Name _____ Class _____ Date _____

CHAPTER 5 The Molecules of Life

Summary of Key Concepts

Concept 5.1 Carbon is the main ingredient of organic molecules. (pp. 92–94)

Other than water, most molecules in a cell include a skeleton of carbon atoms. These carbon-based molecules are called *organic molecules*. In contrast, molecules that do not contain carbon skeletons, like water, are called *inorganic molecules*. *Hydrocarbons* are organic molecules composed of only carbon and hydrogen. Different arrangements of atoms bonded to a carbon skeleton can form *functional groups,* which give specific properties to molecules. For example, hydroxyl groups (–OH) are *hydrophilic*, meaning they attract water.

Molecules in cells are often made up of many similar, smaller molecular units called *monomers*. Long chains of monomers linked together form *polymers*. Each time a monomer is added to a growing polymer chain, a water molecule is released in a dehydration reaction. In a hydrolysis reaction, the addition of water breaks down a polymer.

1. What is the relationship between carbon skeletons and functional groups?

_____

_____

2. How are polymers made and how are they broken down? _____

_____

Concept 5.2 Carbohydrates provide fuel and building material. (pp. 95–97)

Carbohydrates are organic molecules made up of sugar molecules. Sugars consist of carbon (C), hydrogen (H), and oxygen (O) in a ratio of 1 C: 2 H: 1 O. Almost all carbohydrates are hydrophilic. Simple sugars that contain just one sugar molecule are *monosaccharides*. Sugar molecules are the main energy supply for the cell. Cells store extra sugar as larger carbohydrates. Sugars constructed from two monosaccharides are *disaccharides*. Cells break down disaccharides for energy or store them for later use. Long polymer chains made up of simple sugar monomers are called *polysaccharides*, or complex carbohydrates. *Starch* is a polysaccharide found in plant cells. Plants and animals that eat plants break down starch for energy and building materials. In animal cells, excess sugar is stored as *glycogen*. When energy is needed, the cells break down glycogen. Another polysaccharide in plants, *cellulose*, protects and stiffens plant cells.

3. How do cells use simple sugar molecules? _____

_____

4. Contrast a disaccharide and a polysaccharide. _____

_____

_____

Name _____ Class _____ Date_____

Concept 5.3 Lipids include fats and steroids. (pp. 98–99)

Lipids are organic molecules that are *hydrophobic*, or unable to dissolve in water. A *fat* is a lipid made up of a three-carbon backbone attached to three fatty acid chains. Fats store energy for later use, cushion internal organs, and insulate the body. A *saturated fat* is a fat in which all three fatty acid chains contain the maximum possible number of hydrogen atoms. These fats are solids at room temperature. An *unsaturated fat* contains less than the maximum number of hydrogen atoms. These fats are liquid oils at room temperature.

Steroids are lipids in which the carbon skeleton forms four rings that are joined together. Steroids are classified as lipids because they are hydrophobic, but they are very different from fats. Some steroids act as chemical signals. Another steroid, *cholesterol*, is a key molecule found in cellular membranes.

5. What property do all lipids share? _____

_____

6. Contrast the structures of fats and steroids. _____

_____

_____

Concept 5.4 Proteins perform most functions in cells. (pp. 100–102)

A *protein* is a polymer made from a set of 20 kinds of monomers called amino acids. An *amino acid* has a central carbon atom bonded to a hydrogen atom, a carboxyl group, an amino group, and a side group. The side group is different for each amino acid and causes its particular chemical properties. Proteins form cell structures, store nutrients, act as chemical messengers, defend the body from disease, and control chemical reactions. The structure of each protein determines its particular function.

Cells build proteins by linking amino acids together into a chain called a *polypeptide*. Proteins are made up of one or more polypeptide chains. A working protein is twisted, folded, and coiled into a specific shape. A protein's shape is determined by its amino acid sequence and its environment. Changes in pH, temperature, or other environmental quality can cause a protein to lose its normal shape in a process called *denaturation*. Since a protein's function depends on its shape, a denatured protein loses its function.

7. List three functions of proteins. _____

_____

8. How are amino acids, polypeptides, and proteins related? _____

_____

_____

9. What determines the shape of a protein? _____

_____

Concept 5.5 Enzymes are proteins that speed up specific reactions in cells. (pp. 103–105)

Many different chemical reactions occur in cells. To get started, most chemical reactions require *activation energy.* This energy weakens the chemical bonds of the reactants. Compounds called *catalysts* speed up chemical reactions.

Name _____ Class _____ Date _____

Catalysts in cells are proteins called *enzymes*. Enzymes reduce the amount of energy required for activation. Each enzyme acts as a catalyst for a specific kind of chemical reaction.

The shape of each enzyme fits the shape of a specific reactant molecule, or *substrate*. The substrate bonds to the enzyme at the *active site*. The enzyme weakens the bonds of the substrate. Another way enzymes lower activation energy is by holding two substrates in neighboring sites, enabling them to react more easily.

10. What role do enzymes have in the cell? _____

_____

11. What happens at the active site of an enzyme? _____

_____

_____

Reading Skills Practice

Interpreting a diagram Study the diagram in Figure 5-16 on page 104 that illustrates the action of the enzyme sucrase. Identify the substrate for sucrase. Then, explain how sucrase catalyzes the chemical reaction. What happens to sucrase when the reaction is completed?

Vocabulary Review and Reinforcement

In 1–7, write true *if the statement is true. If the statement is false, replace the underlined term with a term that makes the statement true.*

_____ **1.** Sugars that contain just one sugar molecule are <u>monosaccharides</u>.

_____ **2.** Molecules that avoid water are <u>hydrophobic</u>.

_____ **3.** <u>Inorganic</u> molecules are carbon-based.

_____ **4.** A(n) <u>unsaturated</u> fat has the maximum possible number of hydrogen atoms.

_____ **5.** A(n) <u>carbohydrate</u> is made up of amino acids.

_____ **6.** <u>Polymers</u> are small molecular units joined together in large molecules.

_____ **7.** In <u>denaturation</u>, a protein unravels and loses its normal shape.

In 8–13, write the letter of the correct definition on the line next to each term.

_____ **8.** cholesterol
_____ **9.** glycogen
_____ **10.** cellulose
_____ **11.** hydrocarbon
_____ **12.** functional group
_____ **13.** starch

a. polysaccharide in animals that stores energy
b. organic molecule made up of only carbon and hydrogen
c. polysaccharide in plants that stores energy
d. lipid found in the membranes of cells
e. polysaccharide that stiffens plants
f. group of atoms that gives specific properties to a molecule

Name _____ Class _____ Date_____

In 14–18, complete the paragraph with the appropriate Key Terms from the chapter.

To start a chemical reaction, it is first necessary to reduce the **14.** _____, or start-up energy. Compounds that speed up chemical reactions, called **15.** _____, help reduce start-up energy. In cells, these compounds are specialized proteins called **16.** _____. The reactants that are acted upon by a specialized protein are known as **17.** _____. These reactant molecules bind to a particular region of the specialized protein, called the **18.** _____, and the reactants are changed to products.

WordWise

Find and circle nine Key Terms from the chapter in the puzzle below. Words may appear horizontally, vertically, or diagonally. Then write a definition for each term on a separate sheet of paper.

d	o	c	m	y	r	t	l	o	c	p	y	h	b
p	h	y	b	e	f	s	y	t	i	p	l	y	n
p	o	l	y	s	a	c	c	h	a	r	i	d	e
m	g	l	u	r	w	s	k	o	l	o	i	r	a
e	t	i	y	b	e	f	l	u	k	t	f	o	c
l	p	p	r	m	b	t	a	y	l	e	a	p	k
a	c	i	v	t	e	p	j	t	d	i	g	h	w
s	u	d	s	t	e	r	o	i	d	n	l	i	c
e	n	z	p	k	r	w	t	e	i	p	k	l	y
b	t	a	m	i	n	o	a	c	i	d	p	i	r
p	o	l	y	p	e	p	t	i	d	e	e	c	a