Name _____ **Period** _____

Chapter 7: Photosynthesis: Using Light to Make Food

Guided Reading Activities

Big idea: An introduction to photosynthesis

Answer the following questions as you read modules 7.1–7.5:

1. True or false: A photoautotroph is a type of heterotroph that uses solar energy to produce sugars. If false, make it a correct statement.
   False, a photoautotroph is not a heterotroph. Of course, it would be an autotroph.

2. A new bacterium is discovered in Lake Superior. Scientists are able to determine that these bacteria produce oxygen gas. What is likely to be true about these organisms?
   The bacteria are likely photoautotrophs and perform photosynthesis.

3. A plant's leaves are the primary site of photosynthesis. A plant's leaves would be expected to have a large amount of _____.
   chloroplasts (A student could also make an argument for chlorophyll.)

4. A student has been shrunk to fit inside the thylakoid space of a granum. How many layers of phospholipids would he or she need to cross through to get completely out of the mesophyll cell?
   Eight layers of phospholipids

5. Which of the following substances provides the majority of the atoms that make up the sugar produced by photosynthesis?

   a. Water

   b. Carbon dioxide

   c. Oxygen

   d. Hydrogen

6. True or false: During photosynthesis, CO_2 is split to release oxygen gas. If false, make it a correct statement.
   False, O_2 gas is created as a result of splitting H_2O.

7. Complete the following table that compares photosynthesis with cellular respiration.

	Photosynthesis	Cellular respiration
CO_2 is reduced in this process.	Yes	No
$C_6H_{12}O_6$ becomes oxidized in this process.	No	Yes
Overall, this process is exergonic.	No	Yes
Overall, this process is endergonic.	Yes	No

8. The Calvin cycle is also referred to as the light-independent reactions. Briefly explain why referring to the chemical reactions of the Calvin cycle as the light-independent reactions is only partially accurate.
   Although the chemical reactions of the Calvin cycle do not directly depend on solar energy, the reactions do depend on the products produced by the light reactions.
9. A toxin is found to inhibit the uptake of CO_2 into plant leaves. This toxin would most directly affect the _____.

   a. light reactions

   b. splitting of H_2O

   c. Calvin cycle

   d. absorption of solar energy

Big idea: The light reactions: Converting solar energy to chemical energy

Answer the following questions as you read modules 7.6–7.9:

1. True or false: Red wavelengths of light have more energy than purple wavelengths of light. If false, make it a correct statement. Refer to Figure 7.6A on page 112 in your textbook for help to answer this question.
   False, red wavelengths of light have less energy than violet (purple) wavelengths.

2. A botanist discovers a new plant species in the Amazon rainforest that has blue leaves. Briefly explain what can be inferred about the pigments in the leaves of this plant.
   It can be assumed that the pigments in this plant absorb all wavelengths of the visible light spectrum except blue.

3. Figure 7.7A on page 113 clearly depicts the events that occur when a pigment absorbs a photon of light. If a substance somehow kept the boosted electron from falling back to its ground state, would light and heat still be released in the same amount? Briefly explain your answer.
No, if an electron were kept from falling back to its ground state, the energy would not be given off as light and heat in that moment.

4. The two complexes of pigments that constitute a photosystem include light-harvesting complex and the reaction-center complex.

5. If a scientist removes the pair of chlorophyll ***a*** molecules from the reaction-center complex, then which of the following consequences would be most likely to occur?

   a. The primary electron acceptor would capture boosted electrons from the light-harvesting complex.

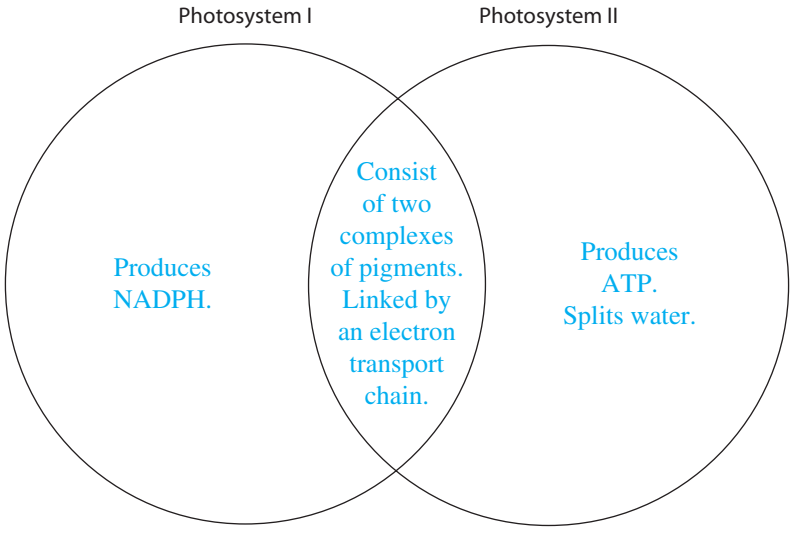
   b. The transfer of energy from the light-harvesting complex to the reaction-center complex would stop.

   c. Light would be absorbed twice as fast to make up for the loss of the chlorophyll *a* pigments.

   d. None of the above consequences would occur.

6. Refer to Figure 7.8 on page 114 in your textbook. What molecules do the two people at the top of the platforms represent?
They represent primary electron acceptors.

7. Complete the Venn diagram that compares photosystem I with photosystem II.



8. What links photosystem I with photosystem II?

   a. The products of the Calvin cycle.

   b. Oxygen gas.

   c. The electrons passed between the two photosystems.

   d. The chlorophyll B molecules in the light-harvesting complex.

9. Briefly explain what would happen to the levels of NADPH and ATP within the stroma if the passage of electrons to the primary electron acceptor of photosystem I were inhibited.
   Because the continuous passing of electrons along the electron transport chain powers the production of ATP, ATP production would stop. Additionally, because the electron transport chain links photosystem II to photosystem I, any interruption in the transport chain would also halt NADPH production.

Big idea: The Calvin cycle: Reducing CO_2 to sugar

Answer the following questions as you read modules 7.10–7.11:

1. The Calvin cycle is cyclic because

   a. CO_2 is constantly acquired during carbon fixation.

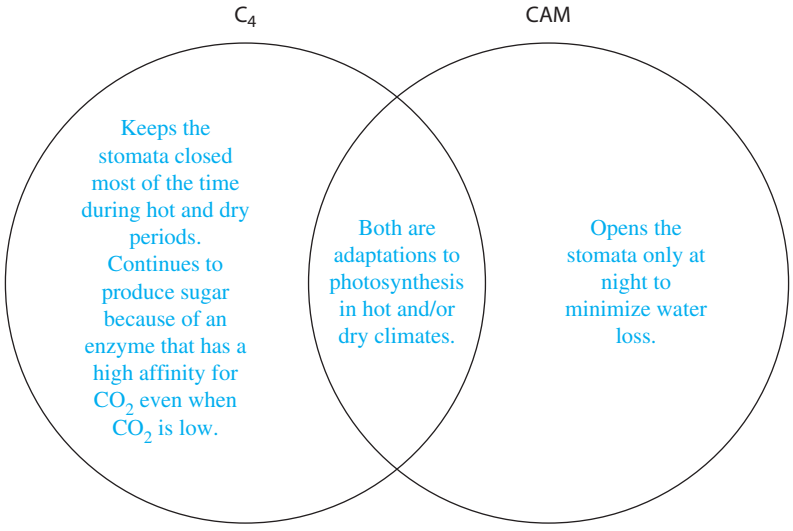
   b. it constantly makes G3P.

   c. RuBP is regenerated in the final chemical reaction.

   d. NADPH and ATP are used from the light reactions.

2. True or false: Each turn of the Calvin cycle produces one molecule of glucose. If false, make it a correct statement.
   False, one turn of the Calvin cycle makes a 3-carbon sugar called G3P. It would take two turns of the Calvin cycle to make a 6-carbon glucose.
3. Briefly explain what links the two stages of photosynthesis with each other.
   The two stages of photosynthesis are linked by the ATP and NADPH produced in the light reactions. ATP and NADPH are used in the dark reactions to power the synthesis of sugar.
4. Photorespiration is the process by which a plant adds O_2 to RuBP instead of CO_2.

5. Complete the Venn diagram that compares C4 with CAM photosynthesis.



Big idea: The global significance of photosynthesis

Answer the following questions as you read modules 7.12–7.14:

1. List three benefits of photosynthetic products to humans.
   Food, fuel, and removal of CO_2 from the atmosphere

2. A plant uses the products of the Calvin cycle for which of the following?

   a. To make starch

   b. To make cellulose

   c. To make molecules used in protein synthesis

   d. All of the above

3. A common misconception is that the greenhouse effect is bad. Briefly explain why this is not necessarily true.
   Without the greenhouse effect, the Earth would be significantly cooler and not as hospitable to life as we know it.
4. What is the overall effect of increased CO_2 levels on poison ivy growth? Refer to Figure 7.13B on page 119 in your textbook.
   The effect has been a significant increase in the growth of poison ivy.

5. ___Chlorine___ reacts with ozone to turn it into _____O_2_____.

6. True or false: The Kyoto Protocol of 1997 eliminated the use of CFCs by all participating countries. If false, make it a correct statement.
   False, the Montreal Protocol eliminated the use of CFCs by all participating countries.

CONNECTING THE BIG IDEAS

Use your knowledge of the information contained within this chapter's "Big Ideas" to answer this question.

You are a graduate student studying the effects of global warming on photosynthesis. What are some different methods that you could think of to measure the rate of photosynthesis in a plant?

