What are the Light Reactions of Photosynthesis?

Worksheet

The light reactions use sunlight absorbed by photosystems II and I to split water, generate an electron transport chain, and produce ATP (via chemiosmosis) and NADPH for use in the Calvin cycle.

Questions

1. Where in the chloroplast do the light reactions take place?

A) Stroma
B) Thylakoid membrane
C) Outer membrane
D) Mitochondrial matrix

2. What gas is released as a byproduct of the light reactions?

A) Carbon dioxide
B) Nitrogen
C) Oxygen
D) Hydrogen gas

3. Which molecule directly powers ATP synthase during chemiosmosis?

A) Glucose
B) H+ ions (proton gradient)
C) NADPH
D) CO2

4. What are the two main products of the light reactions used for in the Calvin cycle?

A) Oxygen and water
B) ATP and NADPH
C) Glucose and CO2
D) Chlorophyll and light

5. A chloroplast's thylakoid membrane absorbs 8 photons in Photosystem II. Roughly how many water molecules must be split to replace the electrons lost, and how much O2 is released?

6. If the electron transport chain pumps H+ ions to build a gradient that produces 3 ATP per 'set' of electrons passing through, how many ATP form from 12 sets of electrons?

7. Why does a plant kept in complete darkness stop producing NADPH, even though the Calvin cycle enzymes are still present?

8. Define: Where do the light reactions occur?

9. Define: What two energy carriers do the light reactions produce?

10. Define: What happens to water during the light reactions?

Answer Key

1. B) Thylakoid membrane - Light reactions occur in the thylakoid membranes, where photosystems and the electron transport chain are located.

2. C) Oxygen - Splitting water (photolysis) releases oxygen as a byproduct.

3. B) H+ ions (proton gradient) - The H+ gradient across the thylakoid membrane drives ATP synthase.

4. B) ATP and NADPH - ATP and NADPH generated in the light reactions power carbon fixation in the Calvin cycle.

5. Splitting each water molecule releases 2 electrons, 2 H+, and 1/2 O2 (so 2 H2O 4e- + 4H+ + O2). 8 photons excite 8 electrons that must be replaced. 8 electrons require splitting 4 H2O molecules, releasing 2 O2 molecules.

6. ATP produced = ATP per set number of sets. ATP = 3 12. ATP = 36 ATP molecules.

7. NADPH is produced only in the light reactions, which require photons to excite electrons in PSI and PSII. Without light, no electrons are excited and the electron transport chain halts. Without ETC activity, NADP+ is not reduced to NADPH, so NADPH production stops immediately in the dark.

8. In the thylakoid membranes of the chloroplast.

9. ATP and NADPH.

10. It is split (photolysis) into electrons, H+ ions, and O2 gas.