

Unit 1:

Macromolecules

Review

Worksheets



Test Your Knowledge: Macromolecules of Life

Biological Macromolecules, Fill in the blank:

Macromolecule	Monomer	Elements Present	Function	Examples
Carbohydrates		C, H, O		
Lipids				Fats, Oils, Phospholipids, Cholesterol, Grease, Waxes, Steroids
Proteins	Amino Acids			
Nucleic Acids			Genetic Information	

Carbohydrates are classified by _____.

The most common simple sugars are glucose, galactose and fructose that are made of a single sugar molecule. These can be classified as _____.

Sucrose and _____ are classified as disaccharides; they are made of two monosaccharides joined by a dehydration reaction.

The most complex carbohydrates are starch, _____ and cellulose, classified as _____.

Lipids most abundant form are _____.

Triglycerides building blocks are 1 _____ and 3 _____ per molecule.

If a triglyceride only contains _____ bonds that contain the maximum number of _____, then it is classified as a saturated fat.

If a triglyceride contains one or more _____ bonds, then it is classified as an unsaturated fat.

Lipids are also responsible for a major component of the cell membrane wall that is both attracted to and repelled by water, called _____.

The tail of this structure is made of 2 _____, that are water insoluble (hydrophobic).

The head of this structure is made of a single _____, that is water soluble (hydrophilic).

Proteins building blocks are amino acids that are held together with _____ bonds. These are covalent bonds that link the amino end of one amino acid with the carboxyl end of another.

Their overall shape determines their _____.

The complex 3D shape of a protein is called a _____.

Proteins have four levels of structure: _____, _____, _____, _____.

Nucleic Acids are polymers made of building blocks called _____.

There are two types of nucleic acids.

_____ is composed of nucleotides that have ribose sugar.

_____ is composed of nucleotides that have deoxyribose sugar.

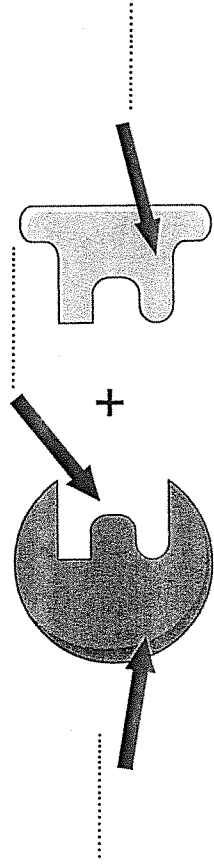
Name: Date:

Enzymes Worksheet Ch. 6 Section 2

1. a) Fill in the gaps in the following sentences using the words in the box below.

different catalysts function the same amino acids catalysts

- i) Enzymes are biological that speed up chemical reactions in living organisms.
 - ii) Enzymes are protein molecules, which are made up of long chains of
 - iii) The sequence and type of amino acids are in each protein, so they produce enzymes with many different shapes and functions.
 - iv) The shape of an enzyme is very important to its
- b) Label the image with the following terms: active site, reactant, enzyme.



2. a) Explain what would happen if a reactant molecule with a different shape to the enzyme came into contact with the enzyme's active site.

.....

b) Name two factors that affect the rate of enzyme-catalyzed reactions.

.....

c) i) Infer: What do you think would happen to an enzyme's reaction rate if the temperature or pH changed significantly beyond the enzyme's optimum level?

.....

ii) Would this have a positive or negative affect on the body?

.....

Name: Date:

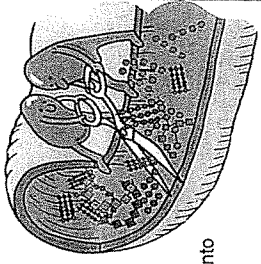
3. A group of students decided to carry out an investigation to find out how enzyme activity is affected by temperature changes. They put samples of salivary amylase and starch into two test tubes. Salivary amylase is an enzyme that breaks down starch into maltose. Its optimum (best) temperature for activity is around 37°C.

- a) What do you think happened to the rate of reaction when they increased the temperature of the first test tube to 37°C?

- b) What do you think happened to the enzyme activity when the students decreased the temperature of the second test tube to 0°C?

4. a) Fill in the missing words in the following text about enzymes and digestion.

..... enzymes are produced by specialized cells in the pancreas and digestive tract. From there, the enzymes pass out of the cells, into the and small intestine where they come into contact with food molecules. Here, they catalyze the of large molecules turning them into monomers, which are then more easily absorbed by the body.



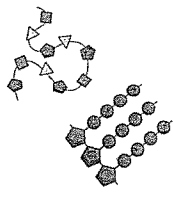
b) Write down the name of the nutrient next to the enzyme that breaks it down. Use the words in the box below. *Use device to look up if needed

fats sucrose starch proteins carbohydrates hydrochloric acid

- i) Carbohydrase is an enzyme that breaks down
- ii) Protease is an enzyme that breaks down
- iii) Lipase is an enzyme that breaks down
- iv) Amylase is an enzyme that breaks down



c) Infer: Lactase is an enzyme that helps your body break down milk sugars called lactose. A person who does not produce enough lactase eats a bowl of ice cream. What do you think will be the effect on the person?



Name: _____ Date: _____

Digestive System

Fill in the words from the word bank in the sentences below.

Word Box			
large intestine	esophagus	anus	liver
digestive system	mouth	saliva	small intestine

1. The _____ breaks down the food we eat.
2. Digestions begins in the _____ when you chew and swallow.
3. A watery liquid called _____ makes the food wet and soft, and it has a chemical that helps digest the food.
4. The _____ connects the bottom of your throat to your stomach.
5. The _____ is a long narrow tube that has spongy walls that soak up nutrients from food.
6. The _____ is on the right side of the body near the lowest rib. Its job is to clean the blood.
7. From the small intestine, leftover food gets pushed into the _____.
8. From the large intestine, food that cannot be digested leaves the body through the _____.

Enzyme Worksheet

- 1) What is an enzyme? _____

- 2) What is the active site and what is its job? _____

- 3) What is a substrate? _____

- 4) What is the product? _____

- 5) Explain how an Enzyme works using the terms from 1 – 5 _____

- 6) What is denaturing and what causes it to occur? _____

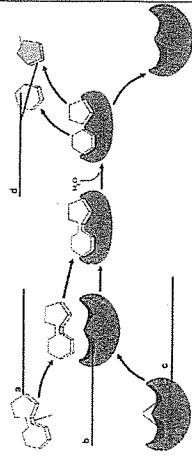
- 7) What 4 things can affect the way enzymes work? Explain how each thing affects an enzyme. _____

- 8) How can a lock and key be used to describe an enzyme? _____

- 9) Why do enzymes generally only bind to one type of substrate? _____

10) Label the following terms in the following picture

- Enzyme
- Product(s)
- Substrate
- Active site



Macromolecules Review Worksheet for Biology

Part A. Classify each as a carbohydrate, protein, or lipid.

- | | | |
|----------|-----------|------------------------|
| 1. _____ | 9. _____ | Polysaccharide |
| 2. _____ | 10. _____ | Phospholipid |
| 3. _____ | 11. _____ | Glycerol |
| 4. _____ | 12. _____ | Monosaccharide |
| 5. _____ | 13. _____ | Cellulose |
| 6. _____ | 14. _____ | amino acid |
| 7. _____ | 15. _____ | unsaturated fatty acid |
| 8. _____ | | |

Part B. Identify the specific molecule (use the above terms) from each description. Some terms may be used more than once.

- _____ provides long-term energy storage for animals
- _____ provides immediate energy
- _____ sex hormones
- _____ provides short-term energy storage for plants
- _____ animal and plant structures
- _____ forms the cell membrane of all cells
- _____ speeds up chemical reactions by lowering activation energy
- _____ one sugar
- _____ monomer of proteins
- _____ provides long-term energy storage for plants
- _____ steroid that makes up part of the cell membranes
- _____ 3-carbon "backbone" of a fat
- _____ provides short-term energy storage for animals
- _____ many sugars
- _____ forms the cell wall of plant cells

Part C. Which specific molecule (saturated fat, unsaturated fat, protein, glucose, starch, cellulose) is each food mostly made of?

- | | | | |
|-----------|------------|-----------|-------------|
| 31. _____ | almond | 39. _____ | celery |
| 32. _____ | spinach | 40. _____ | soy beans |
| 33. _____ | beef jerky | 41. _____ | cranberries |

- | | | | |
|-----------|--------------|-----------|-------------|
| 34. _____ | bacon | 42. _____ | egg white |
| 35. _____ | noodles | 43. _____ | table sugar |
| 36. _____ | orange juice | 44. _____ | popcorn |
| 37. _____ | cheese | 45. _____ | lobster |
| 38. _____ | wheat | 46. _____ | sesame oil |

Part D. State whether each is found in animals, plants or both.

- | | | | |
|-----------|----------------|-----------|----------------|
| 47. _____ | saturated fat | 53. _____ | glucose |
| 48. _____ | protein | 54. _____ | enzyme |
| 49. _____ | steroid | 55. _____ | polysaccharide |
| 50. _____ | amino acid | 56. _____ | glycogen |
| 51. _____ | monosaccharide | 57. _____ | starch |
| 52. _____ | cellulose | 58. _____ | phospholipid |

Part E. Which food molecule (monosaccharide, polysaccharide, lipid, protein) would you eat if...

- ...you needed a quick boost of energy? _____
- ...you wanted to grow strong nails? _____
- ...you haven't eaten in days? _____
- ...you wanted to grow healthy hair? _____
- ...you had a race tomorrow afternoon? _____
- ...you were getting ready for hibernation? _____
- ...you wanted to get bigger muscles? _____
- ...your next meal will be in a week? _____

Short Answer questions

- What is the relationship between glucose, fructose, and galactose? _____
- What are the structural differences between a saturated and an unsaturated fat? _____

- Explain how polymers are related to monomers. _____

Name _____ Date _____ Per _____

Dehydration Synthesis and Hydrolysis Practice

Assignment # _____

A. Match the correct prefix or suffix or definition to its meaning/word below.

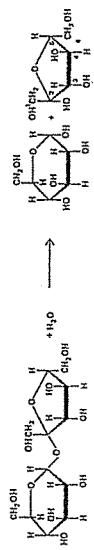
- | | | | | | |
|---|----------------------------|---|--|--|--|
| DEHYDRATE | HYDRO- | SYNTHESIS | -LYSIS | MONOMER | POLYMER |
| 1. To split or break apart; release _____ | 2. To make something _____ | 3. Many monomers hooked together make a _____ | 4. Means to lose or remove water; to take water away _____ | 5. Means water (as in gaining water) _____ | 6. Building block or single unit of a polymer is a _____ |

B. Examine each example. Indicate if each of the following is an example of dehydration synthesis or hydrolysis.

Reaction #1: _____



Reaction #2: _____



Reaction #3: _____

Protein, carbohydrate, or lipid synthesis

Reaction #4: _____

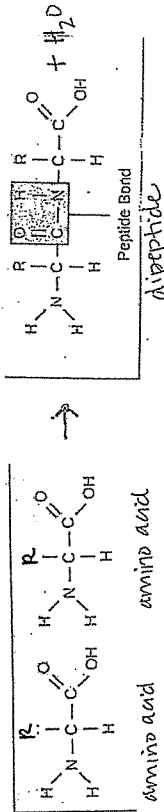
Digestion of proteins, carbohydrate, or lipid

C. Explain in your own words: How can you tell if a chemical equation represents:

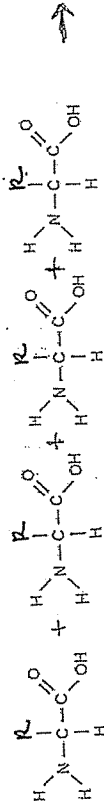
1. Dehydration synthesis? _____
2. Hydrolysis? _____

D. Analyze the following diagrams to answer the questions that follow.

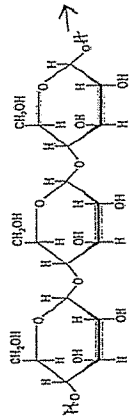
Below is an example of dehydration synthesis. In dehydration synthesis, a hydrogen atom from one molecule joins with a hydroxyl group (-OH) from another molecule to form water, leaving two molecules bonded



Using the diagram above as a guide, show how the following amino acids would begin to form a polypeptide.s



Show how the following molecule would be broken apart (hydrolysis) into simple sugars below:



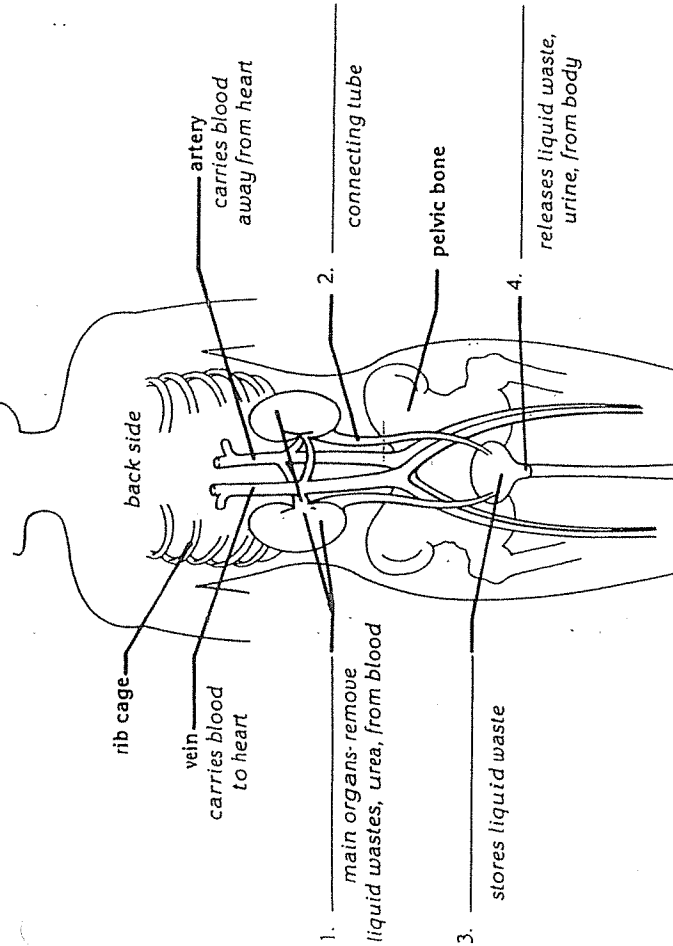
1. What are the reactants of the dehydration synthesis reaction? _____
2. What are the products of the hydrolysis reaction? _____
3. How are these two reactions related? _____

Summary Review:

1. The JOINING of two monomers causes a water molecule to be lost. This joining to make a polymer is called _____.
2. The SPLITTING apart of two organic molecules in a polymer and adding back the water parts to make individual monomers again is called _____.
3. The organic molecules that serve as a source of energy for us are, commonly called _____ in what organ of your body would the splitting apart (hydrolysis) of these be occurring at a high rate right now? _____
4. How many water molecules are lost when you join together 114 amino acids together? _____
5. During dehydration synthesis if 42 water molecules were made how many monosaccharides were joined together to make the complex carbohydrate? _____

The Excretory System

The excretory system removes wastes from the body.



- A. Locate and label these parts of the excretory system in the drawing above:
 bladder kidneys ureter urethra
- B. Match the words in Column 2 with the definitions in Column 1. Write the letter of the word in the space provided.

Column 1

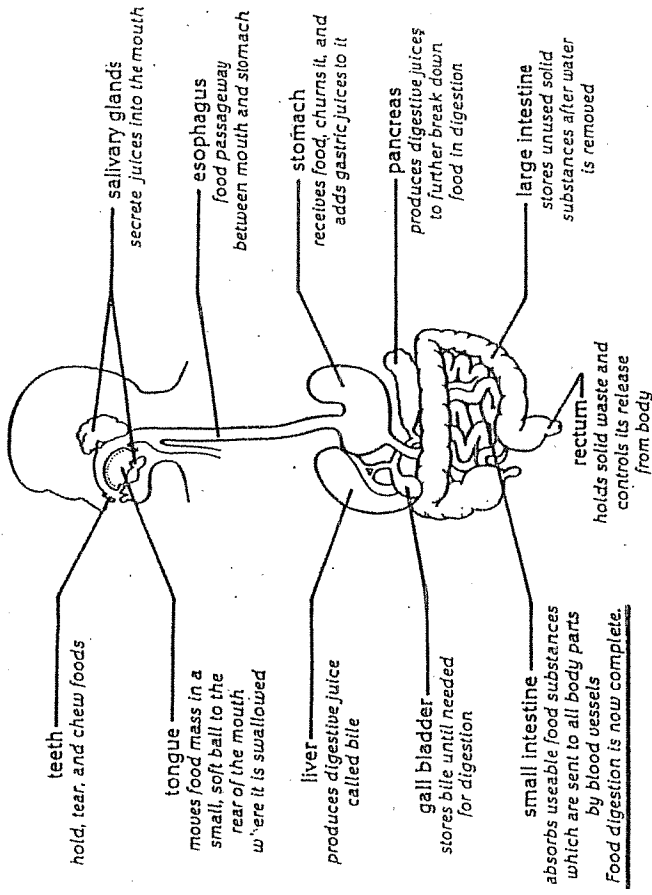
1. _____ tubes connecting kidneys and bladder
2. _____ main filters of waste from blood
3. _____ liquid waste
4. _____ where liquid waste is stored
5. _____ liquid waste found in bloodstream
- _____ where liquid waste is released from body

Column 2

- a. urea
- b. urethra
- c. bladder
- d. urine
- e. ureter
- f. kidneys

The Digestive System

The digestive system changes food into useable substances for the body.



Find the statement in Column B that best describes each word in Column A. Write the letter of that statement in the space provided.

Column A

1. _____ mouth
2. _____ large intestine
3. _____ liver
4. _____ stomach
5. _____ teeth
6. _____ small intestine
7. _____ salivary glands
8. _____ gall bladder
9. _____ villi

Column B

- A. makes bile
- B. produce juices in the mouth
- C. churns food, adds juices
- D. where digestion begins
- E. water removed, solids stored
- F. tiny, finger-like projections found in small intestine
- G. breaks, grinds food into pieces
- H. absorbs food, sends it throughout body
- I. stores bile

Name: _____ Row: _____
 Date: _____ Period: _____

Monomer Polymer Worksheet

- Explain how monomers are related to polymers.
- When polymers are broken down into monomers, what would your body do with those monomers?
- Draw a line to match the monomer on the left to the macromolecule on the right.

Fatty acids and glycerol Monosaccharide Nucleotide Amino acid	protein lipid nucleic acid carbohydrate
--	--
- Draw a line to match the polymer on the left to the macromolecule on the right.

DNA Enzyme Triglyceride Polysaccharide	protein lipid nucleic acid carbohydrate
---	--
- Draw a line to match the monomer on the left to the polymer on the right.

Fatty acids and glycerol Monosaccharide Nucleotide Amino acid	polysaccharide RNA enzyme phospholipid
--	---
- Draw a line to match the monomer on the left to the polymer on the right.

Fatty acids and glycerol Glucose Nucleotide Amino acid	enzyme triglyceride starch DNA
---	---
- Draw a line to match the monomer on the left to the polymer on the right.

Amino acid Nucleotide Monosaccharide Fatty acids and glycerol	glycogen phospholipid protein collagen DNA
--	---
- Draw a line to match the polymer on the left to the macromolecule on the right.

Cholesterol Enzyme RNA Cellulose	protein nucleic acid carbohydrate lipid
---	--

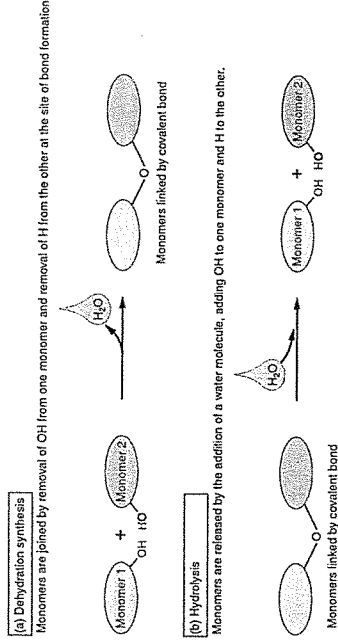
NAME _____ DATE _____ PERIOD _____

PART 3 - Complete the chart below. Remember *mono* means one and *poly* means many.

MACROMOLECULES	FOOD EX.	MONOMER	POLYMER
Carbohydrates			
Lipids			
Proteins			
Nucleic Acids			

Your best friend tells you that they are deathly allergic to certain amino acids in food. Your mom has prepared dinner already, so you need to tell her not to serve what macromolecule to them?

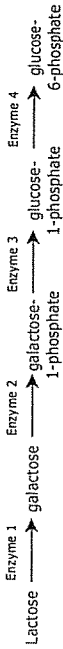
PART 4 - Study the image below then answer the questions on the right.



- Which process breaks polymers into monomers?
- Which process bonds monomers into polymers?
- Which reaction stores energy?
- Which reaction releases energy?

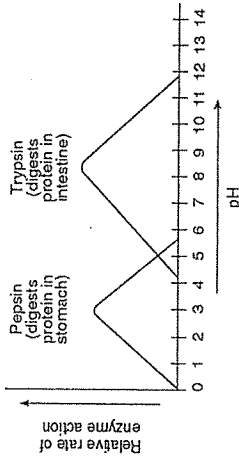
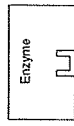
Name: Date:

Infer: Lactose is found in milk products. It is converted by the body into a usable form in a series of chemical reactions. The diagram shows the series of reactions that convert lactose into a usable form.



If enzyme 2 is denatured (destroyed), the levels of which substance will increase?

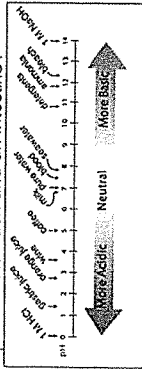
- The enzyme would most likely affect reactions involving
 - molecule A, only
 - molecule C, only
 - molecule C and D
 - molecules B and D
 - molecules A and C



Use the graph above to answer the following questions. * a pH scale has been provided as reference

- What is the optimal pH for both enzymes?
 - Pepsin _____
 - Trypsin _____
- Predict the reactivity of trypsin at pH 14. _____
- When do neither enzyme work? _____
- Compare the rate of the pepsin-catalyzed reaction at pH 3 with the rate of the trypsin-catalyzed reaction at pH 3. _____
- Based on the graph, what can you infer about the pH of a stomach and an intestine? _____

Justify your answer. _____



Digestive Enzymes

- Why do we need enzymes to help with digestion?

[3 marks]

- Large molecules from food are broken down by enzymes to smaller molecules. Complete the table below:

Large molecule	Enzyme that catalyses the reaction	Small molecule
Carbohydrates		Maltose
Proteins	Protease enzymes	
Lipids		(two products)

[4 marks]

- Give two ways that we use the products of digestion in our bodies

[2 marks]

- Where are each of the digestive enzymes produced?

Carbohydrases (e.g. amylase):

Proteases:

Lipases:

[3 marks]

[Total - 12 marks]

Lipids					
Proteins Enzymes end in _____					
Nucleic Acids					

18. What occurs during a chemical reaction?

19. What is the difference between a product and a reactant?

20. Energy is used differently in different types of chemical reactions. Explain how energy use differs in energy-releasing and energy-absorbing reactions.

21. How is energy related to the products and reactants of a chemical reaction?

22. What is the role of an enzyme in living organisms? Explain enzyme specificity. Give example.

23. In what way do enzymes/catalysts increase the rate of reactions? How do enzymes accomplish this task?

24. Describe the relationship between enzymes and substrate.

25. How/Why is the structure of an enzyme so important to its function in living things? Why does the structure of an enzyme determine the type of reaction it will catalyze?

26. What happens to enzyme function when the temperature or pH conditions change? Why?

27. The energy needed to get a reaction started is the:
A. adhesion energy B. cohesion energy C. activation energy D. chemical energy

Keystone released questions
1. Which statement correctly describes how carbon's ability to form four bonds makes it uniquely suited to form macromolecules?
a. It forms short, simple carbon chains. b. It forms large, complex, diverse molecules.
c. It forms covalent bonds with other carbon atoms. d. It forms covalent bonds that can exist in a single plane.

2. The diagram shows a reaction that forms a polymer from two monomers. What is this type of reaction called?
A. glycolysis B. hydrolysis
C. photosynthesis D. dehydration synthesis



3. Carbohydrates and proteins are two types of macromolecules. Which functional characteristic of proteins distinguishes them from carbohydrates?

(Answers on back)

Station 3- Macromolecules

1. Define and illustrate an ionic and covalent bond:
2. What does it mean for a compound to be organic?

3. Water is (circle one) **polar** / **nonpolar** because the electrons are not evenly shared. Draw 2 water molecules and label a covalent and hydrogen bond.

4. Explain the following properties of water and how they are important to living things:
Universal solvent:
Specific Heat:
Cohesion:
Adhesion:
Capillary action:
Polarity:

5. What is the difference between a monomer and polymer?
6. Dehydration synthesis _____ water to _____ a bond, while hydrolysis _____ water to _____ a bond.
Draw 2 amino acids and illustrate dehydration synthesis.

7. Carbohydrates have a _____ ratio of C:H:O. Carbohydrates are the main _____ source for a cell.
8. What are the two monomers of lipids?
9. Lipids make up the majority of the cell _____
10. What are the monomers of a protein?

11. Compared to most other substances, a great deal of heat is needed to raise the temperature of water by a given amount. This is because water:
A. is an acid B. readily forms solutions
C. has a high heat capacity D. acts as a buffer

12. Frozen water is less dense than liquid water. Explain why this is important for aquatic organisms.

13. Define Macromolecules:

Macromolecule	Elements	monomer (building block)	Draw the monomer	Function/s List All!	Examples
Carbohydrates Frequently ends in -					

33.

- A. large amount of stored information
 B. efficient storage of usable chemical energy
 C. ability to catalyze biochemical reactions
 D. tendency to make cell membranes hydrophobic

4. Substance A is converted to substance B in a metabolic reaction. Which statement **best** describes the role of an enzyme during this reaction?

- A. It adjusts the pH of the reaction medium.
 B. It dissolves substance A in the reaction medium.
 C. It provides energy to carry out the reaction.
 D. It speeds up the reaction without being consumed.

5. A scientist observes that, when the pH of the environment surrounding an enzyme is changed, the rate the enzyme catalyzes a reaction greatly decreases. Which statement **best** describes how a change in pH can affect an enzyme?

- A. A pH change can cause the enzyme to change its shape.
 B. A pH change can remove energy necessary to activate an enzyme.
 C. A pH change can add new molecules to the structure of the enzyme.
 D. A pH change can cause an enzyme to react with a different substrate.
 6. Whenever biological organic compounds, such as proteins and carbohydrates, are broken down or synthesized...

- a. a phase change of matter results.
 b. thermal expansion occurs.
 c. sunlight is required.
 d. energy is absorbed or released.

7. Why does an enzyme function as a catalyst in a reaction?

- f. It creates the right pH needed for the reaction.
 g. It decreases the amount of energy needed for the reaction.
 h. It provides the extra energy needed for the reaction.
 i. It maintains the proper temperature needed for the reaction.

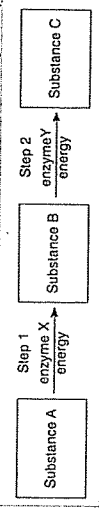
8. Proteins are a major part of every living cell and have many different functions within each cell. Carbohydrates also perform numerous roles in living things.

Part A: Describe the general composition of a protein molecule.

Part B Describe how the structures of proteins differ from the structures of carbohydrates.

Part C: Describe how the functions of proteins differ from the functions of carbohydrates

9. The diagram below represents the chemical pathway of a process in a human liver cell.



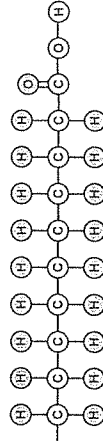
A particular liver cell is unable to make substance C. One possible explanation for the inability of this cell to make substance C is that

1. Excess energy for step 2 prevented the conversion of substance B to substance C
2. An excess of enzyme X was present, resulting in a decrease in the production of substance B
3. Nuclear DNA was altered resulting in the cell being unable to make enzyme Y

4. A mutation occurred causing a change in the ability of the cell to use substance

A scientist formed Chemical X in a laboratory. The material was then analyzed by other scientists.

Molecular Structure of Chemical X



Analysis showed that the chemical was composed of long chains of repeated copies of CH₂ molecules.

- A. It contains the genetic information needed for protein production.
 B. It catalyzes specific chemical reactions in the cytoplasm of a cell.
 C. It stores the energy that a cell needs to perform various life processes.
 D. It allows a cell to regulate the movement of materials into and out of a cell.

Trees are typically able to transport water from their roots to their stems and leaves. Which statement describes the property of water that most supports the transportation of water to all parts of a tree?

- a. Water forms a crystalline structure when it freezes.
 b. Water dissolves fewer substances than any other liquid.
 c. Water has strong attractions to itself and many other molecules.
 d. Water can absorb large amounts of energy with minimal temperature changes.

Which statement best describes a relationship between enzymes and a simple biological reaction?

- a. Enzymes will increase the amount of substrate formed during a biological reaction
 b. Enzymes will decrease the amount of substrate formed during a biological reaction
 c. A reaction rate can be increased when the specific enzyme for a biological reaction is present
 d. A reaction rate can be decreased when multiple enzymes for a biological reaction are present

Look at the image to the right:

Which of the following is a property of water that allows a water strider to walk on the surface of water?



Use the table below to answer question 5.

Students' Descriptions of Four Organic Compounds

Student	Organic Compounds	Description
1	carbohydrates	complex compounds made of purines and pyrimidines that function as data-storage molecules
2	lipids	use the relatively high energy contained in carbon-hydrogen bonds to perform their primary function
3	proteins	chains of amino acids that can function as enzymes, hormones, or antibodies
4	nucleic acids	compounds produced by photosynthetic plants, that contain only carbon, hydrogen, and oxygen

5. Which two students correctly described organic compounds?

- A. students 1 and 2
 B. students 2 and 3
 C. students 3 and 4
 D. students 2 and 4

of the reaction

C. by increasing the time needed for the reaction to occur

- a. Solubility
 b. Cohesion
 c. high specific heat
 d. Low freezing point

Carbonic anhydrase is an enzyme involved in the reaction of carbon dioxide with water to form a molecule that dissolves well in the liquid part of blood. How does carbonic anhydrase affect this reaction?

- a. By making the reaction reversible
 b. By changing chemical products