Enzyme Lock and Key

Name: _____ **Period:** _____ **Date:** _____

> Open **peebedu.com** and navigate to **Enzyme Lock-and-Key Interactive**. Click the **Introduction** button to read the concept cards about Enzymes, Active Site, Specificity, Substrate, ES Complex, and Rate Factors. Then close the introduction and familiarize yourself with the Simulation Controls panel on the left.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Enzyme Lock-and-Key Interactive as a scientific model.

M — Mode

What type of model is the Enzyme Lock-and-Key Interactive? Describe how this computational simulation represents enzyme catalysis. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about how enzymes function.

A — Accuracy

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

(b) Identify two things this simulation **oversimplifies or leaves out** about enzyme catalysis. Consider what you cannot observe in the simulation that would be important for a complete understanding of how enzymes regulate biological reactions.

P — Purpose

What is the learning goal of this simulation? Explain how the Enzyme Lock-and-Key Interactive is designed to help you understand how the structure of an enzyme determines which substrates it can catalyze. In your answer, connect at least one specific simulation feature to why enzyme specificity matters for the regulation of biological processes.

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 Lock-and-Key Interactive. 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 enzyme-substrate interactions?
- 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 enzyme structure to enzyme function?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — Enzyme Specificity and Catalysis

> *Simulation Task: Select **Triase** as the enzyme and **Triangle substrate** as the substrate. Set Enzyme Concentration to 1 and Substrate Concentration to 10. Click **Start** and observe for 15 seconds, then click **Stop**. Note the Total Reactions count and the Molecules vs Time graph. Then click **Reset**, select **Triase** again but change the substrate to **Square substrate**. Set the same concentrations and click **Start**. Compare the results of both trials.*

(A) (1 pt) **Describe** the relationship between the shape of an enzyme's active site and the substrate it can catalyze, based on what you observed in the two trials.

(B) (1 pt) **Explain** why Triase catalyzes a reaction with the triangle substrate but not with the square substrate.

(C) (1 pt) **Predict** what would happen to the Total Reactions count if you repeated the first trial (Triase + Triangle substrate) but increased the Enzyme Concentration slider from 1 to 5 while keeping Substrate Concentration at 10.

(D) (1 pt) **Justify** your prediction by explaining how enzyme concentration affects the rate at which enzyme-substrate complexes form and reactions are catalyzed.

EK 3.1.A.1, EK 3.1.A.2

Analyze Model / Visual Representation

Question 2 — Enzyme-Substrate Complex Model

> *Simulation Task: Select **Squarase** as the enzyme and **Square substrate** as the substrate. Set Enzyme Concentration to 3 and Substrate Concentration to 25. Click **Start** and carefully watch the animation area. Observe the yellow glow that appears when an enzyme and substrate form an enzyme-substrate complex, and note what happens after the product is released. Watch the same enzyme molecule catalyze multiple reactions.*

(A) (1 pt) **Describe** the steps of enzyme-mediated catalysis shown in the simulation, from the moment a substrate approaches an enzyme to the release of the product.

(B) (1 pt) **Explain** the relationship between the structure of an enzyme's active site and its ability to lower the activation energy of a specific chemical reaction.

(C) (1 pt) **Represent** the enzyme-substrate complex model.

Draw your diagram here.

(D) (1 pt) **Explain** how a mutation in the gene encoding an enzyme could alter the shape of its active site and affect its ability to catalyze a reaction.

EK 3.1.A.1, EK 3.1.A.2