Blood Sugar Regulation Simulator Activity: Modeling Glucose Homeostasis

AP Biology/College Level Teacher Guide

Overview

This guide supports implementation of the Blood Sugar Regulation Simulator Activity: Modeling Glucose Homeostasis using the 5E instructional model.

Learning Objectives

- Students will analyze how negative feedback mechanisms maintain blood glucose homeostasis
- Students will evaluate the roles of insulin and glucagon in cell signaling pathways
- Students will predict the effects of disruptions to glucose regulation systems

Standards Alignment

Topic 4.1: Cell Communication

- **LEARNING OBJECTIVE 4.1.B:** Explain how cells communicate with one another over short and long distances.
- **ESSENTIAL KNOWLEDGE 4.1.B.2:** Signals released by one cell type can travel long distances to target cells of another type.
- **ILLUSTRATIVE EXAMPLES:** Insulin, Human growth hormone, Thyroid hormones, Testosterone, Estrogen.

Topic 4.2: Introduction to Signal Transduction

- **LEARNING OBJECTIVE 4.2.A:** Describe the components of a signal transduction pathway.

- **ESSENTIAL KNOWLEDGE 4.2.A.1:** Signal transduction pathways link signal receptions with cellular responses.

Topic 4.4: Feedback

- **LEARNING OBJECTIVE 4.4.A:** Explain how positive and negative feedback helps maintain homeostasis.
- **ESSENTIAL KNOWLEDGE 4.4.A.1:** Organisms use feedback mechanisms to maintain their internal environments in response to internal and external changes.
- i. Negative feedback mechanisms maintain homeostasis by reducing the initial stimulus to regulate physiological processes. If a system is perturbed or disrupted, negative feedback mechanisms return the system back to its target set point. These processes operate at the molecular, cellular, and organismal levels.
- **ILLUSTRATIVE EXAMPLES:** Blood sugar regulation by insulin/glucagon.

Prerequisites

- Understanding of cell signaling basics
- Concept of homeostasis
- Negative feedback mechanisms

Time Estimate

50 minutes

Materials Needed

- Computer with internet access
- Student Activity Sheet
- Graph paper or digital graphing tool

Teaching Tips by Phase

Phase 1: ENGAGE (5-10 minutes)

- Start with the phenomenon or problem presented
- Elicit student predictions and prior knowledge
- Create cognitive dissonance if possible

- Build excitement for investigation

Phase 2: EXPLORE (15-20 minutes)

- Allow students to investigate with minimal guidance
- Circulate and ask probing questions
- Encourage systematic data collection
- Note common discoveries and difficulties

Phase 3: EXPLAIN (10-15 minutes)

- Have students share their findings first
- Build on their observations to introduce concepts
- Address misconceptions directly
- Connect to broader biological principles

Phase 4: ELABORATE (10 minutes)

- Apply knowledge to new scenarios
- Make real-world connections
- Encourage deeper investigation
- Support transfer of learning

Phase 5: EVALUATE (5-10 minutes)

- Use varied assessment strategies
- Focus on conceptual understanding
- Provide immediate feedback
- Plan follow-up based on results

> **Remember:**
>
> The goal is student discovery through guided inquiry. Resist the urge to explain concepts before students have explored them!
