

Student Name _____ Tutor: _____

Biology Tutorial #5

Biology Teacher's Name _____ Period _____

CA State Standard: 1b – Students know enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.

WHAT ARE ENZYMES?

Enzymes, almost all of which are proteins, increase the rate of biochemical reactions. Enzymes do not alter the products or the equilibrium of a reaction, and they are not used up during a reaction. One enzyme molecule can be used over and over to catalyze multiple reactions. There are thousands of enzymes and each works in a specific biochemical reaction.

WHY ARE ENZYMES IMPORTANT? Living things need enzymes to survive because most biochemical reactions occur at such a slow rate that they could not meet the needs of living cells. Without enzymes, processes such as digestion and ATP production would take much too long to sustain life. Enzymes are thus essential to organisms.

HOW DO ENZYMES WORK?

Enzymes reduce the **activation energy**, or the amount of energy that needs to be absorbed by the reactants before a reaction can start. Because the reaction requires less energy, the rate of the reaction increases. The reactant molecule or molecules, called **substrates**, fit into specific sites of the enzyme, called active sites (lock-and-key model). The substrates are brought together and their chemical bonds are weakened. The activation energy required to break these weakened bonds is much less than it would be if the bonds were not weakened.

WHAT AFFECTS ENZYME FUNCTION?

If an enzyme's structure is changed, it may not function properly. An enzyme's ability to catalyze a reaction depends on many factors. The temperature, pH, and concentration of ions can all affect an enzyme's activity. Every enzyme has a narrow range of temperature, pH, and ion concentration in which it functions best. Outside of those ranges, the structure of an enzyme can change.

Low temperature can slow enzyme activity. Enzyme activity increases as temperature increases, up to a certain point-usually, body temperature. A high fever, cause hydrogen bonds within enzymes to break, which, in turn, causes the enzyme's structure to change. When enzyme structure changes, substrates may not be able to bind properly to the enzyme. Similarly, changes in pH (too high or too low) and ion concentration (exposure to inappropriate concentrations or types of salts) may also result in the breakdown of hydrogen bonds and the inactivation of enzymes.

WHAT ARE ACIDS, BASES AND pH?

Acids are ionic compounds (a compound with a positive or negative charge) that break apart in water to form a hydride ion (H^+). There are more hydride ions than water in acids. Bases are ionic compounds that break apart to form a negatively charged hydroxide ion (OH^-) in water. There are more hydroxide ions than water in solution. The strength of an acid or base in a solution is measured on a scale called a pH scale. The pH scale is a measure of the hydrogen ion concentration. It spans from 0 to 14 with the middle point (pH 7) being neutral (neither acidic or basic). Any pH number **greater than 7** is considered a **base** and any **pH number less than 7** is considered an **acid**. 0 is the strongest acid and 14 is the strongest base.

Complete the following questions:

1. What is the function of an enzyme?
2. Explain how an enzyme works to speed up a chemical reaction.

3. How do changes in temperature or pH alter enzyme activity?

4. Proteins that reduce the amount of energy needed to start a chemical reaction are called

- A) reactants B) Ions C) sugars D) enzymes

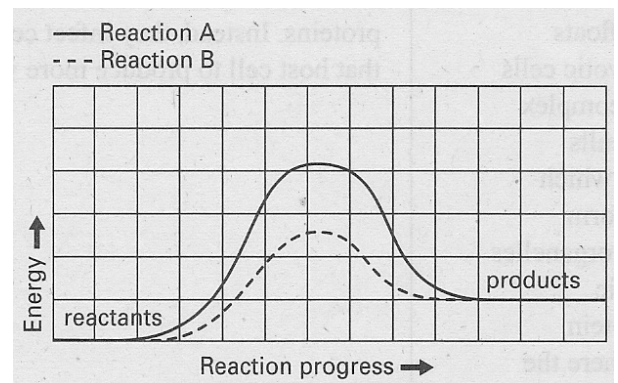
5. After the enzyme amylase breaks down a starch molecule, it can

- A) not be reused B) break down more starch molecules C) change its shape to adapt to a different reactant D) alter equilibrium conditions.

6. Enzymes depend on their structure to function properly. Which of the following does **NOT** alter an enzyme's structure?

- A) temperature B) pH C) concentration of reactants D) ionic conditions

7. Analyze and Explain. The graph on the right shows a biochemical reaction carried out in the presence and also in the absence of an enzyme. In which reaction, Reaction A or Reaction B, is the enzyme present? How can you tell?



8. In an experiment you find that high temperatures reduce enzyme activity. This result is most likely due to the effect of high temperatures on the:

- A) structure of the enzyme B) pH of the environment C) function of the reactants D) amount of activation energy required.

9. What determines whether a solution is acidic or basic?

Use the diagrams below to answer the following questions:

10. Which pathway has the final greatest activation energy usage?

11. Why are 2 pathways shown in the diagram in the graph on the right?

