Name _____ Date _____ Class _____

Chemical Compounds in Cells

Key Concepts

- What are elements and compounds?
- What are the main kinds of organic molecules in living things?
- How is water important to the function of cells?

An element is any substance that cannot be broken down into simpler substances. The smallest unit of an **element** is called an atom. The elements found in living things include carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur. **When two or more elements combine chemically, they form a compound.** The smallest unit of many **compounds** is called a molecule.

Many of the compounds found in living things contain the element carbon, which is usually combined with other elements. Most compounds that contain carbon are called organic compounds. **Some important groups of organic compounds found in living things are carbohydrates, proteins, lipids, and nucleic acids.** Compounds that do not contain the element carbon are called inorganic compounds.

A **carbohydrate** is an energy-rich organic compound made of the elements carbon, hydrogen, and oxygen. Sugars and starches are examples of carbohydrates. Carbohydrates are important components of some cell parts, including cell walls and cell membranes.

Fats, oils, and waxes are all **lipids.** Lipids are energy-rich organic compounds made of carbon, hydrogen, and oxygen. Lipids contain more energy than carbohydrates. Cells store energy in lipids for later use.

Proteins are large organic molecules made of carbon, hydrogen, oxygen, nitrogen, and, in some cases, sulfur. Protein molecules are made up of smaller molecules called **amino acids.** Proteins make up much of the structure of cells. An **enzyme** is a type of protein that speeds up a chemical reaction in a living thing. Without enzymes, many chemical reactions that are necessary for life would either take too long or not occur at all.

Nucleic acids are very long organic molecules made of carbon, oxygen, hydrogen, nitrogen, and phosphorus. Nucleic acids contain the instructions that cells need to carry out all the functions of life. There are two kinds of nucleic acids: DNA and RNA. Deoxyribonucleic acid, or **DNA,** is the genetic material that carries information about an organism that is passed from parent to offspring and directs all of the cell's functions. Ribonucleic acid, or **RNA,** plays an important role in the production of proteins. RNA is found in the cytoplasm as well as in the nucleus.

Water plays many important roles in cells. **Most chemical reactions within cells could not take place without water.** Water also helps cells keep their size and shape and keeps the temperature of cells from changing rapidly.

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Chemical Compounds in Cells (pp. 25–30)

This section identifies the basic building blocks of cells. It also explains the importance of water to cells.

Use Target Reading Skills

As you read, compare and contrast carbohydrates, proteins, and lipids in the table below.

Type of Compound	Elements	Functions
Carbohydrate	Carbon, hydrogen, oxygen	
Lipid		
Protein		

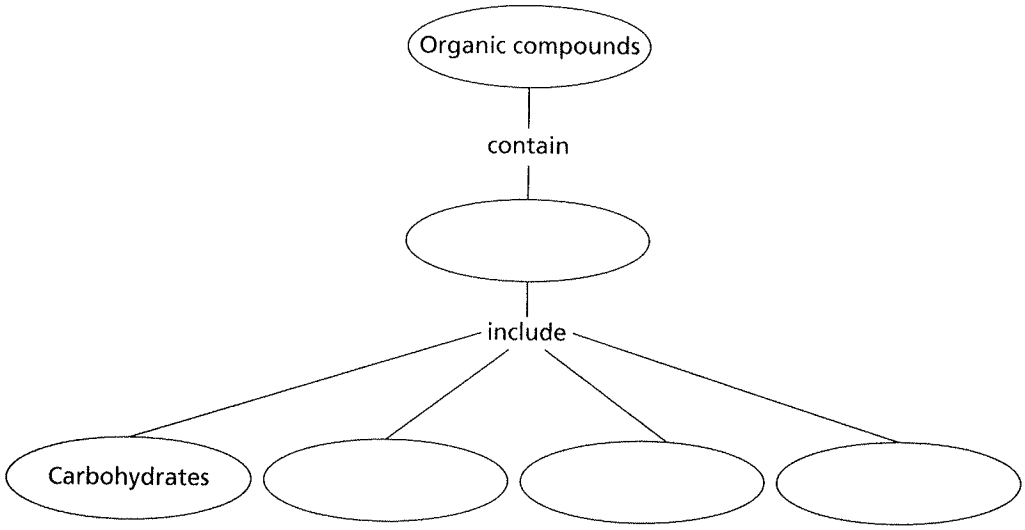
Elements and Compounds (pp. 25–26)

1. A(n) _____ is any substance that cannot be broken down into simpler substances. Its smallest unit is the _____.

2. When two or more elements combine chemically, they form a(n) _____. Its smallest unit is usually called a(n) _____.

Chemical Compounds in Cells *(continued)*

3. Complete this concept map on organic compounds.



4. Compounds that do not contain carbon are called _____.

Carbohydrates (p. 27)

5. A carbohydrate is made of carbon, hydrogen, and _____.

6. Starch is a kind of carbohydrate. What foods have starch?

_____

_____

_____

7. How do cells use carbohydrates?

_____

_____

_____

Lipids (p. 27)

8. What are three examples of lipids?

a. _____ b. _____

c. _____

9. How are lipids like carbohydrates?

_____

_____

10. Cells store _____ in lipids to use later.

Proteins (p. 28)

11. _____ form parts of cell membranes and many of the cell's organelles.
12. What small molecules make up proteins? _____
13. What do enzymes do?

_____

Nucleic Acids (p. 29)

14. Very long organic molecules that contain instructions that cells need to function are called _____.
15. Is the following sentence true or false? Cells use the instructions in nucleic acids to carry out all life functions. _____
16. List the two kinds of nucleic acids.

a. _____ b. _____

Water and Living Things (p. 30)

17. List four ways that cells use water.

a. _____

_____

b. _____

_____

c. _____

_____

d. _____

_____

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Chemical Compounds in Cells

Understanding Main Ideas

Fill in the blanks in the table below.

Organic Compounds		
Type of Compound	**Example**	**Major Roles in Living Things**
Carbohydrates	1. _____	Help form cell walls and membranes; provide energy
2. _____	Fats	Help form cell membranes; 3. _____
4. _____	Enzymes	Help form cell membranes and organelles; speed up chemical reactions
5. _____	DNA	Direct all the cell's functions; 6. _____

Building Vocabulary

Match each term with its definition by writing the letter of the correct definition in the blank beside the term.

_____ **7.** element
_____ **8.** compound
_____ **9.** carbohydrate
_____ **10.** proteins
_____ **11.** amino acids
_____ **12.** enzyme
_____ **13.** lipid
_____ **14.** nucleic acids
_____ **15.** DNA
_____ **16.** RNA

a. type of nucleic acid that plays an important role in the production of proteins
b. type of nucleic acid that passes from parent to offspring and directs all the cell's functions
c. very large organic molecules made of carbon, oxygen, hydrogen, nitrogen, and phosphorus
d. large organic molecules made of carbon, hydrogen, oxygen, nitrogen, and, in some cases, sulfur
e. small molecules that make up proteins
f. the chemical combination of two or more elements
g. type of protein that speeds up chemical reactions in living things
h. any substance that cannot be broken down into simpler substances
i. an energy-rich organic compound such as sugar
j. an energy-rich organic compound such as fat

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Amino Acids and Proteins

Though there are only 20 common amino acids, they can be combined in different ways to produce thousands of unique proteins. Proteins that differ in the order or type of amino acids they contain may have very different structures and functions. In fact, a change in even a single amino acid can sometimes affect the way a protein works.

Suppose that proteins could consist of just two amino acids. To see how many unique proteins, each composed of just two amino acids, can be formed from five different amino acids, fill in the spaces in the table below. Some of the spaces have been filled in to show you how. Assume that each letter represents a different amino acid.

Amino Acids	*A*	*B*	*C*	*D*	*E*
A	*AA*	*AB*	*AC*		
B	*BA*				
C					
D					
E					

Answer the following questions in the spaces provided.

1. What does each letter pair in the table represent?

_____

2. Based on your completed table, how many unique proteins, each composed of just two amino acids, can be formed from five different amino acids?

_____

3. How many unique proteins, each made up of just two amino acids, could be formed from six different amino acids? From 20 different amino acids?

_____

4. Most proteins are made up of not just two, but hundreds or even thousands of amino acids. How does this affect the number of unique proteins that could be formed from just a few amino acids?

_____

_____