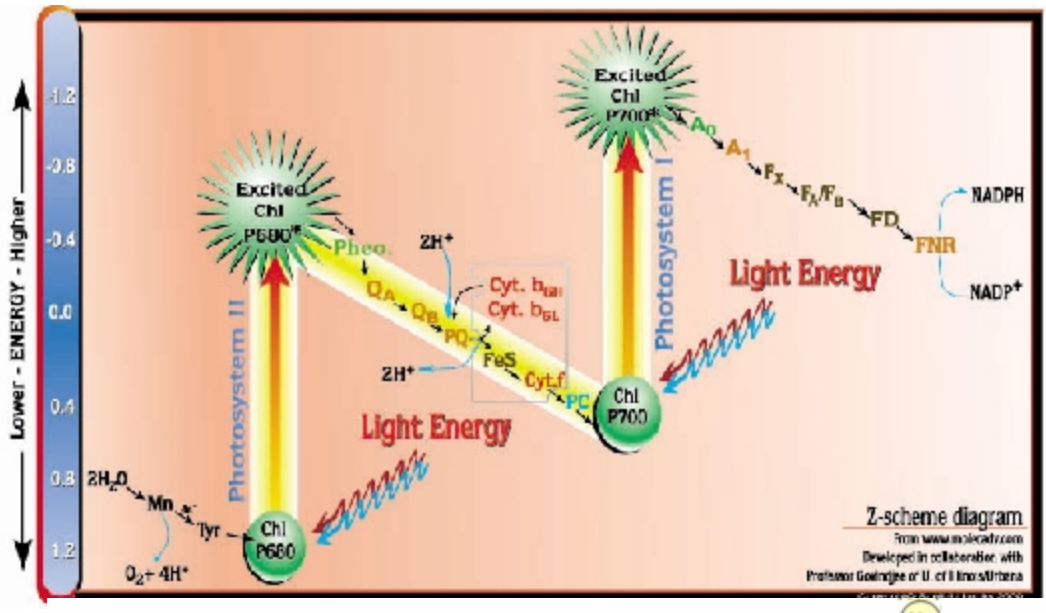
LIGHT REACTIONS: OXIDATION OF WATER

rvsd 11/15/95, 11/20/96, 15 Nov 99, 15 Nov 00, 19 Nov 01, 20 Nov 02, 17 Nov 03, 15 Nov 04, 5Nov07, 12Nov08, 6Nov09, 10Nov10, 6Nov11

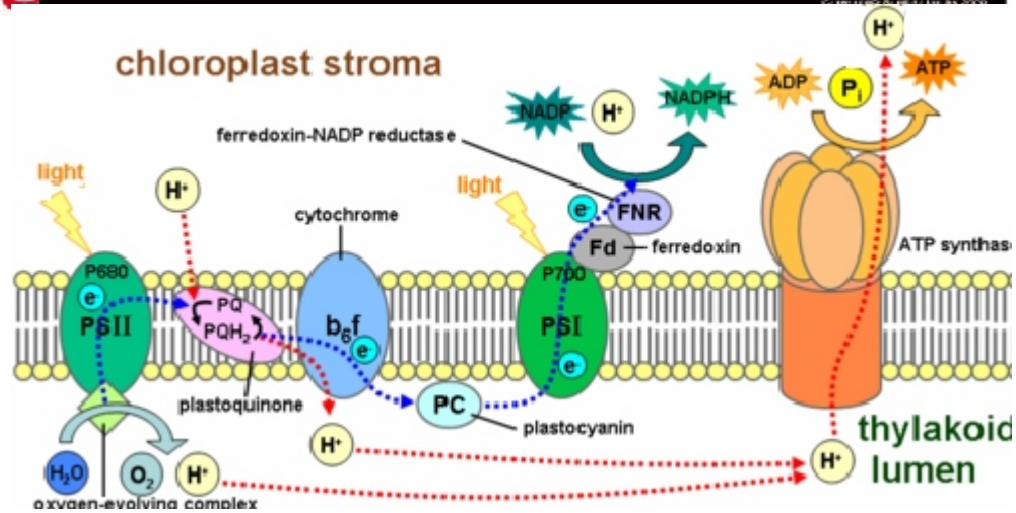
B&D, p. 32, BRP, p381-, BKH: 451-, BKH 5th: 445-474, 6th: 296-303, 7th: 293-313



E_o = standard reduction potential
(ease of adding an electron)
good electron acceptor:
positive E_o, easily reduced
good electron donor:
negative E_o, easily oxidized

Chlorophyll can excite electron only about 1.0 v
From H_2O to ferredoxin (last carrier)is 1.4 v (0.816 + 0.6),
therefore requires two stages of photoexcitation:

Illustrations:
electron potential: p. 303
thylakoid membrane on p. 304



PSII: (P 680)
water is oxidized. Drives proton pump → ATP:

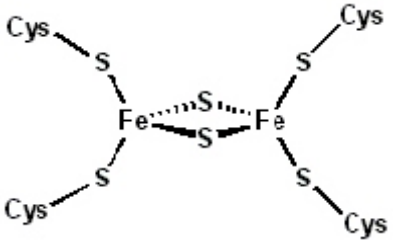
H_2O:		+0.816	releases **oxygen** and **H^+ into thylakoid lumen**
P680	**PS II (P680)**:	[+0.9]	
	PS II activated:	-0.8	transfers to pheophytin
Ph	**pheophytin** (dusky)	-0.6	a modified chlorophyll, has 2 H^+ instead of Mg, formerly called **1° electron acceptor**
PQ_A, PQ_B	**plastoquinones**:	-0.1	plastoquinone reduced to plastoquinol, enter quinol pool, diffuses to *b_6f* complex:

Cytochrome b_6-b_f complex: (quinol powered **proton pump into *thylakoid lumen***)

b_6f	**cytochrome b_6-b_f cmplx**	+0.3	uses energy via FeS to pump **H^+ into thylakoid lumen**
	Note similarity to complex III in mitochondria: receives e- fr quinone, cytochromes transfer to mobile peripheral plastocyanin)		
PC	plastocyanin	+0.4	mobile peripheral membrane protein, contains Cu

PS I: **P700 ferredoxin-NADP+ reductase:**

	PS I (700)	[+0.45]	receives e^- from plastocyanin
	PS I (700) activated	-1.3	transfers active e^- to A_0 (modified chlorophyll) to:
	phylloquinone	-1.0	transfers to FeS centers:
Fd	bound **ferredoxin**:	-0.6	[can donate to cyt b_6/f in cyclic phosphorylation]
	$NADP^+$:	-0.32	releases NADPH into stroma, to be used for dark rxns



PS I more sensitive to 700 nm, PS II to 680, total system works better with both wavelengths

Photosynthetic unit: group of 250-300 antennae chlorophyll molecules

PS I	on **internal face** of fracture plane, about 11 nm diameter particle
PS II	on **external face** of fracture plane, 14 nm

ATP SYNTHESIS: NONCYCLIC H+ accumulates in the thylakoid lumen, drives ATP synthase, exactly as in mitochondrion.

Excellent video (skip to around 40 seconds) http://www.youtube.com/watch?v=hj_WKgnL6MI