LAB: An Enzyme in Plant and Animal Tissues

BACKGROUND INFORMATION:
Liver and other living tissues contain the enzyme catalase. This enzyme breaks down hydrogen peroxide ($\text{H}_2\text{O}_2$), which is a harmful by-product of cellular respiration if it builds up in cells. In this lab, you will perform reactions with the enzyme catalase.

INTRODUCTION:
What would happen to your cells if they made a poisonous chemical? You might think that they would die. In fact, your cells are always making poisonous chemicals. They do not die because your cells use enzymes to break down these poisonous chemicals into harmless substances. Enzymes are proteins that speed up the rate of reactions that would otherwise happen more slowly. The enzyme is not 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. The name of the enzyme is catalase (KAT-uh-LAYSS); it speeds up a reaction that breaks down hydrogen peroxide, a toxic chemical, into 2 harmless substances—water and oxygen.

The reaction is as follows: $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$

This reaction is important to cells because hydrogen peroxide ($\text{H}_2\text{O}_2$) is produced as a byproduct of many normal cellular reactions. If the cells did not break down the hydrogen peroxide, they would build up toxic levels of this chemical and potentially die. In this lab, you will study the catalase found in plant and animal cells. It might seem strange to use dead cells to study the function of enzymes. This is possible because when a cell dies, the enzymes remain intact and active for several weeks, as long as the tissue is kept refrigerated.

OBJECTIVE: Investigate the enzyme catalase in various tissues. How does denaturing the enzyme catalase affect its function?

MATERIALS: 5 test tubes, test tube rack, hydrogen peroxide solution, 100 ml graduated cylinder, forceps, a variety of animal and plant tissues (liver, hotdog, potato, carrot, apple), 2 pieces of paper towel.

PROCEDURES/OBSERVATIONS:
PART A – A Comparison of Tissues
1. On the lab cart are slices of various plant and animal tissues. DO NOT TOUCH the samples at any time with your fingers. Use the appropriate forceps to take a piece of each of the control group tissues and place it on a piece of paper toweling. Keep each piece away from the others on the towel, and LABEL the towel for their identification.
2. Take 5 clean test tubes and pour 5 ml of fresh hydrogen peroxide solution into each tube. (CAUTION: Hydrogen peroxide, if spilled on clothing, will produce discoloration).
3. Select a tissue sample and with CLEAN forceps place it in each tube. Observe and record the results in DATA TABLE #1.
4. Repeat step 2 & 3 until you have tested all tissues and recorded the rest of your results in DATA TABLE #1.

5. Empty the tubes into the trash or waste beaker (DO NOT ALLOW ANY FOOD DOWN THE SINK DRAIN!). Rinse out test tubes and place on drying rack.

Data Table 1- An Enzyme in Control Plant and Animal Tissues

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>PLANT or ANIMAL?</th>
<th>OBSERVATIONS ON A SCALE (0-5)</th>
<th>ACTIVE CATALASE? (YES/NO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot Dog</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Carrot</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Potato</td>
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<td></td>
<td></td>
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<td>Apple</td>
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</tbody>
</table>

PART B – Design An Experiment

In the second part of this lab you are to design an experiment that will answer the question posed in the original objective “How does denaturing the enzyme catalase affect its function?” You will have one class period to design the experiment and one class period to carry out the experiment. You will need to have both the procedure and materials list approved by your teacher.

You have already researched how enzymes work in your pre-lab assignment and studied the control group in part A of the lab. You may conduct more research if it is needed. Be sure to keep track of sources you have used, they will need to be cited. Once you have conducted your research begin by generating a hypothesis and then design the test for it!

Hypothesis:

If…____________________________________________________

Then…__________________________________________________

Because…______________________________________________
Materials:

Procedure:
For your Formal Lab Report

Answer the following questions as part of your Introduction! (Note: These questions should not be the ONLY thing you write in your introduction)

- Catalase is an enzyme. What is the job of all enzymes?
- Write the chemical reaction for the breakdown of hydrogen peroxide by the enzyme catalase.

Answer the following questions as part of your Conclusion! (Note: These questions should not be the ONLY thing you write in your conclusion)

- How did you know whether a sample tissue in this lab had active catalase in it or not?
- Which of the tissues was most active in catalase activity?
- Which of the tissues is least active in catalase activity? Why is this so?
- Hydrogen peroxide is frequently used as an antiseptic. When poured on an open wound, hydrogen peroxide begins to bubble. What does this indicate to you about human tissues?
- What are the effects of a drastic change in pH or temperature on enzyme activity? Be sure to include information that you observed during part B of the experiment.
- The temperature of the liver of the mammal from which the liver was extracted was probably around 38°C. What do you think would happen to the activity of catalase if the liver temperature was increased BRIEFLY to 40°C?
- What do you think would happen to the activity of catalase if the liver temperature were increase drastically to 100°C? Explain and be specific!