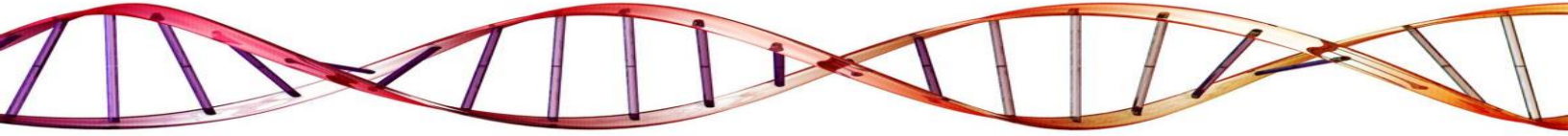




AP[®] Biology

Summer Assignment 2023-2024 Academic Year



Dear students:

Welcome to AP[®] Biology at IMG Academy! AP[®] Biology is a rigorous, fast-paced course. In order to keep up, you will invariably need to spend many hours diligently completing assignments and studying for quizzes and tests. Though your AP Biology teacher will be here for you each step of the way, you will need to develop skills as an independent learner to see the best success. While it is the hope that you will find lectures in class to be valuable, sometimes you will find you need to utilize additional resources to solidify your understanding of concepts.

Your summer assignment will introduce you to a resource that may be very helpful to you throughout the year as you study: Khan Academy. Khan Academy is the official practice partner for AP[®] Biology. As many IMG student athletes travel extensively throughout the school year for their sport, it is valuable to have resources available that can make up for missed lectures in class. Khan Academy is your best resource for these circumstances and you may continue to find this resource to be helpful even when you have not been absent.

1. Your first task will be to create an account on the Khan Academy website so you may track your progress through the AP[®] Biology learning modules. If you already have an account on Khan Academy, you may skip this step. Visit the following link to get started: <https://www.khanacademy.org/science/ap-biology>
2. The first part of your summer assignment is to complete the **Chemistry of Life** learning module on the Khan Academy AP[®] Biology website. This module corresponds to chapters 3-5 of our textbook. Using what you've learned on Khan Academy, you will then complete the questions found in this packet. We will review this material and have two quizzes within the first two weeks of class. It is recommended that you complete this assignment within the month leading up to the start of the school year, so the information is fresh in your brain! Make sure to give yourself enough time to complete this assignment accurately as it will be your first AP Biology grade of the year. Be sure to look up any vocabulary terms you don't understand as you work.
3. To submit the AP[®] Biology summer assignment you will need to create an account on goformative.com using the join code provided below. This account will be utilized throughout the year to submit a variety of assignments, so do not forget your password. The document below has been uploaded into goformative for you to view and select your answer choices. Please **ONLY press the submit button when you have completed the assignment and ready to turn it in.**

Goformative join/class code: 93K2DC

This completed summer assignment packet is due through goformative.com on Monday August 30th at 6pm.

Sincerely,

Mrs. Kretzmann

Cecily.Kretzmann@img.education

STRUCTURE OF WATER AND HYDROGEN BONDING

1. Which of the following best describes why water is classified as a polar molecule?
 - a. Water is found nearly everywhere at the earth's surface, including both polar, subtropical, and tropical regions.
 - b. Water molecules have the ability to create bonds with other water molecules as well as different types of molecules through the forces of cohesion and adhesion.
 - c. If a water molecule is split apart, it can form both H^+ and OH^- ions that affect a solution's pH value.
 - d. The unequal sharing of electrons between hydrogen and oxygen atoms results in a partial positive charge at one end of a water molecule and a partial negative charge at the other end of the water molecule.
2. Which type of bond binds one oxygen and two hydrogen atoms together within a water molecule?
 - a. Polar covalent bond
 - b. Hydrogen bond
 - c. Ionic bond
 - d. James Bond
3. Which of the following options best explains how the phenomenon known as surface tension arises among water molecules?
 - a. The force of cohesion between neighboring water molecules is stronger than the force of adhesion between water molecules and air molecules at the surface of an aqueous solution.
 - b. The force of adhesion between neighboring water molecules is stronger than the force of cohesion between water molecules and air molecules at the surface of an aqueous solution.
 - c. The force of cohesion between neighboring water molecules is weaker than the force of adhesion between water molecules and air molecules at the surface of an aqueous solution.
 - d. The force of adhesion between neighboring water molecules is weaker than the force of cohesion between water molecules and air molecules at the surface of an aqueous solution.
4. Which of the following statements describes why ice floats on liquid water?
 - a. Ice has a lower specific heat than liquid water.
 - b. Ice has a higher specific heat than liquid water.
 - c. Ice has a greater density than liquid water.
 - d. Ice has a lower density than liquid water.
5. Aqueous solutions have which property in common?
 - a. They require a nonpolar substance as a solvent.
 - b. They are made of solutes with low pH values.
 - c. They use water as the main solute.
 - d. They employ water as a solvent.

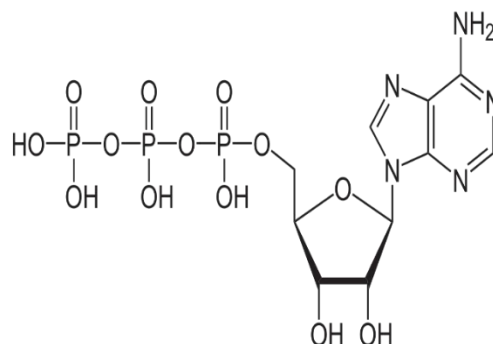
CRITICAL THINKING

6. Tropical climates with greater humidity typically experience relatively small daily variances in temperature. Meanwhile, it is fairly common in desert climates for daytime temperatures to be much hotter than nighttime temperatures. Explain why, using any relevant vocabulary terms. (2 points)

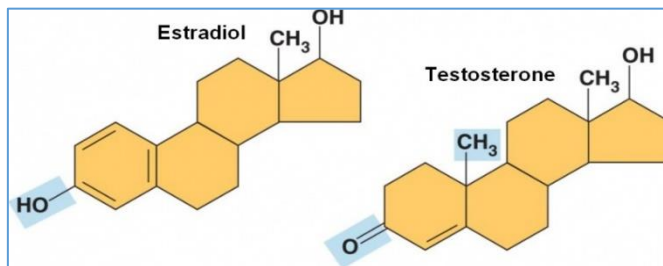
ELEMENTS OF LIFE

7. How many electrons are present in a carbon atom's outermost (valence) shell?
a. One b. Two c. Four d. Six
8. A carbon atom is most likely to form which type of bond with other atoms?
b. Ionic b. Covalent c. Hydrogen d. Disulfide
9. Which of the following elements is NOT a primary component of living organisms?
a. Helium c. Hydrogen
b. Oxygen d. Nitrogen

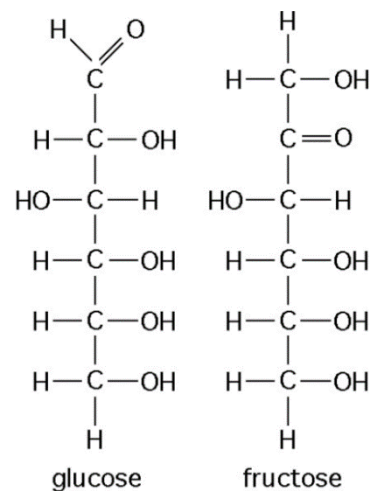
The molecule shown to the right is called adenosine triphosphate, otherwise known as ATP. ATP is considered the energy currency of cells. Examine the structure of ATP and answer the following two questions:



10. How many phosphate functional groups are present in an ATP molecule?
a. One b. Two c. Three d. Four
11. How many amino functional groups are present in ATP?
a. One b. Two c. Three d. Four
12. Which of the following elements are found in hydrocarbons, such as fossil fuels?
a. Water and carbon b. Oxygen and carbon c. Hydrogen and carbon d. Water and oxygen
13. Hydrocarbons are insoluble in water. Which of the following options best explains why?
a. They do not contain phosphorus or sulfur. c. They store energy in their many C-H bonds
b. They contain many hydrophilic functional groups d. They contain many nonpolar functional groups
14. Examine the structures of estradiol and testosterone, two key hormones found in the human body. Which type of functional group is present in testosterone, but absent in estradiol?
a. Hydroxyl c. Methyl
b. Sulfhydryl d. Carbonyl



15. The structures of glucose (blood sugar) and fructose (fruit sugar) are shown in the diagrams to the right. These two types of molecules differ from one another in what way?
a. Molecular formula
b. Number of carbon, hydrogen, and oxygen atoms
c. Arrangement of carbon, hydrogen, and oxygen atoms
d. Number of oxygen atoms joined to carbon atoms by double bonds



INTRODUCTION TO BIOLOGICAL MACROMOLECULES

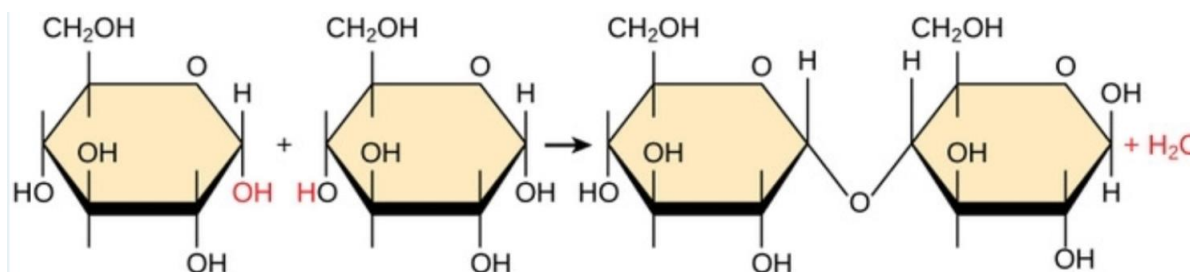
16. The molecular formula for glucose is $C_6H_{12}O_6$. What would be the molecular formula for a polymer made by linking twenty glucose molecules together through dehydration synthesis?

a. $C_{120}H_{240}O_{120}$

b. $C_{120}H_{239}O_{119}$

c. $C_{120}H_{221}O_{101}$

d. $C_{120}H_{202}O_{101}$



17. Examine the figure above. Which type of chemical reaction does it show?

a. Hydrolysis of a polymer

c. Dehydration synthesis of a polymer

b. Ionic bonding of two monomers

d. Formation of disulfide bridges between monomers

18. How many molecules of water are needed to completely hydrolyze a polymer that is 8 monomers long?

a. 1

b. 5

c. 7

d. 8

19. Which of the following molecules is most likely to be directly involved with speeding up a chemical reaction in a living cell?

a. Starch

b. Luciferase

c. Phosphate

d. Sulfhydryl

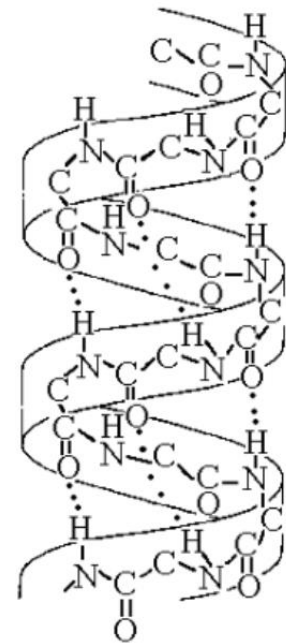
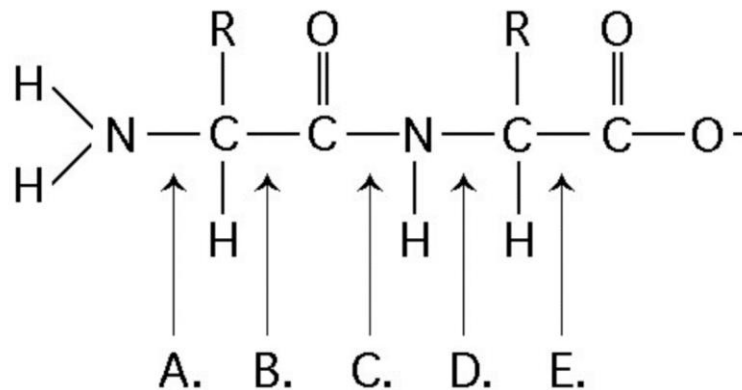
PROPERTIES, STRUCTURE, AND FUNCTION OF BIOLOGICAL MACROMOLECULES

20. Complete the following chart comparing the four classes of macromolecules:

Macromolecule:	Carbohydrates	Lipids	Proteins	Nucleic Acids
2 Notable Examples:				
Key Function(s):				
Monomer name:				

21. Which of the following groups of molecules is not known to contain nitrogenous elements?
- Monosaccharides
 - Amino acids
 - Nucleic acids
 - Proteins
22. Which term includes all others in the list?
- Pentose sugars
 - Starches
 - Carbohydrates
 - Monosaccharides
23. Lactose, a sugar in milk, is made of one galactose molecule that is linked to one glucose molecule through a glycosidic linkage. Thus, lactose is classified as a:
- Pentose
 - Hexose
 - Disaccharide
 - Polysaccharide
24. Which of the following is true of both starch and cellulose?
- They are both polymers composed of glucose monomers.
 - They are cis/trans isomers of one another.
 - They can both be readily digested by humans for energy.
 - They are both formed in the human body for long term energy storage.
25. For this pair of items, choose the option that best describes their relationship:
- (A) The number of double bonds in saturated fatty acids
(B) The number of double bonds in unsaturated fatty acids
- Item (A) is greater than item (B)
 - Item (A) is less than item (B)
 - Item (A) is exactly or very approximately equal to item (B)
 - Item (A) may stand in more than one of the above relations to item (B)
26. Three molecules of a fatty acid with the formula $C_{16}H_{32}O_2$ are joined to one molecule of glycerol with the formula $C_3H_8O_3$. The resulting triglyceride structure would have what formula?
- $C_{48}H_{96}O_6$
 - $C_{48}H_{98}O_9$
 - $C_{51}H_{102}O_8$
 - $C_{51}H_{98}O_6$
27. A molecule with the formula $C_{18}H_{36}O_2$ would most likely be a:
- Polysaccharide
 - Fatty acid
 - Protein
 - Starch
28. Which of the following statements about lipids is FALSE?
- They are extremely hydrophilic.
 - They include waxes and steroids.
 - They are insoluble in aqueous solutions.
 - They are important constituents of cell membranes.
29. Each of the following would contain amino acids EXCEPT:
- Hemoglobin
 - Cholesterol
 - Antibodies
 - Lactase
30. The formation of a peptide bond to form a larger molecule would require the:
- addition of a water molecule
 - release of a water molecule
 - addition of a carboxyl group
 - release of a nitrogen molecule
31. Polysaccharides, lipids, proteins, and nucleic acids are similar in that they:
- are synthesized from monomers by the process of hydrolysis.
 - are synthesized from monomers by dehydration reactions.
 - are synthesized as a result of peptide bond formation between monomers.
 - all contain nitrogen in their monomer building blocks.
32. A given polypeptide is known to contain 84 amino acids. How many peptide bonds are present in this protein?
- 41
 - 42
 - 83
 - 84

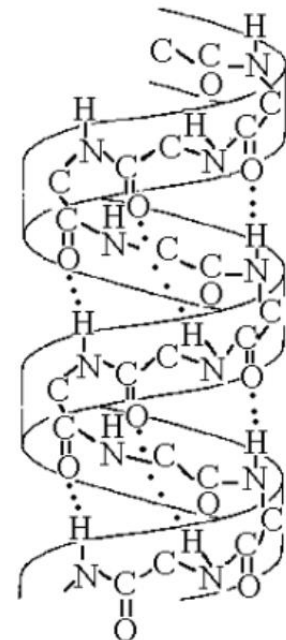
33. What do alpha helices and beta sheets in protein structure have in common?
- They are composed of monomers known as nucleotides
 - They form due to hydrogen bonding between atoms of the polypeptide chain
 - They are part of a protein's primary structure
 - They form due to an association of two or more polypeptides



Examine the molecule shown above. Use your understanding of the molecule to answer questions 35-39.

34. At which bond would water need to be added to achieve hydrolysis of this polymer into its monomers?
- A
 - B
 - C
 - D
35. Which bond is closest to the N-terminus of the molecule?
- A
 - B
 - C
 - D
36. What is the name of the type of bond indicated by the arrow indicated by C.?
- Peptide bond
 - Glycosidic bond
 - Hydrogen bond
 - Phosphodiester bond
37. How many monomers are present in the molecule?
- 1
 - 2
 - 3
 - 4
38. In order for the bond to have formed at the arrow indicated by C., which type of atom or molecule was removed from the structure?
- Carbon
 - Hydroxyl
 - Water
 - Nitrogen
39. What is depicted by the structure shown to the right? →
- The double helix structure of a DNA molecule
 - The alpha helix structure of a protein
 - The beta-pleated sheet structure of a protein
 - 1-4 linkage of the alpha glucose monomers of a starch molecule

40. A gene stores hereditary information. Thus, a gene is an example of a molecule from which class?
- Carbohydrate
 - Lipid
 - Protein
 - Nucleic acid



41. For this pair of items, choose the option that best describes their relationship.

- (A) The number of purines in the DNA strand 5'-AAGAGGAGAAA-3'
 (B) The number of pyrimidines in the DNA strand 5'-AAGAGGAGAAA-3'

- Item (A) is greater than item (B)
- Item (A) is less than item (B)
- Item (A) is exactly or very approximately equal to item (B)
- Item (A) may stand in more than one of the above relations to item (B)

42. Which of these descriptions accurately matches the 5' end of a polynucleotide strand of RNA?

- The 5' end has a phosphate group attached to the number 5 carbon of ribose.
- The 5' end has a phosphate group attached to the number 5 carbon of deoxyribose.
- The 3' end has a phosphate group attached to the number 5 carbon of a pentose sugar.
- The 3' end has a hydroxyl group attached to the number 5 carbon of ribose.

43. Which of the statements below fits most accurately with the class of molecules known as nucleotides?

- ribose sugar and a phosphate group
- deoxyribose sugar and a nitrogenous base
- a phosphate group and an adenine or a uracil
- a nitrogenous base, a phosphate group, and a pentose sugar

44. What is being shown by this diagram? →

- Two nucleotides being linked together
- Two sugars being linked together
- Two amino acids being linked together
- The linkage between a phosphate group and a hexose sugar

45. Which of the following sets of nitrogenous bases contain large, double-ring structures?

- Guanine and adenine
- Thymine and uracil
- Guanine and uracil
- Thymine and adenine

46. Which of the following sets of nitrogenous bases are considered pyrimidines?

- Guanine and adenine
- Thymine and uracil
- Guanine and uracil
- Thymine and adenine

47. In a DNA sample composed of 20% cytosine, what would be the percentage of adenine?

- 10%
- 20%
- 30%
- 40%

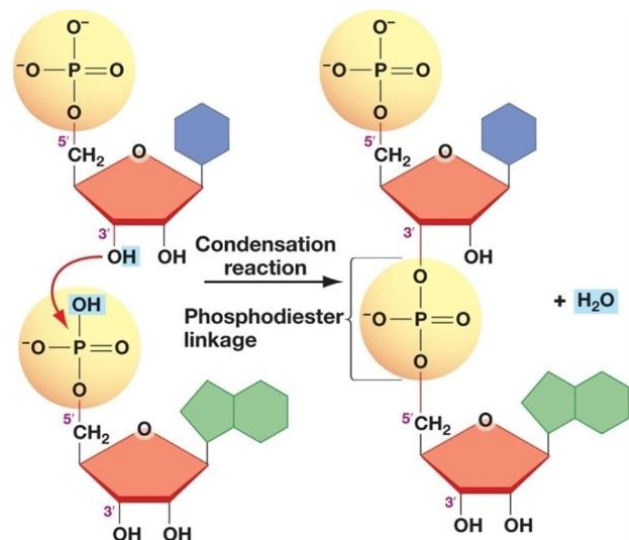
48. A double-stranded molecule of DNA contains a total of 240 purines and 240 pyrimidines.

This DNA molecule could be composed of:

- 120 thymine and 120 uracil molecules
- 240 guanine and 240 cytosine molecules
- 240 guanine and 240 adenine molecules
- 480 guanine and 480 cytosine molecules

49. Which of the following is a difference between DNA and RNA in terms of sugar structure?

- DNA contains a 6-carbon sugar, while RNA contains a 5-carbon sugar.
- The sugar in DNA can link to phosphate groups.
- DNA's sugar contains one less oxygen atom than RNA's sugar
- DNA's sugar is a disaccharide, while RNA's sugar is a monosaccharide.



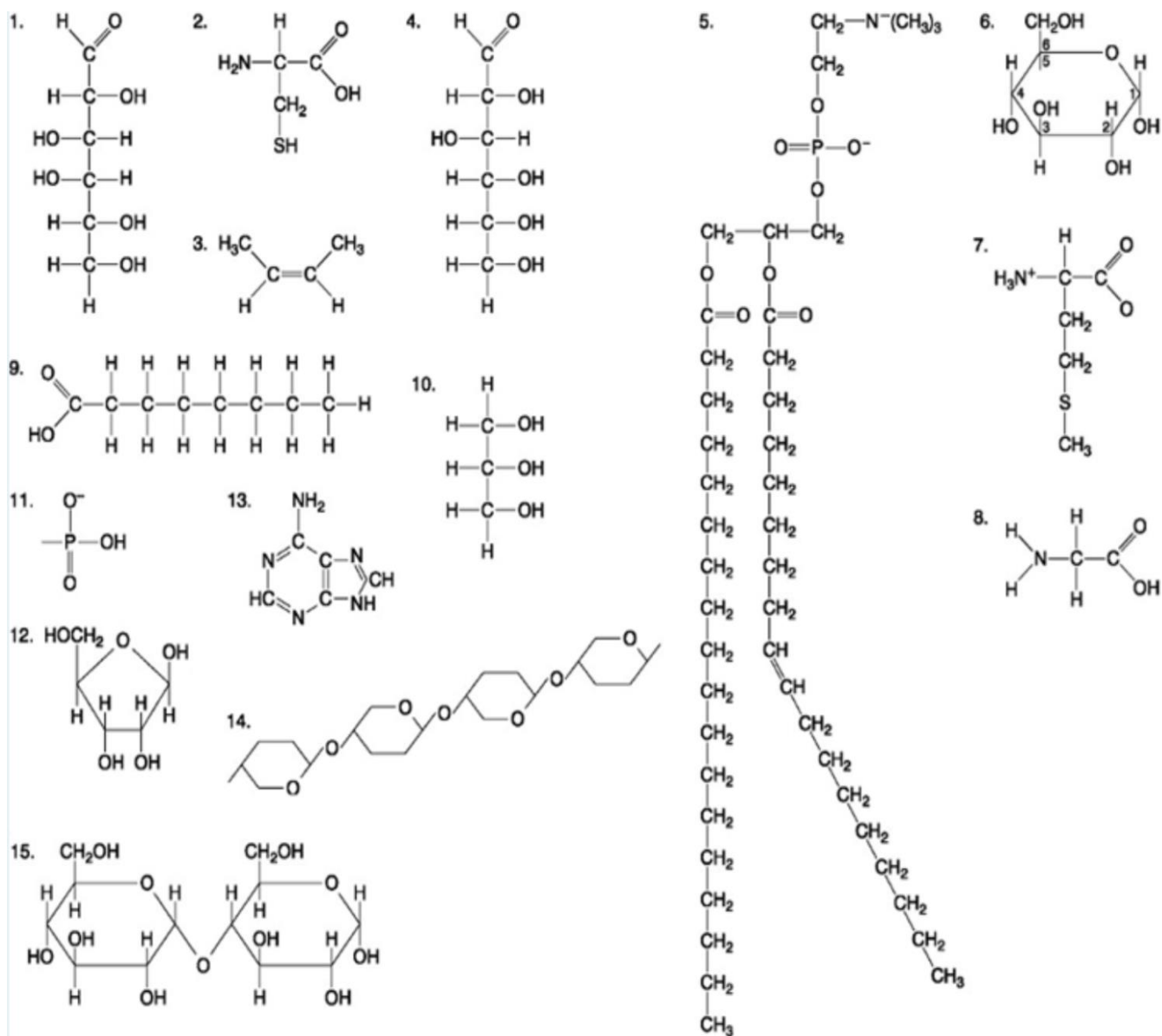
50. Which nitrogenous can base pair to adenine in RNA structures?

- a. Thymine b. Guanine c. Cytosine d. Uracil

51. If one strand of DNA molecule has the sequence of bases 5'TAACGT3', the other complementary strand would have the sequence:

- a. 5'TAACGT3' c. 5'ATTGCA3'
b. 3'AUUGCA5' d. 3'ATTGCA5'

In case your brain hasn't already turned to mush, now examine the set of 15 molecules shown below. Use your understanding of these molecules to answer the remaining questions in this packet. You're smart! You can do this!



52. Which molecule from the set has both polar and non-polar portions and would be found abundantly in a cell membrane?

- a. 1 b. 5 c. 6 d. 12

53. Which molecule from this set represents a saturated fatty acid?

- a. 5 b. 6 c. 8 d. 9

54. Which molecule from this set represents a purine type of nitrogenous base?
a. 2 b. 3 c. 12 d. 13
55. Which molecules from this set could be joined together to form a tripeptide?
a. 1, 4, and 6 b. 2, 7, and 8 c. 7, 8, and 13 d. 12, 13, and 15
56. Which molecules from this set could be joined together to form a nucleotide?
a. 1, 2, and 11 b. 3, 7, and 8 c. 5, 9, and 10 d. 11, 12, and 13
57. Which molecule from this set is an amino acid with a hydrophobic side chain?
a. 7 b. 12 c. 13 d. 15
58. Which combination of molecules from this set could form a fat (triglyceride) after undergoing a dehydration reaction?
a. one molecule of 5 and three molecules of 10
b. three molecules of 5 and one molecule of 9
c. three molecules of 9 and one molecule of 10
d. one molecule of 5 and three molecules of 9
59. Which molecule from this set is the pentose sugar found in RNA molecules?
a. 13 b. 12 c. 6 d. 4
60. Which of the molecules shown has a functional group that is frequently involved with maintaining the tertiary structure of a protein?
a. 2 b. 3 c. 9 d. 11