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

Open **peebedu.com** and navigate to **Light Reactions Simulator**. Click the **Watch the Sunrise** button to begin. Read the introduction popup, which describes the inputs (light energy, H_2O, ADP, Pi, $NADP^+$), outputs (ATP, NADPH, O_2), and the Z-scheme electron flow from Photosystem II through Photosystem I.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Light Reactions Simulator as a scientific model.

M — Mode

What type of model is the Light Reactions Simulator? Describe how this computational simulation represents the light-dependent reactions of photosynthesis. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about the light reactions.

_____

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A — Accuracy

(a) Identify two things this simulation represents **accurately** about the light-dependent reactions. For each, name the specific simulation feature and explain what biological concept it demonstrates.

_____

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_____

(b) Identify two things this simulation **oversimplifies or leaves out** about the light-dependent reactions. Consider what you cannot observe in the simulation that would be important for a complete molecular-level understanding of photosynthetic electron transport.

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P — Purpose

What is the learning goal of this simulation? Explain how the Light Reactions Simulator is designed to help you understand how light energy is converted into chemical energy (ATP and NADPH) through electron transport and chemiosmosis in the thylakoid membrane. In your answer, connect at least one specific simulation feature to a biological function of the light reactions.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the Light Reactions Simulator. 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 light-dependent reactions?
- 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 absorption of light energy to the production of ATP and NADPH?

Part 2 — NGSS Questions

1.

Describe the path that energy follows in the simulation, starting from light striking the chloroplast and ending with the production of ATP and NADPH. Explain how this process converts light energy into chemical energy that the plant cell can use.

HS-LS1-5

2.

Explain the role of water in the light reactions shown in the simulation. Describe what happens to water molecules at Photosystem II and why oxygen is released as a byproduct of this process.

HS-LS1-5

3.

> *Simulation Task: Run the simulation on "Normal" for 30 seconds and record the ATP Produced and NADPH Formed values. Then click Reset, switch the scenario to "No Water," click Play, and observe for 30 seconds. Record the new values.*

Compare the production of ATP and NADPH between the "Normal" and "No Water" scenarios. Explain why removing water causes production to stop, and describe what this reveals about how matter and energy must flow together through the light reactions.

HS-LS1-5

4.

> *Simulation Task: Set the scenario to "Normal" and run the simulation at 50% light intensity for 30 seconds. Record the ATP, NADPH, and O_2 values. Then click Reset, increase the light intensity to 90%, and run for another 30 seconds. Record the new values.*

Describe how increasing light intensity affected the rate of ATP, NADPH, and O_2 production. Explain why more light energy input leads to greater chemical energy output in the chloroplast.

HS-LS1-5

5.

> *Simulation Task: Run the simulation on "Normal" at 50% light intensity. Watch the red H^+ particles accumulate in the lumen and read the Lumen pH and Stroma pH values on the H^+ Gradient panel. Observe the ATP synthase complex as protons flow through it.*

Explain how the buildup of protons inside the thylakoid lumen creates a concentration difference across the membrane. Describe how ATP synthase uses this proton flow to produce ATP, and explain why this process depends on the energy originally captured from sunlight.

HS-LS1-5

6.

In the box below, draw a simplified diagram of the thylakoid membrane showing how light energy is transformed into chemical energy. Label the following: the stroma, the lumen, Photosystem II, Photosystem I, ATP synthase, the direction of electron flow, the movement of H⁺ ions, and where ATP and NADPH are produced.

Draw your diagram here.

HS-LS2-5

7.

The simulation shows that photosynthesis captures light energy and stores it as chemical energy while releasing oxygen. Explain how the chemical energy produced by photosynthesis moves through an ecosystem when other organisms consume the plant. Describe the role of the released oxygen in allowing those organisms to access the stored energy.

HS-LS2-4