Dehydration Synthesis and Hydrolysis

Vocabulary Matching

_____ 1. To split or break apart; to release
_____ 2. To make something
_____ 3. Many monomers hooked together
_____ 4. Means to lose or remove water; to take water away
_____ 5. A process where two molecules lose the “parts” of water and join (bond) together
_____ 6. A process where a molecule splits into two (or more) smaller molecules and gains the “parts” of water on the broken ends
_____ 7. Means water (as in gaining water)
_____ 8. Building block or single unit of a polymer

A. Dehydrate
B. Hydro
C. Synthesis
D. –lysis
E. Dehydration synthesis
F. Hydrolysis
G. Monomer
H. Polymer

Directions: Below the diagrams are three statements that describe the action shown in the diagram, but they are scrambled up. The following diagrams show the process of ____________________________.

Match the statements to the diagrams (draw arrows to the diagrams):

The parts of water are lost from the bonding ends of the two molecules.

Two molecules bond together forming one larger molecule and release water.

Two complete, organic molecules – separated from each other.
The following diagrams show the process of ________________________.

Match the statements to the diagrams (draw arrows to the diagrams):

Each sugar molecule gains a “part” of water to its broken end and is now complete.

A disaccharide, maltose, is made out of two smaller sugar molecules bonded together.

The disaccharide molecule breaks apart (with the help of enzymes).

Describe what is happening in each step of this diagram below:

Step 1 - ____________________________________________________________

Step 2 - ____________________________________________________________

Step 3 - ____________________________________________________________
Summary Questions

1. The losing of water from two organic molecules, then the JOINING of those molecules is termed: ________________________________

2. The SPLITTING apart of two organic molecules followed by the addition of the “parts” of water to the broken ends of each molecule is called ________________________________.

3. According to the process shown on page 1, how many water molecule(s) are formed when ONE BOND is made between two organic molecules? ____________

4. According to the process shown on page 2 of this activity, how many water molecules(s) are needed when ONE BOND holding two sugars (or any organic molecules) breaks? ________________________________

5. If one fat molecule (made out of 4 smaller molecules as indicated on the diagram above) goes through the process of **hydrolysis**, how many water molecules would be needed to complete the process? _____

6. Dehydration synthesis is a process which is exactly the opposite of ________________________________.

7. One bond between two organic molecules forms ________ water molecules.

8. Ten bonds between 11 organic molecules forms ________ water molecules.

9. List four groups of organic compounds: ________________________________, ________________________________, ________________________________, ________________________________.

10. How do you think we get organic molecules (the building blocks of life) into our bodies? ________________

______________________________________________________________
Dehydration Synthesis

Show how the removal of the water molecules takes place by drawing a ring around the components of water. Then draw the structural formula of each product.

Formation of a Disaccharide

\[
\text{monosaccharide} + \text{monosaccharide} \rightarrow \text{disaccharide} + \text{1 water molecule}
\]

Synthesis of a Fat

\[
\text{1 glycerol molecule} + 3 \text{fatty acid molecules} \rightarrow \text{1 lipid molecule} + 3 \text{water molecules}
\]

Formation of a Peptide Bond

\[
\text{amino acid} + \text{amino acid} \rightarrow \text{dipeptide} + \text{1 water molecule}
\]
Carbohydrates Review

1. **Underline** the mistakes in the following statements and **write the correct information** on the lines.

   A. *Organic molecules are molecules containing sulfur.*

   B. *A polymer is made of many smaller units called monomers.*

   C. *The monomers for carbohydrates are called amino acids.*

   D. *Monofatty acids are the same things as simple sugars.*

   E. *Two monosaccharides combined are called a polypeptide.*

   F. *A string of monosaccharides is called a polynucleotide.*

   G. *Three examples of polysaccharides are: starch, glycogen and DNA.*

2. What is the main function of starch in plants? ____________________________________________

3. What is the main function of cellulose in plants? __________________________________________

4. Name the other polysaccharide and describe its main function in animals.
   a. Name: ____________________________________________
   b. Function: __________________________________________

5. Name five foods which contain carbohydrates:
   a. ____________________________
   b. ____________________________
   c. ____________________________
   d. ____________________________
   e. ____________________________

6. What is the main function of carbohydrates? ____________________________________________

7. What are the four organic compounds found in living things?
   a) ____________________________
   b) ____________________________
   c) ____________________________
   d) ____________________________
8. Circle the carbohydrates in the following diagrams:

<p>| | | |</p>
<table>
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<tbody>
<tr>
<td>a. valine</td>
<td>b. asparagine</td>
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<tr>
<td>c. ribose</td>
<td>d. glucose</td>
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<tr>
<td>e. fructose</td>
<td>f. deoxyribose</td>
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</table>

9. Which of the following are monosaccharides (circle all that apply):

- a. Fructose (C₆H₁₂O₆)
- b. Glucose (C₆H₁₂O₆)
- c. Glycerol (C₃H₅O₃)
- d. Galactose (C₆H₁₂O₆)

10. What is the process called by which macromolecules are formed? _________________

11. When monomers join together, what do they form? _________________

12. What molecule is released when two monomers join together? _________________

13. What is the process called when large molecules are broken down by adding a water molecule? _________________

14. What is the process called when large molecules are built by releasing a molecule of water? _________________

15. What is the name of the bond that joins monosaccharides? _________________
16. Identify the carbohydrates as a monosaccharide, a disaccharide or a polysaccharide. Identify the bonds between the molecules where appropriate.
Lipids by Bozeman Science Video

Name: ______________________

Biology

Date: ___________ Period: _____

Please go to the following YouTube pod cast on Lipids by Bozeman Science:
http://www.youtube.com/watch?v=VGHD9e3yRIU

Answer the following questions below while watching the video. Pause the video as many times as needed to get all of the information.

1. What is another name for lipids? ________________________________

2. What enzyme breaks down lipids? ________________________________

3. Not only do fats provide energy they also provide ________________________________

4. Where does the energy come from in lipids? ________________________________

5. Please draw the triglyceride (picture in yellow) from the video:

6. Describe how he explains saturated fats: ________________________________

                                      
                                      
                                      
                                      
7. What picture does he use for saturated fats? ________________________________

8. Describe how he explains unsaturated fats: ________________________________

                                      
                                      
                                      
                                      
9. What picture does he use for unsaturated fats? ________________________________

10. What is the cell membrane of all cells of all organisms made up of? ________________________________
11. Draw a picture of the cell membrane and **LABEL** it from the video (it is the one on the bottom).

12. What is the function of cholesterol for your cell membrane?

   

13. Add cholesterol to your diagram in #11 and label it.
Organic Macromolecule Identification

Label each diagram using the following terms (they can be used more than once):

- monosaccharide
- disaccharide
- polysaccharide
- glycerol
- fatty acid
- lipid
- amino acid
- nucleotide
- water
Use the diagrams to answer each of the questions:

1. Which diagram shows a monosaccharide?
2. Which diagram shows a disaccharide?
3. Which diagram shows a polysaccharide?
4. Which diagram shows a lipid?
5. Which structures are needed to create a lipid?
6. Which diagram shows a fatty acid chain that is part of a saturated fat?
7. Which diagram shows a fatty acid chain that is part of a polyunsaturated fat?
8. What structure/diagram do all of the lipid molecules have in common?
9. What letter(s) represent an amino acid?
10. Which diagram(s) show a single nucleotide?
11. Which diagram shows a molecule that is inorganic?
12. Which diagram(s) show a molecule that is the primary energy source for all our cells?
13. List ALL molecules that were created from dehydration synthesis?

14. In the nucleotide diagram identify the three parts of the nucleotide: circle the nitrogenous base, put a box around the phosphate, and draw a triangle around the sugar.

15. Differentiate between dehydration synthesis and hydrolysis.

16. What are the four macromolecules?

17. What elements do all of the organic compounds have in common?

18. Explain how you can differentiate a carbohydrate from a lipid.

19. Explain how you can differentiate an amino acid from other organic molecules.

20. Explain how you can differentiate a nucleotide from other organic molecules.
Section 2.3 Organic Compounds Review

A. Matching

_____ 1. Macromolecule containing C-H-O-N and sometimes S  
   a. amino acids

_____ 2. A type of bond in a nucleotide  
   b. carbohydrates

_____ 3. are monomers of nucleic acids  
   c. carbon

_____ 4. organic catalysts  
   d. DNA, RNA

_____ 5. element common to all organic compounds  
   e. enzymes

_____ 6. carbohydrate monomer  
   f. ester

_____ 7. the monomer of many carbohydrates  
   g. glucose

_____ 8. bond found in lipids  
   h. glycerol

_____ 9. alcohol common in triglycerides  
   i. glycogen

_____ 10. bond found in proteins  
   j. glycosidic

_____ 11. animal starch  
   k. hormones

_____ 12. bond found in carbohydrates  
   l. lipids

_____ 13. macromolecules containing C-H-O-N-P  
   m. monosaccharides

_____ 14. chemical regulators that can be proteins or lipids  
   n. N-glycosidic

_____ 15. element common to proteins and nucleic acid  
   o. nitrogen

_____ 16. monomers of proteins  
   p. nucleic acid

_____ 17. element common to nucleic acids  
   q. nucleotides

_____ 18. fats, oils and waxes are examples  
   r. peptide

_____ 19. are examples of nucleic acids  
   s. phosphorus

_____ 20. commonly referred to as sugars  
   t. proteins

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

2. Draw a line to match the polymer on the left to the macromolecule on the right.
   DNA             protein
   Enzyme         lipid
   Triglyceride   nucleic acid
   Polysaccharide carbohydrate
Use one or more of the following terms for each statement

<table>
<thead>
<tr>
<th>a. carbohydrates</th>
<th>b. lipids</th>
<th>c. proteins</th>
<th>d. nucleic acids</th>
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<tbody>
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<td>__________ 1.</td>
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<td>have building blocks called amino acids</td>
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<td>__________ 2.</td>
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<td>fats oils and waxes are examples</td>
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<td>__________ 3.</td>
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<td>nitrogen is a common element</td>
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<td>__________ 4.</td>
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<td>monosaccharides are monomers</td>
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<td>__________ 5.</td>
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<td>contains C, H, O</td>
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<td>__________ 6.</td>
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<td>DNA and RNA are examples</td>
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<td>__________ 7.</td>
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<td>Have nucleotides as building blocks</td>
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<td>__________ 8.</td>
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<td>Sulfur is found in some of the monomers</td>
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<td>__________ 9.</td>
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<td>Glycerol and fatty acids are monomers</td>
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<td>__________ 10.</td>
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<td>keratin, hemoglobin and antibodies are examples</td>
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<td>__________ 11.</td>
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<td>glucose, sucrose and starch are examples</td>
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<td>__________ 12.</td>
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<td>the monomer is composed of sugar, an acid and a base</td>
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<td>__________ 13.</td>
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<td>oxygen and hydrogen have a 1:2 ratio respectively</td>
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<td>__________ 14.</td>
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<td>important in both protein synthesis and heredity</td>
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<td>__________ 15.</td>
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<td>cholesterol and steroid hormones are examples</td>
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</table>

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

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

5. 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
   - wax
   - collagen
   - DNA

6. 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
7. Which of the following enzymes would digest a fat?
   a. Sucrose  
   b. Fatase  
   c. Protease  
   d. Lipase

8. At high temperatures, the rate of enzyme action decreases because the increased heat
   a. changes the pH of the system  
   b. alters the active site of the enzyme  
   c. neutralizes the acids and bases in the system  
   d. increases enzyme concentration

9. Which group of organic compounds includes the enzymes?
   a. Proteins  
   b. Starches  
   c. Carbohydrates  
   d. Lipids

10. The "lock and key hypothesis" attempts to explain the mechanism of
    a. vacuole formation.  
    b. pinocytosis.  
    c. sharing of electrons.  
    d. enzyme specificity.

11. Which chemical is classified as an enzyme?
    a. Galactose  
    b. Lipid  
    c. Protease  
    d. Manganese dioxide

12. Which element is present in maltase, but not in maltose?
    a. Carbon  
    b. Hydrogen  
    c. Oxygen  
    d. Nitrogen

13. Which statement best expresses the information represented in the graph shown?

   a. The action of enzymes varies with pH.  
   b. A pH of 7 provides the optimum environment for digestive enzymes.  
   c. Gastric juice is active at a pH extending from 0 to 12.  
   d. Acids have a pH greater than 7.

14. The diagram below represents three steps in the hydrolysis of a molecule of sucrose. In this diagram, structure X is most likely

   a. a molecule of oxygen  
   b. the end product  
   c. an organic catalyst  
   d. the substrate

15. Which is not a structural feature of an enzyme?
    a. Protein  
    b. Substrate  
    c. Active site  
    d. Amino acid
16. The effect of temperature on the relative rate of action of an enzyme is represented in the graph below. The optimum temperature for the action of this enzyme is approximately

![Graph showing the relationship between temperature and enzyme action rate.]

a. 15°C  
   b. 22°C  
   c. 37°C  
   d. 50°C

17. Here are some stages of an enzyme-controlled reaction. An enzyme-substrate complex is represented by diagram

![Stages of enzyme-controlled reaction diagram.]

18. Any substance that is acted upon by an enzyme is called a(n)
   a. coenzyme  
   b. substrate  
   c. vitamin  
   d. polypeptide

19. Organisms produce hydrogen peroxide (H₂O₂), a by-product of metabolism that is toxic to cells. The catalase protein catalyzes the reaction shown below. Which statement describes the reaction?

\[ 2 \text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2 \]

a. Water is the substrate.  
   b. Hydrogen peroxide is the enzyme.  
   c. Catalase is consumed by the reaction.  
   d. Oxygen gas is a product of the reaction

20. The enzyme lactase catalyzes the breakdown of lactose (milk sugar) to glucose and galactose. Students set up a beaker with milk and lactase enzyme. Which describes how the concentrations of these substances will change over time?
   a. The concentration of lactase will decrease, and the concentration of galactose will increase.  
   b. The concentration of lactase will decrease, and the concentration of glucose will increase.  
   c. The concentration of galactose will increase, and the concentration of lactase will remain the same.  
   d. The concentration of galactose will increase, and the concentration of glucose will remain the same.

21. A reaction tube is set up at 37°C with twice as much substrate as enzyme. The pH level of the solution is 5. The reaction rate is measured. Which of the following changes will not affect the rate of the reaction?
   a. Increasing the pH level  
   b. Increasing the temperature  
   c. Increasing the enzyme concentration level  
   d. Increasing the substrate concentration
1. Many biological catalysts, hormones, and receptor molecules are similar in that, in order to function properly, they must
   A. interact with each other at a high pH
   B. interact with molecules that can alter their specific bonding patterns
   C. contain amino acid chains that fold into a specific shape
   D. contain identical DNA base sequences

2. The enzyme amylase will affect the breakdown of carbohydrates, but it will not affect the breakdown of proteins. The ability of an enzyme molecule to interact with specific molecules is most directly determined by the
   A. shapes of the molecules involved
   B. number of molecules involved
   C. sequence of bases present in ATP
   D. amount of glucose present in the cell

3. Use the graph below to answer the following question. The contents of the small intestine have a basic pH. When gastric protease enters the small intestine, the activity of the enzyme will most likely
   A. increase, only
   B. increase and then decrease
   C. decrease, only
   D. remain the same

4. Which statement(s) 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

5. 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 provides energy to carry out the reaction.
   C. It dissolves substance A in the reaction medium.
   D. It speeds up the reaction without being consumed.
Use the diagrams below to answer questions 6 and 7.

6. Which molecule is an example of a carbohydrate? ________

7. Which molecule results from all dehydration synthesis reactions? ________

8. Which molecules are formed from dehydration synthesis? ________

9. The diagram above models how a poison bonds to the active site of an enzyme. Which function is the enzyme most likely unable to perform because of the attachment of the poison molecule?
   A. the release of stored chemical energy
   B. the donation of electrons to the substrate
   C. the supply of activation energy for a reaction
   D. the catalysis of the reaction with the substrate

10. 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 the 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.
11. A researcher noticed that a similar CH₂ molecule structure was also located in the plasma membrane of an animal cell. This CH₂ molecular structure contained a negatively charged phosphate group. Which statement best describes the primary function of the CH₂ and phosphate molecular structure located in the plasma membrane?
   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.

12. Which type of organic molecule was most likely formed by the scientist in the laboratory?
   A. Lipid
   B. Protein
   C. Nucleic acid
   D. Carbohydrate

13. Two chemical reactions are shown below. What do letters A and B represent?

 \[
 \text{maltose} + \text{water} \xrightarrow{A} \text{glucose} + \text{glucose} \\
 \text{fat} + \text{water} \xrightarrow{B} \text{glycerol} + \text{fatty acids}
 \]

   A. A-lipase; B-protease
   B. A-protease; B-maltase
   C. A-maltase; B-lipase
   D. A-maltase; B-protease
14. 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.

A) Describe the general composition of a protein molecule. _________________________________

___________________________________________

___________________________________________

___________________________________________

___________________________________________

B) Describe how the structures of proteins differ from the structure of carbohydrates. ________________

___________________________________________

___________________________________________

___________________________________________

___________________________________________

C) Describe how the functions of proteins differ from the functions of carbohydrates. ________________

___________________________________________

___________________________________________

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___________________________________________
ENZYME WEB ACTIVITY

Introduction:
In this simulation you will be looking at how pH, temperature and competitive enzyme inhibitor molecules affect the rate of enzyme activity. In simulation, will also be able to control the concentration of enzymes and the substrate. Please make sure that you view the animation located above the simulation and read the caption so that you have a better understanding of enzyme catalyzed reactions.

Site: [http://www.kscience.co.uk/animations/anim_2.htm](http://www.kscience.co.uk/animations/anim_2.htm)

Some helpful hints:
- Every time you change the conditions, you must click the setup button to run the simulation with the new conditions.
- Time each trial for 20 seconds,
- Hit the stop button in order to count the number of products created after 20 seconds.

Questions 1: How does a change in pH effect enzyme activity?

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<tr>
<th>pH</th>
<th>Products</th>
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1. Based on your data what is the optimum pH level for this protein? Use evidence to support your answer.

2. What pH level caused the enzyme to be completely ineffective? Explain how a change in pH can prevent an enzyme from working properly.

3. While you were running this experiment, what variable did you decided to keep constant. Also include the exact conditions of the simulation (such as the temperature, number of substrates, number of enzymes, etc.).
4. Why is it important to only change a single variable when you are conducting a controlled experiment?

**Question 2: What is the effect of temperature on the enzyme?**

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<thead>
<tr>
<th>Table 2</th>
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<tbody>
<tr>
<td>Temp (°C)</td>
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5. Based on the data what is the optimum temperature for this enzyme to function? Use evidence to support your answer.

6. Explain how extremely low temperatures affect the rate of enzyme activity.

7. Explain how extremely high temperatures affect the rate of enzyme activity.
Question 3: What effect do inhibitors have on the rate of enzyme activity?

Table 3

<table>
<thead>
<tr>
<th>Substrates</th>
<th>Inhibitors</th>
<th>Products</th>
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<tbody>
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8. Based on your data describe how inhibitors affect the rate of enzyme activity. Use evidence to support your answer.

9. In your own words, define an enzyme inhibitor.

Circle either True or False:

True False 1. All enzyme break down larger substances into smaller substances.

True False 2. All enzymes speed up chemical reaction by lower the activation energy in a reaction.

True False 3. The substrate can only bind to a single location on the enzyme called the active site.

True False 4. Temperatures that are too high decrease enzyme activity because it changes the shape of the substrate.

True False 5. After the chemical reaction occurs, the enzyme cannot be reused.

True False 6. All enzymes are protein molecules.

True False 7. All proteins molecules are enzymes