparin	
Miller and Urey	
Margulis	
Fox	

3. Two models of the origin of life on Earth are the primordial soup model and the bubble model. What do these two models of how life began on Earth have in common?

A. Both explain how UV radiation produces ammonia and methane.
B. Both involve only chemical reactions that take place within the ocean.
C. Both include chemical reactions that take place when there is lightning.
D. Both involve only chemical reactions that take place within the atmosphere.

4. The Miller-Urey experiment showed that, under certain conditions, organic compounds could form from inorganic molecules. What is one consequence of this experiment?

A. Scientists think that life could not have developed through natural chemical and physical processes.
B. The experiment proved that methane and ammonia will always give rise to organic molecules in any circumstance.
C. Scientists think it is possible that organic compounds formed from the inorganic compounds present on Earth billions of years ago.
D. The experiment used the exact inorganic compounds present on Earth billions of years ago and left little doubt about the mechanism of early life.

SC.912.L.15.10	Identify basic trends in hominid evolution from early ancestors six million years ago to modern humans, including brain size, jaw size, language, and manufacture of tools.	Moderate

A primate is a member of the mammalian order Primates. Hominids are primates that walk upright on two legs. Hominids are members of the group that led to the evolution of humans. According to the fossil record, hominids first appeared on Earth about 5 million to 7 million years ago. The early hominids best represented by fossil finds belong to the group known as australopithecines.

Australopithecines belong to the genus *Australopithecus*. Their brains were generally as large as those of modern chimpanzees. They were much smaller, however, than the brains of modern humans. Our genus, *Homo*, is composed of at least three species. The first members of the genus *Homo* appeared on Earth more than 2 million years ago. In the early 1960s, stone tools were discovered near hominid bones. Because of its association with tools, this hominid was named *Homo habilis*. The Latin word *homo* means "man," and the Latin word *habilis* means "handy." Fossils indicated that *Homo habilis* lived in Africa for about 500,000 years and then became extinct.

The species that replaced *Homo habilis* is called *Homo erectus*. *Homo erectus* was larger than *Homo habilis* and also had a large brain. This species evolved in Africa and migrated into Asia and Europe. *Homo erectus* survived for more than 1 million years. The species disappeared about 200,000 years ago, as early modern humans emerged. Most scientists think that *Homo erectus* was the direct ancestor of our species, *Homo sapiens*. Of the three modern humans, *Homo sapiens* is the only surviving species of the genus *Homo*. The name *Homo sapiens* is from the Latin *homo*, meaning "man," and *sapiens*, meaning "wise." Early *Homo sapiens* left behind many fossils and artifacts, including the first known paintings.

SC.912.L.15.10	Identify basic trends in hominid evolution from early ancestors six million years ago to modern humans, including brain size, jaw size, language, and manufacture of tools.	Moderate

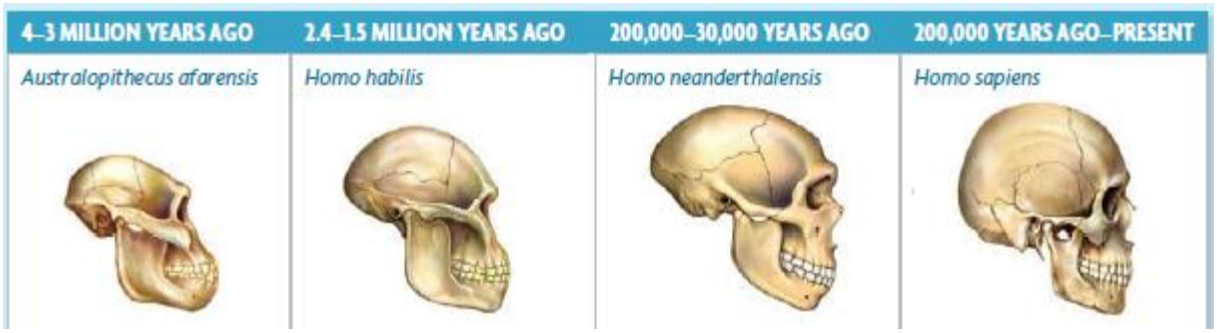
1. Create a <u>vocabulary squares</u> for each of the following terms: Primate, prosimian, hominid, bipedal anthropoid

2. Reciprocal Q & A on the Origins of Life: Using your notes or book make the following questions about the trends in hominid evolution. You may use the readings on the back of the paper and the text in chapter 12.6. See student reference sheet for question stems.

Depth of Knowledge Level	Number of questions you must create
DOK 1	1
DOK 2	2
DOK 3	1

After writing on the paper, exchange with a classmate, and let allow them answer the questions. Check their answers. If wrong, explain to them why. Your papers should have two different handwritings and two different pen/pencil colors on it. Write the author's name and student's name on the paper.

3.



What characteristics are the same among these species? What characteristics are different? What trends do you notice?

4. How do hominids differ from other primates?

F. They are bipedal. **H.** They have grasping hands.

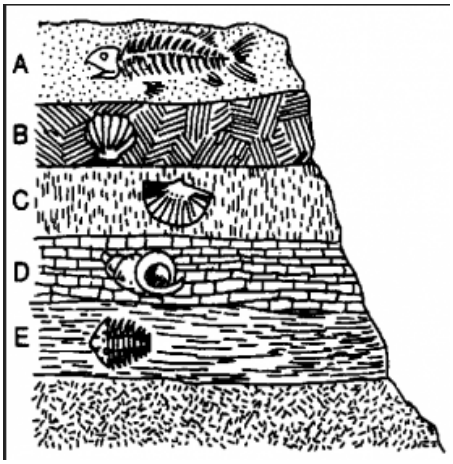
G. They have long arms **I.** They have binocular vision.

5. Bipedalism is a adaptation which mammals have obtained. What advantage did the development of bipedalism **most likely** confer to early hominids?

F. It allowed them to see with binocular vision. **H.** It allowed them to evolve a complex social structure.

G. It allowed them to evolve an opposable thumb. **I.** It allowed them to move and hold objects at the same time.

6. Fossil evidence has allowed us to discover many aspects about early hominoid life.



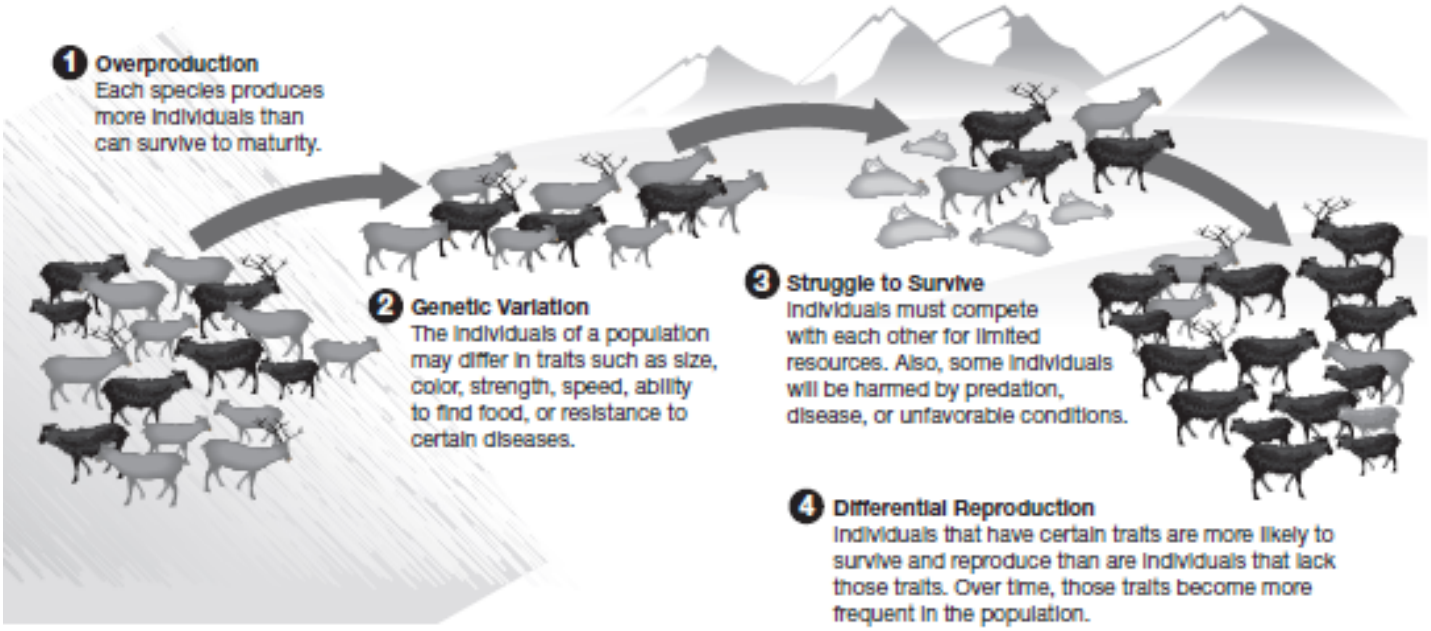
Using the diagram, above which fossil layer is the oldest?

A C

B D

SC.912.L.15.13 AA	Describe the conditions required for natural selection, including: overproduction of offspring, inherited variation, and the struggle to survive, which result in differential reproductive success.	Moderate

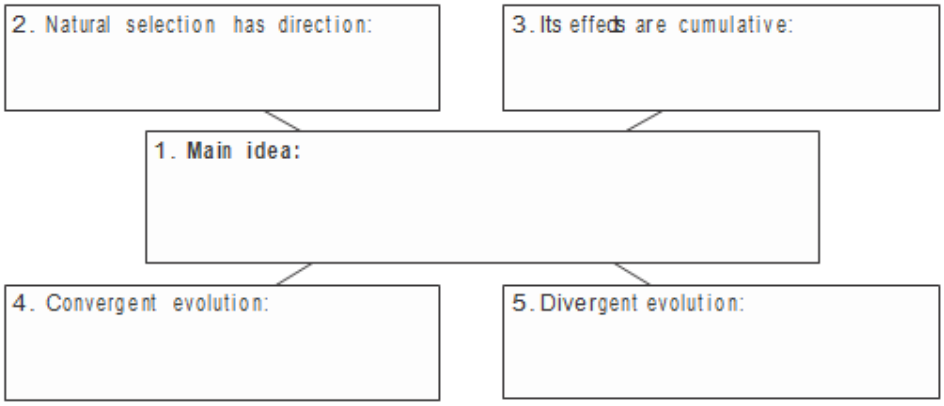
Evolution is a change in the characteristics of a population from one generation to the next. Darwin proposed that evolution happened due to natural selection. Natural selection is the process by which individuals that have favorable variations and are better adapted to their environment survive and reproduce more successfully than less well adapted individuals do. Over many generations, natural selection can result in the evolution of new species, which is called speciation. The diagram below shows how natural selection changes populations.



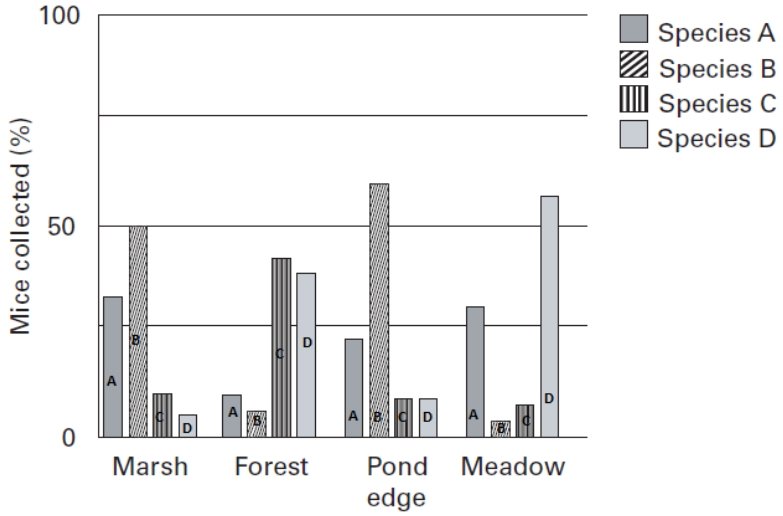
(Source: Holt McDougal Biology 2012 Test Prep)

SC.912.L.15.13 AA	Describe the conditions required for natural selection, including: overproduction of offspring, inherited variation, and the struggle to survive, which result in differential reproductive success.	Moderate

1. **Make a vocabulary burrito** for the following terms: fitness, adaption, variation, overproduction, , artificial selection, natural selection, heritability, directional selection, disruptive selection, stabilizing selection, punctuated equilibrium, adaptive radiation.
2. Complete the main idea web about Natural Selection. Start in the middle (#1) describing the concept of Natural Selection.



3. Punctuate means to "interrupt periodically." How does this meaning apply to the term punctuated equilibrium?
4. An isolated population of termites lives in a tree located in a pine forest. These termites feed on dead wood from the tree. This food is broken down by a species of bacteria that lives inside the intestines of the termites. Without the bacteria, the termites cannot obtain the nutrients they need to survive. One spring, a virus causes most of these bacteria to die. According to the theory of natural selection, what will most likely happen to the termites as a result of the absence of bacteria?
   a. The termites will find a different food source.
   b. The termites will develop a new species of bacteria.
   c. The termite population will decrease to a level near extinction.
   d. The termite population will evolve immediately into a new species.
5. The graph below shows different mouse species collected in different habitats. The percent of mice collected is representative of the reproductive success of each species.



Using the information in the graph, which mouse species is best adapted to wet environments?

A) Species A C) Species C
B) Species B D) Species D

SC.912.L.15.14	Discuss mechanisms of evolutionary change other than natural selection such as genetic drift and gene flow.	Moderate

Genetic changes in a population can be caused by mutation and natural selection. Three forces that cause evolutionary change are gene flow, nonrandom mating, and genetic drift.

The movement of individuals from one population to another can cause genetic change. The movement of individuals to or from a population, called migration, creates gene flow, the movement of alleles into or out of a population. Gene flow occurs because new individuals (immigrants) add alleles to the population and departing individuals (emigrants) take alleles away.

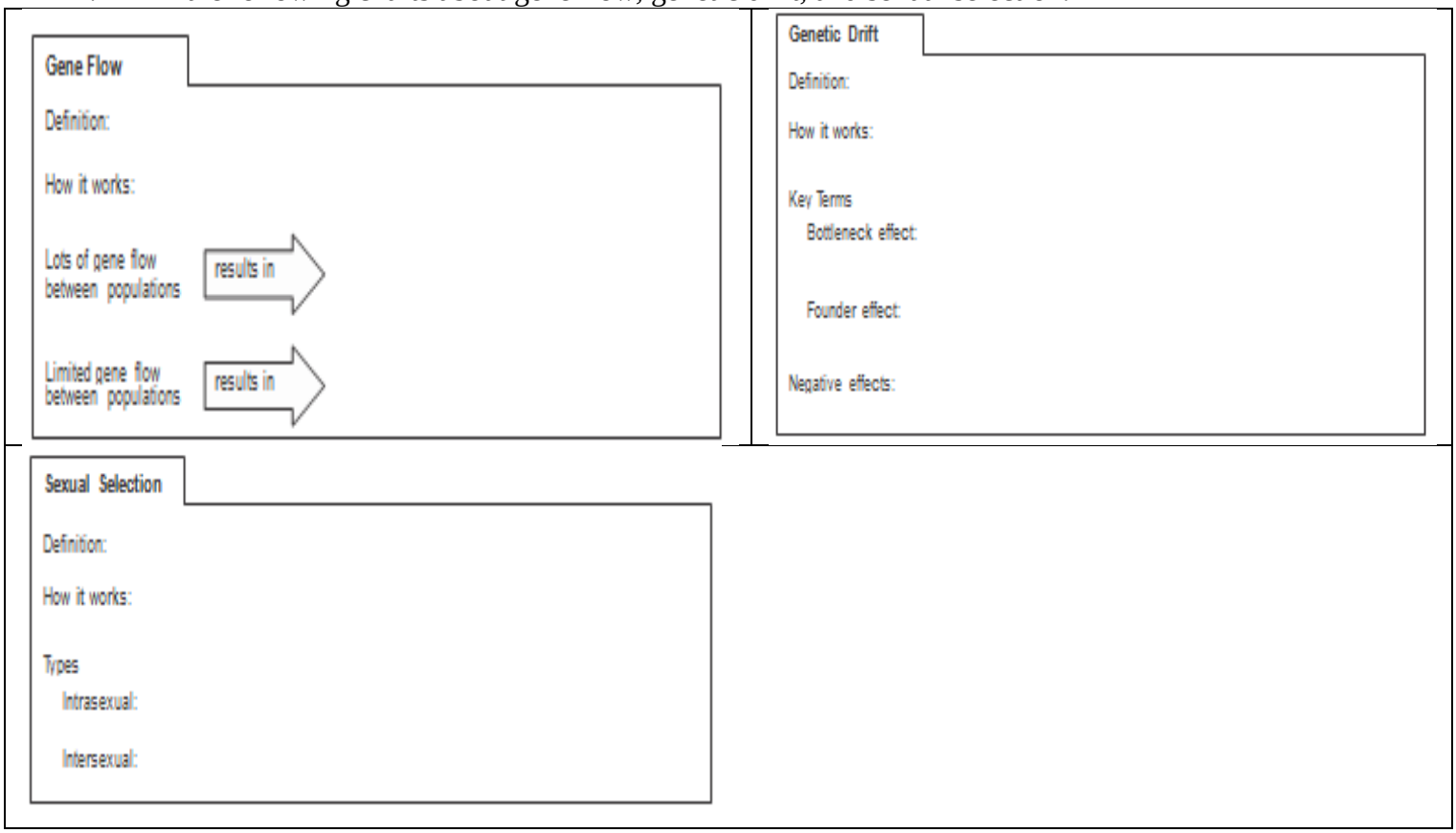
Sometimes individuals prefer to mate with others that live nearby or are of their own phenotype, a situation called nonrandom mating. Mating with relatives (inbreeding) is a type of nonrandom mating that causes a lower frequency of heterozygotes than would be expected in general. Inbreeding does not change the frequencies of alleles, but it does increase the proportion of homozygotes in a population. For example, populations of self-fertilizing plants consist mostly of homozygous individuals. Nonrandom mating also results when organisms choose their mates based on certain traits. In animals, females often select males based on their size, color, ability to gather food, or other characteristics.

In small populations, the frequency of an allele can be greatly changed by a chance event. For example, a fire or landslide can reduce a large population to a few survivors. When an allele is found in only a few individuals, the loss of even one individual from the population can have major effects on the allele's frequency. Because this sort of change in allele frequency appears to occur randomly, as if the frequency was drifting, it is called genetic drift. Small populations that are isolated from one another can differ greatly as a result of genetic drift. The cheetah, for example, is a species whose evolution has been seriously affected by genetic drift, and each cheetah is almost genetically uniform with other members of the population.

SC.912.L.15.14	Discuss mechanisms of evolutionary change other than natural selection such as genetic drift and gene flow.	Moderate

1. Read the supplemental reading on this standard and sections 11.1 and 11.3 in the Biology book.
2. **Create a vocabulary burrito for the following terms:** Gene flow, genetic drift, bottleneck effect, founder effect, sexual selection, reproductive isolation, speciation, behavioral isolation, geographic isolation, coevolution, extinction.

2. Fill in the following charts about gene flow, genetic drift, and sexual selection.



3. Starting in 1954, commercial fishers in the northwest Pacific were paid by weight, rather than by the individual fish, for pink salmon. The fishers increased the use of a type of net that selectively catches larger fish. Over the next 20 years, the fishers found that the average body size of the salmon population decreased significantly. This is an example of which principle?

a) Artificial Selection c) Genetic Drift
b) Embryology d) Natural Selection

4. The African Cheetah is an endangered species because of overhunting. The drastic reduction in the cheetah population caused a bottleneck effect, which is a form of genetic drift. What happens to the alleles in a population when genetic drift occurs?

A) Alleles will have less variation in small populations.
B) Alleles will have more variation in small populations.
C) Alleles will have more variation in large populations.
D) Alleles maintain the same frequency whatever the population size.

SC.912.L.15.15	Describe how mutation and genetic recombination increase genetic variation.	Moderate

Scientists now know that genes are responsible for inherited traits. Therefore, certain forms of a trait become more common in a population because more individuals in the population carry the alleles for those forms. In other words, natural selection causes the frequency of certain alleles in a population to increase or decrease over time. Mutations and the recombination of alleles that occurs during sexual reproduction provide endless sources of new variations for natural selection to act upon.

Although mutation from one allele to another can eventually change allele frequencies, mutation rates in nature are very slow. Most genes mutate only about 1 to 10 times per 100,000 cell divisions, so mutation does not significantly change allele frequencies, except over very long periods of time. Furthermore, not all mutations result in phenotypic changes. Recall that more than one codon—3-base DNA coding sequence—can code for the same amino acid. Therefore, some mutations may result in no change in the amino acid coded for in a protein, and other changes in an amino acid that do occur may not affect how the protein works. Mutation is, however, an important source of variation and thus makes evolution possible.

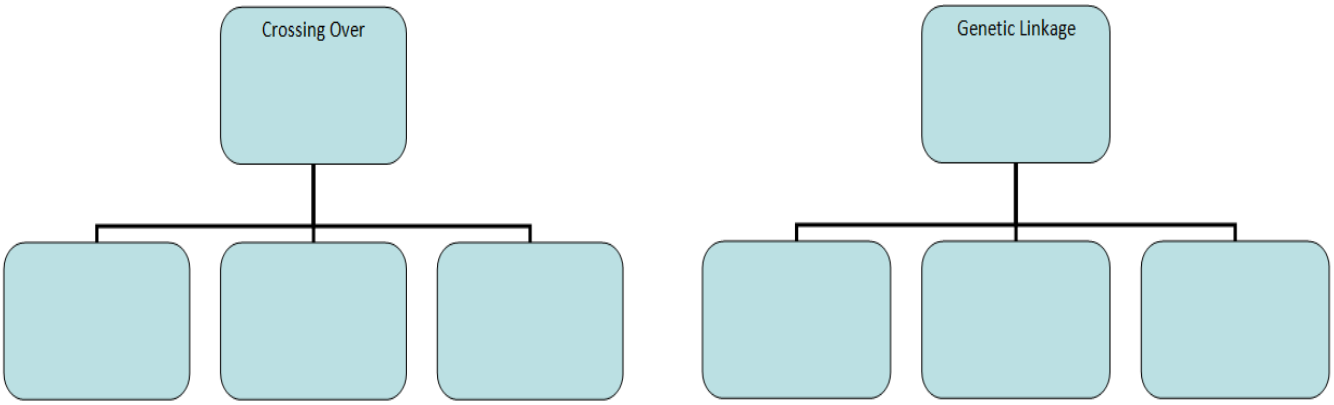
Meiosis and the joining of gametes—processes that recombine alleles—are essential to evolution. No genetic process generates variation more quickly. In many cases, the pace of evolution appears to increase as the level of genetic variation increases. For example, when domesticated animals such as cattle and sheep are bred for large size, many large animals
are produced at first. But as the existing genetic combinations become used up, the ability to obtain larger and larger animals slows down. Further progress must then wait for the formation of new gene combinations.

The pace of evolution is sped up by genetic recombination. The combination of genes from two organisms results in a third type, not identical to either parent. But bear in mind that natural selection does not always favor genetic change. Indeed, many modern organisms are little changed from their ancestors of the distant past. Natural selection may favor existing combinations of genes, slowing the pace of evolution.

SC.912.L.15.15	Describe how mutation and genetic recombination increase genetic variation.	Moderate

1. **Create a <u>vocabulary square</u>** for each of the following terms**:** mutations, alleles, genetic variation.

2. **Create 2 main idea webs. Be** sure to define the terms in your own words at the top**.**



2. How does mutations and crossing over aid the process of speciation?
3. Speciation is the rise of two or more species from one existing species. What process keeps the number of total species on Earth from growing exponentially through speciation?
4. One way that populations can change is when new alleles appear. What is the major source of new alleles in natural populations?

A. mutations in sex cells
B. mutations in somatic cells
C. trait selection by natural selection
D. adaptations in individual organisms

5. At first, a mutation may make no difference to an individual. Even if the mutation results in a nonfunctional protein, the body's cell may have a functional copy of the gene as its second allele. However, this new nonfunctioning version could be passed on as a recessive allele. This kind of mutation is the probable origin of many recessive disorders. Only characteristics that are expressed can be targets of natural selection. Therefore, natural selection cannot operate against recessive alleles, even if they are unfavorable. What does this explain?

F. why recessive alleles are never expressed
G. why genetic disorders can persist in a population
H. why advantageous offspring are more likely to survive and reproduce
I. why natural selection can act only against heterozygous carriers of a recessive disorder

5. Justify your answers with an SRE. Imagine that a mouse has white fur because of a mutation in its DNA. Which of the following conclusions can be drawn?
A. The white mouse increases the diversity of the species.
B. The white mouse decreases the diversity of the species.
C. The internal organs of the white mouse must not function as well as those of other mice.
D. The white mouse is more likely to survive than other mice because it is more visible to predators.

Statement	
Reason	
Evidence	

SC.912.L.16.1 AA	Use Mendel's laws of segregation and independent assortment to analyze patterns of inheritance.	High

Before the experiments of Gregor Johann Mendel in the mid-1800s, many people thought offspring were a blend of the traits of their parents. For example, if a tall plant were crossed with a short plant, the offspring would be medium in height. Mendel's results did not support the blending hypothesis. Instead, he developed these four hypotheses based directly on the results of his experiments:

1. *For each inherited character, an individual has two copies of the gene—one from each parent.*

2. *There are alternative versions of genes.* For example, the gene for flower color in peas can exist in a "purple" version or a "white" version. An individual receives one version, or allele, from each parent. Each allele can be passed on when the individual reproduces.

3. *When two different alleles occur together, one of them may be completely expressed, while the other may have no observable effect on the organism's appearance.* Mendel described the expressed form of the character as dominant. The trait that was not expressed when the dominant form was present was described as recessive. For example, if a plant has both purple and white alleles for flower color but blooms purple flowers, then purple is the dominant form; white is the recessive form.

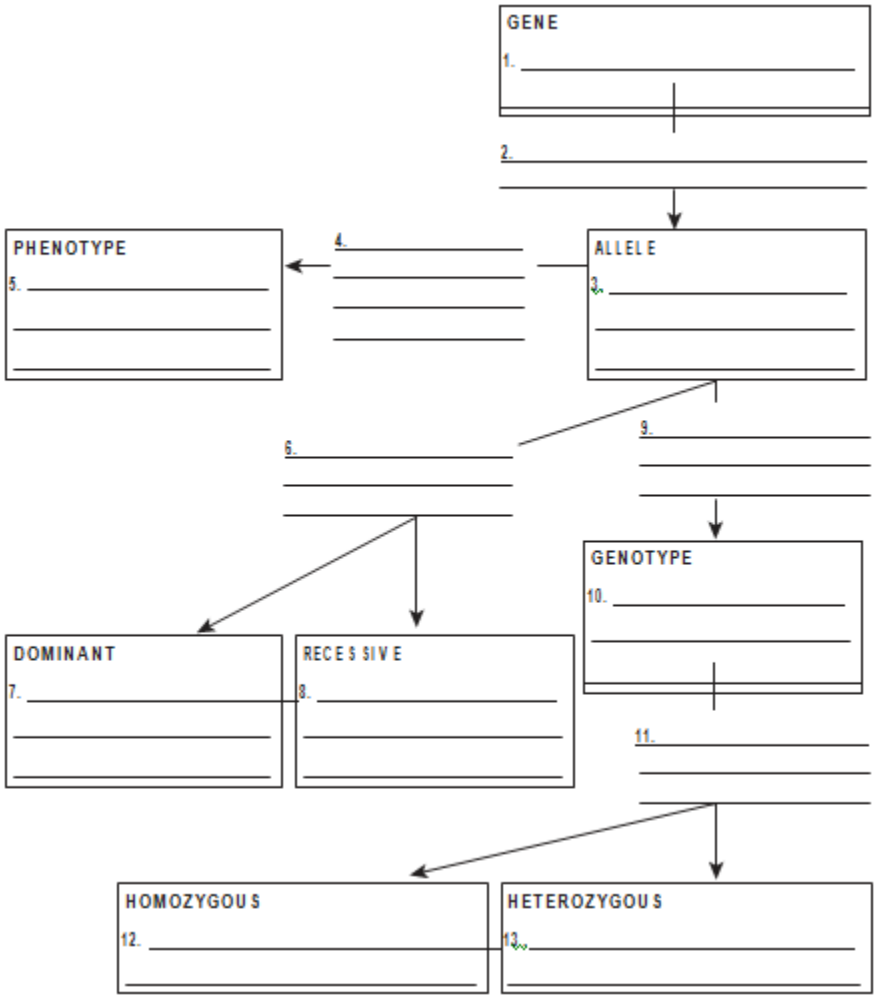
4. *When gametes are formed, the alleles for each gene in an individual separate independently of one another. Thus, gametes carry only one allele for each inherited character. When gametes unite during fertilization, each gamete contributes one allele.*
Each parent can contribute only one of the alleles because of the way gametes are produced during the process of meiosis. Mendel's hypotheses brilliantly predicted the results of his crosses. Similar patterns of heredity have since been observed in countless other organisms. Because of their importance, Mendel's ideas are often referred to as the laws of heredity:

The Law of Segregation: The two alleles for a single gene segregate (separate) when gametes are formed.

The Law of Independent Assortment: The alleles of different genes separate independently of one another during gamete formation.

SC.912.L.16.1 AA	Use Mendel's laws of segregation and independent assortment to analyze patterns of inheritance.	High

1. Define the terms in your own words in the blanks. After defining all the terms, write how the terms relate to each other in the blank spaces.



2. For a certain plant, purple flowers (allele: *P*) are dominant, and white flowers (allele: *p*). A purple plant carrying both types of alleles is crossed with a truebreeding white plant. What are the possible genotypes (allele pairs) of the offspring?

F. *pp* only **G.** *Pp* only
H. *Pp* and *pp* only **I.** *PP*, *pp*, and *Pp*

3.If a corn plant has a genotype of Ttyy, what are the possible genetic combinations that could be present in a single grain of pollen from this plant?

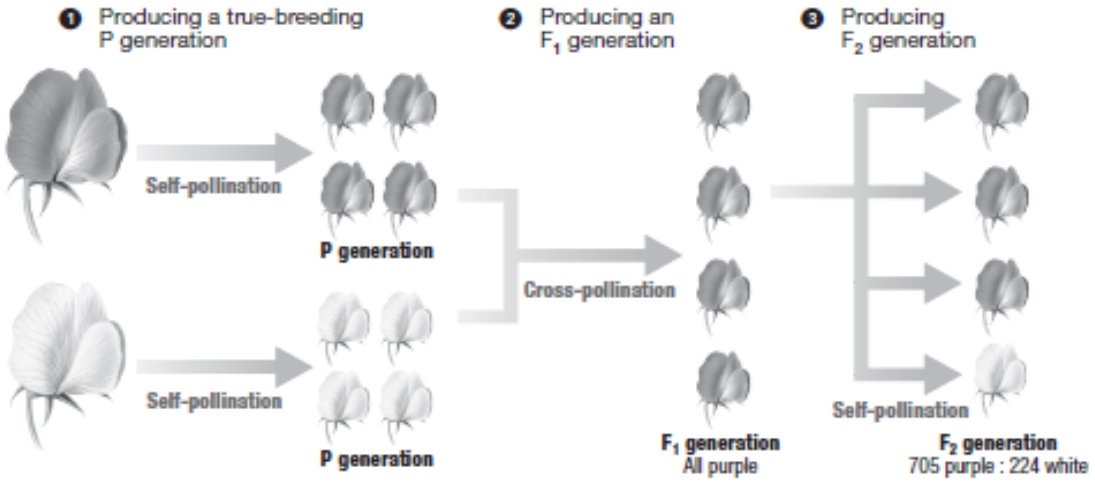
a. Ty, ty c. TY, Ty, ty
b. TY, ty d. Ty, ty, tY, TY

4.In a certain insect, round wings (R) are dominant to pointed wings (r).Which cross will produce the greatest number of genotypic and phenotypic variations?

A. rr × rr **C.** Rr × RR
B. Rr × Rr **D.** RR × RR

SC.912.L.16.2	Discuss observed inheritance patterns caused by various modes of inheritance, including dominant, recessive, codominant, sex-linked, polygenic, and multiple alleles.	Moderate

Modern genetics is based on Gregor Johann Mendel's explanations for the patterns of heredity that he studied in garden pea plants. Mendel's fi rst experiments used monohybrid crosses and were carried out in three steps, which are shown below.



(Source: Holt McDougal Biology 2012 Test Prep)

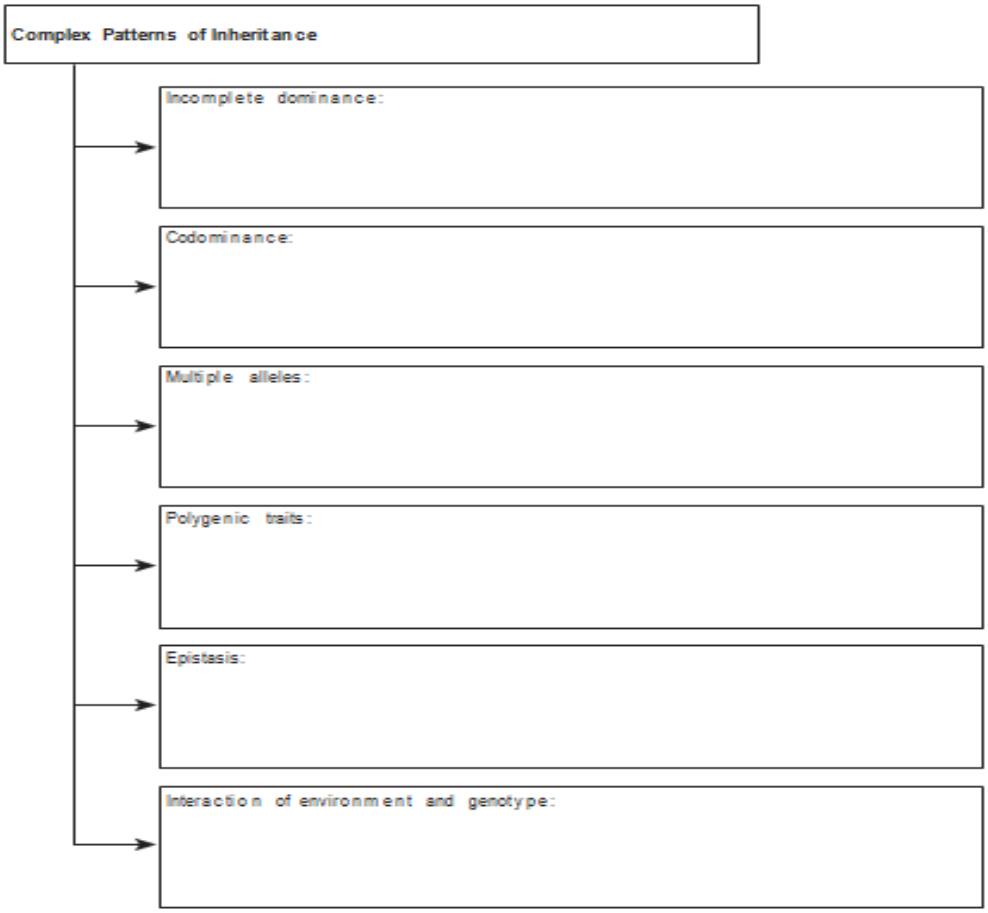
For each of the seven characteristics that Mendel studied in this experiment, he found a similar 3-to-1 ratio of contrasting traits in the F2 generation. Mendel's experiments showed that offspring do not show a trait for every allele they receive. Instead, combinations of alleles determine traits. The set of alleles that an individual has for a characteristic is called the genotype. The trait that results from a set of alleles is the phenotype. In other words, genotype determines phenotype.

Phenotype can also be affected by conditions in the environment, such as nutrients and temperature. If an individual has two of the same alleles of a certain gene, the individual is homozygous for the related character. On the other hand, if an individual has two different alleles of a certain gene, the individual is heterozygous for the related character. In the heterozygous case, the dominant allele is expressed.

Although Mendel was correct about the inheritance of the traits he studied, most patterns of inheritance are more complex than those that Mendel identified. First, not all genes have only two alleles. There can be multiple alleles. Second, not all characteristics are controlled by one gene. Other patterns of inheritance include sex-linked genes (when alleles are located only on the X or Y chromosome), polygenic inheritance (when several genes affect one characteristic), incomplete dominance (when an offspring has a phenotype between that of its parents), and codominance (when both alleles of a gene are fully expressed).

SC.912.L.16.2	Discuss observed inheritance patterns caused by various modes of inheritance, including dominant, recessive, codominant, sex-linked, polygenic, and multiple alleles.	Moderate

1. Fill in the following chart about complex patterns of inheritance. Define the term in your own words and give an example in each box.



2. A gardener crossed a plant with red flowers with a plant that had white flowers. The offspring plants had pink flowers. What is the most likely genetic reason for these differences in color?

3. A population of crabs living on a sandy beach exhibits codomiance three colors: dark brown, light brown, and speckled. The genotypes for these colors are *BB* for dark brown, *bb* for light brown, and *Bb* for speckled. If a dark brown crab were crossed with a light brown crab, what would be the probable phenotypic ratio of their offspring?

A. all speckled
B. all dark brown
C. 3 dark brown : 1 light brown
D. 1 dark brown : 2 speckled : 1 light brown

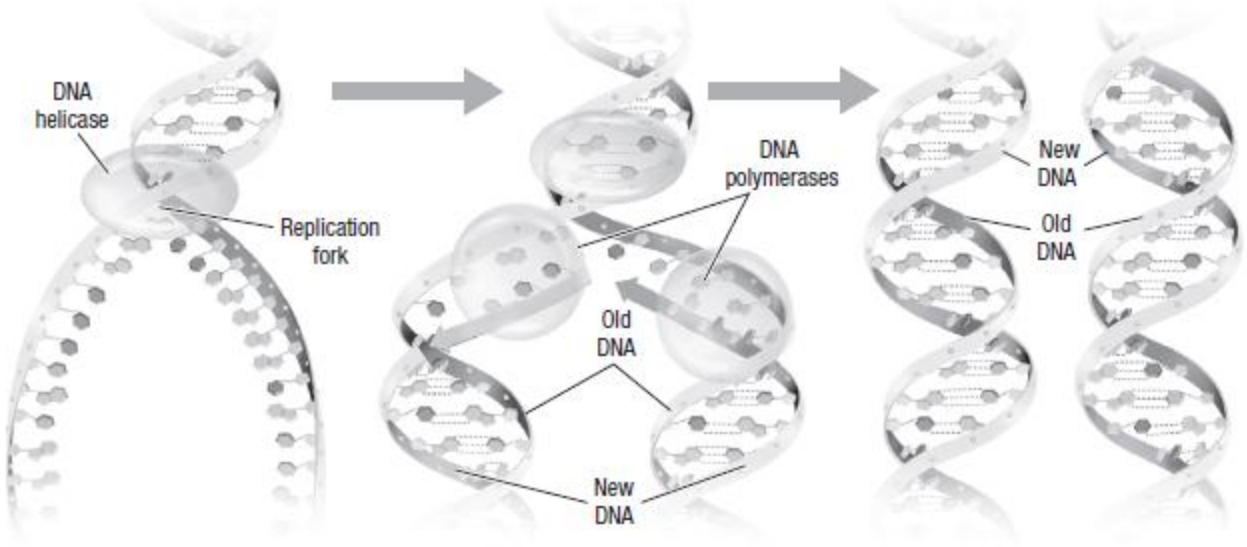
4. In fruit flies the trait of red eyes (R) is dominant to white eyes (r). The trait is carried on the X chromosome.

	X^R	Y
X^R	X^RX^R	X^RY
X^r	X^RX^r	X^rY

Based on the Punnett square above, which statement best describes the eye color of the fruit fly offspring?
a) There is a 50% probability that female offspring will have red eyes.
b) There is a 75% probability that female offspring will have red eyes.
c) There is a 50% probability that male offspring will have red eyes.
d) There is a 75% probability that male offspring will have red eyes.

SC.912.L.16.3 AA	Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic information.	High

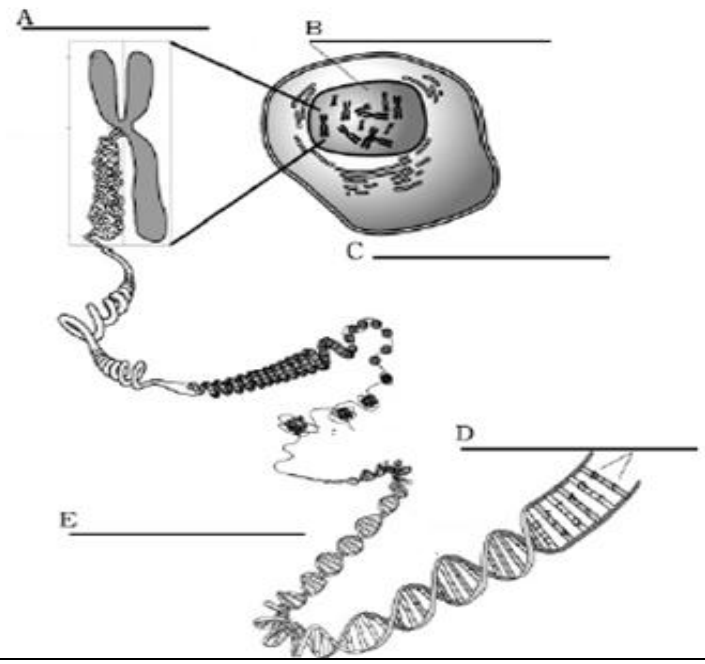
The process of making a copy of DNA is called DNA replication. DNA replication is summarized in the figure below. First, the two original strands separate. Then, DNA polymerases add complementary nucleotides to each strand. Because of the strictness of base-pairing rules, the result is always the formation of two DNA molecules that are identical to the original DNA molecule.

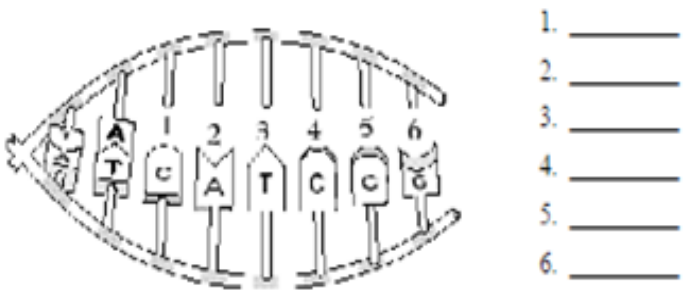


(Source: Holt McDougal Biology 2012 Test Prep)

SC.912.L.16.3 AA	Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic information.	High

1. Label the following structures.





2. Complete the Concept Ladder.

Concept:
DNA

Where is it located?

Made of: **Mention base pairs**

Used for:

Looks like:

Replicates by: **Describe and draw**

3. The mold *Aspergillus flavus* grows on grain. *A. flavus* produces a toxin that binds to DNA in the bodies of animals that eat the grain. The binding of the toxin to DNA blocks replication, so it ***directly*** interferes with the ability of an animal cell to do which of the following?

a) The conversion of genetic code into a protein.
b) The production of genetic material used by ribosomes to create proteins.
c) The production of genetic material that is identical to a template molecule.
d) The transfer of protein-building instructions from the nucleus to the cytoplasm.

SC.912.L.16.4	Explain how mutations in the DNA sequence may or may not result in phenotypic change. Explain how mutations in gametes may result in phenotypic changes in offspring.	High

Although changes in an organism's hereditary information are relatively rare, they can occur. A change in the DNA of a gene is called a mutation. Mutations in gametes can be passed on to offspring of the affected individual, but mutations in body cells affect only the individual in which they occur. Mutations that move an entire gene to a new location are called gene rearrangements.

Changes in a gene's position often disrupt the gene's function because the gene is exposed to new regulatory controls in its new location. Mutations that change a gene are called gene alterations. Gene alterations usually result in the placement of the wrong amino acid during protein assembly. This error will usually disrupt a protein's function.

In a point mutation, a single nucleotide changes. In an insertion mutation, a sizable length of DNA is inserted into a gene. In a deletion mutation, segments of a gene are lost, often during meiosis. In a duplication mutation, a chromosome fragment attaches to its homologous chromosome, which will then carry two copies of a certain set of genes.

Another type of mutation is an inversion mutation, in which the chromosome piece reattaches to the original chromosome but in a reverse orientation. If the piece reattaches to a non-homologous chromosome, a translocation mutation results. Because the genetic message is read as a series of triplet nucleotides, insertions and deletions of one or two nucleotides can upset the triplet groupings. Imagine deleting the letter C from the sentence "THE CAT ATE." Keeping the triplet groupings, the message would read "THE ATA TE," which is meaningless. A mutation that causes a gene to be read in the wrong three-nucleotide sequence is called a frameshift mutation.

SC.912.L.16.4	Explain how mutations in the DNA sequence may or may not result in phenotypic change. Explain how mutations in gametes may result in phenotypic changes in offspring.	High

1. A mutation is the change in an organism's DNA. Complete the following table about different types of mutations.

	Describe in your own words what the mutation is	**Draw a representation**	**Do you think this would have a great affect on a person's phenotype? Why or why not?**
Frameshift Mutation (Insertion)			
Frameshift Mutation (Deletion)			
Point Mutation			

2. Another type of mutation is called a "silent mutation." Propose a hypothesis why it might be called a "silent" mutation.

3.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
T	A	C	A	G	C	C	A	C	T	G	A	G	C	T	C	C	C	G	A	G	C	T	C	C	G	A	A	C	T

Below, rewrite the original **DNA** sequence (from above), but simulating a **point mutation** at the 13th base. It was accidentally changed during DNA replication from a **G** to an **A**.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

Divide the **mRNA** sequence into its triplet **codons** and rewrite them in order below as 3-base groups (triplet codon) in the first row below. Then translate your mRNA triplet codons from this row into the sequence of amino acids composing the protein in the bottom row. You can use the 3 letter amino acid abbreviation found in the universal genetic code chart.

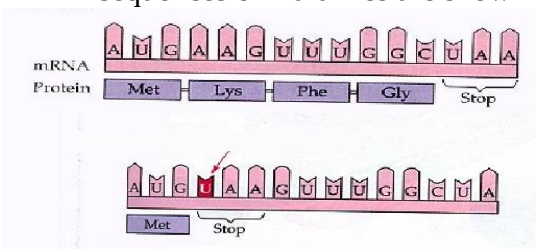
4. A mutation in the DNA that produced the strand of messenger RNA shown in the chart below produced a new strand of mutant messenger RNA.

CODON AND ANTICODON PAIRING				
Transfer RNA	UGA	CUG	CAG	CUU
Messenger RNA	ACU	GAC	GUC	GAA

If the mutation was a point mutation, which strand of the following sequence would **best** represent the resulting mutant messenger RNA?

A. ACG GAC GUC GAA
B. ACU GAC GUC AA
C. ACU GAC GUC CAA
D. ACU GCA CGU CGAA

4. Wild type and mutant mRNA sequences of fruit flies are shown in the illustration below.



What type of mutation is shown in the illustration above?

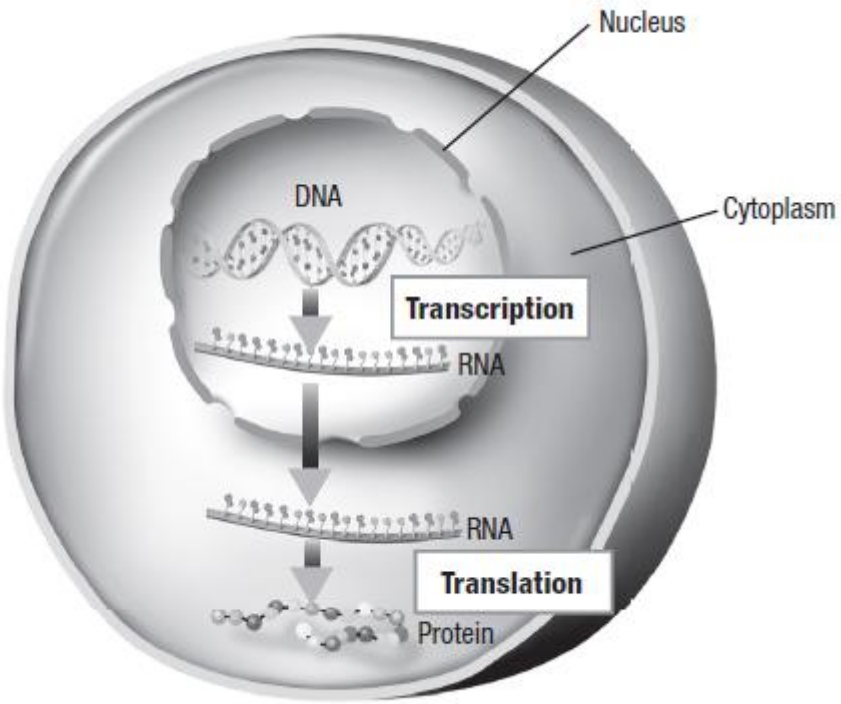
a) Point mutation
b) Silent mutation
c) Frameshift mutation insertion
d) Frameshift mutation deletion

SC.912.L.16.5	Explain the basic process of transcription and translation, and how they result in the expression of genes.	High

Traits, such as eye color, are determined by proteins that are built according to instructions coded in DNA. Recall that proteins have many functions, including acting as enzymes and cell membrane channels. Proteins, however, are not built directly from DNA. Ribonucleic acid (RNA) is also involved.

Like DNA, ribonucleic acid is a nucleic acid—a molecule made of nucleotides linked together. RNA differs from DNA in three ways. First, RNA consists of a single strand of nucleotides instead of the two strands found in DNA. Second, RNA nucleotides contain the fi ve-carbon sugar ribose rather than the sugar deoxyribose, which is found in DNA nucleotides. Ribose contains one more oxygen atom than deoxyribose contains. And third, in addition to the A, G, and C nitrogen bases found in DNA, RNA nucleotides can have a nitrogen base called uracil—abbreviated as U. No thymine (T) bases are found in RNA.

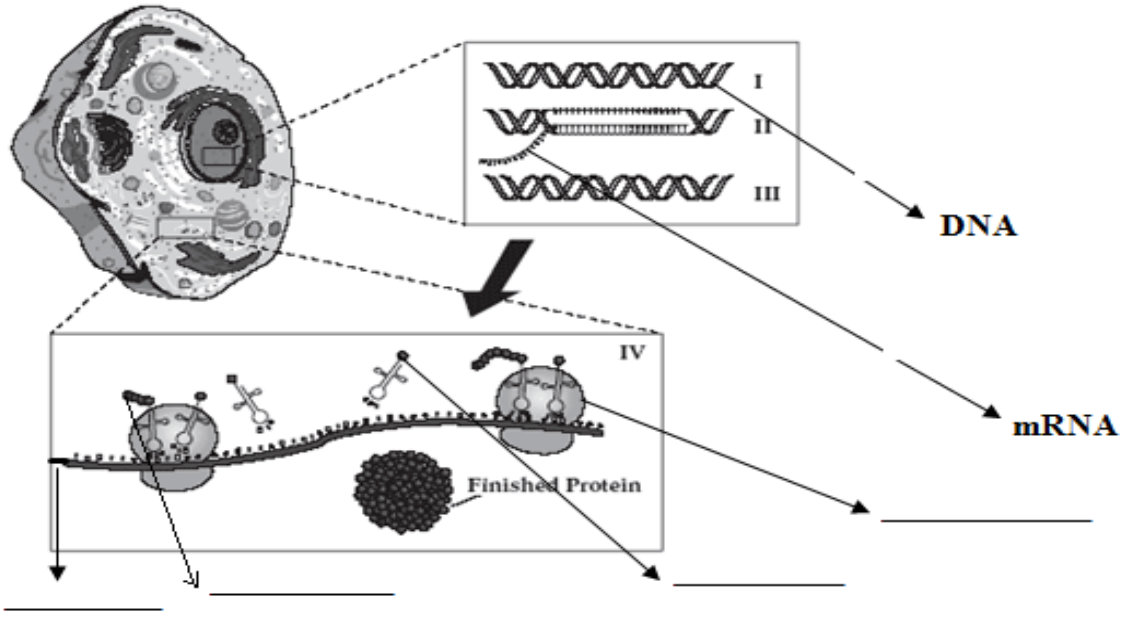
Like thymine, uracil is complementary to adenine whenever RNA base-pairs with another nucleic acid. A gene's instructions for making a protein are coded in the sequence of nucleotides in the gene. The instructions for making a protein are transferred from a gene to an RNA molecule (called messenger RNA) in a process called transcription. Cells then use two different types of RNA (transfer RNA and ribosomal RNA) to read the instructions on the messenger RNA molecule and put together the amino acids that make up the protein in a process called translation. The entire process by which proteins are made based on the information encoded in DNA is called gene expression, or protein synthesis. This process is summarized in the figure below.



(Source: Holt McDougal Biology 2012 Test Prep)

SC.912.L.16.5	Explain the basic process of transcription and translation, and how they result in the expression of genes.	High

1. Label the blanks in the following diagram.



2. What is the purpose of transcription?

3. What is the purpose of translation?

4. Explain the following quote, "DNA gets all the glory, but proteins do all the work!"

5. Using the diagram above describe the process of transcription and translation.

6. Use the chart on below (or pg. 244 Bio Book) to simulate transcription and translation, and build a protein.

DNA	TAA	_____	_____	_____	_____
mRNA	_____	GCU	_____	_____	UGA
tRNA	_____	_____	CUC	_____	_____
Protein	_____	_____	_____	Trp	_____

7. The table below gives the codons found in messenger RNA (mRNA).

Second Base

First Base	U	C	A	G	*Third Base*
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

A scientist extracted a protein fragment from a cell. The fragment had the amino acid sequence: Trp-Met. Which of the following is a possible DNA sequence that is associated with this protein fragment?

a)UGGAUG b) ACCTAC c) GGUUGG d) CCTTAC

Just as traffic lights control the flow of traffic, cells have a system that controls the phases of the cell cycle. Cells have a set of "red light–green light" switches that are regulated by feedback information from the cell. The cell cycle has key checkpoints (inspection points) at which feedback signals from the cell can trigger the next phase of the cell cycle (green light).

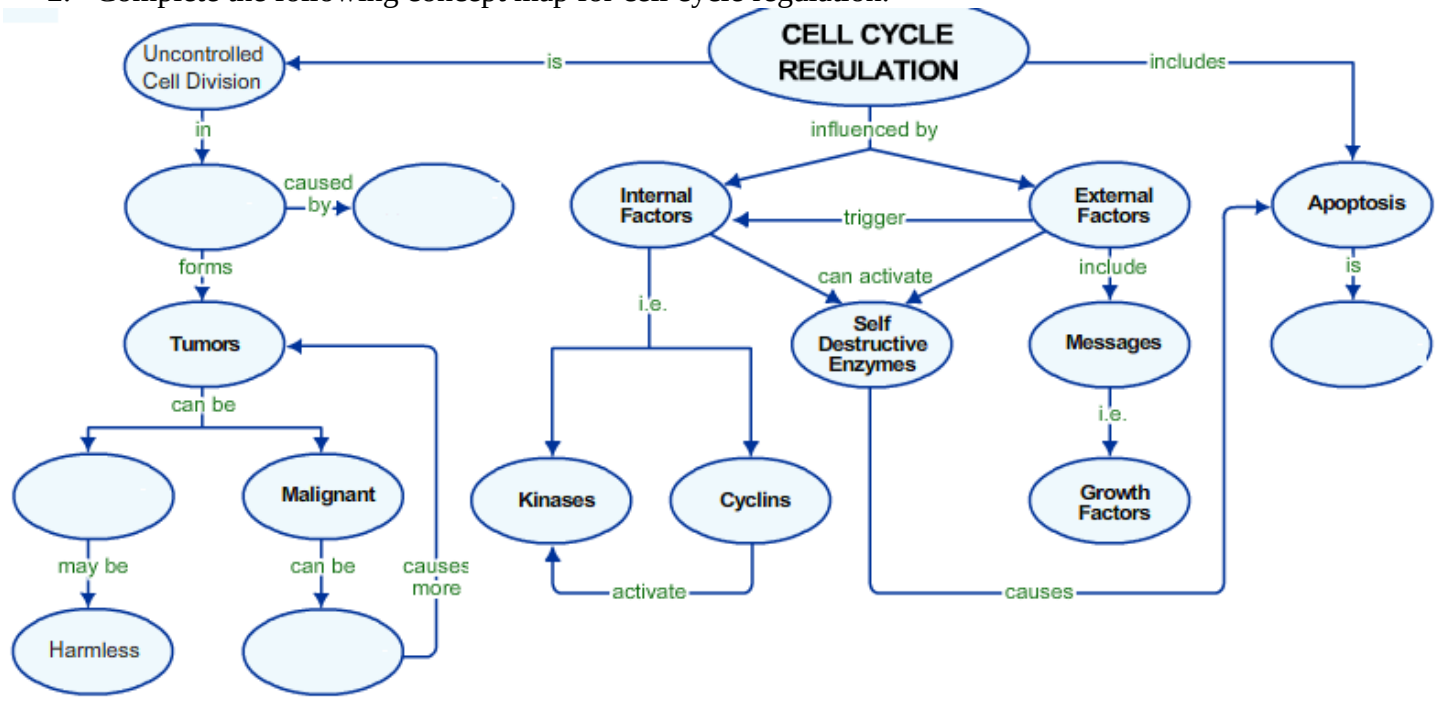
Other feedback signals can delay the next phase to allow for completion of the current phase (yellow or red light). The cell cycle in eukaryotes is controlled by many proteins. Certain genes contain the information necessary to make the proteins that regulate cell growth and division. If one of these genes is mutated, the protein may not function, and regulation of cell growth and division can be disrupted.

Cancer, the uncontrolled growth of cells, may result. Cancer is essentially a disorder of cell division. Cancer cells do not respond normally to the body's control mechanisms. Some mutations cause cancer by overproducing growth-promoting molecules, thus speeding up the cell cycle. Others cause cancer by inactivating the control proteins that normally act to slow or stop the cell cycle.

SC.912.L.16.8	Explain the relationship between mutation, cell cycle, and uncontrolled cell growth potentially resulting in cancer.	Mod

1. Create a vocabulary square for each of the following terms: cancer, mutation, growth factor, malignant, benign, and metastasize.

2. Complete the following concept map for cell cycle regulation.



3. Cancer is often characterized by tumors. Which would **most likely** trigger the formation of a tumor?

a. a parasite that both lived and reproduced within the human body
b. a mutation in a gene that codes for a protein regulating cell division
c. a change in the DNA sequence of a gene that codes for skin coloration
d. a bacterial infection that caused inflammation and swelling in body tissues

4. Respond in an SRE format. Some cancers are caused by mutations that stop certain proteins from working. The inactivation of what kind of protein could lead to cancer?

A. one that sped up the cell cycle
B. one that slowed down the cell cycle
C. one that acted as a growth-promoting molecule
D. one that responded to growth-promoting molecules

Statement	
Reason	
Explanation	

5. Cancerous lung cells do not respond to the signals that regulate normal growth. Which of the following processes does not function normally in cancerous lung cells?

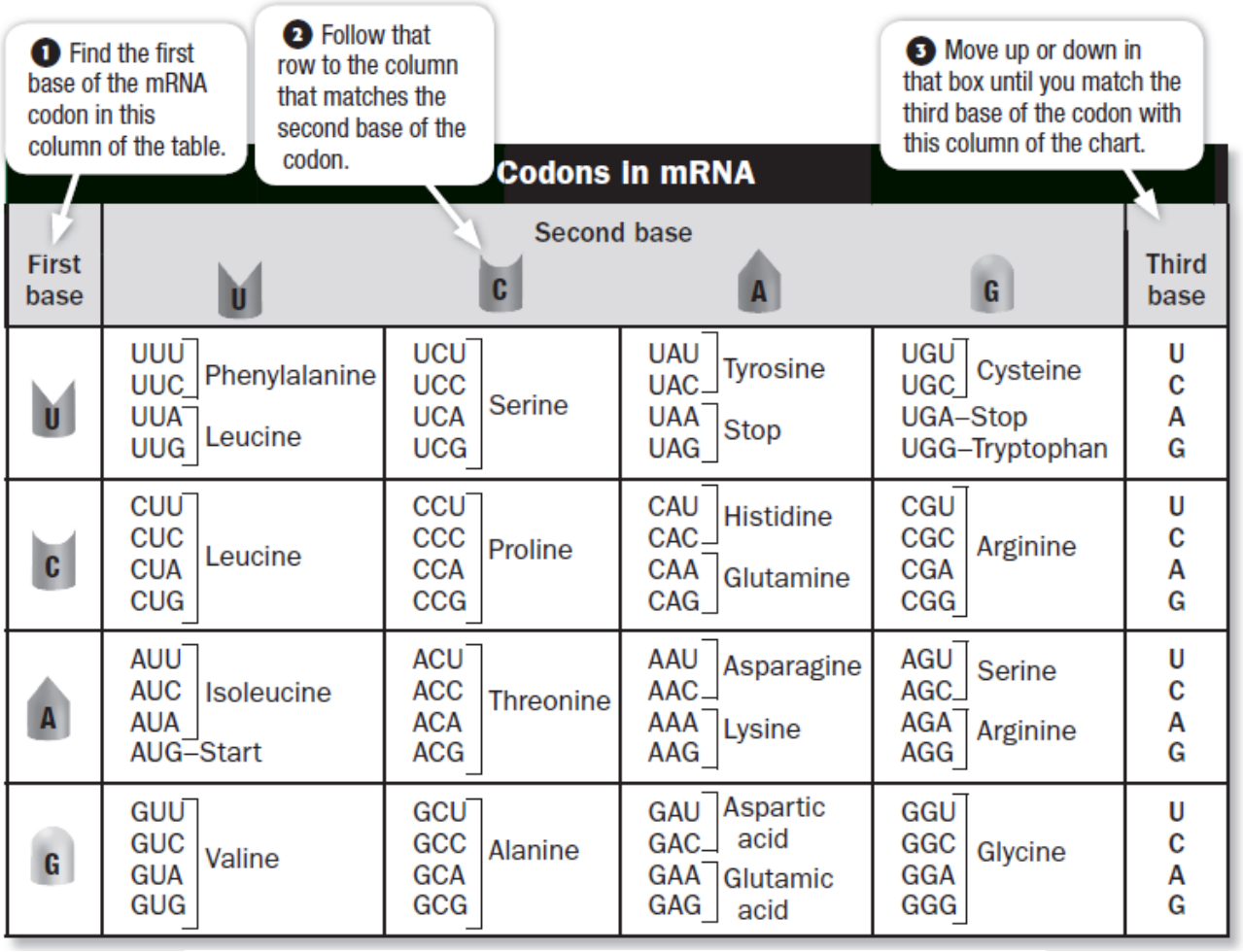
A. osmosis
B. cell cycle
C. meiosis
D. cellular respiration

SC.912.L.16.9	Explain how and why the genetic code is universal and is common to almost all organisms.	Moderate

Messenger RNA (mRNA) is the form of RNA that carries the instructions for making a protein from a gene and delivers it to the site of translation. The information is translated from the language of RNA—nucleotides—to the language of proteins—amino acids. The RNA instructions are written as a series of three-nucleotide sequences on the mRNA called codons. Each codon along the mRNA strand corresponds to an amino acid or signifies a start or stop signal for translation.

The chart below shows the genetic code—the amino acids and "start" and "stop" signals that are coded for by each of the possible 64 mRNA codons. With few exceptions, the genetic code is the same in all organisms. For example, the codon GUC codes for the amino acid valine in bacteria, in eagles, in plants, and in your own cells.

For this reason, the genetic code is often described as being nearly universal. It appears that all life-forms have a common evolutionary ancestor with a single genetic code. Some exceptions include the ways cell organelles that contain DNA (such as mitochondria and chloroplasts) and a few microscopic protists read "stop" codons.



Codons in mRNA

First base	Second base: U	Second base: C	Second base: A	Second base: G	Third base
U	UUU, UUC: Phenylalanine UUA, UUG: Leucine	UCU, UCC, UCA, UCG: Serine	UAU, UAC: Tyrosine UAA, UAG: Stop	UGU, UGC: Cysteine UGA–Stop UGG–Tryptophan	U C A G
C	CUU, CUC, CUA, CUG: Leucine	CCU, CCC, CCA, CCG: Proline	CAU, CAC: Histidine CAA, CAG: Glutamine	CGU, CGC, CGA, CGG: Arginine	U C A G
A	AUU, AUC, AUA: Isoleucine AUG–Start	ACU, ACC, ACA, ACG: Threonine	AAU, AAC: Asparagine AAA, AAG: Lysine	AGU, AGC: Serine AGA, AGG: Arginine	U C A G
G	GUU, GUC, GUA, GUG: Valine	GCU, GCC, GCA, GCG: Alanine	GAU, GAC: Aspartic acid GAA, GAG: Glutamic acid	GGU, GGC, GGA, GGG: Glycine	U C A G

Common Language

The genetic code is shared by almost all organisms—and even viruses. That means, for example, that the codon UUU codes for phenylalanine when that codon occurs in an armadillo, a cactus, a yeast, or a human. With a few minor exceptions, almost all organisms follow this genetic code. As a result, the code is often called universal. The common nature of the genetic code suggests that almost all organisms arose from a common ancestor. It also means that scientists can insert a gene from one organism into another organism to make a functional protein.

(Source: Holt McDougal Biology 2012 Test Prep)

SC.912.L.16.9	Explain how and why the genetic code is universal and is common to almost all organisms.	Moderate

1. To see how differences in the gene sequences are related to the differences in the amino acid sequences, let's look at the two DNA sequences together, matching them letter for letter as best we can. This is called an "alignment" (see below). **Mark with a small line each nucleotide** in the human GULO sequence which **differs** from the corresponding rat GULO nucleotide. **Count these**.

```
TACCCCGTAGAGGTGCGCTTCACCCGAGGCGATGACATTCTGCTGAGCCCC  (from Rat GULO gene)
TACCTGGTGGGGGTACGCTTCACCTGGAG-GATGACATCCTACTGAGCCCC  (from Human GULO sequence)
```

2. How are the differences in the DNA sequences related to the differences in the amino acid sequences coded by this DNA segment? (Be specific.)

3. Based on the observed differences between the rat gene and the human gene, propose a general scenario whereby a mutation could create a nonfunctional version of a gene. **(hint: you will need to take these sequences through the translation process using a codon table)**

4. A strand of messenger RNA is attached to a ribosome and is directing protein synthesis. The next exposed codon of this messenger RNA has the code GAA. It is most likely to bond with a transfer RNA that has which amino acid?

A. arginine **B.** aspartic acid
C. glutamic acid D. glutamine

5. The genetic code is nearly universally. That is, with few exceptions, the same codons code for the same amino acids in all organisms. What does the near universality of the genetic code suggest?

A. All life-forms can reproduce with one another.
B. All life-forms have the same number of genes.
C. All life-forms have a common evolutionary ancestor.
D. All life-forms arose about the same time in Earth's history.

6. Less than 60% of the DNA sequence of the human GM-CSF gene and the mouse GM-CSF gene is the same. When scientists put the human gene into the mice however, it functions properly. Which statement best explains why this happens?

a) The resulting proteins are similar enough.
b) Mice can make an human protein.
c) The DNA is mutated in the mouse.
d) The differences are at the ends of the protein.

SC.912.L.16.10	Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.	High

Biotechnology has both positive and negative effects on individuals, society, and the environment. One topic of current debate is controversy over the risks and benefits of genetically modified crops. Today, genetic engineers can add favorable characteristics to a plant by manipulating the plant's genes. Genetic engineers can change plants in many ways, including making crop plants more tolerant to drought conditions and creating plants that can adapt to different soils, climates, and environmental stresses. Many people, including influential scientists, have expressed concern that genetically modified crops (GM crops) might turn out to be dangerous. Scientists, the public, and regulatory agencies must work together to evaluate the risks and benefits of GM products.

What kind of unforeseen negative effects might "improved" GM crops have? Some food crops, such as corn and soybeans, have been genetically rendered resistant to glyphosate, a weed killer that is harmless to humans. Glyphosate, when used on a food crop, will kill the weeds but will not harm the GM crop, thus increasing food crop yields. Some scientists are concerned that the use of GM crops and the subsequent use of glyphosate will eventually lead to glyphosate-resistant weeds. This will leave farmers with few weed-control alternatives. Some GM crops have genes added to improve nutritional character, as was done in rice. It is important to check that consumers are not allergic to the product of the introduced gene. For this reason, screening of GM crops for causes of allergy problems is now routine.

Are GM crops harmful to the environment? Will introduced genes pass from GM crops to their wild or weedy relatives? This sort of gene flow happens naturally all the time, so this concern is legitimate. For most crops, no closely related wild plant is around to receive the gene. The GM gene cannot pass to a non-relative, because crop plants cannot successfully reproduce with unrelated species, any more than a cat can breed with a giraffe. There are wild relatives of corn in Mexico and Guatemala, which frequently exchange genes with corn crops. Scientists are divided about whether it makes any difference if one of the genes is a GM gene.

Might pests become resistant to GM toxins? Pests are becoming resistant to GM toxins just as they have become resistant to the chemical pesticides that are sprayed on crops. Some argue that because GM crops might select and promote the competition and survival of pests that are resistant to toxins can mean that GM crops do more harm than good.

SC.912.L.16.10	Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.	High

1. Create a vocabulary burrito for the following terms: clone, genetic engineering, genetically modified organism, gene sequencing, genetic screening, gene therapy, Human Genome Project, DNA fingerprint.

2. Some fruits and vegetables are the result of crossing different species. A tangelo, for example, results from crossing a tangerine with a grapefruit. How are the genetic engineering processes of making transgenic organisms similar to and different from crossbreeding?

3. Monsanto, a Biotechnology company which creates genetically modified crops, is currently suing the farmers whose farm land is adjacent to their research laboratories and farm land. The wind is dispersing the genetically modified seeds from the Monsanto laboratories to the surrounding farmers' land. The farmers are then growing and harvesting the new, genetically modified crop.
    a. Should the farmers be liable for growing Monsanto's patented seeds? Why or why not?
    b. Should the genetically modified seeds/ fruits be sold to the public? Why or why not?

4. Some bacteria—sometimes called "super bugs"—have developed a resistance to certain antibiotics. How does drug resistance develop in bacteria?

A. Unsanitary conditions allow all kinds of bacteria to breed, including those that are antibiotic resistant.
B. In the bloodstream, different species of bacteria exchange genes and become resistant to antibiotics.
C. Mutations in some bacterial genes make the bacteria stronger and better able to defeat the body's immune system.
D. In the presence of an antibiotic, bacteria with genes that make them resistant survive and eventually take over the population.

Justify your answer with an SRE

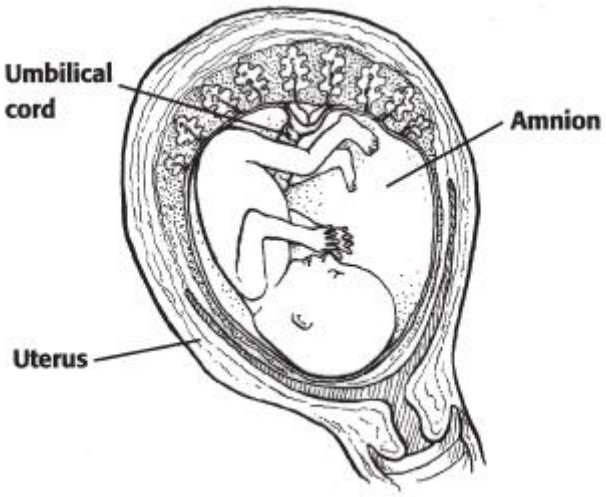
5. Every human begins as a single, fertilized egg. After about five days, a hollow ball has formed that contains about 30 specialized cells called stem cells. Embryonic stem cells can divide endlessly and give rise to every type of tissue in the body. Scientists hope that someday stem cells will make it possible to repair or replace damaged tissues. Embryonic stem cells used in research come from eggs that were fertilized in the laboratory and donated for research. Adult stem cells used in research are found in adult tissues. The use of embryonic stem cells is controversial because a human embryo is destroyed to obtain these cells. However, currently adult stem cells cannot be grown in the lab, and they occur in limited numbers in the body. Currently, large numbers of stem cells are needed for stem cell therapy. How does this fact affect the debate about the two sources of stem cells?

A. Embryonic stem cells are readily available but are not thought to be useful for stem cell therapy.
B. Adult stem cells are rare, and research needs to be done in order to find techniques to harvest more adult stem cells.
C. Embryonic stem cells are rare, and research needs to be done in order to find techniques to harvest more adult stem cells.
D. Somatic cells are destroyed during the collection of adult stem cells and there would be too much damage to justify the harvesting of these cells.

Statement	
Reason	
Explanation	

SC.912.L.16 .13 AA	Describe the basic anatomy and physiology of the human reproductive system. Describe the process of human development from fertilization to birth and major changes that occur in each trimester of pregnancy.	Moderate

During fertilization, an egg and sperm unite within the mother's reproductive system. Development begins upon fertilization, with a single diploid cell from which billions of other cells arise. The uterus provides protection and nourishment during development. Human development takes about 9 months—a period known as gestation, or pregnancy. The 9 months of pregnancy are often divided into three trimesters, or 3-month periods. For the first 8 weeks of pregnancy, the developing human is called an embryo. From the eighth week of pregnancy until childbirth, the developing human is called a fetus. The most crucial events of development occur very early in the first trimester. In the second week after fertilization—shortly after implantation—the embryo grows rapidly. Membranes that will protect and nourish it also develop. One of these membranes, the amnion, encloses and protects the embryo. Another membrane, the chorion, interacts with the uterus to form the placenta.

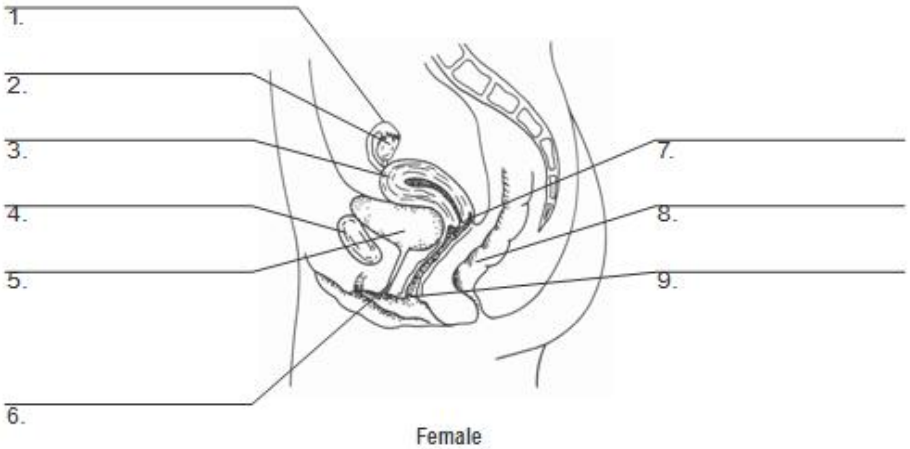


(Source: Holt McDougal Biology 2012 Test Prep)

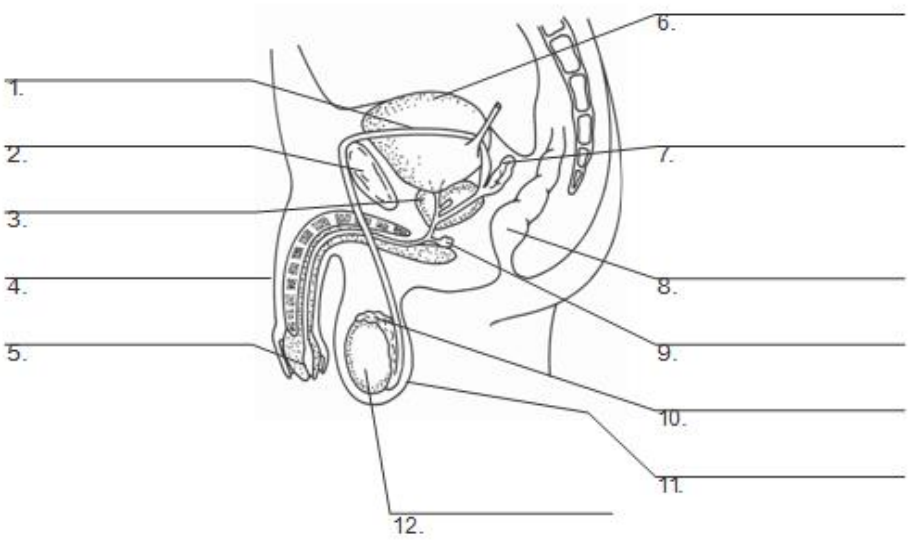
The placenta is the structure through which the mother nourishes the embryo. The mother's blood normally never mixes with the blood of the embryo. Instead, nutrients in the mother's blood diffuse through the placenta and are carried to the embryo through blood vessels in the umbilical cord. The waste products of the embryo also pass through the placenta into the mother's blood. During the second and third trimesters, the fetus grows rapidly as its organs become functional. By the end of the third trimester, the fetus is able to exist outside the mother's body. After about 9 months of development, the fetus leaves the mother's body in a process called labor, which usually lasts several hours. During labor, the walls of the uterus contract, expelling the fetus from the uterus and through the vagina. The placenta and the umbilical cord are expelled after the baby is born.

SC.912.L.16 .13 AA	Describe the basic anatomy and physiology of the human reproductive system. Describe the process of human development from fertilization to birth and major changes that occur in each trimester of pregnancy.	Moderate

1) Label the following structures and define the function of them in your own words.



Female



2) Compare and contrast the function of:

Ovaries vs. Testes

Vas Deferns and Urethra

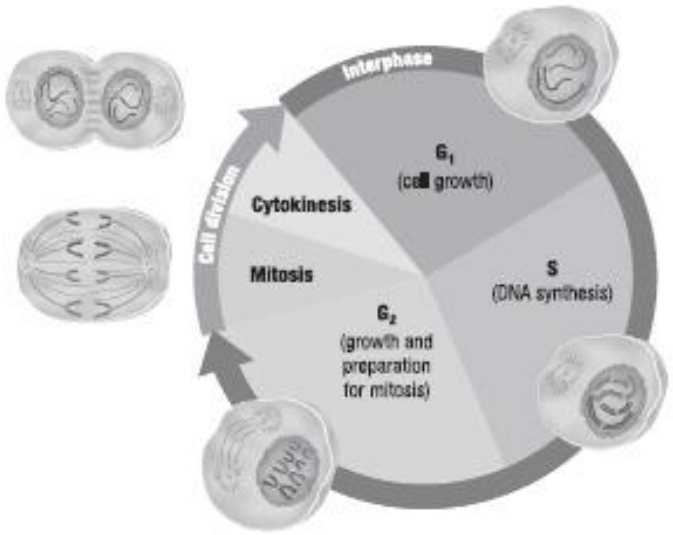
3)After reading the review, create a concept map with the terms: uterus, placenta, blastocyst, egg, sperm, gestation, zygote, fetus, umbilical cord, hormonal control.

4) Create a timeline of the events which happen in the first, second and third trimester.

SC.912.L.16.14	Describe the cell cycle, including the process of mitosis. Explain the role of mitosis in the formation of new cells and its importance in maintaining chromosome number during asexual reproduction.	Moderate

The life of a eukaryotic cell is traditionally shown as a cycle, as illustrated in the figure below. The cell cycle is a repeating sequence of cellular growth and division during the life of an organism. A cell spends 90 percent of its time in the fi rst three phases of the cycle, which are collectively called interphase. A cell will enter the last two phases of the cell cycle only if it is about to divide. The fi ve phases of the cell cycle are summarized below:

1. First growth (G1) phase: During the G1 phase, a cell grows rapidly and carries out its routine functions. For most organisms, this phase occupies the major portion of the cell's life. Cells that are not dividing remain in the G1 phase.
2. Synthesis (S) phase: A cell's DNA is copied during this phase. At the end of this phase, each chromosome consists of two chromatids attached at the centromere.
3. Second growth (G2) phase: In the G2 phase, preparations are made for the nucleus to divide. Hollow protein fibers called microtubules are rearranged during G2 in preparation for mitosis.
4. Mitosis: The process during cell division in which the nucleus of a cell is divided into two nuclei is called mitosis. Each nucleus ends up with the same number and kinds of chromosomes as the original cell.
5. Cytokinesis: The process during cell division in which the cytoplasm divides is called cytokinesis.



(Source: Holt McDougal Biology 2012 Test Prep)

Steps of Mitosis

Step 1: Prophase Chromosomes coil up and become visible during prophase. The nuclear envelope dissolves and a spindle forms.
Step 2: Metaphase During metaphase the chromosomes move to the center of the cell and line up along the equator. Spindle fibers link the chromatids of each chromosome to opposite poles.
Step 3: Anaphase Centromeres divide during anaphase. The two chromatids (now called chromosomes) move toward opposite poles as the spindle fi bers attached to them shorten.
Step 4: Telophase A nuclear envelope forms around the chromosomes at each pole.Chromosomes, now at opposite poles, uncoil and the spindle dissolves. The spindle fibers break down and disappear.

Mitosis is complete. Mitosis and cytokinesis produce new cells that are identical to the original cells and allow organisms to grow, replace damaged tissues, and, in some organisms, reproduce asexually.

SC.912.L.16.14	Describe the cell cycle, including the process of mitosis. Explain the role of mitosis in the formation of new cells and its importance in maintaining chromosome number during asexual reproduction.	Moderate

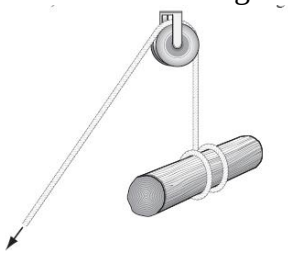
1. **Create a mnemonic device to remember the 8 stages of the cell cycle (which includes mitosis).** An example of a mnemonic device is: **M**y **v**ery **e**ducated **m**other **s**erved **u**s **n**achos represents the order of the planets: **M**ercury, **V**enus, **E**arth, **M**ars, **S**aturn, **U**ranus, and **N**eptune.

2. **Create a <u>vocabulary square</u> for each of the following** somatic, chromosome, chromatid, asexual reproduction, diploid.

3.

Cell Cycle Stage	What is happening? (In your own words)	Drawing with labels

4. Construction workers attach ropes and pulleys to wooden timbers on an old bridge. They use the rope and pulley system like the one in the diagram below to move the timbers away from each other, in order to dismantle the bridge.



Which stage of mitosis is similar to this way of dismantling a bridge?

A. anaphase
B. metaphase
C. prophase
D. telophase

5. The cell cycle is a repeating sequence of cellular growth and division during the life of an organism. Which of the following is **not** a true statement concerning cell division of body cells?

F. Cells divide in a process called meiosis.
G. Cells divide in order to maintain homeostasis.
H. Cells divide when the parent cell gets too big.
I. Cells divide in order to repair themselves when damaged.

SC.912.L.16.16	Describe the process of meiosis, including independent assortment and crossing over. Explain how reduction division results in the formation of haploid gametes or spores.	Moderate

Some organisms reproduce by joining gametes to form the fi rst cell of a new individual. The gametes are haploid—they contain one set of chromosomes. Meiosis is a form of cell division that halves the number of chromosomes when forming specialized reproductive cells, such as gametes or spores. Meiosis involves two divisions of the nucleus—meiosis I and meiosis II.

Steps of Meiosis

Before meiosis begins, the DNA in the original cell is replicated. Thus, meiosis starts with homologous chromosomes. Recall that homologous chromosomes are similar in size,shape, and genetic content. The stages of meiosis are summarized below:

Step 1: Prophase I The chromosomes condense, and the nuclear envelope breaks down.Homologous chromosomes pair along their length. Crossing-over occurs when portions of a chromatid on one homologous chromosome are broken and exchanged with the corresponding chromatid portions of the other homologous chromosome.

Step 2: Metaphase I The pairs of homologous chromosomes are moved by the spindle to the equator of the cell. The homologous chromosomes remain together.

Step 3: Anaphase I The homologous chromosomes separate. As in mitosis, the chromosomesof each pair are pulled to opposite poles of the cell by the spindle fibers. But the chromatids do not separate at their centromeres—each chromosome is still composed of two chromatids. The genetic material, however, has recombined.

Step 4: Telophase I Individual chromosomes gather at each of the poles. In most organisms,the cytoplasm divides (cytokinesis), forming two new cells. Both cells or poles contain one chromosome from each pair of homologous chromosomes. Chromosomes do not replicate between meiosis I and meiosis II.

Step 5: Prophase II A new spindle forms around the chromosomes.

Step 6: Metaphase II The chromosomes line up along the equator and are attached at their centromeres to spindle fiers.

Step 7: Anaphase II The centromeres divide, and the chromatids (now called chromosomes) move to opposite poles of the cell.

Step 8: Telophase II A nuclear envelope forms around each set of chromosomes. The spindle breaks down, and the cell undergoes cytokinesis. The result of meiosis is four haploid cells.

In humans, each gamete receives one chromosome from each of 23 pairs of homologous chromosomes. But, which of the two chromosomes that an offspring receives from each of the 23 pairs is a matter of chance. This random distribution of homologous chromosomes during meiosis is called independent assortment. Each of the 23 pairs of chromosomes segregates (separates) independently. Thus, 223 (about 8 million) gametes with different gene combinations can be produced from one original cell by this mechanism. Crossing over adds even more recombination.

SC.912.L.16.16	Describe the process of meiosis, including independent assortment and crossing over. Explain how reduction division results in the formation of haploid gametes or spores.	Moderate

1. **Create a <u>vocabulary square</u>** for each of the following terms: haploid, crossing over, gametes, independent assortment, sexual reproduction.

2. After reading the review, use this to draw the phases of meiosis and label all the terms which are associated with the cell. **Do not copy the book.** Label crossing over and chromosomal replication.

3. Justify your answer the following question in an SRE (statement, reason, evidence format).
During meiosis, homologous chromosomes line up next to each other. If one arm of a chromatid crosses over the arm of another chromatid, what results?

F. the creation of an additional sex cell
G. the independent assortment of genetic material
H. a possible change in the offspring cell's functionality
I. additional variation in the DNA combination of each sex cell formed

Statement	
Reason	
Evidence	

4. Justify your answer the following question in an SRE (statement, reason, evidence format).
Which statement explains why approximately half of an individual's DNA sequence comes from each parent?

A. A cell from one parent undergoes meiosis, producing offspring cells that have both parents' DNA.
B. A cell from one parent undergoes mitotic cell division, producing offspring cells that have only half of that parent's DNA.
C. Cells in the parents undergo meiosis, producing haploid gametes that meet up during fertilization to produce a diploid individual.
D. Cells in the parents undergo mitosis, producing offspring cells that meet up during fertilization to produce an individual with half of each parent's DNA.

Statement	
Reason	
Evidence	

SC.912.L.16.17 AA	Compare and contrast mitosis and meiosis and relate to the processes of sexual and asexual reproduction and their consequences for genetic variation.	High

Some organisms look exactly like their parents and siblings. Others share traits with family members but are not identical to them. Some organisms have two parents, while others have one. The type of reproduction that produces an organism determines how similar the organism is to its parents and siblings. Reproduction, the process of producing offspring, can be asexual or sexual.

In asexual reproduction a single parent passes copies of all of its genes to each of its offspring; there is no fusion of haploid cells such as gametes. Asexual reproduction involves only mitosis, not meiosis. An individual produced by asexual reproduction is a clone, an organism that is genetically identical to its parent. Prokaryotes reproduce by a type of asexual reproduction called binary fission. Many eukaryotes, such as hydra, also reproduce asexually through a process called budding, in which new individuals split off from existing ones. Some multi-cellular eukaryotes undergo fragmentation, a type of reproduction in which the body breaks into several pieces. Some or all of these fragments
later develop into complete adults when missing parts are regrown. Vegetative propagation is a similar reproductive method that farmers use to grow new crops.

In contrast, in sexual reproduction two parents each form reproductive cells through meiosis that have one-half the number of chromosomes. A diploid mother and father would give rise to haploid gametes, which join to form diploid offspring. Because both parents contribute genetic material, the offspring have traits of both parents but are not exactly like either parent. Sexual reproduction, with the formation of haploid cells, occurs in eukaryotic organisms, including humans.

Asexual reproduction is the simplest and most primitive method of reproduction. In a stable environment, asexual reproduction allows organisms to produce many offspring in a short period of time, without using energy to produce gametes or to find a mate. However, the DNA of these organisms varies little between individuals. This may be a disadvantage in a changing environment because a population of organisms may not be able to adapt to a new environment. Sexual reproduction, on the other hand, provides a powerful means of quickly making different combinations of genes among individuals. Such genetic diversity is the raw material for evolution.

SC.912.L.16.17 AA	Compare and contrast mitosis and meiosis and relate to the processes of sexual and asexual reproduction and their consequences for genetic variation.	High

1. Complete the compare and contrast chart below:

	What type of cells goes through this process?	Which one gives genetic variation and what stage?	Diploid or Haploid cell? Justify why.	What type of reproduction?	When does this happen during the organisms life cycle?
Mitosis					
Meiosis					

2. Konesha's eyes are brown, just like her mother's eyes. Konesha has long fingers like her father, but her mother's fingers are much shorter. What is the **most likely** reason why Konesha's appearance is similar to and different from that of her parents?

A. All of her traits depended upon pure chance.
B. Her eye color is an inherited trait, but finger length is a trait that evolved in Konesha.
C. She inherited some traits, such as eye color, from her mother and others, such as finger length, from her father.
D. She inherited her eye color from her mother but grew longer fingers because she had better nutrition as an infant.

3. **Justify your answer the following question in an SRE** (statement, reason, evidence format).
Imagine that sex cells divided by mitosis instead of meiosis. What would then be the result of fertilization of an ovum by a sperm cell?
F. Fertilization would result in the formation of two identical cells.
G. The new individual would be identical to only one of the parents.
H. Fertilization would cause crossing-over and recombination of genes.
I. Cells of the new individual would have double the necessary number of chromosomes.

Statement	
Reason	
Evidence	

SC.912.L.17.2	Explain the general distribution of life in aquatic systems as a function of chemistry, geography, light, depth, salinity, and temperature.	High

Aquatic systems include freshwater and saltwater communities. Each differs in chemistry, geography, light, depth, salinity, and temperature and thus the kinds of life it supports.

Freshwater Communities Ponds and lakes have three zones in which organisms live. The littoral zone is a shallow zone near the shore. Here, aquatic plants live along with various predatory insects, amphibians, and small fish. The limnetic zone refers to the area that is farther away from the shore but close to the surface. It is inhabited by floating algae, zooplankton, and fi sh. The profundal zone is a deep-water zone that is below the limits of effective light penetration. Numerous bacteria and wormlike organisms eat debris on the lake's bottom, releasing large amounts of nutrients.

Wetland Communities Swamps, marshes, bogs, and other communities that are covered with a layer of water are called wetlands. Wetlands typically are covered with a variety of water-tolerant plants, called hydrophytes ("water plants"). Marsh grasses and cattails are hydrophytes. Wetlands are dynamic communities that support a diverse array of invertebrates, birds, and other animals. Wetlands are among the most productive ecosystems on Earth.

Shallow Ocean Water Communities The zone of shallow water is small in area, but compared with other parts of the ocean, it is inhabited by large numbers of species. The seashore between high and low tide, called the intertidal zone, is home to many species of marine invertebrates. Coral reef communities, the world's most diverse, occur in shallow tropical waters. The world's great fisheries are located in the coastal zones of cooler waters, where nutrients washed out from land support huge numbers of fishes.

Communities at the Surface of the Open Sea Drifting freely in the upper waters of the ocean is a diverse community of plankton, composed of bacteria, algae, fish larvae, and many small invertebrate animals. Fishes, whales, and invertebrates such as jellyfishes feed on plankton. And larger fishes and birds, in turn, feed on some of these animals. Photosynthetic plankton (algae such as diatoms and some bacteria) that form the base of this food chain account for about 40 percent of all the photosynthesis that takes place on Earth. Because light penetrates water only to the depth of about 100 m (328 ft), this rich community is confined to the ocean's surface.

Communities at the Ocean Depths In the deepest waters of the sea, the marine community lives in total darkness, in deep cold, and under great pressure. Despite what seem like hostile conditions, the deep ocean supports a diverse community of invertebrates and fishes. This includes great squids and angler fishes that attract prey with projections from their head that emit light. On the ocean floor, at an average depth of more than 3 km (1.9 mi), researchers have also found an abundance of species.

SC.912.L.17.2	Explain the general distribution of life in aquatic systems as a function of chemistry, geography, light, depth, salinity, and temperature.	High

1. Make a "Y" diagram of the terms **aquatic chemistry** and **salinity**.

2. Using the accompanying reading, create a concept map for the five different oceanic communities mentioned with the term "Aquatic Ecosystems" in the middle.

3. In the reading the author made the, "Wetlands are among the most productive ecosystems on Earth." Use your prior knowledge and/ or other sources to justify this statement.

4. Constance made the table below during a field investigation on ocean life.

Characteristics of Several Ocean Zones	
Zones	**Description**
Intertidal	Air, sun, and water exposure; crashing waves
Neritic	Water depth less than 200 m; lots of sunlight; relatively warm water
Benthic	Very deep water; no light; cold except near thermal vents that emit heat and chemicals

Based on Constance's table, which of the following is a valid conclusion?

A. Organisms in the intertidal zone must be able to withstand very cold water.
B. There are no producers in the benthic zone that rely on photosynthesis.
C. Organisms in the benthic zone must be able to tolerate occasional air exposure.
D. The warm water and abundant sunlight in the neritic zone limits the plankton population.

Statement	
Reason	
Evidence	

SC.912.L.17.4	Describe changes in ecosystems resulting from seasonal variations, climate change and succession.	Moderate

An ecosystem, or ecological system, consists of a community and all the physical aspects of its habitat, such as the soil, water, and weather. Earth's ecosystems may seem stable, but they are not static. They change seasonally, they can change suddenly, and they can even change over time. Climate change is one way that ecosystems can change. They can also change through a regular, progressive process called succession.

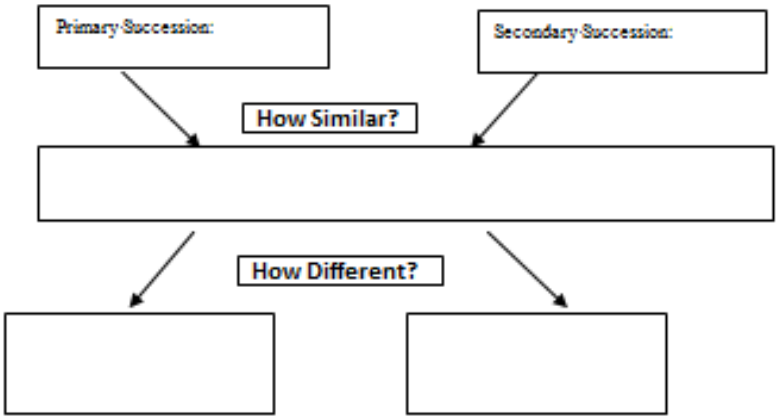
When a volcano forms a new island, a glacier recedes and exposes bare rock, or a fire burns all of the vegetation in an area, a new habitat is created. This change sets off a process of colonization and ecosystem development. The first organisms to live in a new habitat where soil is present tend to be small, fast-growing plants, called pioneer species. They may make the ground more hospitable for other species. Later waves of plant immigrants may then outcompete and replace the pioneer species.

Succession is the somewhat regular progression of species replacement. Succession that occurs where life has not existed before is called primary succession. Succession that occurs in areas where there has been previous growth, such as in abandoned fields or forest clearings, is called secondary succession.

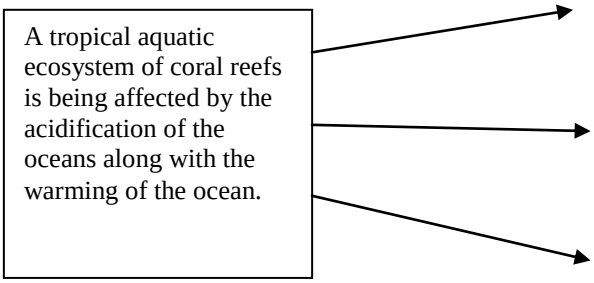
It was once thought that the stages of succession were predictable and that succession always led to the same final community of organisms within any particular ecosystem. Ecologists now recognize that initial conditions and chance play roles in the process of succession. For example, if two species are in competition, a sudden change in the climate may favor the success of one species over the other. For this reason, no two successions are alike.

SC.912.L.17.4	Describe changes in ecosystems resulting from seasonal variations, climate change and succession.	Moderate

1. **Create a compare and contrast** chart for the terms "primary succession" and "secondary succession."



2. **Make cause and effect diagrams**. Fill in the partially completed one below and make two new ones for the following situations.



a) A volcano erupts and creates a new landmass in the Pacific Ocean.

b) A glacier melts into the ocean exposing land.

3. A nursery owner wants Easter lilies to bloom in the spring and poinsettias to bloom during the December holidays. Which plant response would the owner manipulate to make sure each plant bloomed for the appropriate season?

a. photoperiodism, a response to the length of days and nights
b. heliotropism, a response to the position of the Sun in the sky
c. phototropism, a response to the direction from which light is coming
d. dormancy, in which a seed remains inactive until conditions are suitable for growth

4. After fires destroyed 793,000 acres of aspen and pine forest in Yellowstone National Park in the unusually dry summer of 1988, biologists were able to study the long-term effects of fire on an ecosystem. The biologists found that the soil after the fire was more fertile and soon gave rise to small plants and new pine trees. What ecological process were the biologists observing?
F. adaptation
G. pioneer succession
H. primary succession
I. secondary succession

SC.912.L.17.5 AA	Analyze how population size is determined by births, deaths, immigration, emigration, and limiting factors (biotic and abiotic) that determine carrying capacity.	High

A population consists of all the individuals of a species that live together in one place at one time. Every population tends to grow because individuals tend to have multiple offspring over their lifetime. A population grows when more individuals are born than die in a given period. But eventually, limited resources in an environment limit the growth of a population.

When population size is plotted against time on a graph, the population growth curve resembles a *J*-shaped curve and is called an exponential growth curve. An exponential growth curve is a curve in which the rate of population growth stays the same, and as a result, the population size increases steadily.

However, populations do not usually grow unchecked. Their growth is limited by predators, disease, and the availability of resources. Eventually, growth slows, and the population may stabilize. The population size that an environment can sustain is called the carrying capacity.

As a population grows, limited resources (that is, resources in short supply) eventually become depleted. When this happens, the growth of the population slows. The population model can be adjusted to account for the effect of limited resources, such as food and water. These resources are called density-dependent factors because the rate at which they become depleted depends upon the population density of the population that uses them. The population model that takes into account the declining resources available to populations is called the logistic model of population growth, after the mathematical form of the equation. The logistic model is a population model in which exponential growth is limited by a density-dependent factor. Unlike the simple model, the logistic model assumes that birth and death rates vary with population size. When a population is below carrying capacity, the growth rate is rapid.

However, as the population approaches the carrying capacity, death rates begin to rise and birthrates begin to decline. Competition for food, shelter, mates, and limited resources tends to increase as a population approaches its carrying capacity. The accumulation of wastes also increases. As a result, the rate of growth slows. The population eventually stops growing when the death rate equals the birthrate.

SC.912.L.17.5 AA	Analyze how population size is determined by births, deaths, immigration, emigration, and limiting factors (biotic and abiotic) that determine carrying capacity.	High

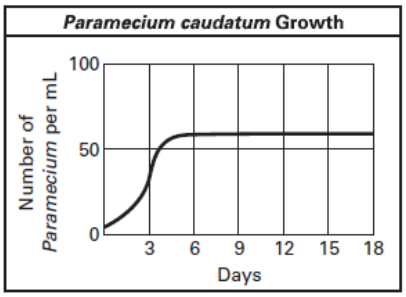
1. In a marsh ecosystem, what are the limiting resources for a frog population?

2. How does competition between frog population affect the population growth?

3. How would immigration affection frog population? How does emigration affect frog population?

4. The population size that an environment can sustain is called the carrying capacity. Which of the following factors would **not** decrease the carrying capacity of a pond environment?
   a. Drought
   b. Flooding
   c. Food shortages
   d. Unusually low temperatures

5. Your class has been observing the population growth of a species of *Paramecium*, a single-celled organism, for 18 days. Your data are shown in the graph below. Food was occasionally added to the test tube in which the paramecia were grown.



Look at the graph above. What is the carrying capacity of the test-tube environment?
F. about 10 paramecia
G. about 50 paramecia
H. about 65 paramecia
I. about 100 paramecia

6. **Justify your response with an SRE.**
Researchers have found that a local squirrel population fluctuates from year to year, increasing one year and decreasing the next. Which of the following factors would cause the squirrel population to grow?
A. the birth rate is equal to the death rate
B. emigration is greater than immigration
C. the death rate is higher than the birth rate
D. the birth rate is greater than the death rate

Statement	
Reason	
Evidence	

SC.912.L.17.8	Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species.	High

The variety of organisms, their genetic differences, and the communities and ecosystems in which they occur is termed biodiversity. Biodiversity is a measure of both the number of different species in a community (species richness) and the relative numbers of each of the species (species diversity). Some of the most diverse communities are those living in tropical rainforests.

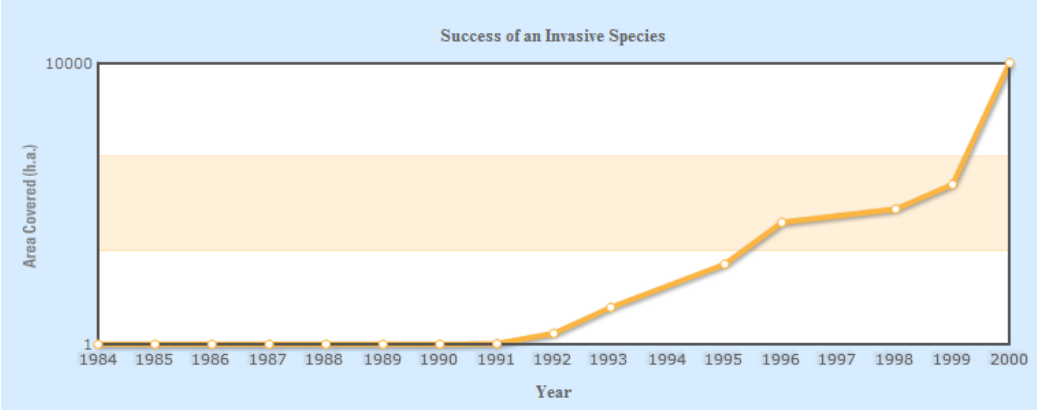
Over the last 50 years, about half of the world's tropical rainforests have been burned to make pasture and farmland or have been cut for timber. Many thousands of square miles more will be destroyed this year. The people responsible, often poor farmers, view the forest lands as a resource to be developed, much as Americans viewed North American forests a century ago. The problem is that as the rainforests disappear, so do their inhabitants. No one knows how many species are being lost. To find out, scientists carefully catalogue all of the residents of one small segment of forest and then extrapolate their data. That is, scientists use what they know to predict what they don't know. The resulting estimates vary widely, but it is clear Earth is losing many species. Some 10 percent of well-known species teeter on the brink of extinction. Worst-case estimates are that we will lose up to one-fifth of the world's species of plants and animals—about 1 million species— during the next 50 years. An extinction of this size has not occurred in at least 65 million years, since the end of the age of dinosaurs.

The tragedy of extinction is that as species disappear, so do our chances to learn about them and their possible benefits. This situation is comparable to burning a library before reading the books—we lose forever the knowledge we might have gained. Also, experiments have clearly demonstrated that an ecosystem's biodiversity and productivity are related. That is, increased species richness leads to greater productivity.

SC.912.L.17.8	Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species.	High

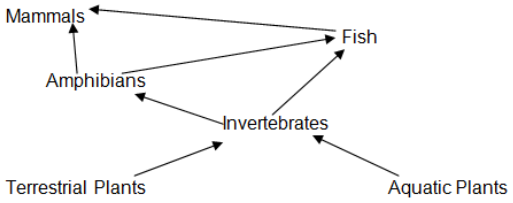
1. **Create a vocabulary** burrito with the following terms: biodiversity, introduced species, climate change, habitat fragmentation, invasive species.

2. An organism will thrive or fail when introduced into a new environment. A tropical seaweed, *Caulerpa taxifolia*, was bred in Europe for aquarium use. However, in 1984 the alga was accidentally released into the Mediterranean Sea off the coast of France. Shortly afterward the release was discovered. Researchers started tracking the seaweed to determine its success and its effects on its new environment.



   a. Describe the growth rate of *Caulerpa* from 1984 to 1990:
   b. Describe the growth rate of *Caulerpa* from 1991 to 2000:
   c. Has the *Caulerpa* been successful in the Mediterranean Sea off the coast of France? Explain.
   d. What impact do you think the *Caulerpa* has had on the native algae?
   e. What impact do you think the *Caulerpa* has had on the native plants?
   f. What impact do you think the *Caulerpa* has had on the native animals?

3. Through the process of biomagnification certain pollutants build up at each link of a food web. The food web below is located next to a factory which makes the river heavily polluted.



   At what link would the pollutant concentrations be at the highest?
   a. Amphibians c. Fish
   b. Aquatic Plants d. Invertebrates

4. As an increasing amount of carbon dioxide is sent into the atmosphere by burning fossil fuels, the oceans absorb more and more of the excess carbon. Some of the carbon reacts chemically in seawater to form an acid. The more carbon the ocean takes in, the more acidic the water becomes. If the water becomes too acidic, tiny organisms that make up plankton may not be able to make protective shells. One of the areas that would be greatly affected is the Antarctic. What effect, if any, might this harm to plankton have on an Antarctic marine food web?

F. It would have no effect, because the organisms in plankton include algae, which do not have shells.
G. It would be beneficial, because consumers in the third trophic level could more easily eat zooplankton that do not have protective shells.
H. Damage to the Antarctic ecosystem would be extensive but could be repaired as new plankton drifts south to replace the plankton that died off.
I. The dying off of these tiny organisms would be disastrous, because zooplankton is a major source of food for small and large marine organisms.

SC.912.L.17.9 AA	Use a food web to identify and distinguish producers, consumers, and decomposers. Explain the pathway of energy transfer through trophic levels and the reduction of available energy at successive trophic levels.	Mod

Everything that organisms do in ecosystems—running, breathing, burrowing, growing—requires energy. The flow of energy is the most important factor that controls what kinds of organisms live in an ecosystem and how many organisms the ecosystem can support.

Most life on Earth depends on photosynthetic organisms, which capture some of the Sun's light energy and store it as chemical energy in organic molecules. These organic compounds are what we call food. The rate at which organic material is produced by photosynthetic organisms in an ecosystem is called primary productivity. Primary productivity determines the amount of energy available in an ecosystem. Most organisms in an ecosystem can be thought of as chemical machines driven by the energy captured in photosynthesis.

Organisms that first capture energy, the producers, include plants, some kinds of bacteria, and algae. Producers make energy-storing molecules. All other organisms in an ecosystem are consumers. Consumers are those organisms that consume plants or other organisms to obtain the energy necessary to build their molecules.

Ecologists study how energy moves through an ecosystem by assigning organisms in that ecosystem to a specific level, called a trophic level, in a graphic organizer based on the organism's source of energy. Energy moves from one trophic level to another. The path of energy through the trophic levels of an ecosystem is called a food chain. However, in most ecosystems, energy does not follow simple straight paths because individual animals often feed at several trophic levels. This creates a complicated, interconnected group of food chains called a food web.

The lowest trophic level of any ecosystem is occupied by the producers, such as plants, algae, and bacteria. Producers use the energy of the Sun to build energy-rich carbohydrates. Many producers also absorb nitrogen gas and other key substances from the environment and incorporate them into their biological molecules. At the second trophic level are herbivores, animals that eat plants or other primary producers. They are the primary consumers. Cows and horses are herbivores, as are caterpillars and some ducks. At the third trophic level are secondary consumers, animals that eat other animals. These animals are called carnivores. Tigers, wolves, and snakes are carnivores. Some animals, such as bears, are both herbivores and carnivores; they are called omnivores.

Many ecosystems contain a fourth trophic level composed of those carnivores that consume other carnivores. They are called tertiary consumers, or top carnivores. In every ecosystem there is a special class of consumers called detrivores, which include worms and fungal and bacterial decomposers. Detrivores are organisms that obtain their energy from the organic wastes and dead bodies that are produced at all trophic levels.

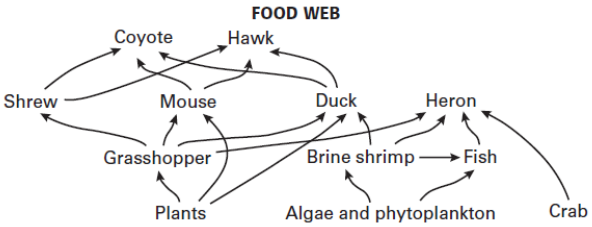
SC.912.L.17.9 AA	Use a food web to identify and distinguish producers, consumers, and decomposers. Explain the pathway of energy transfer through trophic levels and the reduction of available energy at successive trophic levels.	Mod

1. **Create a vocabulary burrito** for the following terms: producers, consumers, decomposers, omnivores, herbivores, carnivores, detritivore, autotroph, heterotroph, trophic level, primary consumer, secondary consumer, tertiary consumer, primary productivity.

2. **Create your own marine food web**. You will be using the four trophic levels (producers, primary consumers, secondary consumers, and tertiary consumers). If you do not know any of the animals ask your teacher and/ or research the animal. **Make sure you show the flow of energy and matter with arrows!**

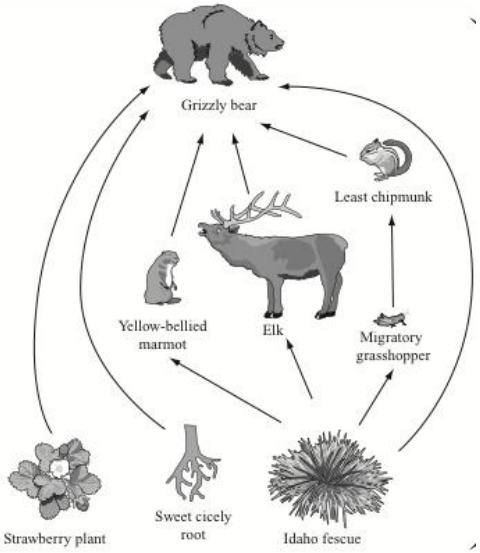
- Shrimp - Kelp - Dolphin - Tiger Shark -Dinoflagellates - Shore Crab - Diatoms -Snapper (fish)
-Algae -Sweep (fish) -Blenny (fish) -Yellow-eyed Mullet (fish) -Water flea -Octopus -Pilchard (fish) -Sea Urchin

4. The food web below represents the interactions between organisms in a salt marsh ecosystem and organisms in an old field ecosystem.



Which of the following is the correct flow of energy?
F. The crab gets energy from eating plants. **G.** The heron gets energy from eating plants.
H. The crab gets energy from eating the heron. **I.** The heron gets energy from eating the crab.

5. **Justify your response with an SRE.**
A partial food web for organisms in Yellowstone National Park is shown below.



Which organism, if removed, would impact the food web the most?
A) Grizzly bear C) Sweet cicely root
B) Elk D) Idaho fescue

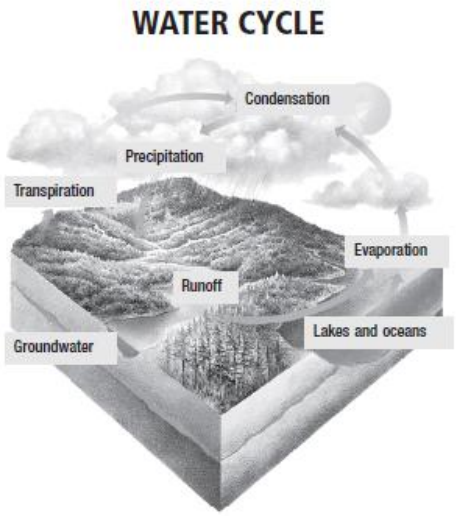
Statement	
Reason	
Evidence	

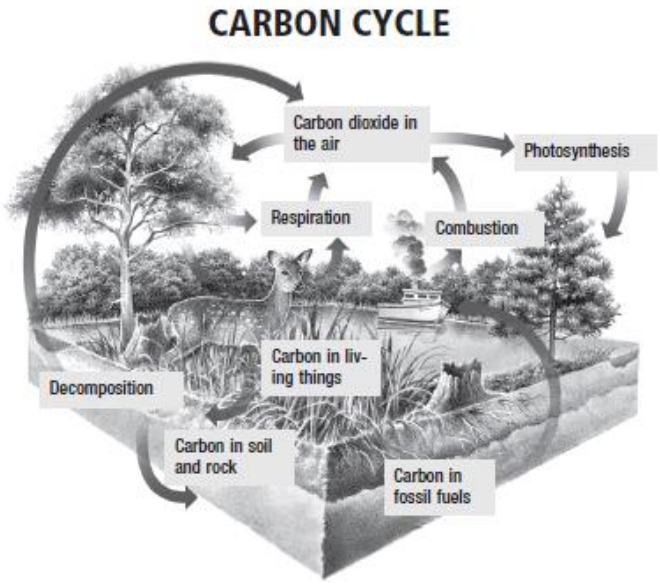
SC.912.E.7.1	Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.	High

The Water Cycle

The movement of water between the oceans, atmosphere, land, and living things is known as the *water cycle.* During *evaporation*, the Sun's heat causes water to change from liquid to vapor. In the process of *condensation*, the water vapor cools and returns to a liquid state.

The water that falls from the atmosphere to the land and oceans is *precipitation.* Some of the precipitation that falls on land flows into streams, rivers, and lakes and is called *runoff.* Some precipitation seeps into the ground and is stored in spaces between or within rocks. This water, known as *groundwater*, will slowly fl ow back into the soil, streams, rivers, and oceans.





(Source: Holt McDougal Biology 2012 Test Prep)

The Carbon Cycle

Carbon is an essential substance in the fuels used for life processes. Carbon moves through the environment in a process called the *carbon cycle*. Part of the carbon cycle is a short-term cycle. In this short-term cycle, plants convert carbon dioxide from the atmosphere into sugars and starches. Plants use these substances for energy, releasing carbon dioxide into the air. Other organisms eat the plants to get the carbon. Like plants, the organisms break down sugars for energy, releasing some of the carbon back into the air. The decay of dead organisms and wastes also releases carbon into the air.

SC.912.E.7.1	Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.	High

1. On your own, sketch and label both the water cycle and the carbon cycle. Label and define the following terms (in your own words):

Water Cycle	**Carbon cycle**
Evaporation Precipitation Condensation Runoff Transpiration	Photosynthesis Respiration Decomposition Combustion Glucose Water Carbon Dioxide Oxygen

2. Define biogeochemical cycles.

3. In what way does the water cycle and the carbon cycle interact?

4. What is the source of energy that fuels each of these cycles?

5. In a different color ink/pencil use arrows to describe the flow of energy through each biogeochemical cycle.

6. Compare and contrast the flow of energy through these cycles to the flow of energy through a food chain.

7. A student set up a terrarium, watered the soil, and covered the terrarium tightly with a lid. The next day, the student observed water droplets on the inside of the lid. The droplets provide evidence that which of the following steps of the water cycle had occurred in the terrarium?

    a. runoff and evaporation
    b. precipitation and runoff
    c. evaporation and condensation
    d. condensation and precipitation

8. Tyler is growing plants in a closed terrarium to study the carbon cycle. He hypothesizes that if plants are grown in a closed environment, then the total amount of carbon in the terrarium will remain constant. He measures the amounts of different gases in the terrarium when he adds the plants, and he will measure again after one month. Which result would best support his hypothesis?

    a. The amount of oxygen decreased as the plants grow.
    b. The amount of carbon dioxide increased as the plants grow.
    c. The amount of carbon dioxide decreased as the plants grow.
    d. The amount of oxygen became less than the amount of carbon dioxide as the plants grow.

SC.912.L.17.11	Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife, and forests.	High

A natural resource is any natural material that is used by humans. Examples of natural resources are water, petroleum, minerals, forests, and animals. Most resources are changed and made into products that make people's lives more comfortable and convenient. The energy we get from resources, such as gasoline and wind, ultimately comes from the Sun's energy.

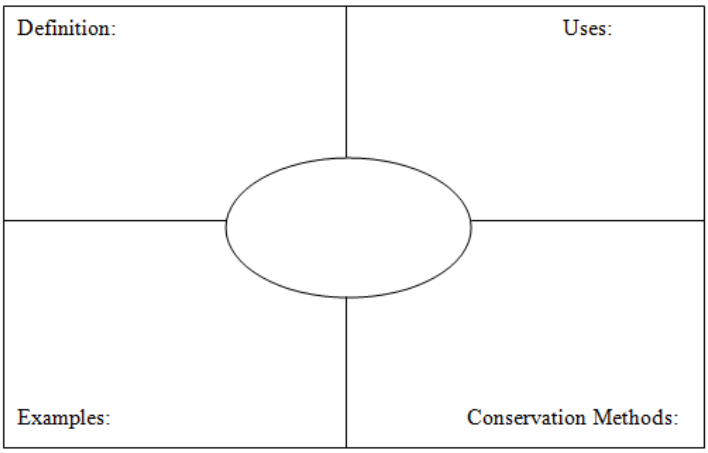
Some natural resources can be renewed. A renewable resource is a natural resource that can be replaced at the same rate at which the resource is used. Although many resources are renewable, they still can be used up before they can be renewed. Trees, for example, are renewable. However, some forests are being cut down faster than new forests can grow to replace them.

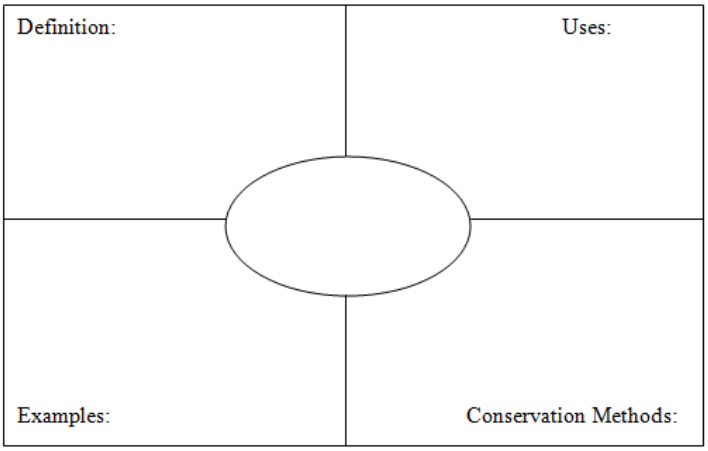
Not all of Earth's natural resources are renewable. A nonrenewable resource is a resource that forms at a rate that is much slower than the rate at which it is consumed. When these resources become scarce, humans will have to find other resources to replace them. Most of the energy we use comes from a group of natural resources called fossil fuels. A fossil fuel is a nonrenewable energy resource formed from the remains of plants and animals that lived long ago.

Examples of fossil fuels include petroleum, coal, and natural gas. Once fossil fuels are used up, new supplies won't be available for thousands or even millions of years. Second, obtaining and using fossil fuels has environmental consequences, such as acid rain and global warming. To continue to have access to energy and to overcome pollution, we must find alternative sources of energy.

SC.912.L.17.11	Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife, and forests.	High

1. After reading the information on the benchmark, construct two Frayer Models for both Renewable Resources and Nonrenewable Resources.





Justify your response with an SRE for the following question

1) When the supplies of a product decrease, the price of the product tends to increase. How might the continuing increases in the price of fossil fuels affect research on the development of renewable resources, such as wind power and solar energy?

A. Research on the development of renewable resources would likely decline.
B. Research on the development of renewable resources would likely increase.
C. There would be less research on alternative energies and more on fossil fuels.
D. Increased fossil fuel prices would have little effect on research and development

Statement	
Reason	
Evidence	

It is easy to get discouraged when considering the world's many serious environmental problems. But do not lose track of the conclusion that emerges from our examination of these environmental problems each of the world's many problems is solvable. If one looks at how environmental problems have been overcome, a clear pattern emerges.

Five Steps to Success

Viewed simply, there are five components to successfully solving any environmental problem.

1. Assessment. The first stage is scientific analysis of the problem, the gathering of information about what is happening. To construct a scientific model of an ecosystem, data must be collected and analyzed. A model makes it possible to describe the current state of the ecosystem. A model would also allow scientists to make predictions about the future of the ecosystem.

2. Risk analysis. Using the information obtained by scientific analysis, scientists predict the consequences of different types of environmental intervention. It is also essential to evaluate any negative effects associated with a plan of action.

3. Public education. When it is possible to describe alternative courses of action, the public must be informed. This involves explaining the problem in understandable terms, such as at a public meeting, presenting the alternative actions available, and explaining the probable costs and results of the different choices.

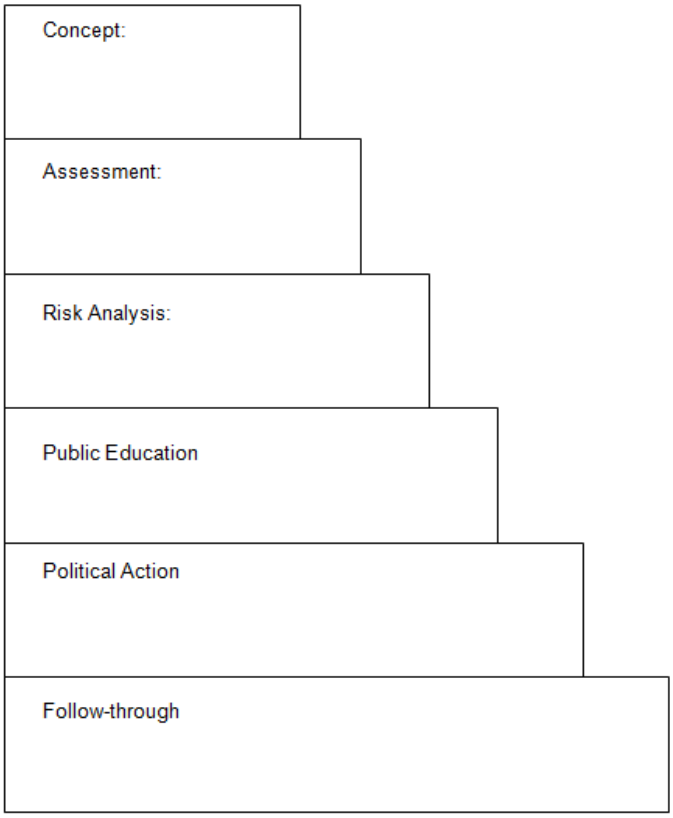
4. Political action. The public, through its elected officials, selects and implements a course of action. Individuals can be influential at this stage by exercising their right to vote and by contacting their elected officials.

5. Follow-through. The results of any action should be carefully monitored to see if the environmental problem is being solved.

SC.912.L.17.13	Discuss the need for adequate monitoring of environmental parameters when making policy decisions.	High

1. After reading the information on the benchmark, make 2 Concept Ladders to follow steps needed to make a policy decisions on an environmental issue.

Scenario #1: Imagine that a community plans to build a shopping mall. What should the local government consider the effects on wildlife of development area?
Scenario #2: Members of an environmental protection group have noticed that fish populations have decreased in a local wetland area. They think that pollution in runoff from nearby farms is to blame. What are the steps they should take to solve the problem and restore the wetland fish population?



2. After implementing a solution to an environmental problem, environmental workers often continue to collect and analyze data associated with the problem area. Why is it important for public officials to follow through and check the results of implemented solutions to environmental problems?

a. Once data is collected in an area, public officials will always have to monitor that area.
b. The act of collecting data ensures that the problem will never come back again in that area.
c. Public officials always monitor the environment whether or not there has been an environmental problem.
d. Collected data can show public officials whether the solution is actually working or whether it needs to be modified.

3. Members of an environmental protection group have noticed that fish populations have decreased in a local wetland area. They think that pollution in runoff from nearby farms is to blame. What is the first step they should take to solve the problem and restore the wetland fish populations?

A. Enact laws that prohibit farming near wetland areas and near creeks that drain into them.
B. Educate other communities whose wetlands are at risk of the dangers of having farms nearby.
C. Collect and analyze data to assess which factors are causing the fish populations to decrease.
D. Bring in fish from other wetlands to restore the original fish population size of the local wetland area.

SC.912.L.17.20 AA	Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability.	High

The global rate of population growth has been declining. The United Nations projects that the world's population will stabilize at 9.7 billion by the year 2050. However, population growth rates are uneven across Earth. Population growth tends to be the highest in countries that can least afford it. Already limited resources are strained further, and natural resources—ground water, land for farming, forests—are ever more quickly depleted or polluted.

No one knows whether the Earth can support six billion people indefinitely, much less the far larger population that lies in our future. Building a sustainable world is the most important task facing humanity's future. The quality of life available to your children in the new century will depend to a large extent on our success.

One industry where sustainable practices can help support human activity without depleting natural resources is agriculture. Sustainable agriculture refers to farming that remains productive and profitable through practices that help replenish the soil's nutrients, reduce erosion, and control weeds and insect pests. In an ecosystem, decomposers return mineral nutrients to the soil. However, when the plants are harvested and shipped away, there is a net loss of nutrients from the soil where the plants were growing. The amount of organic matter in the soil also decreases, making the soil less able to hold water and more likely to erode.

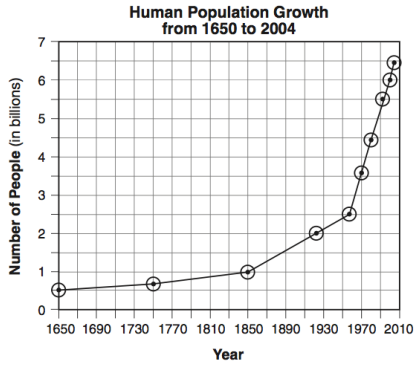
One way to protect soil is through the planting of cover crops. After harvest, farmers can plant cover crops, such as rye, clover, or vetch, instead of letting the ground lie bare. Cover crops keep the soil from compacting and washing away, and they help the soil absorb water. They also provide a habitat for beneficial insects, slow the growth of weeds, and keep the ground from overheating. When cover crops are plowed under, they return nutrients to the soil.

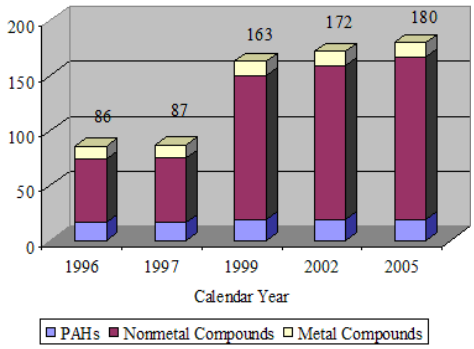
Rotational grazing can also protect land resources. Farmers who raise cattle and sheep can divide their pastures into several grazing areas. By rotating their livestock from one area to another, they can prevent the animals from overgrazing the pasture. This allows the plants on which the animals feed to live longer and be more productive. Water quality improves as the pasture vegetation becomes denser. Animals distribute manure more evenly with rotational grazing than they do in feed lots or unmanaged pastures.

SC.912.L.17.20 AA	Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability.	High

1. How have advances in manufacturing, agriculture, and transportation improved people's lifestyles as compared to 100 years ago? Give specific examples.

2. How have these improvements created problems for Earth's ecosystems? Give specific examples.
3. The following graphs are of Human Population Growth and of "Air Toxic Inventory."





Describe the general trends observed.

4. Name some ways humans combat air and waterway pollution?

5. Describe the process of biomagnification and why it is of great concern.

6. Justify your answer with an SRE.
Public officials in Florida had to decide whether to build a new coal-fired electric power plant or invest in developing more solar energy. Which of the following sums up the arguments likely made by those who favored coal and those who favored solar energy?

F. pro coal: coal mines need more business; pro solar: Florida is an ideal state for solar energy because of its abundant sunshine
G. pro coal: invest in this relatively cheap and reliable energy source; pro solar: invest in solar energy because coal supplies are running out faster than oil supplies
H. pro coal: coal is a relatively cheap and abundant energy source; pro solar: Florida is ideal for solar energy, which produces no pollutants, because of its abundant sunshine
I. pro coal: a coal-fired power plant gives off less pollution than any other type of power plant; pro solar: investments in solar energy will help develop technologies for safer nuclear power plants

Statement	
Reason	
Evidence	

SC.912.L.18.1 AA	Describe the basic molecular structures and primary functions of the four major categories of biological macromolecules.	Moderate

Four principal classes of organic compounds are found in living things: carbohydrates, lipids, proteins, and nucleic acids.

Carbohydrates are organic compounds made of carbon, hydrogen, and oxygen atoms in the proportion of 1:2:1. Carbohydrates are a key source of energy, and they are found in most foods. The building blocks of carbohydrates are single sugars, called monosaccharides, such as glucose, $C_6H_{12}O_6$, and fructose. Disaccharides are double sugars formed when two monosaccharides are joined. For example, sucrose, or common table sugar, consists of both glucose and fructose. Polysaccharides such as starch are chains of three or more monosaccharides. Starch and cellulose, which are found in plants, and glycogen, which is made by animals, are examples of polysaccharides.

Lipids are nonpolar molecules that are not soluble or mostly insoluble in water. They include fats, phospholipids, steroids, and waxes. Phospholipids make up the lipid bilayer of cell membranes. Steroids include cholesterol, which is found in animal cell membranes. Other lipids include some light-absorbing compounds, such as the plant pigment chlorophyll. Fats are lipids that store energy.

Proteins are usually large molecules formed by linked smaller molecules called amino acids. Amino acids are the building blocks of proteins. Twenty different amino acids are found in proteins. Some amino acids are polar, and others are nonpolar. Some amino acids are electrically charged, and others are not charged. Proteins fold into compact shapes, determined in part by how the protein's amino acids interact with water and one another. Some proteins are enzymes and promote chemical reactions. Other proteins have important structural functions. Other proteins called antibodies help your body defend against infection. Specialized proteins in muscles enable your muscles to contract. In your blood, a protein called hemoglobin carries oxygen from your lungs to body tissues.

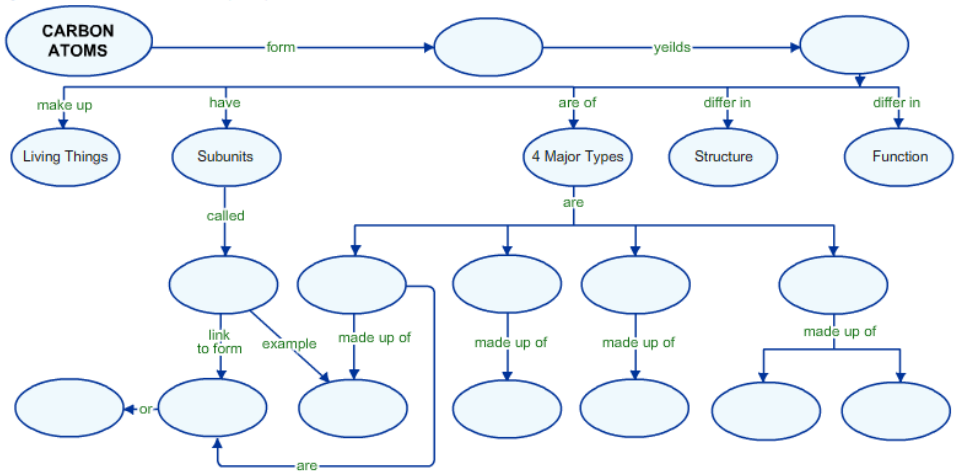
Nucleic acids are long chains of smaller molecules called nucleotides. A nucleotide has three parts: a sugar, a base, and a phosphate group, which contains phosphorus and oxygen atoms. There are two types of nucleic acids—DNA and RNA—and each type contains four kinds of nucleotides. DNA, or deoxyribonucleic acid, consists of two strands of nucleotides that spiral around each other. Chromosomes contain long strands of DNA, which stores hereditary information. RNA, or ribonucleic acid, may consist of a single strand of nucleotides or of based-paired nucleotides. RNA plays many key roles in the manufacture of proteins.

SC.912.L.18.1 AA	Describe the basic molecular structures and primary functions of the four major categories of biological macromolecules.	Moderate

1. What is the relationship between a monomer and a polymer? How do they relate to macromolecules?
2. Complete the following chart for the four principal Macromolecules:

Type of molecule	Name of the monomer	Examples	Function in the body/cell	Draw its structure	How can you recognize it? How is it different?

3. Fill in the concept map with the following terms: 4 stable covalent bonds, amino acids, carbohydrates, carbon based molecules, fatty acids, glycerols, lipids, macromolecules, monomers, nucleic acids, nucleotides, polymers, proteins, simple sugars.

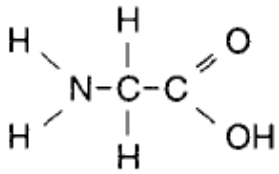


3. Two of the four principle classes of organic compounds are proteins and nucleic acids. What is the relationship between proteins and nucleic acids?

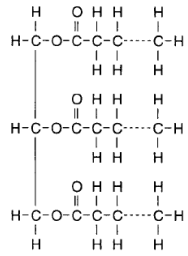
a. nucleic acids use proteins for energy
b. nucleic acids are a subset of proteins
c. proteins are long polymers of nucleic acids.
d. nucleic acids contain the information to make proteins

4. A runner is participating in a marathon which is approximately 26.2 miles long. Halfway through the race he feels as he needs to have an energy boost. Which macromolecule should he ingest give him more energy?

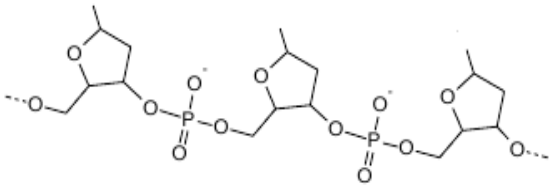
A.



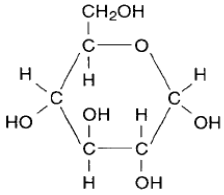
C.



B.



D.



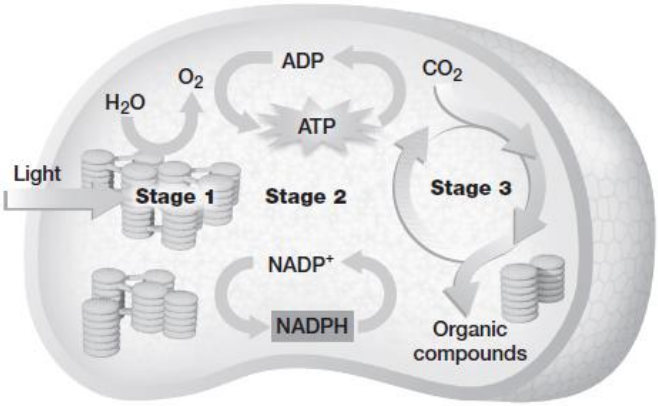
SC.912.L.18.7	Identify the reactants, products, and basic functions of photosynthesis.	Moderate

Photosynthesis is the process that provides energy for almost all life.

Photosynthesis can be summarized by the following equation:

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

As the figure below shows, photosynthesis has three stages:



Stage 1: Energy is captured from sunlight. Pigments such as chlorophyll absorb light energy, which excites electrons.

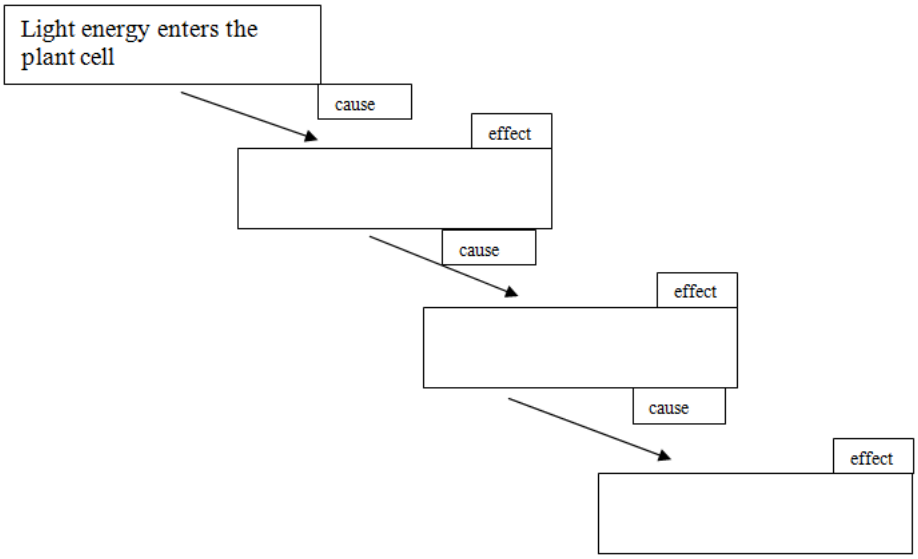
Stage 2: Light energy is converted to chemical energy, which is temporarily stored in ATP and the energy carrier molecule NADPH. This stage occurs when the excited electrons are passed through a series of molecules—called an electron transport chain—along a thylakoid membrane.

Stage 3: The chemical energy stored in ATP and NADPH powers the formation of organic compounds, using carbon dioxide, CO2. The most common way that this happens is called the Calvin cycle.

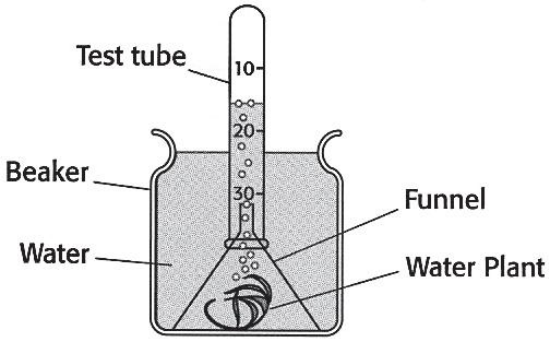
Photosynthesis occurs in the chloroplasts of plant cells and algae and in the cell membrane of certain prokaryotes.

SC.912.L.18.7	Identify the reactants, products, and basic functions of photosynthesis.	Moderate

1. Write the photosynthesis reaction. Describe what is happening in a sentence below it. Point out the reactants and products of the reaction.
2. Where do the photosynthesis reactions take place? What conditions are needed for this to happen?
3. Do stoma (stomata) play any part in photosynthesis? If so, what?
4. Complete a cause and effect chain describing the process of photosynthesis.



2. Write an SRE response. Latecia conducted an experimental investigation of the gas production of a water plant. She placed a beaker upside down over a water plant submerged in water and collected the gas that the water plant produced when kept in sunlight. After several days, a large bubble of gas collected in the upside-down beaker.



Given that the gas came from the water plant, what are the contents of the bubble of gas collected in the test tube?

f. The gas contains one of the products of respiration, oxygen.
g. The gas contains one of the products of photosynthesis, oxygen
h. The gas contains one of the products of respiration, carbon dioxide
i. The gas contains one of the products of photosynthesis, carbon dioxide

Statement	
Reason	
Evidence	

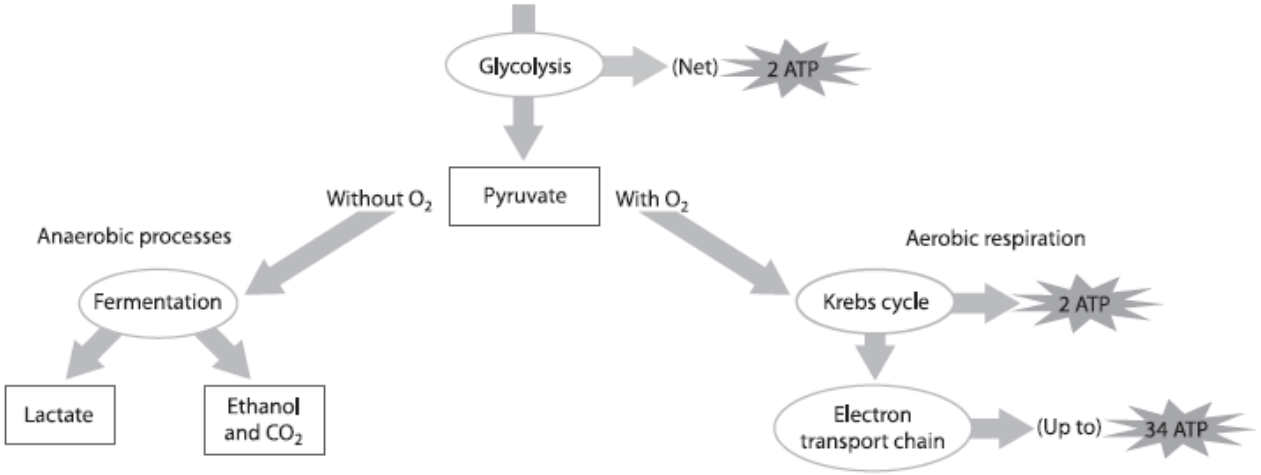
SC.912.L.18.8	Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration.	Moderate

Most of the foods we eat contain usable energy. Much of the energy in a banana, for example, is stored in proteins, carbohydrates, and fats. But before you can use that energy, it is transferred to ATP. Like in most organisms, your cells transfer the energy in organic compounds, especially glucose, to ATP through a process called cellular respiration. Oxygen in the air you breathe makes the production of ATP more efficient, although some ATP is made without oxygen. Metabolic processes that require oxygen are called aerobic. Metabolic processes that do not require oxygen are called anaerobic, meaning "without air."

Cellular respiration is the process cells use to harvest the energy in organic compounds, particularly glucose. The breakdown of glucose during cellular respiration can be summarized by the following equation:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy}$$

As the figure below shows, cellular respiration occurs in two stages.



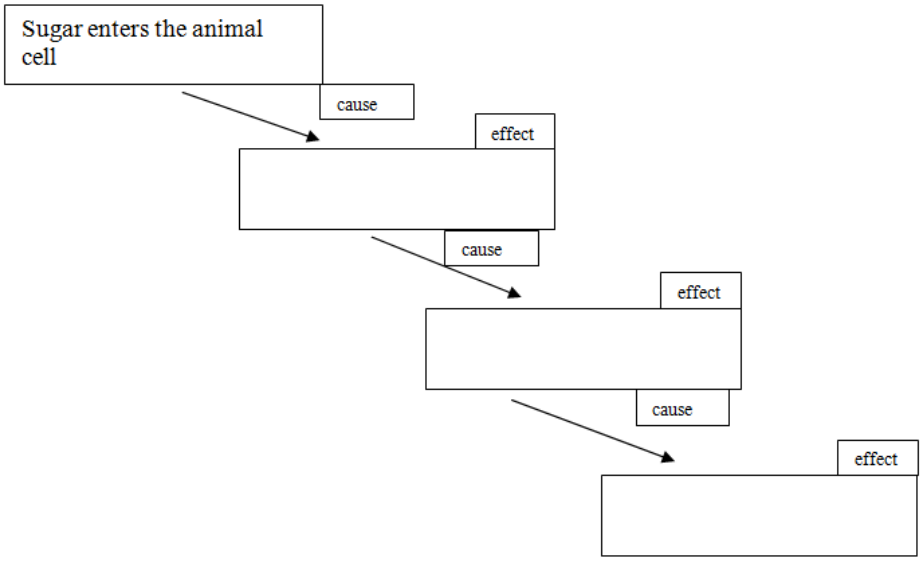
Stage 1: Glucose is converted to pyruvate, producing a small amount of ATP and NADH.
Stage 2: When oxygen is present, pyruvate and NADH are used to make a large amount of ATP. This process is called aerobic respiration. Aerobic respiration occurs in the mitochondria of eukaryotic cells and in the cell membrane of prokaryotic cells. When oxygen is not present, pyruvate is converted to either lactate or ethanol and carbon dioxide.

SC.912.L.18.8	Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration.	Moderate

1. Write the cellular respiration reaction. Describe what is happening in a sentence below it. Point out the reactants and products of the reaction.

2. Where does cellular respiration take place? What conditions are needed for this to happen?

3. Create a cause and effect chain describing the process of cellular respiration.



2. Create a Y-chart that compares/contrasts aerobic respiration and anaerobic respiration, which are two main types of cellular respiration. Be sure to include examples of each process.

3. Describe the differences and similarities between cellular respiration and fermentation.

4. Cells use sugars to produce energy through several different processes. Which process would provide the **most** energy for cell functions?

A. glycolysis
B. aerobic respiration
C. aerobic fermentation
D. anaerobic fermentation

5. Cellular respiration can be divided into two different biochemical processes: aerobic and anaerobic respiration. Which of the following is the major difference between aerobic and anaerobic respiration?

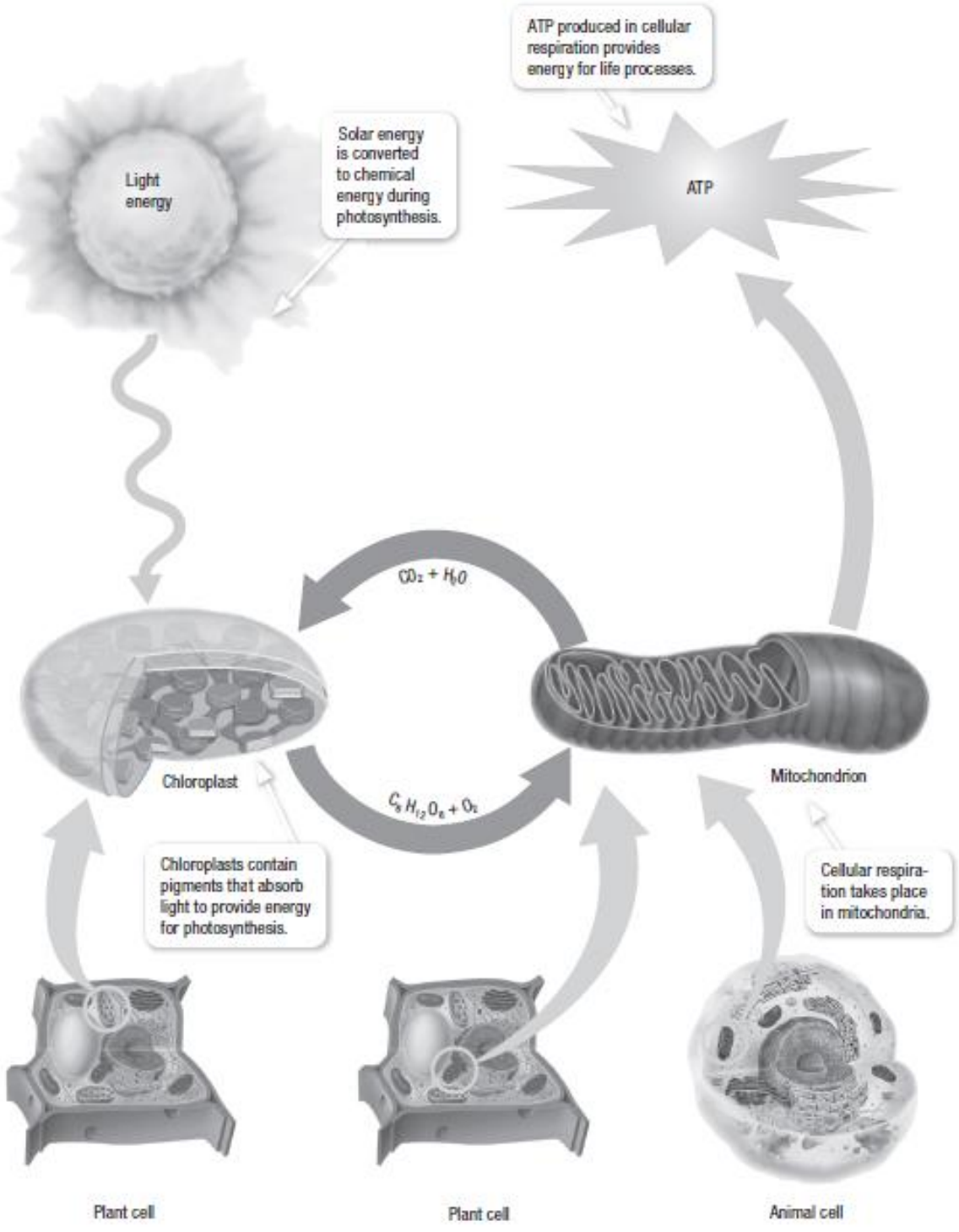
   a. Aerobic respiration forms lactic acid in the absence of oxygen.
   b. Aerobic respiration forms lactic acid in the presence of oxygen.
   c. Aerobic respiration breaks down glucose in the absence of oxygen.
   d. Aerobic respiration breaks down glucose in the presence of oxygen.

6. Running for a long period of time, such as during a marathon, can result in muscle fatigue. Which process is important to a runner at the end of a marathon?

a. the electron transport chain to produce ATP
b. the Krebs cycle to produce NADH and $FADH_2$
c. alcoholic fermentation to release carbon dioxide
d. lactic acid fermentation to produce ATP without oxygen

SC.912.L.18.9 AA	Explain the interrelated nature of photosynthesis and cellular respiration.	Moderate

Photosynthesis and cellular respiration are related processes. The diagram below shows how the substances produced by photosynthesis are used during cellular respiration and vice versa.



SC.912.L.18.9 AA	Explain the interrelated nature of photosynthesis and cellular respiration.	Moderate

1. Complete the following chart

	Photosynthesis	Cellular Respiration
Reactants		
Products		
Takes place in what cell organelle?		
Takes place in plants, animals or both (specifics)?		

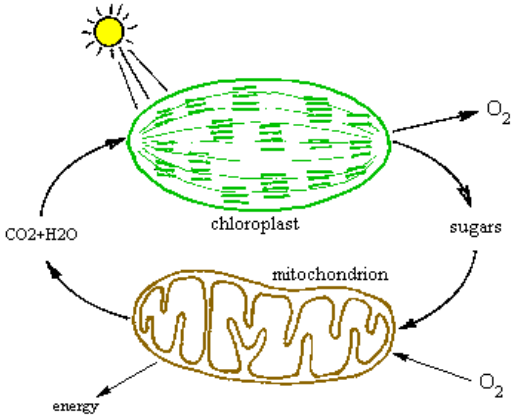
2. Create a flow chart that follows the path of one oxygen molecule from the time it enters a plant through the roots of a plant as water (H_2O) until it is eliminated as waste from an animal as water (H_2O).

3. Create a flow chart that follows the path of one carbon molecule from the time it enters the plant through the stoma as carbon dioxide (CO_2) until it leaves an animal's body as carbon dioxide (CO_2).

4. The chemical equations that sum up photosynthesis and cellular respiration have many of the same substances because these two processes are interrelated. Which two substances are the products of one of these processes and the reactants of the other process?

F. oxygen and water
G. glucose and water
H. carbon dioxide and water
I. carbon dioxide and glucose

5. The diagram below shows the cycling of cellular respiration and photosynthesis.



What are the possible effects if water (H_2O) is eliminated from this cycle?
a) Photosynthesis and cellular respiration will continue at a normal rate.
b) Photosynthesis would stop and cellular respiration would continue at a normal rate.
c) Photosynthesis would slow down and the rate of cellular respiration would increase.
d) Photosynthesis would stop and cellular respiration would slow down and eventually stop.

SC.912.L.18.10	Connect the role of adenosine triphosphate (ATP) to energy transfers within a cell.	High

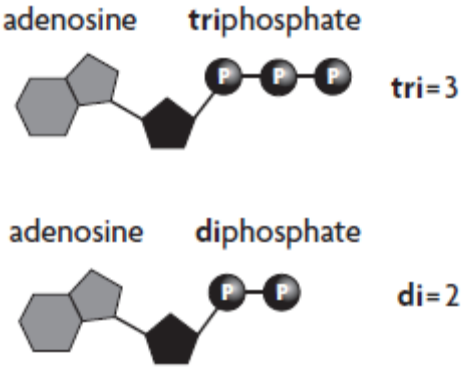
ATP, or adenosine triphosphate, is an important biological molecule. ATP is composed of a single nucleotide with two extra energy-storing phosphate groups. When food molecules are broken down inside cells, some of the energy in the molecules is stored temporarily in ATP.

Cells need a steady supply of ATP to function. When a log burns, the energy stored in wood is released quickly as heat and light. But in cells, chemical energy stored in food molecules is released gradually in a series of enzyme assisted chemical reactions. The product of one chemical reaction becomes a reactant in the next reaction. In the breakdown of starch, for example, each reaction releases energy. When cells break down food molecules, some of the energy in the molecules is released as heat. Much of the remaining energy is stored temporarily in molecules of ATP.

Like money, ATP is a portable form of energy "currency" inside cells. ATP delivers energy wherever energy is needed in a cell. The energy released from ATP can be used to power other chemical reactions, such as those that build molecules. In cells, most chemical reactions require less energy than is released from ATP. Therefore, enough energy is released from ATP to drive most of a cell's activities.

The three phosphate groups in ATP form a chain that branches from a five-carbon sugar called ribose. This phosphate "tail" is unstable because the phosphate groups are negatively charged and therefore repel each other. The phosphate groups store energy like a compressed spring does. This energy is released when the bonds that hold the phosphate groups together are broken. Breaking the outer phosphate bond requires an input of energy. Much more energy is released, however, than is consumed by the reaction. As shown in the figure below, the removal of a phosphate group from ATP produces adenosine diphosphate, or ADP. This reaction releases energy in a way that enables cells to use the energy. Cells use the energy to power metabolism. The following equation summarizes the reaction:

$$H_2O + ATP \rightarrow ADP + P + energy$$



SC.912.L.18.10	Connect the role of adenosine triphosphate (ATP) to energy transfers within a cell.	High

1. Create a main idea web using the reading with the term "ATP" in the middle.

2. Justify your answers with an SRE response.
Daphnia is a small water invertebrate that is almost transparent. Like all animals, *Daphnia* require chemical energy to live. It uses structures called gills to extract oxygen from the water to help it obtain chemical energy. Which statement below describes how they obtain chemical energy?

A. *Daphnia* absorb glucose from algae and then use fermentation to release chemical energy in the form of ATP.
B. *Daphnia* absorb pyruvate from algae and then use gluconeogenesis to release chemical energy in the form of ADP.
C. *Daphnia* absorb glucose from algae and then use cellular respiration to release chemical energy in the form of ATP.
D. *Daphnia* absorb glucose from algae and then use cellular respiration to release chemical energy in the form of NADP.

Statement	
Reason	
Evidence	

3. Justify your answers with an SRE response.
ATP provides the energy needed to carry out many cell functions. Which of the following processes does **not** require ATP?
A. making more ATP
B. muscle contraction
C. active transport of protein across a membrane
D. passive transport of oxygen across a cell membrane

Statement	
Reason	
Evidence	

SC.912.L.18.11	Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, and their effect on enzyme activity.	Moderate

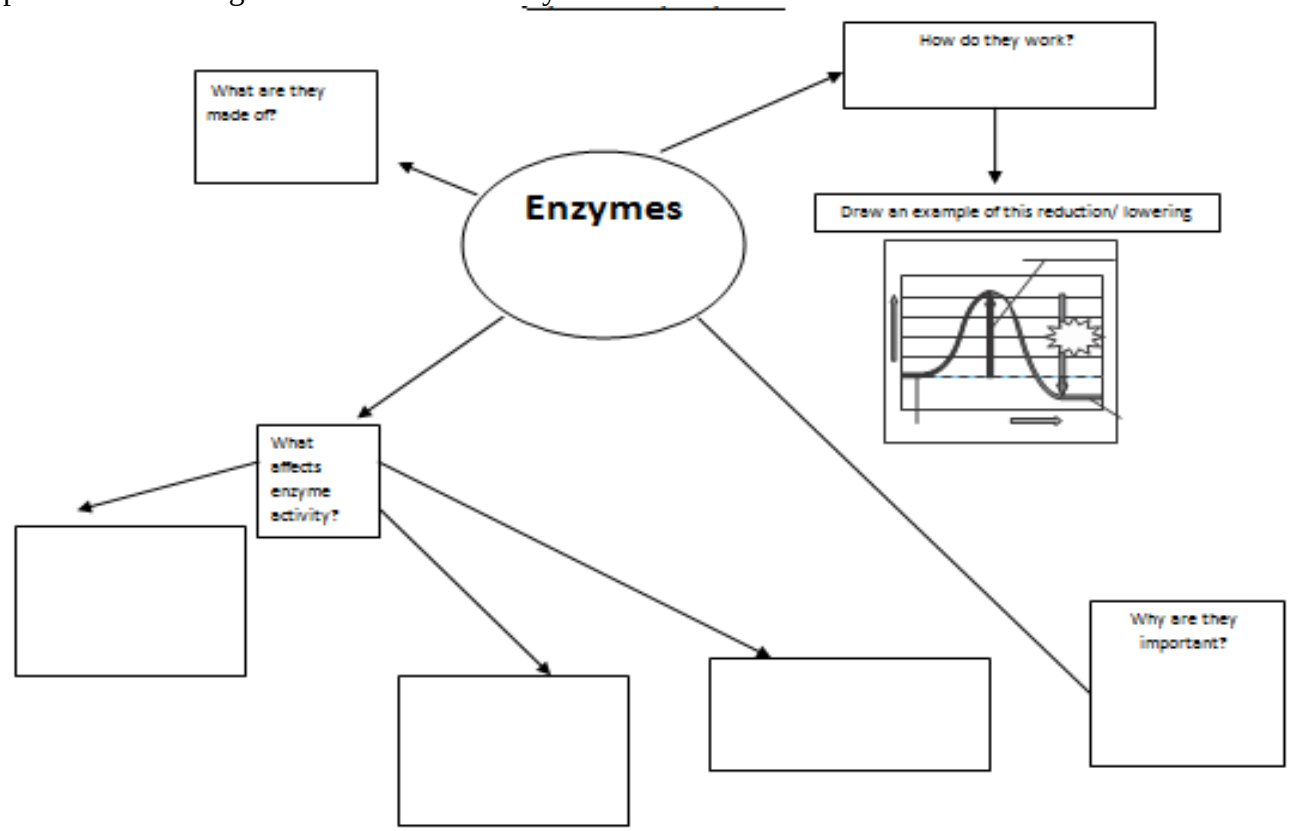
The chemical reactions in cells occur quickly and at relatively low temperatures because of the action of many enzymes. Enzymes are substances that increase the speed of chemical reactions. Most enzymes are proteins. Enzymes are catalysts, which are substances that reduce the activation energy of a chemical reaction. An enzyme increases the speed of a chemical reaction by reducing the activation energy of the reaction. Enzymes help organisms maintain homeostasis. Without enzymes, chemical reactions would not occur quickly enough to sustain life.

Enzymes assist biochemical reactions by bringing key molecules together. A substance on which an enzyme acts during a chemical reaction is called a substrate. Enzymes act only on specific substrates. An enzyme's shape determines its activity. Typically, an enzyme is a large protein with one or more deep folds on its surface. These folds form pockets called active sites. As shown in the figure below, an enzyme's substrate fits into the active site. An enzyme acts only on a specific substrate because only that substrate fits into its active site. Your body's cells contain many different enzymes, and each enzyme catalyzes a different chemical reaction.

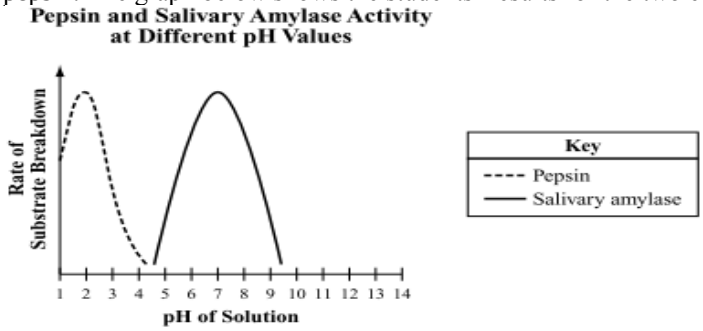
Any factor that changes the shape of an enzyme can affect the enzyme's activity. For example, enzymes operate most efficiently within a certain range of temperatures. Temperatures outside this range can either break or strengthen some of the enzyme's bonds, changing its shape. Moreover, each enzyme operates best within a certain range of pH values. A pH value outside this range can cause bonds in an enzyme to break, reducing the enzyme's effectiveness.

SC.912.L.18.11	Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, and their effect on enzyme activity.	Moderate

1. Vocabulary burrito the following terms: protein, enzyme, activation energy, catalyst.
2. Complete the following schema web about enzymes:



3. The students conducted experiments to study digestive enzyme activity. In the first experiment, the students observed the rate at which salivary amylase breaks down starch (the substrate) in solutions with different pH values. The students then performed the same type of experiment with pepsin. The graph below shows the students' results for the two experiments.



Which of the following statements best describes an effect of pH on the functioning of salivary amylase?

a. Salivary amylase functions most effectively at a pH of about 4.
b. Salivary amylase functions most effectively at a pH of about 7.
c. Salivary amylase cannot break down starch into maltose at pH values less than 7.
d. Salivary amylase breaks down protein instead of starch at pH values greater than 9.

4. An enzyme is at an optimum pH and temperature. What is another way that you could catalyze the reaction?
   a. Increase the pH
   b. Increase the temperature
   c. Increase the activation energy
   d. Increase the concentration of enzyme

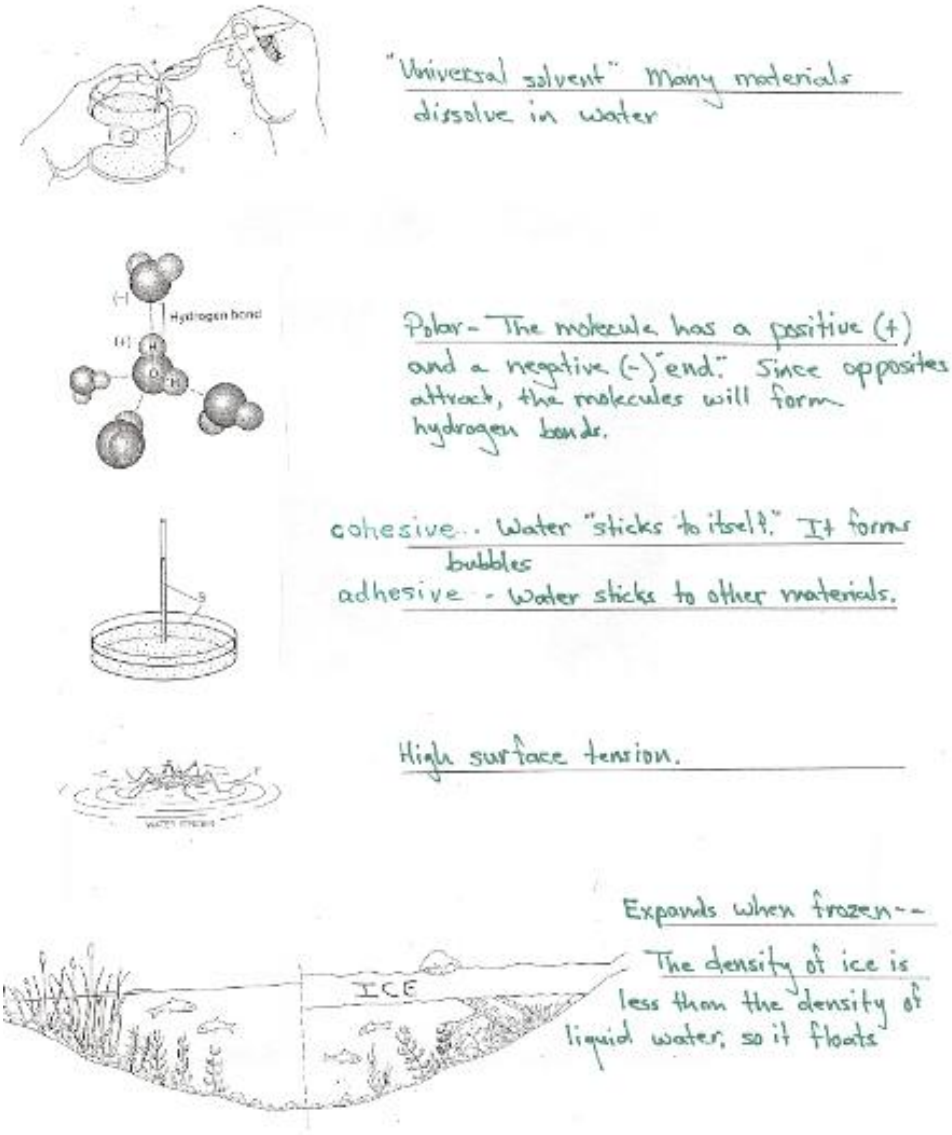
SC.912.L. 18.12 AA	Discuss the special properties of water that contribute to Earth's suitability as an environment for life: cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent.	Moderate

Water has many unique properties that make it an important substance for life. One such property is its ability to store heat energy. Water absorbs heat more slowly and retains this energy longer than many other substances do. Many organisms release excess heat through water evaporation. For example, humans cool themselves by sweating. The water vapor lost through the evaporation of sweat carries heat away from the body.

Two other important properties of water are cohesion and adhesion. Cohesion is an attraction between substances of the same kind. The hydrogen bonds between water molecules cause the cohesion of liquid water. Because of cohesion, water and other liquids form thin films and drops. Adhesion is an attraction between different substances. Water molecules are attracted to many other similarly polar substances. Adhesion powers a process, called capillary action, in which water molecules move upward through a narrow tube, such as the stem of a plant.

Another important property of water is its ability to dissolve many substances. A solution is a mixture in which one or more substances are evenly distributed in another substance. The polarity of water enables many substances to dissolve in water. Ionic compounds and polar molecules dissolve best in water. Nonpolar molecules, however, do not dissolve well in water.

The properties of water are summarized in the illustration below:



SC.912.L. 18.12 AA	Discuss the special properties of water that contribute to Earth's suitability as an environment for life: cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent.	Moderate

1. Define in your own words the following terms: cohesion, adhesion, polarity, surface tension, hydrogen bond, heat capacity.

2. Describe the cohesive nature of water – give an example that we see every day.

3. Describe the adhesive nature of water – give an example that we see every day.

4. Describe the polarity of water – give an example that we see every day.

5. Describe the surface tension of water – give an example that we see every day.

6. Describe hydrogen bonding of water – give an example that we see every day.

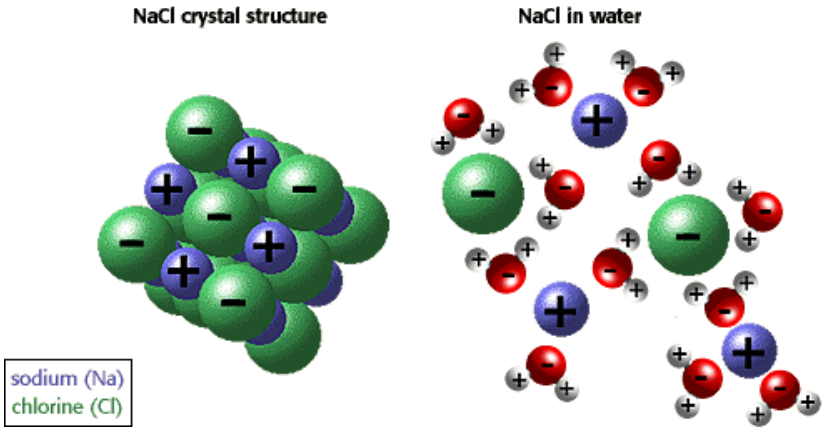
7. Predict how would the Earth (or cells) be different if water did not possess polarity?

8. Predict how would the Earth would be different if water did not possess a high heat capacity?

9. Many fish and aquatic plants can survive a cold winter because the layer of ice that forms at the top of a lake insulates the water below and prevents the lake from freezing solid. What unique property of water contributes to this effect?

a. Water absorbs heat when it evaporates and forms a gas.
b. Water expands and becomes less dense when it freezes.
c. Water molecules completely separate into ions in solution.
d. Water forms hydrogen bonds with ions and other polar substances.

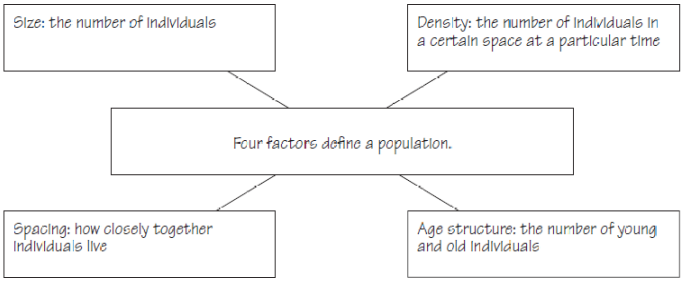
10. The figure shown below illustrates the crystal structure of NaCl and the interaction of NaCl with water.



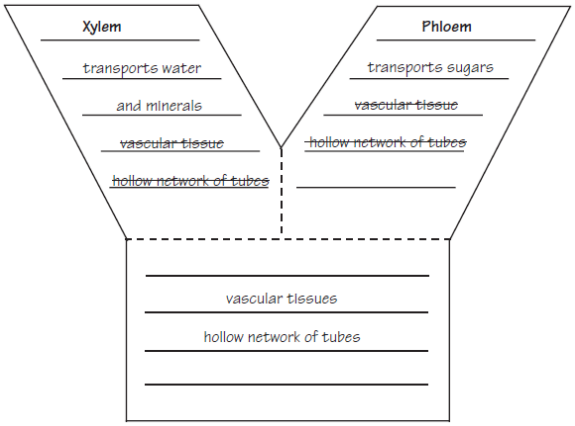
Water has many properties that are important for the sustainability of life on Earth. Which property of water is described in the above figure?
a. Water expands as it freezes.
b. Water is an excellent solvent.
c. Water exhibits cohesive behavior.
d. Water is a liquid at moderate temperatures.

Student Reference Sheet

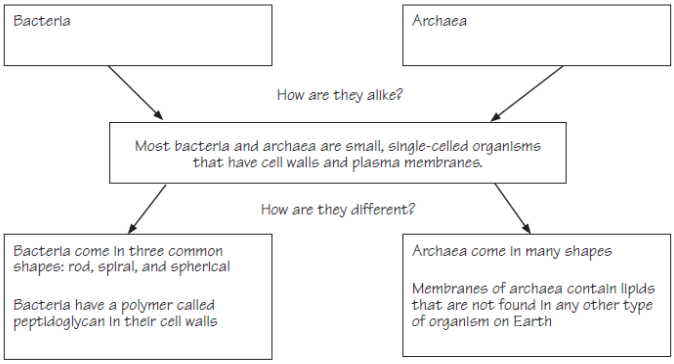
Main Idea Web



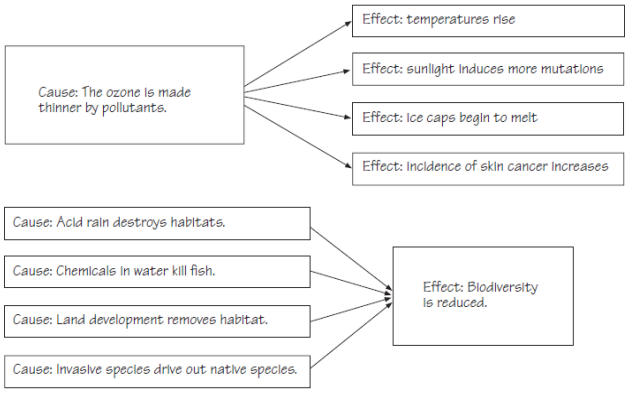
Y Diagram



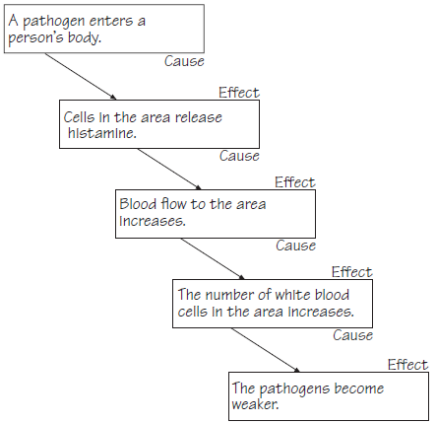
Compare Contrast Chart



Cause and Effect Diagram



Cause/Effect Chain



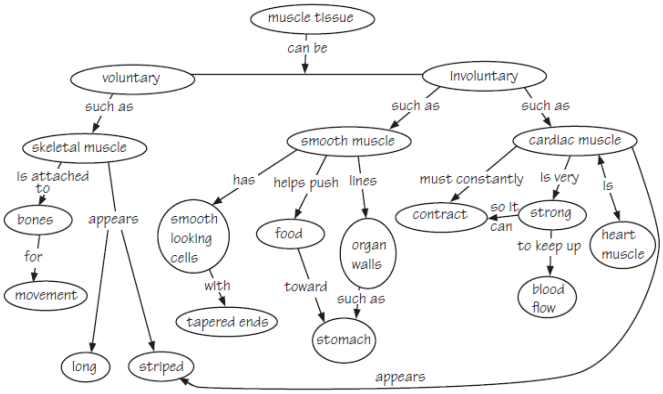
Vocabulary Burritos

Directions: Fold a standard 11x8 piece of paper and fold it in half, then fold it in half again in the same direction. The result should be a "burrito" with 4 sections.

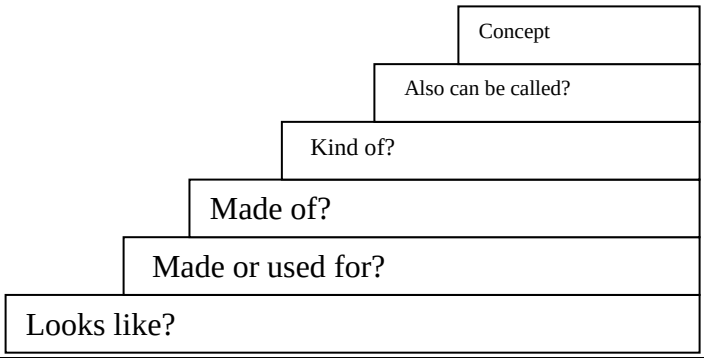
First section- Copy the term and its definition from the glossary of the text. Be sure to **underline** the term.
Second section- You need to write a definition in your own words.
Third section- Write a sentence using the term in proper context. Be sure to **underline** the term.
Fourth section- Draw a visual representation of the term

Word/Definition	*Def. in own words*	*Sentence/word*	*Picture*
Fee: Price paid for a professional service	Money paid to buy a good or service	My family had to pay a fee to get into Disneyland.	

Concept Mapping



Concept Ladder



Vocabulary Square

Word:	Synonym: Antonym:
Symbol/Pic:	Define (in own words):
Use in Sentence:	

Reciporcal Question and Answers: you will need to write questions which range in Depth of Dnowledge (DOK).

Example of Level One DOK Question Stems

Define	List	Recall	Match
Repeat	State	Memorize	Identify
Name	Describe	Label	Record
Give examples	Rewrite	Review	Tell
Restate	Recognize	Locate	Extend
Discuss	Explain	Find	Summarize
Express	Report	Paraphrase	Generalize

Example of Level 2 DOK Question Stems

Dramatize	Use	Translate	Interpret
Practice	Compute	Change	Prepare
Operate	Schedule	Pretend	Demonstrate
Imply	Relate	Discover	Infer
Apply	Illustrate	Solve	
Diagram	Question	Analyze	Criticize
Distinguish	Inventory	Differentiate	Experiment
Compare	Categorize	Select	Break down
Contrast	Outline	Separate	Discriminate
Divide	Debate	Point out	
Compose	Draw	Plan	Modify
Design	Arrange	Compile	Assemble
Propose	Suppose	Revise	Prepare
Combine	Formulate	Write	Generate
Construct	Organize	Devise	

Example of Level 3 DOK Question Stems

Judge	Rate	Choose	Conclude
Value	Justify	Assess	Summarize
Predict	Decide	Select	
Evaluate	Measure	Estimate	

Prove your answer. Support your answer.

Explain your answer. Why or why not?

Give reasons for your answer.

Why do you feel that way?

SRE: Statement – Reason – Evidence

This is used in usually in tandem with a mutltiple choice question. It will help you explain your answer and truly show if you understand a topic.

(S) – Statement – Restate the correct answer in a complete sentence. Do not just write "C."
(R) – Reason – Explain why you think your statement is true. Use the stem, "This statement is true because…"
(E) – Evidence – Cite evidence that supports your reasons. Examples: data from labs, facts, quotes, rules, examples, text.

Statement	
Reason	
Evidence	