

Chapter 10 Photosynthesis

Multiple-Choice Questions

- 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) PGA.
 - B) PGAL.
 - C) glucose.
 - D) RuBP.
 - E) O_2 .

Answer: E

Topic: Concept 10.1

Skill: Application/Analysis

- 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, P_i , and NADP^+
 - D) electrons and H^+
 - E) ATP and NADPH

Answer: E

Topic: Concept 10.1

Skill: Knowledge/Comprehension

- 3) What are the products of the light reactions that are subsequently used by the Calvin cycle?
- A) oxygen and carbon dioxide
 - B) carbon dioxide and RuBP
 - C) water and carbon
 - D) electrons and photons
 - E) ATP and NADPH

Answer: E

Topic: Concept 10.1

Skill: Knowledge/Comprehension

- 4) Where does the Calvin cycle take place?
- A) stroma of the chloroplast
 - B) thylakoid membrane
 - C) cytoplasm surrounding the chloroplast
 - D) chlorophyll molecule
 - E) outer membrane of the chloroplast

Answer: A

Topic: Concept 10.1

Skill: Knowledge/Comprehension

5) In any ecosystem, terrestrial or aquatic, what group(s) is (are) always necessary?

- A) autotrophs and heterotrophs
- B) producers and primary consumers
- C) photosynthesizers
- D) autotrophs
- E) green plants

Answer: D

Topic: Concept 10.1

Skill: Synthesis/Evaluation

6) In autotrophic bacteria, where are the enzymes located that can carry on organic synthesis?

- A) chloroplast membranes
- B) nuclear membranes
- C) free in the cytosol
- D) along the outer edge of the nucleoid
- E) along the inner surface of the plasma membrane

Answer: E

Topic: Concept 10.1

Skill: Knowledge/Comprehension

7) When oxygen is released as a result of photosynthesis, it is a by-product of which of the following?

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

Answer: B

Topic: Concept 10.1

Skill: Knowledge/Comprehension

8) A plant has a unique photosynthetic pigment. The leaves of this plant appear to be reddish yellow. What wavelengths of visible light are being absorbed by this pigment?

- A) red and yellow
- B) blue and violet
- C) green and yellow
- D) blue, green, and red
- E) green, blue, and yellow

Answer: B

Topic: Concept 10.2

Skill: Application/Analysis

Use the following information to answer the questions below.

Theodor W. Engelmann illuminated a filament of algae with light that passed through a prism, thus exposing different segments of algae to different wavelengths of light. He added aerobic bacteria and then noted in which areas the bacteria congregated. He noted that the largest groups were found in the areas illuminated by the red and blue light.

- 9) What did Engelmann conclude about the congregation of bacteria in the red and blue areas?
- A) Bacteria released excess carbon dioxide in these areas.
 - B) Bacteria congregated in these areas due to an increase in the temperature of the red and blue light.
 - C) Bacteria congregated in these areas because these areas had the most oxygen being released.
 - D) Bacteria are attracted to red and blue light and thus these wavelengths are more reactive than other wavelengths.
 - E) Bacteria congregated in these areas due to an increase in the temperature caused by an increase in photosynthesis.

Answer: C

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 10) An outcome of this experiment was to help determine
- A) the relationship between heterotrophic and autotrophic organisms.
 - B) the relationship between wavelengths of light and the rate of aerobic respiration.
 - C) the relationship between wavelengths of light and the amount of heat released.
 - D) the relationship between wavelengths of light and the oxygen released during photosynthesis.
 - E) the relationship between the concentration of carbon dioxide and the rate of photosynthesis.

Answer: D

Topic: Concept 10.2

Skill: Synthesis/Evaluation

- 11) If you ran the same experiment without passing light through a prism, what would you predict?
- A) There would be no difference in results.
 - B) The bacteria would be relatively evenly distributed along the algal filaments.
 - C) The number of bacteria present would decrease due to an increase in the carbon dioxide concentration.
 - D) The number of bacteria present would increase due to an increase in the carbon dioxide concentration.
 - E) The number of bacteria would decrease due to a decrease in the temperature of the water.

Answer: B

Topic: Concept 10.2

Skill: Application/Analysis

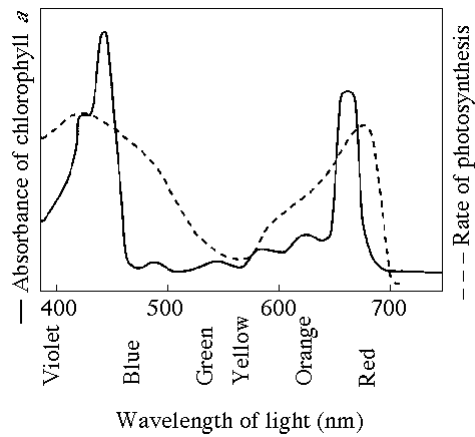


Figure 10.1

- 12) Figure 10.1 shows the absorption spectrum for chlorophyll *a* and the action spectrum for photosynthesis. Why are they different?
- A) Green and yellow wavelengths inhibit the absorption of red and blue wavelengths.
 - B) Bright sunlight destroys photosynthetic pigments.
 - C) Oxygen given off during photosynthesis interferes with the absorption of light.
 - D) Other pigments absorb light in addition to chlorophyll *a*.
 - E) Aerobic bacteria take up oxygen which changes the measurement of the rate of photosynthesis.

Answer: D

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 13) What wavelength of light in the figure is *most* effective in driving photosynthesis?
- A) 420 nm
 - B) 475 nm
 - C) 575 nm
 - D) 625 nm
 - E) 730 nm

Answer: A

Topic: Concept 10.2

Skill: Application/Analysis

- 14) Compared with the lines for chlorophyll *a* in the figure, where would you expect to find the lines to differ for chlorophyll *b*?
- A) The absorption spectrum line would be lowest for chlorophyll *b* somewhat to the right of that for chlorophyll *a* (500–600).
 - B) The rate of photosynthesis line for chlorophyll *b* would be lowest from 600–700 nm.
 - C) The lines for the two types of chlorophyll would be almost completely opposite.
 - D) The lines for the two types of chlorophyll would be almost completely identical.
 - E) The peaks of the line for absorbance of *b* would be shifted to the left, and for rate of photosynthesis would be shifted to the right.

Answer: A

Topic: Concept 10.2

Skill: Synthesis/Evaluation

- 15) 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 P_i
 - D) transfer electrons to ferredoxin and then NADPH
 - E) concentrate photons within the stroma

Answer: B

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 16) The reaction-center chlorophyll of photosystem I is known as P700 because
- A) there are 700 chlorophyll molecules in the center.
 - B) this pigment is best at absorbing light with a wavelength of 700 nm.
 - C) there are 700 photosystem I components to each chloroplast.
 - D) it absorbs 700 photons per microsecond.
 - E) the plastoquinone reflects light with a wavelength of 700 nm.

Answer: B

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 17) Which of the events listed below occur 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*.

Answer: E

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 18) Which statement describes the functioning of photosystem II?
- A) Light energy excites electrons in the electron transport chain in a photosynthetic unit.
 - B) The excitation is passed along to a molecule of P700 chlorophyll in the photosynthetic unit.
 - C) The P680 chlorophyll donates a pair of protons to NADPH, which is thus converted to NADP⁺.
 - D) The electron vacancies in P680 are filled by electrons derived from water.
 - E) The splitting of water yields molecular carbon dioxide as a by-product.

Answer: D

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 19) Which of the following are directly associated with photosystem I?
- A) harvesting of light energy by ATP
 - B) receiving electrons from plastocyanin
 - C) P680 reaction-center chlorophyll
 - D) extraction of hydrogen electrons from the splitting of water
 - E) passing electrons to plastoquinone

Answer: B

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 20) Some photosynthetic organisms contain chloroplasts that lack photosystem II, yet are able to survive. The best way to detect the lack of photosystem II in these organisms would be
- A) to determine if they have thylakoids in the chloroplasts.
 - B) to test for liberation of O₂ in the light.
 - C) to test for CO₂ fixation in the dark.
 - D) to do experiments to generate an action spectrum.
 - E) to test for production of either sucrose or starch.

Answer: B

Topic: Concept 10.2

Skill: Application/Analysis

- 21) What are the products of linear photophosphorylation?
- A) heat and fluorescence
 - B) ATP and P700
 - C) ATP and NADPH
 - D) ADP and NADP
 - E) P700 and P680

Answer: C

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 22) 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
 - E) chlorophyll

Answer: C

Topic: Concept 10.2

Skill: Application/Analysis

- 23) 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⁺

Answer: D

Topic: Concept 10.2

Skill: Application/Analysis

- 24) What does the chemiosmotic process in chloroplasts involve?
- A) establishment of a proton gradient
 - 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

Answer: A

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 25) 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) Only A and B will occur.
 - E) A, B, and C will occur.

Answer: A

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 26) In a plant cell, where are the ATP synthase complexes located?
- A) thylakoid membrane
 - B) plasma membrane
 - C) inner mitochondrial membrane
 - D) A and C
 - E) A, B, and C

Answer: D

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 27) In mitochondria, chemiosmosis translocates protons from the matrix into the intermembrane space, whereas in chloroplasts, chemiosmosis translocates protons from
- A) the stroma to the photosystem II.
 - B) the matrix to the stroma.
 - C) the stroma to the thylakoid space.
 - D) the intermembrane space to the matrix.
 - E) ATP synthase to NADP⁺ reductase.

Answer: C

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 28) Which of the following statements *best* describes the relationship between photosynthesis and respiration?
- A) Respiration is the reversal of the biochemical pathways of photosynthesis.
 - B) Photosynthesis stores energy in complex organic molecules, while respiration releases it.
 - C) Photosynthesis occurs only in plants and respiration occurs only in animals.
 - D) ATP molecules are produced in photosynthesis and used up in respiration.
 - E) Respiration is anabolic and photosynthesis is catabolic.

Answer: B

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 29) Where are the molecules of the electron transport chain found in plant cells?
- A) thylakoid membranes of chloroplasts
 - B) stroma of chloroplasts
 - C) inner membrane of mitochondria
 - D) matrix of mitochondria
 - E) cytoplasm

Answer: A

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 30) Synthesis of ATP by the chemiosmotic mechanism occurs during
- A) photosynthesis.
 - B) respiration.
 - C) both photosynthesis and respiration.
 - D) neither photosynthesis nor respiration.
 - E) photorespiration.

Answer: C

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 31) Reduction of oxygen which forms water occurs during
- A) photosynthesis.
 - B) respiration.
 - C) both photosynthesis and respiration.
 - D) neither photosynthesis nor respiration.
 - E) photorespiration.

Answer: B

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 32) Reduction of NADP⁺ occurs during
- A) photosynthesis.
 - B) respiration.
 - C) both photosynthesis and respiration.
 - D) neither photosynthesis nor respiration.
 - E) photorespiration.

Answer: A

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 33) The splitting of carbon dioxide to form oxygen gas and carbon compounds occurs during
- A) photosynthesis.
 - B) respiration.
 - C) both photosynthesis and respiration.
 - D) neither photosynthesis nor respiration.
 - E) photorespiration.

Answer: D

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 34) Generation of proton gradients across membranes occurs during
- A) photosynthesis.
 - B) respiration.
 - C) both photosynthesis and respiration.
 - D) neither photosynthesis nor respiration.
 - E) photorespiration.

Answer: C

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 35) 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.
 - E) They are only related in certain parts of the spectrum.

Answer: B

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 36) In a protein complex for the light reaction (a reaction center), energy is transferred from pigment molecule to pigment molecule, to a special chlorophyll a molecule, and eventually to the primary electron acceptor. Why does this occur?
- A) The action spectrum of that molecule is such that it is different from other molecules of chlorophyll.
 - B) The potential energy of the electron has to go back to the ground state.
 - C) The molecular environment lets it boost an electron to a higher energy level and also to transfer the electron to another molecule.
 - D) Each pigment molecule has to be able to act independently to excite electrons.
 - E) These chlorophyll a molecules are associated with higher concentrations of ATP.

Answer: C

Topic: Concept 10.2

Skill: Synthesis/Evaluation

- 37) P680⁺ is said to be the strongest biological oxidizing agent. Why?
- A) It is the receptor for the most excited electron in either photosystem.
 - B) It is the molecule that transfers electrons to plastoquinone (Pq) of the electron transfer system.
 - C) NADP reductase will then catalyze the shift of the electron from Fd to NADP⁺ to reduce it to NADPH.
 - D) This molecule results from the transfer of an electron to the primary electron acceptor of photosystem II and strongly attracts another electron.
 - E) This molecule is found far more frequently among bacteria as well as in plants and plantlike Protists.

Answer: D

Topic: Concept 10.2

Skill: Synthesis/Evaluation

- 38) Some photosynthetic bacteria (e.g., purple sulfur bacteria) have photosystem I but not II, while others (e.g. cyanobacteria) have both PSI and PSII. Which of the following might this observation imply?
- A) Photosystem II must have been selected against in some species.
 - B) Photosystem I must be more ancestral.
 - C) Photosystem II may have evolved to be more photoprotective.
 - D) Cyclic flow must be more primitive than linear flow of electrons.
 - E) Cyclic flow must be the most necessary of the two processes.

Answer: B

Topic: Concept 10.2

Skill: Synthesis/Evaluation

- 39) Cyclic electron flow may be photoprotective (protective to light-induced damage). Which of the following experiments could provide information on this phenomenon?
- A) using mutated organisms that can grow but that cannot carry out cyclic flow of electrons and compare their abilities to photosynthesize in different light intensities
 - B) using plants that can carry out both linear and cyclic electron flow, or only one or another of these processes, and measuring their light absorbance
 - C) using bacteria that have only cyclic flow and look for their frequency of mutation damage
 - D) using bacteria with only cyclic flow and measuring the number and types of photosynthetic pigments they have in their membranes
 - E) using plants with only photosystem I operative and measure how much damage occurs at different wavelengths.

Answer: A

Topic: Concept 10.2

Skill: Synthesis/Evaluation

- 40) 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.
 - B) They dissipate excessive light energy.
 - C) They cover the sensitive chromosomes of the plant.
 - D) They reflect orange light.
 - E) They take up toxins from the water.

Answer: B

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 41) In thylakoids, protons travel through ATP synthase from the stroma to the thylakoid space. Therefore the catalytic "knobs" of ATP synthase would be located
- A) on the side facing the thylakoid space.
 - B) on the ATP molecules themselves.
 - C) on the pigment molecules of PSI and PSII.
 - D) on the stroma side of the membrane.
 - E) built into the center of the thylakoid stack (granum).

Answer: D

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 42) Which of the following statements best represents the relationships between the light reactions and the Calvin cycle?
- A) The light reactions provide ATP and NADPH to the Calvin cycle, and the cycle returns ADP, P_i , and $NADP^+$ to the light reactions.
 - B) The light reactions provide ATP and NADPH to the carbon fixation step of the Calvin cycle, and the cycle provides water and electrons to the light reactions.
 - C) The light reactions supply the Calvin cycle with CO_2 to produce sugars, and the Calvin cycle supplies the light reactions with sugars to produce ATP.
 - D) The light reactions provide the Calvin cycle with oxygen for electron flow, and the Calvin cycle provides the light reactions with water to split.
 - E) There is no relationship between the light reactions and the Calvin cycle.

Answer: A

Topic: Concept 10.3

Skill: Knowledge/Comprehension

- 43) Where do the enzymatic reactions of the Calvin cycle take place?
- A) stroma of the chloroplast
 - B) thylakoid membranes
 - C) outer membrane of the chloroplast
 - D) electron transport chain
 - E) thylakoid space

Answer: A

Topic: Concept 10.3

Skill: Knowledge/Comprehension

- 44) 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) transport RuBP out of the chloroplast
 - E) synthesize simple sugars from carbon dioxide

Answer: E

Topic: Concept 10.3

Skill: Knowledge/Comprehension

For the following questions, compare the light reactions with the Calvin cycle of photosynthesis in plants.

- 45) Produces molecular oxygen (O_2)
- A) light reactions alone
 - B) the Calvin cycle alone
 - C) both the light reactions and the Calvin cycle
 - D) neither the light reactions nor the Calvin cycle
 - E) occurs in the chloroplast but is not part of photosynthesis

Answer: A

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 46) Requires ATP
- A) light reactions alone
 - B) the Calvin cycle alone
 - C) both the light reactions and the Calvin cycle
 - D) neither the light reactions nor the Calvin cycle
 - E) occurs in the chloroplast but is not part of photosynthesis

Answer: B

Topic: Concept 10.3

Skill: Knowledge/Comprehension

- 47) Produces NADH
- A) light reactions alone
 - B) the Calvin cycle alone
 - C) both the light reactions and the Calvin cycle
 - D) neither the light reactions nor the Calvin cycle
 - E) occurs in the chloroplast but is not part of photosynthesis

Answer: D

Topic: Concept 10.3

Skill: Knowledge/Comprehension

- 48) Produces NADPH
- A) light reactions alone
 - B) the Calvin cycle alone
 - C) both the light reactions and the Calvin cycle
 - D) neither the light reactions nor the Calvin cycle
 - E) occurs in the chloroplast but is not part of photosynthesis

Answer: A

Topic: Concept 10.2

Skill: Knowledge/Comprehension

- 49) Produces three-carbon sugars
- A) light reactions alone
 - B) the Calvin cycle alone
 - C) both the light reactions and the Calvin cycle
 - D) neither the light reactions nor the Calvin cycle
 - E) occurs in the chloroplast but is not part of photosynthesis

Answer: B

Topic: Concept 10.3

Skill: Knowledge/Comprehension

- 50) Requires CO₂
- A) light reactions alone
 - B) the Calvin cycle alone
 - C) both the light reactions and the Calvin cycle
 - D) neither the light reactions nor the Calvin cycle
 - E) occurs in the chloroplast but is not part of photosynthesis

Answer: B

Topic: Concept 10.3

Skill: Knowledge/Comprehension

- 51) Requires glucose
- A) light reactions alone
 - B) the Calvin cycle alone
 - C) both the light reactions and the Calvin cycle
 - D) neither the light reactions nor the Calvin cycle
 - E) occurs in the chloroplast but is not part of photosynthesis

Answer: D

Topic: Concept 10.3

Skill: Knowledge/Comprehension

- 52) The sugar that results from three "turns" of the Calvin cycle is glyceraldehyde-3-phosphate (G3P). Which of the following is a consequence of this?
- A) Formation of a molecule of glucose would require 9 "turns."
 - B) G3P more readily forms sucrose and other disaccharides than it does monosaccharides.
 - C) Some plants would not taste sweet to us.
 - D) The formation of starch in plants involves assembling many G3P molecules, with or without further rearrangements.
 - E) G3P is easier for a plant to store.

Answer: D

Topic: Concept 10.3

Skill: Synthesis/Evaluation

- 53) In the process of carbon fixation, RuBP attaches a CO₂ to produce a 6 carbon molecule, which is then split in two. After phosphorylation and reduction, what more needs to happen in the Calvin cycle?
- A) addition of a pair of electrons from NADPH
 - B) inactivation of RuBP carboxylase enzyme
 - C) regeneration of ATP from ADP
 - D) regeneration of rubisco
 - E) a gain of NADPH

Answer: D

Topic: Concept 10.3

Skill: Application/Analysis

Use the following figure and the stages labeled A, B, C, D, and E to answer the following questions.

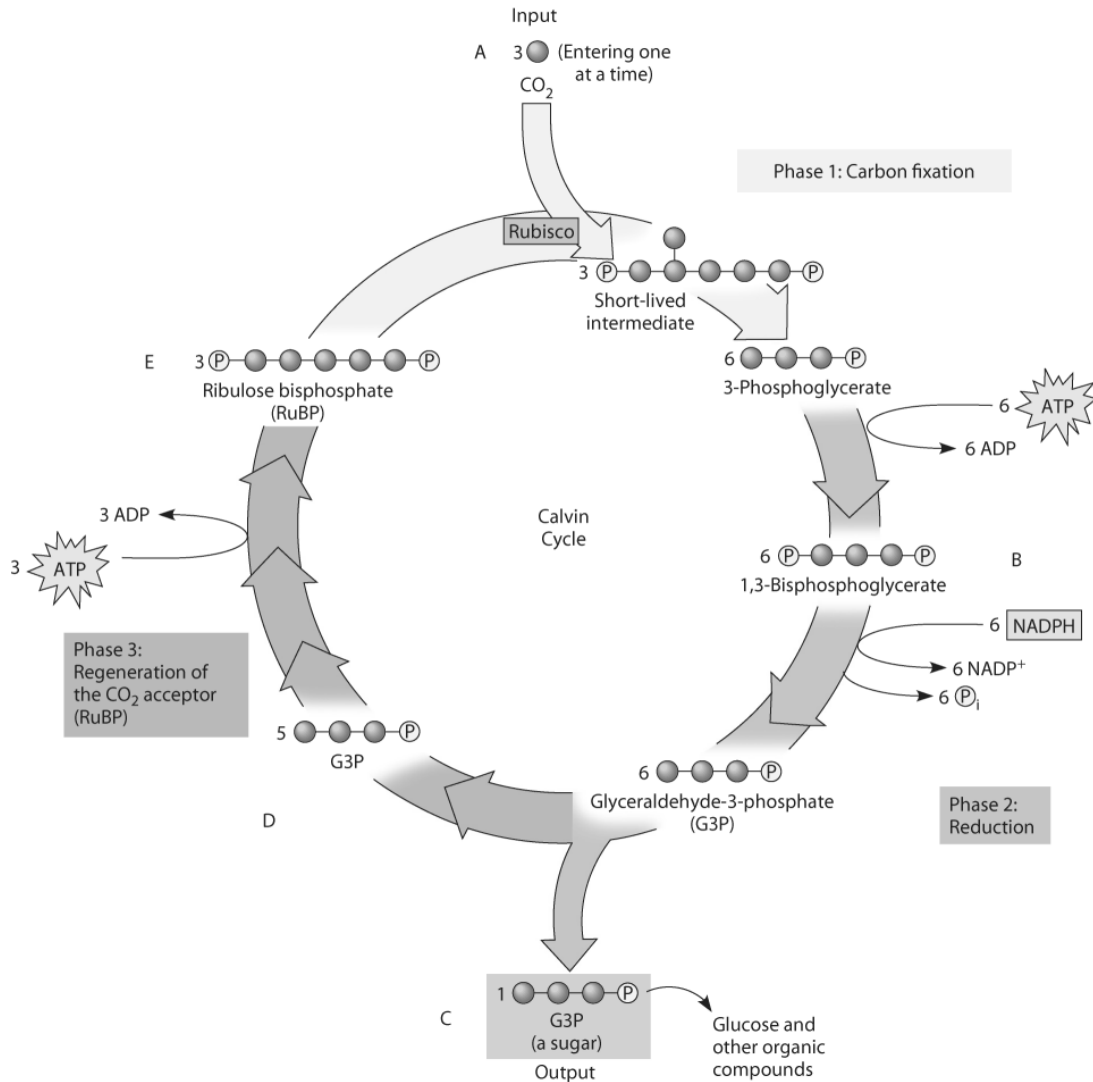


Figure 10.2

- 54) If ATP used by this plant is labeled with radioactive phosphorus, in which molecules will the radioactivity be measurable after one "turn" of the cycle?
- A) in B only
 - B) in B and C only
 - C) in B, C, and D only
 - D) in B and E only

E) in B, C, D, and E

Answer: E

Topic: Concept 10.3

Skill: Application/Analysis

55) If the carbon atom of the incoming CO₂ molecule is labeled with a radioactive isotope of carbon, where will the radioactivity be measurable after one cycle?

- A) in C only
- B) in E only
- C) in C, D, and E
- D) in A, B, and C
- E) in B and C

Answer: B

Topic: Concept 10.3

Skill: Application/Analysis

56) Which molecule(s) of the Calvin cycle is/are most like molecules found in glycolysis?

- A) A, B, C, and E
- B) B, C, and E
- C) A only
- D) C and D only
- E) E only

Answer: D

Topic: Concept 10.3

Skill: Knowledge/Comprehension

57) In metabolic processes of cell respiration and photosynthesis, prosthetic groups such as heme and iron-sulfur complexes are encountered. What do they do?

- A) donate electrons
- B) act as reducing agents
- C) act as oxidizing agents
- D) transport protons within the mitochondria and chloroplasts
- E) both oxidize and reduce during electron transport

Answer: E

Topic: Concept 10.3

Skill: Synthesis/Evaluation

58) The pH of the inner thylakoid space has been measured, as have the pH of the stroma and of the cytosol of a particular plant cell. Which, if any, relationship would you expect to find?

- A) The pH within the thylakoid is less than that of the stroma.
- B) The pH of the stroma is higher than that of the other two measurements.
- C) The pH of the stroma is higher than that of the thylakoid space but lower than that of the cytosol.
- D) The pH of the thylakoid space is higher than that anywhere else in the cell.
- E) There is no consistent relationship.

Answer: A

Topic: Concept 10.3

Skill: Application/Analysis

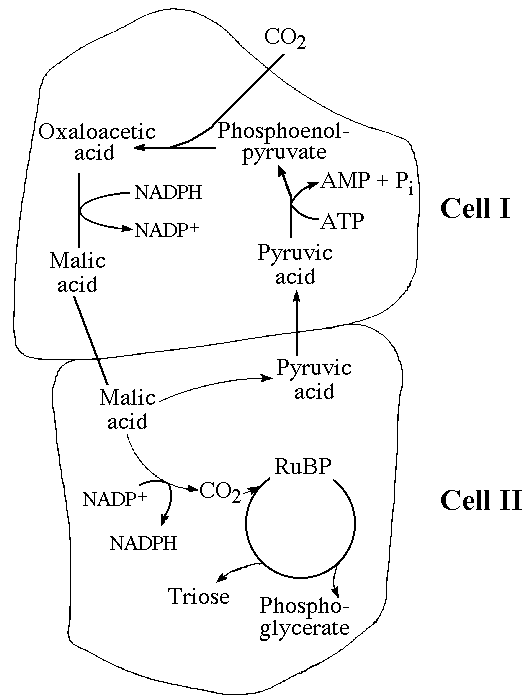


Figure 10.3

59) Which of the following statements is *true* concerning Figure 10.3?

- A) It represents cell processes involved in C₄ photosynthesis.
- B) It represents the type of cell structures found in CAM plants.
- C) It represents an adaptation that maximizes photorespiration.
- D) It represents a C₃ photosynthetic system.
- E) It represents a relationship between plant cells that photosynthesize and those that cannot.

Answer: A

Topic: Concept 10.4

Skill: Knowledge/Comprehension

60) Referring to Figure 10.3, oxygen would inhibit the CO₂ fixation reactions in

- A) cell I only.
- B) cell II only.
- C) neither cell I nor cell II.
- D) both cell I and cell II.
- E) cell I during the night and cell II during the day.

Answer: B

Topic: Concept 10.4

Skill: Application/Analysis

61) In which cell would you expect photorespiration?

- A) Cell I
- B) Cell II
- C) Cell I at night
- D) Cell II at night
- E) neither Cell I nor Cell II

Answer: B

Topic: Concept 10.4

Skill: Application/Analysis

- 62) In an experiment studying photosynthesis performed during the day, you provide a plant with radioactive carbon (^{14}C) dioxide as a metabolic tracer. The ^{14}C is incorporated first into oxaloacetate. The plant is best characterized as a
- A) C_4 plant.
 - B) C_3 plant.
 - C) CAM plant.
 - D) heterotroph.
 - E) chemoautotroph.

Answer: A

Topic: Concept 10.4

Skill: Application/Analysis

- 63) Why are C_4 plants able to photosynthesize with no apparent photorespiration?
- A) They do not participate in the Calvin cycle.
 - B) They use PEP carboxylase to initially fix CO_2 .
 - C) They are adapted to cold, wet climates.
 - D) They conserve water more efficiently.
 - E) They exclude oxygen from their tissues.

Answer: B

Topic: Concept 10.4

Skill: Knowledge/Comprehension

- 64) CAM plants keep stomata closed in daytime, thus reducing loss of water. They can do this because they
- A) fix CO_2 into organic acids during the night.
 - B) fix CO_2 into sugars in the bundle-sheath cells.
 - C) fix CO_2 into pyruvate in the mesophyll cells.
 - D) use the enzyme phosphofructokinase, which outcompetes rubisco for CO_2 .
 - E) use photosystems I and II at night.

Answer: A

Topic: Concept 10.4

Skill: Knowledge/Comprehension

- 65) Photorespiration lowers the efficiency of photosynthesis by preventing the formation of
- A) carbon dioxide molecules.
 - B) 3-phosphoglycerate molecules
 - C) ATP molecules.
 - D) ribulose biphosphate molecules.
 - E) RuBP carboxylase molecules.

Answer: B

Topic: Concept 10.4

Skill: Knowledge/Comprehension

- 66) The alternative pathways of photosynthesis using the C_4 or CAM systems are said to be compromises. Why?
- A) Each one minimizes both water loss and rate of photosynthesis.
 - B) C_4 compromises on water loss and CAM compromises on photorespiration.
 - C) Each one both minimizes photorespiration and optimizes the Calvin cycle.
 - D) CAM plants allow more water loss, while C_4 plants allow less CO_2 into the plant.
 - E) C_4 plants allow less water loss but Cam plants but allow more water loss.

Answer: C

Topic: Concept 10.4

Skill: Knowledge/Comprehension

- 67) If plant gene alterations cause the plants to be deficient in photorespiration, what would most probably occur?
- A) Cells would carry on more photosynthesis.
 - B) Cells would carry on the Calvin cycle at a much slower rate.
 - C) Less ATP would be generated.
 - D) There would be more light-induced damage to the cells.
 - E) More sugars would be produced.

Answer: C

Topic: Concept 10.4

Skill: Knowledge/Comprehension

Self-Quiz Questions

- 1) The light reactions of photosynthesis supply the Calvin cycle with
- A) light energy.
 - B) CO₂ and ATP.
 - C) H₂O and NADPH.
 - D) ATP and NADPH.
 - E) sugar and O₂.

Answer: D

Topic:

Skill:

- 2) Which of the following sequences correctly represents the flow of electrons during photosynthesis?
- A) NADPH → O₂ → CO₂
 - B) H₂O → NADPH → Calvin cycle
 - C) NADPH → chlorophyll → Calvin cycle
 - D) H₂O → photosystem I → photosystem II
 - E) NADPH → electron transport chain → O₂

Answer: B

Topic:

Skill:

- 3) In *mechanism*, photophosphorylation is most similar to
- A) substrate-level phosphorylation in glycolysis.
 - B) oxidative phosphorylation in cellular respiration.
 - C) the Calvin cycle.
 - D) carbon fixation.
 - E) reduction of NADP⁺.

Answer: B

Topic:

Skill:

- 4) How is photosynthesis similar in C₄ and CAM plants?
- A) In both cases, only photosystem I is used.
 - B) Both types of plants make sugar without the Calvin cycle.
 - C) In both cases, rubisco is not used to fix carbon initially.
 - D) Both types of plants make most of their sugar in the dark.
 - E) In both cases, thylakoids are not involved in photosynthesis.

Answer: C

Topic:

Skill:

- 5) Which process is most directly driven by light energy?
- A) creation of a pH gradient by pumping protons across the thylakoid membrane
 - B) carbon fixation in the stroma
 - C) reduction of NADP⁺ molecules
 - D) removal of electrons from chlorophyll molecules
 - E) ATP synthesis

Answer: D

Topic:

Skill:

- 6) Which of the following statements is a correct distinction between autotrophs and heterotrophs?
- A) Only heterotrophs require chemical compounds from the environment.
 - B) Cellular respiration is unique to heterotrophs.
 - C) Only heterotrophs have mitochondria.
 - D) Autotrophs, but not heterotrophs, can nourish themselves beginning with CO₂ and other nutrients that are inorganic.
 - E) Only heterotrophs require oxygen.

Answer: D

Topic:

Skill:

- 7) Which of the following *does not occur* during the Calvin cycle?
- A) carbon fixation
 - B) oxidation of NADPH
 - C) release of oxygen
 - D) regeneration of the CO₂ acceptor
 - E) consumption of ATP

Answer: C

Topic:

Skill: