CHAPTER 3 - MOLECULES OF LIFE

Lecture Outline

1 Molecules of Life—From Structure to Function

A. What Is an Organic Compound?

1. Life's molecules are _____ compounds, with hydrogen and other elements covalently bonded to carbon atoms.

2. Hydrocarbons contain only _____ atoms covalently bonded to carbon.

3. Only living cells can synthesize _____, lipids, proteins, and nucleic acids.

4. Each organic compound is characterized by _____ or more functional groups—particular atoms or clusters of atoms bonded to carbon.

B. Start With Carbon's Bonding Behavior

1. Oxygen, _____, and carbon are the most abundant elements in living things.
   a. Much of the hydrogen and oxygen are linked as _____.

   b. Carbon can share pairs of electrons (covalently bond) with as many as _____ other atoms to form organic molecules of several configurations.

2. The orientation of the _____ attached to a carbon backbone gives rise to the three-dimensional shapes and functions of biological molecules.

C. Ways To Represent Organic Compounds

1. _____ is the simplest organic compound.

2. A ball-and-stick model depicts bonding of _____; space-filling models convey a molecule's size and surfaces.

3. Larger molecules are best visualized using _____ models, such as those generated by computer programs, and even more complex computer models that show local differences in electric charge across molecular surfaces.

3.2 How Do Cells Build Organic Compounds?

A. Four Families of Building Blocks

1. _____, fatty acids, amino acids, and nucleotides are the four major families of small building blocks.

2. _____ can be joined to form larger polymers.

B. A Variety of Functional Groups

1. Functional groups are atoms or groups of atoms covalently bonded to a carbon

backbone; they convey distinct properties, such as solubility and chemical reactivity, to the complete molecule.

2. The common functional groups in biological molecules are: _____, methyl, carbonyl, carboxyl, amino, phosphate, and sulfhydryl.

3.3 The Most Abundant Ones—Carbohydrates

A. The Simple Sugars

1. _____—one sugar unit—are the simplest carbohydrates.

2. They are characterized by solubility in water, _____ taste, and have at least two —OH groups and one aldehyde or ketone group.

3. _____ and deoxyribose (five-carbon backbones) are building blocks for nucleic acids.

4. _____ (six-carbon backbone) is used by cells as instant energy.

B. Short-Chain Carbohydrates

1. An oligosaccharide is a short chain of _____ or more sugar monomers.

2. Disaccharides—_____ sugar units—are the simplest.

   a. Sucrose (glucose + _____) is the most plentiful sugar in nature.

   b. Lactose (glucose + _____) is present in milk.

3. Oligosaccharides with _____ or more sugar monomers are attached as short side chains to proteins where they participate in membrane function.

C. Complex Carbohydrates

1. A polysaccharide is a _____ or branched chain of hundreds or thousands of sugar monomers.

2. _____ is a plant storage form of energy, arranged as unbranched coiled chains

3. _____ is a highly-branched chain used by animals to store energy in muscles and liver.

3.4 Greasy, Oily—Must Be Lipids

A. Fats and Fatty Acids

1. _____ are nonpolar hydrocarbons that do not dissolve in water; fats have one, two, or three fatty acids molecules attached to one glycerol molecule.

2. A fatty acid is a long, _____ hydrocarbon with a —COOH group at one end.

a. _____ fatty acids are liquids (oils) at room temperature because one or more double bonds between the carbons in the tails permit "kinks."

b. _____ fatty acids have only single C—C bonds in their tails and are solids at room temperature.

3. _____, such as butter, lard, and oils, are the body's most abundant and richest source of energy and insulation.

a. These lipids have _____ fatty acid tails attached to a molecule of glycerol.
b. Gram for gram, triglycerides yield more than _____ as much energy as carbohydrates.

B. Phospholipids

1. Phospholipids have a _____ backbone, two fatty acids, a phosphate group, and a small hydrophilic group.

2. They are important components of _____, where the hydrophilic heads face toward the inner and outer surfaces and the hydrophobic tails face inward (bilayer).

3.5 Proteins—Diversity in Structure and Function

A. Proteins function as enzymes, in cell movements, as storage and transport agents, as hormones, as anti-disease agents, and as structural material throughout the body.

B. Structure of Amino Acids

1. Amino acids are small organic molecules with an group, a carboxyl group, and one of twenty varying R groups.
- All of the parts of an amino acid molecule are covalently bonded to a carbon.
- The R group determines the amino acid.

2. There are _____ kinds of amino acids available in nature.

3. Amino acids _____ together to form proteins.
- It is the sequence of amino acids that determines the protein.

C. Some proteins have other organic molecules attached to their polypeptide chains.

1. _____ have side chains of oligosaccharides on the cell surface.
2. Lipoproteins bind and transport lipids.

3.7 Nucleotides, DNA, and the RNAs

A. _____ is a double stranded helix carrying encoded hereditary instructions.

B. _____ is a single stranded structure and functions in translating the code to build proteins.