The power of pineapple: an enzyme lab story

How do pH, heat, and the concentration of enzymes impact the enzymatic activity of protease in breaking down gelatin?

Did you know that **gelatin** starts with animal hides, bones, and cartilage? To extract a protein called gelatin, these parts are crushed, treated with strong bases and acids, and boiled for hours. This protein extract is then dried and flavored to create the colorful snack we know.

In this lab, we are putting gelatin to the test using **enzymes**. Enzymes are specialized proteins that act as biological catalysts, speeding up chemical reactions (like digestion) by lowering the **activation energy** required. Enzymes are substances present in the cell in small amounts that function to speed up or catalyze chemical reactions. Changes in their environment (pH or temperature) as well as the concentration differences, can affect their ability to work correctly.

Our bodies produce them, but some foods carry their own "bite." For example, the slight burn you feel on your tongue after eating pineapple is caused by **bromelain**—a type of enzyme called a **protease**. This enzyme is actually beginning to break down the tissues in your mouth!

Today, we will test various solutions to see if they contain these same powerful proteases by observing how they interact with our gelatin.

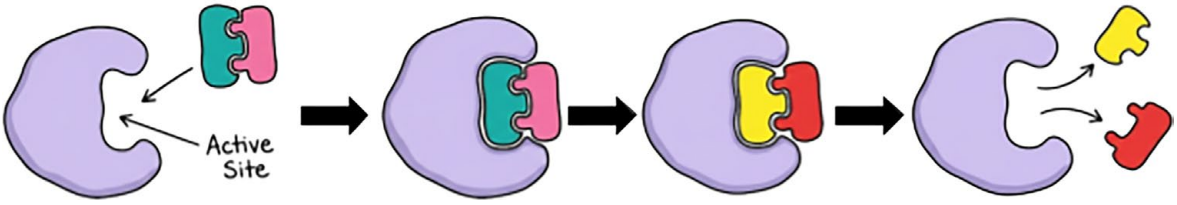
Materials

- 1 saltine cracker
- 1 Petri dish with prepared gelatin
- 1 straw
- 1 flat toothpick
- 1 Sharpie marker
- 1 metric ruler

Procedure

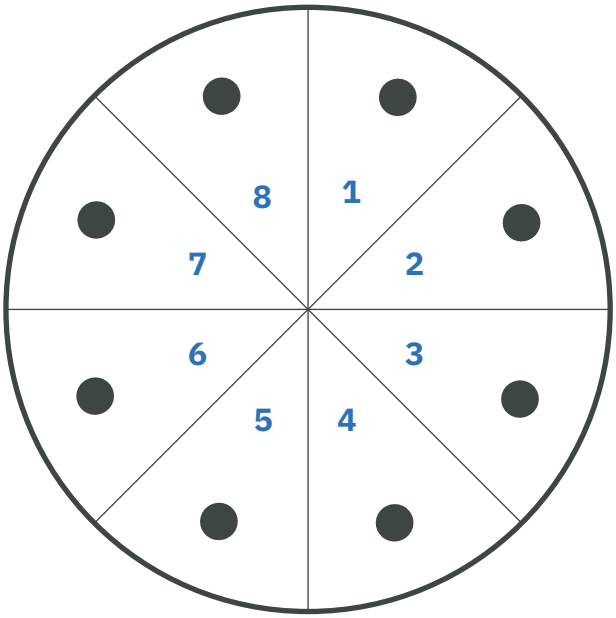
Pre-lab questions for day 1

1. Knowing that the names of enzymes end in -ase, what do you predict is the substrate of protease?
2. Based on the background information about gelatin, what effect might proteases such as bromelain have on the gelatin?
3. Do you think that protease performs hydrolysis or dehydration synthesis on its substrate? Why?
4. Label the following diagram using the terms **substrate, enzyme, enzyme–substrate complex,** and **product.**



Day 1

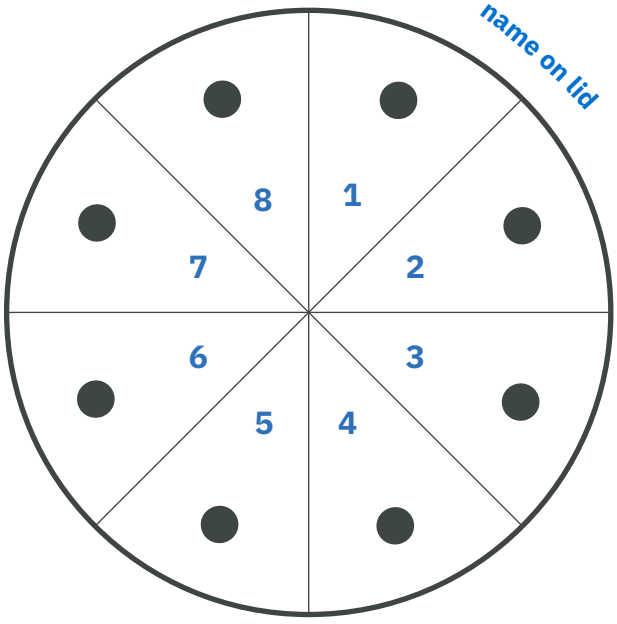
1. Place a gelatin-filled Petri dish upside down (plastic bottom facing you), on the provided template below. With the marker, trace the different sections. Then write your names along the edge.
2. Turn the dish right-side up on the template. Using the end of a straw, cut a well (on the black dots) into each section based on where they are on the picture.
3. Remove the cut sections with a toothpick, being careful not to tear the gelatin layer. Place the plugs on a paper towel and throw it away. **Do not eat the gelatin.**
4. Measure the diameter of each well in millimeters (mm). Record these measurements in the Data Table as "initial diameter".
5. Carefully load 2–3 drops of each solution into the wells. Don't overfill them. **Use only the dropper assigned to each solution.** If any liquid drops on the surface of the gelatin blot it off and note the location of the drop by drawing a picture on the picture of the plate below.
6. Load distilled water into well 7. Do not load anything into well 8.
7. Replace the lid on the Petri dish and write your names on it. Do not turn the dish upside down or the solutions will spill out! Place your dish where your teacher instructs you.



Well	Solution	Diameter of well (mm)		
		Initial	Final	Change
1	25% fresh pineapple			
2	50% fresh pineapple			
3	Frozen pineapple			
4	Canned pineapple			
5	Pineapple pH 1			
6	Pineapple pH 14			
7	Water			
8	(Empty)			

Post-lab questions for day 1

1. Based on the information you read about gelatin and pineapple juice on day 1 of the lab, draw your prediction of what might happen to each well in the gelatin plate using the template to the right.
2. Explain your reasoning for your predictions from the previous question. Be sure to use the terms enzyme, denaturation, and substrate.
3. How might the concentration of each solution affect the rate of enzyme activity?
4. How might the pH of each solution affect the rate of enzyme activity?
5. Why is it important to include a well with water and an empty well?



Day 2

1. After letting the gelatin sit overnight, observe the wells in the dish.
2. Empty the liquids from the Petri dish into the sink.
3. Measure the diameter of each well with a ruler (in mm) and record the data on the chart in the "final" column.
4. Calculate the total change in diameter in each well. (final diameter minus initial diameter)

Post-lab questions for day 2

1. What physical change occurred in some of the gelatin wells?
2. Which solutions increased the diameter of the wells? Why did these solutions increase the diameter?
3. In this lab both fresh pineapple juice and canned pineapple juice were used. What differences did you observe in the results and why did this difference occur?
4. Did protease perform hydrolysis or dehydration synthesis on the gelatin? What evidence from the lab supports this claim?
5. Label the following diagram using the terms **bromelain, gelatin,** and **amino acids.**