**Enzyme Catalysis**

**INTRODUCTION:**

Enzymes are proteins that speed up the rate of chemical reactions in the body. The enzyme is not consumed or altered by the reaction. You have hundreds of different enzymes in each of your cells. Each of these enzymes is responsible for one particular reaction that occurs in the cell.

In this lab, you will study an enzyme that is found in the cells of many living tissues. Hydrogen peroxide (H2O2) is a poisonous byproduct of metabolism that can damage cells if it is not removed. The name of the enzyme is ***catalase***; it speeds up a reaction that breaks down hydrogen peroxide, a toxic chemical, into two harmless substances, water and oxygen.

The reaction is as follows: **2H2O2 ----> 2H2O + O2**

This reaction is important to cells because hydrogen peroxide (H2O2) is produced as a byproduct of many normal cellular reactions. If the cells did not break down the hydrogen peroxide, they would be poisoned and die. In this lab, you will study the ***catalase*** found in liver cells.

**PURPOSE:**

In this investigation, you will be examining this reaction, and several factors that affect the ability of catalase to function. We will be measuring the quantity of oxygen gas liberated as a by-product of this reaction. We will be using catalase extracted from liver cells, which have a high concentration of catalase.

Each group will complete part A, and then continue to investigate and report on one or two of the following questions. EVERY STUDENT IS RESPONSIBLE FOR RECORDING THE RESULTS OF ALL EXPERIMENTS in his/her lab report.

**PROBLEMS:** *Determine a hypothesis for the problems that your group tests in Part B.*

**1. What is the effect of enzyme concentration on enzyme activity?**

**2. What is the effect of substrate concentration on enzyme activity?**

**3. What is the effect of pH on enzyme activity?**

**4. What is the effect of temperature on enzyme activity?**

**MATERIALS AND PROCEDURE:**

Liver extract water prepared reaction chambers

hydrogen peroxide ice 100ml graduated cylinder

forceps plastic dish tubs 20 – 30 filter paper discs (punch-outs)

**Part A: Standardizing the Amount of Catalase**

1. Punch out about 20 – 30 discs from filter paper.

2. Put the discs in the catalase solution until they are saturated.

3. One by one, using forceps, remove four of your discs from the catalase solution and wipe off any extra catalase on the edge of the container. They should be saturated but not dripping.

4. Place all four discs on one interior wall of your reaction chamber.

5. Using a syringe, carefully measure out 10ml of 3% H2O2. While the reaction chamber is upright, add the H2O2. Do not allow the H2O2 to make contact with the catalase dots!

6. Stopper the chamber with the stopper with the plastic tubing inserted into it. Gently lay the reaction chamber on its side in a container of water with the 4 paper catalase dots facing up.

7. Fill a graduated cylinder with water so that there are no air bubbles. Hold the graduated cylinder over the end of the rubber tubing extending out of the reaction chamber

8. Turn the reaction chamber 180o so that the H2O2 comes in contact with the catalase dots.

9. Measure the gas levels in the graduated cylinder at 30 - second intervals for 10 minutes. Record this data into your data table . If your graduated cylinder fills up with gas, have a second cylinder ready to trade places with the first one and continue your readings.

10. Repeat the experiment one more time. Record data on table.

11. Record your data on the board.

**Part B: Design you own experiment**

Choose one of the four options to further investigate factors that can influence the rate of reaction for catalase. You will fill out an Experimental Design Diagram, collect data, and graph the data you collect for Part B. Be sure to record your data on the board for a class discussion. All materials can be found on the teacher table.

1. Enzyme concentration effect on rate of reaction

2. Substrate concentration effect on rate of reaction

3. pH effect on rate of reaction

4. Temperature effect on rate of reaction

##### DATA: (Use your reference page!)

Include two data tables in this section, one for Part A and one for Part B.Make sure to provide appropriate and accurate data, as well as a title for each data table.

**Rate of enzyme activity = volume of O2 evolved ml / time (30 sec. interval).** We will assume that each filter is coated with the same amount of catalase.

For EACH part, construct a **graph** of the independent variable vs. the dependent variable. This means you will have two graphs, one from Part A and one from Part B. Label each axis properly, be sure to include appropriate units. Title each graph.

**RESULTS:**

1. How could you design a control for this experiment?
2. Would catalase function in the mammalian stomach? Would catalase function in the mammalian intestine? Explain
3. The catalase we used came from a liver which was obviously not alive, yet the catalase was still very active. Explain this phenomenon.
4. Explain the results of your independent investigation from Part B. Why did your results occur?

##### CONCLUSION:

Summarize what you did and why. Answer the following questions in a paragraph.

1. Describe the function of catalase. Detail the general conditions which catalase needs to operate effectively. Are these conditions the same for all enzymes? Cite examples.
2. Explain the results of the experiment Part A and Part B. Be sure to include how and why your experiment (Part B) affected the rate of reaction.

