Catalase Under Heat

Use trial data to model how temperature affects an enzyme.

BIO.1B "Students will analyze the structure and function of the macromolecules that make up cells. Develop and use models to compare and contrast the structure and function of carbohydrates, lipids, proteins..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the factor the student changed, circle three conditions kept the same, and number two statements that connect catalase's shape to its activity.

A Potato Enzyme at Work

1. A potato cell uses catalase, a protein enzyme, to break down hydrogen peroxide, a substance that can damage cells. Catalase speeds this reaction without being used up. Its folded shape forms an active site where hydrogen peroxide binds. DNA stores the instructions for making catalase, but DNA does not carry out this reaction.

2. A student tested how temperature affects catalase activity. Equal masses of potato extract were held at each listed temperature for five minutes. The student then added each sample to the same volume and concentration of hydrogen peroxide at that temperature. The pH and reaction time stayed constant. Each number shows oxygen collected in one minute.

OXYGEN COLLECTED FROM POTATO EXTRACT

Temperature (°C)	Trial 1 (mL/min)	Trial 2 (mL/min)
5	1	1
20	4	5
35	8	9
55	2	1

3. More oxygen per minute indicates a faster reaction. Warming can increase collisions between enzyme and substrate, but high heat can change a protein's folded shape and its active site. A lower rate at a high temperature is consistent with this change, though this test alone cannot prove the exact cause. Repeated trials help reveal variation.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do the structures and functions of catalase and DNA differ in this reaction?

2. Using the mean of the two trials at each temperature, how many times as much oxygen per minute was collected at 35°C as at 5°C? Show your calculation.

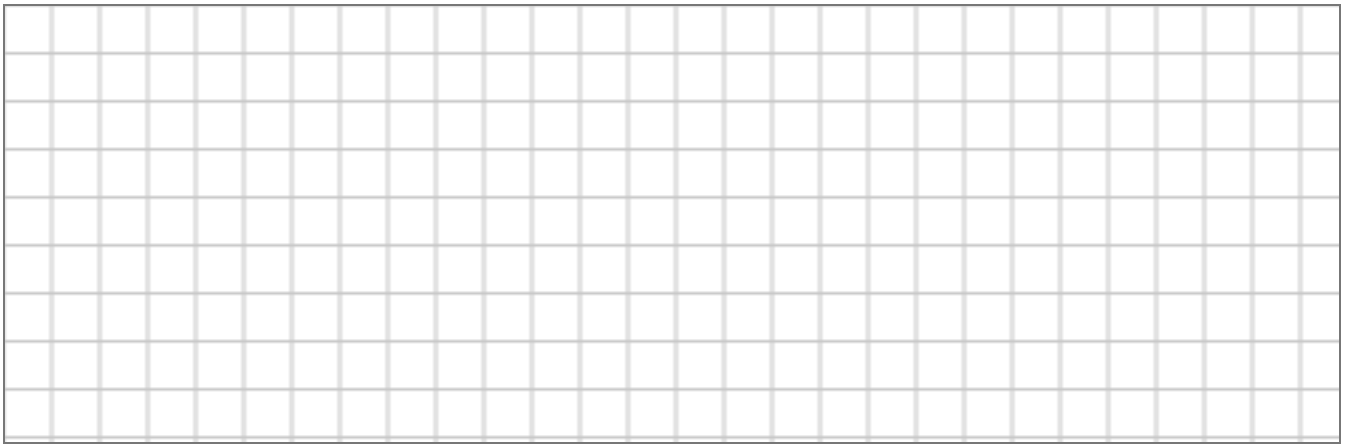
3. Why did the student keep the pH and hydrogen peroxide concentration the same in every test?

4. Which temperature, 5°C or 55°C, showed more variation between trials? Use the table to support your answer.

3 YOUR TURN

Your own words

On the grid, graph the mean oxygen collected per minute at each tested temperature. Below your graph, write two sentences that predict a mean rate at 45°C and explain your prediction using the pattern in your graph.



ANSWER KEY

Catalase Under Heat

PART 1 · READ AND MARK

Underline the factor the student changed, circle three conditions kept the same, and number two statements that connect catalase's shape to its activity. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do the structures and functions of catalase and DNA differ in this reaction?	**Catalase is a folded protein with an active site that speeds the reaction. DNA stores the instructions for making catalase but does not carry out the reaction.**
2	Using the mean of the two trials at each temperature, how many times as much oxygen per minute was collected at 35°C as at 5°C? Show your calculation.	**At 35°C, the mean is (8 + 9) ÷ 2 = 8.5 mL/min. At 5°C, it is 1 mL/min. The ratio is 8.5 ÷ 1 = 8.5 times.**
3	Why did the student keep the pH and hydrogen peroxide concentration the same in every test?	**Keeping them constant helps isolate temperature as the cause of any difference in oxygen production.**
4	Which temperature, 5°C or 55°C, showed more variation between trials? Use the table to support your answer.	**The 55°C trials differed by 1 mL/min, while both 5°C trials measured 1 mL/min, so 55°C showed more variation.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Graph points: (5, 1), (20, 4.5), (35, 8.5), and (55, 1.5), with temperature in °C on the horizontal axis and mean oxygen collected in mL/min on the vertical axis. At 45°C, I predict a mean rate of about 5 mL/min. This estimate is between the rates at 35°C and 55°C, where the graph drops sharply.

For the graph, accept correctly plotted means with labeled axes and units. Accept a reasonable 45°C prediction supported by the plotted pattern; the data do not establish an exact rate at that temperature.