

## 2.3 Carbon Compounds

### Lesson Objectives

- Describe the unique qualities of carbon.
- Describe the structures and functions of each of the four groups of biomolecules.

### Lesson Summary

**The Chemistry of Carbon** Organic chemistry is the study of compounds with bonds between carbon atoms. Carbon atoms have four valence electrons, allowing them to form strong covalent bonds with many other elements, including hydrogen, oxygen, phosphorus, sulfur, and nitrogen. Living organisms are made up of molecules made of carbon and these other elements.

- ▶ One carbon atom can bond to another to form chains and rings.
- ▶ Carbon can form millions of different large and complex structures.

**Biomolecules** The large organic molecules found in living things are known as biomolecules. Many are also known as “macromolecules,” because of their great size. Biomolecules form by polymerization, in which smaller units called monomers join together to form polymers. Biochemists sort the biomolecules in living things into groups based on their chemical composition.

- ▶ Carbohydrates (starches and sugars) are composed of carbon, hydrogen, and oxygen. Carbohydrates are the main energy source for living things. Plants and some animals also use carbohydrates for structural purposes. Molecules with one sugar monomer are monosaccharides. A disaccharide is made of two monosaccharides.
- ▶ Lipids (fats, oils, and waxes) are made mostly of carbon and hydrogen atoms. Lipids can be used to store energy and form parts of biological membranes and waterproof coverings. Steroids manufactured by the body are lipids as well.
- ▶ Nucleic acids contain hydrogen, oxygen, nitrogen, carbon, and phosphorus. They are polymers of nucleotides. A nucleotide has three parts: a 5-carbon sugar, a phosphate ( $-\text{PO}_4$ ) group, and a nitrogenous base. Nucleic acids store and transmit hereditary (genetic) information. There are two kinds of nucleic acids: DNA (deoxyribonucleic acid) and RNA (ribonucleic acid).
- ▶ Proteins are made up of nitrogen, carbon, hydrogen, and oxygen. Proteins are polymers of amino acids. An amino acid molecule has an amino group ( $-\text{NH}_2$ ) on one end and a carboxyl group ( $-\text{COOH}$ ) on the other end. Proteins control the rate of reactions, regulate cell processes, form cellular structures, carry substances into or out of cells, and help fight disease.
  - More than 20 different amino acids are found in nature. Any amino acid can bond with any other.
  - Covalent bonds called peptide bonds link amino acids together to form a polypeptide.
  - Amino acids are assembled into polypeptide chains according to instructions coded in DNA.

## The Chemistry of Carbon

- How many valence electrons does each carbon atom have?  
\_\_\_\_\_
- What gives carbon the ability to form chains that are almost unlimited in length?  
\_\_\_\_\_

## Biomolecules

For Questions 3–5, complete each statement by writing the correct word or words.

- Many of the molecules in living cells are so large they are called \_\_\_\_\_.
- \_\_\_\_\_ is the process that forms large organic molecules.
- When two or more \_\_\_\_\_ join together, a polymer forms.
- Fill in the table in which you compare the components and functions of the following biomolecules: carbohydrates, lipids, nucleic acids, and proteins.

Biomolecule	Components	Functions

- How did organic compounds get their name? How is the word related to its meaning?

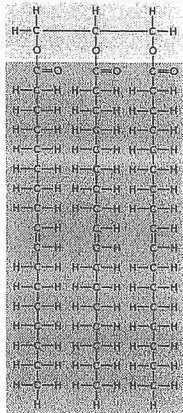
\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Identify each molecule pictured below as one of the following: *amino acid*, *monosaccharide*, *complex carbohydrate*, *lipid*, and *nucleotide*. Then, explain which physical features of each molecule helped you to identify it.

A.



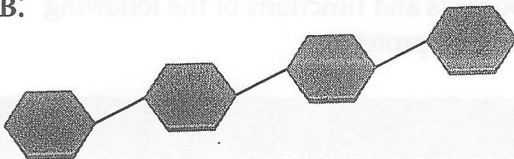
8. What type of molecule is shown in A?

\_\_\_\_\_

9. How can you tell?

\_\_\_\_\_  
\_\_\_\_\_

B.



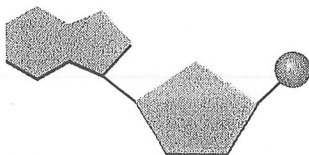
10. What type of molecule is shown in B?

\_\_\_\_\_

11. How can you tell?

\_\_\_\_\_  
\_\_\_\_\_

C.



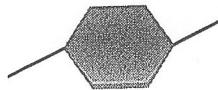
12. What type of molecule is shown in C?

\_\_\_\_\_

13. How can you tell?

\_\_\_\_\_  
\_\_\_\_\_

D.



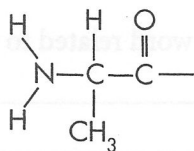
14. What type of molecule is shown in D?

\_\_\_\_\_

15. How can you tell?

\_\_\_\_\_  
\_\_\_\_\_

E.



16. What type of molecule is shown in E?

\_\_\_\_\_

17. How can you tell?

\_\_\_\_\_  
\_\_\_\_\_