

Exercise session: Photosynthetic processes

1. Which incorrectly matches process and location?
 - a. Oxygen gas is produced—the thylakoid space
 - b. Activated chlorophyll donates an electron—the thylakoid membranes
 - c. NADPH is oxidized to NADP⁺—the stroma
 - d. ATP is produced—the intermembrane space
 - e. Rubisco catalyzes carbon fixation—the stroma
2. Of these events from the light reactions, which occurs first?
 - a. Light-induced reduction of the primary electron acceptor in the reaction center of PS II.
 - b. While being split, electrons are taken out of water.
 - c. Donation of electrons from reduced Pq to the cytochrome complex.
 - d. Acceptance of electrons by P_c from the cytochrome complex.
 - e. Pq gets electrons from the reduced primary electron acceptor of PS II.
3. When donating its activated electron, the chlorophyll in photosystem II is a very powerful oxidizing agent. This is best shown by its ability to
 - a. make use of a proton electrochemical gradient to drive the formation of ATP.
 - b. force the oxidation of oxygen in water to oxygen gas.
 - c. donate an electron to plastoquinone (Pq).
 - d. absorb light energy to power redox reactions.
 - e. force the reduction of NADP⁺ to NADPH.
4. One reason for carrying out the production of oxygen gas in the space surrounded by the thylakoid membranes, and not in the stroma of the chloroplasts, is
 - a. that this makes it easier for O₂ to exit the chloroplast.
 - b. that the hydrogen ions released can contribute to the H⁺ electrochemical gradient being generated.
 - c. to reduce the concentration of O₂ in the stroma so that organic matter located there is not oxidized.
 - d. that the concentration of water in this space is high, making it easier to form O₂ from the water.
5. The enzyme rubisco catalyzes the fixation of carbon. Considering all the carbons involved, is the production of 3-PGA a net oxidation, reduction, or neither? Why?
 - a. Oxidation. Adding a carbon dioxide makes the products more oxidized.
 - b. Reduction. Adding the hydrogens from the water results in a more reduced condition.
 - c. Reduction. The carbon in the carbon dioxide has been slightly reduced.
 - d. Neither. There is no change in the total C—O and C—H bonds between the products and reactants.
 - e. Oxidation. The RuBP acts as oxidizing agent in this reaction.

6. One way in which photosynthesis in a typical C₄ plant differs from that in a C₃ plant is that the C₄ plant:

- does not produce any oxygen gas.
- actively pumps oxygen gas away from the cells that contain rubisco.
- avoids the use of rubisco entirely; instead, it uses PEP carboxylase to catalyze all carbon fixation.
- keeps its stomata more open so that more CO₂ can enter the plant.
- carries out the Calvin cycle only in the chloroplasts of bundle-sheath cells.

7. In CAM plants, CO₂ is

- temporarily fixed in phloem cells and later permanently fixed in the bundle-sheath cells.
- mainly obtained from oxidative respiratory processes.
- temporarily fixed at night and later permanently fixed during the day.
- fixed into organic matter just by the action of the enzyme rubisco.
- brought up to the leaves through air spaces in the stem so that the stomata of the leaves can be kept shut to prevent water loss.

8. To make photosynthesis more efficient, which of the following should be eliminated?

- ATP synthase
- proton gradient
- photorespiration
- photophosphorylation
- none of the above

9. Suppose you were visiting a space station that renews the oxygen that you breathe using photosynthesis. Which would not be present in the station?

- land plants
- multicellular algae
- single-celled algae
- cyanobacteria
- purple sulfur bacteria

10. Which is physically closest to the actual production of ATP in photosynthesis?

- thylakoid membrane
- outer membrane
- intermembrane space
- cytoplasm
- inner membrane

11. If a cell contained a radioactive version of rubisco, where would the radioactivity be located?

- cytoplasm
- stroma
- thylakoid space
- outer membrane
- ribosomes

12. Suppose you were preparing to visit a space station that uses photosynthesis to provide you with oxygen. What color lightbulbs should you take with you?

- a. red
- b. green
- c. blue
- d. green and blue
- e. red and blue

13. Which best links photosynthesis and cellular respiration?

- a. four carbon compounds
- b. chemiosmosis
- c. thylakoid membrane
- d. photosystems

14. In which of the following organisms did the process of photosynthesis most likely originate?

- a. land plants
- b. prokaryotes
- c. fungi
- d. unicellular aquatic eukaryotes

15. Which of the following statements best describes the relationship between autotrophs and heterotrophs?

- a. Autotrophs produce their organic molecules from CO₂ and other inorganic molecules, whereas heterotrophs obtain their organic molecules from compounds produced by other organisms.
- b. Heterotrophs produce their organic molecules from CO₂ and other inorganic molecules, whereas autotrophs obtain their organic molecules from compounds produced by other organisms.
- c. Both autotrophs and heterotrophs produce some of their organic molecules from CO₂ and other inorganic molecules.
- d. Heterotrophs are considered the producers of the biosphere, whereas autotrophs are consumers.

16. Which of the following observations would be the best indicator that an organism lacks photosystem II?

- a. It produces glucose in the light and dark.
- b. It does not produce CO₂ in the dark.
- c. It does not produce O₂ in the light.
- d. It produces CO₂ in the light.

17. A mutation that disrupts cyclic electron flow in the light reactions of photosynthesis will specifically reduce the production of which of the following molecules?

- a. CO₂
- b. ATP
- c. NADPH
- d. ADP and NADP⁺

18. Which of the following events are associated with chemiosmosis in chloroplasts?

- a. The pH of the stroma increases and ATP is synthesized.
- b. The pH of the thylakoid space increases and ATP is synthesized.
- c. The pH of the cytosol outside the chloroplast decreases and ATP is synthesized.
- d. The pH of the stroma decreases and ATP is hydrolyzed.

19. Carotenoids are often found in foods that are considered to have antioxidant properties in human nutrition. Which of the following statements best describes a related function they serve 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.