

Prokaryotic Structure

- ☺ Most prokaryotes are unicellular.
- ☺ Some species may aggregate transiently or form true colonies, even extending to division of labor between specialized cell types.
- ☺ The most common shapes among prokaryotes are spheres (cocci), rods (bacilli), and spirals.
- ☺ Most prokaryotes have diameters in the range of 1-5 um, compared to 10-100 um for most eukaryotic cells.

Nearly all prokaryotes have a cell wall external to the plasma membrane

- ☺ In nearly all prokaryotes, a cell wall maintains the shape of the cell, provides physical protection, and prevents the cell from bursting in a hypotonic environment (*what does hypotonic mean??*).
- ☺ Most bacterial cell walls contain **peptidoglycan**, a *polymer* of modified sugars cross-linked by short *polypeptides*.
 - ☺ The walls of archaea lack peptidoglycan.
- ☺ The **Gram stain** is a valuable tool for identifying specific bacteria, based on differences in their cell walls.
- ☺ **Gram-positive** bacteria have simpler cell walls, with large amounts of peptidoglycans.
- ☺ **Gram-negative** bacteria have more complex cell walls and less peptidoglycan.
 - ☺ An outer membrane on the cell wall contains lipopolysaccharides, carbohydrates bonded to lipids.
- ☺ Among pathogenic bacteria (bacteria that cause disease), gram-negative species are generally more threatening than gram-positive species.
 - ☺ The lipopolysaccharides on the walls of gram-negative bacteria are often toxic, and the outer membrane protects these bacteria against the body's defenses.
 - ☺ Gram-negative bacteria are commonly more resistant than gram-positive species to antibiotics because the outer membrane prevents entry of the drugs.
- ☺ Many antibiotics, including penicillins, inhibit the synthesis of cross-links in peptidoglycans, preventing the formation of a functional wall, particularly in gram-positive species.
 - ☺ These drugs are a very selective treatment because they cripple many species of bacteria without affecting humans and other eukaryotes, which do not synthesize peptidoglycans.

- ☺ Many prokaryotes secrete another sticky protective layer, the **capsule**, outside the cell wall (*a.k.a the “slime” layer*).
 - ☺ Capsules are made of polysaccharides or protein.
 - ☺ Capsules adhere the cells to their substratum.
 - ☺ They may increase resistance to host defenses.
 - ☺ They glue together the cells of those prokaryotes that live as colonies.
- ☺ Another way for prokaryotes to adhere to one another or to the substratum is by surface appendages called **pili**.
 - ☺ Pili can fasten pathogenic bacteria to the mucous membranes of its host.
 - ☺ Some pili are specialized for holding two prokaryote cells together long enough to transfer DNA during conjugation.

Many prokaryotes are motile

- ☺ About half of all prokaryotes are capable of directional movement.
- ☺ The action of flagella, scattered over the entire surface or concentrated at one or both ends, is the most common method of movement.
- ☺ The flagella of prokaryotes differ in structure and function from those of eukaryotes.
- ☺ In a prokaryotic flagellum, chains of a globular protein are wound in a tight spiral from a filament which is attached to another protein (the hook), and the basal apparatus.
- ☺ Rotation of the filament is driven by the *diffusion of protons into the cell* through the basal apparatus after the protons have been *actively transported by proton pumps in the plasma membrane*. (*What other process uses a proton gradient???*)
- ☺ In a relatively uniform environment, a flagellated cell may wander randomly.
- ☺ In a heterogenous environment, many prokaryotes are capable of **taxis**, movement toward or away from a stimulus.
 - ☺ Prokaryotes that exhibit chemotaxis respond to chemicals by changing their movement pattern.
 - ☺ May move toward nutrients or oxygen (positive chemotaxis)
 - ☺ May move away from a toxic substance (negative chemotaxis)
 - ☺ Other prokaryotes can detect the presence of light (phototaxis) or magnetic fields.