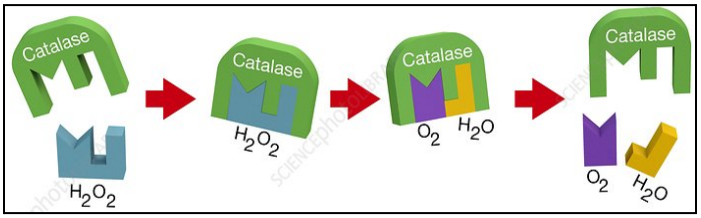
Fizzing Livers: Analyzing Enzymatic Rates

INTRODUCTION:

What would happen to your cells if they made a poisonous chemical? You might think that they would die. Interestingly enough, your cells are always making poisonous chemicals, and not dying. This is because your cells use proteins known as enzymes to speed up the conversion of these poisonous chemicals into harmless ones that are useful.

According to the rule of complementary binding, all of the enzymes in your body are responsible for one specific chemical reaction. In this lab, you will investigate an enzyme called catalase (KAT-uhLAYSS). It is responsible for breaking down hydrogen peroxide (H_2O_2). When hydrogen peroxide accumulates inside cells, it becomes extremely poisonous and could result in cell death. Therefore, cells rely on catalase to convert hydrogen peroxide into nontoxic molecules, such as water and oxygen. Below is the chemical reaction of catalase breaking down hydrogen peroxide:



Different living things have different amounts of catalase in their cells. You can determine the relative amount of catalase present by measuring the cells' rates of reaction when they come into contact with peroxide. A rate of reaction is how fast a chemical reaction occurs. Since enzymes speed up chemical reactions, a fast reaction rate would mean there is a lot of catalase present. Key characteristics of a fast reaction rate are lots of bubbles, foam, and cloudiness. Use the table below as a scale for reaction rates.

Reaction Rate	Description of Reaction Rate
0	No reaction, no bubbles
1	Very slow reaction, very few bubbles/foam
2	Slow reaction, some bubbles/foam
3	Fast reaction, more bubbles/foam than 2
4	Very fast reaction, lots of bubbles/foam

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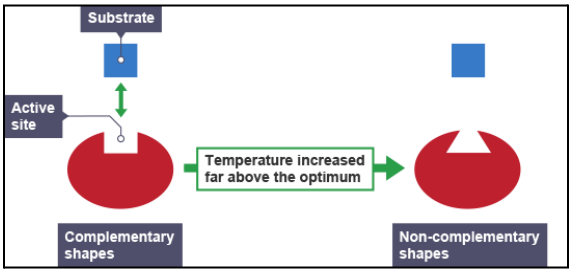
Enzymes stop working when they are placed in extreme conditions outside of their optimum range, such as extreme heat. This is known as denaturation. Denaturation changes the shape of the enzyme's active site, meaning the enzyme and substrate no longer complement one another. As a result, binding does not occur and the chemical reaction will not take place. Hence, a reaction rate of 0.



PURPOSE:

To determine the amount of catalase present in different organisms - chicken liver, apples, and potatoes - and to visualize the effects of heat on catalase.

PROCEDURE:

1. Fill a beaker halfway with water and place it on the hot plate to boil.
2. Using the scalpel and scale, weigh out 1.0 g of potato, apple, and liver. Weigh out TWO 1.0 g samples of liver.
3. Using the tweezers, place ONE sample of chicken liver in a test tube. Be sure to get the sample to the bottom.
4. Stand the test tube in the boiling water and let it boil while completing steps 5-10.
5. Using the tweezers, place the APPLE sample in a test tube. Be sure to get the sample to the bottom.
6. Secure the apple test tube onto the test tube holder.
7. Pour one pipet full of hydrogen peroxide solution into the apple's test tube.
8. Observe the reaction as it occurs. Record any observations you can see, and prescribe a reaction rate number using the rate table.
9. Set aside the apple's test tube by standing it up on the test tube rack.
10. Repeat steps 5-9 for the POTATO and RAW liver sample in new test tubes.
11. Carefully remove the test tube of liver boiling in the water.
12. Repeat steps 6-9 for the BOILED liver test tube.

MATERIALS RECEIPT
PRICES ARE APPROXIMATE

Hydrogen Peroxide (320z)	$1.00
Potato	$1.00
Apple	$0.80
Chicken Liver (1lb)	$2.00
Pipette (20pk)	$4.00
Test Tubes (4/group)	- - -
Test Tube Rack	- - -
Petri Dishes (4/group)	- - -
Knife	- - -
Tweezer	- - -
Glass Stirring Rod	- - -
Scale	- - -
PPE-Gloves, Apron, Goggles	- - -
TOTAL	**$8.80**

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DATA/OBSERVATIONS: **Record** reaction rates of each sample. **Record** visual observations of each sample.

Sample	Reaction Rate (0-4)	Observations
Apple		
Potato		
Raw Liver		
Boiled Liver		

CONCLUSIONS:

1. Which sample contained the MOST catalase enzyme? Use evidence to justify your reasoning.

_____

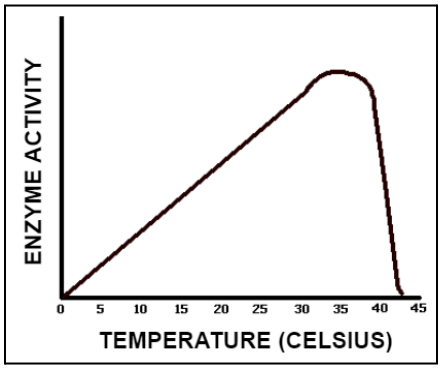
_____

2. Which sample had the SLOWEST reaction rate? Why was this the case?

_____

_____

3. The graph shows the enzymatic activity of catalase at different temperatures.



   A. What is the optimum temperature of catalase? _____

   B. Which sample from the experiment BEST represents catalase working at this temperature? Explain.

_____

_____

   C. Besides 0, what temperature does catalase completely denature? _____

   D. Which sample from the experiment BEST represents catalase working at this temperature? Explain.

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