

Study Guide

BIOCHEMISTRY:

THE COMPOSITION OF LIVING MATTER

Name: _____

14. Use key choices to identify the substances described in the following statements. Insert the appropriate letter(s) or corresponding term(s) in the answer blanks.

Key Choices

A. Acid(s) B. Base(s) C. Buffer D. Salt(s)

- _____ 1. _____ 2. _____ 3. Substances that ionize in water; good electrolytes
- _____ 4. Proton (H^+) acceptor
- _____ 5. Ionize in water to release hydrogen ions and a negative ion other than hydroxide (OH^-)
- _____ 6. Ionize in water to release ions other than H^+ and OH^-
- _____ 7. Formed when an acid and a base are combined
- _____ 8. Substances such as lemon juice and vinegar
- _____ 9. Prevents rapid/large swings in pH

15. Complete the following statements concerning the properties and biological importance of water.

- _____ 1. The ability of water to maintain a relatively constant temperature and thus prevent sudden changes is because of its high _____
- _____ 2. _____ (1). Biochemical reactions in the body must occur in _____ (2). About _____ (3) % of the volume of a living cell is water. Water molecules are bonded to other water molecules because of the presence of _____ (4) bonds. Water, as H^+ and OH^- ions, is essential in biochemical reactions such as _____ (5) and _____ (6) reactions. Because of its _____ (7), water is an excellent solvent and forms the basis of mucus and other body _____ (8).
- _____ 3.
- _____ 4.
- _____ 5.
- _____ 6.
- _____ 7.
- _____ 8.

16. Using the key choices, fully characterize weak and strong acids.

Key Choices

- A. Ionize completely in water
- B. Ionize incompletely in water
- C. Act as part of a buffer system
- D. When placed in water, always act to change the pH
- E. Ionize at high pH
- F. Ionize at low pH
- G. Ionize at pH 7

Weak acid: _____ Strong acid: _____

17. Use an X to designate which of the following are organic compounds.

- | | | | |
|----------------------|------------|----------------|------------------------|
| _____ Carbon dioxide | _____ Fats | _____ Proteins | _____ H ₂ O |
| _____ Oxygen | _____ KCl | _____ Glucose | _____ DNA |

18. Match the terms in Column B to the descriptions provided in Column A. Enter the correct letter(s) or term(s) in the answer blanks.

Column A	Column B
_____ 1. Building blocks of carbohydrates	A. Amino acids
_____ 2. Building blocks of fat	B. Carbohydrates
_____ 3. Building blocks of protein	C. Lipids (fats)
_____ 4. Building blocks of nucleic acids	D. Fatty acids
_____ 5. Cellular cytoplasm is primarily composed of this substance	E. Glycerol
_____ 6. The single most important fuel source for body cells	F. Nucleotides
_____ 7. Not soluble in water	G. Monosaccharides
_____ 8. Contain C, H, and O in the ratio CH ₂ O	H. Proteins
_____ 9. Contain C, H, and O, but have relatively small amounts of oxygen	
_____ 10. _____	11. These building blocks contain N in addition to C, H, and O
_____ 12. Contain P in addition to C, H, O, and N	
_____ 13. Used to insulate the body and found in all cell membranes	
_____ 14. Primary components of meat and cheese	
_____ 15. Primary components of bread and lollipops	
_____ 16. Primary components of egg yolk and peanut oil	

- _____ 17. Include collagen and hemoglobin
- _____ 18. Class that usually includes cholesterol

19. Using key choices, correctly select *all* terms that correspond to the following descriptions. Insert the correct letter(s) or their corresponding term(s) in the answer blanks.

Key Choices

- | | | | |
|----------------|---------------|-------------|------------|
| A. Cholesterol | D. Enzyme | G. Hormones | J. Maltose |
| B. Collagen | E. Glycogen | H. Keratin | K. RNA |
| C. DNA | F. Hemoglobin | I. Lactose | L. Starch |

- _____ 1. Example(s) of fibrous (structural) proteins
- _____ 2. Example(s) of globular (functional) proteins
- _____ 3. Biologic catalyst
- _____ 4. Plant storage carbohydrate
- _____ 5. Animal storage carbohydrate
- _____ 6. The "stuff" of the genes
- _____ 7. A steroid
- _____ 8. Double sugars, or disaccharides

20. Five simplified diagrams of biological molecules are depicted in Figure 2-4. First, identify the molecules and insert the correct names in the answer blanks on the figure. Then select a different color for each molecule listed below and use them to color the coding circles and the corresponding molecules on the illustration.

- | | | |
|--|--------------------------------------|--------------------------------------|
| <input type="radio"/> Fat | <input type="radio"/> Nucleotide | <input type="radio"/> Monosaccharide |
| <input type="radio"/> Functional protein | <input type="radio"/> Polysaccharide | |

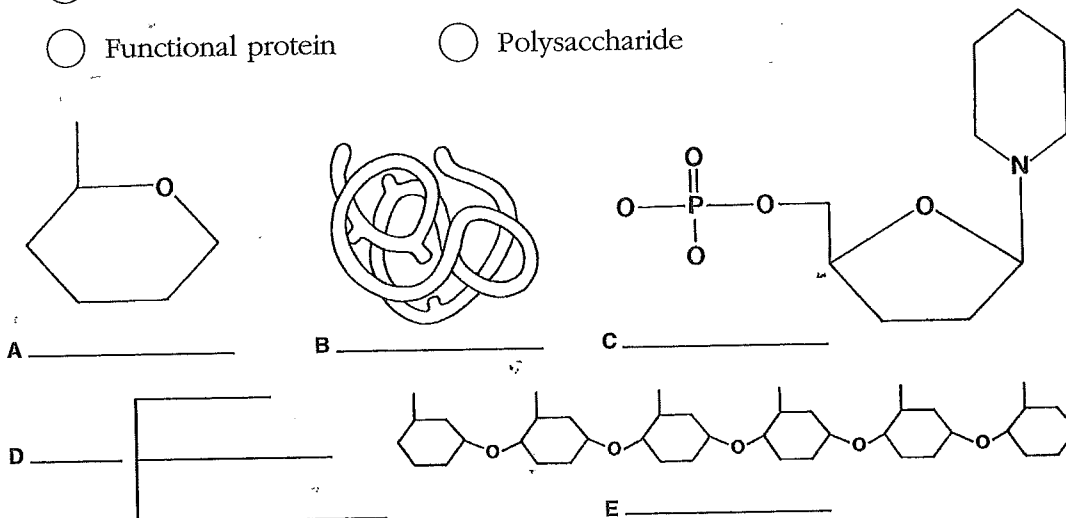


Figure 2-4

21. Circle the term that does not belong in each of the following groupings.

- | | | | |
|---------------|-------------|-----------|-------------|
| 1. Adenine | Guanine | Glucose | Thymine |
| 2. DNA | Ribose | Phosphate | Deoxyribose |
| 3. Galactose | Glycogen | Fructose | Glucose |
| 4. Amino acid | Polypeptide | Glycerol | Protein |
| 5. Glucose | Sucrose | Lactose | Maltose |

22. For each true statement, insert 'T' in the answer blank. If any are false, correct the underlined term and insert your correction in the answer blank.

- _____ 1. Phospholipids are polarized molecules.
- _____ 2. Steroids are the major form in which body fat is stored.
- _____ 3. Water is the most abundant compound in the body.
- _____ 4. Nonpolar molecules are generally soluble in water.
- _____ 5. The bases of RNA are A, G, C, and U.
- _____ 6. The universal energy currency of living cells is RNA.
- _____ 7. RNA is single stranded.
- _____ 8. The four elements comprising over 90% of living matter are C, H, N, and Na.

23. Figure 2-5 shows the molecular structure of DNA, a nucleic acid.

- A. First, identify the two unnamed nitrogen bases and insert their correct names and symbols in the two blanks beside the color-coding circles.
- B. Complete the identification of the bases on the diagram by inserting the correct symbols in the appropriate spaces on the right side of the diagram.
- C. Select different colors and color the coding circles and the corresponding parts of the diagram.
- D. Label one d-R sugar unit and one P unit of the "backbones" of the DNA structure by inserting leader lines and labels on the diagram.
- E. Circle the associated nucleotide.

- | | | |
|---|------------------------------------|---------------------------------|
| <input type="radio"/> Deoxyribose sugar (d-R) | <input type="radio"/> Adenine (A) | <input type="radio"/> _____ () |
| <input type="radio"/> Phosphate (P) | <input type="radio"/> Cytosine (C) | <input type="radio"/> _____ () |

Then answer the questions following Figure 2-5 by writing your answers in the answer blanks.

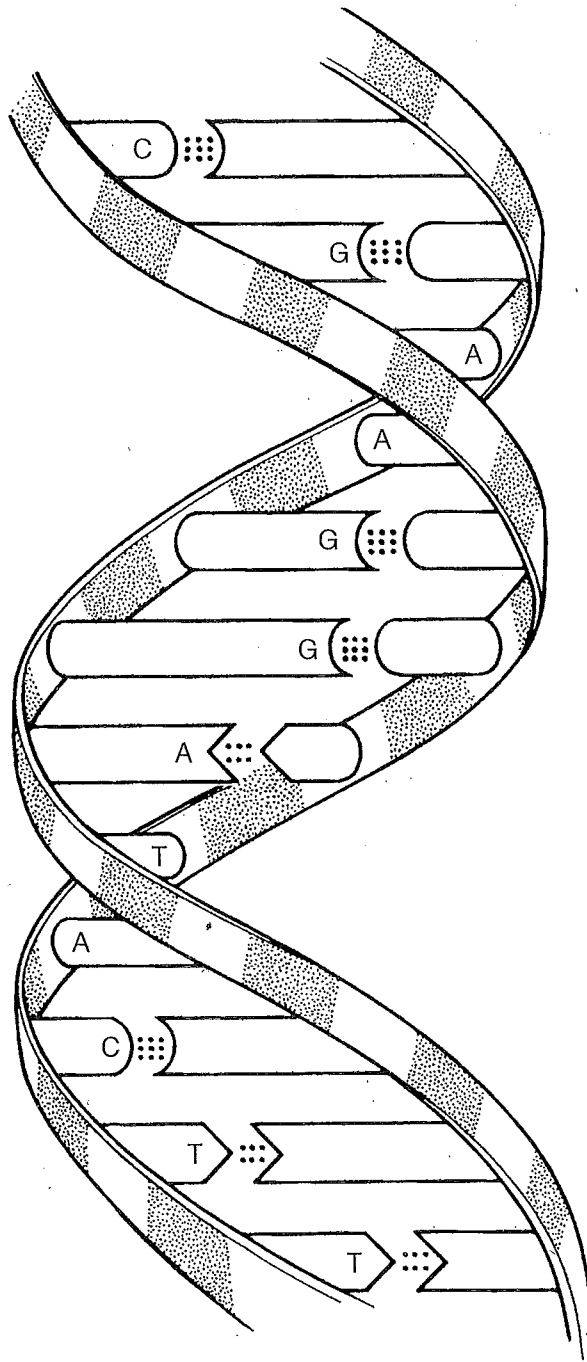


Figure 2-5

1. Name the bonds that help to hold the two DNA strands together. _____
2. Name the three-dimensional shape of the DNA molecule. _____
3. How many base-pairs are present in this segment of a DNA model? _____
4. What is the term that means "base-pairing"? _____

24. The biochemical reaction shown in Figure 2-6 represents the complete digestion of a polymer (a large molecule as consumed in food) down to its constituent monomers, or building blocks. Select two colors and color the coding circles and the structures. Then, select the one correct answer for each statement below and insert your answer in the answer blank.

Monomer

Polymer

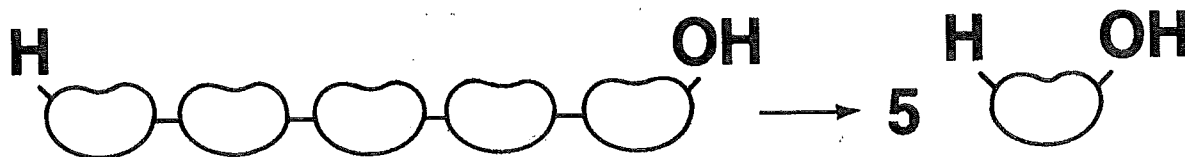


Figure 2-6

- _____ 1. If starch is the polymer, the monomer is:
- A. glycogen B. amino acid C. glucose D. maltose
- _____ 2. During polymer digestion, water as H^+ and OH^- ions would:
- A. be a product of the reaction.
- B. act as a catalyst.
- C. enter between monomers, bond to them, and keep them separated.
- D. not be involved in this reaction.
- _____ 3. Another name for the chemical digestion of polymers is:
- A. dehydration B. hydrolysis C. synthesis D. displacement
- _____ 4. If the monomers are amino acids, they may differ from each other by their:
- A. R group B. amino group C. acid group D. peptide bond



INCREDIBLE JOURNEY

A Visualization Exercise for Biochemistry

... you are suddenly up-ended and are carried along in a sea of water molecules at almost unbelievable speed.

25. Complete the narrative by inserting the missing words in the answer blanks.

- _____ 1. For this journey, you are miniaturized to the size of a very small molecule by colleagues who will remain in contact with you by radio. Your instructions are to play the role of a water molecule and to record any reactions that involve water molecules. Since water molecules are polar molecules, you are outfitted with an insulated rubber wet suit with one (1) charge at your helmet and two (2) charges, one at the end of each leg.
- _____ 2.
- _____ 3.
- _____ 4.
- _____ 5.
- _____ 6. As soon as you are injected into your host's bloodstream, you feel as though you are being pulled apart. Some large, attractive forces are pulling at your legs from different directions!
- _____ 7. You look about but can see only water molecules. After a moment's thought, you remember the polar nature of your wet suit. You record that these forces must be the (3) that are easily formed and easily broken in water.
- _____ 8.
- _____ 9.
- _____ 10. After this initial surprise, you are suddenly up-ended and carried along in a sea of water molecules at almost unbelievable speed. You have just begun to observe some huge, red, disk-shaped structures (probably (4)) taking up O₂ molecules, when you are swept into a very turbulent environment. Your colleagues radio that you are in the small intestine. With difficulty, because of numerous collisions with other molecules, you begin to record the various types of molecules you see.
- _____ 11.
- _____ 12.

In particular, you notice a very long helical molecule made of units with distinctive R-groups. You identify and record this type of molecule as a (5), made of units called (6) that are joined together by (7) bonds. As you move too close to the helix during your observations, you are nearly pulled apart to form two ions, (8), but you breathe a sigh of relief as two ions of another water molecule take your place. You watch as these two ions move between two units of the long helical molecule. Then, in a fraction of a second, the bond between the two units is broken. As you record the occurrence of this chemical reaction, called (9), you are jolted into another direction by an enormous globular protein, the very same (10) that controls and speeds up this chemical reaction.

Once again you find yourself in the bloodstream, heading into an organ identified by your colleagues as the liver. Inside a liver cell, you observe many small monomers, made up only of C, H, and O atoms. You identify these units as (11) molecules because the liver cells are bonding them together to form very long, branched polymers called (12). You record that this type of chemical

_____ 13. reaction is called (13), and you happily note that this reaction also produces (14) molecules like you!

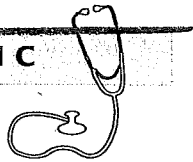
_____ 14.

_____ 15.

After another speedy journey through the bloodstream, you reach the skin. You move deep into the skin and finally gain access to a sweat gland. In the sweat gland, you collide with millions of water molecules and some ionized salt molecules

that are continually attracted to your positive and negative charges. Suddenly, the internal temperature rises, and molecular collisions (15) at an alarming rate, propelling you through the pore of the sweat gland onto the surface of the skin. So that you will be saved from the fate of evaporating into thin air, you contact your colleagues and are speedily rescued.

AT THE CLINIC



26. It is determined that a patient is in acidosis. What does this mean, and would you treat the condition with a chemical that would *raise* or *lower* the pH?

~~27. A newborn is diagnosed with sickle-cell anemia, a genetic disease in which substitution of one amino acid results in abnormal hemoglobin. Explain to the parents how the substitution can have such a drastic effect on the structure of the protein.~~

28. Johnny's body temperature is spiking upward. When it reaches 104°F, his mother puts in a call to the pediatrician. She is advised to give Johnny children's aspirin and sponge his body with cool to tepid water to prevent a further rise in temperature. How might a fever (excessively high body temperature) be detrimental to Johnny's welfare?

29. Mrs. Gallo's physician suspects that she is showing the initial signs of multiple sclerosis, a disease characterized by the formation of hardened plaques in the insulating sheaths surrounding nerve fibers. What medical imaging technique will the physician probably order to determine if such plaques are present?