Biology of Humans: Concepts, Applications, and Issues, 6e **(Goodenough)**
Chapter 2 Chemistry Comes to Life

2.1 Multiple Choice Questions

1) A neutral atom must contain _____.
A) an equal number of protons and neutrons
B) an equal number of protons, neutrons, and electrons
C) an equal number of protons and electrons
D) an equal number of neutrons and electrons
Answer: C
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.1
Section: 2.1

2) An element with more or fewer neutrons than the same element as it appears on the periodic table is known as which of the following?
A) ion
B) buffer
C) isotope
D) isomer
Answer: C
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.1
Section: 2.1

3) Oxygen, with an atomic number of 8, is a neutral atom and has _____ electrons in the first electron shell and _____ electrons in the second electron shell.
A) 1; 7
B) 5; 3
C) 4; 4
D) 2; 6
E) 3; 5
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.1
Section: 2.1

4) The Cl^- ion has a single negative charge and the atomic number of 17. How many electrons are on its innermost shell?
A) 18
B) 17
C) 9
D) 2
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.1
Section: 2.1

5) You have information about a particle that contains 7 protons, 8 neutrons, and 8 electrons. Which of the following statements would be true?
A) It has an atomic weight of 23.
B) It is an ion.
C) It has 8 electrons in its outermost shell.
D) It has an atomic number of 15.
Answer: B
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.2
Section: 2.2

6) The compound magnesium chloride ($MgCl_2$) turns into one Mg^{2+} and two Cl^- when placed in water. You can guess that the Mg and Cl atoms are held together normally by a(n) _____ bond.
A) covalent
B) electronegative
C) hydrogen
D) ionic
Answer: D
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.2
Section: 2.2

7) In what ways are hydrogen bonds and ionic bonds similar?
A) Both are based on attraction between atoms that carry differences in electrical charge.
B) Both are based on attraction between two atoms that carry negative charges.
C) Both are based on repulsion between atoms that carry differences in electrical charge.
D) Both involve an even sharing of electrons between atoms.
E) Both are based on attraction between two atoms that carry positive charges.
Answer: A
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.2
Section: 2.2

8) What is the difference between covalent and ionic bonds?
A) Covalent bonds involve the sharing of electrons, whereas ionic bonds involve the sharing of protons.
B) Covalent bonds involve the attraction between slightly charged molecules, whereas ionic bonds involve the attraction between two fully charged ions.
C) Covalent bonds involve the sharing of neutrons, whereas ionic bonds involve the attraction of slightly charged atoms.
D) Covalent bonds involve the sharing of electrons, whereas ionic bonds involve the transfer of electrons from one atom to another.
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.2
Section: 2.2

9) The interaction between two polar molecules would involve _____.
A) ionic bonds
B) peptide bonds
C) covalent bonds
D) hydrogen bonds
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.2
Section: 2.2

10) Water has very special properties that not all chemicals share. Which of the following is <u>not</u> a property of water?
A) is nonpolar
B) prevents wide temperature fluctuations
C) requires a lot of energy to evaporate it
D) interacts with lots of different substances
Answer: A
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.3
Section: 2.3

11) A substance consists of weak acids or bases designed to maintain a specific pH of a solution within a cell or a biological system. Which of the following describes this substance?
A) buffer
B) catalyst
C) pH
D) acids
Answer: A
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.3
Section: 2.3

12) The pH scale measures _____.
A) OH^- concentration
B) buffer concentration
C) H^+ concentration
D) All of the above are true.
Answer: C
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.3
Section: 2.3

13) Any substance that when dissolved in water will give off H^+ ions is referred to as a(n) _____.
A) pH
B) buffer
C) catalyst
D) acid
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.3
Section: 2.3

14) A substance in which other substances are dissolved is known as a(n) _____.
A) solute
B) acid
C) solvent
D) buffer
Answer: C
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.3
Section: 2.3

15) Your roommate is experiencing heartburn and asks you to purchase her an antacid. Chemically speaking, how do you know that the antacid will help eliminate her pain?
A) It is a buffer and will prevent the pH in her digestive tract from changing.
B) It has a higher OH^- concentration to increase the pH in her digestive tract.
C) It is probably high in H^+.
D) It has a low pH to balance the acidity in her digestive tract.
Answer: B
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.3
Section: 2.3

16) If I tested your intestinal fluid and found that it was basic, which of the pH values listed would best describe this solution?
A) 6.8
B) 3.2
C) 1.2
D) 8.0
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.3
Section: 2.3

17) Which of the following monomers is <u>not</u> paired correctly?
A) glucose-carbohydrates
B) amino acids-proteins
C) nucleotides-nucleic acids
D) All of these are paired properly.
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

18) A molecule consists of a long chain of glucose monomers linked by covalent bonds and serves as an energy source for plants and animals. Which of the following would describe this molecule?
A) polysaccharide
B) oligosaccharide
C) monosaccharide
D) sucrose
Answer: A
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

19) Which of the following carbohydrates is made by plants and is <u>not</u> digested by humans?
A) lactose
B) starch
C) cellulose
D) glycogen
Answer: C
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

20) Saturated fatty acids are so named because they are saturated with _____.
A) hydrogen
B) nitrogen
C) carbon
D) oxygen
Answer: A
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

21) Triglycerides _____.
A) are fatty acids bonded to glycerol through hydrolysis
B) have solid unsaturated forms at room temperature, such as butter
C) can provide twice the energy per gram than proteins
D) All of the above are true.
Answer: C
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

22) These lipids have a hydrophobic part and a hydrophilic part.
A) triglycerides
B) carotenoids
C) phospholipids
D) steroids
Answer: C
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

23) The hydrogen, ionic, and covalent bonds that stabilize the shape of a protein contribute to which level of structure of a protein?
A) primary
B) quaternary
C) secondary
D) tertiary
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

24) Alteration of the _____ structure of a protein can transform the protein into an infectious agent known as a prion.
A) primary
B) secondary
C) tertiary
D) quaternary
Answer: B
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

25) Which of the following is <u>not</u> found in ATP?
A) a nitrogen-containing base
B) a sugar
C) a phosphate group
D) All of these are found in ATP.
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

26) An organic compound that provides instructions for the synthesis or production of polypeptide chains is referred to as which of the following?
A) nucleotide
B) lipids
C) ATP
D) DNA
Answer: D
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

27) You received your genetic material from your parents in the form of DNA. Your DNA provides your cells with instruction for making _____.
A) lipids
B) proteins
C) polysaccharides
D) cholesterol
Answer: B
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

28) A researcher suspects that the food in an ecosystem has been contaminated with radioactive phosphates over a period of months. Which of the following substances could be examined for radioactive phosphate to test the hypothesis?
A) the amino acids within proteins produced by organisms living in the area
B) the starch produced by plants in the area
C) the DNA of the organisms in the area
D) All of the above are true.
Answer: C
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.4
Section: 2.4

29) By analyzing the chemical formulas, you can determine that this molecule, $CH_3CH(NH_2)COOH$, is a(n) _____, whereas the molecule $C_5H_{10}O_5$ is a(n) _____.
A) cholesterol; amino acid
B) amino acid; sugar
C) nucleotide; glycerol
D) fatty acid; sugar
Answer: B
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.4
Section: 2.4

30) Dipeptidase is an enzyme found in your small intestine that helps break polypeptides down. What would its most likely products be?
A) amino acids
B) proteins
C) triglycerides
D) oligosaccharides
Answer: A
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.4
Section: 2.4

2.2 Fill-in-the-Blank Questions

1) Atoms that have the same number of protons but differ in the number of neutrons are called _____.
Answer: isotopes
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.1
Section: 2.1

2) When an electron moves from the outer shell of one element to the outer shell of another element, a(n) _____ bond has been created.
Answer: Ionic
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.2
Section: 2.2

3) A substance that, when dissociated in water, will give off hydrogen ions is referred to as a(n) _____.
Answer: acid
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.3
Section: 2.3

4) The _____ can be used to measure whether a substance is an acid or a base.
Answer: pH scale
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.3
Section: 2.3

5) A polysaccharide that is made by plants and can usually be digested by humans is _____.
Answer: starch
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

6) A molecule with hydrophobic properties and polar molecular attributes would be called a(n) _____.
Answer: lipid
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

7) A protein that speeds up chemical reactions without being consumed in the process is called a(n) _____.
Answer: enzyme
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

8) A(n) _____ consists of many monomer subunits bonded together in order to produce a large molecule.
Answer: polymer
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

9) A(n) _____ is a nonprotein substance that aids in forming the enzyme-substrate complex in metabolic reactions.
Answer: cofactor
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

10) _____ is the process of using water to break down polymers to their monomer subunits.
Answer: Hydrolysis
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

11) _____ refers to a structure of a protein in which two or more polypeptide chains bind together to form a functional protein.
Answer: Quaternary
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

12) This nucleotide is found in RNA but not in DNA: _____.
Answer: uracil
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

13) Partially hydrogenated fats are also referred to as _____ fats.
Answer: *trans*
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

14) A(n) _____ is a type of polymer that helps in support, transport, and movement in the body.
Answer: protein
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

15) The energy-storing polysaccharide that can be found mainly in liver and muscle cells is called _____.
Answer: glycogen
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

16) A(n) _____ is a substance that accepts hydrogen ions or, when it dissociates in water, will give off hydroxide ions.
Answer: base
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.3
Section: 2.4

2.3 Matching Questions

Match each definition in the first column to the correct term in the second column.

A) Polarity
B) Compound
C) Denaturation
D) Monosaccharides
E) Hydrogen bonds
F) Element
G) Triglycerides
H) Amino acids
I) Tertiary structure
J) Active site

1) Weak bonds that function to stabilize proteins and nucleic acids such as DNA.
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.2
Section: 2.2

2) A substance made up of two or more elements whose properties are usually different from those of either of the two original substances.
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.1
Section: 2.1

3) The site where a substrate binds to an enzyme.
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

4) A process that causes a three-dimensional protein to change shape, resulting in the loss of biological function.
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

5) The tendency of a molecule to have positive and negative regions.
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.2
Section: 2.2

6) The overall three-dimensional shape of a protein.
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

7) A pure form of matter that cannot be broken down to simpler forms.
Bloom's Taxonomy: Knowledge/Comprehension

Learning Outcome: 2.1
Section: 2.1

8) The basic monomer of a protein that can be joined by peptide bonds using dehydration synthesis reactions.
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

9) Lipid molecules composed of one glycerol and three fatty acids that can be saturated, unsaturated, or polyunsaturated.
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

10) The smallest molecular units of carbohydrates, also known as simple sugars.
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.4
Section: 2.4

Answers: 1) E 2) B 3) J 4) C 5) A 6) I 7) F 8) H 9) G 10) D

2.4 Short Answer and Essay Questions

1) Explain some of the modern uses for radioisotopes in society.
Answer: Radioisotopes can be used in a variety of medical applications for diagnosis (imaging studies, such as the use of radioactive iodine to detect thyroid cancer) or therapy (such as the use of radioactive seeds to treat prostate cancer). Although not discussed in the chapter, there are other uses. For example, phosphorus isotopes are used to sequence DNA and RNA for medical, forensic, and criminal applications. Many isotopes have been used for a variety of dating in geologic fields (e.g., carbon-14 has been used to date fossils).
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.1
Global LO: G5|G7
Section: 2.1

2) Radioactive iodine (^{131}I) is commonly used in medical situations for diagnosing and treating thyroid conditions. The most common isotope of iodine that is <u>not</u> radioactive is ^{127}I. Chemically, what is the difference between ^{127}I and ^{131}I? What do they have in common?
Answer: The difference between the two isotopes of iodine is their weights (or mass). This is due to a difference in the number of neutrons present in each isotope. These isotopes have in common their atomic number (number of protons), which is what makes them both iodine.
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.1
Global LO: G2|G7
Section: 2.1

3) Explain the major differences between covalent and ionic bonding.
Answer: In covalent bonding, atoms share electrons. In ionic bonding, two oppositely charged ions are attracted to each other.
Bloom's Taxonomy: Knowledge/Comprehension
Learning Outcome: 2.2
Global LO: G7
Section: 2.2

4) Explain the relationship between nucleic acids and proteins. How would a change to the DNA ultimately affect proteins?
Answer: DNA is a nucleic acid that codes for specific amino acids that make up the proteins in the cell and in living organisms. The exact amino acid sequence is vital in producing a functional protein. A change to the DNA would ultimately change the sequence of amino acids in a protein.
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.4
Global LO: G2|G7
Section: 2.4

5) Athletes are often told to eat starch before a strenuous athletic event. What monomer can be released from starch after hydrolysis, and what is it used for? Because cellulose (fiber) is made of the same type of monomer as starch, why aren't athletes told to eat fiber before an event?
Answer: When starch is broken down, glucose is released. This glucose can be used during cellular respiration to produce energy (ATP) for the cells. Cellulose, like starch, is also composed of glucose monomers; however, we lack the enzymes necessary to perform hydrolysis on cellulose. Therefore, the cells cannot use glucose to produce ATP.
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.4
Global LO: G2|G7
Section: 2.4

6) Within your body, there are two major categories of hormones. One category is the steroid (or lipid-soluble) hormones, and the other category is referred to as nonsteroid (or water-soluble) hormones, which are composed of proteins or, in some cases, just amino acids. Estrogen and testosterone are examples of steroid hormones, whereas insulin is an example of a nonsteroid hormone. A researcher heats estrogen, testosterone, and insulin to a very high temperature. After heating the hormones, the researcher tests to determine whether they still work properly. She finds that estrogen and testosterone still function, but insulin does not. Based on the chemical nature of these molecules, explain why insulin no longer functions.
Answer: Given that the insulin is a peptide hormone, it is protein based. Proteins require a specific shape to function properly. Heat is one factor that can denature a protein, damaging its shape so that it can no longer function properly.
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.4
Global LO: G2|G7|G8
Section: 2.4

7) Your friend tells you that all dietary fat is bad for your health. Is this correct?
Answer: Although excess fat can be harmful, especially to the circulatory system, fat does serve important functions in the body, including long-term energy storage, insulation, and protection from blows.
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.4
Global LO: G5|G7
Section: 2.4

8) When a new food product is being analyzed for nutritional content, the food will be subjected to hydrolysis in the lab. The end products are analyzed to determine, for example, fat and sugar content. Suppose a lab is analyzing a new product that claims to be fat free. After the hydrolysis of the product is complete, the examiners find glucose, glycerol, fatty acids, and amino acids. Is this product free of fat? Justify your answer.
Answer: This product is not fat free because it contains fatty acids. It also contains glycerol. Because fats are composed of a glycerol molecule and three fatty acids, this product contains all components found in fat.
Bloom's Taxonomy: Application/Analysis
Learning Outcome: 2.4
Global LO: G7|G8
Section: 2.4