AP Biology Chapter 8 Photosynthesis Exam
Name _____ date _____

1 Multiple-Choice Questions

1. ____ In autotrophic bacteria, where are chlorophyll-like pigments located?
A) in the chloroplast membranes
B) in the chloroplast stroma
C) in infolded regions of the plasma membrane
D) in infolded regions of the cell wall
E) in the central vacuole membrane

2. ____ If photosynthesizing green algae are provided with CO_2 containing heavy oxygen (^{18}O), subsequent analysis will show that ^{18}O is absent from which of the following molecules produced by the algae?
A) O_2
B) glyceraldehyde 3-phosphate (G3P)
C) glucose
D) ribulose bisphosphate (RuBP)

3. ____ If photosynthesizing green algae are provided with CO_2 containing heavy oxygen (^{18}O), subsequent analysis will show that ^{18}O first appears in which of the following molecules produced by the algae?
A) O_2
B) glyceraldehyde 3-phosphate (G3P)
C) glucose
D) ribulose bisphosphate (RuBP)
E) 3-phosphoglycerate

4. ____ If plants are grown with H_2O containing heavy oxygen (^{18}O), subsequent analysis will show that ^{18}O first appears in which of the following molecules produced by the algae?
A) O_2
B) glyceraldehyde 3-phosphate (G3P)
C) glucose
D) ribulose bisphosphate (RuBP)
E) CO_2

5. ____ 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

6. ____ Where does the Calvin cycle take place?
A) stroma of the chloroplast
B) thylakoid membrane
C) outer membrane of the chloroplast
D) interior of the thylakoid (thylakoid space)

7. ____ 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) electron transfer in photosystem I.
E) electron transfer in photosystem II.

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

9. ____ In the thylakoid membranes, what is the main role of the pigment molecules in a light-harvesting complex?
A) split water and release oxygen to the reaction-center chlorophyll
B) transfer light energy to the reaction-center chlorophyll
C) synthesize ATP from ADP and Ⓟ_i
D) transfer electrons to NADPH

10. ____ Which of the following events occurs in the light reactions of photosynthesis?
A) $NADP^+$ is produced.
B) ATP is consumed to yield ADP.
C) Carbon dioxide is fixed in organic molecules.
D) Light is absorbed and funneled to reaction-center chlorophyll *a*.

11. ____ In chemiosmosis in mitochondria, protons flow from the intermembrane space into the matrix, whereas in chemiosmosis in chloroplasts, protons flow from
A) the stroma into the cytosol.
B) the matrix into the stroma.
C) the stroma into the thylakoid space.
D) the intermembrane space into the stroma.
E) the thylakoid space to into the stroma.

12. ____ 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 O_2 in the light.
C) to test for CO_2 fixation in the dark.
D) to the action spectrum for photosynthesis.

13. ____ 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 oxygen
D) formation of glucose, using carbon dioxide, NADPH, and ATP

14. ____ In a plant cell, where are ATP synthase complexes located?
A) thylakoid membranes only
B) plasma membrane only
C) inner mitochondrial membranes only
D) thylakoid membrane and inner mitochondrial membranes
E) thylakoid membrane and plasma membranes

15. ____ In mitochondria, the electron transport chain pumps protons from the matrix into the intermembrane space, whereas in chloroplasts, the electron transport chain pumps protons from
A) the stroma to the cytosol.
B) the matrix to the stroma.
C) the stroma to the thylakoid space.
D) the intermembrane space to the stroma.
E) the thylakoid space to the stroma.

16. ____ Which of the following statements about the relationship between photosynthesis and cellular respiration is true?
A) In cellular respiration the biochemical pathways of photosynthesis run in reverse.
B) In photosynthesis the biochemical pathways of cellular respiration run in reverse.
C) Cellular respiration occurs only in animals and photosynthesis occurs only in plants.
D) There is a net consumption of ATP in cellular respiration and a net production of ATP in photosynthesis.
E) Cellular respiration is catabolic and photosynthesis is anabolic.

17. ____ Where are the molecules of the electron transport chain associated with photophosphorylation located in plant cells?
A) thylakoid membranes of chloroplasts
B) stroma of chloroplasts
C) outer membrane of chloroplasts
D) matrix of mitochondria
E) inner membrane of mitochondria

18. ____ 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 only related in certain parts of the spectrum.

19. ____ $P680^+$ is said to be the strongest biological oxidizing agent. Given its function, why is this necessary?
A) It is the receptor for the most excited electrons in either photosystem.
B) It is the molecule that transfers electrons to the photosynthetic electron transport chain.
C) It transfers its electrons directly to $NADP^+$ to produce NADPH.
D) It obtains electrons from the oxygen atom in a water molecule, so it must have a stronger affinity for electrons than oxygen has.
E) It has a positive charge.

20. ____ A flask containing photosynthetic green algae and a control flask containing water with no algae are both placed under a bank of lights, which are set to cycle between 12 hours of light and 12 hours of dark. The dissolved oxygen concentrations in both flasks are monitored. Predict what the relative dissolved oxygen concentrations will be in the flask with algae compared to the control flask.
A) The concentration of dissolved oxygen in the flask with algae will always be higher.
B) The concentration of dissolved oxygen in the flask with algae will always be lower.
C) The concentration of dissolved oxygen in the flask with algae will be higher in the light, but the same in the dark.
D) The concentration of dissolved oxygen in the flask with algae will be higher in the light, but lower in the dark.
E) The concentration of dissolved oxygen in the flask with algae will be lower in the light, but higher in the dark.

21. ____ What is the primary function of the Calvin cycle?
A) regenerate ATP for use in the light reactions of photosynthesis
B) produce carbon dioxide for use in the light reactions of photosynthesis
C) produce oxygen by oxidizing water
D) produce simple sugars from carbon dioxide

22. ____ In the process of carbon fixation, three molecules of RuBP combine with three molecules of CO_2 to produce three six-carbon molecules, which are then split to produce 12 molecules of 3-phosphoglycerate. After phosphorylation and reduction produce 12 glyceraldehyde 3-phosphate (G3P), what more needs to happen to complete the Calvin cycle?
A) release of two G3P to make sugars and regeneration of ATP from ADP
B) release of two G3P to make sugars and regeneration of RuBP
C) release of one G3P to make sugars and regeneration of NADPH
D) release of one G3P to make sugars and regeneration of citrate
E) release of one G3P to make sugars and regeneration of RuBP

23. ____ 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 lower than that of the stroma.
B) The pH of the stroma is lower than that of either the thylakoid space or cytosol.
C) The pH of the thylakoid space is higher than that of either the stroma or cytosol.
D) The pH of the stroma is higher than that of either the thylakoid space or cytosol.

24. ____ A reduction in the amount of $NADP^+$ available in plant cells in the light will ultimately result in
A) an increase in the rate of the Calvin cycle.
B) a decrease in the rate of linear electron flow.
C) a increase in the rate of linear electron flow.
D) an increase in the rate of oxygen production.

25. ____ What compound provides the reducing power for the Calvin cycle reactions?
A) ATP
B) FAD
C) $FADH_2$
D) NADPH
E) CO_2

26. ____ 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) thylakoid space

27. ____ In C_3 photosynthesis, the reactions that require ATP take place in
A) the 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.

28. ____ The NADPH required for the Calvin cycle comes from
A) reactions initiated in photosystem I.
B) reactions initiated in photosystem II.
C) the citric acid cycle.
D) glycolysis.
E) oxidative phosphorylation.

29. ____ Reactions that consume CO_2 take place in
A) the light reactions of photosynthesis only.
B) the Calvin cycle only.
C) the citric acid cycle only.
D) both the light reactions and the Calvin cycle.
E) both the Calvin cycle and the citric acid cycle.

30. ____ 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 Calvin 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 Calvin 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 carbon fixation, and the Calvin cycle provides the light reactions with sugars to produce ATP.

31. ____ Photorespiration occurs when rubisco combines RuBP with
A) CO_2·
B) O_2·
C) glyceraldehyde 3-phosphate.
D) citrate.
E) NADPH.

32. ____ 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 when temperatures are cooler.
B) fix CO_2 into organic acids in the bundle-sheath cells, which do not rely on stomata.
C) fix CO_2 into organic acids in the mesophyll cells, which do not rely on stomata.
D) fix CO_2 into by combining it with RuBP in the Calvin cycle.
E) obtain CO_2 through their roots during the day.

33. ____ Photorespiration lowers the efficiency of photosynthesis by
A) consuming excess carbon dioxide.
B) reducing the amount of water consumed.
C) reducing the amount of sugar produced.
D) producing excess ATP, but less NADPH.
E) inhibiting electron transfers from photosystem II.

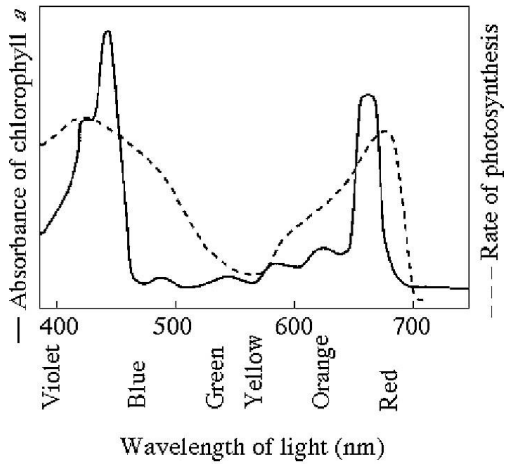


Figure 8.1

34. ____ Figure 8.1 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*.

35. ____ Figure 8.1 shows the absorption spectrum for chlorophyll *a* and the action spectrum for photosynthesis. What wavelength of light is most effective in driving photosynthesis?
A) 420 nm
B) 450 nm
C) 500 nm
D) 650 nm
E) 700 nm

36. ____ Figure 8.1 shows the absorption spectrum for chlorophyll *a* and the action spectrum for photosynthesis. What colors of light are least effective in driving photosynthesis?
A) violet-blue
B) green-yellow
C) yellow-orange
D) orange-red

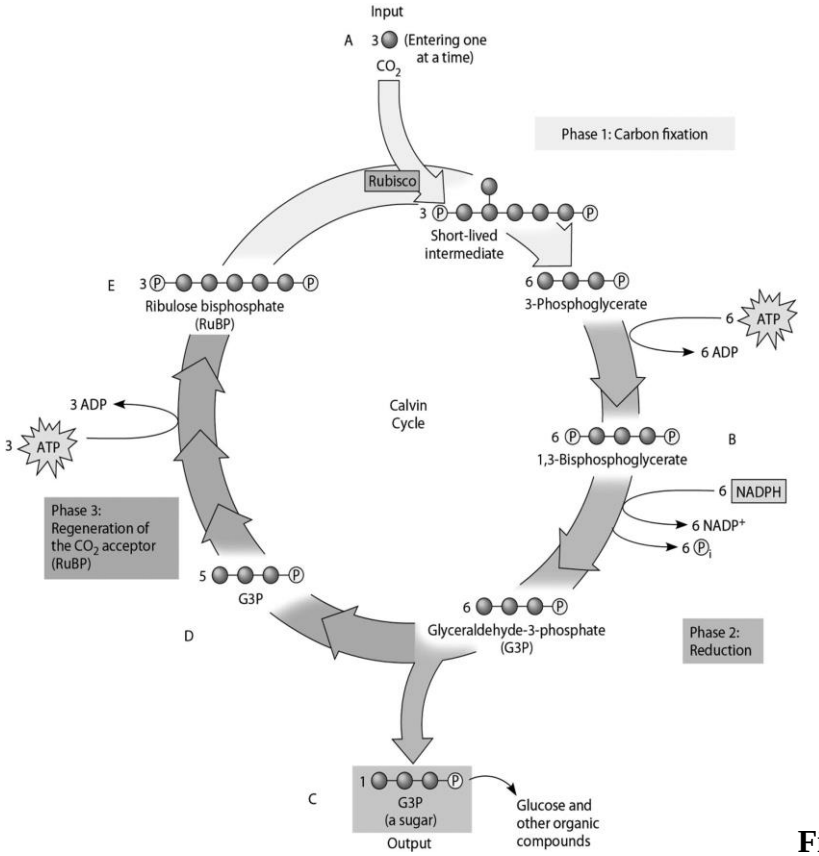


Figure 8.2

37. ____ Use Figure 8.2 and the compounds labeled A, B, C, D, and E to answer the following question. If ATP used by this plant is labeled with radioactive phosphorus, which molecule or molecules of the Calvin cycle will be directly radioactively labeled?
A) B only
B) B and C only
C) B, C, and D only
D) B and E only
E) B and D only

38. ____ Use Figure 8.2 and the compounds labeled A, B, C, D, and E to answer the following question. If the carbon atom of each of the incoming CO_2 molecules is labeled with a radioactive isotope of carbon, which organic molecules of the Calvin cycle will be radioactively labeled after one cycle?
A) C only
B) B, C, D, and E
C) C, D, and E only
D) B and C only
E) B and D only

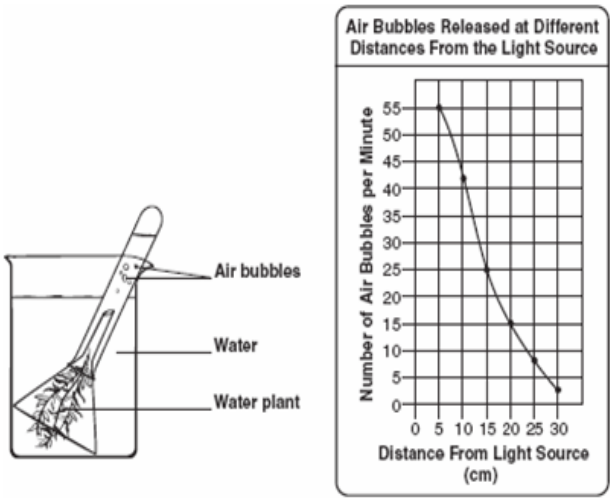
Please use the following information to answer the question(s) below.

A spaceship is designed to support animal life for a multiyear voyage to the outer planets of the solar system. Plants will be grown to provide oxygen and to recycle carbon dioxide. Because the spaceship will be too far from the sun for photosynthesis, an artificial light source will be needed.

39. ____ What wavelengths of light should be used to maximize plant growth with a minimum of energy expenditure?
A) full-spectrum white light
B) green light
C) a mixture of blue and red light
D) yellow light
E) UV light

40. ____ A gardener is concerned that her greenhouse is getting too hot from too much light and seeks to shade her plants with colored translucent plastic sheets, the color of which allows passage of only that wavelength. What color should she use to reduce overall light energy, but still maximize plant growth?
A) green
B) blue
C) yellow
D) orange
E) white

A student prepared two beakers with identical sprigs of a water plant as shown below. She placed one beaker in the shade and the other beaker beside a fluorescent lamp. She then systematically changed the distance from the beaker to the lamp. She counted the bubbles given off by the plants in each beaker. Shown here is the graph of the data for the beaker she placed beside the lamp.



41. What is the Independent Variable? _____

42. What is the Dependent Variable? _____

43. Which group acts as the Control? _____

44. How many bubbles did the plant produce at 10cm? 20cm? _____

45. Why is the student counting the bubbles? What gas is inside the bubbles?

_____

_____

_____

46. Why did the student change the distance of the light source? What does distance from the light source model?

_____

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47. What conclusion can be drawn from the results of this investigation?

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