

## Chapter 2 – The Molecules of Cells

*Complete using BC Biology 12, pages 20 - 61*

### 2.1 Basic Chemistry

pages 24 -26

1. Only \_\_\_\_\_<sup>(a)</sup> naturally occurring elements serve as the building blocks of all matter. Other elements have been “ \_\_\_\_\_<sup>(b)</sup> and are not biologically important. Only six elements are basic to life and make up about \_\_\_\_\_<sup>(c)</sup> of the body weight of organisms. The elements are \_\_\_\_\_<sup>(d)</sup>, \_\_\_\_\_<sup>(e)</sup>, \_\_\_\_\_<sup>(f)</sup>, \_\_\_\_\_<sup>(g)</sup>, \_\_\_\_\_<sup>(h)</sup>, and \_\_\_\_\_<sup>(i)</sup> which can be remembered with the acronym \_\_\_\_\_<sup>(j)</sup>.
2. Of the top six elements, which element is the **most** prevalent in organisms? \_\_\_\_\_
3. Explain how radiation can be both beneficial and harmful to humans. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### 2.2 Molecules and Compounds

pages 26 - 29

4. Where do we get the energy to carry on our daily lives? \_\_\_\_\_  
 \_\_\_\_\_
5. In biological systems, because they are \_\_\_\_\_<sup>(a)</sup> % water, \_\_\_\_\_<sup>(b)</sup> compounds exist primarily in a \_\_\_\_\_<sup>(c)</sup> state (they are \_\_\_\_\_<sup>(c)</sup>).
6. Molecules made up of only two atoms are always \_\_\_\_\_<sup>(a)</sup> while molecules with more than two atoms have a \_\_\_\_\_<sup>(b)</sup> shape. The shapes of molecules are related to the \_\_\_\_\_<sup>(c)</sup> and \_\_\_\_\_<sup>(d)</sup> roles they play in organisms.
7. Name three molecules that rely on their shape to function properly.
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
8. Give an example of a(n)
  - non-polar covalent molecule: \_\_\_\_\_
  - polar covalent molecule: \_\_\_\_\_
9. Weaker than an ionic or covalent bond, a \_\_\_\_\_<sup>(a)</sup> bond is represented by a dotted line. Hydrogen bonding is NOT unique to water. Many biological molecules have polar covalent bonds involving and \_\_\_\_\_<sup>(b)</sup> hydrogen and an \_\_\_\_\_<sup>(c)</sup> oxygen or nitrogen.
10. Using a specific example, explain how the weakness of an individual hydrogen bond and the strength of numerous hydrogen bonds are utilized by organisms. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

11. Use three words or phrases to describe water:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

12. Draw a picture showing the polarity of a water molecule and hydrogen bonding between water molecules.

### Properties of Water

13. Name the six properties of water that make it essential to the existence of life. Then explain the importance of each of the properties as it relates to the survival of an organism.

- a) \_\_\_\_\_ : \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- b) \_\_\_\_\_ : \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- c) \_\_\_\_\_ : \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- d) \_\_\_\_\_ : \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- e) \_\_\_\_\_ : \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- f) \_\_\_\_\_ : \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

14. Match the terms on the left to their correct description on the right.

- |                     |   |
|---------------------|---|
| ___ calorie         | A. result of cohesive forces  |
| ___ solute          | B. molecules that can attract water (“water loving”)                  |
| ___ hydrophilic     | C. property of different molecules or surfaces clinging to each other |
| ___ hydrophobic     | D. amount of heat energy needed to raise 1g of water by 1°C           |
| ___ cohesive        | E. the dissolved substances contained in a solution                   |
| ___ adhesive        | F. like molecules sticking to each other                              |
| ___ surface tension | G. molecules that cannot attract water (“water fearing”)              |

## Acids and Bases

15. Acids are substances that \_\_\_\_\_ when they dissociate in water.

- Example: \_\_\_\_\_

16. Bases are substances that either \_\_\_\_\_ or \_\_\_\_\_.

- Example: \_\_\_\_\_

17. What would the pH be of the following  $[H^+]$  (moles per litre)?

- $0.1 = 1 \times 10^{-1} = \text{pH}$  \_\_\_\_\_
- $0.0001 = 1 \times 10^{-4} = \text{pH}$  \_\_\_\_\_
- $0.000000001 = 1 \times 10^{-9} = \text{pH}$  \_\_\_\_\_

18. What is a **buffer**? \_\_\_\_\_

19. The pH of our blood when we are healthy is always about \_\_\_\_\_<sup>(a)</sup>. If the blood pH drops to about \_\_\_\_\_<sup>(b)</sup> then \_\_\_\_\_<sup>(c)</sup> results. If the blood pH rises to about \_\_\_\_\_<sup>(d)</sup> then \_\_\_\_\_<sup>(e)</sup> results. Both conditions can be \_\_\_\_\_<sup>(f)</sup>.

20. Show the formula for one of the buffer systems used by the body to keep blood pH in balance.

21. Why is a weakly dissociating acid/base a better buffer than a strongly dissociating one? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## 2.4 Organic Molecules

pages 32 - 33

22. Organic molecules always contain \_\_\_\_\_ and \_\_\_\_\_. Carbon atom has \_\_\_\_\_ electrons in its outer shell which it can share \_\_\_\_\_ with as many as \_\_\_\_\_ other atoms.

23. Define the following:

- **functional group**: \_\_\_\_\_
- **macromolecule**: \_\_\_\_\_
- **monomer**: \_\_\_\_\_
- **polymer**: \_\_\_\_\_

24. Complete the table below.

Polymer	Monomer
carbohydrate	
lipid	
protein	
nucleic acid	

25. Diagram of **dehydration synthesis** and **hydrolysis** (*wait for simplified teacher diagram*)

2.5 Carbohydrates

pages 34 - 35

26. The main functions of carbohydrates:

- \_\_\_\_\_ fuel
- \_\_\_\_\_ energy storage
- \_\_\_\_\_ in woody plants, bacteria, and animals such as insects.
- \_\_\_\_\_ (some found on cell surface)

27. Characterized by the presence of atomic grouping \_\_\_\_\_<sup>(a)</sup> and the empirical formula **CH<sub>2</sub>O** which is why the term “\_\_\_\_\_”<sup>(b)</sup> is often used.

28. Three ways to represent the structure of glucose (textbook figure 2.12)

29. If the number of carbon atoms in a molecule is low (from \_\_\_\_\_)<sup>(a)</sup> then the carbohydrate is a \_\_\_\_\_<sup>(b)</sup> which is also known as a \_\_\_\_\_<sup>(c)</sup>.

- 5-carbon sugar = \_\_\_\_\_
- 6-carbon sugar = \_\_\_\_\_
  1. \_\_\_\_\_ (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>, blood sugar)
  2. \_\_\_\_\_ (found in fruits)
  3. \_\_\_\_\_ (found in milk)

30. A \_\_\_\_\_ contains two monosaccharides that have joined during a \_\_\_\_\_ reaction

1. glucose + glucose → \_\_\_\_\_
2. glucose + fructose → \_\_\_\_\_
3. glucose + galactose → \_\_\_\_\_

31. Diagram of two monosaccharides forming disaccharide (textbook figure 2.13)

32. Carbohydrates that contain many glucose subunits are referred to as \_\_\_\_\_.

- \_\_\_\_\_ and \_\_\_\_\_ are large storage forms of glucose found in plants and animals.
- \_\_\_\_\_ is found in plant cell walls
- \_\_\_\_\_ is found in the exoskeleton of crustaceans and insects.

33. Match the terms on the left to their correct descriptions on the right.

\_\_\_ & \_\_\_ starch

\_\_\_ & \_\_\_ glycogen

\_\_\_ & \_\_\_ cellulose

A. indigestible by humans, often referred to as dietary fibre

B. non-branched or slightly branched

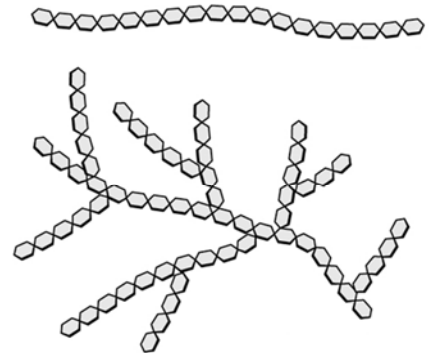
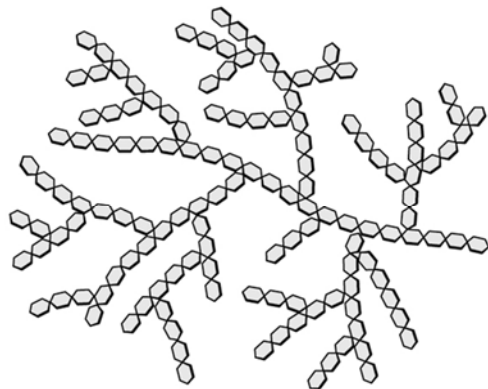
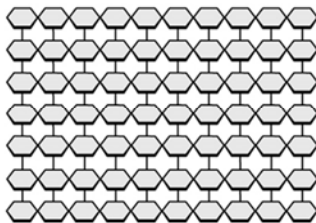
C. high amounts found in flour and potatoes

D. alternating up/down pattern of oxygen atoms between the glucose molecules

E. highly branched

F. created by the liver when the blood glucose levels rise above 0.1%

34. Identify each of the following as either **starch**, **glycogen**, or **cellulose**.



## 2.6 Lipids

pages 36 - 37

35. The main functions of lipids:

- Contain more \_\_\_\_\_ per gram (long term)
- \_\_\_\_\_ molecules
- \_\_\_\_\_ form the cell membrane
- \_\_\_\_\_, includes many types of hormones
- \_\_\_\_\_ against heat loss
- Forms a \_\_\_\_\_ around major organs

36. All lipids \_\_\_\_\_<sup>(a)</sup> dissolve in water as they are \_\_\_\_\_<sup>(b)</sup>

37. 1 \_\_\_\_\_ molecule + 3 \_\_\_\_\_ molecules = \_\_\_\_\_ (neutral fat)

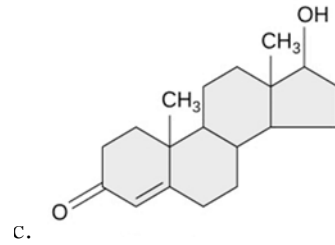
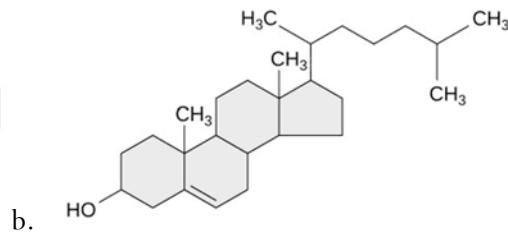
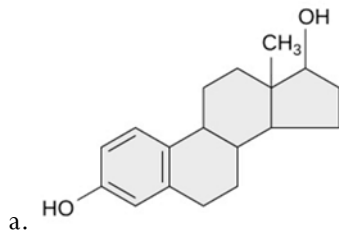
38. What is the difference between...

a) fats and oils?

b) saturated, unsaturated, and trans fats?

39. In a **phospholipid**, the third fatty acid is replaced by a \_\_\_\_\_<sup>(a)</sup>.  
 They differ from fats as they form a polar (\_\_\_\_\_)<sup>(b)</sup> head and a nonpolar  
 (\_\_\_\_\_)<sup>(c)</sup> tail.
40. How are all types of steroids the same? different? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

41. Identify the following steroids.



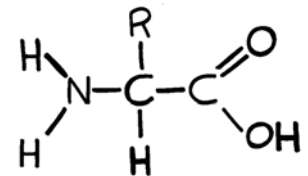
42. Though we often think that cholesterol is “bad” for us in our diet, our bodies require it in a balanced quantity.  
 What important functions does cholesterol serve?

2.7 Proteins

pages 37 - 41

43. Central \_\_\_\_\_ atom bonded to \_\_\_\_\_ atom and three functional groups:

- \_\_\_\_\_ (-NH<sub>2</sub>)
- \_\_\_\_\_ (-COOH)
- \_\_\_\_\_ (differs by amino acid, 20 possibilities)

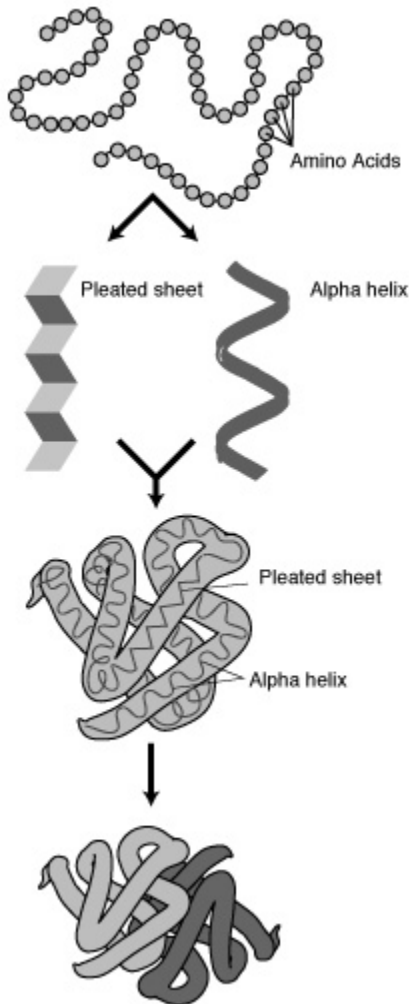


44. The main functions of proteins (the table on page 54 is very helpful)

- **Structural:** \_\_\_\_\_ (makes hair and nails) and \_\_\_\_\_ (lends support to ligaments, tendons, and skin)
- **Movement:** \_\_\_\_\_ & \_\_\_\_\_ (movement of cells and muscle contractions)
- **Transport:** in the plasma membrane they act as \_\_\_\_\_ or \_\_\_\_\_ to allow substances to cross. \_\_\_\_\_ (transports oxygen in red blood cells)
- **Catalytic:** \_\_\_\_\_ (speed up chemical reactions in the body)
- **Regulatory:** \_\_\_\_\_ (chemical messengers)
- **Defense:** \_\_\_\_\_ (prevent infections and therefore maintain homeostasis)

45. What characteristic influences the structure, or shape, of a protein? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

46. Proteins can have up to four levels of structural organization.



**Primary** structure: simple sequence of amino acids joined together by \_\_\_\_\_ bonds.

**Secondary** structure: \_\_\_\_\_ bonds pull amino acid chains into either **alpha helix** or **beta-pleated sheet**

**Tertiary** structure: is maintained by various types of bonding (hydrogen, ionic and covalent) among the \_\_\_\_\_. By virtue of the unique chemistry of each amino acid chain, kinks or bends occur and new bonds form holding into a specific 3D shape.

**Quaternary** structure: two or more tertiary structures associate together and function as a single unit. Examples include \_\_\_\_\_ and most \_\_\_\_\_

47. Proteins can differ in many ways including \_\_\_\_\_<sup>(a)</sup>, \_\_\_\_\_<sup>(b)</sup>, and \_\_\_\_\_<sup>(c)</sup> and chemical composition.

48. Define **denatured**: \_\_\_\_\_

- Possible causes: \_\_\_\_\_
- *Prion?* \_\_\_\_\_

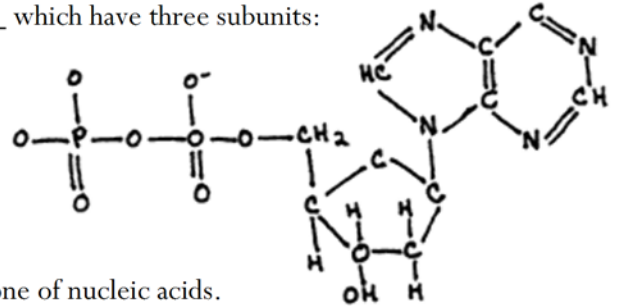
2.8 Nucleic Acids

49. The main functions of nucleic acids:

- \_\_\_\_\_
- \_\_\_\_\_

50. Nucleic acids are made up of \_\_\_\_\_ which have three subunits:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_



51. Write a **(B)** next to the two subunits that make up the backbone of nucleic acids.

52. Complete the table.

	DNA	RNA
<b>Full name</b>		
<b>Sugar</b>		
<b>Bases</b>		
<b>Strands</b>		
<b>Helix</b>		
<b>Function</b>		

53. Why are A, T, C, G, and U called “bases”? \_\_\_\_\_

\_\_\_\_\_

54. Explain the term **complementary base pairing** and why it is important. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

55. Draw two different complementary base pairs. (textbook Figure 2.25c)



56. ATP or \_\_\_\_\_ is known as the universal energy currency of the cells of living systems and can be used for the following types of work.

**Type**

**Example**

- \_\_\_\_\_ :
- \_\_\_\_\_ :
- \_\_\_\_\_ :

57. ATP is composed of

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

58. An input of energy is required to create ATP.

- Where does it come from? \_\_\_\_\_
- What is the reaction called? \_\_\_\_\_
- What percentage of the free energy is transformed into ATP? \_\_\_\_\_

59. Distinguish between an **endergonic** and an **exergonic reaction**. Use a diagram to help if needed.

**Chapter 2 Review Questions**

- |           |           |           |           |
|-----------|-----------|-----------|-----------|
| 1. _____  | 11. _____ | 21. _____ | 31. _____ |
| 2. _____  | 12. _____ | 22. _____ | 32. _____ |
| 3. _____  | 13. _____ | 23. _____ | 33. _____ |
| 4. _____  | 14. _____ | 24. _____ | 34. _____ |
| 5. _____  | 15. _____ | 25. _____ | 35. _____ |
| 6. _____  | 16. _____ | 26. _____ | 36. _____ |
| 7. _____  | 17. _____ | 27. _____ | 37. _____ |
| 8. _____  | 18. _____ | 28. _____ | 38. _____ |
| 9. _____  | 19. _____ | 29. _____ | 39. _____ |
| 10. _____ | 20. _____ | 30. _____ |           |

40. (a) \_\_\_\_\_ (b) \_\_\_\_\_ (c) \_\_\_\_\_ (d) \_\_\_\_\_ (e) \_\_\_\_\_ (f) \_\_\_\_\_  
 (g) \_\_\_\_\_ (h) \_\_\_\_\_ (i) \_\_\_\_\_ (j) \_\_\_\_\_ (k) \_\_\_\_\_ (l) \_\_\_\_\_  
 (m) \_\_\_\_\_ (n) \_\_\_\_\_ (o) \_\_\_\_\_ (p) \_\_\_\_\_

44. \_\_\_\_\_
45. \_\_\_\_\_
47. \_\_\_\_\_
49. \_\_\_\_\_
50. \_\_\_\_\_
51. \_\_\_\_\_
52. \_\_\_\_\_
53. \_\_\_\_\_
54. \_\_\_\_\_
55. \_\_\_\_\_
56. \_\_\_\_\_
57. \_\_\_\_\_
59. (a) \_\_\_\_\_
- (c) \_\_\_\_\_
- (f) \_\_\_\_\_
63. \_\_\_\_\_
- \_\_\_\_\_
66. (b) \_\_\_\_\_
72. \_\_\_\_\_
- \_\_\_\_\_
90. (a) \_\_\_\_\_
- \_\_\_\_\_
- (b) \_\_\_\_\_
91. \_\_\_\_\_
- \_\_\_\_\_

93.


*You must now MARK the review questions using the answer key on pages 524 – 526!*