

Name: _____ Period: _____ Date: _____

Open **peebedu.com** and navigate to **Blood Sugar Regulation App**. Click the **Start Regulating** button to begin. Read the introduction popup, which describes the four stages of blood sugar regulation: Glucose Rise, Insulin Response, Glucose Drop, and Glucagon Response.

Part 1 – Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Blood Sugar Regulation App as a scientific model.

M – Mode

What type of model is the Blood Sugar Regulation App? Describe how this computational simulation represents the process of blood glucose regulation. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about how the body maintains blood sugar levels.

A – Accuracy

(a) Identify two things this simulation represents **accurately** about blood sugar regulation. For each, name the specific simulation feature and explain what aspect of glucose homeostasis it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about blood sugar regulation. Consider what you cannot observe in the simulation that would be important for a complete understanding of hormonal signaling and cellular responses involved in glucose homeostasis.

P – Purpose

What is the learning goal of this simulation? Explain how the Blood Sugar Regulation App is designed to help you understand how negative feedback mechanisms maintain blood glucose homeostasis through the actions of insulin and glucagon. In your answer, connect at least one specific simulation feature to a biological consequence of disrupted glucose regulation.

P – Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the Blood Sugar Regulation App. 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 blood sugar regulation?
- 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 organism-level observation of blood sugar changes to the cellular-level actions of insulin and glucagon?

Part 2 – Free Response Questions

Conceptual Analysis

Question 1 – Negative Feedback and Blood Glucose Homeostasis

*Simulation Task: Set the simulation to **Normal Regulation** mode. Click **Eat Food** twice and observe the glucose meter and trend chart as blood sugar rises. Watch for the pancreas to release insulin and for glucose to return toward the set point. Then click **Exercise** and observe how the system responds when glucose drops below the set point.*

(A) (1 pt) **Describe** the negative feedback mechanism that maintains blood glucose homeostasis, including the roles of insulin and glucagon as signaling molecules released by the pancreas in response to changes in blood sugar levels.

(B) (1 pt) **Explain** how the simulation demonstrates that negative feedback returns a system to its set point after a perturbation.

(C) (1 pt) **Predict** what would happen to blood glucose levels over time if a person's beta cells were destroyed and no external insulin were administered.

(D) (1 pt) **Justify** your prediction by explaining why the loss of beta-cell function disrupts the negative feedback loop and prevents the system from returning to its set point.

Analyze Model / Visual Representation

Question 2 — Comparing Normal and Disrupted Glucose Regulation

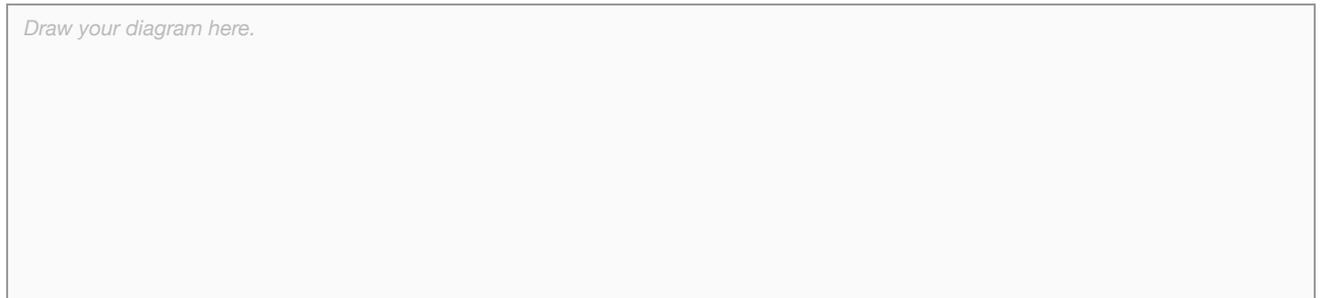
*Simulation Task: First run the **Normal Regulation** scenario: click **Eat Food** and observe the full cycle of glucose rise, insulin release, and return to normal. Then switch to the **Type 1 Diabetes** scenario and click **Eat Food** again. Compare the glucose trend lines and meter readings between the two scenarios.*

(A) (1 pt) **Describe** how organisms use negative feedback mechanisms to maintain their internal environments, using blood glucose regulation as an example of a process that operates at the molecular, cellular, and organismal levels.

(B) (1 pt) **Explain** the relationship between the insulin sensitivity slider setting and the effectiveness of the negative feedback loop, including how reduced insulin sensitivity changes the cellular response to the insulin signal.

(C) (1 pt) **Represent** the negative feedback loop for blood glucose regulation.

Draw your diagram here.



(D) (1 pt) **Explain** how the disruption of negative feedback in blood glucose regulation connects to the broader concept of maintaining homeostasis at the organismal level.

EK 4.4.A.1