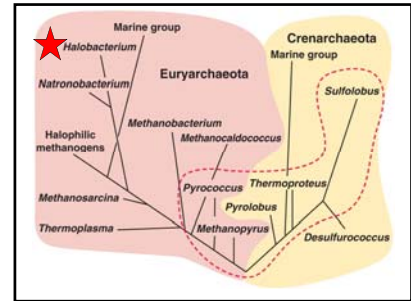
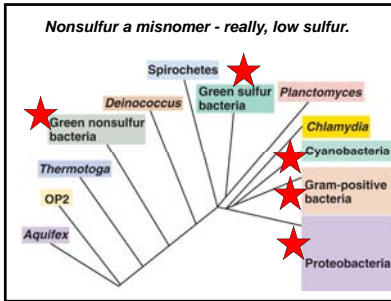
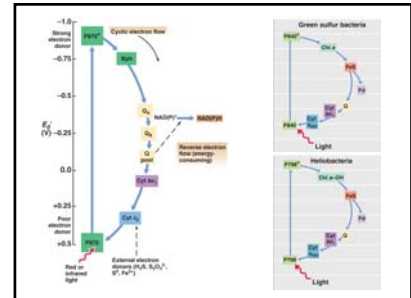
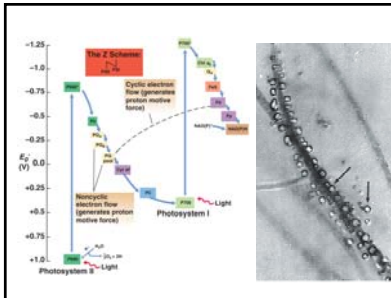
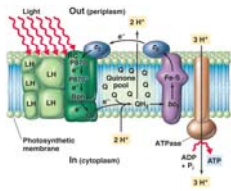


Biology 331
Phototrophic Prokaryotes

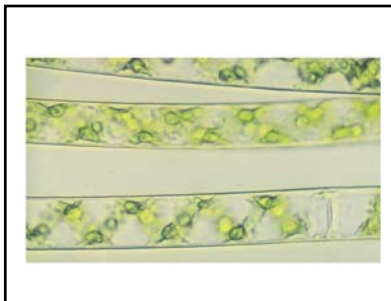
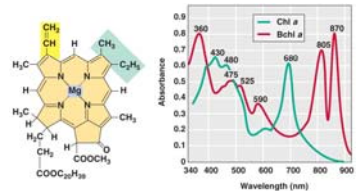


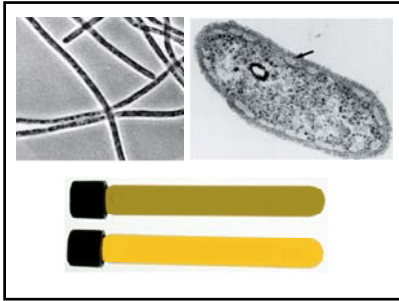
Big Picture – Photosystems (PS)

Light/pigment splits H₂X, e⁻ to ETC - energy
 Oxygenic: PSII splits H₂O into H⁺ and O₂, PSI
 Anoxygenic: PSI splits H₂S to H⁺ and S



Oxygenic - Primary & Accessory Pigments
 Plants & Prochloro - green Chl a & b, carotenes
 Cyanobacteria - green Chl a & blue phycobilins

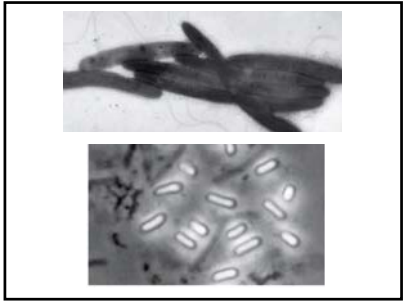




Heliobacteria - Heliobacterium
 Motile unicellular, form spores - anoxic sediment
 Night job fermentation, like Gram (+) relatives

Table 16.4 Major genera of endospore-forming bacteria*

Characteristics	Genera
Rods	
Aerobic or facultative, catalase produced	Bacillus, Paenibacillus, Sporobacillus
Microaerophilic, no catalase, fermentative lactic acid producer	Lactobacillus
Aspores	
Sulfate-reducing	Desulfotomaculum
Does not reduce sulfate, fermentative	Clostridium (see Figure 16.5)
Thermophilic, temperature optimum 65–70°C, fermentative	Thermococcus, Thermoplasma
Obligate anaerobic, can grow as homoacetogens on H ₂ + CO ₂	Syntrophomonas
Halophilic, isolated from the Dead Sea	Sporohalobacter
Produce up to five spores per cell, heat-stable	Acetivibrio
Other rod-shaped endospore formers	
Anaerobic, pH optimum 7	Alcaligenes
Aerophilic, pH optimum 9	Amphibacillus
Photosynthetic	Heliobacterium, Heliobacterium, Heliobacterium, Heliobacterium
Nonmotile, degrades fatty acids but only in coculture with a	Syntrophomonas

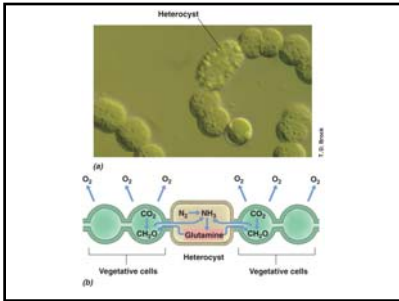
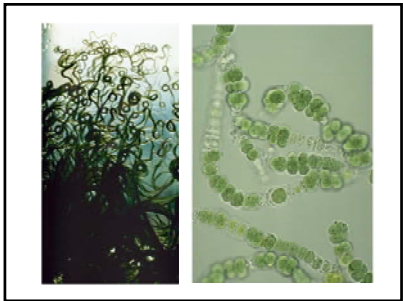


Diversity/Ecology - Oxygenic Bacteria

Cyanobacteria/Prochlorophytes
 Most shapes, gas vesicles or gliding motility
 Most widespread - hot springs, polar, desert...
 Many - geosmins, bloom-associated toxins
Anabaena: freshwater filaments, heterocysts
Prochloron: marine unicellular, chloroplast-like

Table 16.11 Genera and grouping of cyanobacteria

Group	Genera
Group I. Unicellular: single cells or cell aggregates	Gloeothece (Figure 16.24a), Gloeobacter, Synechococcus, Cyanoshece, Gloeocapsa, Synechocystis, Chamaesiphon, Mariprokedia
Group II. Pleurocapsalean: reproduce by formation of small spherical cells called biocones produced through multiple fission	Democarpa (Figure 16.24b), Xenococcus, Democarpella, Pleurocapsa, Myxosarcina, Chroococcoidespa
Group III. Oscillatorian: filamentous cells that divide by binary fission in a single plane	Oscillatoria (Figure 16.24c), Spirulina, Arthrospira, Lyngbya, Microcoleus, Pseudanabaena
Group IV. Nostocalean: filamentous cells that produce heterocysts	Anabaena (Figure 16.24d), Nostoc, Calothrix, Nodularia, Cylinโดsperrum, Scytonema
Group V. Branching: cells divide to form branches	Facharella (Figure 16.24e), Sigonema, Chlorogloeopsis, Haploisiphon



Archaeal Photosynthesis

Light-Dependent ATP Synthesis
 Purple bacteriorhodopsin (Brho), cell membrane
 Light - Brho moves H+ out, PMF/ATPase
Halobacterium = extreme halophile (>5M salt)
 Evaporation ponds, salted foods

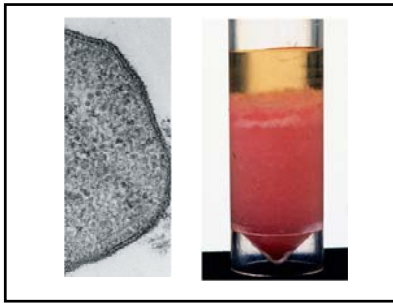
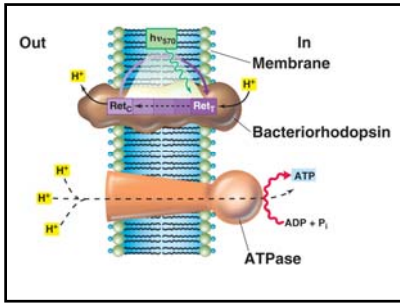
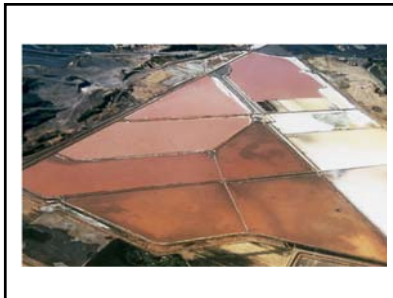


Table 17.2 Some genera of extremely halophilic Archaea

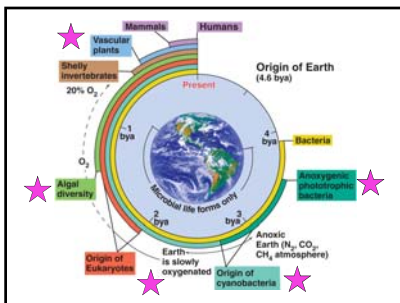
Genus	Morphology	Habitat
Extreme Halophiles		
<i>Halo bacterium</i>	Rods	Salted fish, hides, hypersaline lakes, saltams
<i>Halo bacterium</i>	Rods	Dead Sea, saltams
<i>Halo baculum</i>	Rods	Dead Sea
<i>Halo ferax</i>	Flattened discs	Dead Sea, saltams
<i>Halo sarcula</i>	Irregular discs	Salt pools, Death Valley, CA, marine saltams
<i>Halo cococcus</i>	Cocci	Salted fish, saltams
<i>Halo geometricum</i>	Rods	Solar saltams
<i>Halo terrigena</i>	Rods, ovals	Saline soil
Haloalkaliphiles		
<i>Natronobacterium</i>	Rods	Highly saline soda lakes
<i>Natronema</i>	Rods	Salted fish, hides
<i>Natronaba</i>	Rods	Soda lakes, beach sand
<i>Natronomonas</i>	Rods	Soda lakes
<i>Natronococcus</i>	Cocci	Soda lakes
<i>Natronobrium</i>	Flattened cells	Soda lakes

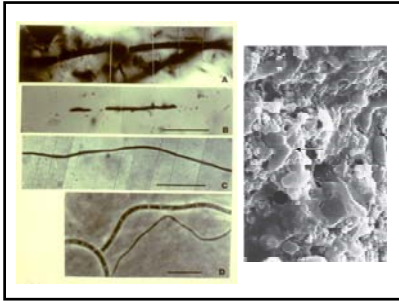


Photosynthesis and Evolution

Microbiology Landmarks in Earth History
 Geochemical dating - earth = 4.6 BYA
 Earliest Stromatolites - 3.6 BYA
 Fully oxygenated environment - 1-2 BYA

Stromatolites = fossilized mats - communities formed by filamentous phototrophic bacteria.





Conditions When Life Began
 NO O2/ozone, high UV/mutation rate, 100° C
 Inorganics - CH4, CO2, N2, NH3, H2, H2S
 Metabolism SIMPLE (uptake, PMF, ATPase)
 Anaerobic chemolithotroph or phototroph

*Heat = infrared (900+ nm), some Bchl absorb...
 were early phototrophs thermo-trophic?*

