Overview of photosynthesis

1. **Light absorption**

water is split→ O2

2. **NADPH**

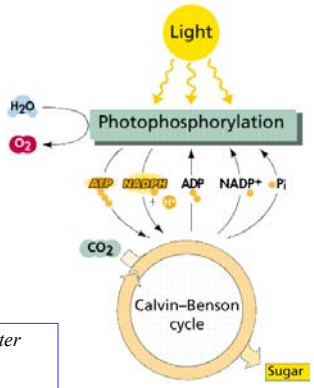
Reducing energy is formed

3. **ATP**

Chemical energy is formed

4. **CO_2 -->--> sugar**

CO_2 is converted to sugars



Q? How are electrons from water transferred to NADPH?

How is ATP formed?

Photosynthesis is a light-driven redox process.

1. The entire process occurs in several steps, because there is insufficient energy to boost e- from H_2O directly into $NADP^{+}$.

$H_2O + NADP^+ + ADP + P_i$ --->1/2 O_2 + NADPH + H^+ + ATP

O_2 evolving organisms have 2 photosystems that operate in series.

2. Organisms obtain energy from ox-red reactions.

3. Plants use 2 photosystems. Each PS has a different function.

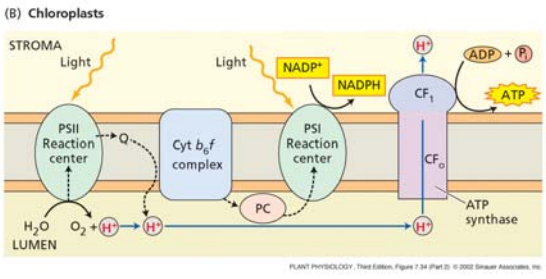
A) PSII: pull electrons from water

b) PSI: e- reduce NADP+ to form reducing power

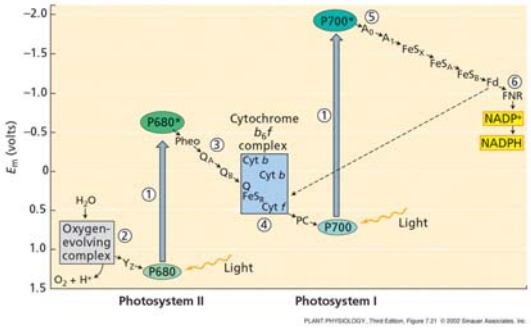
4. Two reaction centers are connected by an electron transport chain

5. Electron transport and water splitting generates a proton gradient that is used to make ATP.

7-34b. Oxygen evolving organisms have 2 photosystems in series.



7-21 Taiz. Z scheme. Electron transport carriers at their redox potentials. Energy is needed to boost e- from water to NADPH.



Organisms obtain energy from oxidation/ reduction reactions

1. Tendency for a redox reaction to proceed depends on the difference in energy of the transferable electron in the two molecules.

The reducing potential is a measure of the readiness with which an atom takes up an electron. Measured as a voltage.

If reducing potential is -, I.e. lower affinity for electron than $H_2/2H^+$

Δ E = E (acceptor) – E (donor)

Table. Mid point redox (reducing) potentials of selected redox couples from respiration and photosynthesis.

	Em (V)
Ferredoxin ox/red	**-0.42**
$2H^+/NAD^+$/ NADH	**-0.32**
$NADP^+ + 2H^+$/ NADPH + H^+	**-0.32**
$2H^+/H_2$	**0**
Ubiquinone	**+0.040**
Cyt c ox/cyt c red	**+0.220**
S + 2H+ /H_2S	**+0.23**
$1/2O_2$+ $2H^+$/ H_2O	**+0.82**

Useful equations to analyze energy changes in redox reactions:

$\Delta E = E$ (acceptor) - E (donor) E = reducing potential (V)

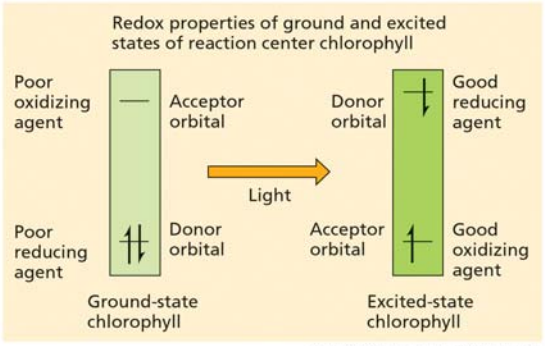
$\Delta G = - zF\Delta E$ ΔE = difference in the reducing potential (v)

z = number of electrons transferred

F = Faraday's constant, 23 kcal/V.mol

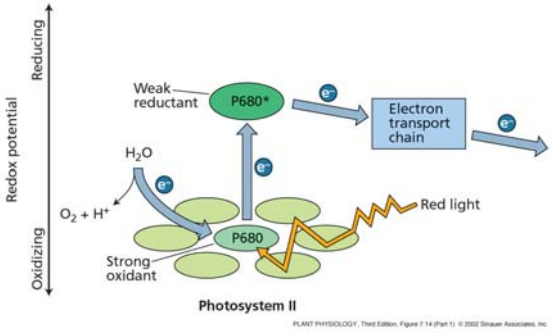
7-23. How do photosystems work?

In the excited state, electron can be lost from chl a.

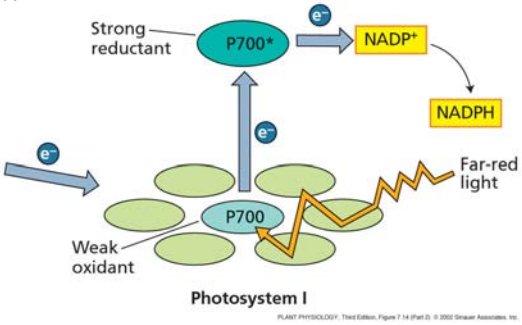


7-14 Taiz. Two photosystems operate in series.

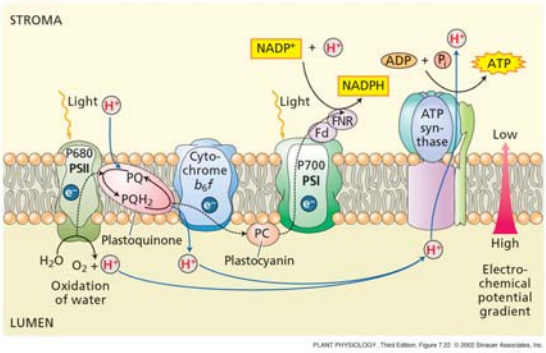
PSII Reaction center chla = 680



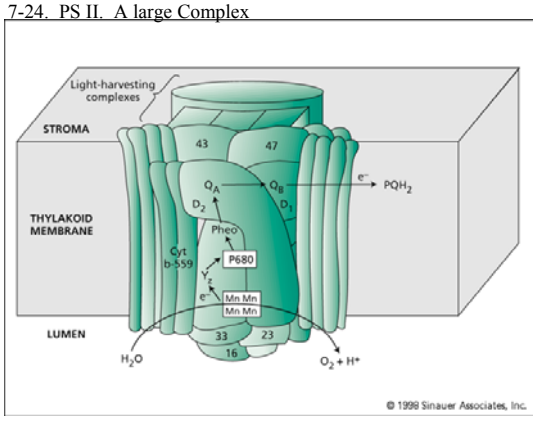
PSI has a RC pigment chla, P700



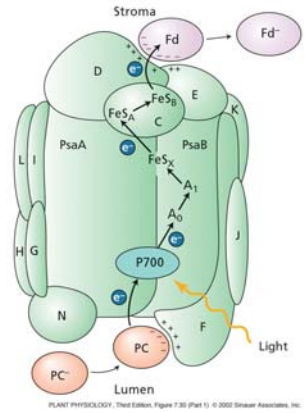
7-22. Two Light reactions are connected by several electron transport carriers



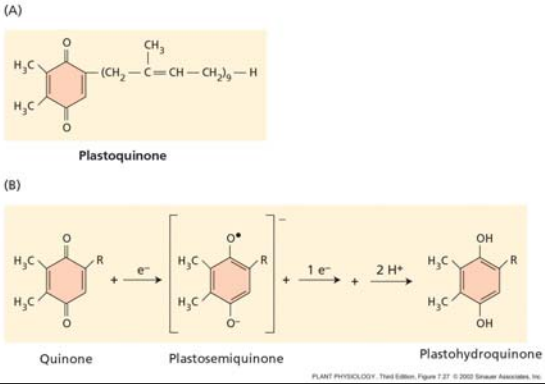
7-24. PS II. A large Complex



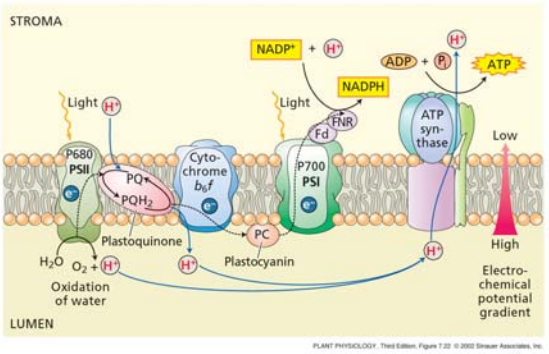
PS I



7-24 Taiz. Plastoquinone is a mobile 2-electron carrier



7-22. Taiz



How is ATP formed?

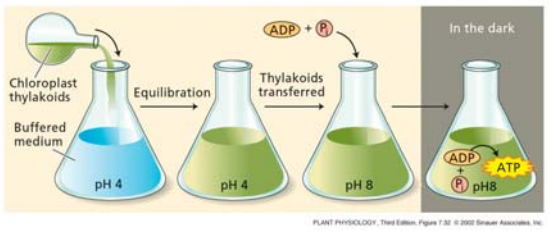
Electron transport and water splitting form a proton motive force (pmf)

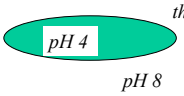
PMF is used to make ATP

Where are protons produced?

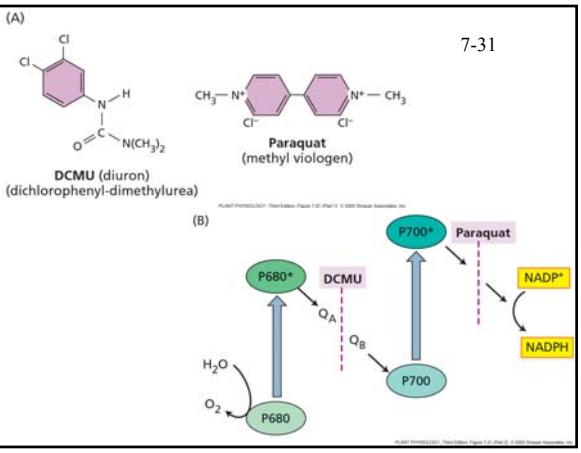
1. *Splitting of water*
2. *PQ oxidation*

7-32 Taiz: How is ATP formed?
Expt showing energy in pH gradient is converted to ATP in the dark.





7-31



7-11 Taiz

-Why is there a red drop?

In lab.

Why did you add

Ferric cyanide?

NH_4Cl?