

Name: _____ Period: _____ Seat #: _____ Date: _____

NORTH CENTRAL HIGH SCHOOL NOTE & STUDY GUIDE

Honors Biology I

Unit 1-2: Biochemistry

*REQUIRED READING FROM BIOLOGY: CONCEPTS & CONNECTION (CAMPBELL, ET. AL.):
CHAPTER 2, THE CHEMICAL BASIS OF LIFE
CHAPTER 3, THE MOLECULES OF CELLS*

Additional resources available at
www.mrdocsonlinelab.com

Grade Chart: (For Teacher Use Only)

Part	Description	Grade	Out of
1	NOTES: Introduction to Chemistry		10
2	Part I: Introduction to Chemistry		10
3	VIDEOLAB NOTES: Properties of Water		10
4	Part II: Properties of Water		10
5	NOTES: Organic/Biochemistry		10
6	PART III: Organic/Biochemistry		10
7	ACTIVITY: Organic Organizer		20
8	NOTES: Enzymes		10
9	Part IV: Enzymes		10
Test Date	TOTAL		100

NOTES: Introduction to Chemistry

Objectives

- *
- *
- *
- *
- *

Matter

- * Everything in the universe is made up of _____.
- * All matter is made up of tiny particles called _____.
- * Atoms are the smallest unit of an _____ that still retain that element's properties.

Atoms

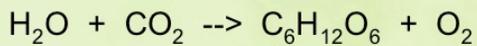
- * Atoms are made up of three **sub-atomic particles**.
 - * **Protons** are positively charged particles and are located in the nucleus.
 - * **Neutrons** have no charge (neutral) and are also located in the nucleus.
 - * **Electrons** have a negative charge, are located on the outside of the atom in the **Electron Cloud**, and are responsible for **bonding**.

Chemical Bonds

- * Atoms can combine with other atoms to form a _____.
- * Like molecules form a _____.
- * There are 2 main types of bonds:
 - * _____ occur when atoms share their outermost electrons.
 - * _____ occur when atoms gain or lose their outermost electrons.

Chemical Reactions

- * When atoms form or break bonds to become new molecules it is called a _____.
- * The substances that go into a chemical reaction are called _____.
- * The substances that are generated as a result of a chemical reaction are called _____.



Redox Reactions

- * Chemical reactions are responsible for the exchange of energy between an organism and the environment.
- * _____ are reactions in which reactants lose electrons (energy.)
- * _____ are reactions in which reactants gain electrons (energy.)
- * A **redox reaction** is when both oxidation and reduction happen in the same reaction.

Making Reactions Happen

- * Many reactions require the addition of energy to happen.
- * The amount of energy required to make a reaction start is called the _____.
- * Substances known as **catalysts** can reduce the activation energy for a reaction.
- * Catalysts are not used up in the chemical reaction.
- * _____ are biological catalysts.

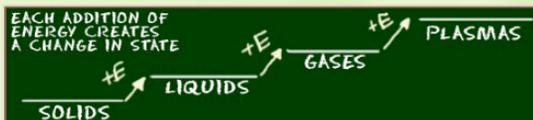
States of Matter

- * _____ states that the particles (atoms and molecules) that make up all matter are constantly in motion.
- * The amount of Kinetic energy (movement) and how close the particles are determines which state of matter the substance is in.

Energy and State

- * Look at the different states of matter and compare the movement.

Purdue Animation



Part I: Introduction to Chemistry

_____ 1. Atoms are composed of

- a. protons with a positive charge.
- b. neutrons with no charge.
- c. electrons with a negative charge.
- d. All of the above

_____ 2. The smallest particle of carbon that can retain the chemical properties of carbon is

- a. a carbon molecule.
- b. a carbon macromolecule.
- c. a carbon atom.
- d. the nucleus of a carbon atom.

_____ 3. A substance that is composed of only one type of atom is called a(n)

- a. nucleus.
- b. cell.
- c. element.
- d. molecule.

_____ 4. All matter in the universe is composed of

- a. cells.
- b. molecules.
- c. atoms.
- d. carbon.

_____ 5. The electrons of an atom

- a. are found in the nucleus along with the protons.
- b. orbit the nucleus in various energy levels.
- c. have a positive charge.
- d. are attracted to the positive charge of neutrons.

_____ 6. Atoms that have gained energy

- a. have protons and neutrons that move farther apart.
- b. lose neutrons from the nucleus.
- c. have electrons that move to higher energy levels.
- d. absorb electrons into the nucleus.

_____ 7. Which of the following states of matter contain(s) particles that are tightly linked together in a definite shape?

- a. solid
- b. liquid
- c. gas
- d. solid and liquid

_____ 8. The bond formed when two atoms share a pair of electrons is called a

- a. hydrogen bond.
- b. nonpolar bond.
- c. covalent bond.
- d. water bond.

_____ 9. Sharing of electrons between atoms of two or more elements

- a. results in the formation of an ion.
- b. results in the formation of a compound.
- c. results in the formation of noble gases.
- d. results in destabilization of the atoms involved.

_____ 10. An atom that has gained or lost electrons is called a(n)

- a. molecule.
- b. nucleon.
- c. ion.
- d. element.

_____ 11. Atoms become more stable when they form compounds because

- a. they always lose electrons when they form compounds.
- b. their outer orbitals become filled when they form compounds.
- c. they always gain electrons when they form compounds.
- d. their nucleus loses extra protons when they form compounds.

_____ 12. Which of the following statements most accurately describes the difference between an ionic bond and a covalent bond?

- a. Atoms held together by ionic bonds separate when placed in water, while atoms held together by covalent bonds do not separate in water.
- b. Ionic bonds hold together atoms of two different types, while covalent bonds hold together atoms of the same type.
- c. Electrons are exchanged between atoms held together by an ionic bond, but they are shared between atoms held together by a covalent bond.
- d. Ionic bonds form between atoms that carry opposite charges, while covalent bonds form between uncharged atoms.

_____ 13. Changing the course or pathway of a chemical reaction so that it requires less activation energy

- a. is a violation of the laws of nature.
- b. requires higher temperatures than those found within cells.
- c. Occurs only when reactants are quickly added to the reaction mixture.
- d. is accomplished by the action of catalysts on reactants.

_____ 14. When a molecule gains an electron, it has been

- a. oxidized.
- b. reduced.
- c. digested.
- d. inactivated.

_____ 15. Oxidation-reduction reactions are important in organisms because they

- a. allow the passage of energy from molecule to molecule.
- b. prevent nuclear reactions from occurring.
- c. allow the creation and destruction of energy.
- d. None of the above; oxidation-reduction reactions do not occur in living organisms.

16. Substances that are changed when they become involved in chemical reactions are called _____, while the new substances that are formed are called _____.

17. The loss of electrons from a molecule is called _____, while the gain of electrons by a molecule is called _____.

18. The energy needed to break existing chemical bonds during the initiation of a chemical reaction is called _____.

19. Explain the connection between chemical reactions, chemical bonds, and energy.

VIDEOLAB NOTES: Properties of Water

INSTRUCTIONS: Watch the video and complete the notes below.

Differentiate between Polar and Nonpolar and why it's important.

Describe the following terms and why they are important with respect to water in living organisms

Adhesion:

Cohesion:

Surface Tension

Describe why water is considered the "universal solvent."

Describe the following terms and why they are important with respect to water in living organisms

Acid:

Base:

Nutral:

pH:

Part II: Properties of Water

- _____ 1. The concentration of a solution is
- the number of particles of a substance in a solvent.
 - the amount of a solvent that is dissolved in a fixed amount of a solution.
 - the amount of a solute that is dissolved in a fixed amount of a solution.
 - the ratio of solute to solvent in a solution.
- _____ 2. A neutral solution has an equal number of
- hydrogen and hydronium ions.
 - hydroxide and hydronium ions.
 - hydrogen and hydroxide ions.
 - oxygen and hydrogen ions.
- _____ 3. The terms *base* and *alkaline* refer to solutions that
- contain dissolved sodium hydroxide.
 - contain more hydronium ions than hydroxide ions.
 - contain more hydroxide ions than hydronium ions.
 - contain more hydroxide ions than hydrogen ions.
- _____ 4. A solution with a pH of 11 is
- acidic.
 - alkaline.
 - neutral.
 - a buffer.
- _____ 5. Acidic solutions have a pH that is
- less than 7.
 - between 0 and 14.
 - a negative number.
 - more than 7.
- _____ 6. Buffers
- are of relatively little importance in living things.
 - are formed when a large number of hydroxide ions are released in a solution.
 - are formed when a large number of hydronium ions are released in a solution.
 - Tend to prevent great fluctuations in pH.
- _____ 7. A water molecule is polar because its hydrogen and oxygen atoms
- Both lose electrons.
 - become ions.
 - Both gain electrons.
 - do not share the electrons equally.
- _____ 8. Polar molecules such as water have
- no negative or positive poles.
 - Both negative and positive poles.
 - only a negative pole.
 - only a positive pole.
- _____ 9. A molecule that has a partial positive charge on one side and a partial negative charge on the other side is called a
- nonpolar molecule.
 - Polar molecule.
 - charged molecule.
 - bipolar molecule.
- _____ 10. Water is a polar molecule because
- it contains two hydrogen atoms for each oxygen atom.
 - it has a charge.
 - different parts of the molecule have slightly different charges.
 - it does not have a charge.

- ____ 11. Water molecules break up other polar substances
- such as salts.
 - because of the uneven charge distribution that exists in water molecules.
 - thus freeing ions in these substances for use by the body.
 - All of the above
- ____ 12. Which of the following characteristics of water is *not* a result of hydrogen bonding?
- adhesive strength
 - Capillarity
 - cohesive strength
 - All of the above are a result of hydrogen bonding.
13. A substance that dissolves in another is called a(n) _____.
14. _____ is the most common solvent in cells.
15. _____ and _____ ions form when water dissociates.
16. An acidic solution is one that has more _____ than _____ ions.
17. A solution with a pH of 3 has _____ times more hydronium ions than a solution with a pH of 6.
18. Buffers are important because body fluids must be maintained within a relatively narrow range of _____.
19. Water is very effective at dissolving other polar substances because of its _____.
20. Breaking of _____ bonds is the first thing that happens when water is heated, which means that it takes a great deal of thermal energy to raise the temperature of water.
21. How does water's polar nature affect its ability to dissolve different substances?

NOTES: Organic/Biochemistry



Objectives

- *
- *
- *
- *
- *



Organic Compounds

* All compounds can be classified into two categories:

- * _____: These compounds are carbon based.
- * _____: These compounds do not contain carbon (with few exceptions.)



The Carbon Atom

* The carbon atom is unique because it can bond with 4 different atoms or even to another carbon atom.

Functional Groups

- * There are some clusters of atoms that are often used to influence the characteristics of molecules.
- * The presence these _____ determines how and what a molecule does.

Functional Groups

TABLE 3-1 Common Functional Groups

Functional group	Structural formula	Example
Hydroxyl	—OH	
Carboxyl		
Amino		
Phosphate		

Monomers & Polymers

- * Many carbon compounds are built from _____, which are simple carbon based molecules that can serve as building blocks for more complex molecules.
- * Monomers combine to form _____.
- * Large polymers can also be called _____.

A little Greek:

mono = _____, poly = _____, micro = _____, macro = _____

Molecules of Life

* There are four essential macromolecules for life and each plays a specific role in the chemistry of the specific organism.

* They are:

- * _____
- * _____
- * _____
- * _____

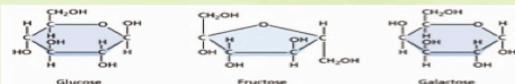
Carbohydrates

* **Monomer:** _____
(Glucose, Fructose, Galactose)

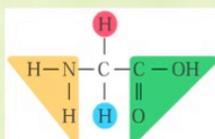
* **General Formula:** CH_2O (1:2:1 Ratio)

* **Polymer:** _____

* **Primary Use:**



Proteins



* **Monomer:** _____

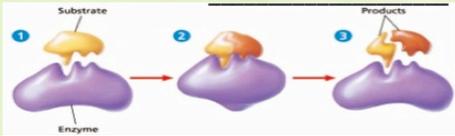
* **General Formula:** Carbon bonded to 1 Hydrogen, 1 carboxyl Group, 1 amino group, and a "R" group.

* **Polymer:**

* **Primary Use:**

Enzymes (Proteins)

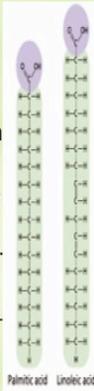
- * Enzymes are a specific type of protein that act as a catalyst to breakdown certain substances (_____).
- * Once a substrate comes in contact with the _____ of an enzyme, it is broken down.



Lipids

- * **Monomer:** _____
- * **General Formula:** Long Carbon chain with carboxyl group on one end and an "X" group.
- * **Polymer:** _____ (X=alcohol)
_____ (X=phosphate),
_____ (X=Alcohol chain).
- * **Primary Use:** _____

* NOTE: The carboxyl end of a lipid is **hydrophilic** (attracted to water) and the other end is often **hydrophobic** (water fearing.)



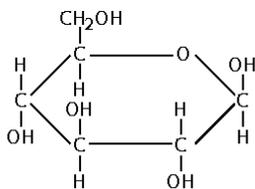
Nucleic Acids

- * **Monomer:** _____
- * **General Formula:** Phosphate group, a Carbon sugar, & Ring-shaped nitrogenous base.
- * **Polymer:** _____ (_____) & _____ (_____)
- * **Primary Use:** _____

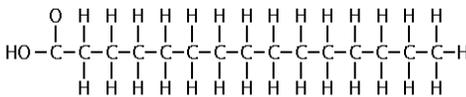
PART II: Organic/Biochemistry

- ____ 1. All organic compounds contain the element
- a. C.
 - b. N.
 - c. Ca.
 - d. Na.
- ____ 2. Carbon is different from many other elements in that
- a. it has four electrons in its outermost energy level.
 - b. it readily bonds with other carbon atoms.
 - c. it can form single, double, or triple bonds with other atoms.
 - d. All of the above
- ____ 3. Which of the following is *not* true of alcohols?
- a. They contain a hydroxyl group (–OH).
 - b. They are polar molecules.
 - c. They can affect processes in living things, either positively or negatively.
 - d. They are the only kind of functional group in organic molecules that contains oxygen.
- ____ 4. The formation of ADP and inorganic phosphate from ATP and water is an example of which kind of reaction?
- a. condensation
 - b. polymerization
 - c. hydrolysis
 - d. oxidation
- ____ 5. Which of the following is a carbohydrate?
- a. DNA
 - b. insulin
 - c. wax
 - d. sucrose
- ____ 6. Which organic molecule below is classified as a carbohydrate?
- a. amino acid
 - b. CH₂ chain
 - c. nucleotide
 - d. sugar
- ____ 7. Animals store glucose in the form of
- a. cellulose.
 - b. glycogen.
 - c. wax.
 - d. lipids.
- ____ 8. Polysaccharides are
- a. carbohydrates.
 - b. lipids.
 - c. proteins.
 - d. unsaturated fats.
- ____ 9. All of the following are examples of carbohydrates *except*
- a. sugar.
 - b. cellulose.
 - c. steroids.
 - d. glycogen.
- ____ 10. Amino acids are monomers of
- a. disaccharides.
 - b. proteins.
 - c. nucleotides.
 - d. steroids.
- ____ 11. Which organic molecule below is most closely related to proteins?
- a. amino acids
 - b. CH₂ chains
 - c. nucleotides
 - d. sugars
- ____ 12. Long chains of amino acids are found in
- a. carbohydrates.
 - b. lipids.
 - c. proteins.
 - d. sugars.

13.



Molecule 1



Molecule 2

Refer to the illustration above. Molecules like molecule 2 are found in

- a. carbohydrates.
- b. lipids.
- c. nucleic acids.
- d. proteins.

14. Lipids are

- a. polar molecules.
- b. similar to water molecules.
- c. protein molecules.
- d. nonpolar molecules.

15. All of the following are examples of lipids *except*

- a. saturated fats.
- b. starch.
- c. cholesterol.
- d. earwax.

16. Saturated fatty acids contain

- a. carbon atoms that are each bonded to four other atoms.
- b. carbon atoms linked by double bonds.
- c. no carboxyl (-COOH) groups.
- d. more than 100 carbon atoms.

17. Lipids are soluble in

- a. water.
- b. salt water.
- c. oil.
- d. All of the above

18. Which organic molecule below is most closely related to lipids?

- a. amino acids
- b. CH₂ chains
- c. nucleotides
- d. sugars

19. Which organic molecule below is most closely related to nucleic acids?

- a. amino acids
- b. CH₂ chains
- c. nucleotides
- d. sugars

20. Nucleic acids include

- a. chlorophyll and retinal.
- b. DNA and RNA.
- c. lipids and sugars.
- d. glucose and glycogen.

21. Energy is released when the bond between

- a. carbon atoms in ATP is broken.
- b. ribose and adenine in ATP is broken.
- c. phosphate groups in ATP is broken.
- d. two ATP molecules is broken.

22. All of the following are functional groups *except*

- a. a hydroxyl group.
- b. an amino group.
- c. a carboxyl group.
- d. a carbonate group.

23. A phospholipid molecule contains all of the following *except*

- a. two fatty acids.
- b. three fatty acids.
- c. a phosphate group.
- d. glycerol.

- _____ 24. Carbon atoms can bond together to form all of the following *except*
- a. ring structures.
 - b. inorganic structures.
 - c. straight chain structures.
 - d. branched structures.
25. Because carbon atoms have four electrons in their outermost energy level, they can form up to _____ covalent bonds with other atoms.
26. In the molecule that has the chemical formula C_2H_4 , the carbon atoms are bonded together with a _____ bond.
27. In a condensation reaction, two molecules become linked together and a molecule of _____ is produced.
28. The formation of polymers from monomers occurs as a result of _____ reactions, and the breakdown of polymers into monomers occurs as a result of _____ reactions.
29. Lipids are _____ molecules because they have no negative and positive poles.
30. A substrate attaches to the _____ of an enzyme.
31. In a triple bond, _____ pair(s) of electrons is (are) shared between two atoms.
32. ATP contains _____ phosphate groups.

ACTIVITY: Organic Organizer

Compounds	Atoms/Elements	Monomers	Polymers	Function	Foods
Carbohydrates					
Proteins					
Lipids					
Nucleic Acids					

NOTES: Enzymes



Objectives

- * _____
- * _____
- * _____
- * _____



Before We Get to Far...

- * It is important to remember that in biology, and elsewhere, _____
- * This means that the shape of something will directly determine what it does.
- * If the shape of something changes it often means

• EXAMPLE:



Reaction Rates

- * The rate of a reaction is a measure of how long it takes for the reaction to occur.
- * Some body processes can take too long to occur, so the body uses proteins called _____ to speed up the reaction rate.
- * An enzyme is a biological catalyst, which increases the speed at which a reaction will occur.

Where Can I Find Enzymes?

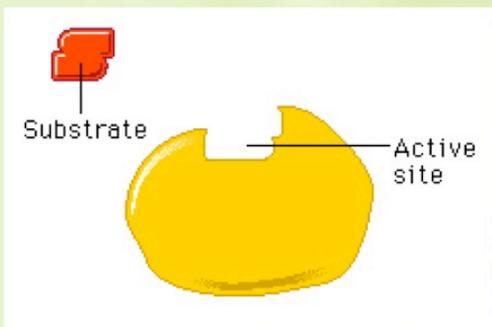
* Enzymes play a crucial role in :

- ♣ _____
- ♣ _____
- ♣ _____
- ♣ _____
- ♣ _____
- ♣ _____
- ♣ _____
- ♣ many more...

How do Enzymes Work?

- * Enzymes work using the _____
- * The enzyme has a place on its surface called the _____
- * The _____, the materials the enzyme will work with, fit onto the active site because their shapes are complimentary.
- * Once the substrate is on the active site, the enzyme can connect them or break them apart as needed.

The Induced Fit Model



Denaturing Proteins

- * The shape of the enzyme can be changed by several factors.
- * If the shape of the protein that makes up the enzyme, or the substrate changes then
 - _____
 - _____
- * _____
- _____
- _____

_____ can alter the shape of proteins.

unfolded
folded

Enzymes and Digestion:

Enzymes and DNA:

Specificity of Enzymes

- * The active site of an enzyme has a _____
- * The substrate has a _____
- * The substrate must fit into the active site _____
- * This means that enzymes can only work with _____
- _____

Part IV: Enzymes

_____ 1. Enzymes

- a. are able to heat up molecules so that they can react.
- b. provide CO₂ for chemical reactions.
- c. are biological catalysts.
- d. absorb excess heat so that reactions occur at low temperatures.

_____ 2. A single organism may contain

- a. thousands of different enzymes, each one specific to a different chemical reaction.
- b. one enzyme that plays a role in thousands of different chemical reactions.
- c. approximately 100 kinds of enzymes, each one specific to a different chemical reaction.
- d. one enzyme that is specific to photosynthesis and one enzyme that is specific to cellular respiration.

_____ 3. A model of enzyme action is the

- | | |
|-------------------------|----------------------------|
| a. induced fit model. | c. activator action model. |
| b. lipid bilayer model. | d. active site model. |

- _____ 4. Without enzymes, the chemical reactions in the body would
- a. happen too fast.
 - b. occur at much the same rate as they do with enzymes.
 - c. require a different pH.
 - d. occur too slowly to support life processes.
5. Describe how an enzyme works using the following terms (underline them as they appear in your answer): *enzyme*, *substrate*, *active site*, *induced fit*, *form*, *function*, *reaction rate*.