Announcements / Reminders:

- Today:
  - Chapter 7: Photosynthesis ~ Part 2 of 2
- Next Class:
  - Chapter 7 Quiz
  - Review for Lecture Exam 2
- Next Week:
  - Chapter 5, 6, 7 Homework due
  - Lecture Exam 2
- Instructor's Office Hours (Ticket Office)
  - Mon, Tue, Wed ~ 8:00 - 9:00am (coffee or tea!)
  - Mon & Wed ~ 1:00 - 2:00pm
  - Thu 8:00 - 11:00am

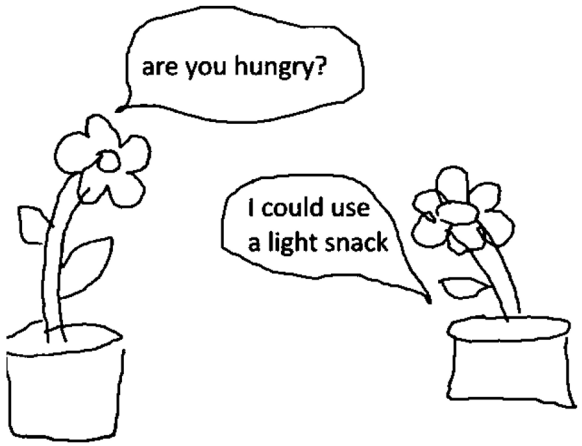
BIOL 1001

Introductory Biology I

version: 06.20.23

Chapter 7

Photosynthesis:
Using Light to Make Food



Learning Objectives

Chapter 7

version: 06.20.23

Previous lecture:

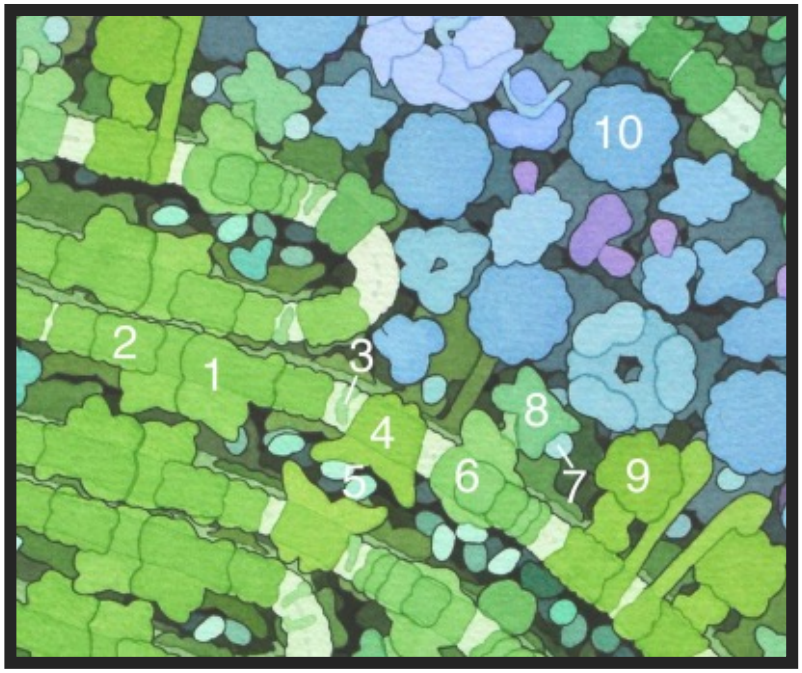
3. Provide the overall chemical equation for photosynthesis.
4. Describe the historical experiments that traced isotopes through the process of photosynthesis.
5. Compare the reactants and products of photosynthesis with those of cellular respiration.
6. Describe the role of redox reactions in photosynthesis.
7. Outline the two major stages of photosynthesis *(the light reactions & the Calvin cycle)*.
8. Diagram the structure of chloroplasts and the locations of photosynthesis within plants.
9. Describe the functions of photosynthetic pigments and their relationship with photosystems.

Today's lecture:

1. Explain why photosynthesis is relevant to everyday life.
2. Define *autotroph*, *heterotroph, photoautotroph, producer,* and *consumer.*
10. Compare the reactants and products of the light reactions.
11. Diagram the chemiosmotic generation of ATP, NADPH, and oxygen during the light reactions.
12. Compare and contrast photophosphorylation with oxidative phosphorylation.
13. Draw a basic diagram of the Calvin cycle, noting the carbon fixation and major reduction steps.
14. Review the overall process of the light reactions and the Calvin cycle, noting the reactants, products, and locations of every major step within a plant cell.

- [if time] Discussion of climate change with topics including rising atmospheric levels of CO_2, the greenhouse effect, fossil fuel use, and deforestation.

"Chloroplast"



1. photosystem II
2. light-harvesting complex II
3. plastiquinone
4. cytochrome bc1
5. plastocyanin
6. photosystem I
7. ferredoxin
8. ferredoxin reductase
9. ATP synthase
10. RuBisCO

begin CH7 slides Part 2 of 2

artwork by David S. Goodsell

Photosynthesis Powers Life

- Life requires energy and in almost all ecosystems, energy ultimately comes from the sun.
- In **photosynthesis**, the energy of sunlight is used to:
  - rearrange the atoms of carbon dioxide (CO_2) and water (H_2O)
  - produce organic molecules - typically glucose!
  - release oxygen (O_2)

To view the relevant gif: click here

gif credit: Amoeba Sisters

- Plants, algae, some photosynthetic protozoans, and some photosynthetic bacteria (e.g. cyanobacteria) are called **photoautotrophs** - meaning they use the energy from light to create organic fuel as a way to feed themselves.
- **autotrophs:** produce their own food - "self-feeder" -*think: producers*
- **heterotrophs:** cannot produce their own food and must consume a producer or decompose organic material -*think: consumers*

General rule: Heterotrophs are completely dependent upon autotrophs for survival

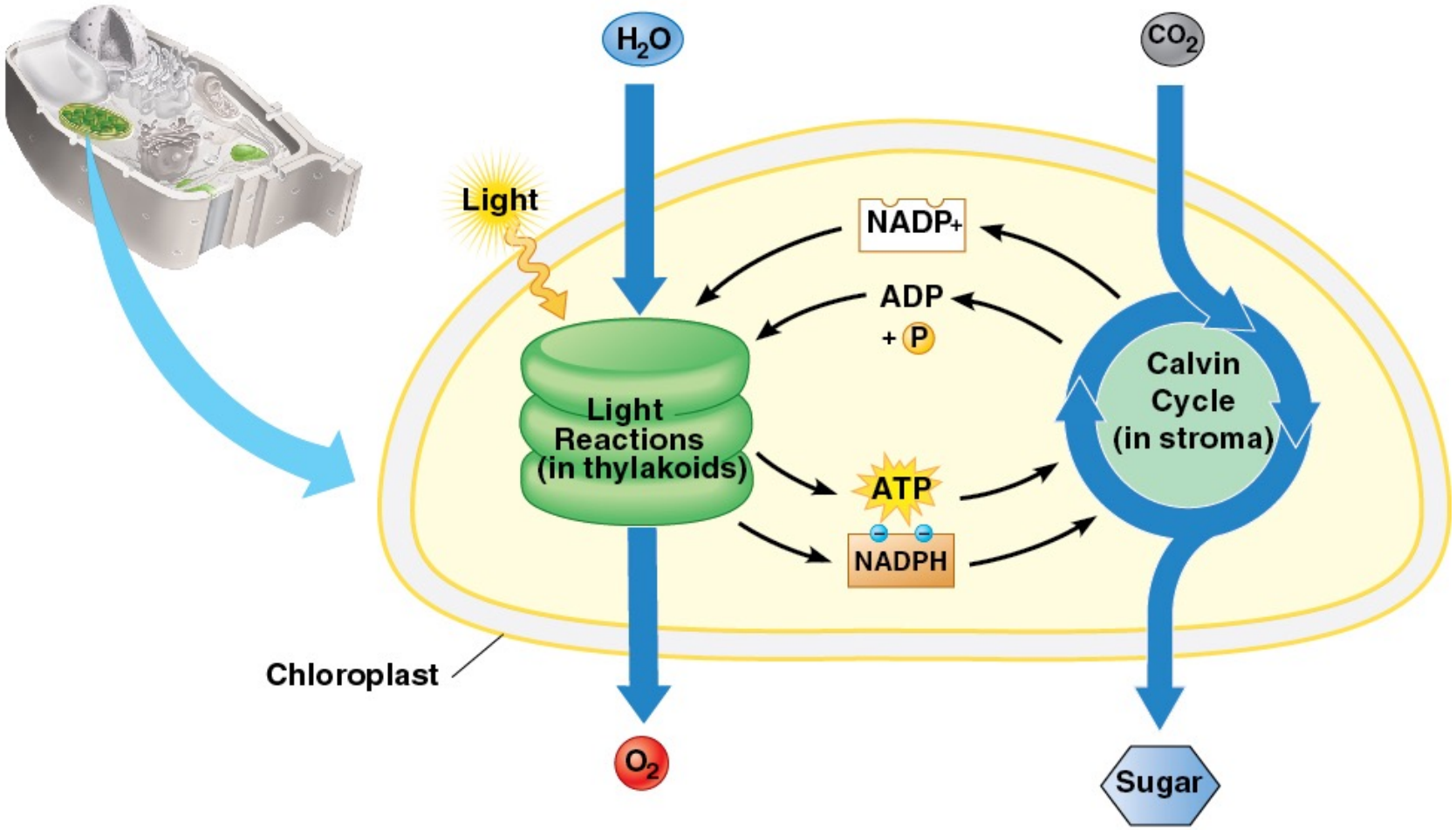
Checkpoint: What is another reason photosynthesis is relevant to humans?

Summary equation for **photosynthesis:**

Light energy + 6 CO_2 + 6 H_2O → $C_6H_{12}O_6$ + 6 O_2

Carbon dioxide | Water | Glucose | Oxygen gas

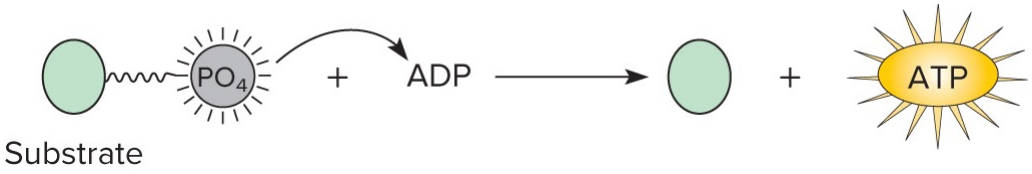
Checkpoint:
What type of redox reaction describes the conversion of NADP+ into NADPH?



Refresher: Three ways cells generate ATP

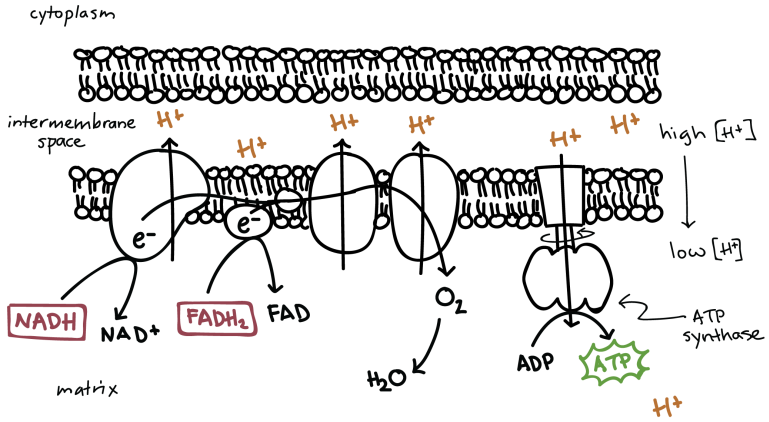
1. _____ phosphorylation:

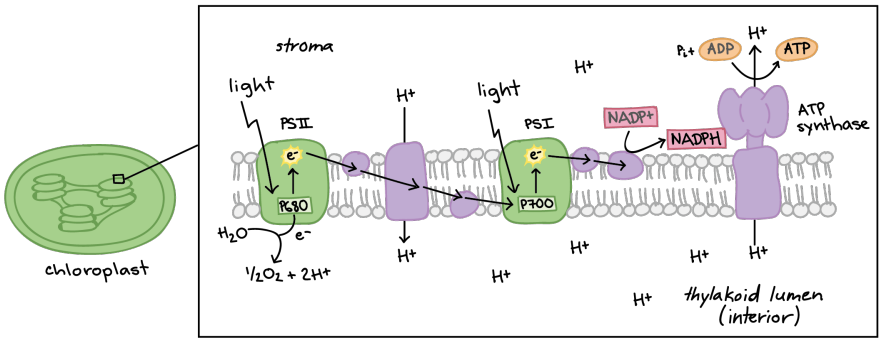
- Generation of ATP by transferring phosphate group from a phosphorylated substrate directly to ADP



2. _____ phosphorylation:

- A series of redox reactions occurring during the final phase of cellular respiration where ATP synthesis is coupled with the electron transport chain





3. Photophosphorylation:

- ATP is formed through a series of sunlight-driven reactions in phototrophs - i.e. the light-dependent reactions in photosynthesis

Drawing activity!

Instructions:

- Grab your drawing of *oxidative phosphorylation* from Chapter 6 and then locate your previous group members
- Diagram photophosphorylation in the space below your first drawing
- I will circulate to each group to provide hands-on, focused instruction
- We will spend about 9 minutes on this activity
  - *Note: timing is subject to change based upon pacing of the class.*

- *Tip: try to use the same style as you did in your previous drawing – this will make it easier for you to compare and contrast these two concepts*

- This drawing activity focuses on the following Learning Objective(s):

10. Diagram the chemiosmotic generation of ATP, NADPH, and oxygen during the light reactions.
11. Compare and contrast photophosphorylation with oxidative phosphorylation.