

# Instructor's Answer Key

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## Chapter 2: Chemical Composition of the Body

### Answers to Test Your Understanding of Concepts and Principles

1. These bonds differ in the way they share electrons. A nonpolar covalent bond is formed when two atoms share electrons equally. When the electrons are unequally shared, a polar covalent bond is produced. An ionic bond is created when one atom loses one or more electrons to another atom, and the two ions thus formed are bonded together by electrostatic attraction. Nonpolar covalent bonds are the strongest of the three types, and ionic bonds are the weakest of these three. [Note: This question is also answered in the Student Study Guide.]
2. An acid is a molecule that donates  $H^+$  (protons) to a solution. A base can be a molecule that releases  $OH^-$ , which combines with protons to form water; and by this means lowers the  $H^+$  concentration of a solution. Since the pH number is inversely related to the  $H^+$  concentration of a solution, acids lower the pH and bases raise the pH.
3. Potato starch and liver glycogen are polysaccharides of glucose, a monosaccharide. The potato plant produces glucose monomers during photosynthesis reactions. Using dehydration synthesis reactions the potato polymerizes glucose monomers into its stored form as starch. When the potato is eaten and digested, enzyme catalyzed hydrolysis reactions in the mouth and small intestine digest the starch to glucose monomers. This form of glucose is then absorbed from the intestine and transported into the blood. The liver and other tissues can remove glucose from the blood for energy production. Furthermore, the liver and skeletal muscle have the enzymes required (via dehydration synthesis reactions) to synthesize glycogen polymers from glucose (glycogenolysis).
4. Fats are triglycerides, a category of lipid in which the molecules are composed of three fatty acids bonded to a glycerol. The term "lipid" refers to all nonpolar, non-water-soluble organic compounds. Triglycerides are lipids, but so are other molecules with somewhat different structures, such as phospholipids and steroids.
5. Fats and oils are two types of triglycerides. Fats tend to be solid at normal temperatures and are composed primarily of triglycerides that are mostly saturated with hydrogen ions (no double bonds). Oils tend to be liquid in form and are composed primarily of triglycerides unsaturated with hydrogen ions (one or more double bonds present). The saturated fat intake should not exceed 10% of a person's total fat intake because they may contribute to high blood cholesterol – a significant risk factor in heart disease and stroke. By contrast, certain oils such as the omega-3 rich fish oils seem to have a protective effect in heart disease.

6. When the hydrogen bonds that joins the two strands of specific enzymes break DNA, the two strands separate from each other and the bases in each strand bond are exposed. Each exposed strand then serves as a template for the formation of a new, identical complementary strand. To accomplish this, free nucleotides within the nucleus are delivered to the exposed template and with the help of synthetic enzymes, a new DNA strand is created that is complementary to the template. In this way the “old” DNA strand becomes bonded to a new complementary DNA strand, forming a new double-stranded DNA that is identical to the original DNA. Since each double-stranded DNA contains one strand from the original that serves as a template (one old strand is conserved), the process of DNA replication is said to be “semiconservative.”

### Answers to Test Your Ability to Analyze and Apply Your Knowledge

1. The *primary* structure of a protein is its amino acid sequence that is coded for by genes in the DNA. *Secondary* structure is the shape of the protein due to weak hydrogen bonds that may form between the hydrogen atom of one amino group and an oxygen atom from a different amino acid nearby (alpha helix, or alternatively, the beta pleated sheet). *Tertiary* structures refers to the complex three-dimensional shape of the polypeptide as it bends and folds in response to chemical interactions between particular amino acids located in different regions of the chain. Substituting amino acids in the original primary sequence would greatly affect the complex interactions between amino acids along the chain and therefore, affect the secondary and tertiary structures of the protein as well. Since the tertiary structure determines the physiological activity of the protein (such as the active site of enzymes and the oxygen-carrying ability of hemoglobin), any alteration in the tertiary structure can seriously disrupt the three-dimensional shape and hence, its physiological activity.
2. If the aqueous (polar) organ solvent extract does not work but the benzene (nonpolar) solvent extract does have an effect, one might conclude that the active substance(s) is (are) lipid soluble. This is not surprising since many lipid hormones already exist within the steroid family and are derivatives of cholesterol.
3. The lipid family includes a large and variable group of molecules including mono-, di-, and triglycerides, phospholipids, steroids, and other molecules such as prostaglandins. The slogan “cholesterol free” may be used on the label of a package containing high-fat foods because as a member of the steroid subgroup of lipids indeed cholesterol may be not be present. Since the public associates cholesterol in foods with health risk and heart disease the slogan may seem to be attractive or at least somewhat healthier than a similar food choice. This product may not have cholesterol but may be loaded with other high calorie lipids such as saturated and unsaturated fats (triglycerides); and with recent evidence about trans fatty acids may be presenting an equal or greater health risk. The general public is misled because “cholesterol free” and “fat free” are not synonymous.