

1. If photosynthesizing green algae are provided with CO_2 synthesized with heavy oxygen (^{18}O), later analysis will show that all but one of the following compounds produced by the algae contain the ^{18}O label. That one is

- A) 3-phosphoglycerate. B) glyceraldehyde 3-phosphate (G3P).
C) O_2 . D) ribulose biphosphate (RuBP).

2. Which of the following are products of the light reactions of photosynthesis that are utilized in the Calvin cycle?

- A) CO_2 and glucose B) H_2O and O_2 C) ADP, Pi, and NADP^+
D) electrons and H^+ E) ATP and NADPH

3. Where does the Calvin cycle take place?

- A) stroma of the chloroplast B) thylakoid membrane
C) cytoplasm surrounding the chloroplast D) outer membrane of the chloroplast

4. In autotrophic bacteria, where are the enzymes located that can carry on carbon fixation (reduction of carbon dioxide to carbohydrate)?

- A) in chloroplast membranes B) in chloroplast stroma
C) in the cytosol D) in the infolded plasma membrane

5. When oxygen is released as a result of photosynthesis, it is a direct by-product of

- A) reducing NADP^+ . B) splitting water molecules.
C) chemiosmosis. D) the electron transfer system of photosystem I.

6. In the thylakoid membranes, what is the main role of the antenna pigment molecules?

- A) split water and release oxygen to the reaction-center chlorophyll
B) harvest photons and transfer light energy to the reaction-center chlorophyll
C) synthesize ATP from ADP and Pi D) transfer electrons to ferredoxin and then NADPH

7. Which of the events listed below occurs in the light reactions of photosynthesis?

- A) NADP is produced. B) NADPH is reduced to NADP^+ .
C) Carbon dioxide is incorporated into PGA. D) ATP is phosphorylated to yield ADP.
E) Light is absorbed and funneled to reaction-center chlorophyll a.

8. What are the products of linear photophosphorylation?

- A) heat and fluorescence B) ATP and P700 C) ATP and NADPH D) ADP and NADP

9. As a research scientist, you measure the amount of ATP and NADPH consumed by the Calvin cycle in 1 hour. You find 30,000 molecules of ATP consumed, but only 20,000 molecules of NADPH. Where did the extra ATP molecules come from?

- A) photosystem II B) photosystem I C) cyclic electron flow D) linear electron flow

10. Assume a thylakoid is somehow punctured so that the interior of the thylakoid is no longer separated from the stroma. This damage will have the most direct effect on which of the following processes?

- A) the splitting of water B) the absorption of light energy by chlorophyll
C) the flow of electrons from photosystem II to photosystem I
D) the synthesis of ATP E) the reduction of NADP^+

11. What does the chemiosmotic process in chloroplasts involve?

- A) establishment of a proton gradient across the thylakoid membrane
B) diffusion of electrons through the thylakoid membrane
C) reduction of water to produce ATP energy

- D) movement of water by osmosis into the thylakoid space from the stroma
- E) formation of glucose, using carbon dioxide, NADPH, and ATP

12. Suppose the interior of the thylakoids of isolated chloroplasts were made acidic and then transferred in the dark to a pH 8 solution. What would be likely to happen?

- A) **The isolated chloroplasts will make ATP.**
- B) The Calvin cycle will be activated.
- C) Cyclic photophosphorylation will occur.
- D) E) The isolated chloroplasts will produce NADPH

13. What is the relationship between wavelength of light and the quantity of energy per photon?

- A) They have a direct, linear relationship.
- B) **They are inversely related.**
- C) They are logarithmically related.
- D) They are separate phenomena.

14. Carotenoids are often found in foods that are considered to have antioxidant properties in human nutrition. What related function do they have in plants?

- A) They serve as accessory pigments to increase light absorption.
- B) **They protect against oxidative damage from excessive light energy.**
- C) They shield the sensitive chromosomes of the plant from harmful ultraviolet radiation.
- D) They reflect orange light and enhance red light absorption by chlorophyll.

15. Where do the enzymatic reactions of the Calvin cycle take place?

- A) **stroma of the chloroplast**
- B) thylakoid membranes
- C) matrix of the mitochondria
- D) cytosol around the chloroplast

16. What is the primary function of the Calvin cycle?

- A) use ATP to release carbon dioxide
- B) use NADPH to release carbon dioxide
- C) split water and release oxygen
- D) **synthesize simple sugars from CO₂**

17. Reactions that require CO₂ take place in

- A) the light reactions alone.
- B) **the Calvin cycle alone.**
- C) both the light reactions and Calvin cycle.
- D) neither light reactions nor Calvin cycle.

18. Photorespiration occurs when rubisco reacts RuBP with

- A) CO₂.
- B) **O₂.**
- C) glyceraldehyde 3-phosphate.
- D) 3-phosphoglycerate.

19. In an experiment studying photosynthesis performed during the day, you provide a plant with radioactive carbon (¹⁴C) dioxide as a metabolic tracer. The ¹⁴C is incorporated first into oxaloacetate. The plant is best characterized as a

- A) **C₄ plant.**
- B) C₃ plant.
- C) CAM plant.
- D) heterotroph.