

Topic #8

**Photosynthesis**

(Campbell and Reece p. 181-198)

**I. Objectives**

- A. Explain the basic steps in photosynthesis
- B. Understand roles of structure and chemistry
- C. Follow the energy

**II. Definitions.**

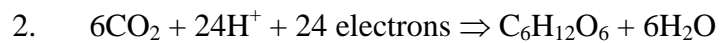
- A. Photosynthesis.
- B. Autotrophs.
- C. Heterotrophs.

**III. History - of mice and plants.**

**IV. Chloroplasts.**

**V. General equations.**

- A.  $6\text{CO}_2 + 12\text{H}_2\text{O} + \text{sunlight} \Rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2$ 
  - 1.  $12\text{H}_2\text{O} + \text{sunlight} \Rightarrow 24\text{H}^+ + 24 \text{ electrons} + 6\text{O}_2.$



3. Energy molecules – transfer energy between sites of reactions.

a) ATP transfers energy (phosphate) from light to dark reactions.

b) NADPH – transfers electrons from light to dark reactions

B. Redox reactions.

1. Oxidation.

2. Reduction.

## VI. Light and Pigments.

A. Sunlight

B. Leaf pigments

1. Pigments absorb light, what we see is what is not absorbed
2. Red and blue light are absorbed, we see what is not absorbed – mostly green
3. Chlorophyll:

4. Accessory pigments, e.g. carotenoid

**VII. Light absorbency and noncyclic pathway.**

A. Photosystems.

1. Complex of molecules designed to trap high energy electrons
2. Reaction center – part of photosystem where electron is transferred to chemicals

B. Photosystem II (P680).

1. Photon absorbed.
2. Energy passed on to reaction center.
3. High energy electron transferred to protein in thylakoids
4. Positive charge in chlorophyll has very strong pull on electrons
5. Water is split to replace lost electron.

C. Photosystem I (P700).

D. Molecules transfer electrons from Photosystem II to Photosystem I along transport chain of proteins

E. Summary.

F. ATP synthesis.

**VIII. Cyclic pathway.**

**IX. Light reaction products.**

**X. Dark reactions - Calvin-Benson Cycle.**

A.  $\text{CO}_2$  is fixed into carbohydrate (sugars).

B. Key reaction.

C. ATP and NADPH needed to form G3P (PGAL)

**XI. C<sub>4</sub> Plants and CAM Plants.**

A.  $\text{CO}_2$  uptake and water loss

B. Photorespiration.

C. Mechanism of C<sub>4</sub> plants.

D. Mechanism of CAM plants.

## XII. Key Terms.

photosynthesis  
autotroph  
heterotroph  
light reactions  
dark reactions  
reduction  
oxidation  
redox reaction  
thylakoid  
grana  
stroma

chlorophyll  
photosystem I  
photosystem II  
reaction center  
photon  
electron-transport proteins  
ATP synthase  
NADP, NADPH  
electochemical gradient  
ATP, ADP, AMP  
noncyclic pathway

cyclic pathway  
Calvin-Benson cycle  
RuBP  
PGA  
Rubisco  
PGAL  
G3P  
C<sub>3</sub> plants  
C<sub>4</sub> plants  
CAM plants