

## AP Biology- Enzyme Activity Lab

### Learning Objective

Describe the properties of enzymes.

### Introduction/Background

**Enzymes are biological catalysts that carry out thousands of chemical reactions, which occur in living cells. They are generally large proteins made up of several hundred amino acids, and often contain a non-proteinaceous group that is important in the actual catalysis.**

In an enzyme-catalyzed reaction, the substance to be acted upon, the **substrate**, binds in the **active site** of the enzyme. The enzyme and substrate are held together in an enzyme-substrate complex by hydrophobic bonds, hydrogen bonds, and ionic bonds.

The enzyme then converts the substrate to the **reaction products** in a process that often requires several chemical steps, and may involve covalent bonds. Finally, the products are released into solution and the enzyme is ready to form another enzyme-substrate complex. **As is true of any catalyst, the enzyme is not used up as it carries out the reaction, but it recycled over and over.** One enzyme molecule can carry out thousands of reaction cycles every minute.

Each enzyme is specific for a certain reaction because its amino acid sequence is unique and causes it to have a unique three-dimensional structure. The "business" end of the enzyme molecule, the active site, also is specific so that only one or a few of the thousands of compounds present in a cell can interact with it. If there is a **prosthetic group** on the enzyme, it will form part of the active site. *Any substance that blocks or changes the shape of the active site will interfere with the activity and efficiency of the enzyme.*

If these changes are large enough, the enzyme can no longer act at all, and has become **denatured**.

There are several factors that are especially important in determining the enzyme's shape, and these are closely regulated both in the living organism and in laboratory experiments to give the optimum or most efficient enzyme activity:

1. **pH** – pH is a negative logarithmic scale that measures the acidity of  $H^+$  concentration in a solution. The scale runs from 0 to 14 with 0 being the highest in acidity and 14 the lowest. Neutral solutions have a pH of 7. Acid solutions have a pH less than 7, basic solutions have a pH greater than 7. Amino acid side chains contain groups such as  $-COOH$  and  $-NH_2$  that readily gain or lose  $H^+$  ions. As the pH is lowered, an enzyme will tend to gain  $H^+$  ions, and eventually enough side chains will be affected so that the enzyme's shape is disrupted. Likewise, as the pH is raised, the enzymes have an optimum in the neutral pH range and are denatured at either extremely high or low pH. Some have an appropriately low pH optimum. A buffer is a compound that will gain or lose  $H^+$  ions so that the pH changes very little.
2. **SALT CONCENTRATION** – If the salt concentration is very low or zero, the charged amino acid side chains of the enzyme will stick together. The enzyme will

# Ap Biology Enzyme Lab Answers

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