



Chapter 2: Molecular biology

- 1 Living organisms and the cells that comprise living organisms are a complex set of interacting chemicals and chemical reactions.
- 2 Water molecules are polar and thus have a relatively negative end (where oxygen is located) and a relatively positive end (where the hydrogens are located).
- 3 Many of the properties of water are explained by its polarity. These properties include being a solvent for other polar molecules, cohesion between water molecules, and also a variety of thermal properties.
- 4 Carbohydrates are organic molecules composed of carbon, hydrogen, and oxygen at or near the ratio of $C_nH_{2n}O_n$, where n = the number of carbon atoms.
- 5 The 'building blocks' of large organic molecules are often called monomers. Think of the smallest carbohydrates (or monomers) as being 'single sugar units'. Monosaccharides are single sugar units, disaccharides are two-sugar units and polysaccharides are many sugar units in size. Lipids are also known as fats and oils. A typical lipid, called a triglyceride, is composed of one molecule of glycerol bonded to three molecules called fatty acids. Proteins are molecules composed of many amino acids bonded together.
- 6 Condensation reactions covalently bond smaller organic molecules together to form larger organic molecules. Hydrolysis reactions reverse this by breaking the larger organic molecules apart into the original smaller molecules.
- 7 The building block units of DNA molecules are called nucleotides. Each nucleotide is composed of a monosaccharide sugar, a phosphate group, and one of four possible nitrogenous bases (adenine, thymine, cytosine, or guanine).
- 8 DNA is composed of two strands of nucleotides. These two strands are held together by hydrogen bonding between complementary bases. Together, they form an overall double helix geometric shape.
- 9 The complementary base pairs of DNA are:
 - adenine and thymine
 - cytosine and guanine.
- 10 DNA replicates in a semi-conservative pattern in which each of the two strands of DNA is used as a template for the formation of a new strand. Thus, all newly formed DNA molecules are actually one half old DNA and one half new DNA.
- 11 Proteins are synthesized using a two-step process. First, a strand of DNA is used as a template to create an messenger (m)RNA molecule in a process called transcription. Second, this mRNA molecule, with the help of a ribosome, transfer (t)RNA, and amino acids, synthesizes the actual protein in a process called translation.
- 12 The genetic code is written in sequences of three bases along the DNA molecule. Each sequence of three bases is called a triplet.
- 13 Some proteins act as organic catalysts within cells and are called enzymes. Each enzyme typically has a single substance that it is 'specific for' and that substance is called the enzyme's substrate. As enzymes are complex proteins, they are affected by variation in temperature, pH, and substrate concentration.
- 14 Cell respiration is common to all cells and explains how a cell derives energy in the form of ATP molecules using organic molecules, such as glucose, as a fuel. Some cells use a relatively inefficient form of cell



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respiration called anaerobic respiration, and others a much more efficient form called aerobic cell respiration. Efficiency in this case is determined by how many ATP molecules are derived from a single fuel molecule (glucose).

- 15 Photosynthesis is a two-stage process whereby light energy is first converted into chemical energy and then that chemical energy is used to 'fix' carbon dioxide into an organic molecule such as glucose. These two stages are called the light-dependent reactions and the light-independent reactions, respectively.