**Catalase Lab**

**Honors Biology 1**

**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Per:\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_**

Why your liver is awesome and other lessons.

**Introduction:**

What would happen to your cells if they made a poisonous chemical? You might think 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 chemicals into harmless substances.

**Enzymes are proteins that speed up reactions.** They are not changed during the reaction, which means they can be used over and over again. You have hundreds of different enzymes in your cells. Each of these enzymes is responsible for one particular reaction that occurs in your cells.

In this lab, you will study an enzyme that is found in the cells of many living things. **The name of this enzyme is catalase.** It speed up a reaction which breaks down Hydrogen Peroxide (H2O2) into 2 harmless substances—water and oxygen.

**Here’s the chemical reaction:**

**Catalase**

**2 H2O2 (l)-------------------------------------► 2 H2O (l) + O2(g)**

If catalase is present

***Which means:*** Hydrogen Peroxide (liquid) ---------changes into---------► Water (liquid) + Oxygen (gas)

**VOCABULARY:** In this reaction which items are **substrates** and which are **products**?

*A substrate is* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

In this lab, the substrate we’re using is\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

*A product is* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

In this lab, the products produced are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

*The enzyme* we are testing is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. In humans and other mammals, catalase is concentrated in your liver, which filters toxins out of your body.

Sometimes, enzymes can become **denatured**, which means their 3-D shape is changed. Since the shape of an enzyme determines its function, denatured enzymes no longer work. High temperatures, high or low pH, and toxins like alcohol or heavy metals can all denature enzymes.

**Procedure: You must wear safety goggles and aprons during this lab.**

1. Gather the following materials and take them back to your desk:
   1. Test tube rack
   2. 4 CLEAN test tubes
   3. 1 CLEAN 10 ml graduated cylinder
   4. 1 CLEAN glass stirring rod
   5. 50 ml of Hydrogen Peroxide in a small CLEAN beaker

\*\*\*BE SURE TO CLEAN YOUR BEAKERS AND TEST TUBES BEFORE YOU START EACH DAY AND BETWEEN TESTS TO AVOID CONTAMINATION!

1. Number your test tubes 1-4 using a red grease pencil or masking tape and a sharpie.

**Part 1: Normal Catalase Activity**

1. Measure 2 ml of Hydrogen Peroxide using your graduated cylinder and pour it into Tube 1. Is the Hydrogen Peroxide bubbling? **Circle one : Yes No**
2. Bring your test tube rack up to the front table. Using forceps, add a small piece of liver to Tube 1. Push it to the bottom using a glass stirring rod. What happens? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. *Refer back to the chemical reaction on the first page.* What gas is creating the bubbles? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Record the rate of reaction you observed\_\_\_\_\_\_\_\_\_\_\_. Consider 0 to be no bubbles and 5 to be bubbling over the top of the tube. ***Draw a guide here:***
4. Feel the bottom of the test tube. Does it feel hot or cold? \_\_\_\_\_\_\_\_\_\_\_\_.

**Exothermic reactions** give off heat while **endothermic reactions** must absorb heat in order to occur. Which type of reaction is occurring here? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Pour ONLY the liquid out of Tube 1 into Tube 2. What is this liquid? \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Test whether catalase can be reused. Add 2 ml of Hydrogen Peroxide to the used liver in Tube 1. Does the liver react again? \_\_\_\_\_\_\_\_\_\_. Is catalase reusable? \_\_\_\_\_\_.

Why? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Now let’s see if the liquid is reusable. Get a fresh piece of liver and place it in Tube 2. What happens?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Why?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Clean Tubes 1 and 2 for the next test. Come up front and get small pieces of the other food items, one cube in each tube. Add 2 ml of Hydrogen Peroxide to each tube and record the rates of reaction in Table 1. (see table 1 on the next page for test tube order)

**Table for Part 1: Normal Catalase Activity**

|  |  |  |
| --- | --- | --- |
| **Test Tube #** | **Food Item** | **Reaction Rate (0-5)** |
| 1 | Raw Liver |  |
| 2 | Carrot |  |
| 3 | Potato |  |
| 4 | Other:\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |

**Sketch a bar graph below: Be sure to label each axis with units and add a title.**



**DAY 2: Part 2: Effect of Temperature on Catalase Activity**

**DRAW A PICTURE HERE OF THE LAB SET-UP FOR PART 2:**

A. Set up 3 beakers at your desk. One ¾ full of ice water, one ¾ full of room temperature water, and one ¾ full of warm water. Use a thermometer to test their temperatures and record in Table 2.

B. Bring your test tube rack back up to the front desk. With forceps, add a piece of BOILED liver to Tube 4. Add RAW liver to Tubes 1, 2, and 3.

C. Get 3 additional clean test tubes and put 2 ml of Hydrogen Peroxide in each one.

D. Place 1 tube of Hydrogen Peroxide and Tube 1 in the Ice Bath, 1 tube of Hydrogen Peroxide and Tube 2 in the Room Temp Bath, and 1 tube of Hydrogen Peroxide and Tube 3 in the Warm Water Bath. Let them sit for 10 minutes.

E. Add 2 ml of Hydrogen Peroxide (room temperature) to Tube 4 (BOILED liver). Record results in Table 2.Explain these results:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

F. After 10 minutes have passed, pour the tubes of Hydrogen Peroxide into their corresponding tubes of liver. Record the reaction rates in chart 2.

What is the independent variable in this test? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

What is the dependent variable? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

What is the optimum temperature for catalase (biggest reaction)? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Why did the reaction proceed so slowly at 0°C? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Table for Part 2: Effect of Temperature on Catalase Activity**

|  |  |  |
| --- | --- | --- |
| **Test Tube #** | **Temperature** | **Reaction Rate (0-5)** |
| 1 | Ice Bath **0°C** |  |
| 2 | Room Temp **\_\_\_\_\_°C** |  |
| 3 | Warm Water Bath **37°C** |  |
| 4 | Boiled Liver **100°C** |  |

**Sketch a bar graph:**



**Part 3: The Effect of pH on Catalase Activity**

A. Starting with clean test tubes, pour 2 ml of the pH-adjusted Hydrogen Peroxide into each tube and record their pH’s in Table 3.

B. Add one piece of liver to each tube and record the reaction rate in Table 3.

What is the independent variable in this test? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

What is the dependent variable? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

What is the optimum pH for catalase (biggest reaction)? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

How would you describe the effect of high and low pH on catalase activity? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Name 2 conditions that slowed or stopped the action of the enzyme catalase.

1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ectothermic organisms have body temperatures that vary with the temperatures of their surroundings (also called cold-blooded). What effect might this variation have on the functioning of enzymes in these organisms? Suggest some ways to cope with this problem.

**Table for Part 3: Effect of pH on Catalase Activity**

|  |  |  |
| --- | --- | --- |
| **Test Tube #** | **pH** | **Reaction Rate (0-5)** |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |



**Conclusions: Write 2 paragraphs describing your findings.**

**Paragraph 1)** Tell me what you learned from this lab. Which tests decreased the level of enzyme activity? Which tests made the rate faster? Provide specific examples from your data and refer to your graphs to explain the optimum pH and temperature for catalase. Why did we get these results?

**Paragraph 2)** Explain errors in this lab and what you would do differently if you did it again. Propose another experiment to test enzyme activity.