

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.

Free Response Questions

Question 1 — Conceptual Analysis

Simulation Task: In the *Light Reactions Simulator*, set the scenario to "Normal" and the light intensity to 50%. Click Play and observe for 30 seconds, recording the ATP Produced, NADPH Formed, and O_2 Released values. Then switch the scenario to "No Water" and observe for another 30 seconds, noting any changes in the production counters and the lumen/stroma pH values.

(A) (1 pt) **Describe** the products that the light-dependent reactions generate in the thylakoid membranes of chloroplasts.

(B) (1 pt) **Explain** why the production of ATP, NADPH, and O_2 all stop when water is no longer available to the chloroplast.

(C) (1 pt) **Predict** what would happen to the amount of NADPH formed in a chloroplast if the light intensity reaching it were reduced from 90% to 15%.

(D) (1 pt) **Justify** your prediction.

Question 2 — Analyze Model / Visual Representation

Simulation Task: *In the Light Reactions Simulator, set the scenario to "Normal" and click "Toggle Labels" to display the names of each protein complex in the thylakoid membrane. Click Play, then Pause after a few seconds. Observe the positions of PSII, PSI, and ATP synthase, and watch where the H^+ particles accumulate. Note the lumen pH and stroma pH values displayed on the H^+ gradient panel.*

(A) (1 pt) **Describe** where protons accumulate in the chloroplast as electrons pass through the complexes of the thylakoid membrane.

(B) (1 pt) **Explain** why the pH inside the thylakoid lumen decreases while the pH of the stroma increases during the light-dependent reactions.

(C) (1 pt) **Represent** the proton gradient of the thylakoid by drawing a labeled cross-section of the thylakoid membrane showing the lumen, the stroma, photosystem II, photosystem I, and ATP synthase, with arrows indicating the direction of H^+ movement.

Draw your diagram here.



(D) (1 pt) **Explain** how the thylakoid membrane's role as an internal membrane barrier makes the buildup of a proton gradient inside the chloroplast possible.

3.4.B.4, 3.4.B.5