Name: _____ Period: _____ Date: _____

Topic 3.4, Photosynthesis, Student Learning Guide

Getting to the tutorials.

- Go to learn-biology.com, then AP Biology, then Unit 3: Cellular Energetics (Energy, Cellular Respiration, Photosynthesis)
- Find Topic 3.4 (see the Unit 3 Main Menu for notes about sequence).
- If you're submitting this electronically to your instructor, please type your answers in blue, red, or any other color your instructor suggests.
- As you go, change ❑ to a ☑

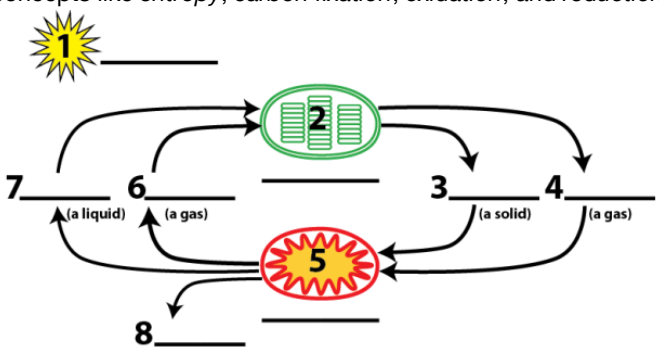
Topic 3.4, Part 1: Introduction

☐ 1. Complete the Interactive Diagram, "Photosynthesis Inputs and Outputs," and read the text below the diagram.

☐ 2. Read "Photosynthesis is an endergonic redox reaction."

☐ 3. Take the quiz "Photosynthesis: the Big Picture."

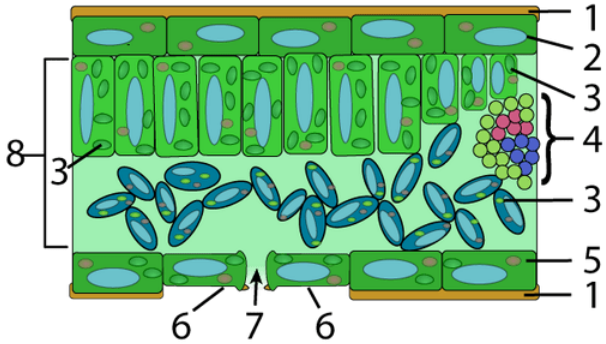
SUMMARIZING: Use the diagram below to write a summary of this section. Don't just write a key: also connect what's below to concepts like *entropy*, *carbon fixation*, *oxidation*, and *reduction.*



Checking Understanding

a. Describe the two phases of photosynthesis

b. In the space below, list the inputs of photosynthesis, and describe where they come in. Then list the outputs, and describe where they come out.



Inputs:

Outputs:

c. List a few ways that the structure of a leaf is adapted to its function.

Continue to Topic 3.4, Part 2: Chloroplasts and the Two Phases of Photosynthesis

1. Read the "Introduction." What's the connection between endosymbiosis and photosynthesis?

☐ 2. Read "Leaves."

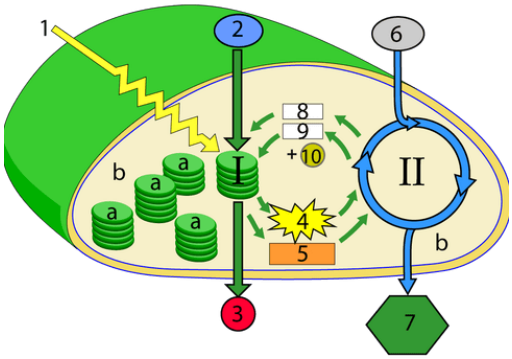
☐ 3. Watch "Chloroplasts and the Two Phases of Photosynthesis: A Video Overview.

☐ 4. Read "Chloroplasts

☐ 5. Read "Within Chloroplasts, Photosynthesis occurs in two Phases."

☐ 6. Take the Quiz: "Chloroplasts and The Two Phases of Photosynthesis."

d. Make a key to the diagram below:



I.	
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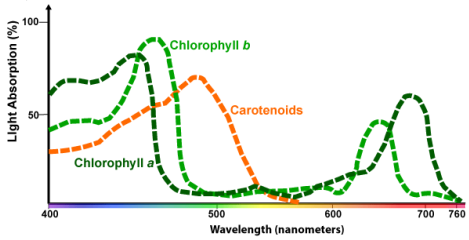
Continue to Topic 3.4, Part 3: Light and Pigments

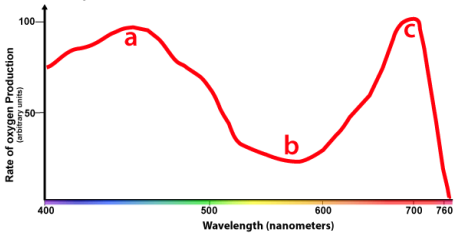
- ☐ 1. Read the introduction, "Review: The Two Phases…"
- ☐ 2. Read "The Energy Transformations of Photosynthesis," and watch the video "Photosynthesis, the Light Reactions "Non-cyclic Flow)."
- ☐ 3. Read "Understanding Light."
- ☐ 4. Read "Chlorophyll: the Key Photosynthetic Pigment."
- ☐ 5. Read "Absorption and Action Spectra,"
- ☐ 6. Watch the music video: "The Light Reactions, Part One."
- ☐ 7. Complete the Interactive Lyrics for "The Light Reactions Part 1."
- ☐ 8. Take the Quiz "Photosynthesis: Light and Pigments,"

Checking Understanding:

a. The diagram below shows the absorption spectrum for Chlorophyll *a*, Chlorophyll *b*, and Carotenoids. In the space to the right and below the diagram, explain what the diagram is saying.



b. This diagram shows the action spectrum for photosynthesis. In the space to the right and below the diagram, explain what an action spectrum is.



c. Explain Englemann's ingenious experiment establishing the action spectrum for photosynthesis (it's in the Light Reactions Video).

d. Explain why the action spectrum and absorption spectrum for chlorophyll *a* are similar, but not exactly alike.

e. You're at the hardware store to buy grow lights for a school project. Your goal is to maximize plant growth. All they have are blue, green, and red lights. Which two colors do you buy, and why? Be sure to relate your answer to the previous question.

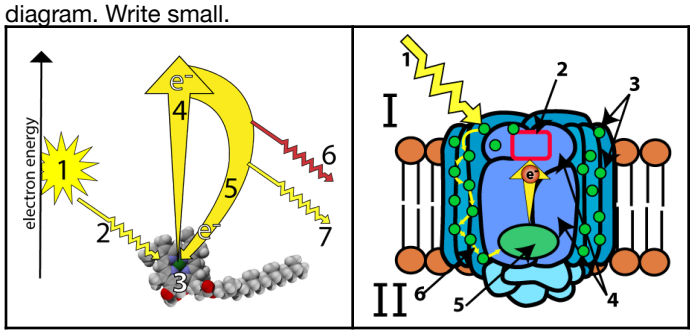
Continue to Topic 3.4, Part 4: The Light Reactions

Topic 3.4, Part 4: The Light Reactions

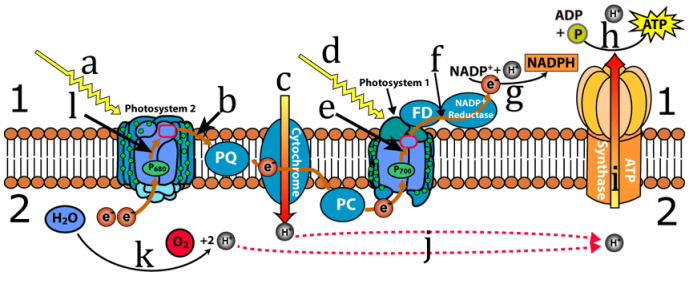
- ☐ 1. Read the introduction
- ☐ 2. Read “Chlorophyll, Photoexcitation, and Photosystems.”
- ☐ 3. Watch the video “Noncyclic Electron Flow.” Read the short introduction first. The video starts at 4:25.
- ☐ 4. Read “ Noncyclic Electron Flow”
- ☐ 5. Take the Quiz: “Photoexcitation, Photosystems, and Non-Cyclic Electron Flow.” Read the introduction first.

Checking Understanding

a. Describe how the diagram on the left is related to the one on the right. As you do, explain each numbered part in each diagram. Write small.



b. In the space below the diagram and on the next column. explain how non-cyclic electron flow creates ATP and NADPH.

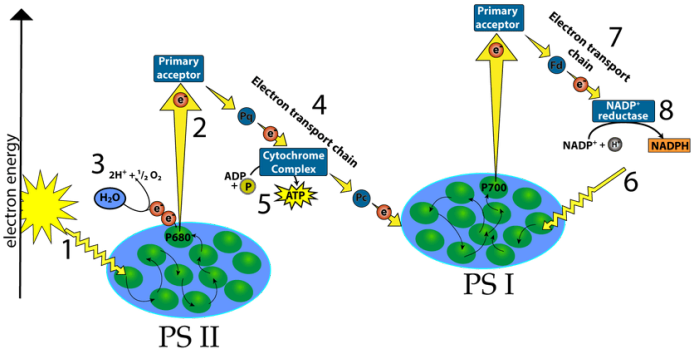


(additional space for light reactions explanation)

- ☐ 6a-c. Read “The Z Scheme,” watch the “Z-scheme” video (starts at 10:14), and take the quiz, “The Z-Scheme.”
- ☐ 7. Watch the music videos “Light Reactions 2” and “Light Reactions 3.”
- ☐ 8. Take the cumulative “Light Reactions” Quiz.

Checking Understanding:

Explain the Z-Scheme

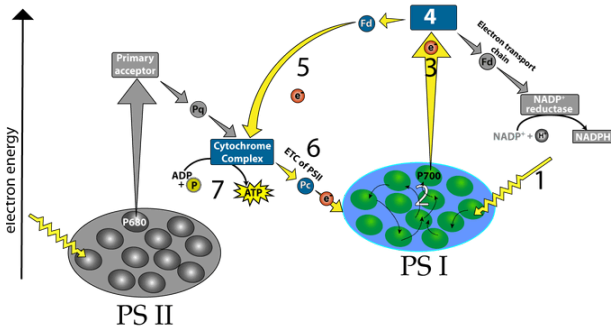


Depending on your teacher’s instructions, either complete the section below or continue on to Topic 3.4, Part 4, The Calvin Cycle.

Supplementary Topic: Cyclic Electron Flow…

1. Read about cyclic electron flow and take the Cyclic Electron Flow Quiz

Checking Understanding: Explain cyclic electron flow:

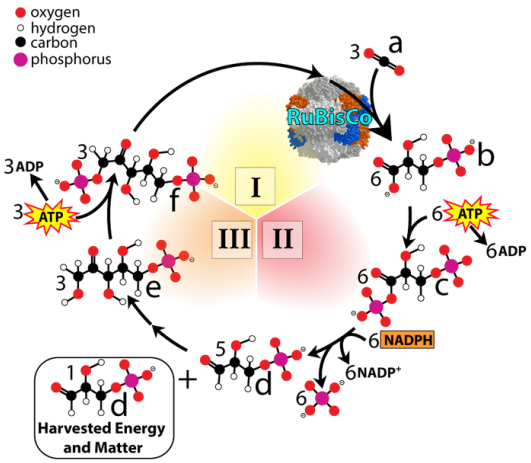


Topic 3.4, Part 5: The Calvin Cycle

- ☐ 1. Read the introduction.
- ☐ 2. Read "The Calvin Cycle."
- ☐ 3. Take the quiz "The Calvin Cycle: Checking Understanding."

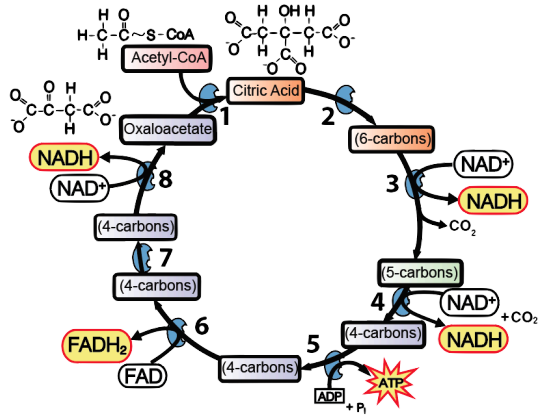
Checking Understanding

a. In the space below this diagram, explain how the Calvin cycle works.



c. Comparing Calvin and Krebs

Pretend that it's the *World Biology Cycling Championship*. The two finalists are the Calvin Cycle and the Krebs cycle. You're a reporter doing pre-game analysis. In the space below and on the next column, write a paragraph comparing and contrasting Krebs and Calvin.



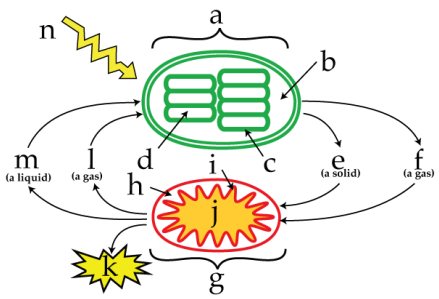
(additional space for Calvin v. Krebs)

Unit 3 Cumulative Flashcards and quizzes

- ☐ 1. Review the Unit 3 Learning Objectives. The goal is for you to be able to explain each one.
- ☐ 2. Complete the Unit 3 Flashcards
- ☐ 3. Complete the Unit 3 Multiple Choice Questions
- ☐ 4. Take the Quiz, "Making Connections Between Photosynthesis and Cellular Respiration."
- ☐ 5. Complete the "Cellular Respiration Click-On Challenge."
- ☐ 6. Complete the "Photosynthesis Click-On Challenge"

Checking Understanding:

a. Create a key to the diagram below.



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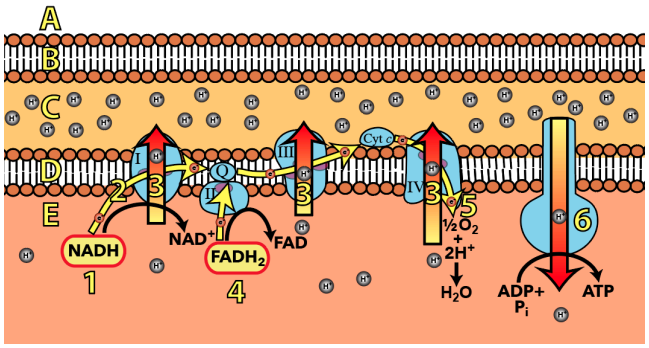
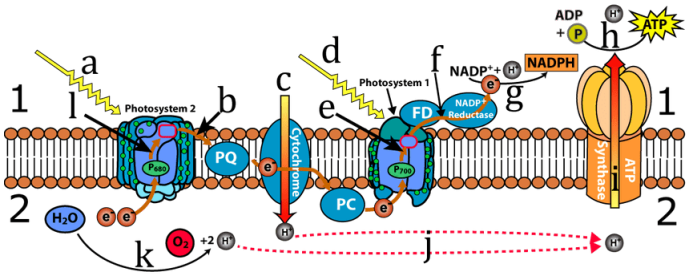
b. UNIT 3 CULMINATING SYNTHESIS: ***Comparing ATP synthesis during photosynthesis and cellular respiration.*** Diagram A below shows a close-up depiction of structures and processes in the inner and outer membranes of a mitochondrion. Diagram B shows structures and processes in the thylakoid membrane.

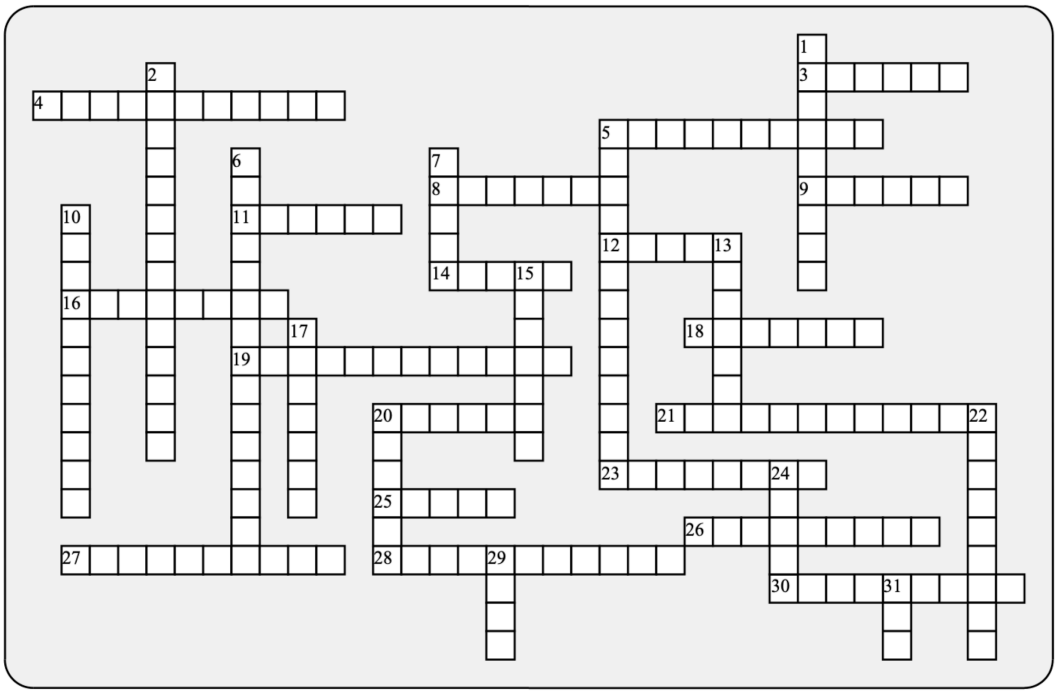
A. The Mitochondrial inner and outer membranes



B. The Thylakoid Membrane



In the space below and the right column, compare how ATP is produced in the light reactions with how it is produced in mitochondria.



Note: if you can't print this out, make a table below these clues and put your answers there.

Across:

3 - The spectrum that tells you how much photosynthesis occurs at various light frequencies.
4 - This kind of diffusion returns protons from the thylakoid space to the stroma.
5 - As far as energy goes, this term describes photosynthesis
8 - In the Calvin cycle, carbon dioxide is
9 - In a chloroplast, this is equivalent to the cytosol, or the mitochondrial matrix
11 - When water is split, this gas is released.
12 - The kind of energy that powers photosynthesis. Also an electricity producing panel.
14 - The reduced electron carrier produced by the light reactions
16 - In the light reactions, water is
18 - Carbon_____ is the source of the carbon in our bodies.
19 - The class of macromolecule produced by photosynthesis
20 - These reactions form a cycle that creates carbohydrates
21 - There are two of these light-trapping, chlorophyll-rich protein complexes in the thylakoid membrane.
23 - In both mitochondria and chloroplasts, you'll find the ATP _____ channel.
25 - These reactions convert light into electricity, and then into short-term chemical energy
26 - This enzyme reduces NADP+ into NADPH.
27 - The shorter the _____, the more energy a photon has.
28 - The key photosynthetic pigment
30 - The little flattened disk that makes the light reactions possible.

Down:

1 - The metal in chlorophyll that makes electron flow possible
2 - _____-3-phosphate is the harvestable product of the Calvin cycle.
5 - Like mitochondria, chloroplasts are _____ that were once free-living bacteria
6 - What happens to chlorophyll when it's exposed to light.
7 - This color drives the least photosynthesis
10 - The organelle where photosynthesis happens
13 - The enzyme that pulls carbon dioxide into carbohydrates.
15 - Packets of electromagnetic energy that are both particles and waves
17 - What gets pumped into the thylakoid space
20 - This type of electron flow creates ATP only.
22 - The _____ of water is responsible for all of the oxygen in our atmosphere.
24 - This pathway makes cyclic electron flow possible.
29 - The five-carbon sugar at the start and end of the Calvin cycle
31 - Chloroplasts create this through photophosphorylation.

Possible Answers: ATP, Calvin, Light, NADPH, RUBP, action, carbohydrate, chlorophyll, chloroplast, cyclic, dioxide, endergonic, endosymbionts, facilitated, glyceraldehyde, green, magnesium, oxidized, oxygen, photoexcitation, photons, photosystems, protons, reduced, reductase, rubisco, shunt, solar, splitting, stroma, synthase, thylakoid, wavelength

SUBMITTING THIS ELECTRONICALLY? TYPE ANSWERS DOWN HERE!