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ADV Biology How Does Temperature Affect Enzyme Activity? Introduction:

Do enzymes work the same at all temperatures? In this experiment you will be heating the enzyme catalase to different temperatures and watching the changes in the reaction. Catalase, an enzyme found inside a potato, breaks down hydrogen peroxide into water and oxygen gas. The advantage of this reaction is that you can see the oxygen gas bubbling out as it is formed so you can tell how fast the reaction is happening.

Materials:

6 test tubes (2 small and 2 large)

hydrogen peroxide

3 equal sized cubes of potato about 1-2 cm on each side

masking tape or glass marking pencil

Procedures:

- 1. Using masking tape or glass marking pencil, label six test tubes as follows (one small and one large test tube):
 - label 2 tubes" Room Temp."

label 2 tubes "100°C"

- label 2 tubes "Body Temp"
- 2. Put 5 mL (be as precise as possible) of water into one of each large test tube (one for "Room Temp," "Body Temp" and one for "100°C")
- 3. Cut 3 cubes of potato, about 1-2 cm on each side. Make sure they are all about equal size, so that you have an equal amount of enzyme in each test tube.
- 4. Put a cube of potato in each of the large test tubes that contain the 5 mL water.
- 5. Now you are ready to heat the enzyme to the appropriate temperatures for 5 minutes minimum:
 - Put the test tube with the water and potato labeled "Room Temp" in your test tube rack.
 - Put the test tube with the water and potato labeled "Body Temp" into the 37°C water bath.
 - Put the test tube with the water and potato labeled 100°C into the "boiling" water bath.
- 6. While you are waiting, pour 5 mL of hydrogen peroxide into the other three small test tubes. It is important you measure accurately so there is the same amount of substrate in each tube.
- 7. Once the enzymes have heated to the appropriate temperatures:
 - Remove the test tubes using test tube tongs.
 - QUICKLY BUT CAREFULLY pour the test tube of hydrogen peroxide into the test tube of water and potato.
 - Do not pour the potato test tube into the hydrogen peroxide because the potato often gets stuck in the test tube and by the time you get it out, it has cooled down (or heated up) and your experiment is no longer valid.
 - You want to pour them quickly, before the enzymes have time to change temperature, but carefully so you do not spill them and have to begin again or burn yourself.
- 8. Carefully observe your results and record your data. Be sure to obtain precise qualitative data!
- 9. Clean up your stations. Throw the potato in the waste basket and the rest of the liquid in the sink. Remove all tape from your test tubes before putting them away.

Data:

- 1. Record how quickly and strongly the hydrogen peroxide bubbled when added to the potato.
 - a. Record the **speed** of the reaction, how quickly the hydrogen peroxide started to bubble.
 - Actually time your reaction and note how many seconds it took before you started to see bubbles.
 - If you never do see bubbles, note that.
 - b. Record the **strength** of the reaction, how strongly the bubbles formed.
 - Did the test tube look like a freshly poured soda, or one that is flat, or was it somewhere in between?
 - Rate the strength on a scale of 1-10 where 1 is weak and 10 is strong.

Record your data in the data table below:

Table 1: Observations of the Reactions between Potato and Hydrogen Peroxide at Different Temperatures

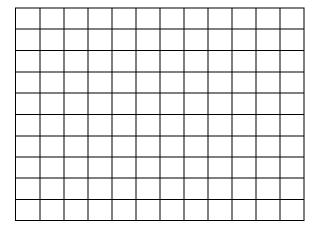
	ROOM TEMP 21 °C	BODY TEMP 37 °C	BOILING 100 °C
SPEED			
(# of			
seconds			
before			
bubbling			
started)			
STRENGTH (description and rating 1-10)			

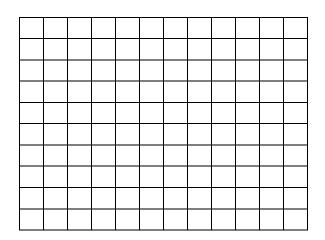
Results:

Create **two** bar graphs using the data you collected in Table 1. Ensure you label your axes and title your graphs:

- 1. Bar Graph 1: Strength versus Temperature
- 2. Bar Graph 2: Speed versus Temperature

Note: If any of the reactions never started (the speed was infinite) note that appropriately in your graph.





Analysis and Conclusion Questions:

- 1. At what temperature was the enzyme most effective (include the additional data into your answer)?
- 2. Why do you think the enzyme work better at that temperature?
- 3. Define the term denature.
- 4. At what temperature was the enzyme denatured?
- 5. What does this mean about what happened to the enzyme we used in the experiment at that temperature?