Section 5.2 Review Answers

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1. A plant uses glucose for cellulose and other structural tissues, for the synthesis of other carbohydrates, for storage as starch, and in the synthesis of other essential compounds such as amino acids.

2. The light-dependent reactions require the absorption of light from the Sun via photosynthetic pigments, to produce ATP and NADPH in the stroma of the chloroplast. When there are sufficient amounts of ATP and NADPH, these molecules are used for the synthesis of glucose. The synthesis of glucose occurs in the light-independent reactions, which as the name implies, can be carried out in the presence or absence of light.

3. Students' sketches should resemble Figure 5.9B.

4. The shape of the action spectrum will parallel that of the absorbance spectrum for the photosynthetic pigments together. However, an action spectrum describes how the rate of photosynthesis varies with the wavelength of light absorbed, and an absorbance spectrum describes how individual pigments absorb light.

5. Most green plants contain more than one photosynthetic pigment because each absorbs light of different colours (wavelengths). Having more than one type of pigment allows plants to use as much solar energy as possible.

6. Photosystems are complexes located on the thylakoid membrane that contain light-absorbing pigments.

7.
- Pigment molecules that are assembled in photosystems absorb light energy, which is concentrated in a chlorophyll *a* molecule.
- Excited electrons are raised to a higher energy level.
- The electrons pass through an electron transport system where the energy released is used to produce ATP.
- A water molecule is split into its elements. The hydrogen atoms reduce $NADP^+$ to NADPH, which participates in the Calvin-Benson Cycle.
- The oxygen atoms combine and leave the cell as oxygen molecules.

8. The electron transport system can be described as a staircase. On each step is a carrier molecule that accepts high-energy electrons from above and passes them down to a carrier below. High-energy electrons lose energy as they are passed from carrier to carrier. This energy can be used to produce ATP molecules.

9. NADPH is a reduced molecule. The oxidized version (i.e., the version containing one less electron) is $NADP^+$.

10. Electrons that are lost from chlorophyll molecules in photosystem II are replaced by the splitting of water.

11. The process of chemiosmosis involves the use of a proton gradient across a membrane to synthesize ATP.

12. The ATP and NADPH required for the synthesis of glucose is obtained from the light-dependent reactions.

13. Carbon dioxide enters the Calvin-Benson cycle by combining with a molecule of ribulose bisphosphate to form an unstable six-carbon compound that immediately breaks down to two three-carbon compounds. ATP and NADPH produced in the light-dependent reactions act in converting these compounds to PGAL molecules. Some PGAL molecules combine to form glucose. Others are converted back to ribulose bisphosphate, which is needed to continue the cycle.

14. (a) Since aerobic bacteria need oxygen to survive, greater concentrations of bacteria reflect greater concentrations of oxygen, and thus imply greater rates of photosynthesis. Photosynthesis is greatest in violet and blue light and red light. Photosynthesis is least in green and yellow light.

(b) Each hypothesis should have a manipulated variable, a responding variable, and an explanation of why the effect might be expected. For example, light of differing colours will have different rates of photosynthesis because each photosynthetic pigment will absorb light differently. Support (or lack of support) must be provided based on Englemann's experiment. For the hypothesis provided, support is provided by the differing concentrations of bacteria around blue light as compared to green light.