

Table 4-10 Characteristics of Photoautotrophic Microorganisms

Group and Examples	Description	Bacteriochlorophylls (Bchl) or Chlorophylls (Chl) and Carotenoids	Photosynthetic Membranes
PURPLE SULFUR BACTERIA (CHROMATIACEAE) <i>Chromatium,</i> <i>Ectothiorhodospira</i>	Gram-negative anoxygenic bacteria that grow only in the absence of air; depend on sulfide as an electron donor for generating reduced coenzymes; purple-red to red-brown in color	Bchl <i>a</i> or Bchl <i>b</i> , Lycopanol, Spirilloxanthin, Okenone	Vesicles, tubules, or lamellae that are continuous with the cytoplasmic membrane
PURPLE NONSULFUR BACTERIA (RHODOSPIRILLACEAE) <i>Rhodospirillum,</i> <i>Rhodopseudomonas,</i> <i>Rhodobacter</i>	Gram-negative anoxygenic bacteria; can utilize sulfide only at very low concentrations; otherwise use organic acids as electron donors; purple-red in color	Bchl <i>a</i> or Bchl <i>b</i> , Spheroidene, Spirilloxanthin, Lycopanol	Vesicles, tubules, or lamellae that are continuous with the cytoplasmic membrane
GREEN SULFUR BACTERIA (CHLOROBIAACEAE) <i>Chlorobium</i> <i>Pelodictyon</i>	Gram-negative anoxygenic bacteria that grow only in the absence of air; depend on sulfide or thiosulfide as an electron donor to generate reduced coenzymes; fix carbon dioxide but grow better on simple organic acids, such as acetate; they typically form the lowest layer of photoautotrophs growing in a stratified lake; green to brown in color	Bchl <i>c</i> , Bchl <i>d</i> , or Bchl <i>e</i> ; some Bchl <i>a</i> , Chlorobactene	Photosynthetic apparatus in cytoplasmic membrane; light harvesting pigments in chlorosomes
GREEN NONSULFUR BACTERIA (CHLOROFLEXACEAE) <i>Chloroflexus</i> <i>Chloronema</i>	Gram-negative anoxygenic bacteria that flex and glide and usually occur as a golden mat under a layer of cyanobacteria; typically found in hot springs; capable of photoheterotrophic growth using light energy to generate ATP and organic compounds to generate reduced coenzymes and cellular macromolecules; green to golden in color	Bchl <i>a</i> and Bchl <i>c</i> or Bchl <i>d</i> , β -Carotene, γ -Carotene	Photosynthetic apparatus in cytoplasmic membrane only
GRAM⁺: <i>Heliobacteria,</i> <i>Heliobacterium,</i> <i>Heliobacillus</i>	Gram-positive anoxygenic bacteria that are relatively tolerant of air; green-golden in color; photoheterotrophic	Bchl <i>g</i> Neurosporene	Photosynthetic apparatus in cytoplasmic membrane only
CYANOBACTERIA <i>Anabaena, Nostoc</i>	Oxygenic photosynthetic bacteria	Chl <i>a</i> phycobiliproteins	Thylakoid membranes
PROCHLOROBACTERIA <i>Prochloron</i>	Oxygenic photosynthetic bacteria	Chl <i>a</i> and Chl <i>b</i> phycobiliproteins, β -carotene	Thylakoid membranes
ALGAE	Oxygenic photosynthetic eukaryotes; green, golden, red, or brown	Chl <i>a</i> , Chl <i>b</i> , Chl <i>c</i> or Chl <i>d</i> β -Carotene, Phycoerythrin Phycocyanin, Xanthophylls, Fucoxanthin	Thylakoid membranes of chloroplasts

Table 9.4. Some properties of the four families of phototrophic bacteria

	Rhodospirillaceae (purple nonsulfur bacteria)	Chromatiaceae (purple sulfur bacteria)	Chlorobiaceae (green sulfur bacteria)	Chloroflexaceae (green gliding bacteria)
bacteriochlorophylls present	BCHL a or b	BCHL a or b	BCHL a and c, d, or e	BCHL a and c or d
use of H ₂ S as H-donor	– (some +)	+	+	(+)
accumulation of S ⁰ and use of S ⁰ as H-donor	–	+ (i) ^a	+ (e) ^b	–
use of H ₂ as H-donor	+	+	+	+
use of organic substrates as H-donor	+	+	–	+
carbon source	CO ₂ organic substrates	CO ₂ organic substrates	CO ₂ organic substrates	CO ₂ organic substrates
aerobic dark growth	+	–	–	+

^a i Intracellular accumulation except genus *Ectothiorhodospira*.

^b e Extracellular accumulation.