Name: _____ Date: _____ Block: _____

Guided Notes
Unit 1: Biochemistry

Chapter 2: The Chemistry of Life

I. Concept 2.1: Atoms, Ions, and Molecules

a. Atoms

i. Atom: _____

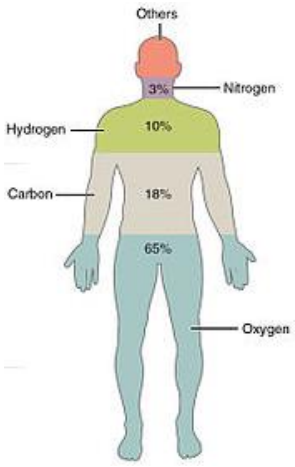
ii. (They are SUPER small! It would take 3 million carbon atoms to stretch across the period printed at the end of a sentence in your textbook.)

iii. Subatomic Particles

1. Subatomic particles are the small components of an atom.
    a. Proton: _____
    b. Electron: _____
    c. Neutron: _____
    d. Nucleus: central core of protons & neutrons

iv. Elements

1. Element: _____ - a pure substance that cannot be broken down into other substances by chemical means
2. Different elements have different properties – these different properties are due to the atom of that element's structure.
3. Essential Elements
    a. About 25 elements are essential to life. 96% of living matter is made up of four elements:
        i. _____
        ii. _____
        iii. _____
        iv. _____



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

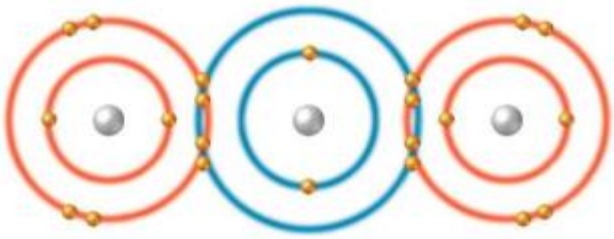
v. Compounds

1. Compound: _____

_____

_____

2. A compound's properties may differ greatly from those of its component elements.
3. Example: Water (H_2O) is a liquid at room temperature, but both oxygen and hydrogen are gases in their elemental state.
4. What compound is shown below? _____



vi. Reactivity

1. Atoms that are more _____ tend to react with other atoms, filling their highest occupied energy levels.
2. Examples: Hydrogen, carbon, oxygen, and nitrogen are chemically reactive because their valence electron shells are not completely full.

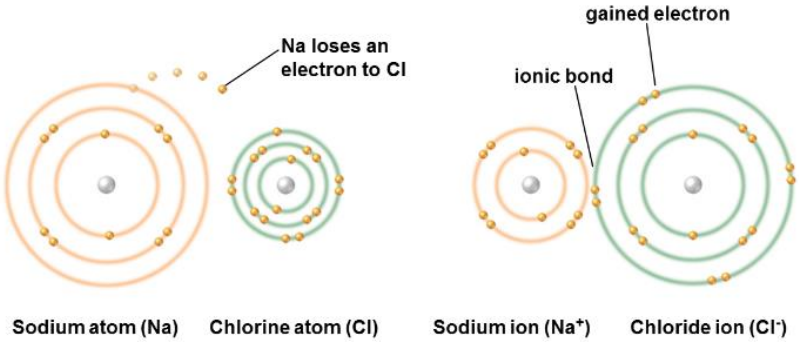
b. Bonds

i. Ionic Bonds

1. Ionic bond: _____

_____

2. Example: table salt (NaCl)
3. Ion: atoms (or groups of atoms) that have become _____



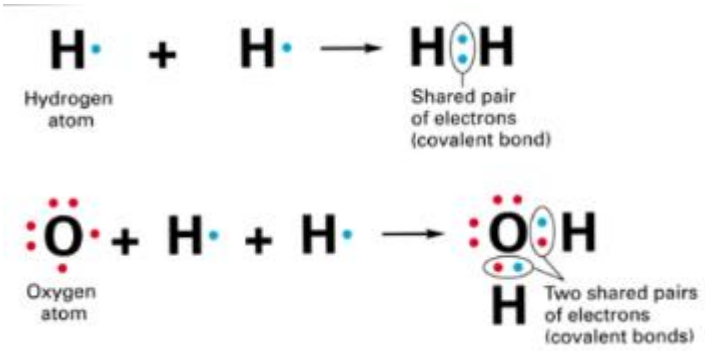
_____

i. Covalent Bonds

4. Covalent bond: _____

_____

5. Example: water (H_2O)



6. Molecules

a. Molecule:

_____

_____

Modeling Molecules

Chemical formula	Structural formula	Space-filling model
H_2	H—H	
O_2	O═O	
H_2O		

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

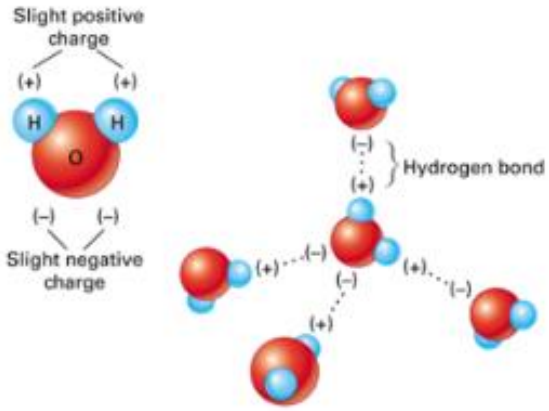
i. Water is a _____.

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. Cohesion & Adhesion

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

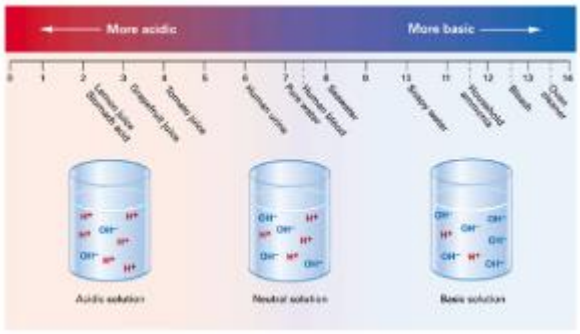
ii. Adhesion: the tendency of _____ molecules to stick to one another

e. pH Scale

i. _____

_____

ii. 0 = most acidic 14 = most basic



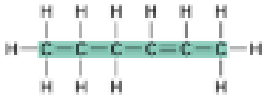
III. Concept 2.3: Carbon-Based Molecules

a. Carbon Skeletons

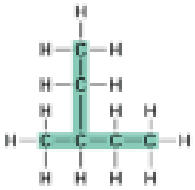
i. Recall: A carbon atom has _____ electrons – so it can form up to four bonds with other atoms.

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

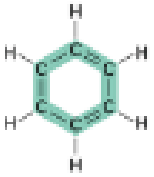
_____.



Straight chain



Branched chain



Ring

iii. Organic molecule: _____

1. (Examples: CH_4, CO)

iv. Inorganic molecule: _____

1. (Examples: H_2O, O_2, NaOH)

v. Monomers

1. Monomers: _____

_____

vi. Polymers

1. Polymers: _____

_____

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

_____.

b. Carbohydrates

i. Carbohydrate: _____

1. Include _____
2. Broken down to _____
3. Simple sugars are often _____
4. Monosaccharides

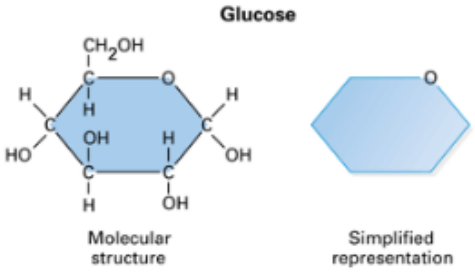
a. _____

_____

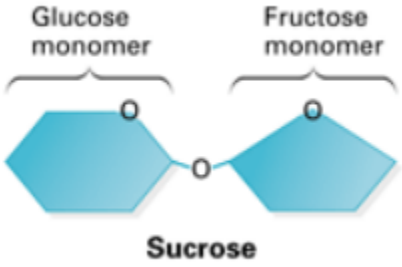
(called a monosaccharide)

b. These are the monomer units of carbohydrates.

c. Examples: glucose, frustose, galactose

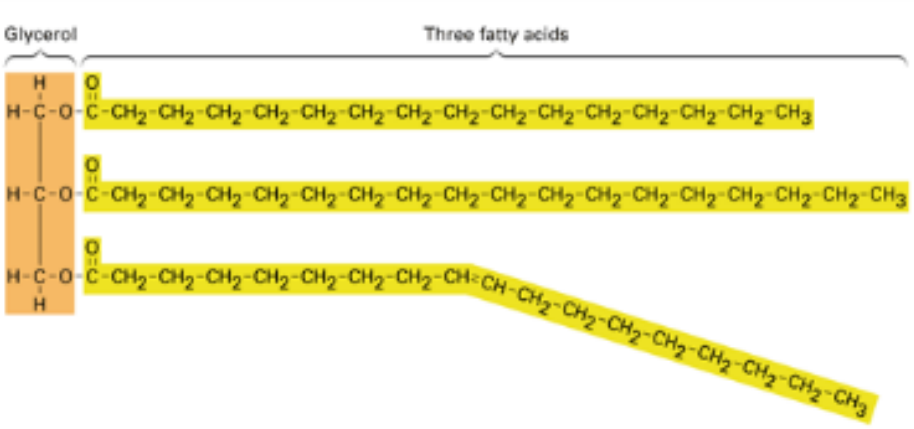


5. Disaccharides
    a. _____
    _____
    b. Example: sucrose = glucose + frustose



6. Polysaccharides
    a. Polysaccharides: _____
    _____
    b. Examples: starch, glycogen, cellulose

c. Lipids
    i. Lipids: _____ (Because lipids are nonpolar, they do not mix well in water – they are _____.)
    ii. Hydrophobic: _____
    iii. Examples: Fats, oils, steroids
    iv. Fats & Oils
        1. _____: a three-carbon backbone called glycerol attached to three fatty acids, which contain long hydrocarbon chains

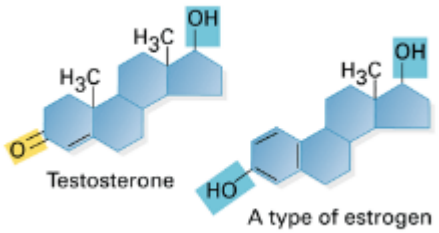


v. Steroids

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



d. Proteins

i. Protein: _____

_____

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

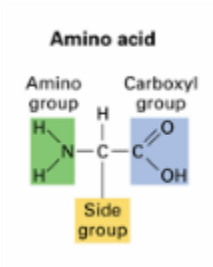
1. Form structures like hair/fur
2. Make up muscles
3. Provide long-term nutrient storage
4. Circulate in the blood and defend the body against microorganisms
5. Act as signals, conveying messages from one cell to another
6. Control the chemical reactions in the cell

iii. Amino Acids

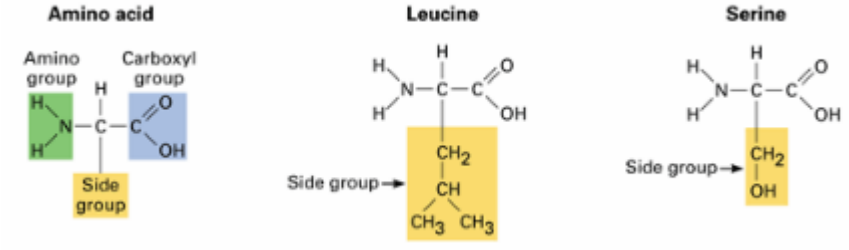
1. Amino acid: _____

_____

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:

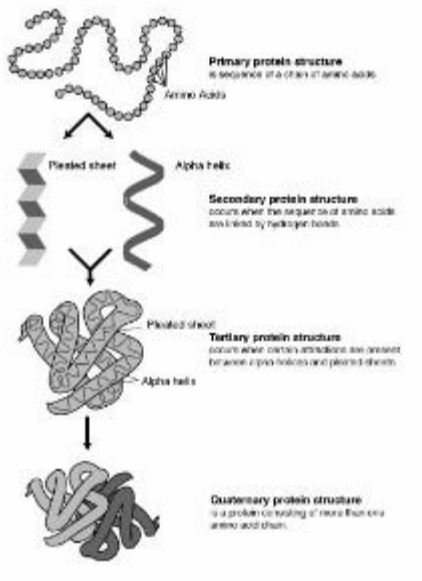


iv. Building a Protein

1. Polypeptide: _____
2. Amino acids form covalent bongs, 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 _____.



e. 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.

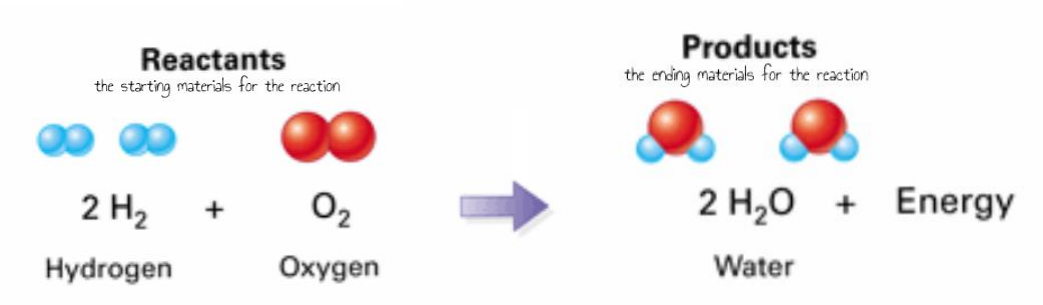
IV. Concept 2.4: Chemical Reactions

a. Chemical Reactions

i. The _____

_____

are called chemical reactions.



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.

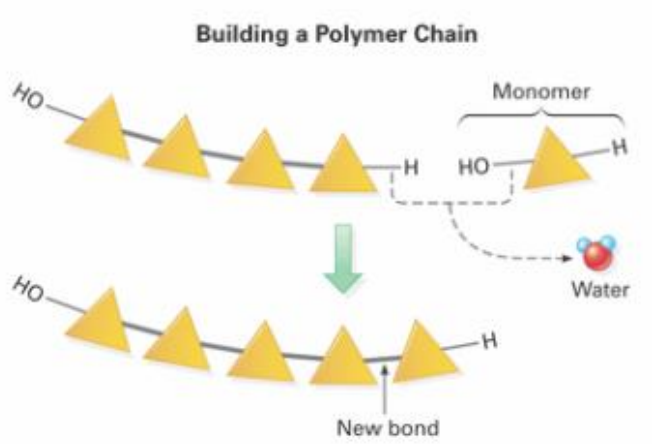
1. Energy is _____.

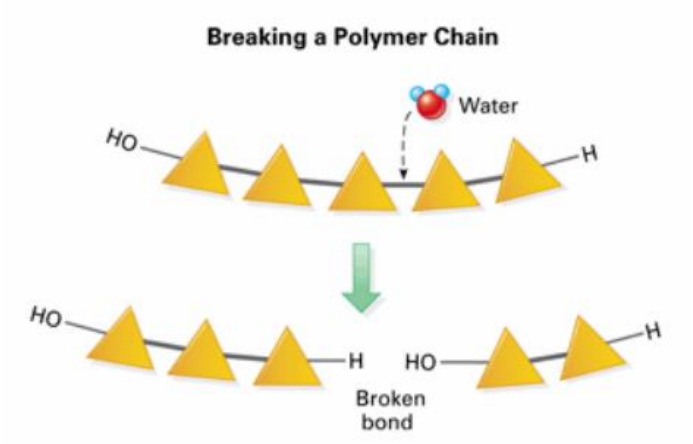
d. Breaking Polymers

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

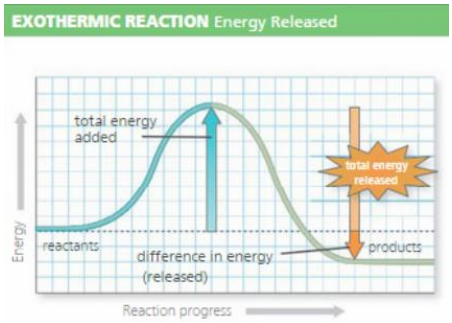
i. Exothermic reaction: _____

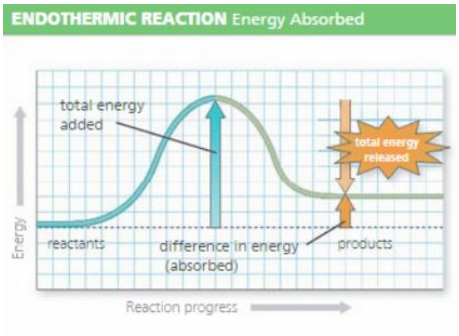
_____

g. Endothermic Reaction

i. Endothermic reaction: _____

_____





V. Concept 2.5: Enzymes

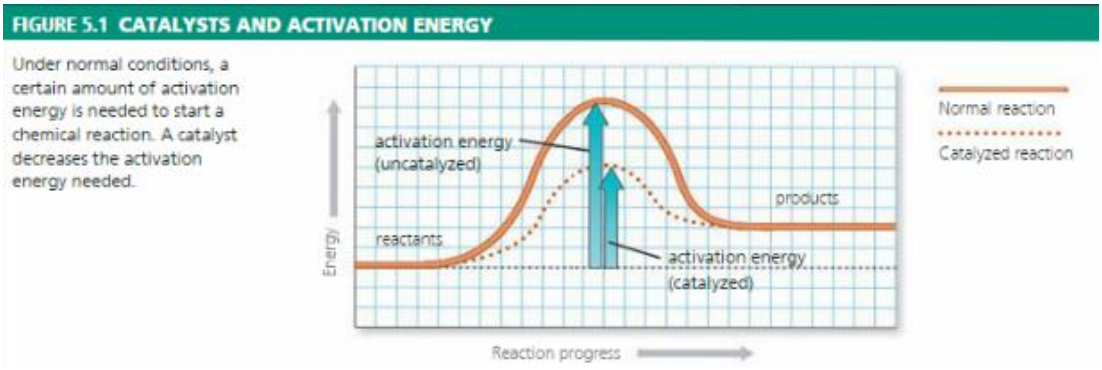
a. Catalysts

i. Catalyst: _____

_____

_____

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



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.

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