## Communication, Photosynthesis and Respiration Retake

**Multiple Choice**

*Identify the letter of the choice that best completes the statement or answers the question.*

____ 1. Plants that fix $CO_2$ into organic acids at night when the stomata are open and carry out the Calvin cycle during the day when the stomata are closed are called

| | |
|---|---|
| a. | $C_3$ plants. |
| b. | $C_4$ plants. |
| c. | CAM plants. |
| d. | B and C only. |
| e. | A, B, and C |

____ 2. Which example below is a protein that can hold several other relay proteins as it binds to an activated membrane receptor?

| | |
|---|---|
| a. | active transcription factor |
| b. | third messenger |
| c. | ligand |
| d. | scaffolding protein |
| e. | protein kinase |

____ 3. The oxygen consumed during cellular respiration is involved directly in which process or event?

| | |
|---|---|
| a. | glycolysis |
| b. | accepting electrons at the end of the electron transport chain |
| c. | the citric acid cycle |
| d. | the oxidation of pyruvate to acetyl CoA |
| e. | the phosphorylation of ADP to form ATP |

*Refer to the choices to answer the following questions. Each choice may be used once, more than once, or not at all. Indicate whether the following events occur during*

| | |
|---|---|
| A. | photosynthesis |
| B. | respiration |
| C. | both photosynthesis and respiration |
| D. | neither photosynthesis nor respiration |

____ 4. reduction of oxygen which forms water

| | |
|---|---|
| a. | A |
| b. | B |
| c. | C |
| d. | D |

____ 5. the splitting of carbon dioxide to form oxygen gas and carbon compounds

| | |
|---|---|
| a. | A |
| b. | B |
| c. | C |
| d. | D |

____ 6. synthesis of ATP by the chemiosmotic mechanism

| | |
|---|---|
| a. | A |
| b. | B |
| c. | C |
| d. | D |

____ 7. Which kind of metabolic poison would most directly interfere with glycolysis?

| | |
|---|---|
| a. | An agent that reacts with oxygen and depletes its concentration in the cell |
| b. | An agent that binds to pyruvate and inactivates it |
| c. | An agent that closely mimics the structure of glucose but is not metabolized |
| d. | An agent that reacts with NADH and oxidizes it to $NAD^+$ |
| e. | An agent that blocks the passage of electrons along the electron transport chain |

____ 8. Which of the following is used as second messenger in signal transduction pathways?

| | |
|---|---|
| a. | calcium ions |
| b. | cyclic AMP |
| c. | inositol trisphosphate |
| d. | A and B only |
| e. | A, B, and C |

____ 9. Where are the proteins of the electron transport chain located?

| | |
|---|---|
| a. | cytosol |
| b. | mitochondrial outer membrane |
| c. | mitochondrial inner membrane |
| d. | mitochondrial intermembrane space |
| e. | mitochondrial matrix |

____ 10. Cellular respiration harvests the most chemical energy from which of the following?

| | |
|---|---|
| a. | substrate-level phosphorylation |
| b. | chemiosmotic phosphorylation |
| c. | converting oxygen to ATP |
| d. | transferring electrons from organic molecules to pyruvate |
| e. | generating carbon dioxide and oxygen in the electron transport chain |

____ 11. What does cyclic electron flow in the chloroplast produce?

| | |
|---|---|
| a. | ATP |
| b. | NADPH |
| c. | glucose |
| d. | A and B |
| e. | A, B, and C |

*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.

____ 12. 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. |

____ 13. 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 |

____ 14. Where is ATP synthase located in the mitochondrion?

| | |
|---|---|
| a. | cytosol |
| b. | electron transport chain |
| c. | outer membrane |
| d. | inner membrane |
| e. | mitochondrial matrix |

____ 15. Molecules that can potentially be converted to intermediates of glycolysis and/or the citric acid cycle include

| | |
|---|---|
| a. | amino acids and proteins. |
| b. | glycerol and fatty acids. |
| c. | glucose and sucrose. |
| d. | starch and glycogen. |
| e. | all of the above |

____ 16. An animal deficient in adenylyl cyclase

| | |
|---|---|
| a. | would not respond properly to epinephrine. |
| b. | could not convert GTP to ATP. |
| c. | would lack plasma membrane bound receptors. |
| d. | A and B only |
| e. | A, B, and C |

____ 17. The general name for an enzyme that transfers phosphate groups from ATP to a protein is

| | |
|---|---|
| a. | phosphorylase. |
| b. | phosphatase. |
| c. | protein kinase. |
| d. | ATPase. |
| e. | protease. |

____ 18. The ATP made during glycolysis is generated by

| | |
|---|---|
| a. | substrate-level phosphorylation. |
| b. | electron transport. |
| c. | photophosphorylation. |
| d. | chemiosmosis. |
| e. | oxidation of NADH to $NAD^+$. |

____ 19. An inhibitor of which of the following could be used to block the release of calcium from the endoplasmic reticulum?

| | |
|---|---|
| a. | tyrosine kinases |
| b. | serine/threonine kinases |
| c. | phosphodiesterase |
| d. | phospholipase C |
| e. | adenylyl cyclase |

____ 20. What is the term for metabolic pathways that release stored energy by breaking down complex molecules?

| | |
|---|---|
| a. | anabolic pathways |
| b. | catabolic pathways |
| c. | fermentation pathways |
| d. | thermodynamic pathways |
| e. | bioenergetic pathways |

____ 21. In the thylakoid membranes, what is the main role of the accessory 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 |
| e. | concentrate photons within the stroma |

____ 22. 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 |

____ 23. Substrate-level phosphorylation accounts for approximately what percentage of the ATP formed during glycolysis?

| | |
|---|---|
| a. | 0% |
| b. | 2% |
| c. | 10% |
| d. | 38% |
| e. | 100% |

____ 24. The response of a particular cell to a signal depends on

| | |
|---|---|
| a. | its particular collection of signal receptor proteins. |
| b. | its relay proteins. |
| c. | the proteins needed to carry out the response. |
| d. | A and B only |
| e. | A, B, and C |

____ 25. G proteins and G-protein-linked receptors

| | |
|---|---|
| a. | are found only in animal cells. |
| b. | are found only in bacterial cells. |
| c. | are thought to have evolved very early, because of their similar structure and function in a wide variety of modern organisms whose common ancestors diverged billions of years ago. |
| d. | probably evolved from an adaptation of the citric acid cycle. |
| e. | are not widespread in nature and were unimportant in the evolution of eukaryotes. |

____ 26. The ATP made during fermentation is generated by which of the following?

| | |
|---|---|
| a. | the electron transport chain |
| b. | substrate-level phosphorylation |
| c. | chemiosmosis |
| d. | oxidative phosphorylation |
| e. | aerobic respiration |

____ 27. Why is glycolysis considered to be one of the first metabolic pathways to have evolved?

| | |
|---|---|
| a. | It produces much less ATP than does oxidative phosphorylation. |
| b. | It is found in the cytosol, does not involve oxygen, and is present in most organisms. |
| c. | It is found in prokaryotic cells but not in eukaryotic cells. |
| d. | It relies on chemiosmosis which is a metabolic mechanism present only in the first cells-prokaryotic cells. |
| e. | It requires the presence of membrane-enclosed cell organelles found only in eukaryotic cells. |

____ 28. One bean plant is illuminated with green light and another bean plant of similar size and leaf area is illuminated with blue light. If all other conditions are identical, how will the photosynthetic rates of the plants most probably compare?

| | | | |
|---|---|---|---|
| a. | Neither plant will carry on photosynthesis | c. | the plant under the blue light will carry on photosynthesis at a greater |

| | | | |
|---|---|---|---|
| | | | rate than the one under the green light. |
| b. | photosynthesis will occur at the same rate in both plants. | d. | the plant under the green light will carry on photosynthesis at a greater rate than the one under the blue light. |

____ 29. Which process in eukaryotic cells will proceed normally whether oxygen ($O_2$) is present or absent?

| | |
|---|---|
| a. | electron transport |
| b. | glycolysis |
| c. | the citric acid cycle |
| d. | oxidative phosphorylation |
| e. | chemiosmosis |

____ 30. The function of both alcohol fermentation and lactic acid fermentation is to

| | |
|---|---|
| a. | reduce $NAD^+$ to NADH. |
| b. | reduce $FAD^+$ to $FADH_2$. |
| c. | oxidize NADH to $NAD^+$. |
| d. | reduce $FADH_2$ to $FAD^+$. |
| e. | none of the above |

____ 31. During photosynthesis

| | | | |
|---|---|---|---|
| a. | there is no ATP production | c. | ATP production occurs during the light-dependent reactions |
| b. | ATP production occurs during the dark reactions | d. | ATP production is replaced by NADPH production |

____ 32. Active transport (pumping) of protons to maintain a concentration gradient occurs during

| | | | |
|---|---|---|---|
| a. | photosynthesis | c. | both photosynthesis and cellular respiration |
| b. | cellular respiration | d. | neither photosynthesis nor cellular respiration |

____ 33. In a typical cell, calcium ions are

| | |
|---|---|
| a. | far more abundant in the blood and other extracellular fluid than in the cytoplasm. |
| b. | rapidly released from the endoplasmic reticulum in response to G-protein-mediated signals. |
| c. | often concentrated within the endoplasmic reticulum. |
| d. | A and B only |
| e. | A, B, and C |

____ 34. Testosterone functions inside a cell by

| | |
|---|---|
| a. | acting as a signal receptor that activates ion-channel proteins. |

| | |
|---|---|
| b. | binding with a receptor protein that enters the nucleus and activates specific genes. |
| c. | acting as a steroid signal receptor that activates ion-channel proteins. |
| d. | becoming a second messenger that inhibits adenylyl cyclase. |
| e. | coordinating a phosphorylation cascade that increases glycogen metabolism. |

____ 35. From the perspective of the cell receiving the message, the three stages of cell signaling are

| | |
|---|---|
| a. | the paracrine, local, and synaptic stages. |
| b. | signal reception, signal transduction, and cellular response. |
| c. | signal reception, nucleus disintegration, and new cell generation. |
| d. | the alpha, beta, and gamma stages. |
| e. | signal reception, cellular response, and cell division. |

____ 36. Phosphofructokinase is an allosteric enzyme that catalyzes the conversion of fructose-6-phosphate to fructose-1,6-bisphosphate, an early step of glycolysis. In the presence of oxygen, an increase in the amount ATP in a cell would be expected to

| | |
|---|---|
| a. | inhibit the enzyme and thus slow the rates of glycolysis and the citric acid cycle. |
| b. | activate the enzyme and thus slow the rates of glycolysis and the citric acid cycle. |
| c. | inhibit the enzyme and thus increase the rates of glycolysis and the citric acid cycle. |
| d. | activate the enzyme and increase the rates of glycolysis and the citric acid cycle. |
| e. | inhibit the enzyme and thus increase the rate of glycolysis and the concentration of citrate. |

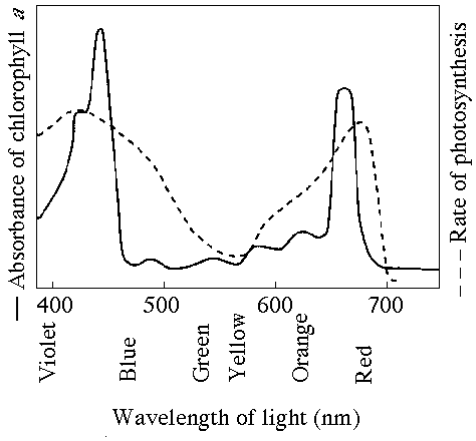
____ 37. A young relative of yours has never had much energy. He goes to a doctor for help and is sent to the hospital for some tests. There they discover his mitochondria can use only fatty acids and amino acids for respiration, and his cells produce more lactate than normal. Of the following, which is the best explanation of his condition?

| | |
|---|---|
| a. | His mitochondria lack the transport protein that moves pyruvate across the outer mitochondrial membrane. |
| b. | His cells cannot move NADH from glycolysis into the mitochondria. |
| c. | His cells contain something that inhibits oxygen use in his mitochondria. |
| d. | His cells lack the enzyme in glycolysis that forms pyruvate. |
| e. | His cells have a defective electron transport chain, so glucose goes to lactate instead of to acetyl CoA. |

____ 38. Which of the following is *true* of synaptic signaling and hormonal signaling?

| | |
|---|---|
| a. | Hormonal signaling occurs in animals only. |
| b. | Hormonal signaling is important between cells that are at greater distances apart than in synaptic signaling. |
| c. | Both act on target cells by a G-protein-signaling pathway. |
| d. | Only A and B are true. |
| e. | A, B, and C are true. |

____ 39. The figure below 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. |

____ 40. Which of the following intermediary metabolites enters the citric acid cycle and is formed, in part, by the removal of a carbon ($CO_2$) from one molecule of pyruvate?

| | |
|---|---|
| a. | lactate |
| b. | glyceraldehydes-3-phosphate |
| c. | oxaloacetate |
| d. | acetyl CoA |
| e. | citrate |

____ 41. 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 do experiments to generate an action spectrum. |
| e. | to test for production of either sucrose or starch. |

____ 42. Which of the following statements describes the results of this reaction?

$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$ + Energy

| | |
|---|---|
| a. | $C_6H_{12}O_6$ is oxidized and $O_2$ is reduced. |
| b. | $O_2$ is oxidized and $H_2O$ is reduced. |
| c. | $CO_2$ is reduced and $O_2$ is oxidized. |
| d. | $C_6H_{12}O_6$is reduced and $CO_2$ is oxidized. |
| e. | $O_2$ is reduced and $CO_2$ is oxidized. |

____ 43. Which statement is *false?*

| | |
|---|---|
| a. | Thylakoid membranes contain the photosynthetic pigments. |
| b. | The $O_2$ released during photosynthesis comes from water. |

| | |
|---|---|
| c. | RuBP is produced during cyclic electron flow in the light reactions of photosynthesis. |
| d. | The light reactions of photosynthesis provide the energy for the Calvin cycle. |
| e. | When chlorophyll is reduced, it gains electrons. |

____ 44. Membrane receptors that attach phosphates to specific amino acids in proteins are

| | |
|---|---|
| a. | not found in humans. |
| b. | called receptor tyrosine-kinases. |
| c. | a class of GTP G-protein signal receptors. |
| d. | associated with several bacterial diseases in humans. |
| e. | important in yeast mating factors that contain amino acids. |

____ 45. Where does glycolysis takes place?

| | |
|---|---|
| a. | mitochondrial matrix |
| b. | mitochondrial outer membrane |
| c. | mitochondrial inner membrane |
| d. | mitochondrial intermembrane space |
| e. | cytosol |

____ 46. Which enzyme below is considered an argument in favor of evolution because it is present in all photosynthesizing organisms and has an affinity for both carbon dioxide and oxygen?

| | | | |
|---|---|---|---|
| a. | PEP Carboxylase | c. | Rubisco |
| b. | Hexokinase | d. | Amino Acyl tRNA Synthetase |

____ 47. Which of the following statements is (are) correct about an oxidation-reduction (or redox) reaction?

| | |
|---|---|
| a. | The molecule that is reduced gains electrons. |
| b. | The molecule that is oxidized loses electrons. |
| c. | The molecule that is reduced loses electrons. |
| d. | The molecule that is oxidized gains electrons. |
| e. | Both A and B are correct. |

____ 48. During photosynthesis, visible light has enough energy to

| | |
|---|---|
| a. | force electrons closer to the nucleus. |
| b. | excite electrons. |
| c. | split a water molecule into hydrogen and oxygen. |
| d. | B and C only. |
| e. | A, B, and C. |

____ 49. Of the following, what do both mitochondria and chloroplasts have in common?

| | |
|---|---|
| a. | thylakoid membranes |
| b. | chemiosmosis |
| c. | ATP synthase |
| d. | B and C only |

| | |
|---|---|
| e. | A, B, and C |

____ 50. If photosynthesizing green algae are provided with CO2 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 exception is

| | |
|---|---|
| a. | PGA. |
| b. | PGAL. |
| c. | glucose. |
| d. | RuBP. |
| e. | $O_2$. |

Essay Question

a. Describe the light reactions of photosynthesis
b. For both a C3 and a C4 plant, trace the path of a carbon dioxide molecule from the point at which it enters a plant to its incorporation into a glucose molecule. Include leaf anatomy in your discussion of each type of plant.

## Communication, Photosynthesis and Respiration Retake
## Answer Section

### MULTIPLE CHOICE

1. ANS: C TOP: Concept 10.4
2. ANS: D TOP: Concept 11.4
3. ANS: B TOP: Concept 9.1
4. ANS: B TOP: Concept 10.2
5. ANS: C TOP: Concept 10.2
6. ANS: C TOP: Concept 10.2
7. ANS: C TOP: Concept 9.2
8. ANS: E TOP: Concept 11.3
9. ANS: C TOP: Concept 9.4
10. ANS: B TOP: Concept 9.3
11. ANS: A TOP: Concept 10.2
12. ANS: C TOP: Concept 10.2
13. ANS: E TOP: Concept 10.1
14. ANS: D TOP: Concept 9.4
15. ANS: E TOP: Concept 9.6
16. ANS: A TOP: Concept 11.3
17. ANS: C TOP: Concept 11.3
18. ANS: A TOP: Concept 9.1
19. ANS: D TOP: Concept 11.3
20. ANS: B TOP: Concept 9.1
21. ANS: B TOP: Concept 10.2
22. ANS: A TOP: Concept 10.1
23. ANS: E TOP: Concept 9.2
24. ANS: E TOP: Concept 11.4
25. ANS: C TOP: Concept 11.2

26. ANS: B TOP: Concept 9.5

27. ANS: B TOP: Concept 9.5

28. ANS: C

29. ANS: B TOP: Concept 9.1

30. ANS: C TOP: Concept 9.5

31. ANS: C

32. ANS: C

33. ANS: E TOP: Concept 11.3

34. ANS: B TOP: Concept 11.2

35. ANS: B TOP: Concept 11.1

36. ANS: A TOP: Concept 9.6

37. ANS: A TOP: Concept 9.3

38. ANS: B TOP: Concept 11.1

39. ANS: D TOP: Concept 10.2

40. ANS: D TOP: Concept 9.3

41. ANS: B TOP: Concept 10.2

42. ANS: A TOP: Concept 9.1

43. ANS: C TOP: Concept 10.3

44. ANS: B TOP: Concept 11.2

45. ANS: E TOP: Concept 9.1

46. ANS: C

47. ANS: E TOP: Concept 9.1

48. ANS: B TOP: Concept 10.2

49. ANS: D TOP: Concept 10.2

50. ANS: E TOP: Concept 10.1

STANDARDS:

a) LIGHT REACHTIONS:
__ Light reactions on thylakoids (in grana) or on inner membrane

__ Cyclic and non-cyclic photophosphorylation
__ e-s come from splitting of H2O
__ Chlorophyll e-s excited by sunlight (must describe e-s on chlorophyll as those that are excited)
__ Energy of e-s used to make ATP and NADPH
__ Chemiosmosis or proton gradient
__ Protons pumped to thylakoid space
__ mention or discussion of redox (oxidation/reduction)

b) C3 AND C4 ANATOMICAL AND BIOCHEMICAL PATHWAYS
__ CO2 enters through stomates
__ Dark reaction/CO2 fixation in stroma (fluid)
__ Energy of ATP and NADPH used to drive reaction
__ C4 plants have mesophyll and bundle sheath cells
__ C4 plants have chloroplasts in bundle sheath cells
__ C3 plants use enzyme Rubisco
__ C4 plants us enzyme PEP Carboxylase
__ C4 plants send 4-C (organic compound) to bundle sheath