In both cases, enzymes speed up reactions. However, each macromolecule usually has its own specific enzymes. For example, lactase is used to break down the carbohydrate lactose, whereas glycogen synthase is used to make the carbohydrate glycogen. Enzymes called proteases, such as pepsin and peptidase, break down proteins, whereas enzymes called lipases break down lipids. We will take a closer look at how enzymes function later when we discuss proteins.

CONCEPTS IN ACTION - Visit this site to see visual representations of dehydration synthesis and hydrolysis.

Check your knowledge

Hydrolysis reactions result in _____.

a. polymers
b. monomers
c. water molecules
d. oxygen molecules

Answer: b

Section Summary

Carbohydrates, lipids, proteins, and nucleic acids are the four major classes of biological important molecules. Most biologically important molecules are comprised of single units called monomers that are joined by covalent bonds to form larger polymers. When a monomer forms a covalent bond with another monomer as a result of a water molecule being released, this reaction is called dehydration synthesis. Hydrolysis reactions occur when polymers break down into smaller units (monomers) with the help of a water molecule. Dehydration synthesis and hydrolysis reactions are similar for all macromolecules, but each monomer and polymer reaction is specific to its class. Dehydration synthesis reactions and hydrolysis reactions typically require the help of enzymes to speed up the rate of the chemical reactions.

Exercises

1. What is released when monomers are joined together in a dehydration synthesis reaction?
    a. water
    b. oxygen
    c. monomers
    d. none of the above

2. Which of the statements below is correct?
    a. During dehydration synthesis, macromolecules are broken down.
    b. Water is involved in hydrolysis reactions but not dehydration synthesis.
    c. Hydrolysis reactions build macromolecules.
    d. Enzymes are used in both dehydration synthesis and hydrolysis reactions.

3. What role do electrons play in dehydration synthesis?

Answers

1. (a)
2. (d)
3. During a dehydration synthesis, the monomers share electrons and form covalent bonds.

Glossary

dehydration synthesis: a reaction where monomers combine with the help of water (and often an enzyme) to form polymers

hydrolysis reactions: a reaction where a water molecule (and usually an enzyme) is used to break a chemical bond within a polymer

monomers: the single subunits, or building blocks that make up polymers

polymers: larger molecules that are formed by combining monomers using covalent bonds

3.3 Biological Molecules – Carbohydrates

Learning objectives

By the end of this section, you will be able to:

- *Identify the four major classes of biologically important molecules found in cells*
- *Recognize monomers and polymers for carbohydrates*
- *Understand the functions of different types of carbohydrates*
- *Be able to define and explain all bolded terms*

There are four major biological macromolecule classes (carbohydrates, lipids, proteins, and nucleic acids). Each is important for cell homeostasis and performs a wide variety of functions. We will take a closer look at each of these biologically important molecules starting first with carbohydrates.

Carbohydrates

Carbohydrates are macromolecules that students may be familiar with. To lose weight, some individuals adhere to "low-carb" diets. Athletes, in contrast, often "carb-load" before competitions to ensure that they have sufficient energy to compete at a high level. Carbohydrates are an essential part of our diet. Grains, fruits, and vegetables are all-natural sources of carbohydrates. Carbohydrates provide energy for the body, mainly through glucose, a simple sugar. Carbohydrates also have other essential functions. For example, in plants, the carbohydrate cellulose provides structural support, whereas, in some insects, their hard-outer shell is composed of a different carbohydrate called chitin. We will explore various functions of carbohydrates later in this section.

Carbohydrates are represented by the formula $(C_nH_{2n}O_n)$, where n is the number of carbon and oxygen atoms in the molecule. In other words, the ratio of carbon to hydrogen to oxygen is 1:2:1 in carbohydrate molecules. For example, the chemical formula for glucose is $C_6H_{12}O_6$. Carbohydrates are classified into three subtypes: monosaccharides, disaccharides, and polysaccharides.

Monosaccharides

Monosaccharides (mono- = "one"; sacchar- = "sweet") are simple sugars, the most common of which is glucose. In monosaccharides, the number of carbon atoms usually ranges from three to six. Most monosaccharides have names ending with the suffix -ose, such as glucose, galactose, and fructose (Figure 3.9).

In most living species, glucose is an essential source of energy. During cellular respiration, glucose is used as a source of energy, when its covalent bonds are broken. The energy released is used to make adenosine triphosphate (ATP), an energy-rich molecule that powers most cellular activity. Plants can synthesize their glucose using light energy, carbon dioxide, and water through the process of photosynthesis. Animal cells cannot perform photosynthesis, so they must