

(1)

PHOTOSYNTHESIS

8.1

- Anatomy of LEAF FIG 8.3

- Mesophyll - interior of leaf
most chloroplasts located here

- STOMATA - pores - O_2, CO_2 enter/exit

CHLOROPLASTS

- double-membraned - with? evolutionary history

- Thylakoids \Rightarrow contain
chlorophyll (magnesium at center)

porphyrin ring \Rightarrow hemoglobin is another
 \Rightarrow complexed with metal ion).

\Rightarrow A grana is a stack of thylakoids
(plural grana)

\Rightarrow stroma is fluid inside chloroplast

H_2O splitting

\Rightarrow electrons are transferred along
with hydrogen ions to carbon
dioxide, reducing the carbon dioxide
to sugar

\Rightarrow the source of the O_2
given off by photosynthesis.

(2)

- FIG 8.5

- Inputs and Outputs of Photosynthesis

LIGHT REACTIONS \Rightarrow thylakoid membrane
CALVIN CYCLE \Rightarrow strand

CARBON FIXATION

\rightarrow the incorporation of the CARBON from carbon dioxide into organic compounds

8.2

PHOTONS

- ?? particle? wave?

$$\lambda v = c; \Delta E = h\nu$$

- visible light \rightarrow 380 nm - 750 nm

chlorophyll a -	blue-green
chlorophyll b -	olive-green
carotenoids -	yellow-orange

\hookrightarrow photo protection

\hookrightarrow also in human eye

\hookrightarrow ??? Vitamin A - carrots - eyesight?

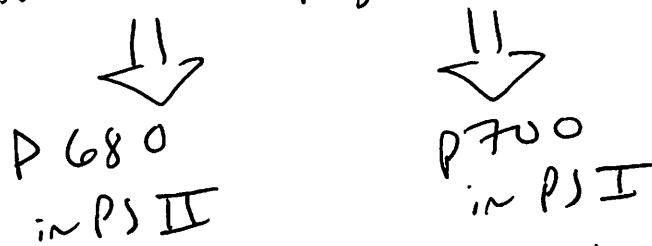
PHOTOSYSTEM

ANATOMY \Rightarrow Reaction Center Complex surrounded by light-harvesting complex.

(3)

Key Terms / Concepts

- (1) "Special pair of chlorophyll a molecules"



(names for wavelength they best absorb)

- (2) Primary electron receptor (varios)

- (3) Cytochrome complex - cyt b₆f

- is a pump that uses e⁻ to pump 4 H⁺ into thylakoid space that results in proton-motive force that powers the ATP synthase
 ↳ the ATP synthase is oriented with the production side in the stroma and the ATP is then available for the Calvin cycle

FIG
8.16

- (4) An enzyme is required for the splitting of the H₂O molecule (complex contains a Mn ion!)

- (5) Plastoquinone (Pq) carries e⁻ to the cytochrome b₆f complex

- (6) Plastocyanin (Pc) carries e⁻ to PS I

- (7) Ferredoxin (Fd) carries e⁻ to NADH reductase → which takes up a H⁺ from stroma to produce NADPH !!

(4)

8.3 Calvin Cycle

- G3P (glyceraldehyde 3-phosphate) is final product [One produced for use, five go back into cycle]

- Rubisco (enzyme) - ribulose bisphosphate carboxylase \rightarrow gets the process started by fixing + C from CO_2 to RuBP (ribulose 1,5-biphosphate)

\Rightarrow ATP and NADPH from the light reactions are used to phosphorylate and reduce to ① G3P; and to ②: to convert 5 G3P (15 carbon total) into 3 RuBP (15 carbon total)

(See Diagram) on
p. 172 text

Photo-respiration

(5)

→ Although Rubisco preferentially adds CO_2 to ribulose 1,5-biphosphate (RuBP) it can use O_2 as a substrate in place of CO_2

AND ...

if the concentration of CO_2 is low \Rightarrow it will add O_2 to ribulose 1,5-biphosphate (RuBP) instead !!

→ This is the first step in a pathway called photorespiration



effect is to use up O_2 and liberate CO_2 without the production of useful energy stores.

→ About $1/3$ of the CO_2 fixed is lost again as CO_2 because of photorespiration.



- when plants are forced to close their stomata because of heat and resulting H_2O loss, CO_2 levels drop and photorespiration kicks in

→ MOST Plants are C-3 plants

↳ carbon is captured into a 3-carbon compound called 3-phosphoglycerate

→ C4 plants (corn, sugar cane) are special adaptations

→ rubisco is only contained in the chloroplasts of bundle-sheath cells (Fig 14-40 Albert)

↳ surrounded by mesophyll cells that pump carbon dioxide into the bundle-sheath cells via a 4-carbon "shuttle" molecule which breaks down into CO_2 and 3-carbon molecule which goes back to mesophyll to recharge into 4C again

Bottom Line → CO_2 gets highly concentrated in Bundle Sheath cells & photorespiration avoided.

(7)

CAM Plants (pineapples, cacti, succulents)

- open stomata at night and close during day

↳ CO_2 taken up at night and fixed into CRASSULACEAN ACID

↳ mesophyll cells store the CO_2 in the organic acid(s) overnight and in day time the CO_2 is released and available to combine with ATP and NADPH from light reactions to synthesize SUGARS

C₄

CAM

Separation
of steps

CORN, sugar cane

Temporal
separation
of
steps
cacti, succulents.

~~Most~~ MOST plants are C₃ !!