

# CHAPTER 2 Review

## Reviewing and Understanding Key Concepts

- What is the electric charge on each of the three subatomic particles in an atom?
  - a proton has no charge; an electron has a negative charge; a neutron has a positive charge
  - a proton has a negative charge; an electron has a positive charge; a neutron has no charge
  - a proton has a positive charge; an electron has no charge; a neutron has a negative charge
  - a proton has a positive charge; an electron has a negative charge; a neutron has no charge
- Which of the following is true about a potassium atom and a potassium ion?
  - They both have the same number of protons, but a different number of neutrons.
  - They both have the same number of neutrons, but a different number of protons.
  - They both have the same number of protons, but a different number of electrons.
  - They both have the same number of electrons, but a different number of protons.
- A substance that resists large changes in pH is known as
  - water.
  - a base.
  - an acid.
  - a buffer.
- When the pH of a solution rises from 9 to 12, how many times more basic has the solution become?
  - 3 times
  - 10 times
  - 100 times
  - 1000 times
- 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

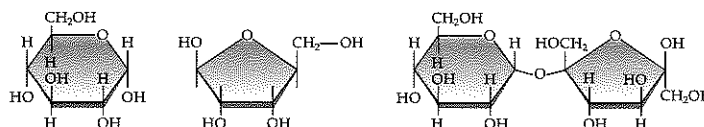
- Which of the following rows correctly describes a hydrophilic molecule and a hydrophobic molecule?

	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

- Which of the following lists a polymer with its corresponding monomer?
  - ATP and ribose
  - steroid and fatty acid
  - protein and amino acid
  - triglyceride and glycogen

- Which of the following reactions would result in the production of a water molecule?
  - the hydrolysis of a cellulose into glucose
  - the breakdown of maltose into two glucose molecules
  - the formation of a peptide bond between alanine and lysine
  - the formation of a hydrogen bond between two water molecules
- Which of the following is an example of a dehydration reaction?
  - the breakdown of starch into maltose
  - the formation of dipeptides from polypeptides
  - the digestion of sucrose into glucose and fructose
  - the conversion of monosaccharides into polysaccharides

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



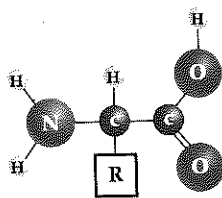
**Glucose**  
 $C_6H_{12}O_6$

**Ribose**  
 $C_5H_{10}O_5$

**Sucrose**  
 $C_{12}H_{22}O_{11}$

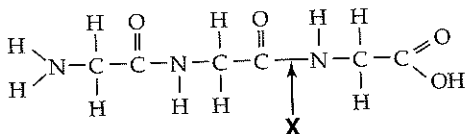
- These molecules are classified as
  - lipids.
  - steroids.
  - proteins.
  - carbohydrates.
- What do these three molecules have in common?
  - They are monomers for cellulose.
  - The ratio of carbon atoms to hydrogen atoms is 2:1.
  - They are structural components of the plant cell wall.
  - They have twice as many hydrogen atoms as oxygen atoms.
- The bonding of glucose and ribose would result in a
  - dipeptide.
  - triglyceride.
  - disaccharide.
  - polysaccharide.
- How many water molecules are needed during the hydrolysis of a triglyceride resulting in three fatty acids and a glycerol molecule?
  - 1
  - 2
  - 3
  - 4
- Compared to saturated fats, unsaturated fats contain more
  - single bonds.
  - double bonds.
  - hydrogen atoms.
  - adjacent fused rings.
- What feature distinguishes a phospholipid from a triglyceride?
  - the steroid
  - the fatty acid
  - the phosphate group
  - the glycerol molecule
- Which of the following molecules can be converted into the female sex hormone estrogen?
  - glycerol
  - cholesterol
  - ribonucleic acid
  - 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?
- stores genetic information
  - speeds up chemical reactions
  - serves as an energy source for the cell
  - provides a fluid consistency in the plasma membrane
18. An example of a substance that could be produced from this molecule is
- ATP.
  - keratin.
  - glycerol.
  - 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?
- starch
  - insulin
  - glycogen
  - a triglyceride

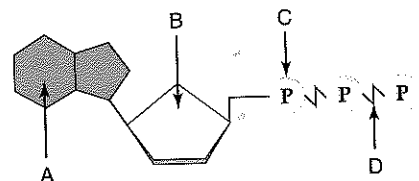
Use the following diagram to answer questions 20 to 25.



20. Identify bond X.
- an ionic bond
  - a peptide bond
  - a hydrogen bond
  - a phosphodiester bond
21. What component of the subunits of this molecule makes it unique from the other subunits?
- the R group
  - the acid group
  - the amino group
  - the central carbon
22. What does the "H" attached to the central carbon represent?
- glycerol
  - R group
  - fatty acid
  - acidic group
23. What will the hydrolysis of this molecule produce?
- nucleotides
  - amino acids
  - glucose molecules
  - glycerol, a phosphate group, and two fatty acids
24. How many monomers are present in this molecule?
- 2
  - 3
  - 4
  - 5
25. What type of bonding between the subunits of this molecule is responsible for the alpha helix structure?
- ionic bonding
  - peptide bonding
  - covalent bonding
  - hydrogen bonding

26. The primary structure of a protein is determined by
- the linear sequence of amino acids.
  - the ionic bonding between the R groups.
  - the interaction between two polypeptides.
  - the hydrogen bonding between adjacent amino acids.
27. Two proteins have different functions because they are polypeptide chains that are
- folded in the same way and have the same secondary structure.
  - folded differently due to the hydrogen bonding and have a different sequence of amino acids.
  - folded in the same three dimensional configuration and have the same sequence of amino acids.
  - 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?
- energy is released
  - another phosphate bond is added to adenosine
  - the bond between adenine and ribose is broken
  - a molecule of inorganic phosphate is added to the molecule
29. What element is present in ATP, but not in a triglyceride?
- carbon
  - oxygen
  - hydrogen
  - phosphorus

Use the following diagram to answer questions 30 to 32.



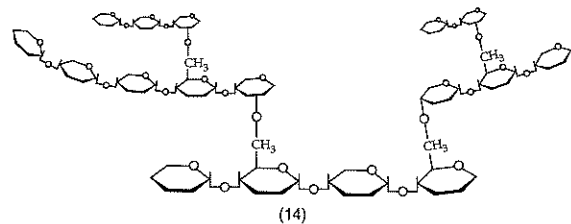
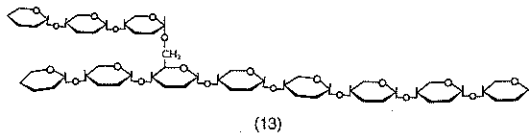
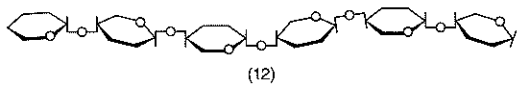
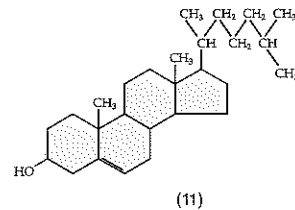
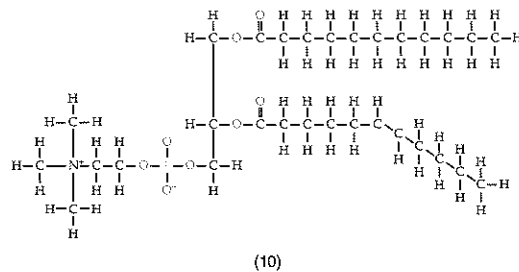
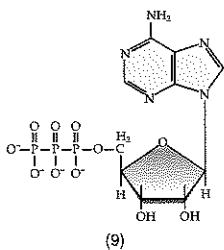
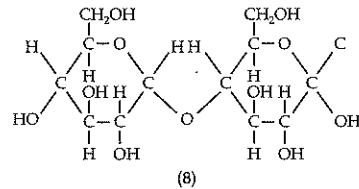
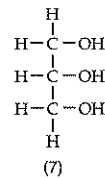
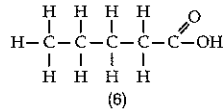
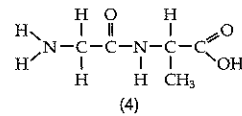
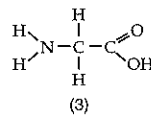
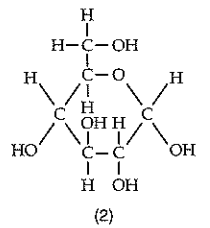
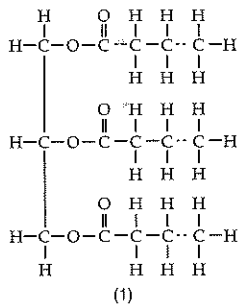
30. This molecule represents a
- nucleotide.
  - triglyceride.
  - nucleic acid.
  - nitrogenous base.
31. What is structure B?
- glycerol
  - a steroid
  - a polysaccharide
  - a monosaccharide
32. What other biological molecule has structure B?
- DNA
  - RNA
  - cellulose
  - glycogen
33. The element that is present in RNA and a protein but not in starch is
- carbon.
  - oxygen.
  - nitrogen.
  - hydrogen.
34. Which of the following does not have hydrogen bonding?
- RNA
  - DNA
  - an alpha helix of a protein
  - a pleated sheet of a polypeptide chain
35. The components of a nucleotide may include
- a glycerol molecule and three fatty acid chains.
  - a phosphate group, a nitrogenous base, and a ribose sugar.
  - a nitrogenous base, a glucose molecule, and a fatty acid chain.
  - 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

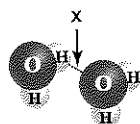
40. Match the following structures to the corresponding descriptions of biological molecules. There may be more than one answer for each description.

- |  |   |   |
|--|---|---|
| a. building block of a phospholipid              | g. provides structural support in the plant cell wall   | l. molecule that contains an amino group and an acidic group                |
| b. monomer of collagen and keratin               | h. monosaccharide that is a primary energy source       | m. molecule that is the major storage form of energy in animal cells        |
| c. molecules classified as carbohydrates         | i. molecule produced during dehydration reaction        | n. molecule that has already undergone at least one dehydration reaction    |
| d. precursor to testosterone and progesterone    | j. forms lipid bilayer of the plasma membrane of a cell | o. molecule that is the building block for hemoglobin, insulin, and trypsin |
| e. provides long-term energy storage in plants   | k. energy molecule produced during cellular respiration | p. inorganic molecule responsible for most chemical reactions in the body   |
| f. found in both phospholipids and triglycerides |   |   |



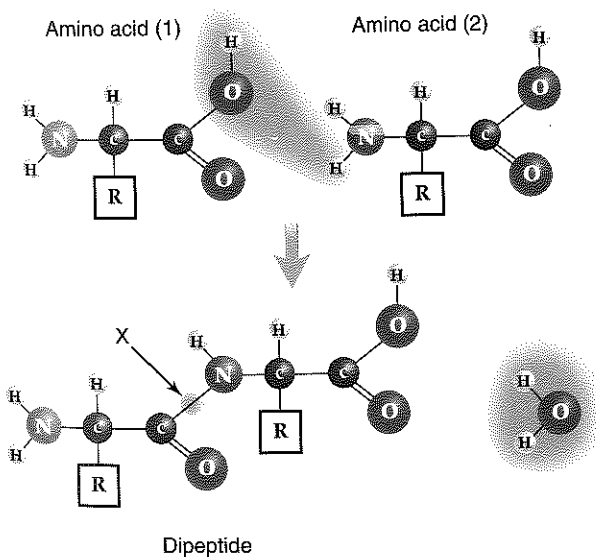
- Explain how an atom consists of charged subatomic particles, but is neutral.
- The saying "opposites attract" can be used to describe static electricity. How can this saying also be used to explain the attractive forces between water molecules?
- The strong acid hydrogen chloride can be dissolved in water. What will happen to the pH of the solution?

Use the following diagram to answer questions 44 to 48.



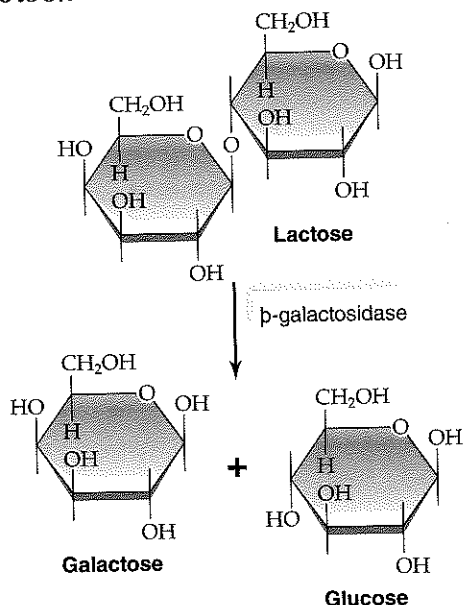
- What is bond X?
  - Why does bond X form between these two molecules?
  - Describe three functions of the molecules shown in the diagram.
  - What accounts for the polarity within these molecules?
  - What do the positive and negative charges on the molecules allow the molecule to act as?
- Explain why runners eat meals with large quantities of carbohydrates a few days before a marathon?
  - 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.



- What biological process is illustrated above?
- Identify bond X.
- What molecules will form as a result of this reaction?
- 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.



- What is lactose classified as?
  - What molecule is required for this reaction to occur?
  - What process is illustrated above?
- Explain the saying "water and oil do not mix."
  - How are the following terms associated with each other?
    - DNA and protein
    - nucleic acid and nucleotide
    - monosaccharide and polysaccharide
    - polypeptide and peptide bond
    - hydrogen bonding and secondary structure of a protein
    - polarity in water molecules and cohesion
  - Distinguish between the following terms.
    - glycerol and fatty acid
    - phospholipid and triglyceride
    - hydrogen bond and peptide bond
    - unsaturated fatty acid and saturated fatty acid
  - What advantage does each of the following characteristics of polymers have for the cell? Give an example.
    - A polysaccharide is formed using the same kind of dehydration reaction to add successive glucose subunits.
    - The bonds between monomers are broken by the addition of water and are formed by the removal of water.
  - 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.
  - When a mixture of phospholipids and water is shaken, why do the phospholipids spontaneously assemble into vesicles surrounded by a lipid bilayer?
  - 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			

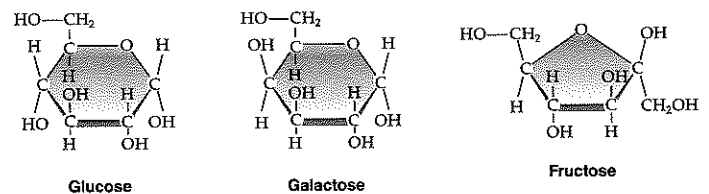
77. Complete the following table comparing the three types of carbohydrates.

	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?			

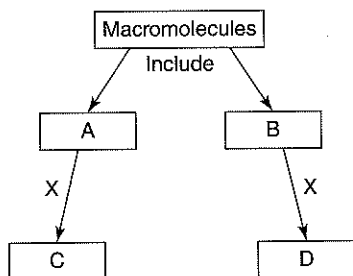
Use the following diagrams of glucose, galactose and fructose to answer question 80.



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.
- Identify A, B, C, D, and X.
  - What molecule would form if two units of molecule D underwent a dehydration reaction?
  - Name two other polymers that can be formed by molecule D?

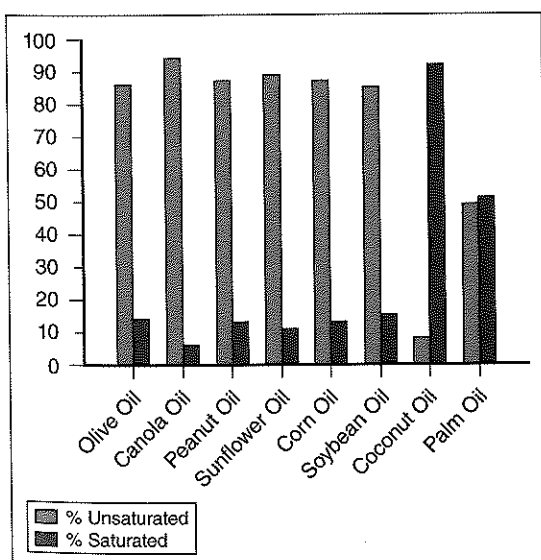
Use the following information to answer questions 84 and 85.

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.
- Describe how this type of diet could result in weight loss.
  - 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.
- two amino acid molecules from a dipeptide
  - a disaccharide from two molecules of glucose
  - 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, monosaccharides, nucleotide, nucleotides, proteins, polysaccharides, triglycerides, peptides, phosphate groups, RNA.

