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 Observation: Watch the introductory animation showing blood glucose levels throughout a typical day.

1. What patterns do you notice in blood glucose levels?

2. Despite eating meals that contain large amounts of glucose, blood sugar levels remain relatively stable. How might the body accomplish this?

Initial Model: Draw and label your initial model of how the body might regulate blood glucose levels. Include any organs, molecules, or processes you think are involved.

Phase 2: EXPLORE (20 minutes)

Investigation 1: Normal Glucose Regulation

Part A: Baseline Observations

1. Set the simulator to "Normal" mode. Observe the blood glucose graph for 2 minutes without any interventions.
2. Record the baseline blood glucose range: _____ to _____ mg/dL
3. What happens to insulin and glucagon levels during this time?

Part B: Meal Response

1. Click "Add Meal" and select a high-carbohydrate meal.
2. Complete the data table as you observe the response:

Time Point	Blood Glucose (mg/dL)	Insulin Level	Glucagon Level	Cellular Response
Before meal				
Peak glucose				
Return to baseline				

Part C: Exercise Response

1. Click "Add Exercise" and select moderate intensity.
2. How does the glucose regulation response differ from the meal response?

3. Which hormone becomes more active during exercise? Why?

Investigation 2: Disrupted Regulation

Part A: Type 1 Diabetes Simulation

1. Switch to "Type 1 Diabetes" mode.
2. Add a meal and observe the response.
3. Compare this response to the normal condition:

Aspect	Normal Response	Type 1 Diabetes Response	Explanation
Peak glucose level			
Time to return to baseline			
Insulin production			

Part B: Type 2 Diabetes Simulation

1. Switch to "Type 2 Diabetes" mode.
2. How does this differ from Type 1 diabetes?
3. What happens to insulin sensitivity in target cells?

Phase 3: EXPLAIN (15 minutes)

Constructing Your Explanation

Mechanism Analysis: Based on your observations, explain the feedback mechanisms involved in blood glucose regulation.

1. **Negative Feedback Loop for High Glucose:**
    - Stimulus: _____
    - Sensor: _____
    - Control Center: _____
    - Effector: _____
    - Response: _____
2. **Negative Feedback Loop for Low Glucose:**
    - Complete the same analysis for low glucose conditions

Molecular Mechanism: Explain how insulin affects target cells at the molecular level. Include:

- Receptor binding
- Signal transduction

- Cellular response (GLUT4 translocation)

CER Framework: Develop a scientific argument:

Claim: Blood glucose homeostasis is maintained through...

Evidence: (Cite specific data from your investigations)

Reasoning: (Connect evidence to biological principles)

Phase 4: ELABORATE (10 minutes)

Clinical Applications

Scenario Analysis: A patient presents with fasting blood glucose of 180 mg/dL.

1. What additional tests would help determine if this is Type 1 or Type 2 diabetes?
2. Design a treatment plan for each possibility:
   - **If Type 1:**
   - **If Type 2:**

Research Extension: Use the simulator to investigate:

1. How would consuming different types of carbohydrates (simple vs. complex) affect the glucose response curve?
2. Design and test an experiment to determine the optimal timing of insulin administration relative to meals.

Phase 5: EVALUATE (10 minutes)

Assessment and Synthesis

Model Revision: Revise your initial model from Phase 1 to include:

- All key organs and hormones
- Feedback loops with (+) and (-) indicators
- Cellular mechanisms
- Points of disruption in diabetes

Application Questions:

1. A person skips breakfast and lunch. Predict and explain the hormonal changes throughout the day.
2. Why might a person with diabetes experience both hyperglycemia and hypoglycemia?
3. Evaluate the statement: "Diabetes is just about having too much sugar in your blood."

Model Evaluation:

Identify one strength and one limitation of this simulation model:

- **Strength:**
- **Limitation:**