

PEEBEDU Enzyme Environment Explorer (NGSS)

Unit 3: Cellular Energetics

Name: _____ Period: _____ Date: _____

Open **peebedu.com** and navigate to **Enzyme Environment Explorer**. Use the **enzyme selector** to choose an enzyme, then adjust the **temperature** and **pH sliders** to observe how environmental conditions affect enzyme shape and catalytic activity. Try multiple enzymes to compare their optimal conditions.

Part 1 – Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Enzyme Environment Explorer as a scientific model.

M – Mode

What type of model is the Enzyme Environment Explorer? Describe how this computational simulation represents the effects of environmental conditions on enzyme function. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about how enzymes respond to changes in temperature and pH.

A – Accuracy

(a) Identify two things this simulation represents **accurately** about the effects of temperature and pH on enzyme function. For each, name the specific simulation feature and explain what biological concept it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about how environmental conditions affect enzyme activity. Consider what you cannot observe in the simulation that would be important for a complete molecular-level understanding of enzyme denaturation.

P – Purpose

What is the learning goal of this simulation? Explain how the Enzyme Environment Explorer is designed to help you understand why changes in temperature and pH alter enzyme structure and reduce catalytic efficiency. In your answer, connect at least one specific simulation feature to a biological example of why optimal enzyme conditions matter for living organisms.

P – Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the Enzyme Environment Explorer. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for environmental effects on enzyme function?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the simulation help you connect the concept of protein structure to enzyme function under different environmental conditions?

Part 2 – NGSS Questions

1.

Simulation Task: Select Amylase from the enzyme selector. Set the temperature slider to 37°C and adjust the pH slider until you find the highest activity level. Note the enzyme's shape at this optimal pH.

Describe the relationship between the shape of the enzyme and its ability to speed up chemical reactions. Explain why the enzyme works best at a specific pH and what happens to its shape when you move the pH away from that value.

HS-LS1-6

2.

Simulation Task: Keep Amylase selected. Set the pH to its optimal value. Start with the temperature slider at 0°C and slowly increase it to 37°C, watching the activity indicator change as you go.

Explain why enzyme activity increases as you raise the temperature from 0°C toward the optimal temperature. In your answer, describe how temperature affects the movement of molecules and how this influences how often the enzyme and its substrate come into contact.

HS-LS1-6

3.

Simulation Task: With Amylase still selected at optimal pH, continue raising the temperature slider past 37°C all the way to 80°C. Observe how the enzyme's shape and activity change at high temperatures.

Describe what happens to the enzyme's shape at high temperatures. Explain why extreme heat causes the enzyme to lose its ability to function, even though higher temperatures increase molecular movement.

HS-LS1-6

4.

Simulation Task: Select Pepsin from the enzyme selector. Find its optimal pH (near pH 2). Then switch to Amylase and find its optimal pH (near pH 7). Compare the two enzymes' optimal conditions.

Explain why Pepsin and Amylase have different optimal pH values. Describe how the environment where each enzyme normally works in the human body relates to the conditions where it functions best in the simulation.

HS-LS1-6

5.

Simulation Task: Select Catalase from the enzyme selector. Find its optimal temperature and pH. Then move the temperature slider to above 70°C to observe denaturation. Return the slider to the optimal temperature and observe whether the enzyme recovers its shape and activity.

Based on what you observed, explain whether denaturation appears to be reversible or permanent in this simulation. Describe what denaturation means in terms of the enzyme's three-dimensional structure and why a denatured enzyme can no longer speed up reactions.

HS-LS1-3

6.

Simulation Task: Select any enzyme and slowly sweep the temperature slider from 0°C to 100°C. Watch how the activity indicator changes across the full temperature range.

In the box below, draw a graph with “Temperature” on the x-axis and “Enzyme Activity” on the y-axis. Sketch a curve that matches what you observed in the simulation. Label the optimal temperature, the region where activity increases, and the region where denaturation causes activity to decrease.

Draw your graph here.

HS-LS1-6

7.

Simulation Task: Select an enzyme and set it to its optimal temperature. Imagine this enzyme belongs to a cold-water fish species. Now slowly raise the temperature slider by 10–15°C beyond the optimal value and observe the effect on enzyme shape and activity.

Suppose the water temperature in a lake increases over many years due to climate change. Using what you observed in the simulation, explain how rising temperatures could affect enzyme function in organisms that live in that lake. Describe how this change could influence which individuals in a population are more likely to survive and reproduce over many generations.

HS-LS4-5