**Worksheet: How Enzymes Function**

Enzymes are some of the most important kinds of molecules found in living cells. Cells could not function without enzymes. They control the chemical reactions of the cells.

To understand how enzymes work, you will be answering questions about simple chemical reactions with hydrogen peroxide. You may have hydrogen peroxide in your medicine cabinet at home. It is commonly used as a bleaching and disinfecting agent.

Hydrogen peroxide has the chemical formula $\text{H}_2\text{O}_2$. Notice the similarity between this formula and the formula for $\text{H}_2\text{O}$. Hydrogen peroxide is a compound which turns into water by the following reaction:

$$2 \text{H}_2\text{O}_2 \rightarrow 2 \text{H}_2\text{O} + \text{O}_2$$

**hydrogen peroxide**  **water**  **oxygen**

Hydrogen peroxide is formed as a product of chemical reactions in living cells. It is toxic, and if it were not immediately removed or broken down by cells it would destroy those very cells. In the presence of a **catalyst**, in this case the **enzyme** **catalase**, hydrogen peroxide is converted into two harmless substances, oxygen and water. All **catalysts in living cells are enzymes**.

$$2 \text{H}_2\text{O}_2 \rightarrow 2 \text{H}_2\text{O} + \text{O}_2$$

**catalase**  **hydrogen peroxide**  **water**  **oxygen**

1. What are the products of this reaction?

2. What is the reactant in this equation?

3. What is the enzyme in this reaction?

4. What is the substrate in this reaction?

5. Based on your observation of the above reaction and your knowledge about enzymes, which of the following statements is the most probable assumption? Circle the letter of the statement you chose.
   a. The hydrogen peroxide is used up and the catalase remains unchanged.
   b. The catalase is used up and the hydrogen peroxide remains unchanged.
   c. Both the hydrogen peroxide and the catalase are used up.
   d. Neither the hydrogen peroxide nor the catalase is used up.

6. Where in organisms is catalase stored?

7. When this reaction occurs, bubbles are present, what do the bubbles represent?

**General Questions About Enzymes**

1. List three characteristics of enzymes.

    ____________________________
    ____________________________
    ____________________________

2. What is the function of an enzyme?

**Enzyme Worksheet**

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Refer to the diagram for the following questions 3-5.

3. What does segment A represent?

4. Which segment would be different if it were catalyzed by an enzyme?

5. Which segment represents the amount of energy released in the reaction?

6. Would the enzyme catalase act on substrates other than hydrogen peroxide? Explain your answer?

Refer to the diagram to answer questions 7 - 11.

7. If X represents a glucose molecule, and Y represents a fructose molecule, the Z would represent a
   A. dipeptide molecule
   B. starch molecule
   C. triglyceride molecule
   D. sucrose molecule

8. Which of the following would represent the enzyme-substrate complex?
   A. N B. X C. Y D. XYN E. Z

9. Which of the following would represent an enzyme?
   A. N B. X C. Y D. XYN E. Z

10. If Z represents a dipeptide molecule, which of the following would represent an amino acid?
    A. N B. X C. XYN D. none of the above

11. Does the process shown represent dehydration synthesis of hydrolysis?
    A. dehydration synthesis B. hydrolysis
4 CHEMICAL COMPOUNDS OF LIFE
Activity 2. Enzymes

ENZYME ACTIVITY

Enzymes are proteins that act as catalysts in living cells. As catalysts, they increase the rate of chemical reactions, allowing the reactions to proceed rapidly when they would otherwise occur only very slowly.

Enzymes are highly specific in their catalytic activity. The specificity of enzyme action is the result of a "lock-and-key" arrangement in which the enzyme and the substance it reacts with (the substrate) join together to form an enzyme-substrate complex. In this case the place of reaction, called the active site, is fixed. The "induced-fit" hypothesis suggests that the active site is not a fixed arrangement but is flexible, to allow for a better fit.

When a reaction is completed, the enzyme and the newly formed reaction products separate, leaving the enzyme unchanged. Enzymes are highly efficient catalysts. Only small quantities are needed to catalyze the reaction of relatively large amounts of materials. Each enzyme has an optimum range of temperature and pH at which it operates most efficiently.

1. The substance with which an enzyme reacts is its ____________________________

2. Is an enzyme "used up" by the reaction it catalyzes? Explain.

3. In what way does an enzyme affect the reaction it catalyzes? How does the enzyme produce this effect?

4. What is the active site of an enzyme?

5. What is meant by enzyme specificity?

6. Could life as we know it exist without enzymes? Explain.
Questions 7–10 are based on the preceding graphs.

7. According to graph A, at what temperature is enzyme activity the greatest?

8. According to graph B, what is the optimum pH for pepsin? As pH increases above that point, what happens to enzyme activity?

9. According to graph C, how does increasing enzyme concentration affect the rate of enzyme action when the substrate concentration remains constant?

10. According to graph D, how does increasing substrate concentration affect the rate of enzyme action when enzyme concentration remains constant?