AP Biology **Name:** **P:**

Chapter 8 Reading Guide: Photosynthesis

How to use this reading guide: Look over the entire reading guide—read each question to prepare yourself for reading the chapter. Read the chapter carefully and thoroughly. Make sure to look at all of the figures and pictures and read their captions. Then…answer the questions posed below.

1. Explain the phrase "Life on earth is solar powered."

2. How can organisms on the planet obtain the organic compounds that provide it with energy and carbon skeletons?

3. What is an autotroph? Describe how they sustain themselves.

    a. Why to biologists call them "producers"?

4. What is a heterotroph? Describe how they obtain their energy and nutrients—include the variations mentioned in the text (humans and fungus).

    a. For what are heterotrophs dependent upon autotrophs?

Photosynthesis converts light energy to the chemical energy of food

5. Where in a plant will photosynthesis take place? What is common to all these have in common?

6. Which part of the plant carries out MOST of the photosynthesis? Why?

7. Chlorophyll is the pigment located in chloroplasts that is responsible for the green color of plants and for absorbing the light for photosynthesis.
    a. Where are the chloroplasts located within the leaf?
    b. Draw a chloroplast and label the: stroma, grana, thylakoid space, outer membrane, intermembrane space, and the inner membrane.

    c. Where is the chlorophyll located within the chloroplast?
8. In words, summarize what happens in photosynthesis.

    a. Write an overall chemical equation for photosynthesis (in simplified-not in simplest!!!- form). Is this the ONLY process taking place in plants?

9. Science is a process—not just a collection of facts!!!! One of the coolest discoveries ever made was trying to figure out where the oxygen that comes out of photosynthesis comes from. Describe C.B. Van Neil's experiment.
    a. Where does the oxygen come from?

10. How was his hypothesis later confirmed? Explain the experiment and the results.

11. Photosynthesis is a redox reaction (like cellular respiration). But one liberates energy and the other stores it. Explain why photosynthesis is endergonic (requires an energy input).

12. Photosynthesis is a "Two Step" process. Name and describe each step. Where are they located?
    a. What is the reason for each "step" in the process?

13. What is NADPH? What is its function? What molecule is it like?

14. What is photophosphorylation? What does it produce? What is NOT produced? Why is this necessary?

15. Why is the Calvin Cycle sometimes referred to as the "Dark reactions"? Why is this a misnomer?

16. Write the overall chemical equation for photosynthesis AGAIN…but this time identify what is being oxidized and what is being reduced.

The light reactions convert solar energy to the chemical energy of ATP and NADPH (Make sure you read about light—but we don't have time to go over the EM spectrum!)

17. What can happen to light when it meets matter?

18. What is a pigment? What do they do with light?

19. What is a spectrophotometer? How does it work?

20. What is an absorption spectrum?
    a. What is the absorption spectrum for chlorophyll a? What does that tell us about the light used in photosynthesis?

    b. How does an absorption spectrum differ from an action spectrum? How do you get an action spectrum? (Make sure you read and understand Engelmann's experiment).

21. Why doesn't the absorption spectrum for chlorophyll a exactly match the action spectrum of photosynthesis? What can account for the difference?

22. Explain what photoprotection does.
    a. What molecules are involved? (What do they do for humans?)
    b. Why is it advantageous?

23. Know and be able to recognize chlorophyll!!!!
    a. What holds chlorophyll in the thylakoid membrane?
    b. Look at the structure of chlorophyll—why would plants need magnesium in the soil?

24. What happens when a molecule absorbs a photon of light?

25. Why do pigments have specific absorption spectrums? (How is it related to photons and electron states?)

26. What is a photosystem?

    a. Draw a picture of a photosystem.
    b. Label and describe: the light-harvesting complex and the reaction center.

27. Describe the 1st step of the light reaction.

28. There are two photosystems located in the thylakoid membrane that cooperate in the light reactions.
    a. What are the two photosystems?
    b. How do their reaction centers differ from each other?
    c. How do their chlorophyll molecules compare?

29. What are the two main products of the light reactions?

30. Briefly describe the "non-cyclic" flow of electrons in photosynthesis.
    a. How does this flow lead to the production of NADPH and ATP?

31. For what is the NADPH and ATP created in the light reactions used? What happens to the oxygen produced?

32. Describe what happens in Cyclic Electron Flow.
    a. Why is this necessary?
    b. How might the concentration of NADPH "regulate" the switch between Non-Cyclic and Cyclic electron flow?

33. Compare and contrast chemiosmosis in cellular respiration and photosynthesis.
    a. What is similar in both processes?

    b. What is unique to photosynthesis?

34. Draw a picture of the current model for the light reactions. Be sure to show where protons are built up, where water is split, and where NADPH and ATP are made.

<u>The Calvin Cycle uses ATP and NADPH to convert CO_2 to sugar</u>

35. How does the Calvin cycle compare to the Krebs cycle?

36. What is directly produced in the Calvin cycle? What provides the energy and what provides the electrons and hydrogen ions (H^+)?

37. The Calvin Cycle is generally divided into three phases—Carbon Fixation, Reduction, and Regeneration. Describe each phase.
    a. Carbon Fixation-

    b. Reduction-

    c. Regeneration-

38. Total up the number of ATP and NADPH used in the production of one glyceraldehyde phosphate.

Alternative mechanisms of carbon fixation have evolved in hot, arid climates

39. How does CO_2 get into the leaf of plants?
    a. What else passes through? Why is this a problem associated with "terrestrial" life?

    b. What do plants normally do on hot, dry days? What is the benefit and the problem associated with this?

40. Most plants are known as C_3 plants. Explain what this means.

    a. On a hot, dry day C_3 plants engage in "photorespiration". What happens in photorespiration?

    b. This process if costly—it costs ATP without producing any. Why would a plant do this process?

41. Plants, such as sugarcane, corn, and grasses, use a C_4 pathway to avoid photorespiration. Explain what happens in a C_4 pathway.

a. In what type of environment would you find plants that use a C_4 pathway?

42. A second approach to the problem of photorespiration is CAM.
    a. Identify at least 3 plants that do CAM carbon fixation.

    b. In what type of environment would you find these plants?

    c. Describe how these plants get the CO_2 needed and what they do with it.

43. What is the fate of the products of photosynthesis?