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Prokaryotes

Up to this point we have been talking about organelles associated with Eukaryotic cells but will now shift our attention to prokaryotic cells which are single celled organisms that lack nuclei and membrane bound organelles. Prokaryotes can be separated into two domains: **bacteria** and **archaea**. As a reference, organisms with a nucleus are placed into the third domain, Eukaryota. For those who study the origin of life, the prokaryote is hypothesized to have started before the eukaryotes.

Prokaryotes also lack membrane bound organelles like mitochondria, endoplasmic reticuli, Golgi apparati etc., however some prokaryotes appear to have compartments formed by protein shells or carbohydrate-enclosed microcompartments. Prokaryotes do contain vacuoles and a cytoskeleton; the most prominent part of the cytoskeleton being arranged into a structure called the **flagellum**. The flagellum is a long, whip-like structure that helps the prokaryote move, although the structure is not always present. Other cytoskeleton structures include **fimbriae** (numerous short appendages used to adhere) and the **sex pili** (protein-based tubes that pull cells together to transfer DNA). In addition to the cell membrane, some prokaryotes (bacteria) also contain a cell wall which is an outer covering that gives the cell shape and protection. Cell walls are comprised of polysaccharide chains that are cross-linked together by short polypeptides, and together the structure forms a **peptidoglycan**. Cell walls differ slightly between groups of bacteria and this difference can be seen through a technique called gram staining. Gram staining involves the application of two dyes; red safranin (stains all cells) and crystal violet (gets trapped in peptidoglycan walls). This technique revealed two categories of bacteria, a **Gram-Positive** group and a **Gram-Negative** group. If a cell is gram-positive it means that the peptidoglycan cell wall was very thick and the crystal violet remained “stuck” despite several washings, leaving the cell a purple color (safranin + crystal violet). If a cell is gram-negative it means that the cell was thin, so that the crystal violet washed out, leaving the cell pink (from the safranin). This categorization is very important when it comes to antibiotics because knowing the composition of the cell wall determines which antibiotic is likely to work or not. Some bacteria can secrete additional polysaccharides that surround the cell wall forming a **capsule** that allows the cell to adhere to surfaces and help prevent dehydration. A common capsule type is called a **slime layer**.

Prokaryotic Morphology and Reproduction