CHAPTER 2 Review

Reviewing and Understanding Key Concepts

1. What is the electric charge on each of the three subatomic particles in an atom?
   - **a.** a proton has no charge; an electron has a negative charge; a neutron has a positive charge
   - **b.** a proton has a negative charge; an electron has a positive charge; a neutron has no charge
   - **c.** a proton has a positive charge; an electron has no charge; a neutron has a negative charge
   - **d.** a proton has a positive charge; an electron has a negative charge; a neutron has no charge

2. Which of the following is true about a potassium atom and a potassium ion?
   - **a.** They both have the same number of protons, but a different number of neutrons.
   - **b.** They both have the same number of neutrons, but a different number of protons.
   - **c.** They both have the same number of protons, but a different number of electrons.
   - **d.** They both have the same number of electrons, but a different number of protons.

3. A substance that resists large changes in pH is known as
   - **a.** water.
   - **b.** a base.
   - **c.** an acid.
   - **d.** a buffer.

4. When the pH of a solution rises from 9 to 12, how many times more basic has the solution become?
   - **a.** 3 times
   - **b.** 10 times
   - **c.** 100 times
   - **d.** 1000 times

5. Which of the following rows shows the bonding within a water molecule and the bonding between two water molecules?

	Bond within a water molecule	Bond between two water molecules
a.	ionic	hydrogen
b.	covalent	ionic
c.	covalent	hydrogen
d.	hydrogen	ionic

6. Which of the following rows correctly describes a hydrophilic molecule and a hydrophobic molecule?

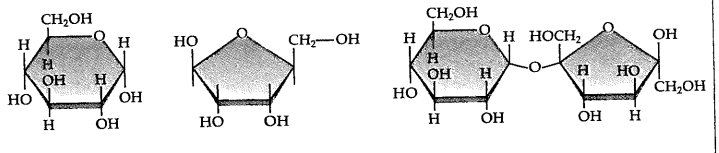
	Hydrophilic molecule	Hydrophobic molecule
a.	Polar, water-fearing	Nonpolar, water-loving
b.	Polar, water-loving	Nonpolar, water-fearing
c.	Nonpolar, water-loving	Polar, water-fearing
d.	Nonpolar, water-fearing	Polar, water-loving

7. Which of the following lists a polymer with its corresponding monomer?
   - **a.** ATP and ribose
   - **b.** steroid and fatty acid
   - **c.** protein and amino acid
   - **d.** triglyceride and glycogen

8. Which of the following reactions would result in the production of a water molecule?
   - **a.** the hydrolysis of a cellulose into glucose
   - **b.** the breakdown of maltose into two glucose molecules
   - **c.** the formation of a peptide bond between alanine and lysine
   - **d.** the formation of a hydrogen bond between two water molecules

9. Which of the following is an example of a dehydration reaction?
   - **a.** the breakdown of starch into maltose
   - **b.** the formation of dipeptides from polypeptides
   - **c.** the digestion of sucrose into glucose and fructose
   - **d.** the conversion of monosaccharides into polysaccharides

Use the following diagram of glucose, ribose, and sucrose to answer questions 10 to 12.



Glucose $C_6H_{12}O_6$ **Ribose** $C_5H_{10}O_5$ **Sucrose** $C_{12}H_{22}O_{11}$

10. These molecules are classified as
    - **a.** lipids.
    - **b.** steroids.
    - **c.** proteins.
    - **d.** carbohydrates.

11. What do these three molecules have in common?
    - **a.** They are monomers for cellulose.
    - **b.** The ratio of carbon atoms to hydrogen atoms is 2:1.
    - **c.** They are structural components of the plant cell wall.
    - **d.** They have twice as many hydrogen atoms as oxygen atoms.

12. The bonding of glucose and ribose would result in a
    - **a.** dipeptide.
    - **b.** triglyceride.
    - **c.** disaccharide.
    - **d.** polysaccharide.

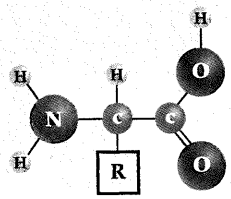
13. How many water molecules are needed during the hydrolysis of a triglyceride resulting in three fatty acids and a glycerol molecule?
    - **a.** 1
    - **b.** 2
    - **c.** 3
    - **d.** 4

14. Compared to saturated fats, unsaturated fats contain more
    - **a.** single bonds.
    - **b.** double bonds.
    - **c.** hydrogen atoms.
    - **d.** adjacent fused rings.

15. What feature distinguishes a phospholipid from a triglyceride?
    - **a.** the steroid
    - **b.** the fatty acid
    - **c.** the phosphate group
    - **d.** the glycerol molecule

16. Which of the following molecules can be converted into the female sex hormone estrogen?
    - **a.** glycerol
    - **b.** cholesterol
    - **c.** ribonucleic acid
    - **d.** saturated fatty acid

Use the following diagram to answer questions 17 and 18.

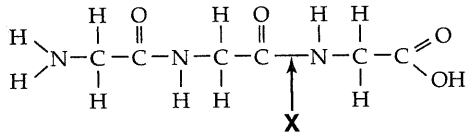


17. Which of the following is a function of a polymer formed from this molecule?
- **a.** stores genetic information
- **b.** speeds up chemical reactions
- **c.** serves as an energy source for the cell
- **d.** provides a fluid consistency in the plasma membrane

18. An example of a substance that could be produced from this molecule is
- **a.** ATP.
- **b.** keratin.
- **c.** glycerol.
- **d.** fatty acid.

19. Radioactive nitrogen-15 is used in a lab during a dehydration reaction. Into which of the following molecules would nitrogen-15 mostly likely be incorporated?
- **a.** starch
- **b.** insulin
- **c.** glycogen
- **d.** a triglyceride

Use the following diagram to answer questions 20 to 25.



20. Identify bond X.
- **a.** an ionic bond
- **b.** a peptide bond
- **c.** a hydrogen bond
- **d.** a phosphodiester bond

21. What component of the subunits of this molecule makes it unique from the other subunits?
- **a.** the *R* group
- **b.** the acid group
- **c.** the amino group
- **d.** the central carbon

22. What does the "H" attached to the central carbon represent?
- **a.** glycerol
- **b.** *R* group
- **c.** fatty acid
- **d.** acidic group

23. What will the hydrolysis of this molecule produce?
- **a.** nucleotides
- **b.** amino acids
- **c.** glucose molecules
- **d.** glycerol, a phosphate group, and two fatty acids

24. How many monomers are present in this molecule?
- **a.** 2
- **b.** 3
- **c.** 4
- **d.** 5

25. What type of bonding between the subunits of this molecule is responsible for the alpha helix structure?
- **a.** ionic bonding
- **b.** peptide bonding
- **c.** covalent bonding
- **d.** hydrogen bonding

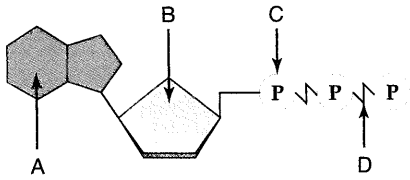
26. The primary structure of a protein is determined by
- **a.** the linear sequence of amino acids.
- **b.** the ionic bonding between the *R* groups.
- **c.** the interaction between two polypeptides.
- **d.** the hydrogen bonding between adjacent amino acids.

27. Two proteins have different functions because they are polypeptide chains that are
- **a.** folded in the same way and have the same secondary structure.
- **b.** folded differently due to the hydrogen bonding and have a different sequence of amino acids.
- **c.** folded in the same three dimensional configuration and have the same sequence of amino acids.
- **d.** folded differently due to the interactions between their *R* groups and have the same sequence of monosaccharides.

28. What happens when ATP breaks down to ADP?
- **a.** energy is released
- **b.** another phosphate bond is added to adenosine
- **c.** the bond between adenine and ribose is broken
- **d.** a molecule of inorganic phosphate is added to the molecule

29. What element is present in ATP, but not in a triglyceride?
- **a.** carbon
- **b.** oxygen
- **c.** hydrogen
- **d.** phosphorus

Use the following diagram to answer questions 30 to 32.



30. This molecule represents a
- **a.** nucleotide.
- **b.** triglyceride.
- **c.** nucleic acid.
- **d.** nitrogenous base.

31. What is structure B?
- **a.** glycerol
- **b.** a steroid
- **c.** a polysaccharide
- **d.** a monosaccharide

32. What other biological molecule has structure B?
- **a.** DNA
- **b.** RNA
- **c.** cellulose
- **d.** glycogen

33. The element that is present in RNA and a protein but not in starch is
- **a.** carbon.
- **b.** oxygen.
- **c.** nitrogen.
- **d.** hydrogen.

34. Which of the following does not have hydrogen bonding?
- **a.** triglyceride
- **b.** DNA
- **c.** an alpha helix of a protein
- **d.** a pleated sheet of a polypeptide chain

35. The components of a nucleotide may include
- **a.** a glycerol molecule and three fatty acid chains.
- **b.** a phosphate group, a nitrogenous base, and a ribose sugar.
- **c.** a nitrogenous base, a glucose molecule, and a fatty acid chain.
- **d.** a phosphate group, two fatty acid chains, and a glycerol molecule.

36. What component is different between RNA and DNA?

a. adenine **b.** the fatty acid

c. the pentose sugar **d.** the phosphate group

37. Which base is usually used to synthesize RNA, but not DNA?

a. uracil **b.** adenine

c. cytosine **d.** thymine

38. Which of the following components of DNA are held together by hydrogen bonds?

a. cytosine and guanine

b. phosphate and thymine

c. deoxyribose and adenine

d. phosphate and deoxyribose

39. A student wants to determine whether or not juice contains glucose. Which of the following sets of lab equipment could the student use?

a. safety goggles, juice, brown paper bag

b. safety goggles, juice, Lugol's iodine solution, test tube, test tube rack, graduated cylinder, rubber gloves

c. safety goggles, juice, Biuret solution, test tube, test tube rack, graduated cylinder, rubber gloves

d. safety goggles, juice, Benedict's solution, test tube, test tube tongs, graduated cylinder, hot plate, beaker, water, rubber gloves

40. Match the following structures to the corresponding descriptions of biological molecules. There may be more than one answer for each description.

a. building block of a phospholipid

b. monomer of collagen and keratin

c. molecules classified as carbohydrates

d. precursor to testosterone and progesterone

e. provides long-term energy storage in plants

f. found in both phospholipids and triglycerides

g. provides structural support in the plant cell wall

h. monosaccharide that is a primary energy source

i. molecule produced during dehydration reaction

j. forms lipid bilayer of the plasma membrane of a cell

k. energy molecule produced during cellular respiration

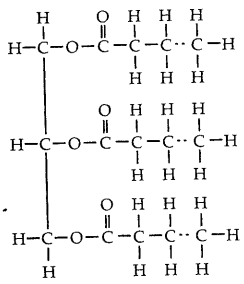
l. molecule that contains an amino group and an acidic group

m. molecule that is the major storage form of energy in animal cells

n. molecule that has already undergone at least one dehydration reaction

o. molecule that is the building block for hemoglobin, insulin, and trypsin

p. inorganic molecule responsible for most chemical reactions in the body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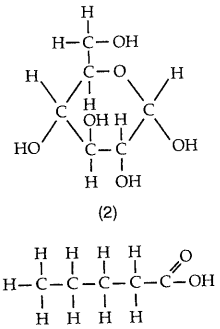
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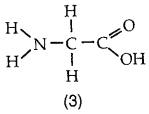
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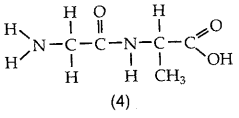
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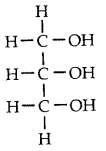
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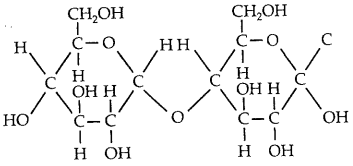
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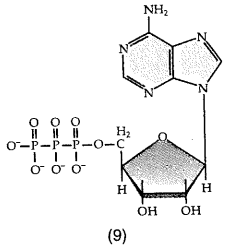
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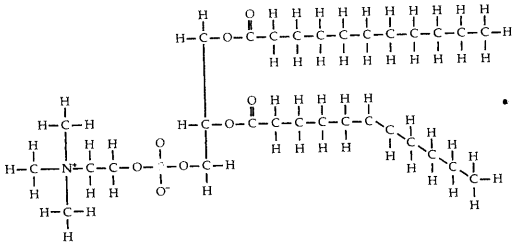
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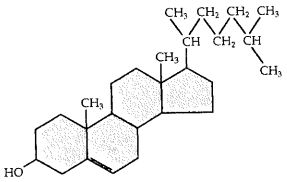
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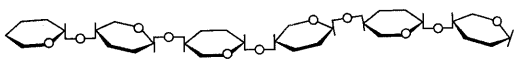
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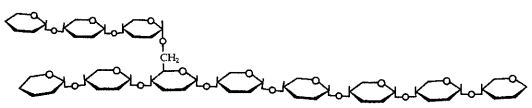
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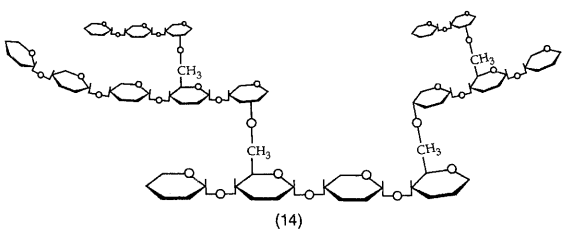
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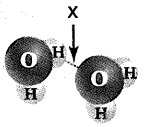
41. Explain how an atom consists of charged subatomic particles, but is neutral.

42. The saying "opposites attract" can be used to describe static electricity. How can this saying also be used to explain the attractive forces between water molecules?

43. The strong acid hydrogen chloride can be dissolved in water. What will happen to the pH of the solution?

Use the following diagram to answer questions 44 to 48.



44. What is bond X?

45. Why does bond X form between these two molecules?

46. Describe three functions of the molecules shown in the diagram.

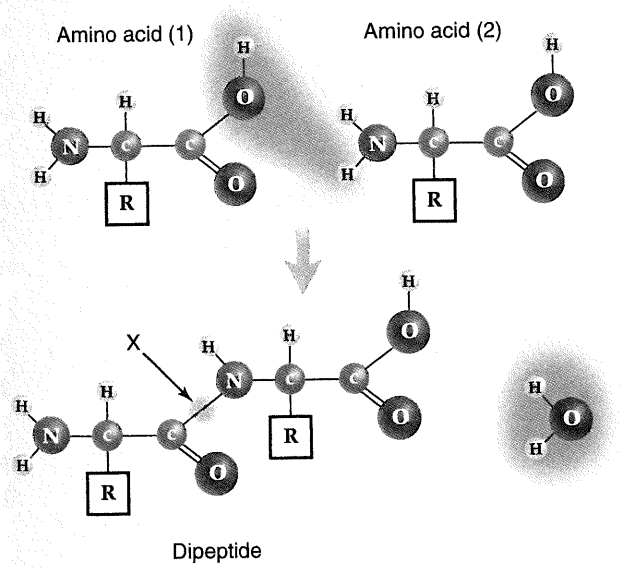
47. What accounts for the polarity within these molecules?

48. What do the positive and negative charges on the molecules allow the molecule to act as?

49. Explain why runners eat meals with large quantities of carbohydrates a few days before a marathon?

50. If sucrose ($C_{12}H_{22}O_{11}$) is made up of a glucose ($C_6H_{12}O_6$) molecule and a fructose ($C_6H_{12}O_6$) molecule, why do the number of hydrogen atoms and oxygen atoms in sucrose not add up to that of glucose and fructose?

Use the following diagram of a biological process to answer questions 51 to 54.



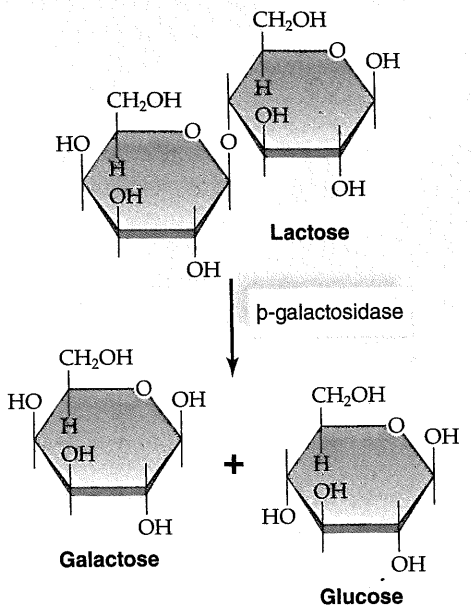
51. What biological process is illustrated above?

52. Identify bond X.

53. What molecules will form as a result of this reaction?

54. How many water molecules are produced if 10 amino acids are linked together?

Use the following diagram of a biological process to answer questions 55 to 57.



55. What is lactose classified as?

56. What molecule is required for this reaction to occur?

57. What process is illustrated above?

58. Explain the saying "water and oil do not mix."

59. How are the following terms associated with each other?
    - **a.** DNA and protein
    - **b.** nucleic acid and nucleotide
    - **c.** monosaccharide and polysaccharide
    - **d.** polypeptide and peptide bond
    - **e.** hydrogen bonding and secondary structure of a protein
    - **f.** polarity in water molecules and cohesion

60. Distinguish between the following terms.
    - **a.** glycerol and fatty acid
    - **b.** phospholipid and triglyceride
    - **c.** hydrogen bond and peptide bond
    - **d.** unsaturated fatty acid and saturated fatty acid

61. What advantage does each of the following characteristics of polymers have for the cell? Give an example.
    - **a.** A polysaccharide is formed using the same kind of dehydration reaction to add successive glucose subunits.
    - **b.** The bonds between monomers are broken by the addition of water and are formed by the removal of water.

62. A student is conducting an experiment using Benedict's solution to test two different carbohydrate solutions. He gets a positive test for both the disaccharide maltose and the monosaccharide glucose. Explain this observation.

63. When a mixture of phospholipids and water is shaken, why do the phospholipids spontaneously assemble into vesicles surrounded by a lipid bilayer?

64. Explain how the molecular structure of phospholipids determines their function as the primary component of cell membranes.

65. Phospholipids make up the plasma membrane and cellulose is the major structural component of the plant cell walls. How do the chemical structures and physical properties of these two biological molecules relate to their functions in cells?

66. The label on a container of shortening indicates that it is "partially hydrogenated soybean oil and palm oil."
- **a.** What is the chemical purpose of "partial hydrogenation"?
- **b.** Predict what the content of the container physically looked like before the partial hydrogenation.

67. What is meant by the phrase "starch and glycogen are storage compounds for energy"?

68. In a given polypeptide chain, the amino acid leucine is replaced by the amino acid valine due to a mutation. Is this a change in primary or secondary structure? How might this replacement in an amino acid result in a change of the tertiary structure or quaternary structure of a protein?

69. Explain why proteins are considered to be polymers, but steroids are not.

70. Explain how hydrophobic interactions and hydrogen bonding determine form and function of proteins.

71. The radioisotope phosphorus-32 is used in science laboratories to tag biological molecules for study. Identify four biological molecules that would take up phosphorus-32 and incorporate it into their structural component.

72. Explain why proteins are more structurally and functionally diverse than carbohydrates.

73. Explain how the amino acid sequence of one or more polypeptide chains affects the three-dimensional structure and function of proteins.

74. Keratin in human hair is a fibrous protein with an alpha helical structure. It is extensible and elastic. Silk fibroin is also a fibrous protein, but consists of a beta pleated sheet. It cannot stretch, but is very strong. Explain the differences between these two proteins.

75. Describe how the structure of DNA would be different if hydrogen bonding did not occur.

76. Compare the different types of bonds by completing the table.

Type of Bond	Ionic Bond	Covalent Bond	Hydrogen Bond
Description			

77. Complete the following table comparing the three types of carbohydrates.

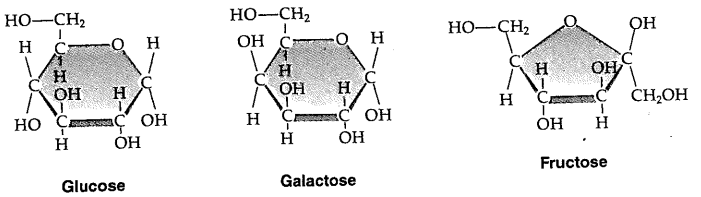
	Cellulose	Starch	Glycogen
Monomer			
Description of Structure			
Plant Cell or Animal Cell			
Function			

78. Explain why the structural polysaccharide cellulose is an unbranched molecule, but the storage polysaccharide glycogen is a branched-chain polymer. Relate their structure to their function.

79. Compare DNA, RNA, and protein molecules by completing the following table.

Characteristic	DNA	RNA	Protein
Is it a polymer?			
Does it have a three-dimensional structure?			
Does it contain nitrogen atoms?			
Does it contain phosphorus atoms?			
Does it contain hydrogen bonding?			

Use the following diagrams of glucose, galactose and fructose to answer question 80.



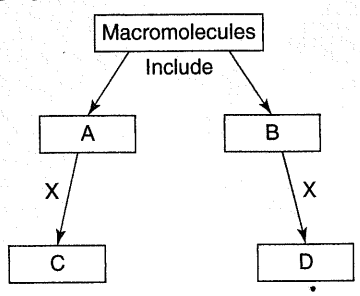
80. Describe three structural similarities that glucose, galactose and fructose share.

81. What type of bonding is responsible for each of the levels of protein organization?
- **a.** primary structure
- **b.** secondary structure
- **c.** tertiary structure
- **d.** quaternary structure

82. Use a Venn diagram to compare and contrast DNA and RNA.

Engage

Use the following information to answer question 83.



83. Making Connections Molecule A fights infections, transports oxygen, provides structural support, and enables movement. Molecule B is the structural component of plant cell walls.

a. Identify A, B, C, D, and X.

b. What molecule would form if two units of molecule D underwent a dehydration reaction?

c. Name two other polymers that can be formed by molecule D?

Use the following information to answer questions 84 and 85.

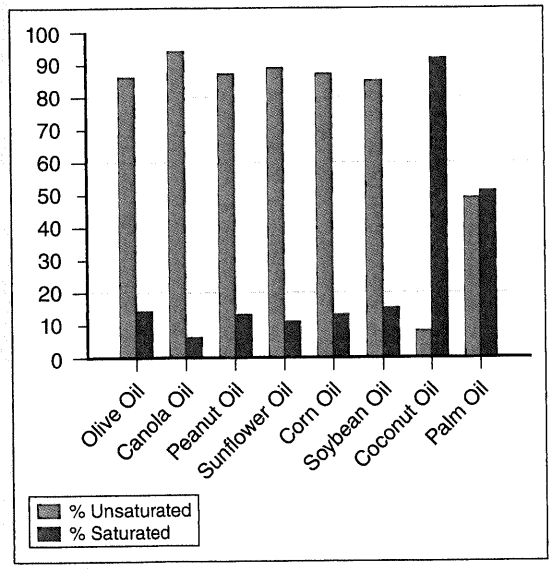
A calorimeter was used to burn 30 g of fat, 30 g of protein, and 30 g of carbohydrate. Each nutrient was burned separately. The number of kilojoules produced per gram by each nutrient was recorded in the data table below.

Biological Molecule	Kilojoules Per Gram Produced
fat	38
protein	17
carbohydrate	16

84. Analyzing Data What can be concluded from the data shown?

85. Applying Concepts Consider the structural difference among these three molecules. What can account for such a difference in the amount of energy produced between these three molecules?

Use the following graph to answer questions 86 and 87.



86. Interpreting Graphs Using the graph, what can you conclude about different types of oils?

87. Interpreting Graphs What generalization can be made about unsaturated fats?

88. Making Connections Biochemistry is the study of chemical processes in biological systems. It is a field of science that combines the disciplines of biology and chemistry. Identify and describe two other science disciplines that are interdisciplinary, where the knowledge and understanding of one discipline of science overlaps with the other.

89. Making Connections Describe how scientists can use the process of radioisotope tracing to study the digestion of different biological macromolecules. What radioisotopes could be used to track carbohydrates and proteins through the digestive system? Explain what scientists can learn from this study.

90. Evaluating A low-carbohydrate, high protein diet has been promoted as an effective method of losing weight.

a. Describe how this type of diet could result in weight loss.

b. What nutrient would your body start to burn as fuel?

91. Predicting What might be the result of a diet that lacks proteins?

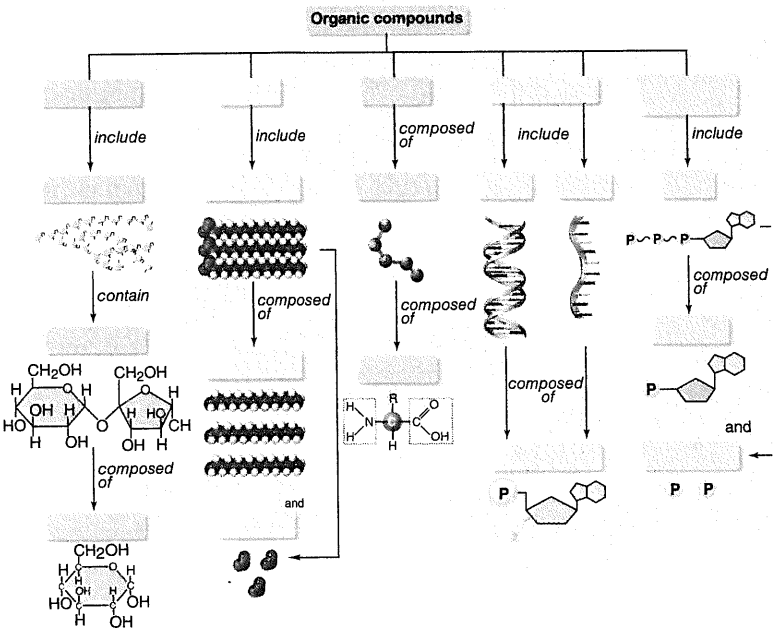
92. Making Connections Sketch a representation of the dehydration reaction or synthesis reaction of the molecules listed below. Indicate how many water molecules are required or produced.

a. two amino acid molecules from a dipeptide

b. a disaccharide from two molecules of glucose

c. a triglyceride from one molecule of glycerol and three fatty acid molecules

93. Interpreting Graphics Use the following list of words to complete the flow chart shown below: amino acids, ATP, carbohydrates, disaccharides, DNA, fatty acids, glycerol, high-energy compounds, lipids, nucleic acids, monoscacharides, nucleotide, nucleotides, proteins, polysaccharides, triglycerides, peptides, phosphate groups, RNA.



20. An atom has no charge. An ion has a charge because it has either lost or gained electrons. The ion has a full valence shell, while the atom does not.
21. A covalent compound results from non-metallic atoms sharing electrons to form covalent bonds, while an ionic compound results when an ionic bond forms between a positively charged ion and a negatively charged ion.
22. Soil pH and Gardening – gardeners might have to determine the pH of soil to see if certain plants can grow in it; Pools and Hot Tubs – pH of the water has to be tested otherwise algae can grow; Baking – baking involves a series of chemical reactions that require the ingredients to be at a specific pH; Hair – use of hair dyes and shampoos require the correct pH balance to work.
23. Diagram
24. Diagram
25. Water forms beads of water because of attractive cohesive forces between the water molecules are responsible for surface tension.

Chapter 2 Review Questions

1. **d.** a proton has a positive charge; an electron has a negative charge; a neutron has no charge
2. **c.** They both have the same number of protons, but different number of electrons.
3. **d.** a buffer
4. **d.** 1000 times
5. **c.** covalent; hydrogen
6. **b.** Polar, water-loving; Nonpolar, water-fearing
7. **c.** protein and amino acid
8. **c.** the formation of a peptide bond between alanine and lysine
9. **d.** the conversion of monosaccharides into polysaccharides
10. **d.** carbohydrates
11. **d.** they have twice as many hydrogen atoms as oxygen atoms
12. **c.** disaccharide
13. **c.** 3
14. **b.** double bonds
15. **c.** the phosphate group
16. **b.** cholesterol
17. **b.** speeds up chemical reactions
18. **b.** keratin
19. **b.** insulin
20. **b.** a peptide bond
21. **a.** the R group
22. **b.** R group
23. **b.** amino acids
24. **b.** 3
25. **d.** hydrogen bonding
26. **a.** the linear sequence of amino acids
27. **b.** folded differently due to the hydrogen bonding and have a different sequence of amino acids
28. **a.** energy is released
29. **d.** phosphorus
30. **a.** nucleotide
31. **d.** a monosaccharide
32. **b.** triglyceride
33. **c.** nitrogen
34. **a.** triglyceride
35. **b.** a phosphate group, a nitrogenous base and a ribose sugar
36. **c.** the pentose sugar
37. **a.** uracil
38. **a.** cytosine and guanine
39. **d.** Safety goggles, juice, Benedict's solution, test tube, test tube tongs, graduated cylinder, hot plate, beaker, water, rubber gloves
40. **a.** 6 (fatty acid), 7 (glycerol)
    b. 3 (amino acid)
    c. 2 (glucose), 8 (maltose), 12 (cellulose), 13 (starch), 14 (glycogen)
    d. 11 (steroid)
    e. 13 (starch)
    f. 6 (fatty acid), 7 (glycerol)
    g. 12 (cellulose)
    h. 2 (glucose)
    i. 5 (water)
    j. 10 (phospholipid)
    k. 9 (ATP)
    l. 3 (amino acid)
    m. 14 (glycogen)
    n. 1 (triglyceride), 4 (dipeptide), 8 (maltose), 10 (phospholipid), 12 (cellulose), 13 (starch), 14 (glycogen)
    o. 3 (amino acid), 4 (dipeptide)
    p. 5 (water)
41. An atom has the same number of protons and electrons. The positive charges of the protons and the negative charges of the electrons add up to zero, making the atom neutral.
42. The negatively charged oxygen of one water molecule is attracted to the positively charged hydrogen of another water molecule.
43. The pH of the solution will decrease becoming more acidic.
44. Bond X is a hydrogen bond.
45. Bond X forms between the two molecules because the molecules are polar.
46. Three functions of water: 1. acts as a solvent – dissolves substances; 2. acts as a lubricant – lubricates joints; 3. acts as a temperature regulator – regulates body temperature.
47. The unequal sharing of electrons accounts for the polarity.
48. The partially positive and negative charges on the molecule allow water to act as a solvent.
49. The body will store the carbohydrates needed for the race. On the day of the race, glycogen will be converted into glucose so that glucose can be used to produce ATP during cellular respiration.

50. Two hydrogen atoms and one oxygen atom are used to produce a water molecule during the dehydration reaction.

51. The process is a dehydration reaction.

52. Bond X is a peptide bond.

53. A dipeptide (2 amino acids held together by a peptide bond) and a water molecule will form as a result of this reaction.

54. Nine water molecules are produced when 10 amino acids are linked together.

55. Lactose is classified as a disaccharide.

56. A water molecule is required for this reaction to occur.

57. A hydrolysis reaction is illustrated.

58. When nonpolar molecules, such as oil, come into contact with polar molecules, like water, they do not mix. The oil molecules tend to clump together rather than mix with the water. This is because oil molecules are nonpolar and therefore hydrophobic (water-fearing).

59. **a.** DNA codes for the sequence of amino acids in a protein.

b. A nucleotide consists of a nitrogenous base, a sugar and a phosphate group. It is the monomer that makes up a nucleic acid.

c. A monosaccharide consists of one sugar molecule, while a polysaccharide consists of many sugar molecules.

d. A polypeptide is a chain of amino acids held together by peptide bonds.

e. The secondary structure of a protein is determined by the hydrogen bonding between the different amino acids.

f. Due to the unequal sharing of electrons on a water molecule, the water molecule is said to be polar. The negative charge of one water molecule is attracted to the positively charged part of another water molecule. This causes the water molecules to stick together, displaying cohesion.

60. **a.** A glycerol molecule is only composed of a three-carbon chain, while a fatty acid is a long chain of carbons. Both of these molecules make up a triglyceride.

b. A triglyceride has a glycerol molecule attached to three fatty acid chains, while a phospholipid has a glycerol molecule attached to two fatty acid chains and a phosphate group.

c. A peptide bond forms between the carbon of the carboxyl group and the nitrogen of the amino group in a dipeptide. A hydrogen bond forms between different amino acids in the polypeptide chain.

d. Unsaturated fatty acids have double bonds, while saturated fatty acids only have single bonds.

61. **a.** A large amount of molecules can be produced with the same monomer. For example, glucose (a monomer) can form three different polymers (cellulose, starch and glycogen).

b. Hydrolysis breaks down a polymer that is no longer needed and its monomers can be used to produce other polymers through a dehydration reaction.

62. A positive test for Benedict's solution indicates the presence of glucose. Since maltose is made up of two glucose molecules it should test positive like the glucose solution.

63. The phospholipid bilayer forms in an aqueous solution because the polar (hydrophilic) head is soluble in water, while the non-polar (hydrophobic) tails are not. The hydrophilic heads will interact with the water on the outside and inside of the vesicle, while the hydrophobic tails interact with each other.

64. The molecular structure of a phospholipid consists of a hydrophilic head and a hydrophobic tail. The polar hydrophilic head faces outwards toward the watery solutions and the non-polar tails form the hydrophobic interior.

65. The non-polar, hydrophobic tails of the phospholipids are packed tightly together to form the interior of the cell membrane and the hydrophilic heads face outward where they interact with water. The phospholipids bilayer allows only lipid-soluble substances to pass through it. Cellulose is a huge polysaccharide consisting of unbranched chains of glucose molecules. The rigid structure of the plant cell wall owes its physical strength to cellulose.

66 **a.** The purpose of partial hydrogenation is to remove double bonds and to replace them with single bonds in the unsaturated fatty acid. This will add more hydrogen atoms to the unsaturatec fatty acid.

b. The content of container would be liquid oil.

67. Starch and glycogen can be broken down into glucose monomers. Glucose can then be used to produce energy for cellular activities through cellular respiration.

68. It is a change in primary structure. The change in amino acid sequence might affect the tertiary structure and quaternary structure because valine now will bond differently with other amino acids in the polypeptide forming different hydrogen bonds, ionic bonds and covalent bonds. The interactions of the different amino acids along the polypeptide chain will affect the 3D globular shape of the polypeptide and now one polypeptide chain will interact with another polypeptide chain.

69. A polymer is a large molecule formed from the joining of smalle unit molecules called monomers. Proteins are made up of repeating units of amino acids, while steroids consist of just on component, a ringed structure.

70. A protein will fold a particular way as hydrogen bonding forms between the different R-groups of the amino acids along the polypeptide chain. In addition to this, non-polar hydrophobic R-groups of amino acids will move toward the interior of the protein's 3D shape. The resulting tertiary structure will determine the function of the protein.

71. Four biological molecules that would have phosphorus in then are ATP, DNA, RNA, and phospholipid.

72. With all the different combinations of amino acids and the different hydrogen bonding that form between the amino acid thousands of different proteins are possible. With a variety in the amino acid sequence, this will result in different tertiary structures. The functions of proteins are dependent on the protein's 3D structure.

73. The sequence of amino acids along a polypeptide will affect how one amino acid interacts with another amino acid in the polypeptide chain. Hydrogen bonds, covalent bonds, and ioni

bonds will cause the polypeptide to fold into a specific shape based on what amino acids interact with one another along the chain.

74. The difference lies in the hydrogen bonding between the amino acids. The coiling of the chain produces an alpha helix, while the folding of the chain results in a beta pleated sheet.

75. If hydrogen bonding was absent, DNA would not be a double stranded molecule because there would not be complementary base pairing between the bases of the two strands.

76.

Type of Bond	Ionic Bond	Covalent Bond	Hydrogen Bond
Description	- bond that forms in compounds between a positively charged ion and a negatively charged ion - results in the transfer of electrons	- bond that forms within molecules due to sharing of electrons	- bond that forms between the partially positively charged hydrogen of one polar molecule and the partially negatively charged atom of another polar molecule.

77.

	Cellulose	Starch	Glycogen
Monomer	glucose	glucose	glucose
Description of Structure	no side chains	some side chains	many side chains
Plant Cell or Animal Cell	plant cell	plant cell	animal cell
Function	structural component of plant cell wall	energy storage in plants	energy storage in animals

78. The absence of side chains in cellulose allows the linear molecules to be side by side, adding strength and rigidity for the plant. Glycogen has many branches and acts as energy storage. The branching of the side chains allows glycogen to be more soluble and it can be synthesized and broken down more quickly for energy.

79.

Characteristic	DNA	RNA	Protein
Is it a polymer?	Yes (consists of nucleotides)	Yes (consists of nucleotides)	Yes (consists of amino acids)
Does it have a three dimensional structure?	Yes	Yes	Yes
Does it contain nitrogen atoms?	Yes (contains nitrogen in the bases)	Yes (contains nitrogen in the bases)	Yes (contains nitrogen in the amino group)
Does it contain phosphorus atoms?	Yes (phosphorus is in the sugar-phosphate backbone)	Yes (phosphorus is in the sugar-phosphate backbone)	No (amino acid does not have phosphorus)
Does it contain hydrogen bonding?	Yes (has hydrogen bonding between A-T and C-G)	Yes (has hydrogen bonding between A-U and C-G)	Yes (has hydrogen bonding between the amino acids)

80. Structural similarities include: they are monosaccharides, hexose, simple sugars; they have the same molecular formula; they occur as ring structures; they have "ose" endings; they provide energy.

81. a. The primary structure of a protein is due to the peptide bonding between the adjacent amino acids.

b. The secondary structure of a protein is due to the hydrogen bonding between the amino acids.

c. The tertiary structure of a protein is due to the covalent, ionic, and hydrogen bonding between the R-groups.

d. The quarternary structure of a protein is due to the bonding between 2 or more polypeptides.

82. Venn Diagram should have two circles interlocking. Place DNA label above the circle on the left hand side and RNA above the circle on the right hand side. The part where the two circles overlap will list the similarities that these two molecules have. Similarities include: nucleic acid, adenine, guanine, cytosine pentose. In the DNA circle, students should list: double stranded, thymine, double helix, deoxyribose, replication. In the RNA circle, students should list: single stranded, uracil, three type of RNA (mRNA, tRNA and rRNA), ribose, transcription.

83. a. A = proteins; B = cellulose; C = amino acids; D = glucose; X = hydrolysis

b. Maltose (a disaccharide) would form if two units of molecule D underwent a dehydration reaction.

c. Two other polymers that would form from glucose are glycogen and starch.

84. Fats produce almost twice the amount of energy for a given gram of protein and carbohydrate.

85. The carbons in fatty acids have more electrons around them. When the fatty acids are oxidized (eg. the electrons are transferred to oxygen), more energy is released than the same process with carbohydrates and proteins.

86. Different types of oils have different percentage of unsaturated and saturated fats. They tend to have the "healthier" unsaturated fats rather than the saturated fats.

87. Unsaturated fats are derived from plants and are liquid at room temperature.

88. Answers may vary – biomechanics, molecular biology, nuclear medicine, biomedical engineering, neuroscience, immunogenetics, microbiology, electrochemistry, geophysics.

For example, biomechanics uses engineering concepts to analyze structure and function in biological systems. Geophysics uses the concepts of physics (eg. electricity and magnetism) to study the Earth.

89. Scientists can inject radioactive material into a patient and trace its movement through the digestive system. They may want to use the radioisotope carbon-14 to track the digestion of starch into maltose, and then into glucose. By analyzing the path that the carbon takes, scientists can determine where carbohydrate digestion takes place in the body. Since nitrogen is found in proteins, scientists can use the radioisotope nitrogen-15 to track the digestion of proteins into peptides, and then into amino acids.

90. a. By restricting the consumption of carbohydrates, the body will not convert excess carbohydrates into fat. The body will also start to burn body fat instead of carbohydrates for fuel. This will result in weight loss.

b. Your body would start to burn fats rather than carbohydrates as fuel.

91. A lack of proteins would not give the body the amino acids it needs to build important proteins for the body (eg. enzymes for metabolic reactions, keratin, collagen, etc.).

92. Diagram

93. Header: Organic Compounds

First column: Carbohydrates; polysaccharides; dissacharides; monosaccharides

Second column: Lipids; triglyceride; fatty acids; glycerol

Third column: Proteins; peptides; amino acids

Fourth column: Nucleic acids; RNA; DNA; nucleotides

Fifth column: High-Energy Compounds; ATP; nucleotide; phosphate groups

Chapter 3 Diagnostic Questions

1. a. A red blood cell is larger than a virus.

2. c. the plasma membrane

3. b. to control all of the cell's activities

4. d. a cell wall

5. c. water + carbon dioxide + sunlight $\rightarrow$ oxygen + glucose

6. d. $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + ATP$

7. d. Mitochondria are found in both plant and animal cells, while the chloroplasts are found only in plant cells.

8. b. by diffusion

9. A cell is the basic unit of life.

10. A. nuclear envelope; **B.** nucleolus; **C.** nuclear pore; **D.** water vacuole; **E.** chloroplast; **F.** mitochondrion; **G.** microtubules; **H.** microfilaments; **I.** plasma membrane; **J.** granum of the chloroplast; **K.** cell wall; **L.** cytoplasm; **M.** Golgi apparatus; **N.** vesicle; **O.** smooth endoplasmic reticulum; **P.** rough endoplasmic reticulum; **Q.** ribosome

11. 1. nucleus; **2.** chromosome; **3.** mitochondria; **4.** ribosome; **5.** chloroplast; **6.** vacuole; **7.** endoplasmic reticulum; **8.** plasma membrane; **9.** lysosome

12. Students might say that they could not find everyday examples for every cell structure.

13. DNA and RNA are found in the nucleus.

14. Answers may vary. When you are travelling through a crowded hallway at school into an empty classroom, you are going from an area of high concentration to an area of low concentration.

15. Answers may vary. The diffusion of food aroma molecules comes from the kitchen as someone is cooking.

Chapter 3 Review Questions

1. a. The cell is the basic unit of life.

2. b. a cell with a surface-area-to-volume of 3:2

3. d. cell structure 12

4. d. organelle 11

5. d. 7

6. b. the plasma membrane

7. c. cholesterol

8. c. diagram of polypeptide chain

9. d. it is a double membrane structure that has pores and separates the contents of the cytoplasm from the nucleus

10. b. DNA

11. d. rough endoplasmic reticulum

12. c. rough endoplasmic reticulum

13. d. a plastid that has the ability to capture light energy and convert it into organic molecules

14. b. peroxisome – fatty acids

15. d. mitochondria

16. c. membrane-bound vesicles that have hydrolytic enzymes

17. a. The secretion of peptidase would not occur.

18. c. glucose

19. d. cellular respiration

20. c. to produce ATP for active transport of calcium ions

21. a. cell division

22. c. I, II and III only

23. a. They both use a carrier protein.

24. c. pinocytosis

25. c. exocytosis

26. c. glycoprotein

27. d. the plasma membrane and the nuclear envelope

28. c. the number of amino acids entering the cell would decrease

29. d. only certain substances can move across it

30. d. the excretion of hydrogen ions in the distal convoluted tubule of the kidneys

31. a. IV (DNA replication)

b. V (protein synthesis)

c. VII (intracellular digestion)

d. III (rRNA synthesis)

e. I (photosynthesis)

f. V (protein synthesis)

g. II (lipid synthesis)