ATP Cycle

Name: _____ **Period:** _____ **Date:** _____

> Open **peebedu.com** and navigate to **ATP Cycle**. This is a fast-paced game where you interpret prompts and decide whether each cellular scenario requires the **phosphorylation of ADP** (storing energy) or the **hydrolysis of ATP** (releasing energy). Read the instructions carefully before you begin.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the ATP Cycle simulation as a scientific model.

M — Mode

What type of model is the ATP Cycle simulation? Describe how this computational game represents the cycling of ATP and ADP in cells. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about the ATP/ADP cycle.

A — Accuracy

(a) Identify two things this simulation represents **accurately** about the ATP/ADP cycle. For each, name the specific simulation feature and explain what biological concept it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about the ATP/ADP cycle. Consider what you cannot observe in the simulation that would be important for a complete molecular-level understanding of ATP cycling.

P — Purpose

What is the learning goal of this simulation? Explain how the ATP Cycle game is designed to help you understand the relationship between ATP hydrolysis and ADP phosphorylation in powering cellular work. In your answer, connect at least one specific simulation feature to a biological process that depends on the ATP/ADP cycle.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the ATP Cycle game. 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 the ATP/ADP cycle?
- 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 concept of free energy change to specific cellular processes that require ATP?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — ATP Hydrolysis and Energy Coupling

> *Simulation Task: Play the ATP Cycle game through at least two full rounds. For each prompt, note whether the correct answer is ATP hydrolysis (energy release) or ADP phosphorylation (energy storage). Keep a tally of how many cellular processes require hydrolysis versus phosphorylation.*

(A) (1 pt) **Describe** the structural difference between ATP and ADP.

(B) (1 pt) **Explain** why the ATP/ADP cycle is described as energy coupling.

(C) (1 pt) **Predict** what would happen to a cell's ability to perform active transport and biosynthesis if a toxin blocked the phosphorylation of ADP back into ATP while ATP hydrolysis continued.

(D) (1 pt) **Justify** your prediction by explaining the relationship between the continuous regeneration of ATP and the cell's ability to maintain energy-requiring processes.

EK 3.3.A.2, EK 3.3.B.1

Analyze Model / Visual Representation

Question 2 — The ATP/ADP Cycle and Cellular Work

> *Simulation Task: During the game, identify three different cellular processes that appear as prompts. For each, record whether the process requires ATP hydrolysis or ADP phosphorylation and note the type of cellular work involved (e.g., mechanical, transport, chemical).*

(A) (1 pt) **Describe** how the free energy released by ATP hydrolysis is used to drive endergonic reactions in cells.

(B) (1 pt) **Explain** why ATP is described as the universal energy currency of the cell rather than a long-term energy storage molecule.

(C) (1 pt) **Represent** the ATP/ADP cycle.

Draw your diagram here.

(D) (1 pt) **Explain** how a disruption in the ATP/ADP cycle in a multicellular organism could affect cell communication and ultimately reduce the organism's ability to respond to environmental stimuli.

EK 3.3.A.2, EK 3.3.B.1