Name: **Date:** **Section:**

Enzyme Environment Activity: Environmental Effects on Enzyme Function

Investigating Environmental Effects on Enzyme Function

Phase 1: ENGAGE (5 minutes)

Getting Started:

Open peebedu.com and navigate to Enzyme Environmental Impact Explorer

Read the introduction popup to understand enzyme structure, temperature, and pH effects.

Essential Questions:

1. How do environmental conditions affect enzyme structure and function? _____
2. What molecular mechanisms underlie enzyme denaturation? _____

Pre-Activity Predictions:

Based on your knowledge of protein structure:

- How should temperature affect enzyme activity? _____
- Which digestive enzyme would work best in the stomach? _____

Phase 2: EXPLORE (20 minutes)

Systematic Investigation of Enzyme Conditions

Part A: Enzyme Selection and Initial Observations

1. Select **Pepsin** first

- Observe enzyme structure at 25°C, pH 7.0
- Enzyme movement: _____
- Structural state: Folded / Unfolded

Part B: Temperature Investigation

1. Keep pH at 7.0, vary temperature systematically:

Temperature	Enzyme Activity	Ion Behavior
0°C	_____	_____
20°C	_____	_____
40°C	_____	_____
60°C	_____	_____
80°C	_____	What happens to ion behavior at 80°C? _____

Phase 3: EXPLAIN (10 minutes)

Molecular Mechanisms Analysis

1. **Temperature Effects - Identify Patterns:**

- Pattern 2: Excessive heat → disruption of _____ bonds

1. **pH Effects - Cause and Effect:**

Complete the molecular explanations:

- Low pH → excess H+ → protonation of _____ groups → charge _____
- Charge repulsion → protein _____ → loss of _____

1. **Structure-Function Relationship:**

Explain how the simulation demonstrates:

- Primary structure: _____
- Active site integrity: _____

1. **Digestive System Adaptation:**

Match enzyme to digestive location based on optimal pH:

- Mouth (pH ~6.8): _____
- Small intestine (pH ~8): _____

Phase 4: ELABORATE (10 minutes)

Real-World Applications

Scenario Analysis:

1. **Fever Response:**

Normal body temp: 37°C, Fever: 40°C

- Which enzymes remain functional? _____
- Evolutionary advantage of fever? _____

1. **Antacid Effects:**

Patient takes antacids, raising stomach pH from 2 to 5:

- Effect on pepsin activity: _____
- Alternative solutions: _____

1. **Lactose Intolerance:**

Based on lactase properties:

- Optimal conditions: _____
- Effect of consuming hot beverages with dairy: _____

Phase 5: EVALUATE (5 minutes)

Assessment Questions

1. **Data Analysis:** Plot enzyme activity curves for one enzyme showing:

- Temperature vs. activity (bell curve)

- pH vs. activity (bell curve)

Explain the molecular basis for each curve shape. (3 pts)

1. **Pattern Application:** You discover a new enzyme from thermophilic bacteria with optimal temperature of 75°C. Predict:

- How would you determine its denaturation temperature? _____

(3 pts)

1. **Systems Integration:** Explain how the simulation's visual elements (movement, charge interactions, unfolding) accurately represent:

- Electrostatic interactions: _____

(4 pts)

Model Evaluation:

- Most accurate representation: _____
- Missing element: _____

Research Challenge:

Investigate one enzyme adaptation:

- Psychrophilic enzymes (cold-adapted)
- Thermophilic enzymes (heat-adapted)
- Acidophilic enzymes (acid-adapted)

Compare structural features to mesophilic enzymes: _____