Name:	_Period:	_ Date:		
Ms. Randall A & P (compliments of biologycorner.com)				
Lab activity: Enzymes				

Background: 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; it speeds up a reaction which breaks down hydrogen peroxide, a toxic chemical, into two harmless substances \rightarrow water and oxygen.

The reaction is: $2H_2O_2 \rightarrow 2H_2O + O_2$

This reaction is important to cells because hydrogen peroxide (H_2O_2) 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. You will be using chicken or beef liver. 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.

Objectives

- Measure the effects of changes in temperature, pH, and enzyme concentration on reaction rates of an enzyme
- Explain how environmental factors affect the rate of enzyme-catalyzed reactions.

Materials:

6 Test tubes Test tube holders 3% Hydrogen peroxide Straight-edged razor blade Scissors and Forceps Measuring Pipettes Stirring rod Fresh liver, Apple, and Potato, Yeast Vinegar / Baking Soda HCL and NaOH pH paper (optional) Ice bath Warm water bath Boiling water bath

CLAIM-EVIDENCE-REASONING (RUBRIC)

	Accomplished (3)	Proficient (2)	Developing (1)
CLAIM	Makes an accurate and complete claim, uses complete and grammatically correct sentences	Makes an accurate, but incomplete claim, or grammatically incorrect	Claim is not accurate, incomplete, or unintelligible
EVIDENCE	Provides appropriate and sufficient evidence to support claim by referencing specific data, observations, or text evidence (for readings)	Provides appropriate data but insufficient data, too general or lacking in details	Provides evidence but it is insufficient, inaccurate, no details
REASONING	Provides thorough reasoning that links evidence to the claim, references scientific principles that are relevant to claim	Provides reasoning that links evidence to the claim, lacks scientific principles	Does not provide reasoining, or reasoning does not link evidence.

Throughout this investigation you will estimate the rate of the reaction (how rapidly the solution bubbles) on a scale of 0-5. $(0=no\ reaction,\ 1=slow,\\ 5=very\ fast)$. Assume that the reaction in step 2 proceeded at a rate of ''4''

Safety goggles must be worn at all times!!!!

PART A - Is catalase reusable?

Your prediction:

1. Place 2 ml of the 3% hydrogen peroxide solution into a clean test tube.

2. Using forceps and scissors cut a small piece of liver and add it to the test tube. Push it into the hydrogen peroxide with a stirring rod. Observe the bubbles.

What gas is being released? (Consider the equation.)

3. Recall that a reaction that absorbs heat is **endothermic**; a reaction that gives off heat is **exothermic**. Now, feel the temperature of the test tube with your hand.

Has it gotten warmer or colder ______ Is the reaction endothermic or exothermic? ______

4. Pour off the liquid into a second test tube. Assuming the reaction is complete.

What is this liquid composed of? _______

5. What do you think would happen if you added more liver to this liquid?

- Test this and record the reaction rate. Reaction Rate (0-5)
- 6. Add another 2 ml of hydrogen peroxide to the liver remaining in the first test tube.
 - What is the reaction rate? (0-5)

Analysis: Is catalase reusable?

CLAIM:

EVIDENCE:

<u>REASONING</u>:

Part B: Do all living tissues contain catalase?

Your prediction:

You will now test for the presence of catalase in tissues other than liver. Add each of the three test substances to the tubes then add 2 ml of hydrogen peroxide into each. As you add each test substance, record the reaction rate (0-5) for each tube.

Substance	Apple	Potato	Yeast
Rate of Reaction (0-5)			

Analysis: Do <u>all</u> living tissues contain catalase?

<u>CLAIM</u>:

EVIDENCE:

REASONING:

PART C – How does temperature affect the catalase enzyme?

Your prediction:

1. Put a piece of liver into the bottom of a clean test tube and cover it with a small amount of water. Use a test tube clamp to place it in a boiling water bath for 5 minutes.

Remove the test tube from the hot water bath, allow it to air cool, then pour out the water. Add 2 ml of hydrogen peroxide.

• What is the reaction rate for the boiled liver and peroxide?

3. Put equal quantities of liver into 2 clean test tubes and 1 ml H_2O_2 into 2 other test tubes. Put one test tube of liver and one of H_2O_2 into an ice bath. Place the other set in a warm water bath (not boiling).

After 3 minutes, pour each tube of H₂O₂ into the corresponding tube of liver and observe the reaction

- What is the reaction rate for the cold liver/peroxide?
- What is the reaction rate for the warm liver/peroxide?





Analysis: How does temperature affect the catalase enzyme?

<u>CLAIM</u>:

EVIDENCE:

REASONING:

PART D - How does pH affect the activity of enzymes?

The following graph shows reaction rates of various enzymes in the body. Pepsin is found in the stomach, amylase in the saliva, and phosphatase in the liver.



Question: What will be the optimal pH for the catalase?

Your prediction:

Adjust the pH of liver in 5 test tubes using the following. Caution HCl and NaOH are strong acids and bases and can burn the skin.

3M HCl 3M NaOH Acetic acid Baking soda Tap Water

Use pH paper to determine the actual pH of each liver sample once it has been treated. Add 2 mL of H_2O_2 and determine the enzyme reaction rates for each on a scale of 0-5.

	3M HCl	3M NaOH	Acetic Acid	Baking Soda	Tap water
pН					
Reaction Rate					

Analysis: What will be the optimal pH for the catalase?

CLAIM:

EVIDENCE:

REASONING: