Prokaryotic cell structure

- Filamentous appendages
- Surface layers
- Cell wall
- Cell boundary
- Intracellular structures

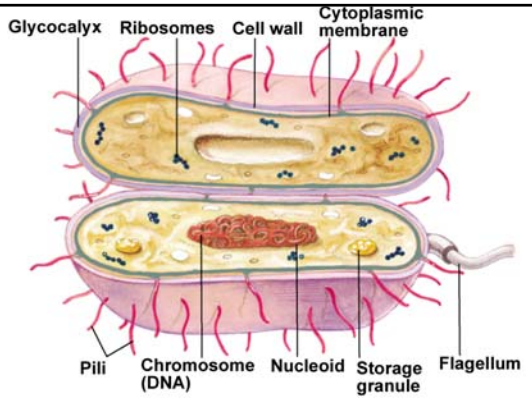


Figure 3.23 – Typical prokaryotic cell

Filamentous protein appendages

- Flagella
- Pili

Figure 3.38 – Bacterial flagella

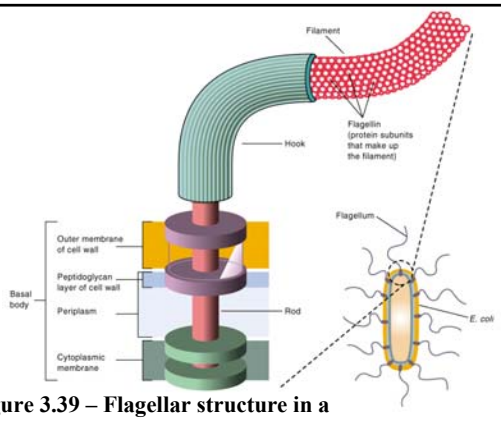


Figure 3.39 – Flagellar structure in a Gram-negative bacterium

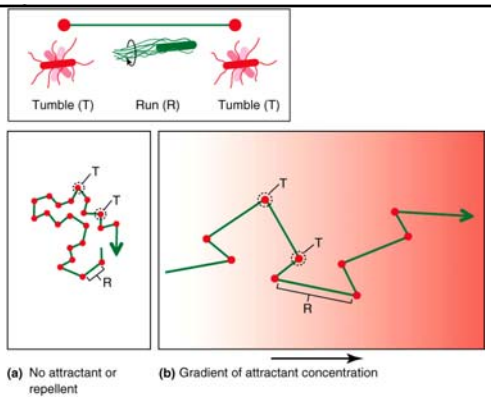


Figure 3.40 - Chemotaxis

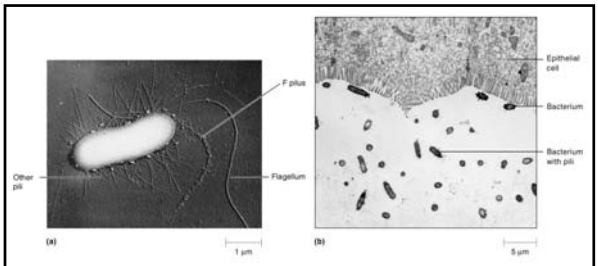


Figure 3.42 – Pili on *E. coli* include fimbriae that mediate adherence and the F pilus involved in bacterial mating.

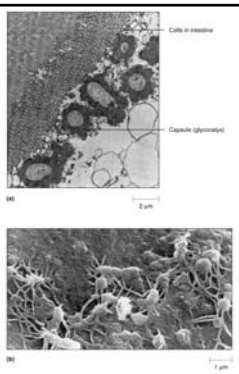


Figure 3.37 – The glycocalyx enables bacteria to attach to specific surfaces. (a) capsules, (b) cells adhering to slime.

Bacterial Cell Walls

- **Contain peptidoglycan**
- **Gram-positive**
- **Gram-negative**

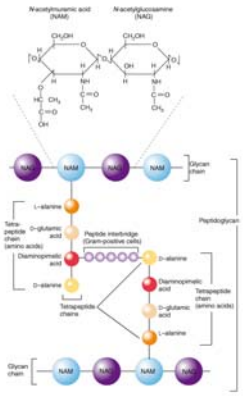


Figure 3.22 – components and structure of peptidylglycan

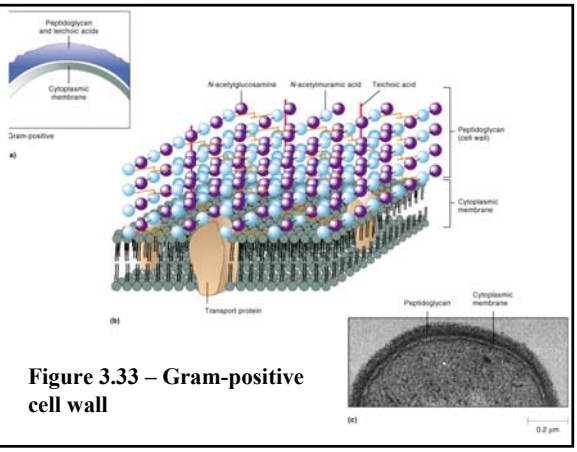


Figure 3.33 – Gram-positive cell wall

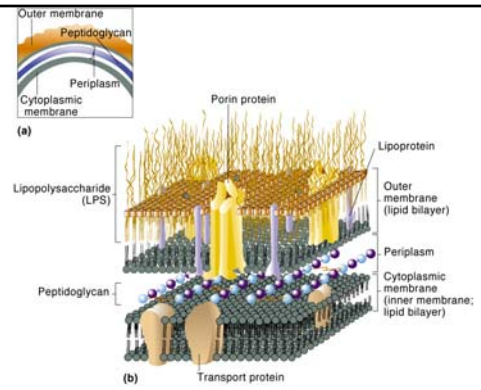


Figure 3.34 – Gram-negative cell wall

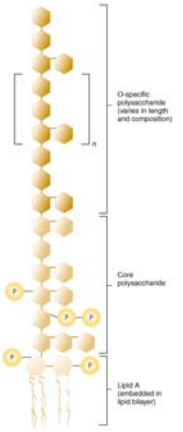


Figure 3.35 – Chemical structure of lipopolysaccharide (LPS)

Figure 3.36 – *Mycoplasma* species lack cell walls

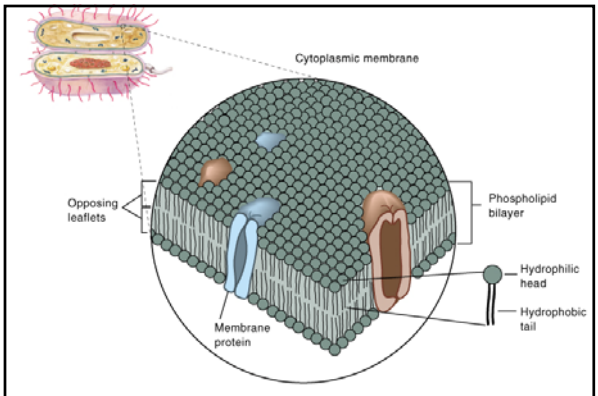


Figure 3.24 – The structure of the cytoplasmic membrane

Intracellular Structure

- **Deoxyribonucleic acid (DNA)**
- **Endospores**
- **Gas vesicles**
- **Granules**
- **Ribosomes**

Figure 3.43 – Bacterial Chromosomes

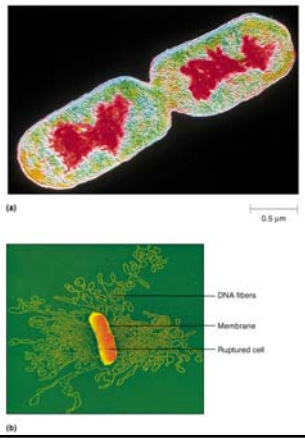


Figure 3.46 Endospores

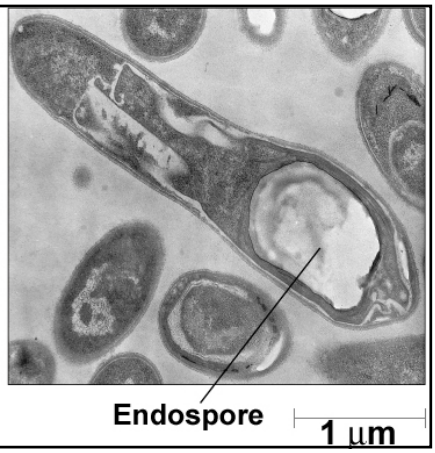
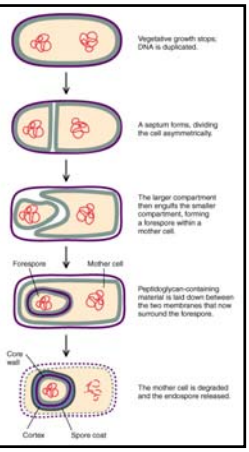


Figure 3.47 –
Endospore formation



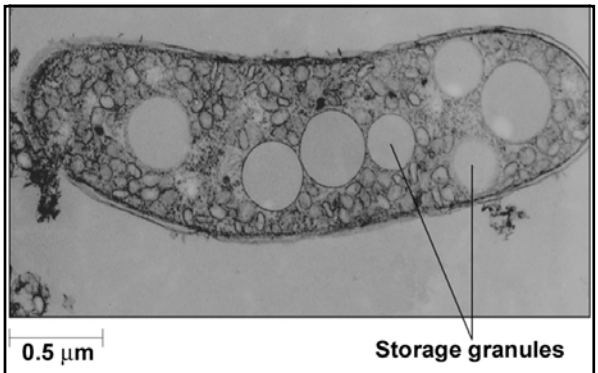


Figure 3.45 – Storage granules:
Poly-β-hydroxybutyrate in *Rhodospirillum rubrum*

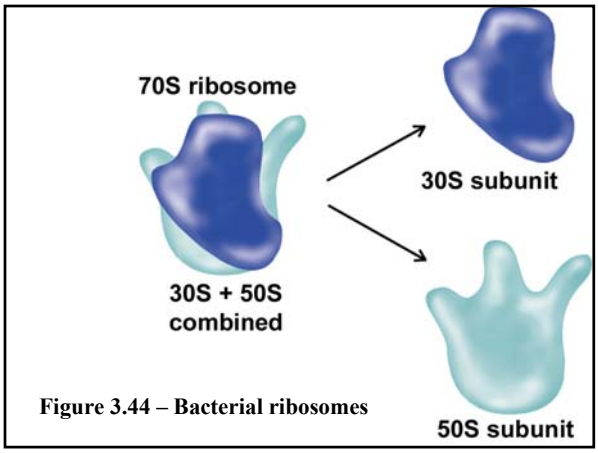


Figure 3.44 – Bacterial ribosomes

Eukaryotic Cell Structure

- Internal protein structures
- Membrane-bound organelles

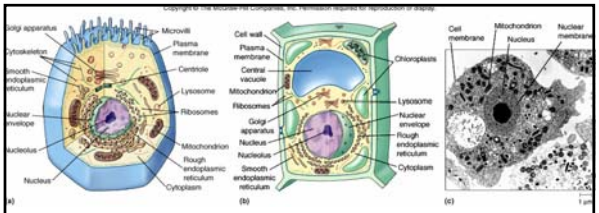


Figure 3.48 – Eukaryotic cell structure

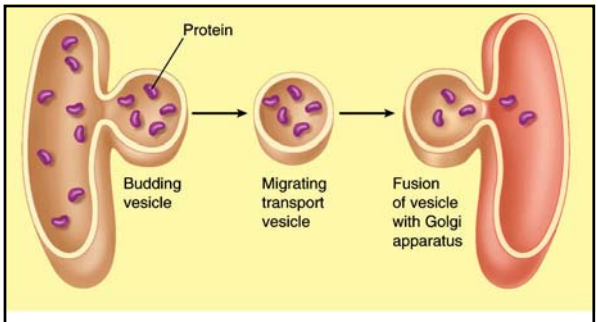
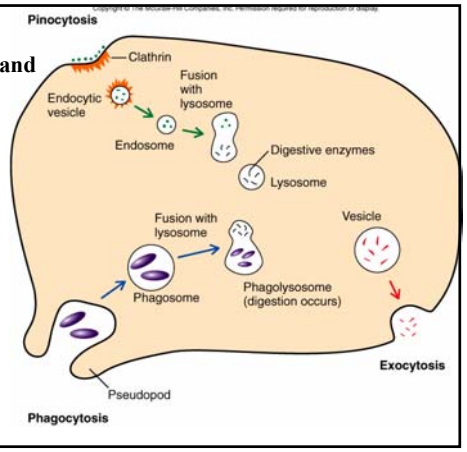


Figure 3.49 – Vesicle formation and fusion

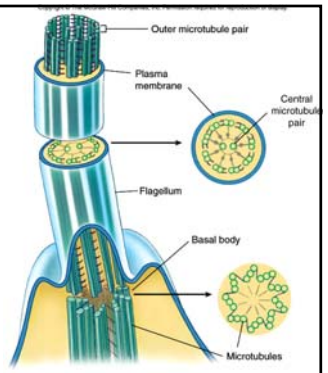
Figure 3.50 Endocytosis and exocytosis



Internal protein structures

- **Flagella and cilia**
- **Cytoskeleton**

Figure 3.52 Eukaryotic flagella



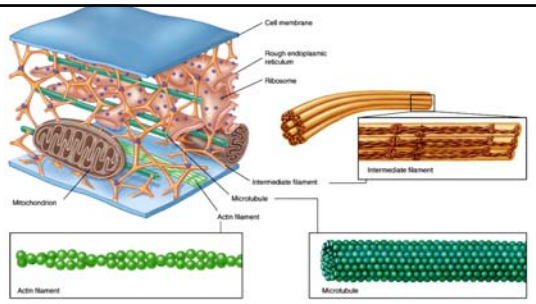


Figure 3.51 Eukaryotic Cytoskeleton

Membrane-bound organelles

- **Chloroplast**
- **Endoplasmic reticulum**
- **Golgi apparatus**
- **Lysosome**
- **Mitochondria**
- **Nucleus**
- **Peroxisome**

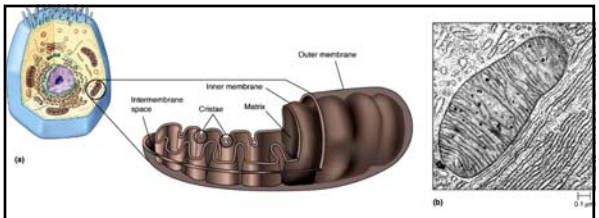


Figure 3.55 - Mitochondria

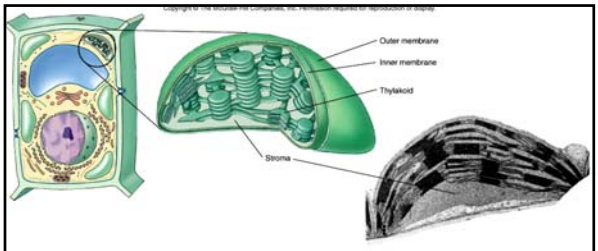


Figure 3.56 - Chloroplasts

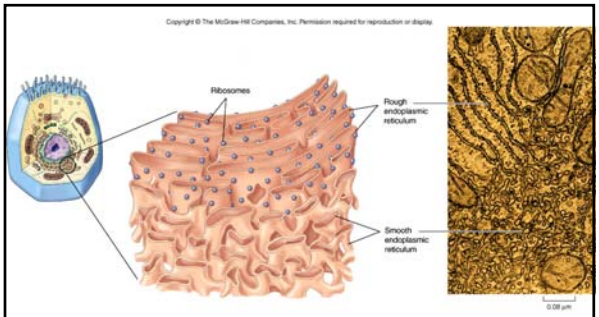


Figure 3.57 Endoplasmic reticulum (ER)

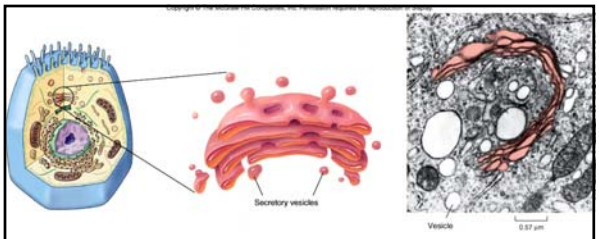


Figure 3.58 Golgi apparatus

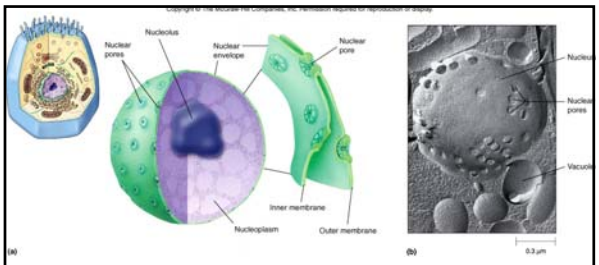


Figure 3.53 - Nucleus

Figure 3.54 Eukaryotic Chromatin

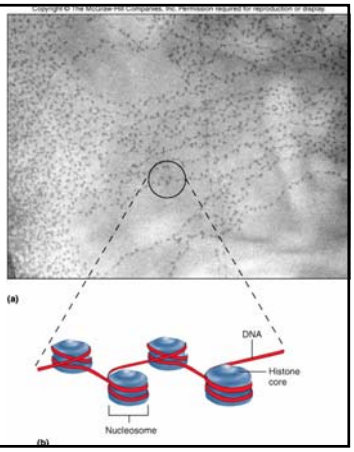


Table 3.7 Comparison of Prokaryotic and Eukaryotic Cell Structures/Functions

	Prokaryotic	Eukaryotic
General Characteristics		
Size	Generally 0.3–2 μm in diameter.	Generally 5–50 μm in diameter.
Cell Division	Chromosome replication followed by binary fission.	Mitosis followed by division.
Chromosome location	Located in a region of the cell called the nucleoid, which is not membrane-bound.	Contained within the membrane-bound nucleus.
Structures		
Cell membrane	Relatively symmetric with respect to the lipid content of the bilayers.	Highly asymmetric; lipid composition of outer leaflet differs significantly from that of inner leaflet.
Cell wall	Composed of peptidoglycan; Gram-negative bacteria have an outer membrane as well.	Absent in animal cells; composition in other cell types may include: chitin, glucans and mannans (fungi), and cellulose (plants).
Chromosome	Single, circular DNA molecule is typical.	Multiple, linear DNA molecules. DNA is wrapped around histones.
Flagella	Composed of protein subunits.	Made up of a 9 + 2 arrangement of microtubules.
Membrane-bound organelles	Absent.	Present; includes the nucleus, mitochondria, chloroplasts (only in plant cells), endoplasmic reticulum, Golgi apparatus, lysosomes, and peroxisomes.
Nucleus	Absent; DNA resides as an irregular mass forming the nucleoid region.	Present.
Ribosomes	70S ribosomes, which are made up of 50S and 30S subunits.	80S ribosomes, which are made up of 60S and 40S subunits. Mitochondria and chloroplasts have 70S ribosomes.

Table 3.7 Comparison of Prokaryotic and Eukaryotic Cell Structures/Functions

	Prokaryotic	Eukaryotic
Functions		
Degradation of extracellular substances	Enzymes are secreted that degrade macromolecules outside of the cell. The resulting small molecules are transported into the cell.	Macromolecules are brought into the cell by pinocytosis or, in the case of protozoa and phagocytes, phagocytosis. Lysosomes carry digestive enzymes.
Motility	Generally involves flagella, which are composed of protein subunits. Flagella rotate like propellers, using proton motive force for energy.	Involves cilia and flagella, which are made up of a 9 + 2 arrangement of microtubules. Cilia move in synchrony; flagella propel a cell with a whiplike motion or thrash back and forth to pull a cell forward. Both use ATP for energy.
Protein secretion	A characteristic signal se uence marks proteins for secretion by the general secretory pathway. The precise mechanisms of translocation are still poorly understood.	Secreted proteins are translocated to the lumen of the rough endoplasmic reticulum as they are being synthesized. From there, they are transported to the Golgi apparatus for processing and packaging.
Strength and rigidity	Peptidoglycan-containing cell wall.	Cytoskeleton composed of microtubules, intermediate filaments, and microfilaments. Some have a cell wall; some have sterols in the membrane.
Transport	Primarily active transport; mechanisms include major facilitator superfamily and ABC transport. Group translocation.	Facilitated diffusion and active transport; mechanisms include major facilitator superfamily and ABC transport. ion channels.