Pre-Lab Reading (Two Pages)

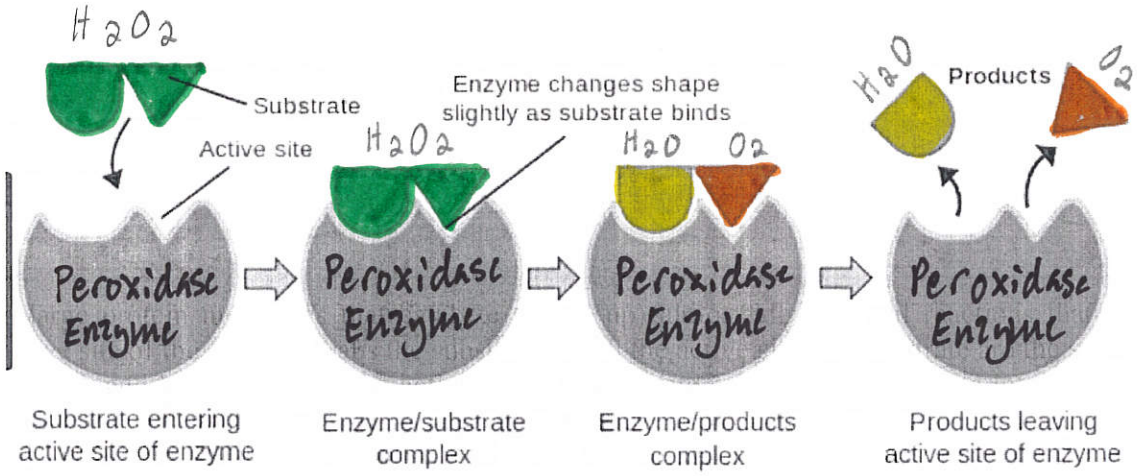
Chemical Reactions:
A chemical reaction is when molecules are changed. The molecule to be changed is called the substrate and the molecule it changes to is the product. Below is how chemical reactions are written:

$$\text{Substrate(s)} \xrightarrow[\text{Reaction}]{\text{Chemical}} \text{Product(s)}$$

The conversion of Hydrogen Peroxide (H_2O_2) into O2 and H20 is a good example of a chemical reaction. Below is how this chemical reaction is written:

$$H_2O_2 \xrightarrow[\text{Peroxidase}]{\text{Chemical Reaction}} H_20 + O_2$$

Enzymes:
Enzymes are large protein molecules that catalyze (speed up) almost all chemical reactions that occur in living things. The active site of the enzyme grabs the substrate. Both the active site and substrate are the same shape and fit together like a lock and key. While in the active site, the substrate converts the substrate into products. After the enzyme releases the products from the active site, it is ready to catalyze another reaction. The enzyme responsible for converting H_2O_2 into H_20 and O_2 is catalase in animals and peroxidase in plants. In addition to peroxidase/catalase, animals and plants have many other enzymes in their cells.

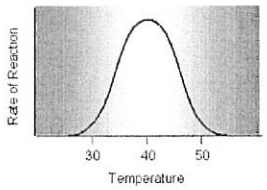


Peroxidase/Catalase Enzyme:
The purpose of peroxidase/catalase is to destroy toxic substances (hydrogen peroxide), which may be introduced into cells. If cells did not break down hydrogen peroxide, they would be poisoned and die, leading to the death of the organism. Hydrogen Peroxide (H_20_2) is a normal by-product of cellular metabolism but it is also toxic to cells. Under normal conditions, organisms produce the enzyme peroxidase that quickly changes hydrogen peroxide into two harmless substances, oxygen and water. However, the function of the enzyme is affected by changes in the environment.

Conditions Affecting Enzymes:
Enzymes have evolved to work most efficiently at the temperature and pH found in the part of the organism where they are needed. Many enzymes in potatoes for instance function most efficiently at room temperature (25° Celsius) and in soil with a pH of 7.4. If temperature and pH are too high or low, the enzymes will begin to denature (change shape), making it difficult for the substrate to fit in the enzyme's active site. Depending on how much the active site is altered will determine how much the reaction slows. The reaction may even stop altogether if each enzyme is denatured.

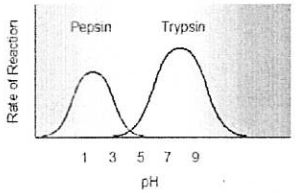
Temperature:
Each enzyme has an optical pH. Any temperature below or above the enzyme's optimal temperature causes the enzyme to denature (change shape). When the enzyme changes shape, the active site no longer fits with its substrate, the rate of the reaction begins to decline. For example, high temperatures causes egg whites to coagulate (thicken) because the enzymes within them denature. If the protein is not severely denatured, it may regain its normal structure. The rate of chemical reactions therefore increases with temperature but then decreases as enzymes denature. Refer to Figure 1.

Figure 1



pH:
Each enzyme has an optimal pH. Any pH below or above the enzyme's optimal pH also causes the enzyme to denature. Once again, when the enzyme's active site no longer fits with its substrate, the rate of the reaction begins to decline. The diagram below shows that pepsin functions best in an acid environment. This makes sense because pepsin is an enzyme that is normally found in the stomach where the pH is low due to the presence of hydrochloric acid. Trypsin is found in the duodenum, and therefore, its optimum pH is in the neutral range to match the pH of the duodenum. Refer to Figure 2.

Figure 2



Purpose of Lab:
During this lab, you will be testing the effects of pH and temperature on the peroxidase enzyme found in potato tuber. A tuber is the part of a potato plant that you eat. Potatoes need a specific climate to grow tubers. If conditions (temperature and pH) are not ideal, the tubers will die or stop growing.