Name: _____ Date: _____ Block: _____

Guided Notes
Unit 1: Biochemistry

Chapter 2: The Chemistry of Life

I. Concept 2.1: Atoms, Ions, and Molecules

a. Elements

i. Element: _____ - a pure substance that cannot be broken down into other substances by chemical means

ii. Different elements have different properties – these different properties are due to the atom of that element's structure.

iii. Essential Elements

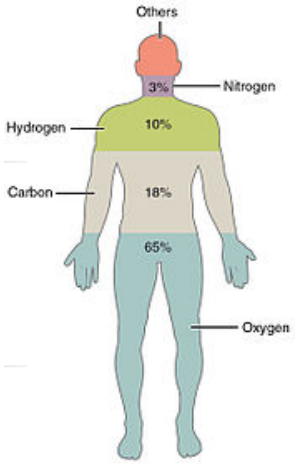
1. About 25 elements are essential to life. 96% of living matter is made up of four elements:

a. _____

b. _____

c. _____

d. _____



iv. Trace Elements

1. The remaining 4% is made of trace elements like calcium (Ca), phosphorus (P), potassium (K), sulfur (S), and others.

II. Concept 2.2: Properties of Water

a. The Structure of Water

i. Water = _____

ii. Each hydrogen is tied to the oxygen by a single covalent bond. (However, the oxygen pulls more heavily on the electrons the two atoms share, making it more negative than the hydrogens.)

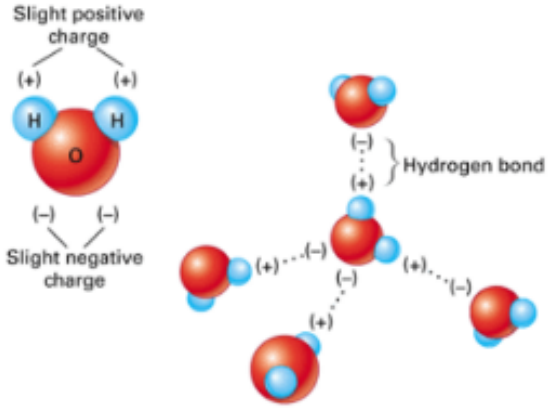
b. Polar Molecule

i. Water is a _____.

ii. Oxygen _____ towards its nucleus, causing a "V" shape to the water molecule, and giving oxygen a slightly negative charge and giving hydrogen a slightly positive charge.

c. Hydrogen Bond

i. The slightly _____ on one water molecule is attracted to the slightly _____ of a second water molecule – this creates a _____.



d. Properties of Water (due to water's hydrogen bonds)

i. Cohesion: the tendency of molecules of the _____ to stick to one another

ii. Adhesion: the tendency of _____ molecules to stick to one another

iii. High Specific Heat: water has better ability to resist _____ _____ than most substances

e. Water's Interactions with Other Molecules (due to water's polarity)

i. Because water is a polar molecule, some molecules are _____ to water, while others are _____ by water.

ii. Hydrophilic: to be ""_____" " - other polar molecules are attracted to water and mix well with water

iii. Hydrophobic: to be "_____" - nonpolar molecules are repelled by water and do not mix well with water

f. Benefits of Water's Polarity

i. Water's ability to attract and repel molecules is essential for life on Earth.

ii. Examples:

1. Creates surface tension, essential for small animals, such as water striders and some spiders
2. Allows for plants to absorb and transport water
3. Prevents quick evaporation in bodies of water like lakes and oceans

g. Water's Ability to Dissolve Other Substances

i. Solution: a uniform mixture of a substance

ii. Solvent: the substance present in _____ amount

iii. Solute: the substance present in a _____ amount

iv. Aqueous solution: a solution where _____ is the solvent

v. FYI: Water is the main solvent in blood, cells, and plants. This allows our bodies to dissolve things with polar areas or with ions.

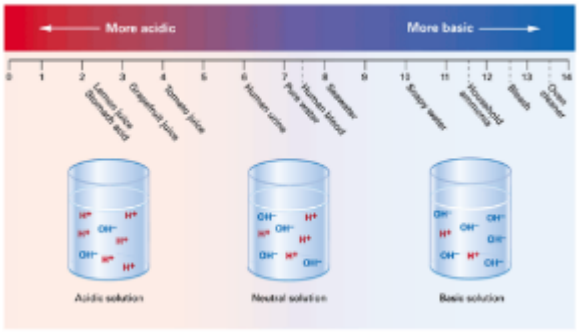
h. pH Scale

i. pH is not a part of the Unit 1 Learning Targets but will be references when learning about protein denaturation in LT 1.8.B.

ii. _____

_____

iii. 0 = most acidic 14 = most basic



1. *Pure water has an equal amount of H+ and OH- ions. Therefore, it has a pH of 7. It is neither acidic nor basic. Most biological fluids have a pH within the range of 6 to 8.*

III. Concept 2.3: Carbon-Based Molecules

a. Carbon Skeletons

i. Recall: A carbon atom has _____ electrons – so it can form up to four bonds with other atoms.

ii. When carbon forms bonds with other carbon atoms, it will produce _____

_____.

iii. This structure allows for carbon to be the backbone of all organic macromolecules in living things.

b. Macromolecules

i. Macromolecule: a large molecule containing _____ of atoms; found in all _____

ii. There are four main categories of macromolecules (polymers): _____ _____

iii. All macromolecules are made of smaller parts, called monomers.

iv. Monomers

1. Monomers: _____ _____

v. Polymers

1. Polymers: _____ _____

c. Carbohydrates

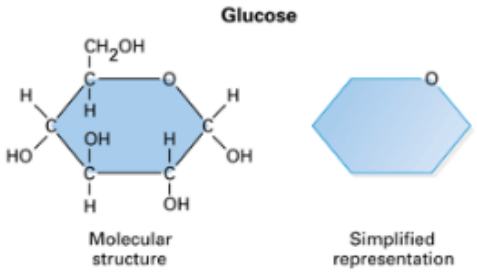
i. Carbohydrate: _____

1. Include _____
2. Broken down to _____
3. Major component in plant cell structure
4. Simple sugars are often _____
5. Monosaccharides

a. _____ _____ (called a monosaccharide)

b. These are the monomer units of carbohydrates.

c. Examples: glucose, frustose, galactose



6. Polysaccharides
    a. Polysaccharides: _____
    _____
    b. Polysaccharides are often broken down into monosaccharides in order to provide living things with energy. Some polysaccharides serve as a support system for plant cells (ex: they form cell walls).
    c. Examples: starch, glycogen, cellulose

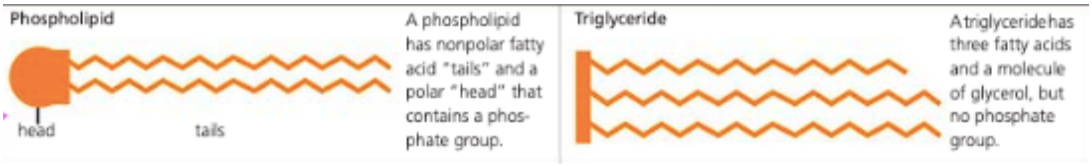
d. Lipids
    i. Lipids: _____ (Because lipids are nonpolar, they do not mix well in water – they are _____.)
    ii. Hydrophobic: _____
        1. Examples: fats, oils, steroids
        2. *(We will not study lipid monomers and polymers, as they vary in different lipids.)*
    iii. Fats & Oils
        1. Fats & oils are types of lipids because they hydrophobic. They store large amounts of energy in living things.
        2. _____ are found in foods such as meat and butter.
        _____ are found in oils, such as olive oil and peanut oil.
        3. The structures of fats and oils are similar. Their structure is in the form of a triglyceride.
        4. _____: a three-carbon backbone called glycerol attached to three fatty acids, which contain long hydrocarbon chains

        5. Difference between Fats & Oils
            a. Saturated fat: solid fat
                i. Examples: lard, butter, animal fats
            b. Unsaturated fat: liquid fat
                i. Examples: fruit, vegetable, and fish fat, oils

c. Diets rich in saturated fats are unhealthy. They promote the build-up of plaque, which line blood vessels and reduce blood flow (leading to heart disease).

iv. Phospholipids

1. A lipid molecule with a _____ head and two fatty acid _____ tails
2. Phospholipids are lipids because they are hydrophobic. They are different from fats in structure and function.



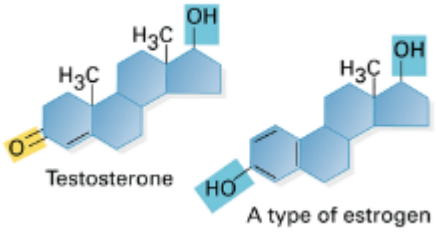
3. Phospholipids make the cell membrane.

v. Steroids

1. _____

_____

2. Steroids are lipids because they are _____. They are different from fats in structure and function.
3. Examples: chemical signals like estrogen and testosterone



4. Example: cholesterol – found in membranes of cells

e. Proteins

i. Protein: _____

_____

ii. There are many functions of proteins. Some are:

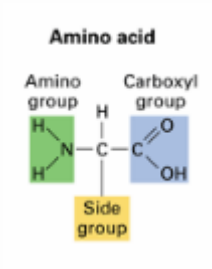
1. Form structures like hair/fur
2. Make up muscles
3. Provide long-term nutrient storage
4. Circulate in the blood and defend the body against microorganisms
5. Act as signals, conveying messages from one cell to another
6. Control the chemical reactions in the cell

iii. Amino Acids

1. Amino acid: _____

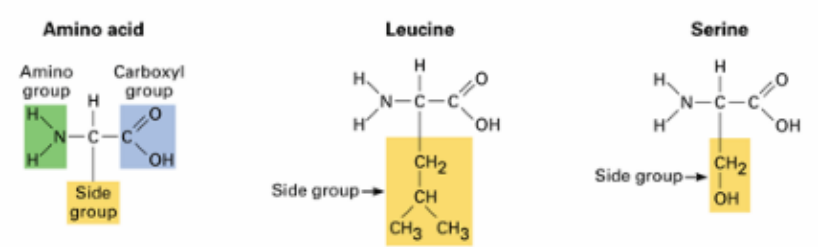
_____

2. Three of the partners are ALWAYS: a hydrogen atom, a carboxyl group, and an amino group.



3. The _____ is unique to each amino acid and gives the amino acid its chemical properties.

4. Examples:



a. Living things use 20 different amino acids to build proteins. The human body can make 12 of the amino acids. The others come from foods, such as meat, beans, and nuts.

iv. Building a Protein

1. Polypeptide: _____
2. Amino acids form covalent bonds, called _____, with each other. This links the amino acids into chains called _____.
3. Proteins are composed of one or more polypeptide chains. Each protein has a unique sequence of amino acids.

v. Protein Shape

1. A functional protein consists of one or more polypeptides precisely _____

_____.

2. Unfavorable changes cause proteins to unravel and lose their normal shape. This is

_____.

3. *We will discuss denaturation again for LT 1.8.B, within Concept 2.5 of this presentation.*

f. Nucleic Acids

i. Nucleic Acid: _____

_____

ii. There are two types of nucleic acids: _____.

1. (We learn more about these in Unit 5.)

iii. Nucleic acids work together to make _____ - DNA carries the information to make the protein, and RNA builds the protein.

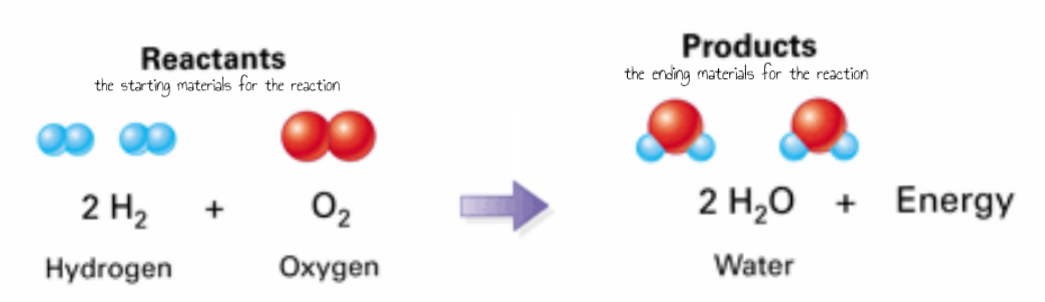
IV. Concept 2.4: Chemical Reactions

a. Chemical Reactions

i. The _____

_____

are called chemical reactions.



ii. In a chemical reaction, atoms are not created nor destroyed - they are _____.

b. Bond Energy

i. Energy is _____ bonds in molecules.

ii. Bond energy: the amount of energy that will break a bond between two atoms.

iii. Energy is _____.

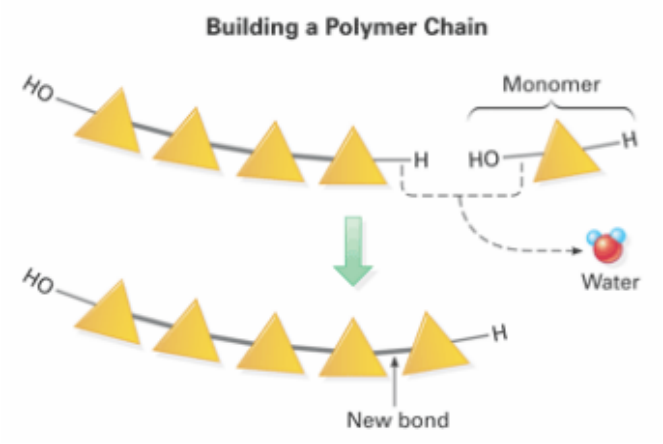
c. Building Polymers

i. Each time a monomer is _____ to a chain, a _____

_____ - called a _____

reaction.

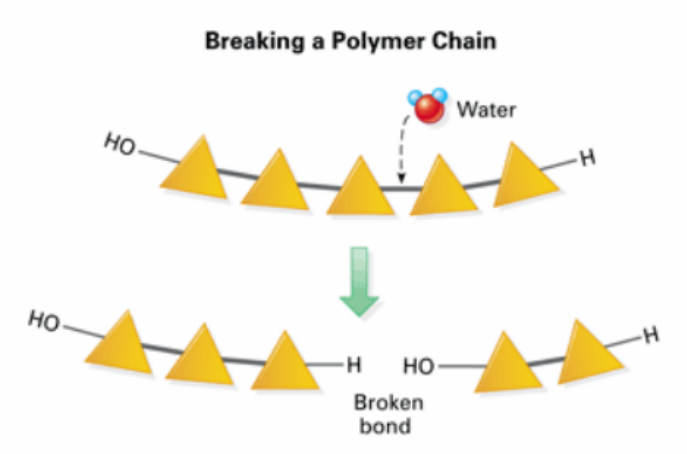
1. Energy is _____.



d. Breaking Polymers

i. Cells break bonds between monomers by _____ to them – called _____. (The reverse of the dehydration reaction.) Cells gain energy through this reaction of breaking down molecules.

1. Energy is _____.



e. Activation Energy

i. In order to start a chemical reaction, energy is needed to weaken the bonds in the reactant molecules.

ii. Activation energy: _____

_____

f. Exothermic Reaction

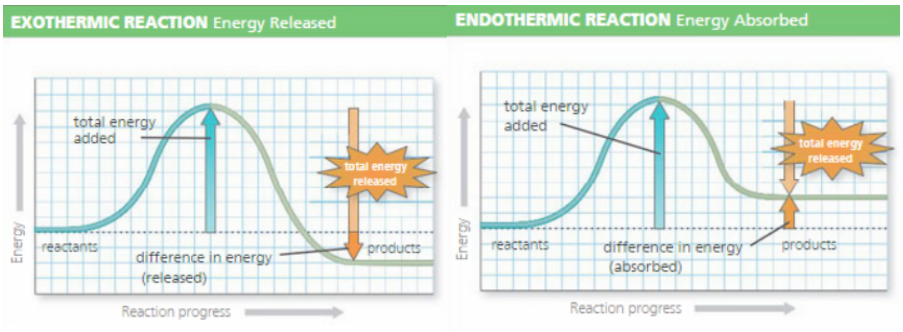
i. Exothermic reaction: _____

_____

g. Endothermic Reaction

i. Endothermic reaction: _____

_____



V. *Concept 2.5: Enzymes*

a. Catalysts

i. Catalyst: _____

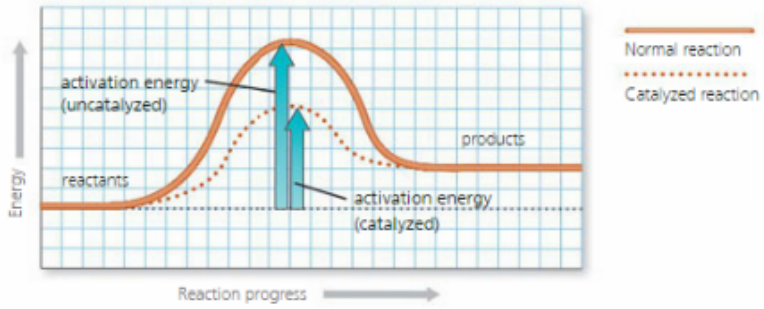
_____

_____

ii. (As a result, a catalyst will also increase the rate of the chemical reaction.)

FIGURE 5.1 CATALYSTS AND ACTIVATION ENERGY

Under normal conditions, a certain amount of activation energy is needed to start a chemical reaction. A catalyst decreases the activation energy needed.



b. Enzymes

i. Enzyme: _____

_____

ii. Enzymes are involved in almost every process in organisms (like breaking down food or building proteins).

iii. Enzymes are easy to pick out – their names usually end in *–ase*.

iv. Enzyme Conditions

1. Like all proteins, enzymes work best in certain environments.
2. _____

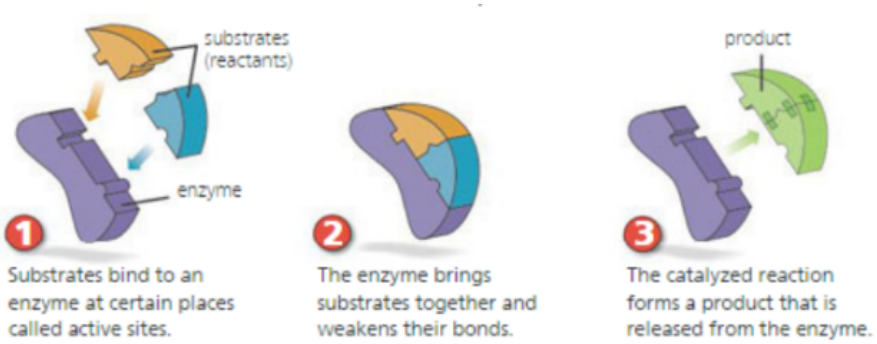
_____ lead to enzymes losing proper structure, causing a loss in proper function.
3. When a protein, such as an enzyme, has lost its ability to function due to these changes in temperature or pH, the protein has _____.

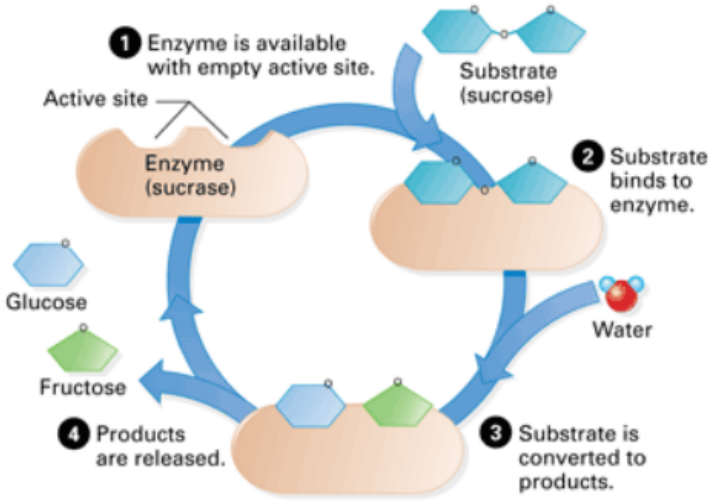
v. How Enzymes Work

1. Enzymes catalyze specific reactions – How? _____

_____
2. Substrate: _____

_____
3. Active site: the particular region of the enzyme that fits a certain substrate


substrates
(reactants)
enzyme
1
Substrates bind to an enzyme at certain places called active sites.
2
The enzyme brings substrates together and weakens their bonds.
product
3
The catalyzed reaction forms a product that is released from the enzyme.


1 Enzyme is available with empty active site.
Active site
Enzyme (sucrase)
Substrate (sucrose)
2 Substrate binds to enzyme.
Water
3 Substrate is converted to products.
4 Products are released.
Glucose
Fructose