

# PEEBEDU Enzyme Environment Explorer

Unit 3: Cellular Energetics

Name: \_\_\_\_\_ Period: \_\_\_\_\_ Date: \_\_\_\_\_

Open [peebedu.com](http://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.

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## 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.

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(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.

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## 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.

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## 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.

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## 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?

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## Part 2 – Free Response Questions

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### Conceptual Analysis

#### Question 1 – Temperature, pH, and Enzyme Denaturation

*Simulation Task: Select Amylase from the enzyme selector. Set the temperature slider to 37°C and adjust the pH slider to find the optimal pH. Note the enzyme's shape and activity level. Then slowly increase the temperature to 80°C and observe what happens to the enzyme's shape and activity.*

**(A)** (1 pt) **Describe** how environmental temperatures outside the optimal range for an enzyme cause changes to its structure that alter the efficiency with which it catalyzes reactions.

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**(B)** (1 pt) **Explain** why the enzyme's catalytic activity increased as you raised the temperature from 0°C toward the optimal temperature.

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**(C)** (1 pt) **Predict** what would happen to the rate of a metabolic reaction catalyzed by Pepsin if the pH of its environment were changed from pH 2 to pH 7.

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**(D)** (1 pt) **Justify** your prediction by explaining how a change in environmental pH disrupts the hydrogen bonds that maintain an enzyme's three-dimensional structure, reducing its ability to catalyze reactions.

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## Analyze Model / Visual Representation

### Question 2 — Enzyme Structure, Denaturation, and Environmental Change

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

**(A)** (1 pt) **Describe** the relationship between the change in enzyme shape observed in the simulation at extreme temperatures and the loss of catalytic function.

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**(B)** (1 pt) **Explain** why different enzymes in the simulation (such as Pepsin and Amylase) have different optimal pH values.

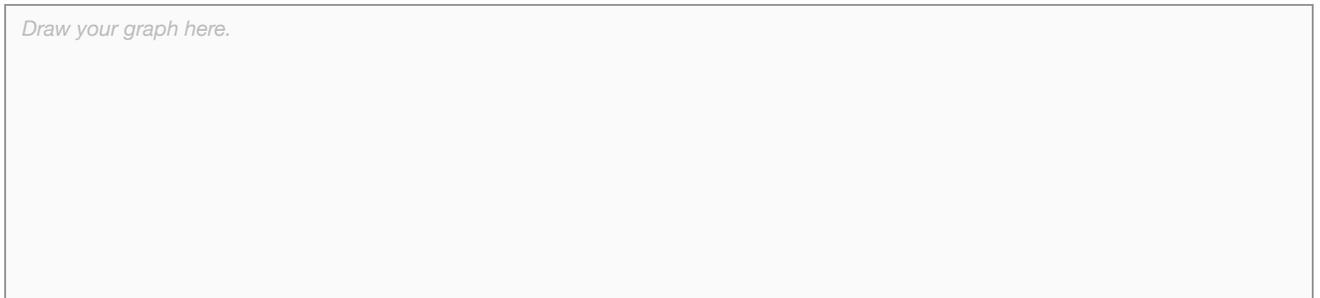
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**(C)** (1 pt) **Represent** how temperature affects enzyme activity.

*Draw your graph here.*



**(D)** (1 pt) **Explain** how an increase in global environmental temperature could alter enzyme function in an ectothermic organism (such as a reptile).

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EK 3.2.A.1, EK 3.2.A.2, EK 3.2.B.1, EK 3.2.B.2