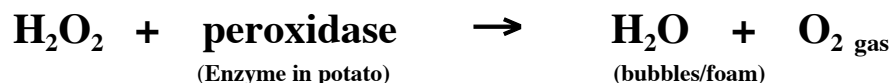


Does Temperature Affect an Enzyme Reaction?

CLASS SET – PLEASE RETURN!

Background Information:

The compound hydrogen peroxide (H_2O_2), is a by-product of metabolic reactions in most living things (cells). However, hydrogen peroxide is damaging to delicate molecules inside cells. As a result, nearly all organisms contain the enzyme peroxidase, which breaks down H_2O_2 as it is formed. Potatoes are one source of peroxidase. Peroxidase speeds up the breakdown of hydrogen peroxide (H_2O_2) into water and gaseous oxygen. This reaction can be detected by observing the oxygen bubbles generated. See reaction below.



I. Purpose: (*don't copy this!*)

To observe enzyme activity at various temperatures.

Problem:

Does the enzyme peroxidase work in cold temperatures? Does peroxidase work better at higher temperatures? Does peroxidase work after being frozen or boiled?

II. Hypotheses: (*don't copy this!*)

Make a hypothesis regarding how you think temperature will affect the rate (speed) at which the enzyme peroxidase breaks down hydrogen peroxide. Consider low, medium, and high temperatures.

III. Materials:

Clock or timer, 400-mL beaker, scalpel, beaker tongs, pieces of potato, calibrated vials, 3% hydrogen peroxide(H_2O_2), ice, hotplate, and $^{\circ}\text{C}$ thermometer.

Plan the experiment: (*procedural hints- don't copy this!*)

1. Decide on a way to test your hypothesis. Keep the available materials in mind.
2. When testing the activity of the enzyme at a certain temperature, consider the length of time it will take for the potato to reach that temperature, and how the temperature will be measured. Be sure to **completely cover the potato with hydrogen peroxide**.
3. To test for peroxidase activity, add several drops of hydrogen peroxide(H_2O_2) to the potato.
4. When heating a piece of potato, first place it in a calibrated vial that is then placed in a small amount of water in the beaker (a water bath). Then heat the beaker slowly so that the temperature of the water and the temperature of the potato are always the same.
5. Make observations at 4 different temperatures between 5°C and 95°C .

HINT: Room temperature is about 26°C and does not require a water bath!

Check the plan: (*discuss the following points with your partner to decide on your final procedure for your experiment - don't copy this!*)

1. What data will you collect (*data tables*).
2. What factors or variables should be controlled?
3. What temperatures will you test?
4. How will you achieve those temperatures?
5. How many trials will you run?
6. How many trials will you run for each temperature?

IV. Procedure: Give a step-by-step detail of your experimental design.

V. Identify The Variables:

- What is the independent variable (X) (*the cause*)?
- What is the dependent variable (Y) (*the effect*)?
- What factors do you need to control in your tests?

VI. Data:

- Make a table including all data to be collected with proper units!
- Remember to run more than one trial in order to calculate averages.

Teacher sign off: _____

* Now you have the green light to begin your experiment.

VII. Analysis:

- Calculate the average foam production and overall *rate of reaction* for each temperature.
- Create a **line graph** to illustrate your data.
- Be sure to have a ***title and properly labeled axis***.
- You will be graphing the rate of reaction versus temperature.

$$\text{Rate of reaction (ml/min)} = \frac{\text{average amount of foam (ml)}}{\text{reaction time (minutes)}}$$

VIII. Conclusion Questions: (*complete sentences please!*)

1. At what temperature did the enzyme peroxidase work best? How do you know?
2. According to your data, discuss what the affects of temperature is on enzyme activity (the rate of the reaction). In other words, how do changes in temperature affect the amount of foam produced?
3. If you've ever used hydrogen peroxide as an antiseptic to treat a cut or scrape, you know that it foams as soon as it touches an open wound. Based on your knowledge of peroxidase, how can you explain this observation of the wound foaming up? (Refer to the above chemical reaction)
4. According to your graph, what temperature(s) might be considered dangerous to the enzymes in your body? In other words, what temperature(s) *denature* the enzymes?

IX. Hypothesis Conclusion: (*write in paragraph form*)

- Restate your hypothesis. Does your data support or reject your hypothesis?
- Explain your results (give numbers here!)