Grade 12 Biology - Study Notes

Matter, Elements, and Compounds

____________________ is anything that takes up space and has mass.

_____________ are the smallest units of a substance that still possess the fundamental chemical and physical properties of the substance

molecules can be chemically broken down into simpler constituents called ______

An ___________________ a substance that cannot be broken down by ordinary means. The material making up matter.

There are __________ naturally occurring elements, of these 25 are essential to life. 4 of these make up _________% of living matter (Carbon, Hydrogen, Oxygen,and Nitrogen). The rest are called trace elements. These are required in minute amounts(zinc, cobalt, iron, magnesium).

Small units of matter are called ______________. **Protons**(______), **neutrons**(______), and **electrons**(______), are the sub units of atoms.

ATOMIC NUMBER is the
____.

ATOMIC MASS is the
____.

ISOTOPES: Different atomic forms caused by varying the number of ___________.

Example: Normal carbon is 12, carbon isotope is 14.

Some isotopes are radioactive, they undergo a transformation to gain a stable condition. This transformation is called the half-life of the isotope. Example: Let's say the half-life of carbon 14 is about __________________ years, If we have 100g. of carbon 14 now, in ______________ years we'll have 50g. In _______________ years we we'll have 25g. etc.

two useful applications of radioisotopes are:

1. ____________________

when the ratio of carbon-12 to carbon-14 in a dead or fossilized organism is measured, scientists can predict the amount of time that has elapsed since the organism's death

2. _____________________

when radioactive elements exist in living tissue, they emit radiation this radiation can be detected using various kinds of equipment – which means that any radioactive element can be followed or traced chemical reactions

this is how scientists learn about reaction mechanisms and biochemical processes such as respiration and photosynthesis

carbon-14 and hydrogen-3 (tritium) are commonly used tracers in biological research

BONDING

- using statistics, scientists can determine the most probable location of electrons in regions of space called __________
- these fixed, 3-dimensional, regions of space around the nucleus are called _______(Figure 4, p. 11)
- orbitals can only accommodate ___ electrons
- each energy level that surrounds a nucleus of an atom possesses _______that contain these orbitals
- for example, energy level one possesses ____ subshell, (the s subshell), which in turn, is the first orbital, energy level two possesses ______ subshells, (the s and the p subshell), therefore 4 orbitals, the s, and the three p orbitals, energy level three possesses _______ subshells, (the s, the p, and the d subshell), therefore nine orbitals, the one s, the three ps, and the five ds, etc.
- the 1st orbital of every energy level has the same shape, the 2nd orbital has another distinct shape (see Figure 4, p. 11)
- the maximum number of electrons that each energy level can hold can be calculated using ____, where ____ is the energy level
- for example, energy level ____, alone, can hold a maximum of $2(\_\_\_)^2 = 18$ electrons
- an atom that has ______ energy levels can hold a maximum of $2(1)^2 + 2(2)^2 + 2(3)^2 = 28$ electrons
- the arrangement of electrons in the orbitals is called an atom's _______________(Table 3, p. 12)
- the outermost orbitals contain the electrons _____________from the nucleus of an atom
- the orbitals that exist on the outer-most level contain the electrons that are responsible for _________to form ___________
- electrons found in these outer-most orbitals are called _________________
- they are the ones involved in the _____________of that atom
- the chemical stability of an atom is determined by the arrangement of an atom's _______________
- atoms that have completely filled orbitals are more stable, and less reactive than atoms with half-filled, or incomplete orbitals ex: ___________________
- all other elements in the universe have incomplete_____________, therefore are reactive
- Figure 5, p. 12 shows the number of valence electrons that the first 20 elements of the periodic table each possess

- elements can become chemically stable by either taking, losing, or sharing valence electrons
- the elements on the left of the periodic table will ___________to become stable
- The elements on the right will __________ to become stable
- for example, if a sodium atom were in contact with a chlorine atom, the sodium would _____one electron to the chlorine, resulting in a stable number of 10 electrons (just like ________)
- as a result, sodium becomes a ________ with a positive one in charge, and chlorine becomes an _________ with a negative one charge
- positive sodium is attracted to negative chloride, resulting in a force of attraction that keeps them together called an ___________ ; sodium chloride is an ______________
- ___________ forces of attraction are forces that result from sharing of electrons between two atoms
- for example, if a carbon atom were in contact with two oxygen atoms, neither would lose nor gain electrons
- instead, the carbon would share two electrons with one oxygen, and two with the other
- the covalent bonds within the molecule are referred to as___________________.
- groups of atoms held together by covalent bonds are called true molecules -- Table 4, p. 13, shows examples of different compounds

Homework: Practice 8-9, p. 16

POLARITY DUE TO ELECTRONEGATIVITY

- all the atoms of the periodic table have a certain ability to attract electrons of other atoms – this ability is called ________________
- atoms on the right upper hand corner of the periodic table are the smallest, and as a result, their positive proton can get close to electrons of other atoms to attract them away from the other atom and bring them over to themselves – this means that these atoms have a high electronegativity
- atoms on the lower left hand corner of the periodic table are the largest, therefore have a low electronegativity
- when two or more atoms combine, the greater their difference in electronegativity, the greater the polarity of that substance
- in all cases of ionic bonding, and in some cases of covalent bonding where sharing of the electron pair is not equal, the molecule results in being ________ - it has a positive end and a negative end
- this is because the electrons spend more time around one species (the more electronegative one), and less time around another (the less electronegative one)

· this means that each end of the molecule is oppositely charged – one end is slightly positive, the other, slightly negative

· to determine the amount of polarity in a molecule, the electronegativity values of the atoms involved are subtracted from one another

· if the difference is less than _______, the molecule is said to be a __________substance

· if the difference in electronegativity greater than _______, the molecule is said to be ________in character (see Figure 8, p. 14)

· for example, hydrogen chloride is more polar than chlorine gas because the difference in electronegativity between hydrogen and chlorine is 2.9 – 2.1 = 0.8, and the difference between the two atoms of chlorine in chlorine gas is 2.9 – 2.9 = 0.0.

· hydrogen chloride is_________, and chlorine gas is completely _________(the truest molecule you can get)

INTERMOLECULAR BONDS

· the polarity of an entire molecule is dependent on two things – the bond polarity and the molecular shape

· symmetrical molecules (like Figure 10 (a)) are non-polar, while asymmetrical molecules are polar in nature

· all molecules attract other molecules – these forces of attraction are called ________________

· these are the bonds that are broken in a substance when it changes state from solid to liquid to gas

· there are three types of intermolecular bonds, or van der Waals Forces: (Figure 12, p. 17)

1. _______________– weakest of the three; exist between all atoms and molecules; occur between non-polar substances

2. _______________ – hold polar molecules together; positive side of one molecule with the negative end of another

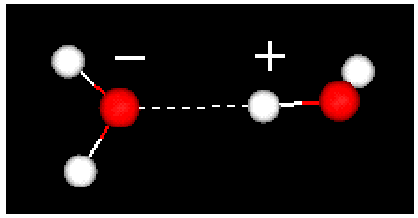
3. __________________ – strongest of the three; occur between a hydrogen of one molecule and a very electronegative atom of another neighboring molecule, such as nitrogen (N), oxygen (O), or fluorine (F)

· Figure 13 and 14, p. 18 shows a diagram of H-bonding

Water and the Fitness of the Environment

Hydrogen bonding of Water molecules: Due to the _______________ covalent bonds that hold a water molecule together, Hydrogen bonds form where the _______________ charged Oxygens and the ________________ Hydrogens are located.

Drawing of Hydrogen bonded water molecules:



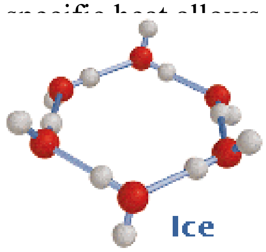
The results of these bonds are as follows:

1. ________________________: is the sticking together of similar molecules. Water is very cohesive. This allows water to be pulled along a pathway with relative ease.

2. ___________________ _________________: cohesion allows water to pull together and form droplets or form an interface between it and other surfaces. The measure of how hard it is to break this interface is its surface tension.

3.________________________: The sticking of one substance to another. Water is a good adhesive. It will cling on to many objects and act as a glue. _________________ Action is an example of cohesion and adhesion working together to move water up a thin tube.

4. ________________________________: Specific heat of a substance is the heat needed (gained or lost) to change the temperature of 1g. of a substance 1degree Celsius. It takes 1,000 calories to raise 1,000g. of water 1 degree C. Nutritional Packaging has the calorie measurements in Kilocalories. One gram of Protein = 3 calories. This means 3,000 small calories or 3 Kilocalories.



This high water to act as a ___________________. Water will retain its temperature after absorbing at, and retain its temperature after losing equally large amounts of heat. The reason fo __________ bonds must ________________ heat to break. They must ________ ey form. The Ocean acts as a tremendous heat sink to moderate the earth's temperatu

5. **High** : Water must _________________ a certain amount of additional heat to change from a liquid into a gas. This extra heat is called ________________________________. In humans, this value is 2407 joules/g. This results in evaporative cooling of the surface. Alcohol has a value of 991 joules/g. and chloroform 247 joules/g.

As one can see water removes much more heat from a surface upon evaporation than does either alcohol or chloroform.

6. **Freezing and Expansion of Water**: Water is most __________________ at 4 degrees C. At) degrees C. it is 10% less dense. Ice floats because ____________________ Hydrogen bonding occurs at 0 degrees C.

$H_2O \rightleftharpoons H^+ + OH^-$

7. **Versatile Solvent**: Water is a major _________________ in nature. When water and another substance is mixed the resulting solution is called an __________________ solution. Any solution contains the following parts:

________________(what's being dissolved) + ___________________ (what is doing the dissolving) = Solution.

Solute Concentration: The concentration of the dissolved materials in relation to the solvent. This is always measured in moles. 1 mole = 6.02 x 10^{23} atoms, molecules, or formula units of a substance.

One must first find the atomic weights of the substance involved and add them together for the representative molecule and change the value to grams.

Molarity occurs when the mole (gram atomic weight of the substance) is placed in a container and dissolved in water to equal one liter.

pH: Refers to the dissociation of water molecules.

The pH constant is $K_w = 1.0 \times 10^{-14}\ (mol/L)^2$

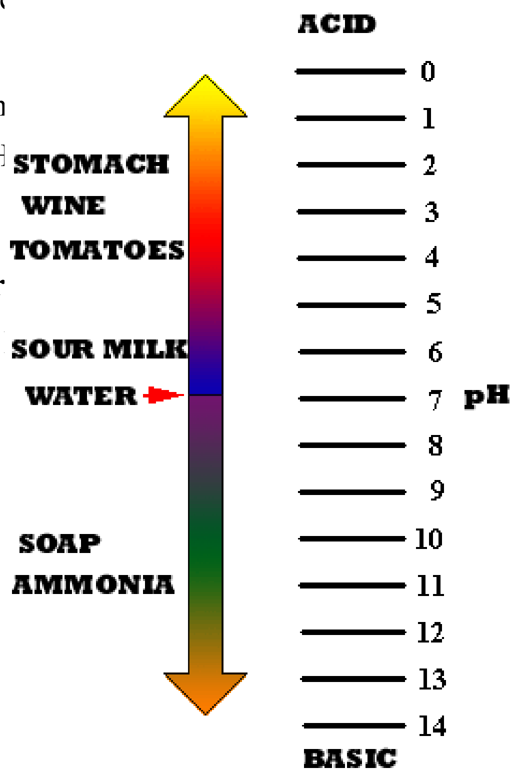
This constant shows that water dissociates at the rate of 1 molecule for every 554 million.

We have an even split of ... and ____________ ions.

If ... of the H ion is 1×10^{-7} and the conc of the OH ion is also 1×10^{-7}

Th ... og of the hydrogen ion concentration.

pH



Pr

1. ... the pH.

2. ... the pH.

pH represents a 10 fold difference in the concentrations of each ion. A pH of 1 is 10x smaller than a pH of 2 and 100x smaller than a pH of 3, etc.

_______: Abrupt changes in pH is harmful to the cell and any living organism. In order to minimize this harm cells contain buffering systems. In order to change the pH of a solution H ions must be added or taken from it. Buffers do just that.

Carbon and Molecular Diversity

Carbon has a valence of 4 which, makes it capable of entering into 4 covalent bonds.

The following are variations in which carbon may form different chemical compounds:

1). Length of the carbon skeleton may differ (C-C, C-C-C, C-C-C-C-C, etc..).

2). Branching of the carbon skeleton (C-C-C-C- C-C-C-C-C)

|
C

3). The number of double bonds may differ (C=C-C-C, C=C=C-C).

4). The molecular structure may be in ring form.

Chemical compounds with the same molecular formula but different structural formulas are called isomers.

THERE ARE 3 TYPES OF ISOMERS:

a).__________: These isomers differ from others due to the differing covalent arrangements of the atoms.

b).__________: These isomers contain the same covalent arrangement but different spatial arrangements. The double bonds make the molecule rigid, which prevents atomic rotation.

c). __________: These isomers are mirror images of one another. There are right and left handed versions of these compounds.

FUNCTIONAL GROUPS: These are certain groups of atoms attached to the carbon skeleton. This area is usually on the end of the molecule.

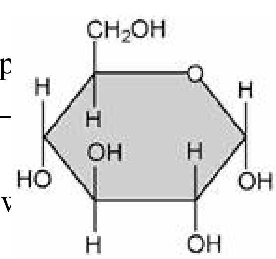
1. _____________**:** R- OH makes molecule polar and produces an alcohol.
2. _____________**:** R=O produces compounds known as ketones and aldehydes
3. _____________**:** R=O and OH forms organic acids (carboxylic acids: formic, acetic, etc).
4. _____________**:** R- N + 1 charge, usually basic, acts as a good buffer.
5. _____________**:** R- S-H thiols, stabilizes protein molecular structures.
6. _____________**:** R- O- P- O plus 2 more Oxygens attached to the P. energy storage that can be passed on from one molecule to another by the transfer of the group.

Structure and Function of Macromolecules

Organic molecules that weigh more than ____________________ atomic mass units (one atomic mass unit is 1/12th the mass of C) are referred to as macromolecules.

These macromolecules are constructed of smaller units called __________________. These _____________________________ are subdivided into their basic units called ________________________.

Making and breaking of polymers:



Dehydration synthesis: is a ______________________ p molecules are chemically bonded through the use of enzymes and a loss of ______

Example: **glucose + glucose = maltose + __________.**

Hydrolysis: is a _______________________ process by v een monomers are broken by the enzyme and the addition of __________.

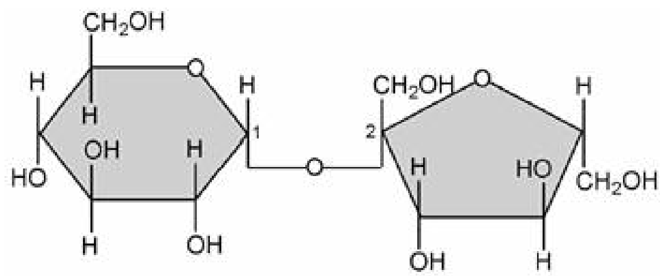
Example: **Sucrose + __________________ = glucose + fructose**.

The Four Major Organic Compounds found in Living Things.

1. Carbohydrates: include __________________ and their polymers. They include monosaccharides, disaccharides, and polysaccharides. The monosaccharide is a monomer, the disaccharide is a polymer, and the polysaccharides are macromolecules.

Monosaccharides: The basic formula (CH_2O)

Examples: Glucose, ____________________, and __________________ are hexose (6 Carbon) sugars. _____________________ and Ribose are (5 carbon) pentose sugars.



Disaccharides: These are double sugars with the formula $\mathbf{C_{12}H_{22}O_{11}}$. Notice that one molecule of water is missing from the formula. The covalent bond holding the two monomers together is called a glycoside linkage. Examples: **sucrose = glucose + fructose**; **maltose = glucose + glucose; and lactose = glucose + galactose.**

Polysaccharides: The basic formula is $\mathbf{(C_6H_{10}O_5)_n}$.

A. Storage Polysaccharides: _______________ is a plant storage polysaccharide that is composed entirely of glucose. **Amylose** is the simplest form of starch. **Amylopectin** is more complex and is branched. **Glycogen** is an animal starch stored in the ________________ and muscles of vertebrates.

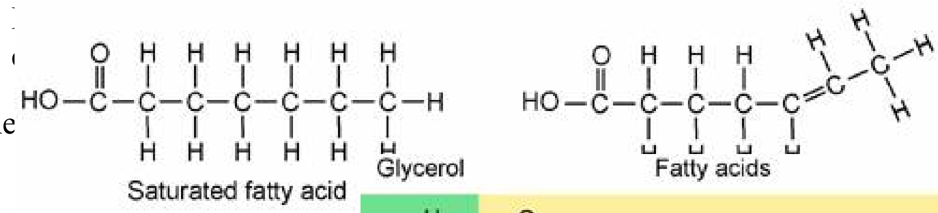
B. Structural Polysaccharides: __________________ and ______________ are examples of structural polysaccharides.

A. Cellulose is the most abundant organic compound on earth. It is made of glucose, like starch, but they differ in the type of 1-4 linkage. Instead of an α linkage as in starch cellulose contains a β 1-4 linkage. Enzymes find it difficult to break the β 1-4 linkage.

B. Lipids: A group of polymers that have one characteristic in common, they do not mix with __________________. They are hydrophobic. Some important groups are fats, phospholipids, and steroids.

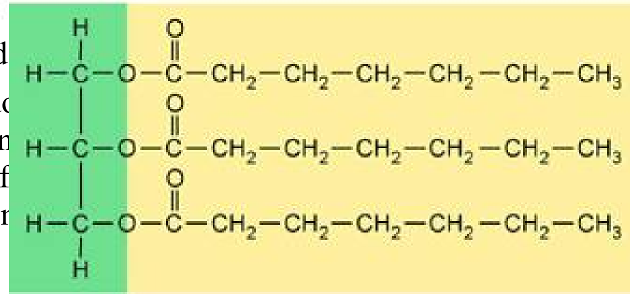
__________ (an alcohol

The ...d an ester bond.



The two types of fatty acid ... ________________________.

The saturated fatty acids d... between the carbons. Unsaturated fatty acids con... bons. These double bonds cut down on the number of ... to the carbon in the molecule. This causes the ... nd sites.



Fat

Characteristics of Fats:

PRIVATE**Saturated**	**Unsaturated**
1. solid at room temperature	1. liquid at room temperature
2. found mostly in animals	2. found mostly in plants
3. no double bonds between carbons	3. double bonds found between carbons

Function of fats:

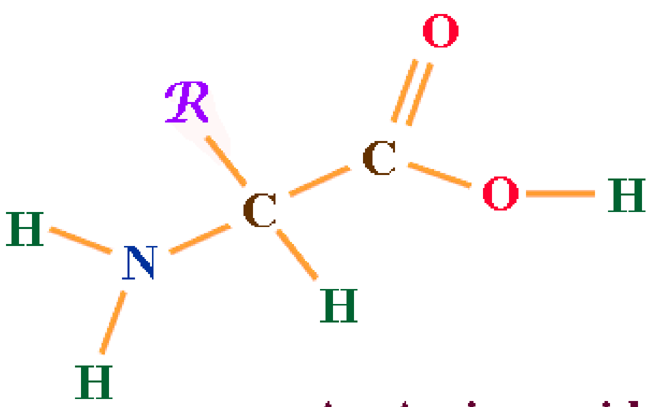
- acts as insulation in higher vertebrates,
- serves as an energy storage source 1g.= 37.7 kJ of energy,
- and acts as a shock absorber for internal organs.

Phospholipids: structurally related to fats but contain 2 fatty acids and one molecule of __________________________. These molecules are found making up the plasma membrane of cells. They exhibit a polar and non polar quality. The phosphate group is _______________________ while the fatty acid area is ______________________________.

Steroids: Lipids characterized by a carbon skeleton of 4 fused rings. __________________________ is an important steroid found in all animal tissue. Plants **do not** contain cholesterol. Cholesterol functions in many ways: it is a precursor from which many of the bodies steroids are constructed from. It also adds strength to the plasma membrane in animal cells.

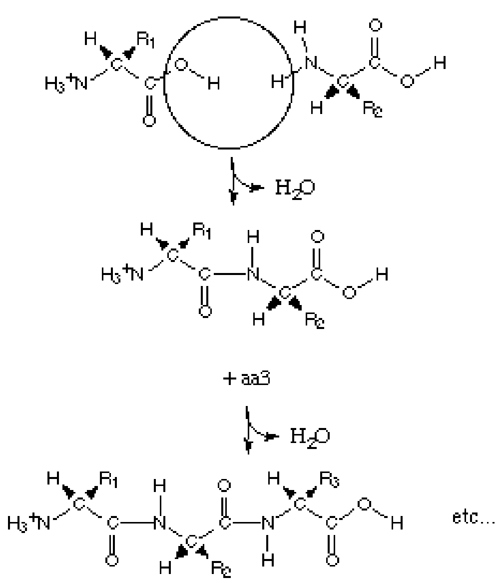
C. Proteins: macromolecules that make up _______________% of the dry weight of most cells. Their monomers are called _________________________. Most amino acids consist of a carbon bonded to an amino group, hydrogen, an R group, and a _____________________ group. Amino acids (a.a) are amphiprotic (possess both acidic (____________) and basic (____________)) functional groups.

When dissolved in water the carboxyl group donates a H+ ion to amino groups. Therefore the carboxyl group becomes _________ and the amino group becomes __________. A.a. may be polor (hydrophilic or nonpolar (hydrophobic), or charged (acidic or basic) depending on its side chains.



An Amino-acid

There are _______ different amino acids. The bond formed between amino acids is called a _______________________ bond. This is a ______________ synthesis.



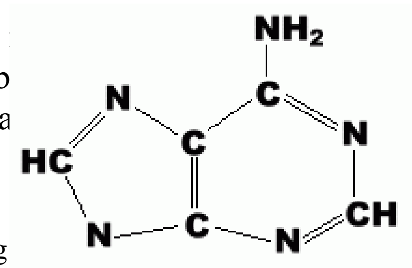
PEPTIDE BOND FORMED BETWEEN HYDROXYL GROUP OF ONE A.A. AND THE AMINE GROUP OF ANOTHER

Types of proteins:

1. _________: functions in support, examples: elastin, collagen, and keratin
2. ________: food source, examples: ovalbumin and casein
3. _________: moves other substances, examples: hemoglobin and cell membrane proteins (into and out of cells)
4. _________: coordinates bodily activities, example insulin (controles blood glucose levels)
5. _________: movement, examples: actin and myosin (Muscles)
6. _________: defense, examples: Ig.E, IgA, and Ig.G
7. _________: aid in chemical reactions, examples: amylase and proteases

D. Nucleic Acids: DNA and RNA.

_____________________ are the to form a nucleic acid. They contain either a ribose or deoxyrib itrogenous base (guanine, adenine, cytosine, thymine , or ura -U, C-G.

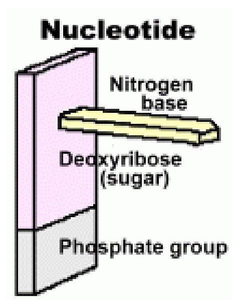


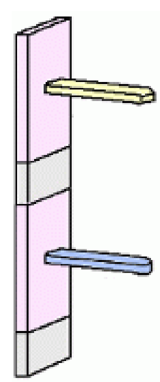
Pyrimidines are constructed of a single ring a double ring.

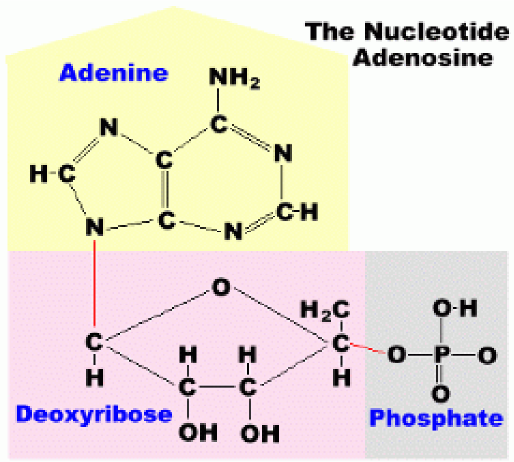
The nucleotides are joined together by phosphodiester bonds.

Base pairing rule. A-T, A-U, C-G. DNA has a double helix shape, while RNA is single stranded.s a double helix shape, while RNA is single stranded.

Adenine







Chemical Reactions: The combination of 2 or more elements forming a different product or products.

- Each reaction contains reactants and products. The reactants are written on the ______side of the equation, while the products are written on the ________ side.

The reactants and products must contain the same number of atoms making the reaction balanced.

Introduction to Metabolism

__________: the totality of an organisms chemical processes. It is divided into two parts: __________ biological pathways used in the breaking down of substances(respiration, digestion, etc.) and _________ biological pathways that build complex molecules (photosynthesis, protein synthesis).

Metabolism manages the material and energy resources of the cell.

__________: the ability to do work. There are two types of energy: _______ and _________. Kinetic is energy of ___________(thermal and light) while potential Figure 2, p. 60 is energy of position or ____________(chemical).

Energy is transformed (not cycled) from one form to another. The study of these transformations is called ________________.

Laws of Thermodynamics: ________ states that energy of the universe is constant. It may change from one form to another but cannot be created or destroyed. This is sometimes called the_______________________.

The ___________ states that "once energy has been used to do work, it becomes less available to do additional work" or every process increases the entropy (S) of the universe.

_________ is the quantitative measure of disorder of a system. If we look at any organism as a system that needs and uses energy, we can see what would happen if the energy supply was cut off. The system would fail due to lack of the necessary energy to meet its needs. This type of system is considered a closed system. No new energy can enter, while the available energy is changed into useless heat, causing the system to fail.

Heat is a useless form of energy unless it is used to maintain temperature of a system, but it must move from a warm area to a cool one. The earth and its organisms are not closed systems. They are considered open, due to the fact that _______________________ when needed. The sun and food are their means of replacement. If for some reason the energy supply stops they will become a closed system and fail. All open systems will eventually fail due to the process of energy turning into useless heat. The universe will eventually die due to a lack of useful energy and an abundance of heat. The universe is a closed system.

_____________: is stored in the bonds of the chemical they are holding together. Covalent bonds contain the most energy, while hydrogen bonds contain much less. During a chemical reaction 2 things must occur,

1). Energy must be absorbed to break the bonds of the reactants. 2). Energy is released when new bonds are formed. This is called _____________.

$$CH_4 + 2O_2 \text{ -------------->} CO_2 + 2H_2O$$

Each C-H bond contains ____________of stored energy. Since methane contains 4 of them its total bond energy is _____________. The double bonded oxygen contains ___________ and there are 2, giving us ____________. Since these bonds must be broken the total energy absorbed is______________.

On the products side (new molecules being formed), each C = O bond contains 174 kcal /mole since there are 2 each carbon dioxide contains 348 kcal / mole of energy. The O-H bond contains 111 kcal / mole, and there are 4 of them giving us a total of 444 kcal / mole. The total amount of energy released is 792 kcal / mole. 160 kcal / mole is the net energy released or the heat we feel from the reaction. This is the heat of the reaction or delta-H = - 160 kcal / mole. This refers to the stored energy being released. Always subtract the product answer from the reactant answer. If a reaction has a negative delta H, it is said to be exothermic.

___________ : The total potential energy of a molecule. Enthalpy relates to the amount of heat energy released from a chemical reaction.

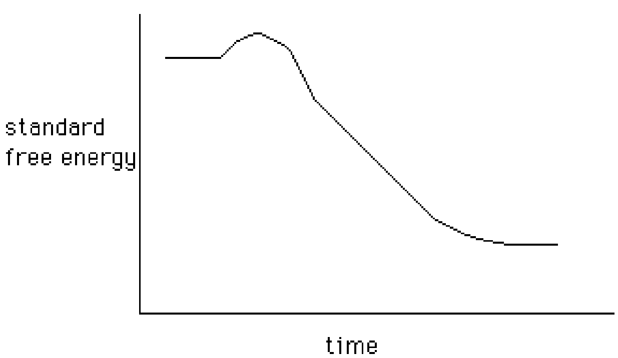
In an exothermic reaction the enthalpy of the products is less than the reactants, hence you feel the heat.

In an endothermic reaction the reverse is true, since the products have more enthalpy than the reactants. This occurs at the expense of its surroundings.

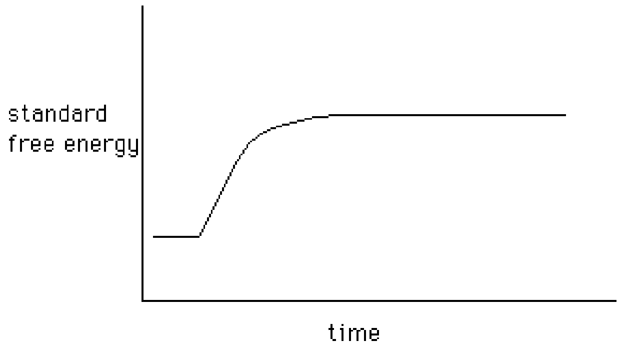
_______________: is a reaction that will occur without any outside help. Specifically it can occur without the introduction of external energy. A nonspontaneous reaction cannot occur on its own; it will only happen if external energy is added.

_____________: The quantity that combines total energy (enthalpy) and entropy is free energy. Free energy is represented by the letter (G). Spontaneous reactions occur when the free energy of the system decreases. During nonspontaneous reactions the free energy of the system ____________.

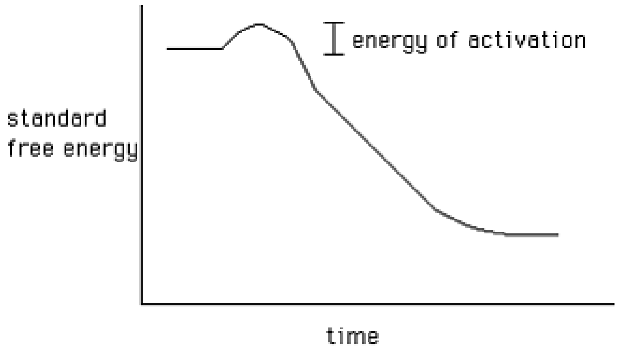
Based on free energy movement in a system the terms __________ and _________ are used to determine the direction of this free energy. An _________ reaction will release energy from the reaction,



while an ___________reaction will absorb free energy from its surroundings.



In order for an endergonic reaction to go to completion it needs an outside source of energy.



In the cell this energy source comes from the chemical compound_____. ATP helps the cell carry on 3 main types of work. ___________(cell movement), __________ (anabolism), and __________ (pumping materials into and out of the cell). ATP (adenosine triphosphate) is constructed of a molecule of adenine attached to a molecule of ribose sugar which is attached to 3 phosphates.

ATP + H_2O ---------------> ADP + P + ΔG = -7.3 kcal / mol

This occurs in a test tube. In the human cell -10 / -12 kcal / mol are given off.

ATP transfers this energy to whatever it is reacting with. When the new chemical receives the P it is said to be _______________. _______________ has occurred.

ATP is renewable. ADP + P -----------------> ATP ΔG = + 7.3 kcal / mol (endergonic)

REDOX REACTIONS

When biochemical reactions involve the transferring of electrons from one molecule to another, it is called a ________________or _____________

The process of losing electrons is called __________, and the process of gaining electrons is called ___________(remember….LEO THE LION ROARSGER)

Example:

Na + Cl_2 -----> 2NaCl

The Na starts out with an oxidation number of zero (0) and ends up having an oxidation number of 1+. It has been ___________ from a sodium atom to a positive sodium ion.

The Cl_2 also starts out with an oxidation number of zero (0), but it ends up with an oxidation number of 1-. It, therefore, has been ____________ from chlorine atoms to negative chloride ions.

The substance bringing about the oxidation of the sodium atoms is the chlorine, thus the chlorine is called an ______________. In other words, the oxidizing agent is being reduced (undergoing reduction).

The substance bringing about the reduction of the chlorine is the sodium, thus the sodium is called a ______________. Or in other words, the reducing agent is being oxidized (undergoing oxidation).

Figure 12, p. 67 shows this coupled redox process

Any burning or combustion is categorized as a redox rx this is because oxygen (a good oxidizing agent – thus the name), _______________from fuel that it burns the result is a decrease in potential energy of the_________________, thus a release of free energy – heat, light

For example, Figure 13, p. 67 illustrates how oxygen removes methane's electrons, causing them to lose potential energy and release it as heat

Cellular respiration is a slow, controlled redox reaction

Homework: p. 68, 1-10.

ENZYMES

____________: are catalysts that speed up a chemical reaction by lowering its activation energy. Enzymes are proteins that act on a substance called a substrate.

enzyme

substrate -------------> product

In the above reaction the enzyme's active site binds with the substrate. This active site is specific for each different type of substrate. Even the slightest change in the form of this site will alter the enzyme's function.

___________________________: Temperature, pH, and a particular chemical that specifically influences that enzyme. Enzymes work best at temperatures between 35^{o} and 40^{o}C in humans. pH range between 6 and 8 promotes optimum function. Salts inhibit enzyme action.

____________: are non protein chemicals that help enzymes act. Many of these coenzymes are vitamins.

Enzyme Inhibitors:

1. _______________: These chemicals mimic or resemble the normal substrate molecule.
2. __________________: These chemicals attach themselves to the enzyme at another point and alters the enzyme's shape. This causes the enzyme's active site to become non receptive to the substrate.
3. ___________________: Most enzymes that are affected by this type of regulation are composed of 2 or more polypeptide chains. These enzymes fluctuate between an active and inactive substance.

The enzyme contains 2 sites the active site and the allosteric site, located away from the active site. The allosteric site must contain an activator substance that will allow the active site to remain open. If the activator is missing then an inhibitor occupies the space and inactivates the enzyme. Figure 7, p. 73

_____________________: The most common form of metabolic control. The process involves the switching off of the metabolic pathway by its end product.

Homework: p. 77, 1-8.

Cellular Respiration

Energy Review:

Cells require a constant source of energy to carry out their life functions.

The main source of energy for most living systems is ___________.

Photosynthetic organisms capture sunlight and transform it into a useable source of energy via the chemical bonds in the organic compounds it produces.

Cells use some of this chemical bond energy to make ______, the energy source for cellular work.

Much of this energy is released as______________.

_____________: Chemical pathways that break down materials and release energy.

The catabolic process of respiration transfers the energy stored in food molecules to ATP.

Organisms use _____________molecules to capture and release small amounts of energy to fuel various bodily functions.

The molecule contains the nitrogenous base _____________connected to three molecules of phosphorous.

When ATP releases the terminal (end)____________, energy is released while forming a new compound ________. ADP can be refitted with another phosphate to form ATP again.

In order for the most efficient production of ATP to occur the cell must transfer this energy from the chemical bonds of the organic compounds to the ATP molecule with minimal loss.

Homework: p. 93, 1-4.

Cellular respiration can be divided up into 3 stages:

1.
2.
3.

Glycolysis:

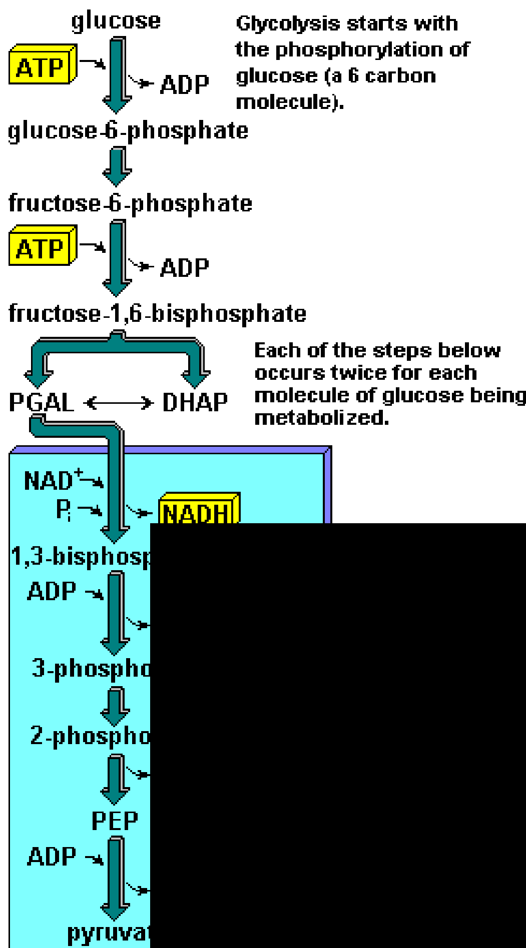
Harvests chemical energy by oxidizing glucose to ___________.

_______________ is a catabolic pathway during which six-carbon glucose is split into 2 three- carbon sugars, which are then oxidized and rearranged to produce two pyruvate molecules

It occurs under ____________or ______________ conditions.

The process occurs in two phases: The ________________________and the ___________________________

The Steps of Glycolysis:



[redacted]

The Krebs Cycle:

Completes the energy yielding oxidation of [redacted]

The fate of pyruvate depends upon the presence or absence of _________. If _________is present, pyruvate enters the ______________ where it is completely oxidized by a series of enzyme-controlled reactions.

The junction between glycolysis and the Krebs Cycle is the formation of ____________. The Acetyl-CoA combines with __________________to begin the cycle. This process occurs in the mitochondrial matrix.

The Electron Transport Chain:

Is made of electron carrier molecules embedded in the ________________membrane.

Each successive carrier in the chain has a higher _________________than the carrier before it, so the electrons are pulled down hill toward the oxygen.

Except for _______________(Q), most of the carriers are protein containing a non -protein cofactor.

_______________: a cell process that can produce ATP without the presence of oxygen. Fermentation recycles NAD^+ from NADH. The two most common forms of fermentation are: 1) alcoholic and 2). lactic acid fermentation.

<u>Alcohol Fermentation</u> (plants cells).

$$\text{Pyruvate} + \text{NADH} = \text{Ethanol} + \text{NAD} + CO_2$$

- _____________ is a toxic material to cells
- The Process allows the cell to rejuvenate its supply of NAD
- This also occurs without the presence of Oxygen

Lactic [redacted]

- Strenuous exercise causes the muscle cell to produce _____________.
- Lack of ___________ allows this process to occur.
- Lactic acid accumulation causes the muscle pH to _______, causing fatigue and pain.
- Lactic acid is changed back to ___________ in the liver.

Homework: p. 124 (1-13)

PHOTOSYNTHESIS

CHLOROPLAST STRUCTURE:

Double membrane enclosing stacks of green disc like structures called _________.

These grana make up what are called the __________. These thylakoids are surrounded by a dense fluid called the ______________.

Nature of Sunlight and The electromagnetic spectrum:

GAMMA RAYS- X-RAYS - UV VISIBLE LIGHT INFRARED MICRO RADIO WAVES

PRIVATEVIOLET	INDIGO	BLUE	GREEN	YELLOW	ORANGE	RED
380 nm	450 nm	500 nm	550 nm	600 nm	650 nm	700 nm

Plants use light in the _____________________range.

Various plant pigments help use light.

Carotenoids, chlorophyll a, b, and c. Chlorophyll a absorbs ________________lights, b absorbs blue and orange -red,

c absorbs blue and orange in smaller amounts.

-

________________is a molecule containing 2 main parts: a complex ring with a magnesium ion in the center and a nonpolar tail.

Homework: 1-9, pp. 145-146. ***Homework:*** pp. 154 – 155 (1-11)

OVERVIEW OF PHOTOSYNTHESIS:

The reactions of photosynthesis take place in two main stages:

1.
2.

LIGHT REACTIONS:

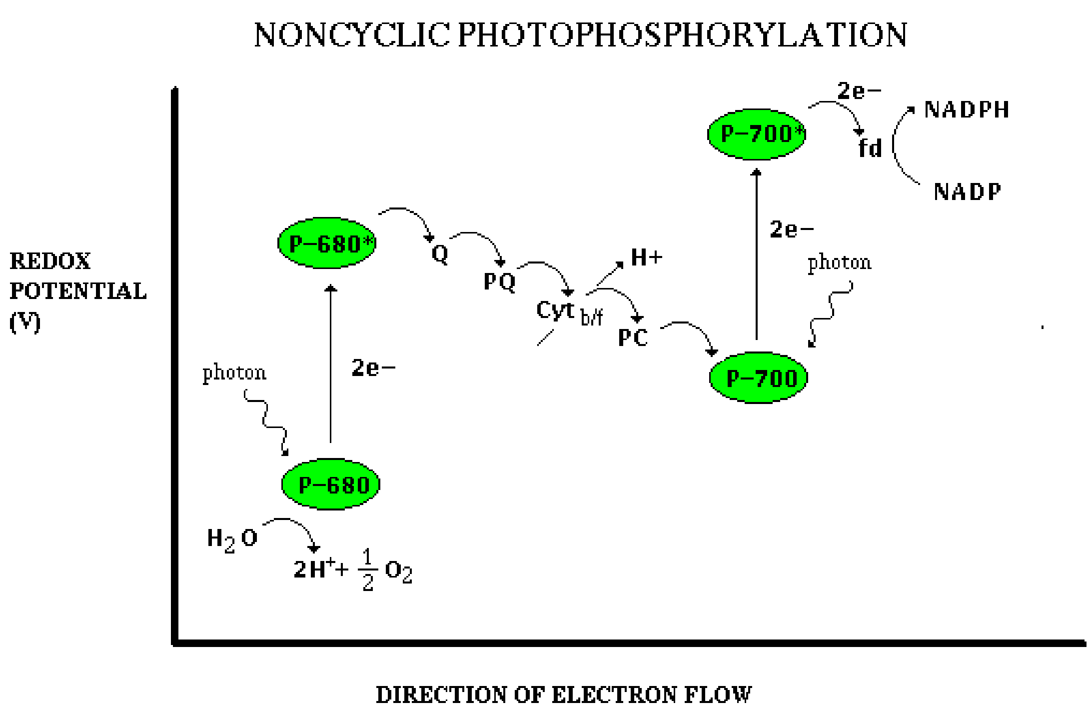
These reactions take place in the_____________ membranes. They involve 2 sets of light-absorbing reactions and 2 sets of electron transport chain reactions.

STEP 1. Light hits ... ass
into an electron tra ... oid
membrane and rel

STEP 2: at the enc ... zed
by more sunlight.

This energizes the

This chain passes ... the
stroma to form NA



These electrons are replaced by the splitting of _________, that also produces H+ and O_2.

The H+ stays in the thylakoid and becomes part of the H+ reservoir that will power the chemiosmotic synthesis of ATP.

The Calvin Cycle:

ATP and NADPH produced by the light reactions are used in the Calvin cycle to reduce________________________.

The Calvin cycle is similar to the Krebs cycle in that the starting material is regenerated by the end of the cycle.

Carbon enters the Calvin cycle and leaves as ______________.

ATP is the energy source, while NADPH is the reducing agent that adds _________________to form sugar.

The Calvin cycle actually produces a ___ carbon sugar glyceraldehyde 3-phosphate.

The Calvin cycle may be divided into 3 steps.

Step 1._________________. This phase begins when a carbon dioxide molecule is attached to a 5 carbon sugar, ribulose biphosphate (RuBP).

This reaction is catalyzed by the enzyme ___________________(rubisco) one of the most abundant proteins on earth.

The products of this reaction is an unstable 6 carbon compound that immediately splits into 2 molecules of________________________.

For every 3 molecules of carbon dioxide that enter the cycle via rubisco, 3 RuBP molecules are carboxylated forming 6 molecules of_____________________.

Step 2:______________. This endergonic reduction phase is a 2 step process that couples ATP hydrolysis with the reduction of 3-phosphoglycerate to glyceraldehyde phosphate.

An enzyme ___________________(adds a phosphate) _______________________by transfering a phosphate from the ATP. The product is_______________________.

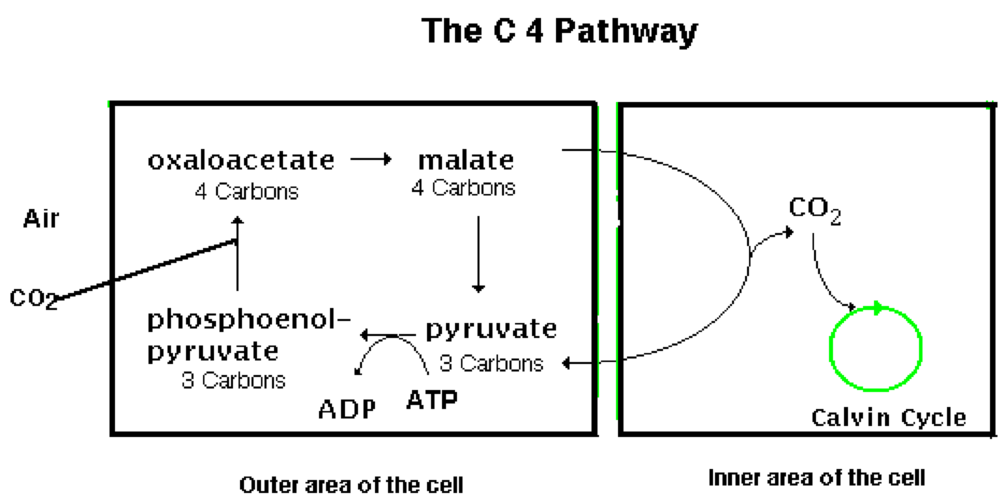
El[redacted] aldehyde group of[redacted]

Fo[redacted]yde-3-phosphates ar[redacted]lecules of __[redacted]

St[redacted]of 5 gl[redacted]

Th[redacted]

RuBP is thus regenerated to begin the cycle again.



_______________: Many
compound. These are called the C_4 plants.

They include the________________________. These plants live in areas that are very hot and semi-arid.

The intermediate process is shown below and the product is then introduced to the bundle sheath cells where the Calvin cycle will take place.

Homework: 1-13, p. 166
Homework: 1-9, p. 172

Photosynthesis and Cellular Respiration

Comparison	Respiration	Photosynthesis
1. Overall Reaction		
a. reactants	• organic molecules (e.g. glucose)	• CO_2 + H_2O

b. products c. energy	• CO_2 + H_2O • Released	• organic molecules • stored
2. Electrons a. source b. carrier(s)	• organic molecules (e.g. glucose) • NAD^+, FAD^+	• Water • $NADP^+$
3. Electron Transport System a. energy profile b. electron source c. electron sink d. products	Energy time • NADH and $FADH_2$ • oxygen • ATP	Energy time • water • NADPH • ATP and NADPH
4. ATP Synthesis and Organelle Structure and Function a. location of ETC b. H^+ ion reservoir and the pumping action of the ions by the ETC c. membrane embedded ATPase and the	• inter membrane (cristae) • pumped out of the matrix and into the inner membrane space	• thylakoid membrane • pumped into the out of the stroma and into the thylakoid lumen

synthesis pf ATP by chemiosmosis	• ATPase is oriented such that the H^+ ions move from the outside in and ATP is made on the matrix side	• ATPase is oriented such that the H^+ ions move from the inside out and ATP is made on the stroma side

Homework: 1-5, p. 182

Name ______________________

Date ______________

Notes on Glycolysis

Stored energy in a glucose molecule cannot be released all at once. Instead the cell takes glucose through a series of chemical reactions in an effort to slowly release its energy.

The first step of this process is called ____________________.

I. ______________________ (breaking up sugar).

a). It takes place in the ___________________ of the cell.

b). It does not need __________________ to carry out its reactions. The term ________________ refers to a lack of oxygen.

II. In order to begin the process of ___________________, the cell will add 2 molecules of a high energy compound called ____________. This will allow glucose to remain in the cell and split into 2 very reactive compounds called _________________.

III. Each ______________ molecule will undergo a series of chemical reactions producing 2 molecules of _____________, 1 molecule of _______________ (a highly energized molecule) and the three carbon compound __________________.

IV. Since each glucose molecule is split into 2 ______________molecules the total amount of ATP produced is _______, NADH produced is _________ and pyruvate is ________.

V. _________________ is the final molecule produced by glycolysis. If there is ___________ present in the cell, these molecules will be changed into a compound called ____________________, before they are allowed to enter the cellular organelle called the _______________________. During this change from pyruvate into _________________

1 molecule of NADH is produced. Since ____ pyruvates are produced from a glucose molecule _______NADH's are produced.

VI.Each NADH has enough stored energy to produce __________ATP molecules. Now the Acetyl Co A will enter the mitochondrion and enter the center part of it called the ____________. Here the _______________ cycle will begin. This cycle contains _______ steps or chemical reactions. Each turn of this cycle will produce________ATP's, __________ NADH's , and __________ $FADH_2$. Since there are ________ Acetyl CoA's produced per glucose, the total amount of ATP is ________, NADH is__________, and $FADH_2$ is __________.

VII. All of the NADH and $FADH_2$ will leave the matrix and enter a series of proteins embedded in the ____________________ wall of the mitochondrion. This is called the _____________. The __________ is where the final ATP production takes place.

Total ATP produced:

Glycolysis: ATP =______

Pyruvate to Acetyl Co A: ATP = _______

Krebs Cycle : ATP = ______

ETS: $FADH_2$ = _____ **X 2** = ATP_______; + NADH _______ **x 3** = ATP. = _____

Total = __________