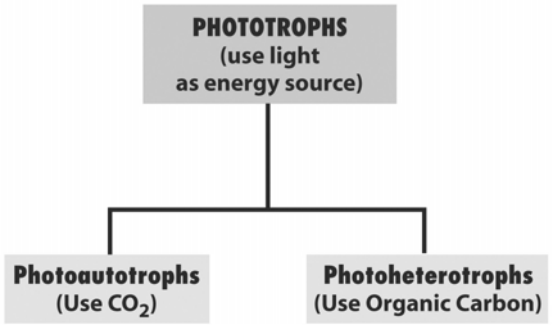
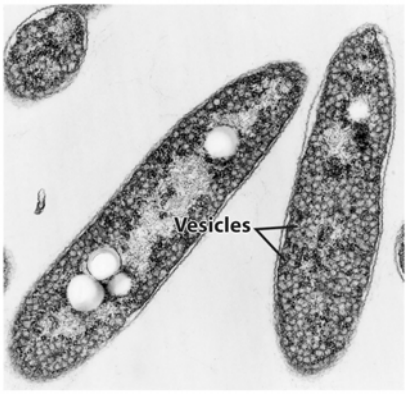
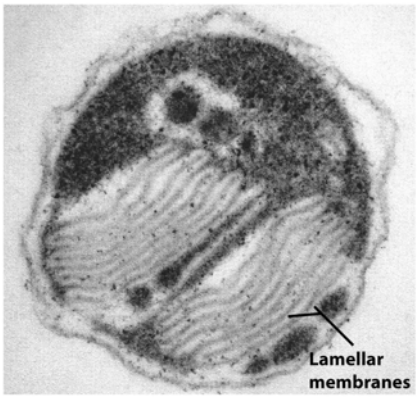
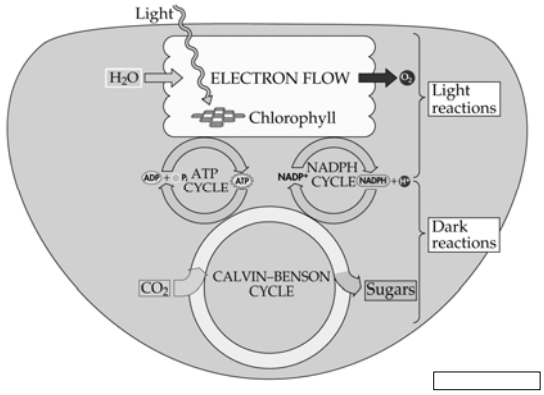
More on Phototrophic Potential

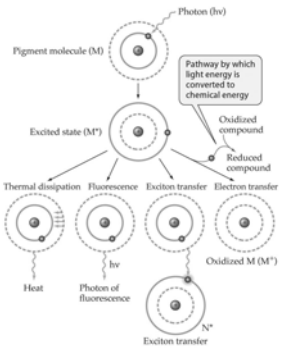


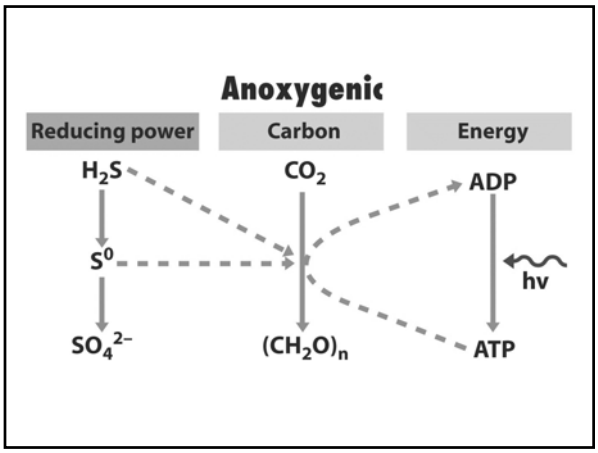


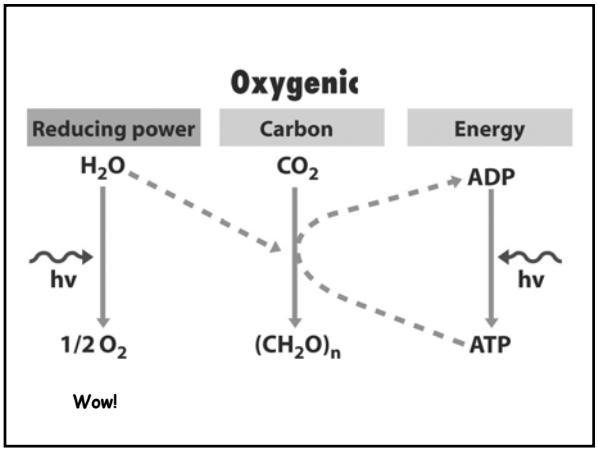




The possible fates of an excited electron

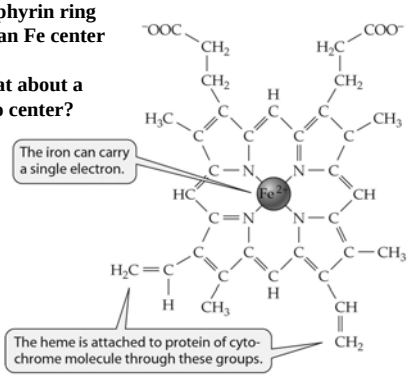


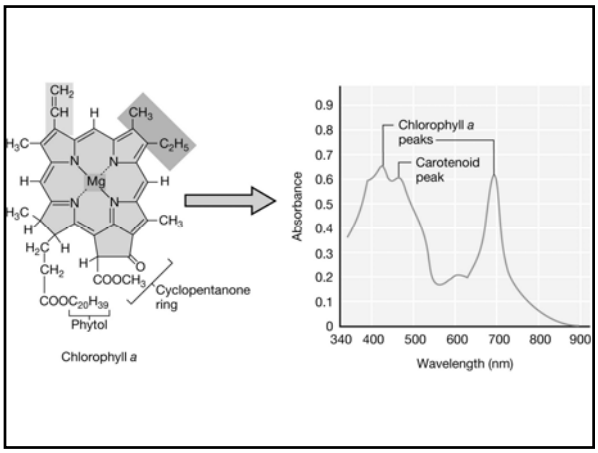


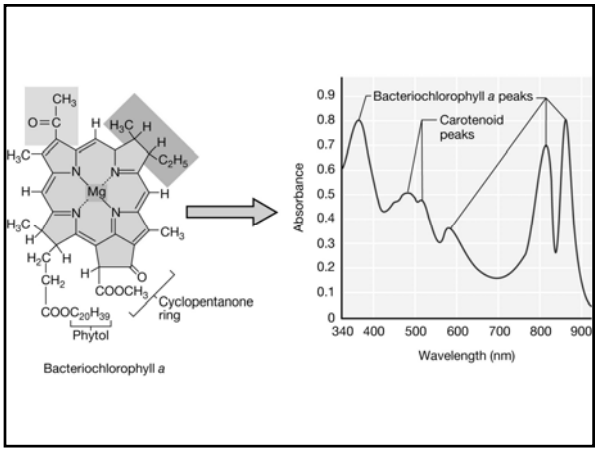


Porphyrin ring with an Fe center

What about a Co center?







Bacteriochlorophyll Structures

Pigment/Absorption maxima (*in vivo*)	R_1	R_2	R_3	R_4	R_5	R_6	R_7
Bchl *a* (purple bacteria)/ 805, 830–890	—C(=O)—CH_3	$—CH_3$[b]	$—CH_2—CH_3$	$—CH_3$	—C(=O)—O—CH_3	P/Gg[d]	—H
Bchl *b* (purple bacteria)/ 835–850, 1020–1040	—C(=O)—CH_3	$—CH_3$[c]	=C(H)—CH_3	$—CH_3$	—C(=O)—O—CH_3	P	—H
Bchl *c* (green sulfur bacteria)/745–755	—C(H)(OH)—CH_3	$—CH_3$	$—C_2H_5$ / $—C_3H_7$[d] / $—C_4H_9$	$—C_2H_5$ / $—CH_3$	—H	F	$—CH_3$
Bchl c_S (green nonsulfur bacteria)/740	—C(H)(OH)—CH_3	$—CH_3$	$—C_2H_5$	$—CH_3$	—H	S	$—CH_3$
Bchl *d* (green sulfur bacteria)/705–740	—C(H)(OH)—CH_3	$—CH_3$	$—C_2H_5$ / $—C_3H_7$ / $—C_4H_9$	$—C_2H_5$ / $—CH_3$	—H	F	—H
Bchl *e* (green sulfur bacteria)/719–726	—C(H)(OH)—CH_3	—C(H)=O	$—C_2H_5$ / $—C_3H_7$ / $—C_4H_9$	$—C_2H_5$	—H	F	$—CH_3$
Bchl *g* (heliobacteria)/ 670, 788	—C(H)=CH_2	$—CH_3$[b]	$—C_2H_5$	$—CH_3$	—C(=O)—O—CH_3	F	—H

[a] P, Phytyl ester ($C_{20}H_{39}O$—); F, farnesyl ester ($C_{15}H_{25}O$—); Gg, geranylgeraniol ester ($C_{20}H_{37}O$—); S, stearyl alcohol ($C_{18}H_{37}O$—).

[b] No double bond between C_3 and C_4; additional H atoms are in positions C_3 and C_4.

[c] No double bond between C_3 and C_4; an additional H atom is in position C_3.

[d] Bacteriochlorophylls *c*, *d*, and *e* consist of isomeric mixtures with the different substituents on R_3 as shown.

Chloroplast Structure

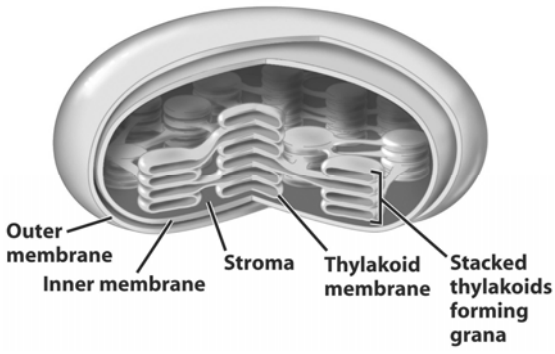
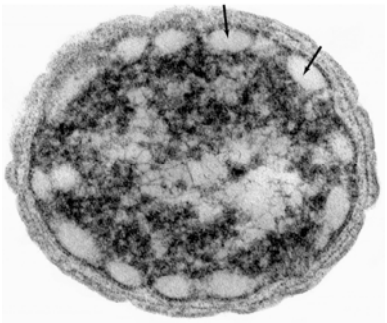


Table 9.1 Some general properties of the various photosynthetic bacteria

	Nonsulfur Purple Bacteria	Purple Sulfur Bacteria	Green Sulfur Bacteria	Cyano-bacteria	Helio-bacteria
Source of reducing power (e^-)	H_2, reduced organic	H_2S	H_2S	H_2O	Lactate, organic
Oxidized product	Oxidized organic	SO_4^{2-}	SO_4^{2-}	O_2	Oxidized organic
Source of carbon	CO_2 or organic	CO_2	CO_2	CO_2	Lactate pyruvate
Heterotrophic growth	Common	Limited[a]	Limited[a]	Limited[a]	Required

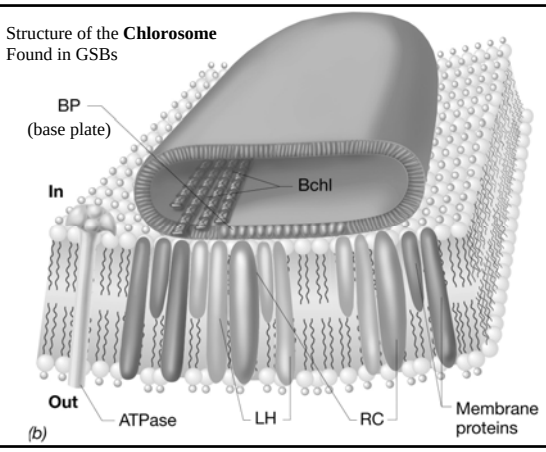
[a]Generally limited to assimilation of low molecular weight organics during autotrophic growth.

Structure and Location of the **Chlorosome**

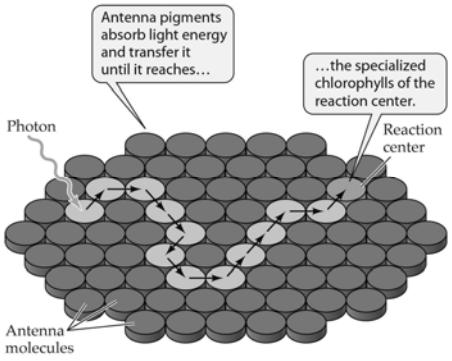


Found in *GSBs*

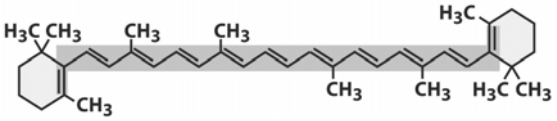
Structure of the **Chlorosome**
Found in GSBs



Photosynthetic unit



Beta-Carotene, a typical carotenoid



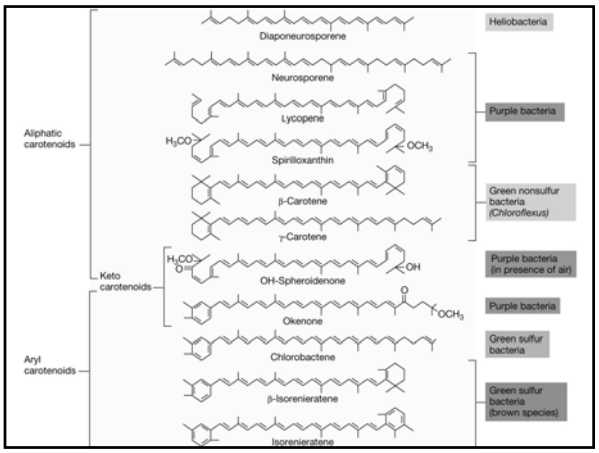
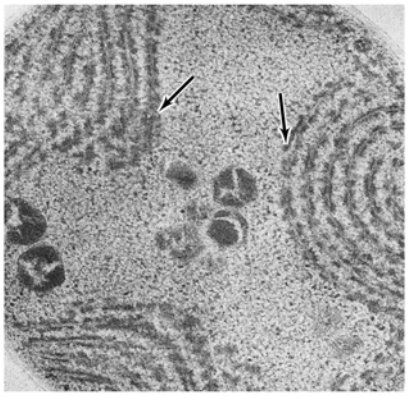


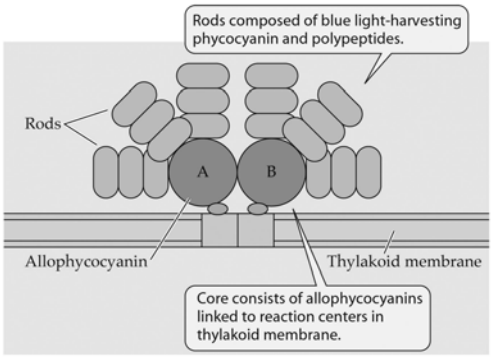
Table 9.2 The bacteriochlorophyll present in photosynthetic bacteria and primary acceptors involved in energy conserving reactions

	Electron Donor	Electron Acceptor
Purple nonsulfur bacteria	Bacteriochlorophyll *a* and *b*	Bacteriopheophytin *a*, Q_A, and Q_B
Green sulfur bacteria	Bacteriochlorophyll *c*, *d*, and *e*	Bacteriopheophytin *a* and FeS-protein
Cyanobacteria photosystem I	Chlorophyll *a*	Chlorophyll *a* and FeS-protein
Cyanobacteria photosystem II	Chlorophyll *a*	Pheophytin *a*, Q_A, Q_B, and plastoquinones
Heliobacteria	Bacteriochlorophyll *g*	Bacteriochlorophyll *c* and FeS-protein

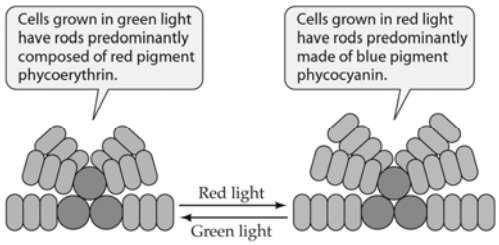
Structure and Location of **Phycobilisomes**



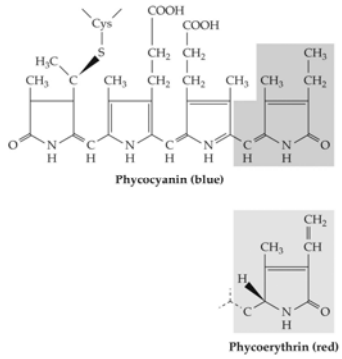
Phycobilisome of cyanobacteria



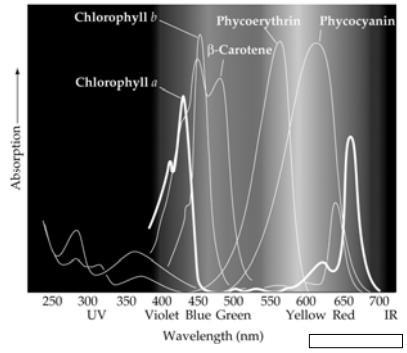
Chromatic adaptation of a phycobilisome

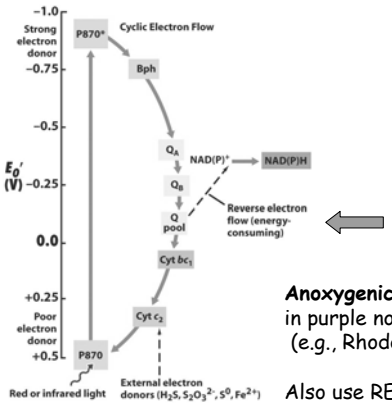


Chromophores of phycobilisomes



Absorption Spectra for Cyanobacteria

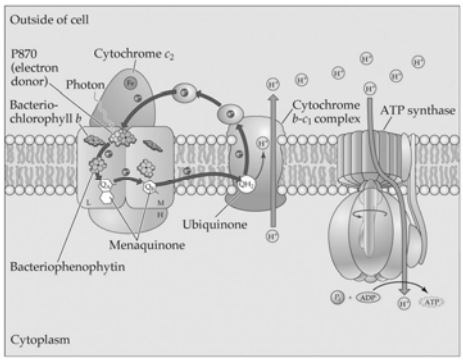




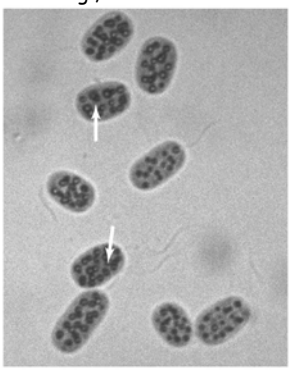
Anoxygenic photosynthesis in purple nonsulfur bacteria (e.g., Rhodobacter)

Also use REF: GNBs & PSBs

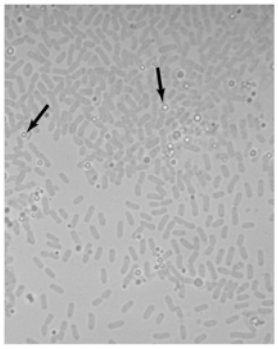
Reaction center of purple nonsulfur bacteria



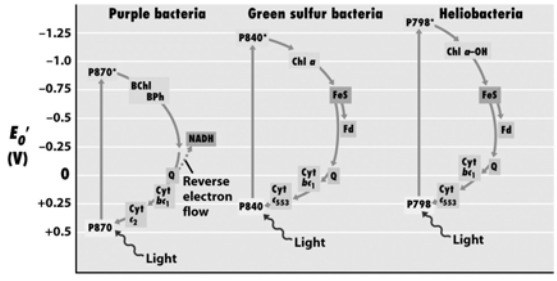
Sulfur granules in purple sulfur bacteria
e.g., Chromatium

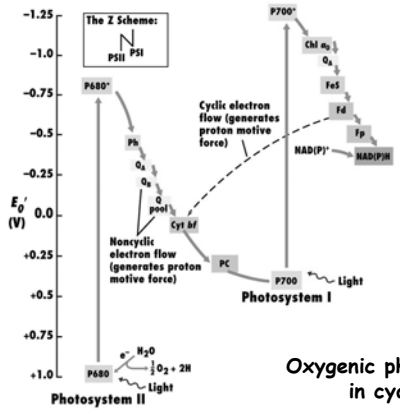


Sulfur granules in green sulfur bacteria
e.g., Chlorobium

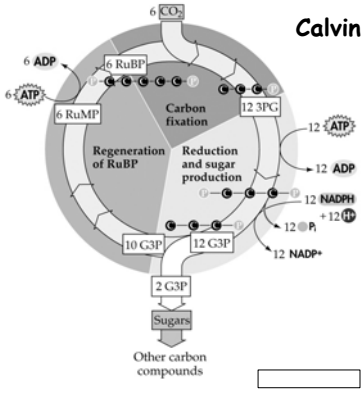


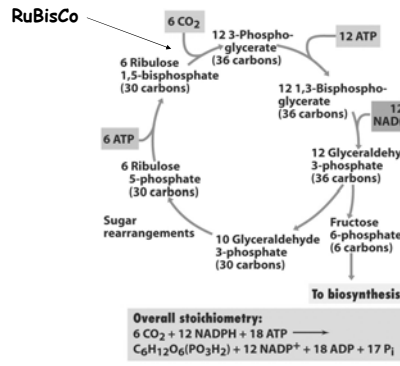
Electron flow in phototrophs



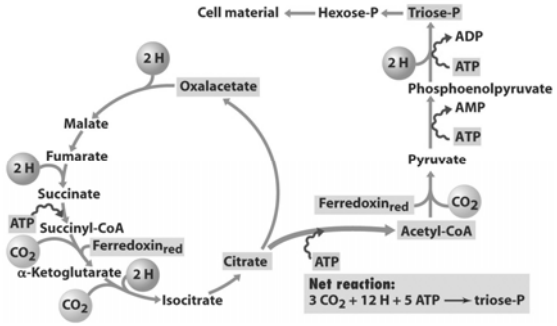


Oxygenic photosynthesis in cyanobacteria

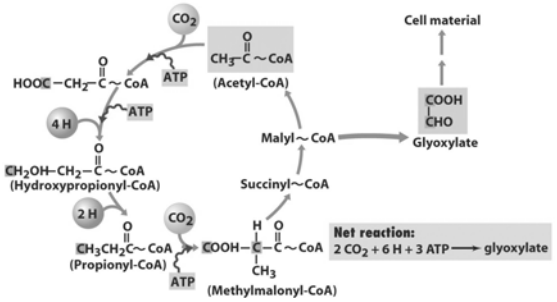




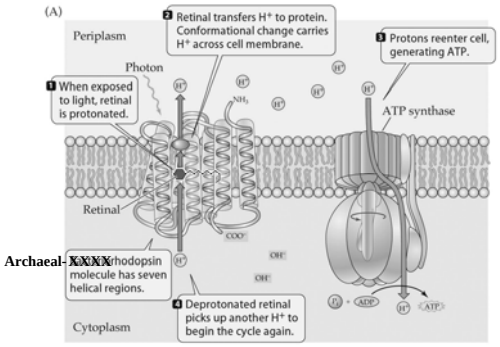
Reverse TCA in GSBs



Hydroxyproprionate in GNBs



A light-driven proton pump of halophilic archaea



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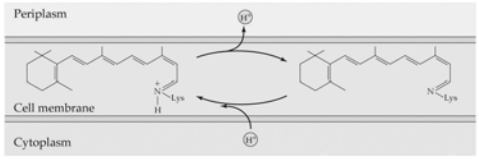

Archaeal rhodopsin: retinal structure

Proteorhodopsin
in marine *Bacteria*
and *Archaea*