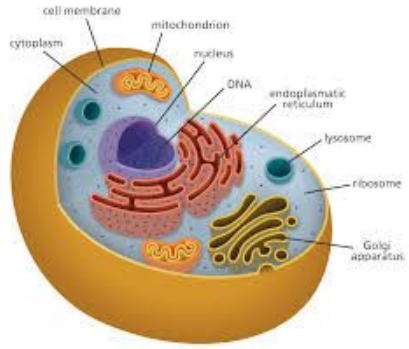
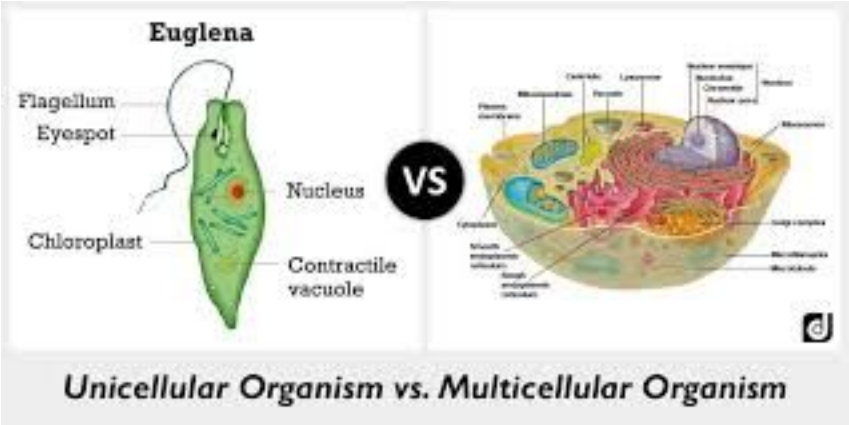
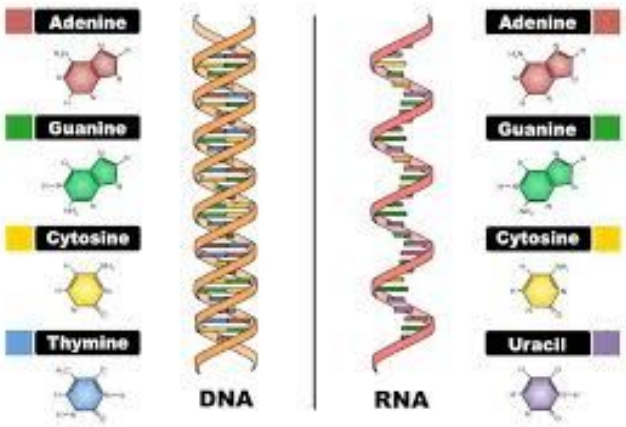
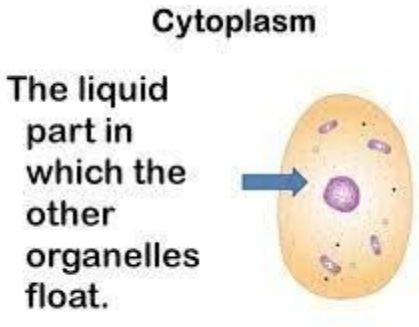
Basic biochem

The first thing you need to know about biochem is that
An organism is a living thing such as animals,plants ,fungi ,protist or bacteria.
A cell makes up the basic unit of life, A unicellular organism such as bacteria has a
Single cell to carry out all life functions.
Multicellular organisms such as animals and plants may have trillions of
Cells with specialized functions in that organism's life cycle. The cells work together
To carry out the organism's function.Homeostasis is the process of maintaining a stable internal environment.But both unicellular and multicellular organisms may reproduce sexually or
Asexually. Plants reproduce asexually were as animals reproduce sexually.









The Plasma membrane or (Cell membrane) is a molecular bilayer that encloses a cell
Next is your Cytoplasm this is the substance that fills the cell's internal volume mostly
Being water. (Remember that the liquid inside of the cell is Cytoplasm).
DNA is the molecule that stores genetic information which allows the cell to pass it on
To future generations Genes, ANd this Is where RNA comes into play to be copied onto
Soon The RNA Is moved to the Ribosome which is the smallest organelles within the cell,
You can find them all throughout the Cytoplasm, but the purpose of the Ribosome is
To decode the information in the MRNA to assemble amino acids into proteins

Part 2

Prokaryotic cells are unicellular organisms that lack membrane bound
Organelles.
Eukaryotes are much more complex they have membrane-bound organelles located within the plasma membrane.
Prokaryotic cell is much smaller and simpler than a Eukaryotic cell, lacking a nucleus
And other membrane bound organelles.
All multicellular organisms
Are Eukaryotes so all multicellular organisms have cells with nuclei and organelles.

	Prokaryotic	Eukaryotes
Nucleus	No	Yes
Cell Number	Unicellular	Unicellular or multicellular
DNA	Circular chromosome found in cytoplasm.	Linear chromosomes contained in nucleus.
Examples	Bacteria	Plants, animals, fungi, protists
Plasma membrane	yes	Yes
Membrane-bound organelles	No	Yes
Ribosomes	Yes, small	Yes, Large
Cell wall	Yes	Present in plants and fungi
Cell Diameter	1-10 micrometers(ym)	10-100 micrometers(qm)

1) **What makes up the basic unit of life**

-DNA
-Cells
-Atom
-Ribosome

2) what is the difference between
Prokaryotic and Eukaryotes

- **Is it because of the size**
- **Is it do to the lack of membrane bound Organelles.**
- **Eukaryotes has not cell nuclei**
- **Does it have something to do with the cytoplasm.**

3) what does Rna do?
-Help code the information from one Dna to another Dna
-does RNA turn the information into proteins
-does RNA than dna into proteins
-can Rna go inside the ribosome

4 what are some characteristics of Prokaryotic cells that are help the body And some thing that the cell does not help with.

_____
_____
_____
_____

5 why is a cell the basic life unit

_____
_____
_____
_____

Genes and proteins synthesis

In genes and proteins synthesis you dive into learning about what Dna breaks down to In smaller componts you learn with it means for each Nucleotide to be piece of a lot of Nucleotides to make up dna.

Deoxyribonucleic acid or DNA Is the molecule that stores genetic information for living things.

nucleotides are made up of substances that make up DNA each nucleotide consists of a sugar a phosphate group and a nitrogen base that varies among nucleotides.

These long chains of nucleotides can be consistent of 4 different nitrogen bases adenine,cytosine,thymine,guanine.

Your DNA is usually found in the form of double strands made up of two molecules joined by bonds in the middle of the bases the DNA bases can bind only a specific way

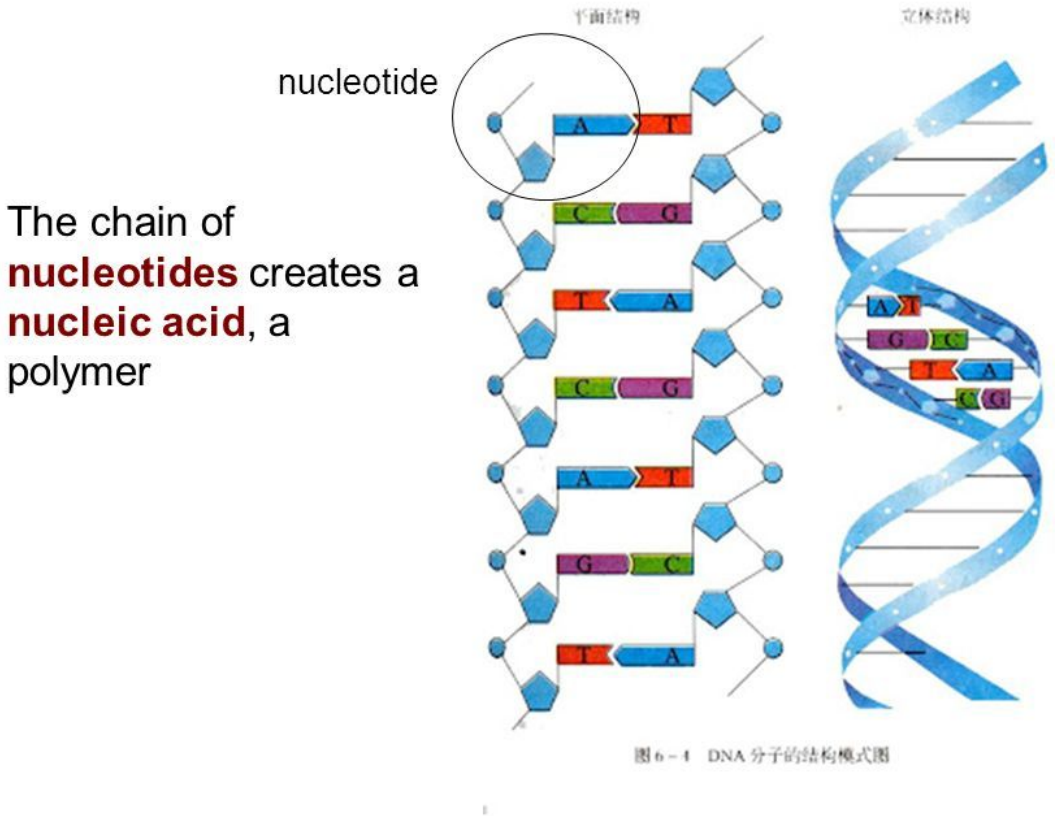


图 6－4 DNA 分子的结构模式图

adenine only can bond with thymine, and cytosine can only bond with guanine The rules of this bondage is called (complementary base pairing) .

Hydrogen bonds between nitrogen bases hold two Dna strands together as a double srand.A codon has a sequence of three nucleotide bases that codes for a specific amino acid

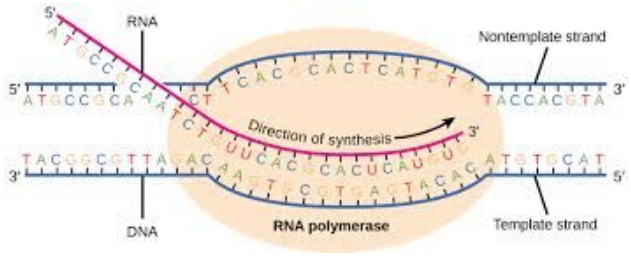
In the chain.

A gene can be a stretch Dna that contains the information needed to make a protein
Although species differ in many of their genes, the genetic code is the same for all most.
All organisms on Earth. Thus stating that there is a common origin for all life.
Your chromosome is a single piece of Dna that's made up of genes.

Ribonucleic acid or Rna is a single stranded nucleic
Acid and contains a uracil base (U) in place of the thymine (T) found in DNa.
Transcription is the process in which genetic information from Dna is copied to mRna.
The sequences of junk Dna may be snipped out of an mRna transcript out of an mRna transcript by enzymes in the nucleus.

(Translation from RNA to protein)

A protein consists of one or more long chains of amino acids, the chains fold to
Give it a three dimensional
Structure.
Translation is the process in which the base sequence in a strand of mRna is
Converted or translated into the amino acid sequence of a protein.
The ribosome of eukaryotic cells may be found free in the cytoplasm or
Bound to the rough endoplasmic reticulum. rRna and proteins make up each ribosome.
tRna stands for transfer Rna, because it trainsfers free amino acids to the growing peptide chain on the ribosome.



An anticodon is a sequence of three tRna bases that binds to a complementary mRna codon. tRna and rRna are also transcribed from genes in the nucleus
Some amino acids are coded for by more than one codon. For example histidine
Is coded for by both CAUand CAC.

A polypeptide is a chain of amino acids ie. a protein

The order of amino acids in a protein is only one of the factors that determine the Proteins properties. Once
The chain has formed, it's folds in a specific way giving it a particular three-Dimensional shape.

The shape of the protein is very important in allowing it to Function properly. Disruption to the shape of a protein can change The protein's function or make nonfunctional.

Special start and stop codons on mRna tell the ribosome where translation Should begin and end .

(Protein synthesis in the cell)

The central dogma of molecular biology states that information in Dna is translated to protein. In prokaryotic cells which lack nuclei, transcription and translation to protein.

In prokaryotic cells which lack nuclei transcription and translation both take place in the cytoplasm
In eukaryotes ribosomes may be found either free in the cytoplasm or bound to The rough endoplasmic reticulum (ER)
There are two kinds of ER rough and smooth. Smooth ER is involved in the Production of fatty acids and lipids. No ribosomes are attached to smooth ER.
A vesicles from the ER to the Golgi apparatus and then to the plasma membrane.
The Golgi apparatus is an organelle made up of many stacks or folds of Membrane. It accepts proteins from the ER modifies the proteins package them into vesicles on the side nearest the plasma membrane.

1) why do you think that complementary base pairing happens?
- because of the number of hydrogenbonds between the two sets
-because guanine and cytosine are good friends
- because of the way Dna forms

2) DNA is usually found in the form of

- **Double strains**
- **Single strain**
- **Globe**
- **Single molecule**

3) why deos the shape of protein matter?

- **To ensure proper function**
- **Because nature likes to have shape**
- **Theirs a way the protein need thing to pass by them.**

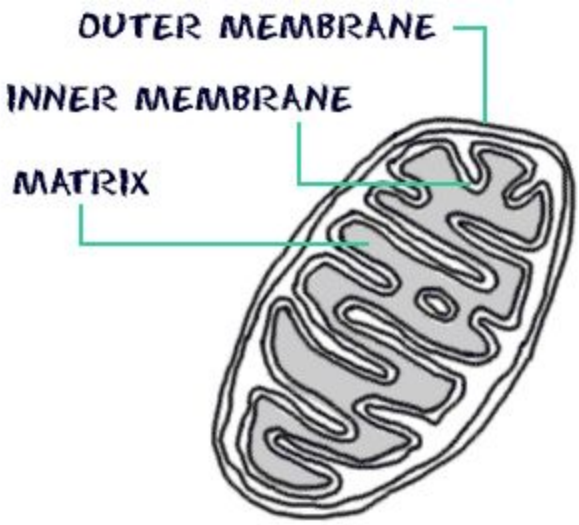
4) why do you think some codons are coded by more than one codon. For example histidine Is coded for by both CAUand CAC and what would be the result of just one Half of it being coded.

5) why does it make a diffrence to fold the codons and if so how does this help

BIOENERGETICS: ATP, CELLULAR RESPIRATION, and PHOTOSYNTHESIS
BIO.A.3.1.1, A.3.2.1,A.3.2.2
ATP and Cellular Respiration
How does a cell provide energy to power its metabolic reactions?

Reactions release energy, but many consume energy. How does the cell provide energy to power its reactions. The body uses **ATP** as energy and it provides energy for the processes in Cellular respiration. It is known as the “energy currency” in cells. It has 3 Phosphate groups, when the end phosphate group is disconnected, it releases energy and become **ADP**. This creates a repeating cycle of ATP being broken down and re-formed in cells.

ATP is being used over and over in the process of **CELLULAR RESPIRATION**. In the first stage of Cellular Respiration, glucose molecules are being broken down into smaller molecules during glycolysis (the splitting of sugars). This process occurs without the use of Oxygen and only 2 molecules of ATP form from the energy released from a glucose molecule. This is an Anaerobic respiration & it releases less energy (ATP) stored in glucose than aerobic respiration does.



In the second and third stages, aerobic respirations take place in the **mitochondria,** which are organelles in animal & plant cells that produce energy/ATP for the cell. The process happens in the Matrix of the mitochondria. In the matrix enzymes help break down the products of glucose further in a series of chemical reaction, from this carbon dioxides are produced. During the first 2 stages, Hydrogen ions are building up in the matrix and at the third stage, these ions flow across the inner membrane of the organel. As this is happening, an enzyme called ATP synthase is powered, and this enzyme is attached to the inner membrane. It

synthesis ATP from ADP and phosphate. ATP is produced as the ions exit the matrix.

STAGES OF AEROBIC CELLULAR RESPIRATION

Stage	Description	Number of ATP per Glucose
I	Glucose is broken down.	2
II	Carbon compounds are converted to CO_2.	2
III	ATP synthase produces ATP.	32–34
Total		36–38

Tips:

- Think of Mitochondria as a powerhouse of the cell, it's like a battery for an electronic device, energy (ATP) in the battery or mitochondria being used to keep it functioning.
- Aerobic respiration is the process of Cellular Respiration with oxygen and Anaerobic respiration is the process without oxygen. An- without

Questions

1. **How many layers does the mitochondria have?**

a. **5**
b. **1**
c. **4**
d. **2**

2. **What is the definition of Glycolysis?**

a. **Splitting of cells**
b. **Splitting of tissues**
c. **Splitting of mitochondria**
d. **Splitting of sugars**

3. **What's the Difference between Aerobic Respiration and Anaerobic Respiration?**

   _____

4. **Why is Mitochondria so important for the cell?**

   _____

5. **What is the product of Cellular Respiration?**

   _____

Answer key

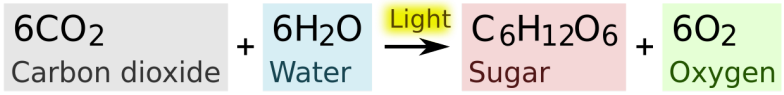
1. **2, the inner and outer membrane of the Mitochondria**
2. **D. Splitting of sugars.**
3. **Aerobic Respiration requires oxygen while Anaerobic respiration doesn't need oxygen.**
4. **Mitochondria is important because it is the source of energy of the cell, this organelle creates ATP which is the currency of energy for all life.**
5. **The product of Cellular Respiration are carbon dioxide and water.**

BIO .A.3.1.1, A.3.2.1, A.3.2.2

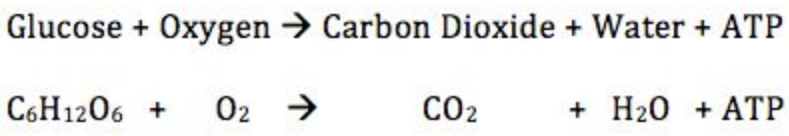
Photosynthesis

Where do we receive oxygen and food from?

Photosynthesis is a process that converts light energy from the sun into chemical energy stored in sugars like glucose. Photosynthetic organisms use sunlight to produce glucose and oxygen from carbon dioxide and water.



The glucose made from photosynthesis can be used right away or saved for later. Plants can carry cellular respiration like animals do. The equation for cellular respiration is opposite of photosynthesis.



Chloroplasts are the organelles where photosynthesis takes place in cells. A chloroplast have have 2 membranes that surround stomata/ inner fluid, and in the stromata there are disks called thylakoids. These disks contain chlorophyll, this pigment captures energy from sunlight & this is the energy that drives photosynthesis. The leaf cells take carbon dioxide through openings called stomata and plants open up their stomata to take in carbon dioxide and release oxygen.

There are 2 stages of Photosynthesis and it occurs in the different parts of the chloroplast. The first stage is a light dependent, this is happening inside the thylakoid, where the chlorophyll takes in sunlight and, water molecules are being split to prepare for the next stage. ATP and other energy-rich molecules are produced and oxygen is being released from the leaf. This is the light-dependent reaction.

The second stage is the light-independent reaction (also called Calvin cycle) require no light. It takes place in the stroma of the chloroplast and this reaction depends on the energy produced by the light-dependent reactions. Organic compounds (contain carbon and hydrogen, they are used to build glucose and other important molecules) and Carbon dioxide are being converted into organic molecules such as glucose.

Tips: - Plants can do both photosynthesis and cellular respiration.

- Photosynthesis uses Carbon dioxide and water to make glucose and oxygen

Questions

1. **Which one is the product of photosynthesis?**
a. **Glucose**
b. **Carbon Dioxide**
c. **Water**
d. **Chlorophyll**
2. **Which part of the chloroplasts absorb light and gives leaves their color?**
a. **Stomata**
b. **Thylakoids**
c. **Vacuole**
d. **chlorophyll**
3. **What happens during the first stage of photosynthesis?**
- **_____**
4. **Scientists supplies plants with water that has heavier oxygen isotope, oxygen-5. Which product of photosynthesis will have this isotope? why?**
- **_____**
5. **What is the relationship between photosynthesis and cellular respiration? Why are they so important for each other?**
- **_____**

Answer key

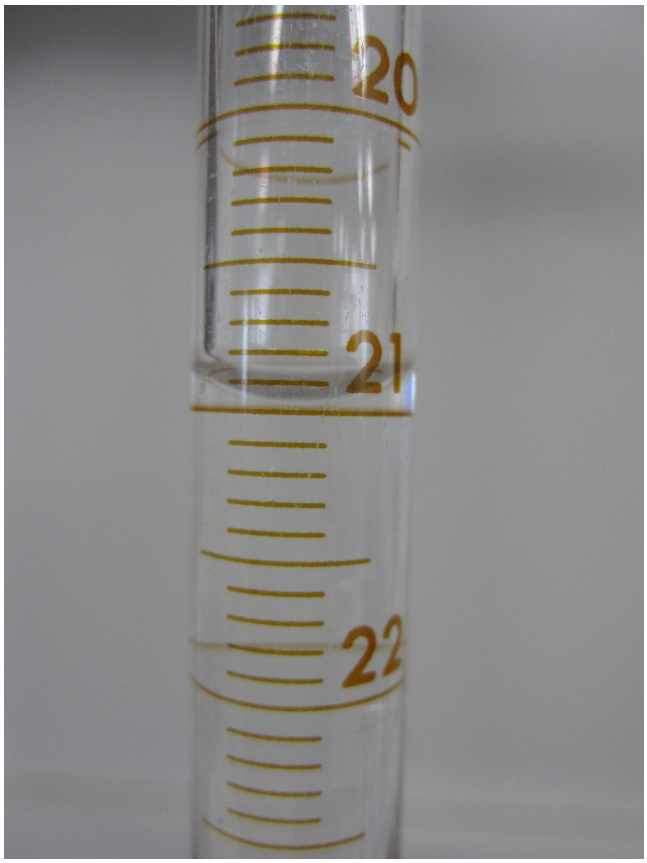
1. **A. Glucose, it's the product of the process of photosynthesis.**
2. **D. Chlorophyll**
3. **During the first stage of photosynthesis, light is being absorbed and water molecules are being split into smaller molecules. This creates oxygen and organic compounds for the next stage of photosynthesis.**
4. **Oxygen will have this isotope because it comes from the water and as water come in its molecules are being split creating Oxygen and other compounds.**
5. **Photosynthesis needs the products of cellular respiration which is water and carbon dioxide and cellular respiration needs the product of photosynthesis, which is oxygen and glucose. If one of either is not present then nothing will be left.**

Chemical Basis of Life:

A.211:

Introduction:

Most of an organism's cells are made up of water. Human bodies have on average, over 65% containing water. Water molecules consist of two hydrogen and one oxygen atom. They are bonded together through **covalent bond**. Covalent bond is bonded through atoms that share the electrons. However, this may not be the case as covalent bonds do not always share the same electrons equally. Different parts of water carry different charges, making it a polar molecule. Since water molecules are polar, they form **hydrogen bond interactions** with each other. Water can be considered the Universal Solvent as it can dissolve many other polar and ionic substances. However, some substances cannot dissolve in water, such as **Lipids**. Lipids are composed of nonpolar molecules which means that it is insoluble in water. The hydrogen bonding interactions between the water molecules give water the property of **cohesion**. Cohesion is the tendency of water molecules to attract and stick together. Whereas **adhesion** is the tendency for water to stick to other surfaces. **Meniscus** is the curve of water near the surface because of adhesive forces. (Refer to the picture below)

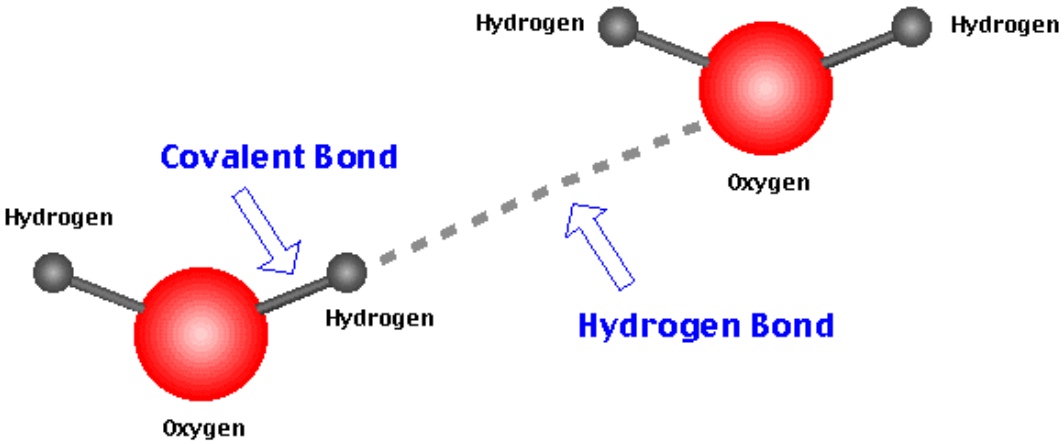


With cohesion and adhesion, plants are able to move water through their own roots due to their ability that allows liquid to flow against gravity. This is known as the **capillary action, or capillarity.** Water also has a high capacity to absorb and hold heat, known as **specific heat**. Specific heat is the amount of heat energy needed to increase temperature of the substance. When a liquid absorbs enough heat, evaporation occurs changing the liquid into a gas. When water reaches its **freezing point** the water molecules begin to arrange itself into an orderly

structure leaving more space in between. Due to ice being less dense than liquid water, it begins to float.

Tips for Testing:

- Water is consisted of 2 Hydrogen and 1 Oxygen atoms combined through **covalent bond** however, other water molecules combined together are through **hydrogen bonds**
    - To remember this, try drawing a “v” shape and always remember oxygen is at the center.
    - Be careful though, the atoms are bonded through **covalent bond**, *not* **hydrogen bond!** Hydrogen bond is when water combines with another water molecule!
        - **If you are still confused, refer to the picture below.**



- Water is considered to be the **Universal Solute** as it can dissolve many other polar/ionic substances.
    - However, remember that water **cannot dissolve nonpolar molecules** like Lipids!

- **Cohesion** is when water molecules attract and stick together. Whereas **adhesion** is when water sticks to surfaces.
    - As a result of both, **meniscus** is the curve of the water near the surface.
    - Think about when an umbrella reflects water off of you. It forms droplets so that it can go off the umbrella. **Cohesion** attracts the water molecules together.
    - Continuing with the last tip, think about how the water still remains on the umbrella even after it stopped raining. **Adhesion** is when water sticks to the surfaces.

- **Capillary action** is when liquids move against its gravity, ie. roots of a plant.
    - Try drawing a water going upstream!

Practice Test:

A plant is transporting water through its roots, it goes up the root despite going against its gravity. What is this known as?

A) Capillary Action
B) Cohesion
C) Adhesion
D) Water

Answer: A is correct because Capillary Action is when liquids move against its gravity.

A team of scientists discovered that water droplets are sticking to the surface of the house after a slight rainfall. What is this known as?

A) Cohesion
B) Adhesion
C) Salt
D) All of the above

Answer: B is correct because Adhesion is when water has the tendency to stick to a surface.

(Continue off of the previous question) After analysing the water droplets further, they realized that the water droplets are slightly being pushed together. Combining together to form a bigger droplet. This is known as?

A) Meniscus
B) Adhesion
C) Covalent Bond
D) Cohesion

Answer: D is correct because Cohesion is when water has the tendency to attract other water molecules and stick together.

Another scientist, Holly, analyzes the river and notices that there are ice sheets floating downward. She also notes down in her notebook that the sheets of ice were slowly floating downstream. What is the main cause of this and what characteristics does the ice have?

_____
_____
_____
_____

_____

Answer: The main cause of this would be the freezing point of water being just around 0 degrees Celsius. If the ice is moving slowly downstream, it can be concluded that the ice is highly dense.

Holly decides to take a sample of the river water with a jar. She then pours the contents over to a test tube but notices that the murky water was forming a weird curve at the very top of the tube. She measures 5mL of murky water with the graduated cylinder. What is this known as and what is the cause of it?

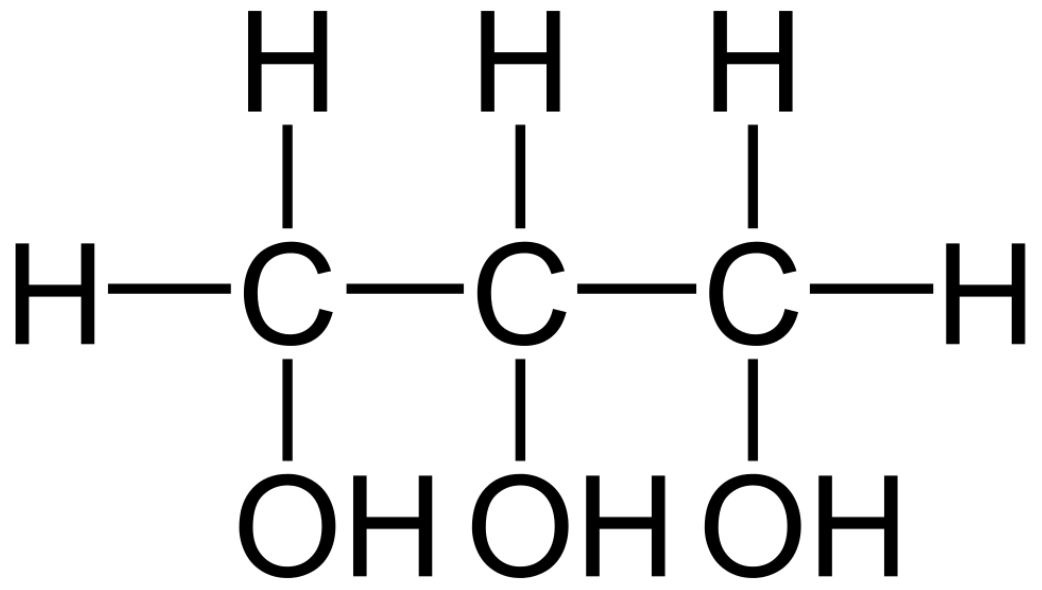
_____
_____
_____
_____
_____

Answer: This is known as meniscus, meniscus is when the adhesive force between the water molecules and the container. Forming the oddly shaped curve at the very top of the tube.

A 221, A222, A223:

Introduction:

When atoms share the same electrons, covalent bonds are formed. Hydrogen atoms can form single covalent bonds with another atom and Oxygen can form up to two bonds. So what is special about Carbon? Carbon can hold up to four covalent bonds! Carbon atoms are stable when all of the four “slots” are filled. Carbon can hold four hydrogen atoms, the organic molecule is known as methane. **Organic molecules** contain carbon atoms that are bonded to hydrogen atoms. **Covalent bonds** can be single, double, or triple bonds. For a single bond, a pair of electron is shared between the two atoms. For a double bond, two pairs are shared and three are shared in a triple bond. The unique structure of carbon allows formation of **Macromolecules**. Macromolecules are large complex molecules with chains of smaller molecules. Lipids would be an example of a Macromolecule. **Lipids** include fats, oils, waxes, and sterols. Fatty acid “tails” are connected to the glycerol molecule and produces a long chain of carbon atoms connected to each other. Lipids consist almost entirely of hydrogen and carbon atoms with few oxygen atoms. (Refer to the picture below for overview of Lipids)



Fatty acids can be saturated or unsaturated. Saturated fatty acids have carbons which have maximum number of single bonds. Unsaturated fatty acid has fewer than maximum number of bonds. Lipids have important functions. **Energy Storage** Organism convert organic molecules to lipids to store energy. **Cell Membranes** Phospholipids help to form the plasma membrane for the cell. Phospholipids contain a polar phosphate attached to glycerol. **Insulation and protection** Fats help insulate the body and protect the major organs. **Chemical messengers** Class of lipids, the sterols, act as chemical messengers or hormones. The plasma membrane is formed up of **phospholipids**. Phospholipids are major components of cell membranes. Lipid portions are nonpolar, therefore, impermeable to water. Two fatty acid chains make up the nonpolar tails, while the phosphate group is the polar head. The fatty acid tails are nonpolar whereas the head is polar. **Carbohydrates** consist of carbon, hydrogen, and oxygen. Glucose is a compound used by cells for energy. Glucose is the simplest type of carbohydrate, a monosaccharide. Monosaccharides can be linked up together in chains to form bigger macromolecules. **Monomers** are smaller building block molecules that combine to form large polymers. Glucose can link together to form various polysaccharides such as starch, glycogen, and cellulose. **Starch** is a complex carbohydrate produced by plants to store their energy. **Glycogen** is the human equivalent of starch, which can be found in the livers and muscle. **Cellulose** is a structural carbohydrate that makes the plant cell walls. Carbohydrates also have many different functions. **Cellular respiration** Carbohydrates are digested to glucose, and used in cell respiration. **Energy storage** Glycogen and starch can store energy for animals and plants. **Structure** Cellulose gives strength to the Cell wall. Organisms have specific chemical reactions that join monomers together and breaks the polymers apart. Dehydration synthesis occurs when two monomers join together. **Dehydration synthesis** joins monomers together to form larger polymers and water is produced as a by product. During Dehydration synthesis, the two -OH groups join together losing the hydrogen atoms and one oxygen atom. **Hydrolysis** is when organism need to break down polymers into monomers. In this reaction, the -OH groups are added back from the water molecule.

Tips for Testing:

- **Organic Molecules** contain carbon, hydrogen, and oxygen.
    - **Carbon** can hold up to four single covalent bonds
        - **Carbon can have four covalent bonds** with hydrogen atoms, forming molecule methane

- **Covalent bonds** can be single bonded, double bonded, or triple bonded.
    - Electron is shared during covalent bonds, one for single bonds, two for double bonds, and three for triple bonds.

- **Carbon's unique structure allows Macromolecules to be formed.**
    - A lipid is a macromolecule as it composed of smaller molecules to form a bigger molecule.
    - Think about it like a list of ingredients to make the cake.

- **Lipids** have important function such as: **Energy Storage, Cell Membranes, Insulation and Protection to the cell, and Chemical Messengers.**
    - Think of it as the bank, or the guardian to the cells in the body.

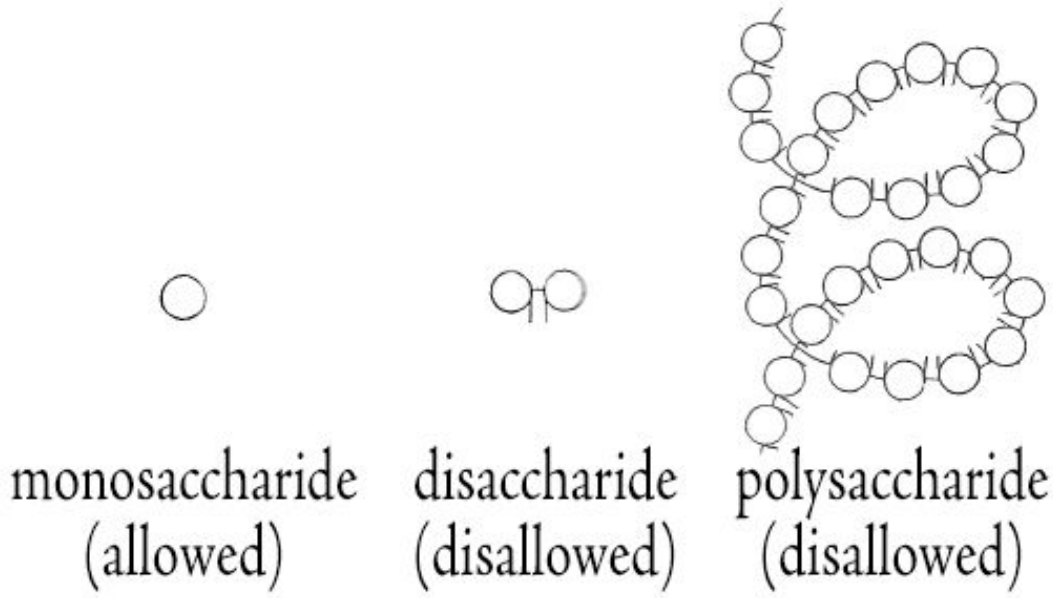
- **Plasma membrane** is *formed* up of **phospholipids**, they are a major component to the cell membrane.
    - Phospholipids are impermeable to water.
    - There are two fatty acid tails and a polar head that make up a phospholipid group.
    - Think of it like a "v" with the vertex of the "v" being the polar head.

- **Carbohydrates consist of Carbon, Hydrogen, and Oxygen.**
    - Glucose is an example of a carbohydrate.
    - Glucose is also a monosaccharide.

- A **monosaccharide** can *bond* together through **dehydration synthesis** and form a larger compound such as a polysaccharide.
    - Dehydration synthesis removes the -OH creating water as a byproduct.
    - Compounds can also *separate* through **hydrolysis.**
        - The -OH group is restored using a water molecule.

- **Monosaccharides** consist of molecules grouped together.
    - Monosaccharides are, **Glucose, Fructose and Galactose.**

- **Polysaccharides** consist of monosaccharides grouped together.
    - Polysaccharides are, **Glycogen, Starch, and Cellulose.**



- **Monomers** are the smaller molecule building blocks to form a <u>larger molecule.</u>
    - Disaccharides would be the monomer to polysaccharides.

- **Carbohydrates** consist of the functions: **Cellular Respiration, Energy Storage, and Structure.**
    - **Cellular Respiration** allows carbohydrates to be <u>digested for glucose.</u>
    - **Energy Storage** allows <u>animals and plants to store energy.</u>
        - Glycogen stored in the muscles and liver can be broken down into glucose.
        - Plant starches like wheat and potato can be ingested for energy.
    - **Structure** allows Cellulose to <u>strengthen the plant cell walls.</u>

Practice Test:

The Monomer of a Polysaccharide is:

A) Monosaccharide
B) Disaccharide
C) Both
D) All of the above

Answer: B is correct because the monosaccharide is the monomer of a disaccharide.

How many covalent bonds can carbon form with Hydrogen atoms? Also, what is special about Carbon and Macromolecules?

A) Carbon can form 3 covalent bonds with Hydrogen atoms, Carbon is special to Macromolecules because its special structure allows the formation of it.
B) Carbon can form 4 covalent bonds with Hydrogen atoms, Carbon is special to Macromolecules because the structure is important because carbon can only have 1 covalent bond.
C) Carbon can form 4 covalent bonds with Hydrogen atoms, Carbon is special to Macromolecules because its special structure allows the formation of it.
D) Carbon can form 3 covalent bonds with Hydrogen, Carbon is special to Macromolecules because the structure is important because carbon can only have 1 covalent bond.

Answer: C is the correct choice because carbon is special to Macromolecules because the special structure allows the formation of it. Carbon can form 4 covalent bonds with hydrogen atoms.

What do Monosaccharides and Polysaccharides consist of?

A) Monosaccharides are, Glucose, Fructose and Galactose, Polysaccharides are, Glycogen, Starch, and Cellulose.
B) Monosaccharides are, Glycogen, Starch, and Cellulose, Polysaccharides are, Glucose, Fructose and Galactose.
C) Monosaccharides are, Glycogen, Glucose, and Cellulose, Polysaccharides are, Starch, Fructose and Galactose.
D) Polysaccharides are, Fructose, Galactose, and Cellulose. Monosaccharides are Glycogen, Starch and Glucose.

Answer: A is correct because monosaccharides consist of Glucose, Fructose, and Galactose. Polysaccharides consist of Glycogen, Starch and Cellulose.

Albert is analyzing carbohydrates and notices that they possess unique functions to the body. He also notices that lipids possess unique functions to the body as well. He notes that carbohydrates allow cellular respiration, energy storage, and gives structure. He also notes that Lipids allow energy storage, cell membranes, insulation and protection, and chemical messengers. What are these functions in animals and plants?

_____
_____
_____
_____
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_____

_____
_____
_____
_____

Answer: For carbohydrates, allows glucose to digest carbohydrates and can be used in cellular respiration. For carbohydrates, Energy can be stored in glycogen for humans and starch for plants. For carbohydrates, Cellulose giving strength to the Cell wall provides structure. For lipids, Energy can be stored as organisms can convert organic molecules into lipids to store energy. Phospholipids help the cell membrane and fats help protect and insulate the body.

If monosaccharides can combine together to form bigger molecules, describe Dehydration synthesis and Hydrolysis.

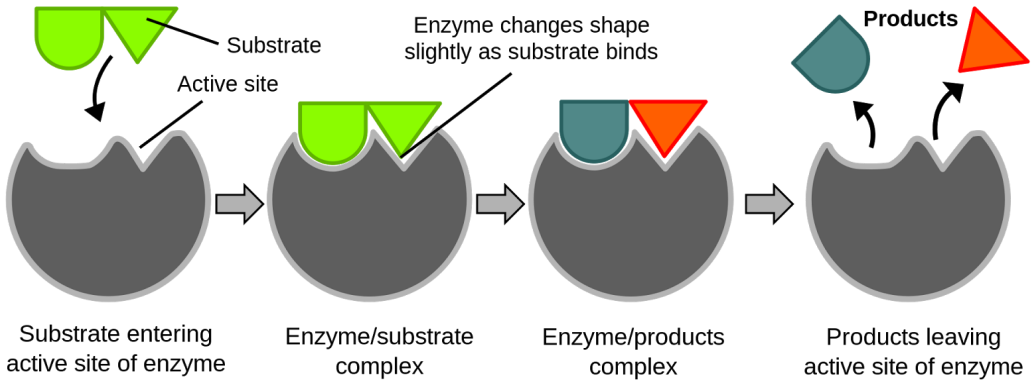
_____
_____
_____
_____
_____

Answer: Dehydration Synthesis removes the -OH group so that monosaccharides can bond together and form a larger compound structure. During Dehydration synthesis, water is produced as a byproduct. Compounds can be separated through hydrolysis, the -OH group is restored using a water molecule.

A231 and A232

Introduction:

Proteins are important for our body as they play many roles in the cell. Some of the proteins can function as **enzymes**, enzymes are protein catalysts that speeds up the reaction. Enzymes lower the activation energy of the chemical reaction. Enzymes acts on the reactants, the materials at the start of a reaction. The substance is called as a **substrate**. The enzymes bind to specific substrates. The shape of the enzyme is what makes it possible for the substrate to be specific to the enzyme. Since enzymes are proteins, they are folded into three-dimensional structures. The structures have folds or pockets on the surface, and as such, are called **active sites**. Active sites are the regions where the enzymes binds to the substrate. Enzymes are essentially proteins that speed up the chemical reactions, they bind to substrates with their unique structures through their active sites. (For a more detailed observation, look at the picture below)



Enzymes can also be affected by conditions. Meaning, enzymes can be affected by pH levels and temperature. The reaction rate will slow down when it is not in the most optimal conditions. This occurs because enzymes are proteins. Being three dimensional structures, the conditions can disturb the enzyme's structure. Affecting the reaction rate in general. However, this also means that enzymes can function at different conditions and temperatures optimally. Temperatures or pH levels that are too high or low **denatures** the enzyme. Denaturation is the process when the enzyme becomes inactive because of the many factors that alter with the structure of the enzyme. A denatured enzyme can not catalyze a reaction. If you add more substrate concentration, it does not affect the reaction rate. Increasing the concentration does not affect the enzyme's ability to speed up the chemical reaction. However, it is limited through enzyme concentration. If there were more enzyme concentration, it would increase the chemical reaction rate.

Tips for Testing:

- Remember than an enzyme is a protein that is three dimensional with a unique structure suitable for certain substrates.

- Remember that enzymes speed the process of the chemical reaction, not the amount of product produced.

- The area where enzymes and substrates bind together is called an **active area**.
    - Think about it as if you were putting the pieces to a jigsaw puzzle.

- Enzymes can denature when the temperature/pH level is too low or high. This affects the chemical reaction because it would not catalyze at all.

- Enzymes have optimal temperatures and pH levels.
    - Some enzymes can function in the liver but some cannot due to the pH levels.

Practice Test:

Thermophilic bacteria lives in the hot springs with temperatures of 70 degrees Celsius. A group of scientists decide to collect and analyze the bacteria, how would they protect it?

A) The scientists would need to put it in a very warm and cozy room.
B) The scientists would need to put the bacteria at its optimal conditions, as such, they would need to be in a 70 degrees Celsius solution in order to grow.
C) The scientists would need to put the bacteria in a solution that has 70 degrees Fahrenheit.
D) All of the above

Answer: B is the correct answer because since the bacteria lives in the hot springs with a temperature of 70 degrees Celsius. They would need to put it in a solution containing that optimal temperature in order to analyze the growth of it.

Thomas knows that enzymes speed up chemical reactions. However, he is hypothesizing whether enzymes would slow down due to a higher concentration of substrate. If Thomas were to increase the concentration of substrate, would this affect the rate of chemical reaction?

A) This would not affect the chemical reaction rate.
B) This would affect the chemical reaction rate because the enzymes would have to bind to more substrates in order to speed up the process.
C) This would affect the chemical reaction because it alters the enzyme's unique structure.
D) This would affect the chemical reaction because enzymes are proteins.

Answer: A is correct because the amount of substrate concentration does not affect the chemical reaction, only the enzyme concentration.

What is a structural feature of an enzyme?

A) Protein
B) Lipids
C) Substrate
D) Cytoplasm

Answer: A is the correct answer because proteins are a structural feature of an enzyme.

Matthew pours the enzyme catalase in a solution of hydrogen peroxide. He notices that there are bubbles forming as the solution begins to increase rapidly, what does this mean?

_____
_____
_____
_____

_____

Answer: The enzyme catalase is reacting with the substrate Hydrogen Peroxide. The bubbles he is noticing are the Oxygen molecules being produced as a byproduct.

(Continue) After analyzing for a couple more minutes, he notices that the bubbles are slowing down, what does this mean?

_____
_____
_____
_____
_____

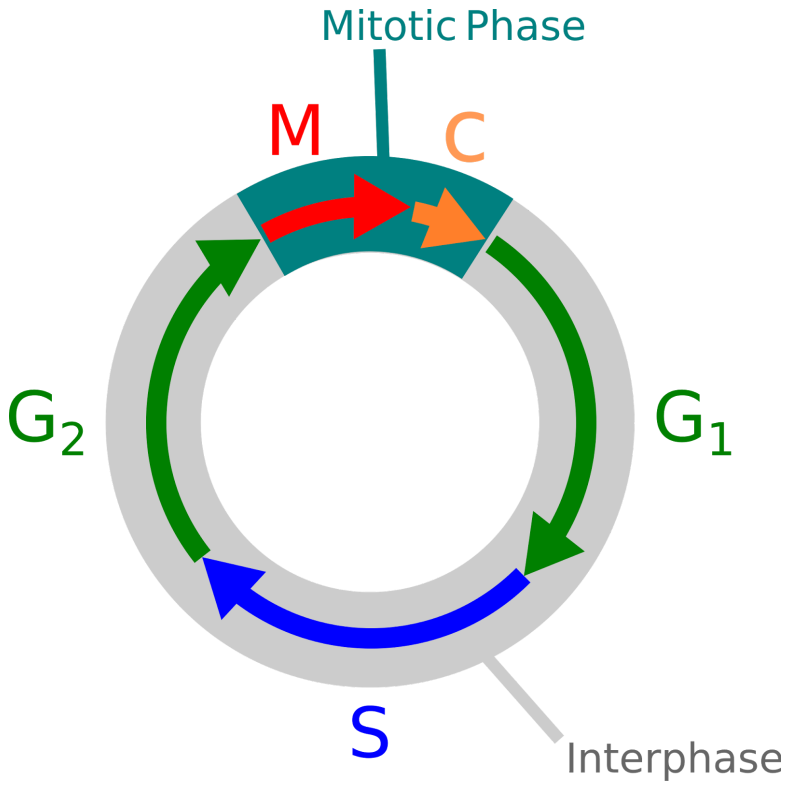
Answer: The rate of chemical reaction is slowing down as the enzyme continues to keep reacting with the Hydrogen Peroxide. The bubbles will start to slow down because the reaction is slowing down.

Cell Growth and Reproduction:

B 112 & B122

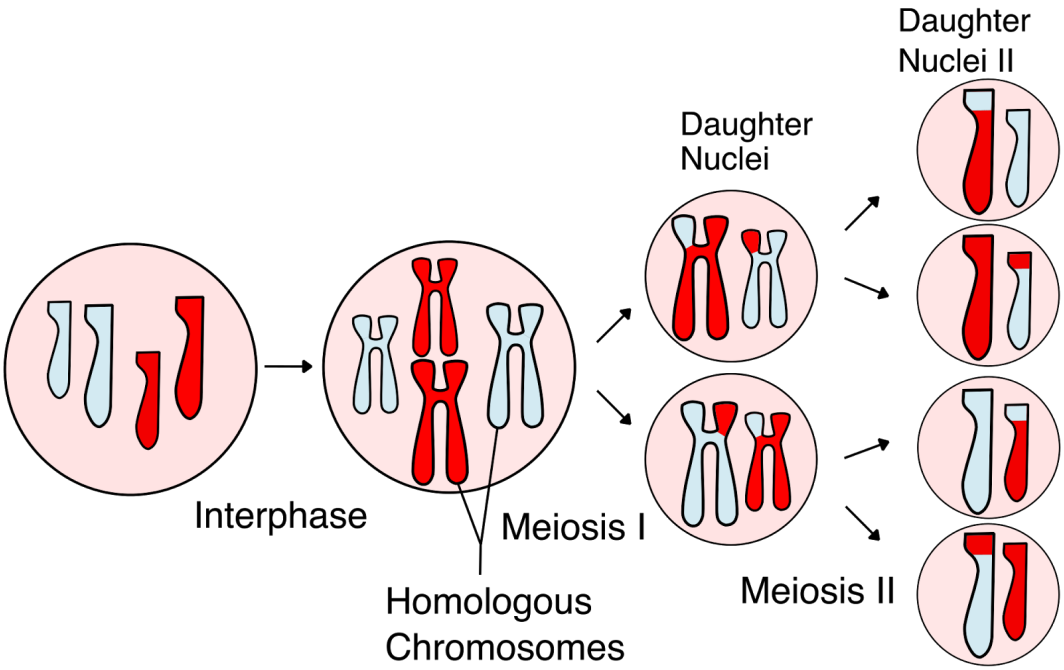
Introduction:

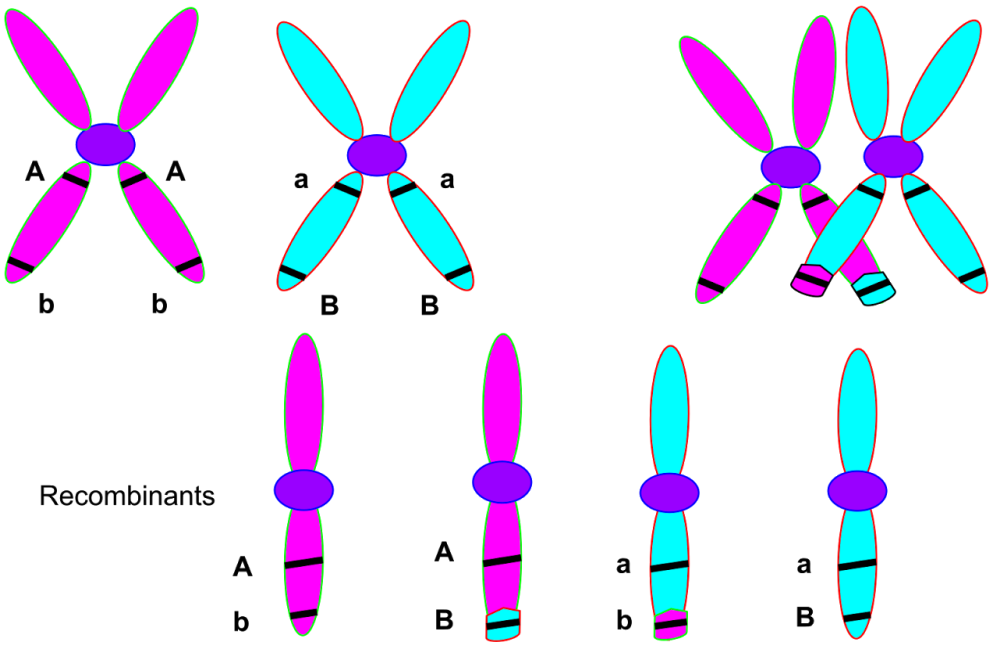
A cell cycle describes the stages of life of a single cell's life. There is Interphase, Nuclear Division and Cytokinesis. Interphase is the longest which is dividing into three stages: **G1, S, and G2**. G1 is the stage in Interphase that the new cell grows. In stage S, the cell replicates the DNA. This stage in Interphase is known as synthesis. In G2, the cell produces the proteins needed to undergo Mitosis or Meiosis. **Mitosis** produces the most cells of the body and produces the exact replica of the nucleus. Mitosis also produces the same amount of chromosomes, as they remain the same in the two daughter cells that would form. Cytokinesis is the final stage in which the original parent cell splits into two daughter cells. **Cytokinesis** is when the cytoplasm divides in two, producing new cells.(Refer to the picture below for the Cell Cycle) Mitosis has four main stages: Prophase, Metaphase, Anaphase, and Telophase. During **prophase** the nuclear membrane breaks down as the DNA molecules coil up making chromosomes smaller with centrioles beginning to move to the center poles of the cell. During **metaphase** the centrioles produce structures called spindles or protein chains. The protein chains attach to the centromeres on the sister chromatids as they line up at the center of the cell. In **anaphase**, the chains shorten as the sister chromatids are pulled apart from each pair of the cell. Finally in **telophase**, The nuclear membrane forms around the separated chromosomes.



Mitosis can not produce gametes because it keeps the same number of chromosomes in the daughter cell and parent cell. Mitosis is the process in which the body grows and repairs itself. Another type of cell division is **Meiosis**. Meiosis is a type of cell division that produces gametes, or cells used in sexual reproduction. Every species has a characteristic chromosome. A characteristic chromosome is basically that every specimen in the species has the same amount of chromosomes in their body. Humans have 46 chromosomes with 23 pairs. Meaning that for every human cell, it would contain two copies of each of the 23 different chromosomes that total up to 46. The chromosomes are found in homologous pairs. Gametes are produced by meiosis, another type of cell division. Meiosis produces gametes through two rounds of cell division. Meiosis I is the first stage of meiosis, the homologous chromosomes are separated allowing each daughter cell to have one chromosome from each pair. During the second stage of meiosis, Meiosis II, the chromosomes that were replicated are separated into two chromosomes. The daughter cell still has the same amount of chromosomes, but they are now unreplicated. In the early stages of meiosis, the homologous chromosomes pair up and **crossing-over** occurs. Crossing over shuffles the genetic material so that each sister chromatid has a different combination of the **alleles**. An Allele is a version of a gene. There are now four alleles in comparison to two. This is why offsprings have the ability to inherit unique combinations of the alleles. There are four phases during each meiosis round: prophase, metaphase, anaphase, and telophase. In **Mitosis**, the chromosomes would condense and the nuclear membranes breakdown. Allowing the protein chains from each centriole to connect to the chromosomes. The chromosomes would line up in the center and separate. They are then reeled by the protein chains to the other side of the cell. This produces two daughter cells.

However, meiosis is different as the chromosomes that lined up are separated. During **Prophase I**, the nuclear membrane breaks down as the homologous chromosomes pair up and do crossing-over. In **Metaphase I**, the protein chains attach to the centromeres of the sister chromatids as they line up at the center of the cell. In **Anaphase I**, the chains shorten as the homologous chromosomes separate. However in Anaphase I of meiosis, the sister chromatids remain joined. Finally in **Telophase I**, cytokinesis occurs and two new cells are formed. In Meiosis II, the sister chromatids are separated into different daughter cells. This is very similar to Mitosis. In **Prophase II**, the chromosomes would condense as protein chains form. In **Metaphase II**, the chains attach to the centromeres of the sister chromatids as the chromatids line up at the center, similar to Meiosis I. In **Anaphase II**, the chains are shorten and the chromatids separate. Finally, in **Telophase II,** the chromosomes begin to elongate as the new nuclear membranes form around the chromosomes. (Refer to the picture below for a graph of each phase)





Tips for Testing:

- Meiosis is a type of cell division.
    - Meiosis produces gamete

- Alleles are a flavor of a gene.
    - Some people have different color of hair, such as redheads as they may have one version of MC1R while the blonds may have a different version.

- A gamete contains only one chromosome per a pair.

- Mitosis is different to Meiosis as Mitosis is the cell division that replicates the chromatids equally whereas Meiosis is the cell division has daughter cells that inherit different chromatids.
    - Think about it like this, Mitosis is cell division, however, it is only replicating itself with the same sister chromatids. Meiosis is cell division used in reproduction. The offspring will inherit unique allele combinations.

- For Mitosis and Meiosis I and II, there are four phases, Prophase, Metaphase, Anaphase, and Telophase.

Practice Test:

If a human has 46 chromosomes, how many homologous chromosome pair would a human have?

A) 12
B) 46
C) 23
D) 32

Answer: C is the correct choice because humans will have 23 homologous chromosome pair.

If a specimen has 36 homologous pairs of chromosomes, how many chromosomes would be in a gamete?

A) 18
B) 36
C) 12
D) 28

Answer: B is the correct choice because a gamete has one chromosome for each pair. This means that the gamete would have 36 chromosomes per pair.

What is the phase order of Meiosis?

A) Metaphase > Prophase > Anaphase > Telophase
B) Metaphase > Anaphase > Prophase > Telophase
C) Prophase > Metaphase > Telophase > Anaphase
D) Prophase > Metaphase > Anaphase > Telophase

Answer: D is the correct choice because Meiosis I and II both start at Prophase, Metaphase, Anaphase, and finally Telophase.

Jerry is analyzing the main differences between Mitosis and Meiosis. What is the main difference between Mitosis and Meiosis?

_____
_____
_____
_____
_____

Answer: Mitosis is slightly different than Meiosis because they are both forms of Cell Division. However, Mitosis is Cell Division primarily used to repair the cells in the body by replicating

itself. This means that the genetic material will be identical with the same number of chromosomes. In Meiosis, this form of cell division is mostly used in reproduction. Meiosis allows unique sister chromatids to form through crossing over. The sister chromatids will remain joined as two new cells are formed after Meiosis I.

Describe all of the phases in Meiosis II.

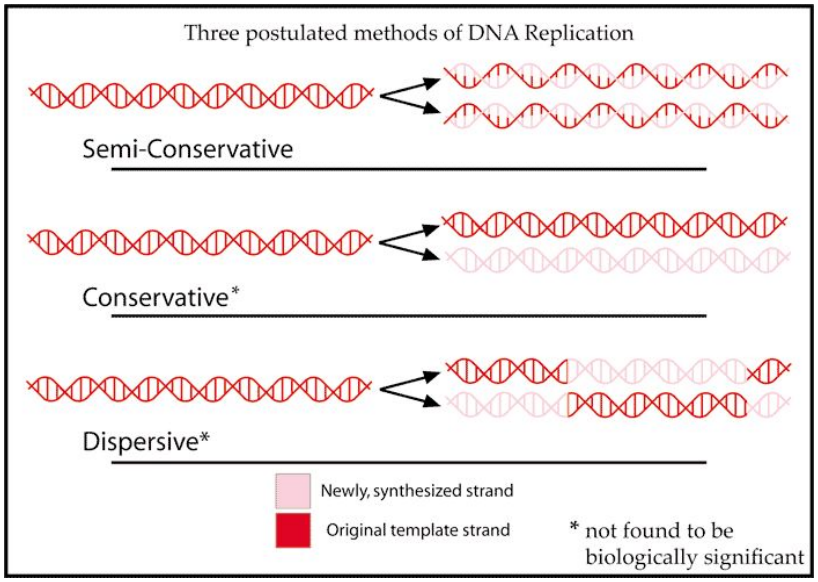
_____
_____
_____
_____
_____

Answer: Similar to Meiosis I, Meiosis II has Prophase, Metaphase, Anaphase, and Telophase. In Prophase II, the protein chains will form again as the chromosomes condense. In Metaphase II, the protein chains will attach itself to the centromeres at the center of the cell. During Anaphase II, the protein chains shorten as the sister chromatids are separated. Finally, in Telophase II, the new cell will elongate and nucleic membranes will form around the new four daughter cells.

B121 & B122

A cell must first duplicate its nucleus in order for it to form two genetically identical daughter cells. If the parent cell has 46 chromosomes, the daughter cell would also have 46 chromosomes. DNA replication produces the same exact copy of the genetic material in a chromosome. A chromosome consists of two arms and a centromere in the center. DNA replication creates an identical copy that is still connected to the centromere, this is known as a sister chromatids. They will remain connected until Nuclear division. DNA replication is carried out by enzymes, as an enzyme, DNA helicase, binds to the site of a double stranded DNA and begins to separate it. DNA polymerase moves along the strands pairing with the nucleotides in the strand. DNA replication is known as a **semiconservative replication**. This means that the double strands consist of one original strand and a newly assembled one. Each Homologous chromosome is very similar, and have nearly the same DNA sequences. However, they have different **alleles**. Allele is a version of a gene. Gametes are drastically different. Each sperm/egg cell only contains half the number of chromosomes. Each gamete holds a chromosome from each pair, only one allele for a gene. The offspring inherits a chromosome from each homologous pair from each parent. The alleles in an organism determines the organism's traits. Traits are usually **polygenic**. A polygenic trait is determined through many different genes. There are dominant and recessive alleles. A **phenotype** is the appearance of the trait. Whereas **genotype** is the combination of alleles of a specific gene. Dominant alleles are usually represented by the capital letters and the recessive alleles are represented by the lowercase

letters. A **dominant** allele is expressed if an individual inherits a single copy of the allele. A **recessive** allele is expressed if the individual inherits two copies of the allele.



Tips for Testing:

- DNA replication is known as semiconservative
    - Meaning that each new double strand consist of one original strand and a newly assembled strand

- Alleles are a version of a gene
    - Some people have different color of hair, such as redheads as they may have one version of MC1R while the blonds may have a different version.

- Polygenic traits are traits that are determined by the gene.
    - There are dominant and recessive alleles.

- Phenotype is the appearance of the trait. Whereas a genotype is the combination of the alleles of a specific gene.

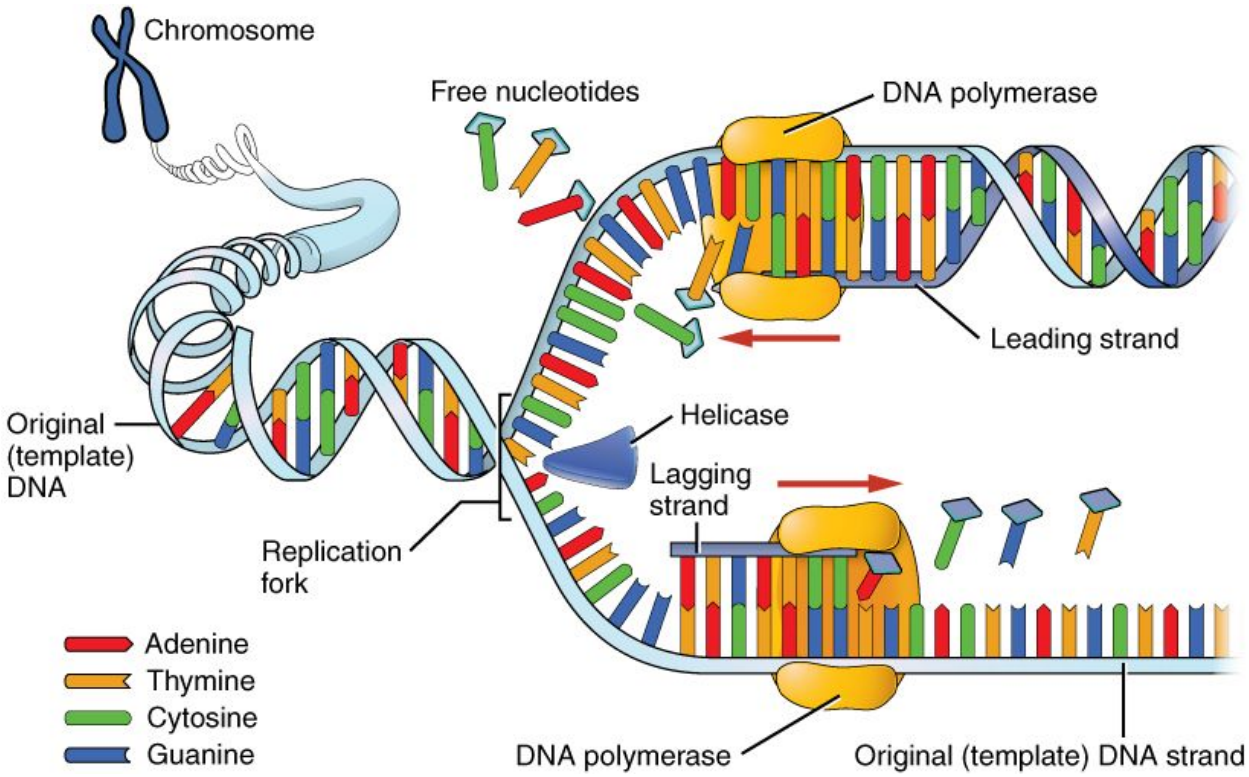
- Remember that dominant alleles are usually represented with capital letters and Recessive Alleles are usually represented with a lowercase letter.

- DNA helicase is an enzyme with the main task of separating the two strands of DNA.

- DNA helicase is followed by DNA polymerase as it moves along each strand.
    - DNA polymerase moves along the strand pairing it’s free nucleotides to the nucleotides in the strands.

- Remember that there are special traits that genes have and their allele types (Dominant and Recessive)

- DNA replication occurs when DNA helicase separates the strands of DNA and DNA polymerase begins pairing it's nucleotides to the nucleotides on the strands.



Practice Test:

What does DNA replication do?

A) Produces exact copy of genetic materials in a chromosome
B) Phospholipids allow water to enter through the Aquaporin
C) Produces more chromosomes, adding it to the homologous chromosome pair list
D) All of the above

Answer: A is correct because DNA replication produces the exact same copy of the genetic material in the chromosome.

What is also known as a semiconservative replication?

A) Mitosis
B) Meiosis

C) DNA replication
D) All of the above

Answer: C is the correct choice because a semiconservative replication is known as DNA replication.

In what phase does the cell replicate in? What is the stage of the phase?

A) Mitosis, Metaphase
B) Interphase, S Stage
C) Interphase, G1 Stage
D) Meiosis, Prophase II

Answer: B is correct because the cell replicates DNA (synthesis) in Interphase S stage.

How is Genetic Information inherited from the parent cell?

_____
_____
_____
_____
_____

Answer: Genetic Information is inherited from the parent cell because crossing over allows the chromatids to have a unique allele combination. The genetic information is also inherited when the sister chromatids separate. Genetic Information is inherited from one chromosome of each pair from your mother and father. The Genes contains the inheritance from your parents.

Why is Meiosis importance to inheritance for offsprings?

_____
_____
_____
_____
_____

Answer: Meiosis allows the chromatids in the cell to cross-over and split into daughter cells. The chromatids will separate again as they split into new cells. Meiosis is important for offsprings because it allows it to gain a unique combination of alleles and increase genetic variations.

Homeostasis and Transport

Passive Transport

Objectives:

- Identify the processes that transport materials for the cell.
- Identify the structures that help the cell transport materials.

Key Terms

- Passive transport
- Diffusion
- Facilitated diffusion
- Transport protein
- Concentration gradient
- Osmosis
- Hypotonic
- Hypertonic
- Isotonic

Consider these essential questions while reading:

- What is passive transport?
- How are materials transported using passive transport?

Any type of cellular transport that doesn't require any energy input is called **passive transport**. Since large molecules, charged ions, and polar molecules cannot readily cross the membrane transport proteins provide a way for them to enter and exit the cell. This is called facilitated diffusion because it is helped by proteins. **Facilitated diffusion** is also a form of passive transport so it requires no energy. Facilitated diffusion uses transport proteins to move a substance down its concentration gradient. A **transport protein** is a protein built into the plasma membrane that helps certain kinds of molecules or ions pass through. When a dissolved substance is more concentrated in one area it forms a concentration gradient. A **concentration gradient** is a gradual difference in the concentration of a substance in a solution as a function of distance. The movement of a dissolved substance down a concentration gradient is called **diffusion**. It stops when equilibrium is reached and requires no energy. **Osmosis** is the movement of water from areas of higher water concentration to areas of lower water concentration. It is also passive transport and requires no energy. A **hypotonic** fluid has a lower concentration of dissolved substances than a cell's interior. An **isotonic** fluid has an equal concentration of dissolved substances to a cell's interior. A **hypertonic** fluid has a greater concentration of dissolved substances than a cell's interior.

Questions

1. Which of the following is **not** involved in the transport of molecules by facilitated diffusion?

a. Phospholipids
b. Concentration gradient
c. ATP
d. Protein channels

Answer: The answer is C because facilitated diffusion is a form of passive transport.

2. When a substance is more concentrated in one area it forms what?

a. Phospholipid bilayer
b. Concentration gradient
c. Cell membrane
d. Protein channels

Answer: B because concentration gradients are formed when substances are more concentrated in one area.

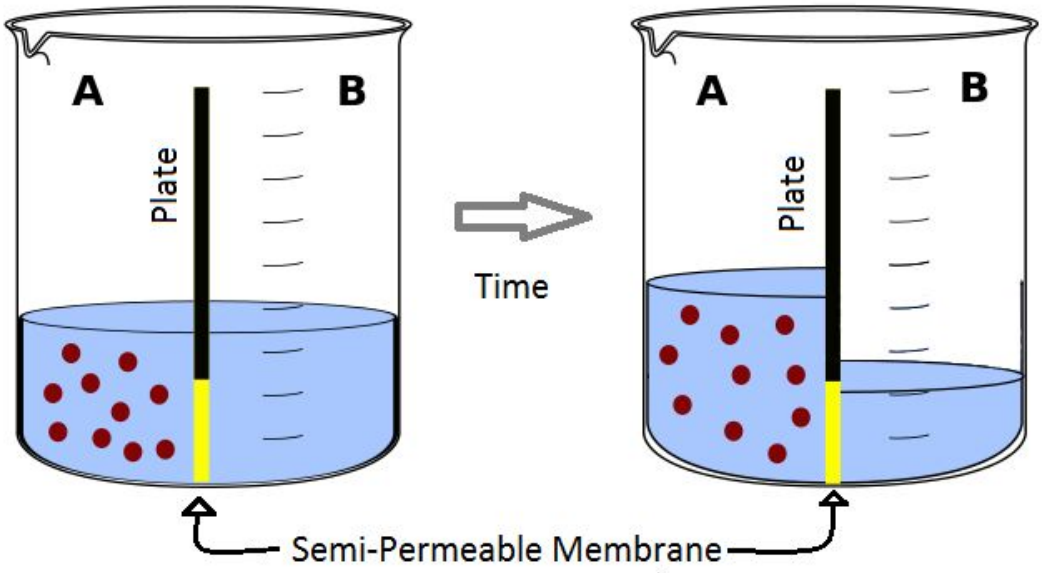
3. A fluid that has a greater concentration of dissolved substances than a cell's interior is called what?

a. Hypotonic
b. Hypertonic
c. Isotonic
d. Cotonic

Answer: B

4. Explain how facilitated diffusion differs from diffusion.

Answer: Facilitated diffusion requires transport proteins to function properly and diffusion requires a concentration gradient.



5. Explain the process that occured in the picture above.
Answer: Osmosis moved the water from the right side of the beaker to the left side in order to reach equilibrium.

Active Transport

Objectives

- Identify the different types of active transport.
- Identify the different structures that help active transport.

Key Terms

- Active transport
- Ion pumps
- Molecular pumps
- Vesicles
- Exocytosis
- Endocytosis

Consider these essential questions while reading:

- What is active transport?
- How are material transported using active transport?
- How does active transport compare to passive transport?

Active transport is the movement of particles from an area of low concentration across a membrane to an area of high concentration. This type of transport requires energy in the form of ATP. A common type of active transport is the use of membrane proteins called **ion pumps** and **molecular pumps**. They use ATP to move substances against a concentration gradient. Ion pumps move ions. Molecular pumps move uncharged molecules. Macromolecules are usually too big to pass through the cell membrane so the cell uses vesicles to move them in and

out of the cell. **Vesicles** are small membrane sacs that transport material throughout the cytoplasm. In **exocytosis** a vesicle moves toward the membrane and fuses with it. Then it releases substances outside of the cell. In **endocytosis** a vesicle that is already fused with the membrane takes in substances from outside the cell and releases it in the cytoplasm.

Questions

1. What is the difference between Active and Passive transport?

a. Active transport involves a concentration gradient, while passive does not
b. Active transport requires no energy, while passive does
c. Active transport requires energy, while passive does not
d. Active transport uses membrane proteins, while passive transport

Answer: C because active transport uses energy and passive transport does not.

2. How does a cell take in materials from extracellular fluid and release it into the cell?

a. Osmosis
b. Exocytosis
c. Diffusion
d. Endocytosis

Answer: D

3. What is the purpose of ion pumps?

a. Transport ions
b. Help repair the cell membrane
c. Transport vesicles
d. Keep fluids isotonic

Answer: A

4. Explain the process of exocytosis.

Answer: Exocytosis is the process where vesicles take substances from the cytoplasm and fuses with the cell membrane to release the substances outside the cell.

5. What are vesicles?

Answer: Vesicles are small membrane sacs that transport material throughout the cytoplasm.

Homeostasis

Objectives

- Identify the different types processes that maintain homeostasis.
- Explain why homeostasis is important.

Key Terms

- Homeostasis
- Negative feedback loop
- Positive feedback loop

- Thermoregulation
- Osmoregulation
- Gas exchange
- Blood glucose regulation

Consider these essential questions while you read:

- Why is homeostasis important?
- How would a person's health change without the presence of homeostasis?

Homeostasis is the process the body goes through to maintain a constant internal state of balance. The processes by which an organism monitors and maintains a constant state, such as temperature, is a homeostatic mechanism. To maintain homeostasis, the body may rely on a cycle of monitoring and responding to internal conditions, called a negative feedback loop. A **negative feedback loop** reacts to any change to a system and causes the system to return to its original state. A **positive feedback loop** does the exact opposite of a negative feedback loop. The positive loops amplify a change to a system and moves it farther from its original state. An example of positive feedback is if the a blood vessel gets cut the body sends platelets to plug the cut and the platelets release hormones to signal other platelets to come as well until the cut is completely sealed. **Thermoregulation** controls the body's temperature and relies on negative feedback to bring the body's temperature back to its original state. Examples of this are if the body gets cold it shivers to produce heat. **Osmoregulation** is the process the body goes through to regulate the balance of water and solutes. This type of regulation also relies on negative feedback. An example of this is if the body has too much water in the body it sends signals to urinate in order to release the excess fluid. The body's cells require oxygen to carry out respiration, which produces carbon dioxide. The levels of dissolved oxygen and carbon dioxide are regulated by **gas exchange**. The gas exchange makes sure that the body has healthy balance of oxygen and carbon dioxide. The human body requires a blood glucose level of around 90 mg. **Blood glucose regulation** relies on negative feedback to control the glucose levels.

<u>Questions</u>

1. If a person's internal body temperature drops below the normal temperature how would the body react in order to maintain homeostasis?

a. Perspiring
b. Shivering
c. Deeper breaths
d. Quicker breaths

Answer: B because if the body's temperature drops below normal the person will shiver in order to raise their temperature.

2. Sweating due to overheating is an example of…

a. Negative feedback loop
b. Blood glucose regulation

c. Positive feedback loop
d. Gas exchange

Answer: A Because the body is sweating to counteract the overheating and get the body's temperature back to its original state.

3. Osmoregulation controls which of the following?

a. Blood glucose levels
b. Oxygen and carbon dioxide levels
c. Body temperature
d. Water and solutes

Answer: D

4. Describe how a person's body would react to a blood vessel getting cut.

Answer: The body would send platelets to seal the cut and the platelets would signal for more to come help seal the cut creating a positive feedback loop.