Topic 3: The Energy of Life

Level 1

1. D
2. D
3. A
4. C
5. B
6. D
7. C
8. B
9. D
10. A
11. C
12. B
13. A
14. B
15. D
16. B
17. D
18. C
19. A
20. D
21. C
22. A

Level 2

1. D
2. A
3. C
4. A
5. C
6. B
7. D
8. D
9. B
10. D
11. B
12. D
13. C
14. C
15. A

Grid-Ins

1. 90
2. -3.9
3. 18

FRQ (next page)

(a) Although plants have two photosystems, they both work in the same way. Both photosystems have two components: the light-harvesting complexes and the reaction center. The light-harvesting complex is made up of many chlorophyll and accessory pigment molecules. When one of the pigment molecules absorbs light energy in the form of photons, one of the molecule's electrons is raised to an orbital of higher potential energy. The pigment molecule is then said to be in an "excited" state. The increase in potential energy is transferred to the reaction center of the photosystem. The reaction center consists of two chlorophyll *a* molecules, which use the increased potential energy passed to them by the photosynthetic pigments to donate electrons to the primary electron acceptor. The solar-powered transfer of an electron from the reaction-center chlorophyll *a* pair to the primary electron acceptor is the first step of the light reactions. This is the conversion of light energy to chemical energy.

(b) Glycolysis is the first stage of cellular respiration and occurs in the cytoplasm. Glycolysis involves the breakdown of glucose to two pyruvate molecules. To accomplish this, 2 ATP molecules are invested, which helps to destabilize glucose, making it more reactive and allowing glucose to break into two three-carbon molecules. By the time the pathway has produced pyruvate, 4 ATP molecules have been produced along with 2 NADH molecules. This gives a net energy gain of 2 ATP and 2 NADH. Thus, one important role of glucose is to produce energy molecules for the cell to use in its life processes. The second role is to produce pyruvate, which can feed into the citric acid cycle in the mitochondria and ultimately into the electron transport chain, where most of the ATP in cellular respiration is produced.

(c) In cellular respiration water is a product of the reaction, whereas in photosynthesis water is a reactant. In cellular respiration water is formed when the electrons at the end of the electron transport chain in the inner membrane of the mitochondria combine with hydrogen ions and an atom of oxygen to form water. Oxygen is the ultimate electron acceptor in cellular respiration and when combined with protons, water is formed. In photosynthesis an enzyme splits a water molecule into two electrons, two hydrogen ions, and an oxygen atom. The electrons are supplied as needed directly to the chlorophyll molecules in the reaction center of photosystem II. In photosynthesis water is the ultimate electron donor. Additionally, the oxygen atom released immediately joins with another oxygen atom to form O_2. The oxygen on Earth comes almost entirely from the splitting of water in photosynthesis.

This student has written a particularly clear essay. Notice how carefully sequenced the responses are. Also note the

Photosynthesis Lab Q's

1. C
2. B
3. C
4. B

Cell Respiration Lab Q's

1. B
2. A
3. D
4. D

Enzyme Lab

1. C
2. B