

Actinomycetes are bacteria, but, morphologically, actinomycetes resemble molds with their long and highly branched hyphae. However, the lack of a nuclear membrane and the composition of the cell wall require classification as bacteria. Actinomycetes are important sources of antibiotics. Certain Actinomycetes possess amylolytic and cellulolytic enzymes and are effective in enzymatic hydrolysis of starch and cellulose. *Actinomyces*, *Thermomonospora*, and *Streptomyces* are examples of genera belonging to this group.

Other distinctions within the eubacteria can be made based on cellular nutrition and energy metabolism. One important example is photosynthesis. The cyanobacteria (formerly called blue-green algae) have chlorophyll and fix CO₂ into sugars. Anoxygenic photosynthetic bacteria (the purple and green bacteria) have light-gathering pigments called *bacteriochlorophyll*. Unlike true photosynthesis, the purple and green bacteria do not obtain reducing power from the splitting of water and do not form oxygen.

When stained properly, the area occupied by the procaryotic cell's DNA can be easily seen. Procaryotes may also have other visible structures when viewed under the microscope, such as *ribosomes*, *storage granules*, *spores*, and *volutins*. Ribosomes are the site of protein synthesis. A typical bacterial cell contains approximately 10,000 ribosomes per cell, although this number can vary greatly with growth rate. The size of a typical ribosome is 10 to 20 nm and consists of approximately 63% RNA and 37% protein. Storage granules (which are not present in every bacterium) can be used as a source of key metabolites and often contain polysaccharides, lipids, and sulfur granules. The sizes of storage granules vary between 0.5 and 1 µm.

Some bacteria make intracellular spores (often called endospores in bacteria). Bacterial spores are produced as a resistance to adverse conditions such as high temperature, radiation, and toxic chemicals. The usual concentration is 1 spore per cell, with a spore size of about 1 µm. Spores can germinate under favorable growth conditions to yield actively growing bacteria.

Volutin is another granular intracellular structure, made of inorganic polymetaphosphates, that is present in some species. Some photosynthetic bacteria, such as *Rhodospirillum*, have chromatophores that are large inclusion bodies (50 to 100 nm) utilized in photosynthesis for the absorption of light.

Extracellular products can adhere to or become incorporated within the surface of the cell. Certain bacteria have a coating or outside cell wall called *capsule*, which is usually a polysaccharide or sometimes a polypeptide. Extracellular polymers are important to biofilm formation and response to environmental challenges (e.g., viruses). Table 2.3 summarizes the architecture of most bacteria.

2.1.4.2. Archaeobacteria. The archaeobacteria appear under the microscope to be nearly identical to many of the eubacteria. However, these cells differ greatly at the molecular level. In many ways the archaeobacteria are as similar to the eucaryotes as they are to the eubacteria. Some examples of differences between archaeobacteria and eubacteria are as follows:

1. Archaeobacteria have no peptidoglycan.
2. The nucleotide sequences in the ribosomal RNA are similar within the archaeobacteria but distinctly different from eubacteria.
3. The lipid composition of the cytoplasmic membrane is very different for the two groups.