Section Summary

Lipids are a class of biological molecules that are nonpolar and hydrophobic. Major types include fats, waxes, phospholipids, and steroids. Fats and oils are a stored form of energy. Phospholipids are the major component of the cell membrane. Steroids are the precursor molecules important in forming cholesterol and many required hormones. Waxes are generated by both plants and animals and are essential in both waterproofing and preventing organisms from drying out.

Exercises

1. Phospholipids are important components of _____.
    a. the plasma membrane of cells
    b. the ring structure of steroids
    c. the waxy covering on leaves
    d. the double bond in hydrocarbon chains

2. Which lipids are made up of a hydrocarbon chain with an alcohol (–OH) group and form the cuticle of plants?
    a. saturated fats
    b. triglycerides
    c. waxes
    d. phospholipids

3. Explain at least three functions that lipids serve in plants and/or animals.

4. Compare and contrast unsaturated fat and saturated fats.

Answers

1. (a)
2. (c)
3. Fat serves as a valuable way for animals to store energy. It can also provide insulation. Phospholipids and steroids are essential components of cell membranes. Lipids also form hormones that control or regulate different physiological processes.
4. Both are types of lipids and are hydrophobic. Unsaturated fats are fats with at least one double bond, in a specific configuration, between carbon atoms. This results in a bend in the chain's carbon backbone, preventing triglyceride molecules from packing too tightly together and results in them being in a liquid form at room temperature. In contrast to unsaturated fats, saturated fats do not have double bonds between carbon atoms saturated fats. Saturated fats are solid at room temperature and usually of animal origin.

Glossary

fat: a lipid molecule composed of three fatty acids and glycerol (triglyceride) that typically exists in a solid form at room temperature

hormone: a chemical signaling molecule, usually a protein or steroid, secreted by an endocrine gland or group of endocrine cells; acts to control or regulate specific physiological processes

hydrophilic: describes a substance that dissolves in water; water-loving

hydrophobic: describes a substance that does not dissolve in water; water-fearing

lipids: a class of macromolecules that are nonpolar and insoluble in water

oil: an unsaturated fat that is a liquid at room temperature

phospholipid: a major constituent of the membranes of cells; composed of two fatty acids and a phosphate group attached to the glycerol backbone

saturated fatty acid: a long-chain hydrocarbon with single covalent bonds in the carbon chain; the number of hydrogen atoms attached to the carbon skeleton is maximized

steroid: a type of lipid composed of four fused hydrocarbon rings

trans-fat: a form of unsaturated fat with the hydrogen atoms neighboring the double bond across from each other rather than on the same side of the double bond

triglyceride: a fat molecule; consists of three fatty acids linked to a glycerol molecule

unsaturated fatty acid: a long-chain hydrocarbon that has one or more than one double bonds in the hydrocarbon chain

waxes: a type of lipid made up of a hydrocarbon chain with an alcohol (–OH) group and a fatty acid

3.5 Biological Molecules – Proteins

Learning objectives

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

- *Recognize the monomers and polymers for proteins*
- *Describe the basic chemistry of amino acids*
- *Explain how peptide bonds are formed*
- *Understand the functions of different proteins*
- *Explain the various structures of proteins*
- *Be able to define and explain all bolded terms*

Proteins

Proteins are one of the most abundant organic molecules in living systems and have the most diverse range of functions of all macromolecules. Proteins may be structural, regulatory, contractile, or protective. They may serve in transport, storage, or they may be used as toxins or enzymes. Each cell in a living system may contain thousands of different proteins, each with a unique function. The structures of proteins, like their functions, vary greatly. All proteins, however, are polymers made up of amino acids arranged in a linear sequence.

Types and Functions of Proteins

Enzymes are proteins that speed up the rate of chemical reactions. Enzymes do this by decreasing the amount of activation energy needed to start the chemical reaction. Enzymes are usually complex proteins. Each enzyme has a specific **substrate,** a reactant that binds to the enzyme. An enzyme may assist in hydrolysis reactions or dehydration synthesis reactions. Enzymes that break down their substrates are called catabolic enzymes, whereas those that build more complex molecules are called anabolic enzymes. Salivary amylase is an example of a catabolic enzyme. Salivary amylase hydrolyzes starch into simple sugars like glucose. An example of an anabolic enzyme is rubisco, which plants use during photosynthesis to make sugar from carbon dioxide.

Some enzymes function as hormones. **Hormones** are molecules that are important for chemical signaling between cells. Hormones regulate specific physiological processes, including growth, development, metabolism, and reproduction. For example, insulin is a protein hormone that helps regulate blood glucose levels. Not all hormones are protein-based. Some hormones, such as estradiol and testosterone, are made of lipids.

Proteins also provide structural support for many cells. Plants have several different structural proteins found in their rigid cell walls. Cell wall structural proteins offer support and protection for the plant. Actin is a structural protein found in muscle cells that allows for muscle contraction. Keratin, another critical protein in mammals, is the major component of skin and hair. Hair provides physical protection from damaging UV rays and helps organisms maintain stable body temperatures.