**Chapter 3**

**Prokaryotic Cells**

* Prokaryotes
	+ Do not have membrane surrounding their DNA; lack a nucleus
	+ Lack various internal structures bound with phospholipid membranes
	+ Are small, ~1.0 µm in diameter
	+ Have a simple structure
	+ Composed of Bacteria and Archaea

 **External Structures of Prokaryotic Cells**

* Glycocalyces
	+ Gelatinous, sticky substance surrounding the outside of the cell
	+ Composed of polysaccharides, polypeptides, or both
	+ Two Types of Glycocalyces
		- Capsule
			* Composed of organized repeating units of organic chemicals
			* Firmly attached to cell surface
			* Protects cells from drying out
			* May prevent bacteria from being recognized and destroyed by host
		- Slime layer
			* Loosely attached to cell surface
			* Water soluble
			* Protects cells from drying out
			* Sticky layer that allows prokaryotes to attach to surfaces
* Flagella
	+ Are responsible for movement
	+ Have long structures that extend beyond cell surface
	+ Are not present on all prokaryotes
	+ Structure
		- Composed of filament, hook, and basal body
		- Flagellin protein (filament) deposited in a helix at the lengthening tip
		- Base of filament inserts into hook
		- Basal body anchors filament and hook to cell wall by a rod and a series of either two or four rings of integral proteins
		- Filament capable of rotating 360º
	+ Function
		- Rotation propels bacterium through environment
		- Rotation reversible, can be clockwise or counterclockwise
		- Bacteria move in response to stimuli (taxis)
			* Runs
			* Tumbles
* Fimbriae and Pili
	+ Rod-like proteinaceous extensions
	+ Fimbriae
		- Sticky, bristlelike projections
		- Used by bacteria to adhere to one another, to hosts, and to substances in environment
		- Shorter than flagella
		- May be hundreds per cell
		- Serve an important function in biofilms
	+ Pili
		- Tubules composed of pilin
		- Also known as conjugation pili
		- Longer than fimbriae but shorter than flagella
		- Bacteria typically only have one or two per cell
		- Mediate the transfer of DNA from one cell to another (conjugation)

**Prokaryotic Cell Walls**

* Provide structure and shape and protect cell from osmotic forces
* Assist some cells in attaching to other cells or in eluding antimicrobial drugs
* Not present in animal cells, so can target cell wall of bacteria with antibiotics
* Bacteria and archaea have different cell wall chemistry

**Bacterial Cell Walls**

* + Most have cell wall composed of peptidoglycan
	+ Peptidoglycan is composed of sugars, NAG, and NAM
	+ Chains of NAG and NAM attached to other chains by tetrapeptide crossbridges
		- Bridges may be covalently bonded to one another
		- Bridges may be held together by short connecting chains of amino acids
	+ Two basic types of bacterial cell walls:
	+ Gram-positive cell walls
		- Relatively thick layer of peptidoglycan
		- Contain unique polyalcohols called teichoic acids
			* Some covalently linked to lipids, forming lipoteichoic acids that anchor peptidoglycan to cell membrane
		- Retain crystal violet dye in Gram staining procedure; so appear purple
		- Up to 60% mycolic acid in acid-fast bacteria helps cells survive desiccation
	+ Gram-negative cell walls
		- Have only a thin layer of peptidoglycan
		- Bilayer membrane outside the peptidoglycan contains phospholipids, proteins, and lipopolysaccharide (LPS)
		- May be impediment to the treatment of disease
		- Appear pink following Gram staining procedure

**Archaeal Cell Walls**

* + Do not have peptidoglycan
	+ Contains variety of specialized polysaccharides and proteins
	+ Gram-positive archaea stain purple
	+ Gram-negative archaea stain pink

**Prokaryotic Cytoplasmic Membranes**

* **Structure**
	+ Referred to as phospholipid bilayer; composed of lipids and associated proteins
	+ Approximately half composed of proteins that act as recognition proteins, enzymes, receptors, carriers, or channels
		- Integral proteins
		- Peripheral proteins
		- Glycoproteins
	+ Fluid mosaic model describes current understanding of membrane structure
* **Function**
	+ Energy storage
	+ Harvest light energy in photosynthetic prokaryotes
	+ Selectively permeable
	+ Naturally impermeable to most substances
	+ Proteins allow substances to cross membrane
		- Occurs by passive or active processes
	+ Maintain concentration and electrical gradient
		- Chemicals concentrated on one side of the membrane or the other
		- Voltage exists across the membrane

**Cytoplasm of Prokaryotes**

* **Cytosol** – liquid portion of cytoplasm
* **Inclusions** – may include reserve deposits of chemicals
* **Endospores** – unique structures produced by some bacteria that are a defensive strategy against unfavorable conditions
* **Nonmembranous Organelles**
	+ Ribosomes – sites of protein synthesis
	+ Cytoskeleton – plays a role in forming the cell’s basic shape

**Eukaryotic Cell Walls & Cytoplasmic Membranes**

* Fungi, algae, and some protozoa have cell walls but no glycocalyx
* Composed of various polysaccharides
	+ Fungal cell walls composed of cellulose, chitin, and/or glucomannan
	+ Algal cell walls composed of cellulose, proteins, agar, carrageenan, silicates, algin, calcium carbonate, or a combination of these