What Are Light-Dependent Reactions?

Worksheet

Light-dependent reactions convert light energy into chemical energy (ATP and NADPH) and release O from water. They happen in thylakoids and provide the energy carriers needed for the light-independent (Calvin) cycle.

$$H_2O + NADP^+ + ADP + Pi \xrightarrow{light} O_2 + NADPH + ATP$$

Questions

1. What is the primary product of light-dependent reactions?

A) glucose
B) ATP, NADPH, and O
C) CO
D) water

2. Where do light-dependent reactions happen?

A) stroma
B) thylakoid membranes
C) mitochondria
D) cytoplasm

3. What provides the electrons needed to replace chlorophyll electrons?

A) ATP
B) water
C) NADPH
D) glucose

4. How does the proton gradient power ATP synthesis?

A) photons directly phosphorylate ADP
B) H ions flow through ATP synthase
C) electrons bond to phosphate
D) glucose donates energy

5. What is the role of water in light-dependent reactions?

6. Why is ATP produced in light-dependent reactions?

7. Explain why both Photosystem I and Photosystem II are needed.

8. Define: What are light-dependent reactions?

9. Define: Where do light-dependent reactions occur?

10. Define: What is photolysis?

Answer Key

1. B) ATP, NADPH, and O - Light reactions produce ATP (energy), NADPH (reducing power), and O (from water). Glucose is made in the Calvin cycle.

2. B) thylakoid membranes - Light reactions occur in thylakoid membranes within chloroplasts. The Calvin cycle happens in the stroma.

3. B) water - Water splitting (photolysis) provides electrons that replace those lost by chlorophyll in Photosystem II.

4. B) H ions flow through ATP synthase - Chemiosmosis: the flow of H ions through ATP synthase provides the energy to phosphorylate ADP ATP.

5. Water is the electron donor. Water splits (photolysis): 2 HO O + 4 H + 4 e Electrons replace those lost by chlorophyll. Oxygen is released as a byproduct (and waste for the plant).

6. Electron transport creates a proton gradient across the thylakoid membrane. H ions concentrate in the thylakoid lumen. H ions flow back through ATP synthase (chemiosmosis). The flow powers ADP + Pi ATP.

7. Photosystem II absorbs light, splits water, and starts electron transport. Photosystem I re-energizes electrons coming from the transport chain. Re-energized electrons reduce NADP to NADPH. Two photosystems produce both ATP (chemiosmosis) and NADPH.

8. The first stage of photosynthesis in thylakoids; they convert light energy to ATP and NADPH and release oxygen.

9. In the thylakoid membranes of chloroplasts.

10. The splitting of water: 2 HO O + 4 H + 4 e. Provides electrons and protons.