8.8A: Overview of Gram-Positive Bacteria and Actinobacteria

*Actinobacteria* are Gram-positive bacteria with high guanine and cytosine content in their DNA and can be terrestrial or aquatic.

**Learning Objectives**

- Discuss the characteristics associated with Actinobacteria

**Key Points**

- *Actinobacteria* include some of the most common soil life, freshwater life, and marine life, playing an important role in the decomposition of organic materials, such as cellulose and chitin, and thereby playing a vital part in organic matter turnover and carbon cycle.
- *Actinobacteria* are well-known as secondary metabolite producers and are hence of high pharmacological and commercial interest, since they can produce antibiotics like actinomycin.
- *Actinobacteria* are responsible for the peculiar odor emanating from the soil after rain (petrichor), mainly in warmer climates.

**Key Terms**

- **actinomycin**: Any of a class of toxic polypeptide antibiotics found in soil bacteria of genus *Streptomyces*.
- **actinobacteria**: A group of Gram-positive bacteria with high guanine and cytosine content in their DNA

*Actinobacteria* is one of the dominant phyla of bacteria. They are Gram-positive bacteria with high guanine and cytosine content.
content in their DNA and can be terrestrial or aquatic. Analysis of glutamine synthetase sequence has been suggested for their phylogenetic analysis.

Actinobacteria include some of the most common soil life, freshwater life, and marine life, playing an important role in the decomposition of organic materials, such as cellulose and chitin; thereby playing a vital part in organic matter turnover and carbon cycle. This replenishes the supply of nutrients in the soil and is an important part of humus formation.

Other Actinobacteria inhabit plants and animals, including a few pathogens, such as Mycobacterium, Corynebacterium, Nocardia, Rhodococcus, and a few species of Streptomyces.

Figure: **Actinomycetes israelii**: Scanning electron micrograph of Actinomyces israelii.

Actinobacteria are well-known as secondary metabolite producers and are hence of high pharmacological and commercial interest. In 1940 Selman Waksman discovered that the soil bacteria he was studying made actinomycin, a discovery for which he received a Nobel Prize. Since then, hundreds of naturally-occurring antibiotics have been discovered in these terrestrial microorganisms, especially from the genus *Streptomyces*.

Some Actinobacteria form branching filaments, which somewhat resemble the mycelia of the unrelated fungi, among which they were originally classified under the older name *Actinomycetes*. Most members are aerobic, but a few, such as *Actinomycetes israelii*, can grow under anaerobic conditions. Unlike the Firmicutes, the other main group of Gram-positive bacteria, they have DNA with a high GC-content, and some Actinomycetes species produce external spores.

Some types of Actinobacteria are responsible for the peculiar odor emanating from the soil after rain (petrichor), mainly in warmer climates. The chemical that produces this odor is known as Geosmin. Most Actinobacteria of medical or economic significance are in subclass *Actinobacteridae*, order *Actinomycetales*. While many of these cause disease in humans, Streptomyces is notable as a source of antibiotics.