Chapter 1
Living in a Microbial World

1. **Which of the following is not an example of a microorganism?**
   a. a bacterium
   b. a protozoan
   c. a flea
   d. a virus
   e. a single-celled fungus

2. **Which of the following statements is true?**
   a. All living things are unicellular.
   b. All living things are multicellular.
   c. Most microorganisms are multicellular.
   d. Living things are composed of one or more cells.

3. **Which of the following statements is true?**
   a. Most microorganisms have eukaryotic cells.
   b. Most microorganisms have cells containing organelles.
   c. Many microorganisms have cells in which the genetic material is not surrounded
      by a nuclear membrane.
   d. Animals have prokaryotic cells.
   e. Plant cells do not contain organelles.

4. **Cells have the ability to maintain internal conditions within ranges compatible with life. This ability is called:**
   a. homeostasis.
   b. evolution.
   c. metabolism.
   d. environmental response.

5. **Which of the following are not composed of cells?**
   a. Bacteria and archaea
   b. Fungi and protozoa
   c. Viruses and prions

6. **Metabolism refers to:**
   a. the transfer of genetic information from generation to generation.
   b. the changes in the characteristics of living things over time.
   c. the response of living things to chemical signals in their environment.
   d. the ability to reproduce.

e. the ability to assimilate and use energy.

7. **Which of the following is an example of basic science?**
   a. a study to determine the mechanism used by bacteria to adhere to the lining of the intestine
   b. the development of a new anti-tuberculosis drug
   c. the use of microorganisms to digest oil released during an oil spill
   d. a study to determine how to prevent corrosion of water pipes by microorganisms
   e. research into the use of microorganisms as a source of biofuel

8. **Which of the following statements about model organisms is true?**
   a. They tend to be slow growing.
   b. They tend to have unique biological properties, very different from other organisms.
   c. They tend to reproduce quickly.
   d. They tend to be more complex and harder to study than other living things.
   e. They are used regularly in applied science, but not in basic science.

9. **Which of the following statements about a hypothesis is true?**
   a. A hypothesis is an explanation for a scientific phenomenon that has been repeatedly tested for many years and never disproved.
   b. A hypothesis can never be disproved. It can only be proved.
   c. A hypothesis is the initial observation of a natural phenomenon that leads to a question.
   d. A hypothesis is the question that stems from the observation of a natural phenomenon.
   e. A hypothesis is used to make a prediction about a future event that can later be observed or tested experimentally.

10. **Those factors that are kept the same in the experimental group and the control group are called:**
   a. control variables.
   b. experimental variables.
   c. manipulated variables.
   d. observed variables.

11. **What are the primary differences between prokaryotic and eukaryotic cells? Which groups of microorganisms have which cell type?**

12. **Which typical characteristics of living things are not observed in viruses?**

13. **Why are control groups necessary in a proper scientific experiment?**

Chapter 1 Answers

1. c
2. d
3. c
4. a
5. c
6. e
7. a
8. c
9. e
10. a
11. Prokaryotic cells are simpler and usually smaller in size than eukaryotic cells. In prokaryotic cells, membrane-bound organelles, including the nuclear membrane, are not present. In eukaryotic cells, cellular processes occur in organelles, with different activities taking place in discreet locations within the cell. Bacteria and Archaea have prokaryotic cells. Fungi, protozoa, and algae all have eukaryotic cells.
12. Viruses are not composed of cells. They are unable to replicate outside the cells of other organisms and they have little if any independent metabolism.
13. In a proper experiment, the effect of the experimental variable, if any, is compared between the experimental group and the control group. Without the control group, in which the experimental variable was not manipulated, there would be no way to evaluate the effect of the experimental variable.

Chapter 2
The Chemistry of Life

1. **Which of the following is a *mismatched* pair?**
   a. electrons: negative charge
   b. neutrons: no charge
   c. protons: positive charge
   d. atomic mass number: protons plus electrons
   e. uncharged atom: the number of electrons = the number of protons

2. **If an atom X has an atomic number of 18, then:**
   a. there are 18 protons.
   b. there are 9 protons and 9 electrons.
   c. there are 18 neutrons.
   d. there are 9 protons and 9 neutrons.
   e. it also has a mass number of 18.

3. **When one atom donates electrons and another atom accepts those electrons, a(n) _____ bond forms.**
   a. polar covalent
   b. hydrogen bond
   c. nonpolar covalent
   d. ionic

4. **An atom has 1 electron in an outer shell that holds a maximum of eight electrons. This atom:**
   a. is most likely an inert gas.
   b. will most likely form polar covalent bonds.
   c. will most likely gain electrons to achieve stability.
   d. will most likely become a negatively charged ion to achieve stability.
   e. will most likely lose its outer electron to achieve stability.

5. **Which of the following compounds will not dissolve in water?**
   a. one consisting largely of non-polar covalent bonds
   b. one consisting largely of polar covalent bonds
   c. one consisting largely of ionic bonds
   d. one that readily forms hydrogen bonds
   e. one in which many of the atoms have partial charges

6. **Which of the following statements is correct?**
   a. A base is a H^+ ion donor.
   b. Pure water is completely neutral and has a pH of 0.
   c. As the concentration of H^+ goes up, the pH also goes up.
   d. If the hydroxyl ions outnumber the H^+ ions, the pH will be less than 7.0.
   e. Bases reduce the concentration of H^+ in water.

7. **When two monosaccharides are joined together, _____ is formed through _____ synthesis.**
   a. a disaccharide; hydrolysis
   b. a polysaccharide; hydrolysis
   c. glucose; condensation
   d. a disaccharide; condensation
   e. starch; condensation

8. **The building blocks of _____ are _____ .**
   a. polysaccharides; fatty acids
   b. DNA; nucleotides
   c. nucleic acids; amino acids
   d. polysaccharides; glycerol
   e. fats; monosaccharides

9. **Enzymes function by _____, which speeds up the rate of a chemical reaction.**
   a. increasing the stability of the reactants
   b. multiplying the number of active sites on the reactants
   c. lowering the energy of activation
   d. increasing the energy of activation
   e. keeping the pH constant

10. **The purines of nucleic acids are _____ and _____.**
   a. thymine; guanine
   b. adenine; guanine
   c. adenine; cytosine
   d. thymine; cytosine
   e. cytosine; guanine

11. **Describe the relationship between an atom's stability and its energy. How does this impact an atom's reactivity?**

12. **What factors determine if a substance will or will not dissolve in water?**

13. **Why do proteins become less active as they lose their three-dimensional shape?**

Chapter 2 Answers

1. d
2. a
3. d
4. e
5. a
6. e
7. d
8. b
9. c
10. b
11. There is an inverse relationship between an atom's stability and its energy level. They are more likely to interact with other atoms (they are more reactive) when their energy is greater and their stability is lower.
12. Water is a highly polar molecule, because of the polar covalent bonds between oxygen and hydrogen atoms. These polar covalent bonds result in partial charges on each atom in a water molecule; partial negative on the oxygen and partial positive on the hydrogen atoms. These partial charges can attract charges, either partial or full, on other molecules, allowing the water to hydrogen bond with these charged molecules. Consequently, any molecule with charges (ionic compounds or compounds consisting of largely polar covalent bonds) will hydrogen bond with water, and the collective force of many hydrogen bonds causes the molecule to dissolve. Molecules that are composed of mainly nonpolar covalent bonds lack charges, and therefore cannot hydrogen bond with water. They therefore do not dissolve in water.
13. The ability of a protein to carry out its specific functions is dependent on its precise three-dimensional folding, which allows the protein to interact with other molecules in a highly specific manner. Anything that interferes with the protein's complex three-dimensional shape reduces the ability of the protein to properly interact with other molecules and therefore reduces its activity. As proteins lose their three-dimensional shape, they are said to be denatured. High temperature and pH extremes are common causes of protein denaturing.