Lecture 23: A Bacterial Survey

I. Anaerobic chemoheterotrophs
   A. Fermentation

   The Genus

   *Phylum: Firmicutes, Class: Clostridia*

   *Bergey's Manual Volume 3 (Low G+C Gram-positives)*

   1) Generate ATP by fermenting a wide variety of as well as
      and ethanol.

   2) Many species are
      pathogenic: *C. botulinum*, , and *C. perfringens*.

   3) Commonly found in anaerobic microenvironments within the
      Some species are normal flora of the
B. Anaerobic respiration

*Phylum: Proteobacteria, Orders: Desulfovibrionales, Desulfobacterales and Desulfuromonadales*  
*Volume 2 of Bergey's Manual*

1. Generate ATP when __________ are used as the __________ in the electron transport chain. This reduction produces (H$_2$S).

2. Found in __________ or marine sediment, sediments of polluted lakes and streams, sewage lagoons and digesters. These locations are rich in organic material and oxidized sulfur compounds.

3. There are __________ including __________ and *Desulfuromonas*.
II. Anoxygentic phototrophs

Generally inhabit rare ecological niches that are but have little or no .

A. The bacteria that are due to the light absorbing pigments (e.g. bacteriochlorophyll).

1. Purple sulfur bacteria

*Phylum: Proteobacteria, Class: γ-proteobacteria*

a. Generally photolithoautotrophic, and use .

b. (> 5 μm), motile cells that commonly contain enabling them to move to the desired water depth. Most also have internal that may eventually be oxidized further. Representative genera include
c. Found in such as sulfur springs.
Fig 20.20 and 20.21 (8th ed.) or 22.21 and 22.22 (9th ed.)
2. Purple Nonsulfur Bacteria

*Phylum: Proteobacteria, Class: α-proteobacteria*

*Bergey's Manual: Volume 2*

a. Generally use \( \text{H}_2\text{S} \) rather than \( \text{H}_2\text{S} \) as a source of electrons. They are very \( \text{anaerobic} \) and although growth is generally \( \text{anoxic} \) and \( \text{phototrophic} \), most can grow using \( \text{chemotrophic} \) metabolism.

b. Cells and sulfur storage granules.

c. Most are

d. Morphology varies: *Rhodospirillum* (rods), and *Rhodocyclus* (half circles or circles)

e. Found in a variety of aquatic environments such as and moist soils.
B. The Green Bacteria
Gram-negative bacteria that are green or brown in color.

1. Green sulfur bacteria
   *Phylum: Chlorobi*
   *Bergey's Manual: Volume 1*
   a. Generally use and are strictly anaerobic.
   b. Diverse morphologically: rods, cocci or vibrios
   c. Cells but they and sulfur granules form Representative genera include *Chlorobium* and *Pelodictyon*.
   d. Like purple sulfur bacteria, they generally live in

   Fig. 19.5 (8th ed.) or 21.9 (9th ed.)
2. Green nonsulfur bacteria
   
   a. Like purple nonsulfur bacteria, use as a source of electrons. Also like purple nonsulfur bacteria, they are and can use chemotrophic metabolism.
   
   b. Growth is and cells often use gliding motility.
   
   c. is the main representative. It is thermophilic, and lives in where it grows into orange-reddish mats along with cyanobacteria.

[Image: www.bact.wisc.edu/Bact303/Chloroflexus.jpeg]
III. Oxygenic phototrophs

*(Phylum: Cyanobacteria, Bergey's Manual: Volume 1)*

A. Metabolism

1. Obtain their energy from
2. Nitrogen fixation

\[
\text{An enzyme} \\
+ 8 \text{ H}^+ + 8\text{e}^- + 16 \text{ ATP} \quad \rightarrow \quad + \text{H}_2 + 16 \text{ ADP} + 16 \text{ Pi}
\]

Cyanobacteria from oxygen in a variety of ways. For instance, *Synechococcus* fixes nitrogen when photosynthesis is not taking place. *Nostoc* only fixes nitrogen in specialized cells called that are fairly impermeable to oxygen and lack photosystem II so do not themselves produce oxygen! In microbial mats (pictured previously) only the cells in an anoxic environment fix nitrogen.
B. Characteristics

1. There are 62 species and 24 genera of bacteria. Some are typical prokaryotic shapes: . Some form that may be enclosed in a sheath. Some trichomes have heterocysts!

2. Often have and can move by

3. Use a variety of mechanisms of reproduction: budding, fragmentation and (cell enlarges and divides several times).

4. Some can develop which are dormant, resting structures that are resistant to desiccation.
2. Excessive growth causes cells to form and in summer these cells will die and decay leading to a smelly scum called
C. Environmental niche

Generally inhabit and marine habitats, soils and

Microbiotic crust

Taken by Rachel in Utah in May of 2004