Objectives for Unit Five: Chapter 8
Photosynthesis, Adaptations, and Comparisons to Photosynthesis

You should be able to:

1. In an ecosystem, draw the relationship between light energy, photosynthesis, food, cellular respiration,
2. Discuss the relationships between oxidation, reduction, electrons gained, electrons lost, energy lost, energy gained.
3. For photosynthesis and respiration, identify which compounds are oxidized and which are reduced.
4. Write the overall balanced equation for photosynthesis and cellular respiration.
5. Compare and contrast photosynthesis and cellular respiration. Include overall purpose, location within the cell, inputs, outputs, electron carrier molecules, directions of H+pumping and flow, initial source of high energy electrons, etc.
6. Identify the redox reaction in photosynthesis, that is, identify where electrons and hydrogen ions are lost and where they are gained.
7. Describe and label the structure of a chloroplast. Associate various aspects of photosynthesis with regions of the chloroplast.
8. Compare electron transport and chemiosmosis in mitochondria and in chloroplasts.
9. Identify which colors of light are absorbed by various pigments in plants. Draw an absorption spectrum for spinach. Distinguish between an absorption spectrum of chlorophyll a and an action spectrum for photosynthesis. What is the relationship between wavelengths of light absorbed and the wavelengths of light used for photosynthesis?
10. Explain Engelmann's experiment that associated light wavelenths with use in photosynthesis.
11. Explain why a solution of extracted chlorophyll will glow red after strong light has been shined on it.
12. Describe where & when the light (dependent) reaction occurs.
    a. How are electron transport and chemiosmosis involved?
    b. What are the inputs and the outputs of the light reaction?
    c. Explain why the cyclic pathway for electron flow in the light reactions is necessary.
13. Describe where and when the Calvin Cycle (light-independent reactions) occurs.
    a. What are the inputs and the outputs of Calvin cycle?
    b. What is the role of RUBISCO?
    c. Identify the relationships between the light reaction and the Calvin Cycle; identify what molecules are produced by one and used by the other.
14. For a C(3), a C(4) plant, and a CAM 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 and biochemical pathways in your discussion of each type of plant.
15. Describe under what conditions photorespiration occurs and explain why photorespiration is a problem for plants.
16. Discuss adaptations that some plants (CAM and C4 plants) have to prevent photorespiration.
17. LAB: Leaf Chromatography and Photosynthesis Activities
    a. Describe the general purpose of paper chromatography and the specific purpose of our leaf pigment chromatography activity.
    b. Name some of the major pigments found in a leaf and tell their color. What is their role in photosynthesis?
    c. Why can leaves "turn colors" in the fall?
    d. Given a chromatogram, calculate Rf values.
    e. Identify the parts of a dicot leaf and discuss their role in photosynthesis.
    f. Discuss how leaves are well adapted for the process of photosynthesis.
18. LAB: Rate of the Light Reactions using DPIP
    a. Design an experiment to measure the effect of light's color (wavelength) on the rate of the light reactions.
    b. Describe controls that should be used in your experimental design.
    c. Explain how DPIP is used to measure the rate of the light reactions.
    d. Describe the effect of light/dark and boiled/unboiled chloroplasts on the light reactions.
    e. Draw a graph of the expected results from your experiment describe in "a" above.
19. LAB: Rate of Photosynthesis (Leaf disk floatation)
    a. Draw a graph to illustrate the relationship between light intensity and the rate of photosynthesis.
    b. Explain how the leaf disk flotation method can be used to measure the rate of photosynthesis.
    c. Design a procedure to measure the effect of temperature or some other factor like light intensity on the rate of photosynthesis.
    d. Leaf disks that have been in the light for a while are currently floating. What will happen if these disks are now placed in the dark? Explain your answer.

e. When graphing data from this experiment, (a) we used the median of the float time for ten disks rather than the mean and (b) we graphed the inverse of the float times rather than the float times. Explain why in each case.

20. Each chapter has some multiple choice questions and a few other additional questions at its end. Give these a try. You might see them again!

Some Examples of Short Free Response Questions: (2-3 sentences): These might be the actual questions.

1. Remember, ANY objective above could be turned into a short free response question.
2. Describe the role of membranes in the synthesis of ATP in either cellular respiration or photosynthesis.
3. Identify two times during the biochemical pathways of photosynthesis and cellular respiration when an oxidation/reduction reaction occurs.
4. **Explain** how chemiosmosis produces ATP in chloroplasts.
5. **Explain** how the structure of the mitochondria or the choloroplast is important to the production of ATP by the organelle you choose.
6. List two similarities and two difference between ATP production in chloroplasts and mitochondria.
7. Describe the adaptation of C(4) metabolism and how it has increased the evolutionary success of these plants.
8. Leaf disks that have been in the light for a while are currently floating. What will happen if these disks are now placed in the dark? Explain your answer.
9. Relate the structure of an angiosperm leaf to adaptations for photosynthesis and food storage
10. Relate the structure of an angiosperm leaf to adaptations for food translocation and water transport
11. Relate the structure of an angiosperm leaf to specialized adaptations to a desert environment
12. Relate the structure of an angiosperm leaf to adaptations to an aquatic habitat.
13. For plants, describe one way of separating and identifying plant pigments.
14. Summarize Engelmann's experiment that addressed whether the light wavelenths absorbed by plant pigments are the same ones used in photosynthesis.
15. Explain how the metabolic processes of cellular respiration and photosynthesis recycle oxygen.

A controlled experiment was conducted to analyze the effects of darkness and boiling on the photosynthetic rate of incubated chloroplast suspensions. The dye reduction technique was used. Each chloroplast suspension was mixed with DPIP, an electron acceptor that changes from blue to clear when it is reduced. Each sample was placed individually in a spectrophotometer and the percent transmittance was recorded. The three samples used were prepared as follows:

- *Sample 1 - Chloroplast suspension + DPIP*
- *Sample 2 - Chloroplast suspension surrounded by foil wrap to provide a dark environment + DPIP*
- *Sample 3 - Chloroplast suspension that has been boiled + DPIP*

Percent Transmittance in Three Samples

Time (min)	**Light, Unboiled % Transmittance Sample 1**	**Dark, Unboiled, % Transmittance Sample 2**	**Light, Boiled % Transmittance Sample 3**
0	28.8	29.2	28.8
5	48.7	30.1	29.2
10	57.8	31.2	29.4
15	62.5	32.4	28.7
20	66.7	31.8	28.5

24. On the axes provided, **construct** and **label** a graph showing the results for the three samples.

25. **Identify** and **explain** the control or controls for this experiment.

26. The differences in the curves of the graphed data indicate that there were differences in the number of electrons in the three samples during the experiment. **Discuss** how electrons are generated in photosynthesis and why the three samples gave different transmittance results.

The results below are measurements of cumulative oxygen consumption by germinating and dry seeds. Gas volume measurements were collected for changes in temperature and pressure.

Cumulative Oxygen Consumered (mL)					
Time (Min) →	0	10	20	30	40
22oC Germinating Seeds	0	8.8	16.0	23.7	32.0
22oC Dry Seeds	0	0.2	0.1	0	0.1
10oC Germinating seeds	0	2.9	6.2	9.4	12.4
10oC Dry Seeds	0	0	0.2	0.1	0.2

27. Using the graph paper provided, plot the results for the germinating seeds at 22 o C and at 10 o C.
28. Calculate the rate of oxygen consumption for the germinating seeds at 22 o C, using the time interval between 10 and 20 minutes.
29. Account for the difference in oxygen consumption observed between:
    - (1) germinating seeds at 22 o C and at 10 o C;
    - (2) germinating seeds and dry seeds.
30. Describe the essential features of an experimental apparatus that could be used to measure oxygen consumption by a small organism. Explain why each of these features is necessary.
