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 — NGSS Questions

1.

> *Simulation Task: Play the ATP Cycle game through one full round. Pay attention to the visual representation that appears when ATP is broken down into ADP and a phosphate group.*

Describe the structure of an ATP molecule, including its three main components. Explain what happens to the molecule when the bond between the second and third phosphate groups is broken, and identify what is released during this process.

HS-LS1-7

2.

> *Simulation Task: As you play, keep a tally of the prompts that require ATP hydrolysis (energy release) versus those that require ADP phosphorylation (energy storage). Count each type over one full round.*

Based on your tally, explain why cells need to constantly rebuild ATP from ADP and a phosphate group rather than storing large amounts of ATP. Describe what makes ATP effective as an energy currency that cells use over and over again.

HS-LS1-7

3.

> *Simulation Task: During the game, identify two prompts that describe a cell needing to release energy (for example, muscle contraction or active transport). Note the type of cellular work involved in each prompt.*

Choose one of the cellular processes you identified and explain how the energy released by breaking down ATP into ADP and a phosphate group powers that specific process. Describe what would happen to the cell if it could no longer break down ATP.

HS-LS1-7

4.

> *Simulation Task: Play a round and focus on the prompts that require phosphorylation (rebuilding ATP from ADP). Notice the visual feedback showing energy being absorbed to reattach the phosphate group.*

Explain where the energy comes from to reattach a phosphate group to ADP and rebuild ATP. Describe how the food molecules an organism eats are connected to the regeneration of ATP inside its cells.

HS-LS1-7

5.

> *Simulation Task: Observe the cycle visualization in the simulation showing ATP being broken down and then rebuilt repeatedly. Pay attention to how the cycle forms a continuous loop.*

A student claims that ATP is "used up" by the body and must be replaced entirely by eating food. Evaluate this claim. Explain why the ATP/ADP cycle is described as a cycle rather than a one-way process, and describe what is actually recycled.

HS-LS2-3

6.

> *Simulation Task: Play through two full rounds of the game. Observe both directions of the cycle: ATP breaking down to release energy for cellular work, and ADP being rebuilt into ATP using energy from food breakdown.*

In the box below, draw a diagram of the ATP/ADP cycle. Show ATP being broken down into ADP and a phosphate group on one side (label the energy released and one example of cellular work it powers), and ADP being rebuilt into ATP on the other side (label the energy source). Use arrows to show that this is a continuous cycle.

Draw your diagram here.

HS-LS2-3

7.

> *Simulation Task: Reflect on all the cellular processes you encountered during the game. Consider where the energy originally came from before it was stored in ATP.*

Trace the path of energy from sunlight to ATP in a muscle cell. Explain how plants capture light energy and convert it into sugars, how an animal obtains that energy by eating the plant, and how the animal's cells then use the sugar to rebuild ATP. Describe how this sequence shows that energy flows through living systems and that ATP serves as the link between food molecules and cellular work.

HS-LS1-5 / HS-LS2-4
