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

Blood Sugar Regulation Simulator Activity: Modeling Glucose Homeostasis

Phase 1: ENGAGE (10 minutes)

Getting Started: Open `peebedu.com` and navigate to the **Blood Sugar Regulation Simulator**.

Phenomenon: Athletes can run marathons lasting several hours without eating, yet their muscles continue to function. Their blood glucose levels remain stable despite this intense energy demand.

Initial Observations:

1. Watch the opening animation. What happens to blood glucose after a meal?
2. Predict: How might the body prevent glucose levels from staying high?
3. Draw your initial model of blood sugar regulation:

Phase 2: EXPLORE (15 minutes)

Investigation: Feedback Mechanisms in Glucose Regulation

Setup: Use the simulator in "Normal" mode first.

Part A: Establishing Patterns

1. Observe baseline conditions for 1 minute. Record:
    - Normal glucose range: _____ to _____ mg/dL
    - What do you notice about insulin and glucagon levels?

Part B: Meal Response Investigation

1. Add a high-carbohydrate meal and observe for 3 minutes.
2. Create a data table tracking changes:

Time After Meal	Glucose Level	Insulin	Glucagon	What's Happening?
0 min				
15 min				
30 min				
60 min				

Part C: Exercise Investigation

1. Reset the simulation. Add moderate exercise.

2. Compare to meal response:
    - Which hormone increases during exercise? _____
    - Why would this be beneficial?

Part D: Comparing Diabetes Conditions

1. Switch to "Type 1 Diabetes" mode. Add a meal.
2. Key observation: What's different about insulin production?
3. Switch to "Type 2 Diabetes" mode. Add the same meal.
4. Key observation: What's different about cellular response?

Phase 3: EXPLAIN (10 minutes)

Building Scientific Understanding

Feedback Loop Analysis:

1. Complete the negative feedback loop for HIGH blood glucose:

   High glucose → Pancreas detects → _____ released → Cells _____ → Glucose _____

2. Complete the negative feedback loop for LOW blood glucose:

   Low glucose → Pancreas detects → _____ released → Liver _____ → Glucose _____

Making Connections:

1. Why is this called "negative" feedback?
2. How do insulin and glucagon work as antagonistic hormones?

Claim-Evidence-Reasoning:

Question: How does the body maintain stable blood glucose despite changing conditions?

Claim: The body maintains glucose homeostasis through...

Evidence: (Use specific data from your observations)

Reasoning: This evidence shows that...

Phase 4: ELABORATE (10 minutes)

Real-World Applications

Scenario 1: The Student Athlete

Jamie has Type 1 diabetes and wants to play basketball. Use the simulator to investigate:

1. What challenges might Jamie face during practice?
2. Test different management strategies in the simulator. What works best?

Scenario 2: Understanding Treatment

1. Why do Type 1 and Type 2 diabetes require different treatments?
2. Design an experiment using the simulator to show how insulin injections help Type 1 diabetes:

Making Predictions:

A person eats a candy bar, then immediately runs a mile. Predict the glucose curve:

Phase 5: EVALUATE (5 minutes)

Synthesis and Assessment

Revised Model: Update your Phase 1 model with your new understanding. Include:

- Organs involved (pancreas, liver, muscle, fat cells)
- Hormones and their effects
- Feedback loops with arrows
- Where diabetes disrupts the system

Application Questions:

1. Why do people with untreated diabetes often feel very thirsty?
2. Explain why someone might feel shaky and confused if they skip meals:
3. How does understanding feedback loops help us treat diabetes?

Model Evaluation:

- One thing this model shows well: _____

- One limitation of this model: _____