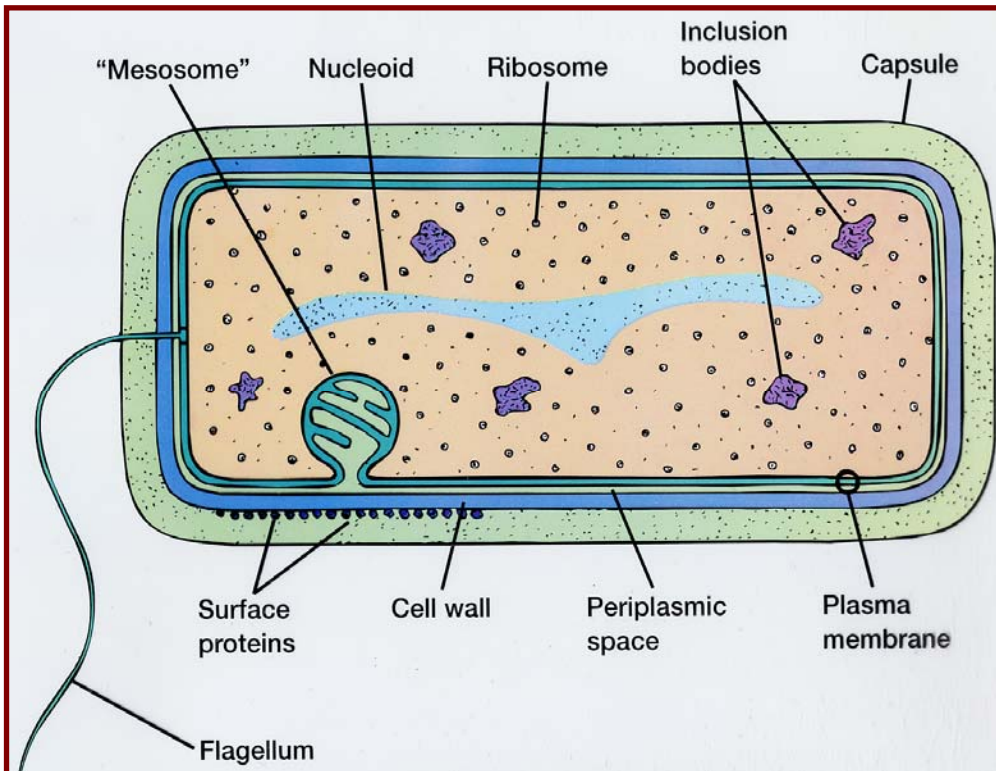
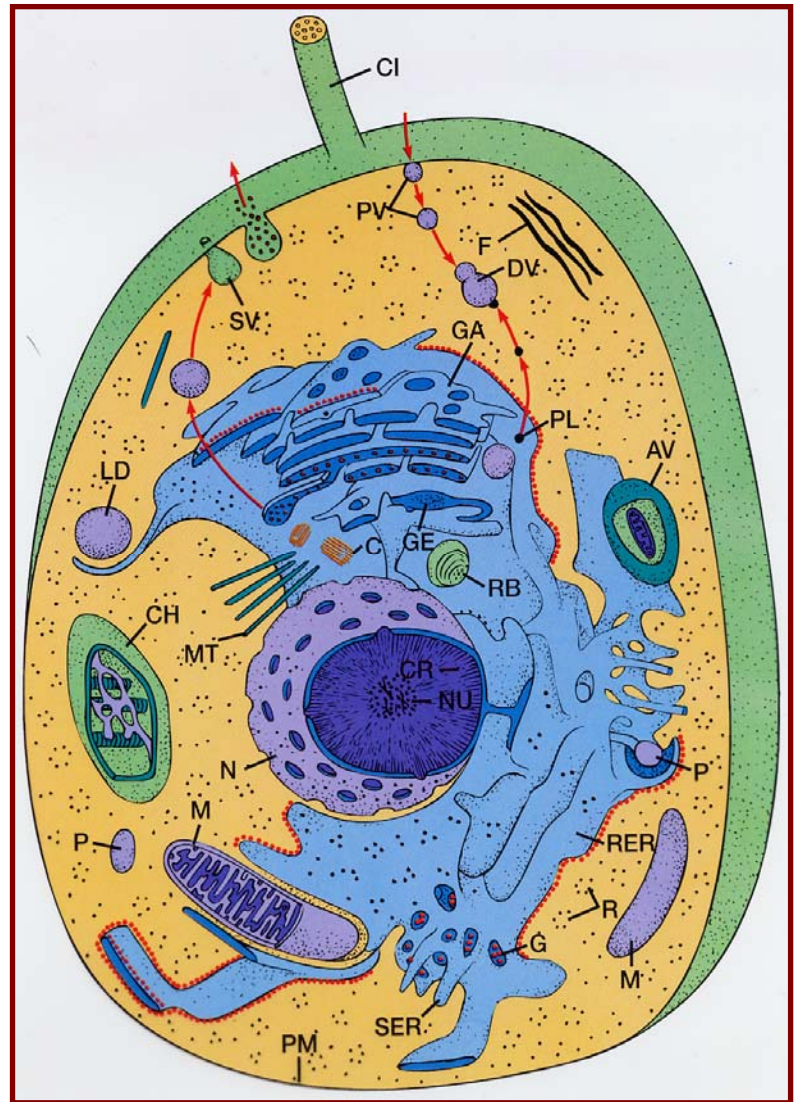


Cell structure and function
(Text pages 55-97)

General overview of the types of cells
(Source of figures to right and below:
Prescott et al. 1993)

- Prokaryote
- Eucaryote

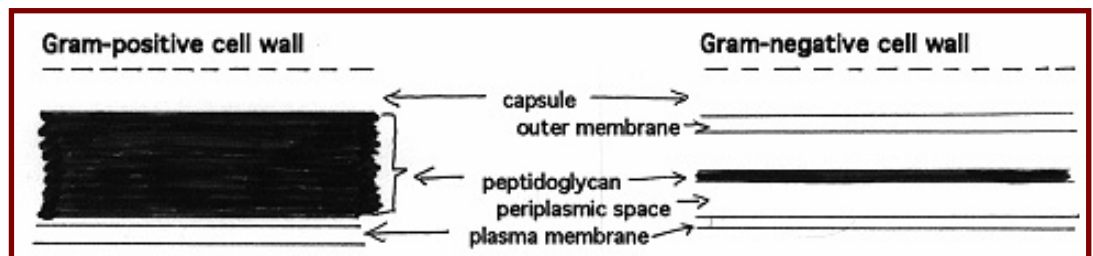
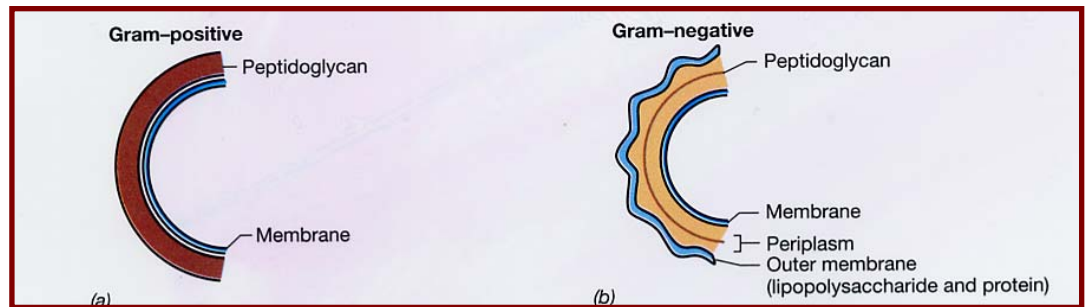


Some features comparing Prokaryote and Eukaryote cell types		
Characteristic	Prokaryote	Eukaryote
Types of organisms	Bacteria, Cyanobacteria, Archaeobacteria	Algae, Fungi, Protozoa, Plants Animals
Size	0.2 –2.0 μM	2.0 – 20.0 μM
Location of genetic material	Diffuses in cytoplasm	Nucleus, Mitochondria, chloroplast
Structure of genetic material	Not membrane bound	Membrane bound
Chromosome	Typically 1, circular	> 1 linear
Proteins associated with chromosome	Histone like	Histones
Division type	Binary fission	Mitosis and Meiosis
Mole % G+C	28-73	Typically ~ 40
Cytoplasmic streaming	Absent	Present
Pinocytosis	Absent	Present
Mesosomes	Present	Absent
Ribosomes	70 S	80 S cytoplasm, 70 S mitochondria
Chloroplast	Absent	Present
Endoplasmic reticulum	Absent	Present
Membrane features	No sterols but hopanoids Contains electron transport systems and photosynthetic systems	Sterols
Wall features	Peptidoglycan	If present, cellulose or chitin
Flagella type (locomotion)	Rigid fibril, Gliding, never psuedopods	Microtubule, psuedopods

Detailed Discussion

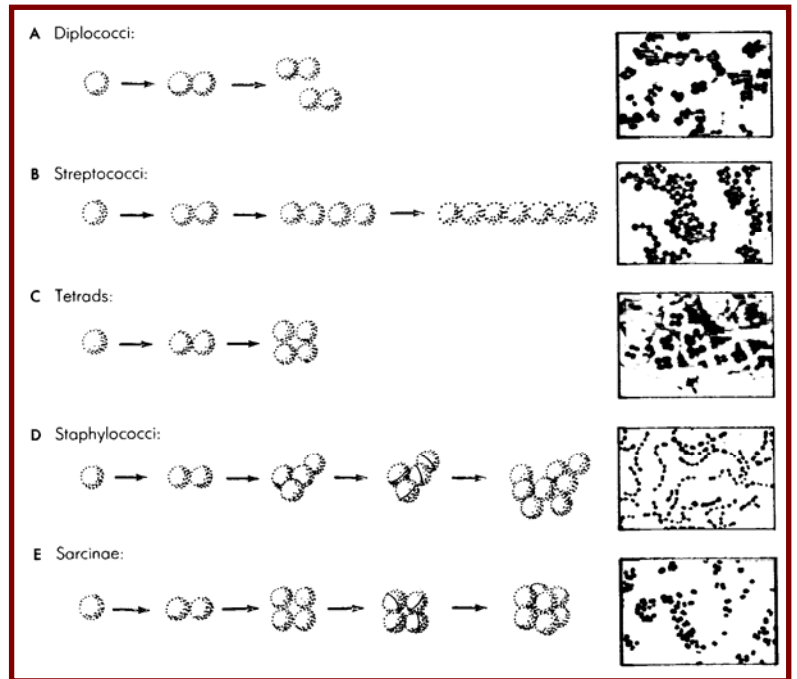
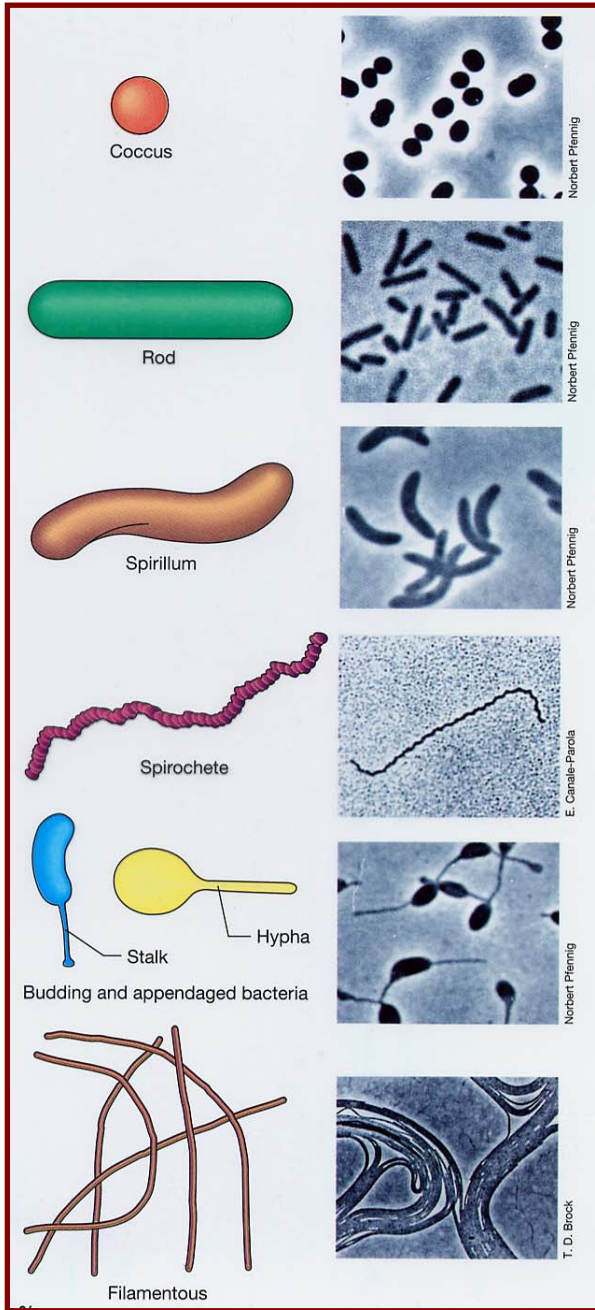
Types of Bacteria cells (Source of Figures to right: top; Madigan et al 2002, bottom;
<http://www.textbookofbacteriology.net/structure.html>)

- Gram Positive
- Gram Negative



Shapes of cells (Source of figures below: left; Madigan et al 2002; right; Pelczar et al. 1977)

- Coccus
 - Variation on the theme
- Rods
 - Variation on the theme
- Spirals
 - Variation on the theme
- Spirochetes
- Stalked

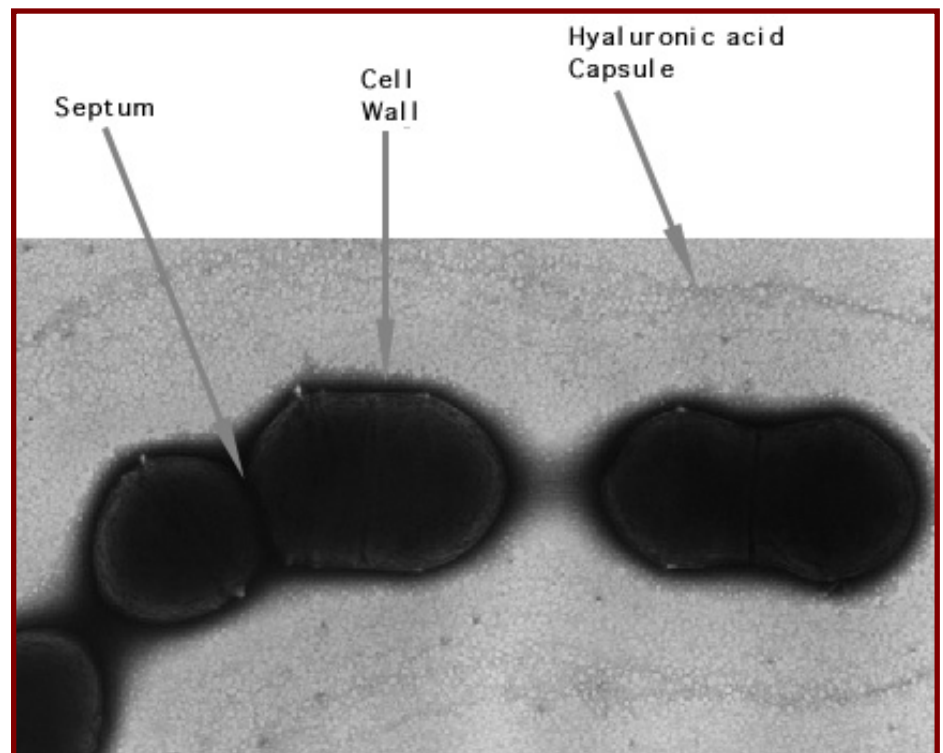
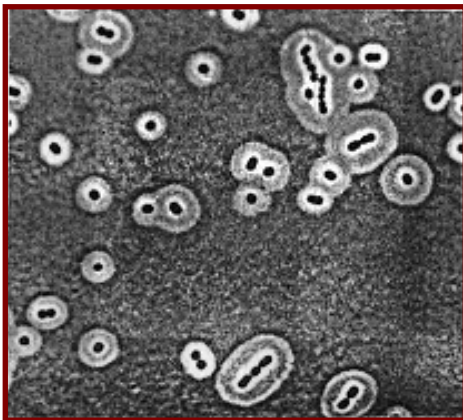


Cell surface structures (Source of figure to right: Madigan et al 2002)

- Fimbriae
 - Protein extensions from some cells (short)
 - Function uncertain but probably adhesion
- Pili
 - Long protein extensions from some cells
 - Ridged, brittle
 - Function in mating and adhesion

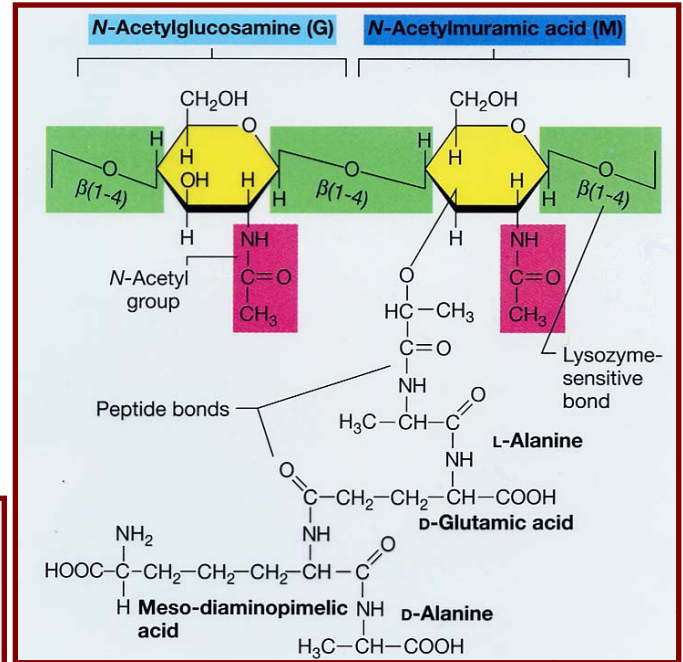
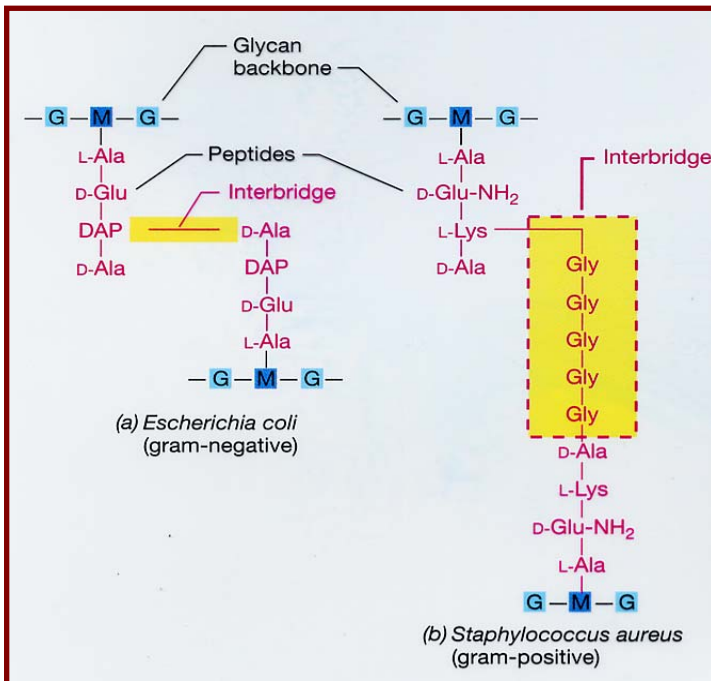
Capsules

- Slimy polysaccharide coat surrounding cells
 - Synonyms
 - Slime layer
 - Glycocalyx
 - Variable
 - Composition
 - Thickness
 - Consistency
 - Function
 - disease relationships
 - desiccation (Source of figures below:
<http://www.textbookofbacteriology.net/structure.html>)



Cell Walls

- Defined
 - Rigid polysaccharide-protein structure exterior to the cell membrane
 - Sugars
 - n-acetylmuramic acid
 - n-acetylglucosamine
 - linkage
 - Tetrapeptide descended chain
 - Cross linking

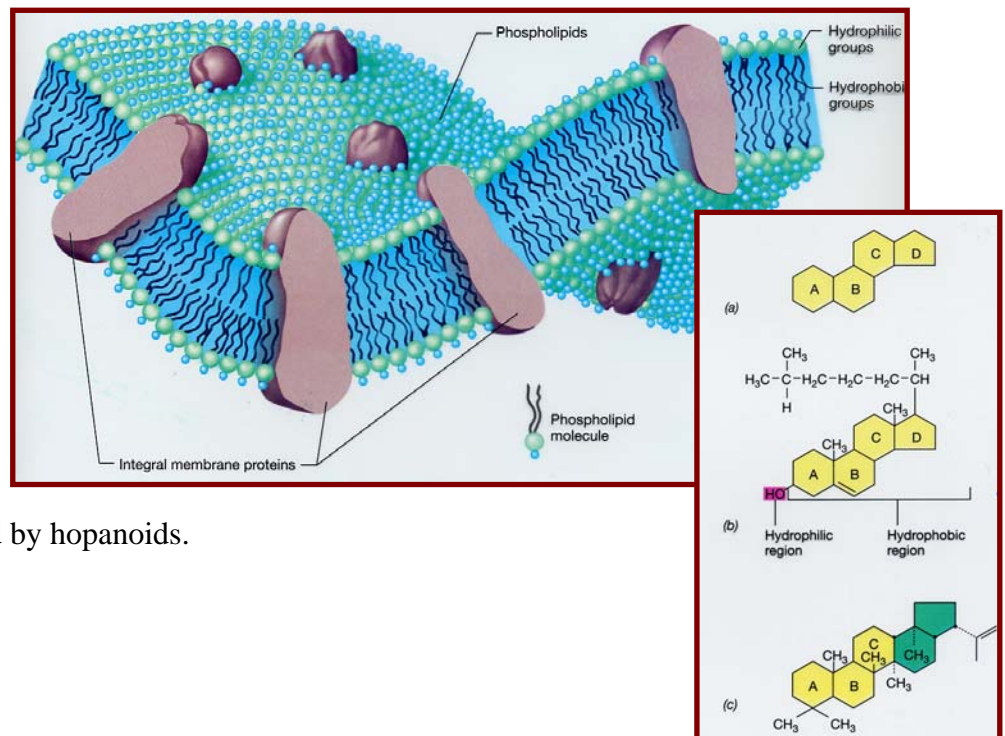


Source of figures: Madigan et al 2002

Cell Membranes

General description

- 4-5 nm thick
- Surrounds cell
- Selectively permeable
- A bilayer of phospholipids
- Sided-ness
- Impacted by proteins imbedded in the bilayer or residing at surfaces
- Additional stability and increased density imparted by hopanoids.



Function (Source of figures: Madigan et al 2002)

- Permeability barrier
 - Passive movement of polar solutes does not readily occur
 - Small non-polar and lipid soluble molecules may traverse the barrier
 - Charge molecules must be transported across the barrier
- Transport
 - Review
 - Diffusion and why it is a problem for cells
 - Difference between diffusion and osmosis
 - What is Transport
 - Transport proteins
 - Characteristics
 - Some may be channel forming
 - Highly specific
 - For specific molecules
 - For class of molecules
 - Action of
 - Simple transport
 - Group Translocation
 - ABC transporters
 - Role of binding proteins
 - Gram positive
 - Periplasmic in gram negative

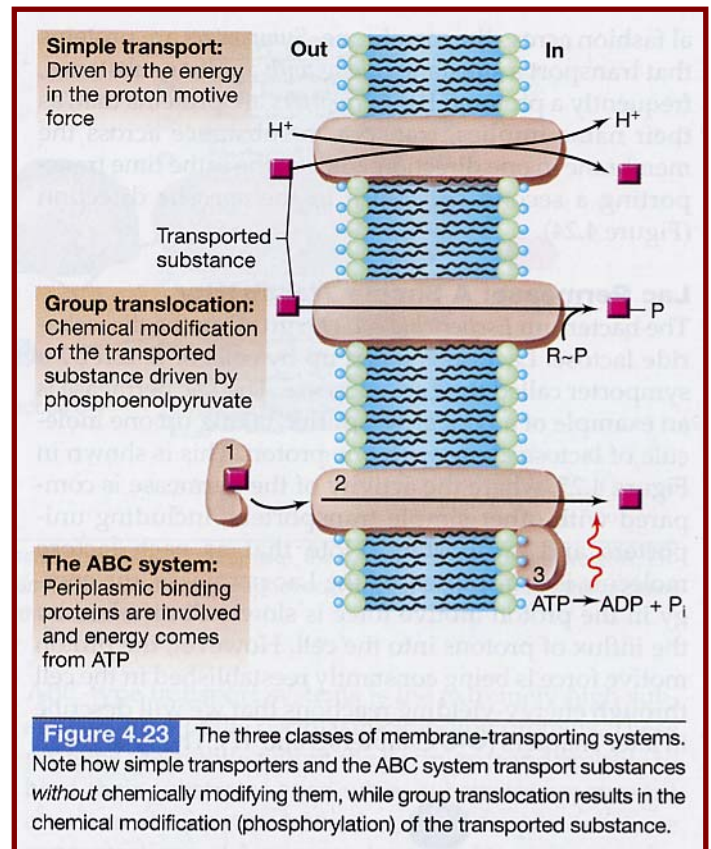
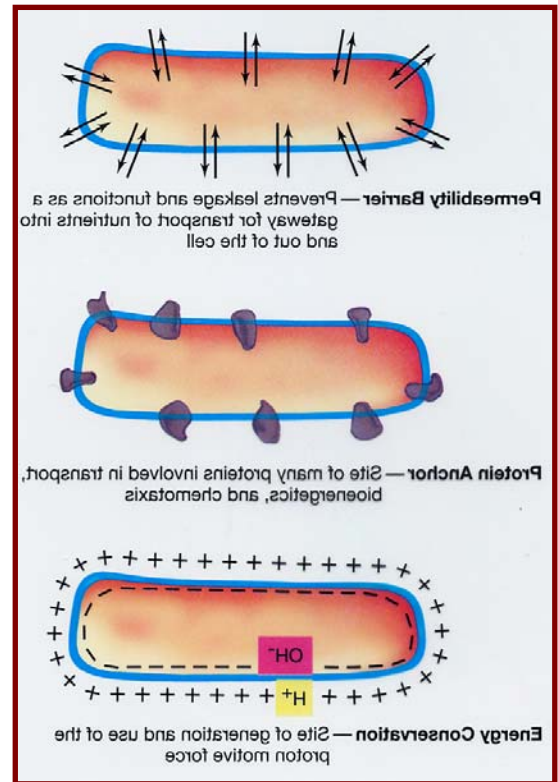
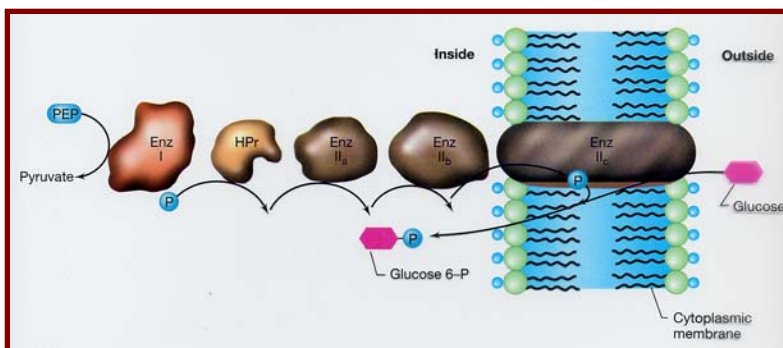


Figure 4.23 The three classes of membrane-transporting systems. Note how simple transporters and the ABC system transport substances *without* chemically modifying them, while group translocation results in the chemical modification (phosphorylation) of the transported substance.



- Classes
 - Uniporters
 - Symporters
 - Antiporters

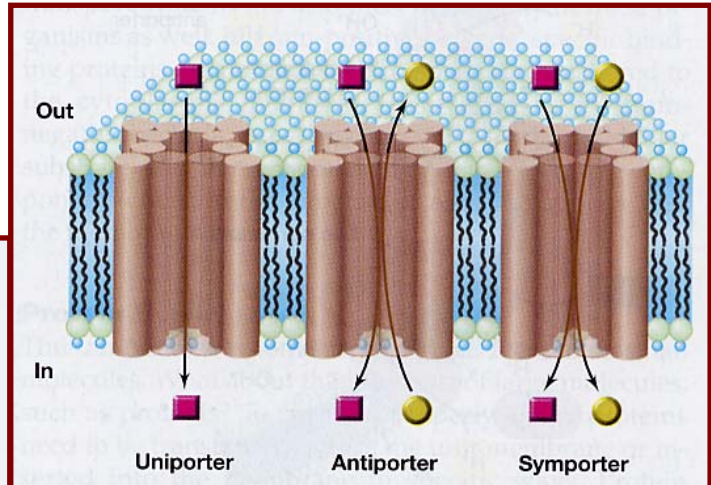
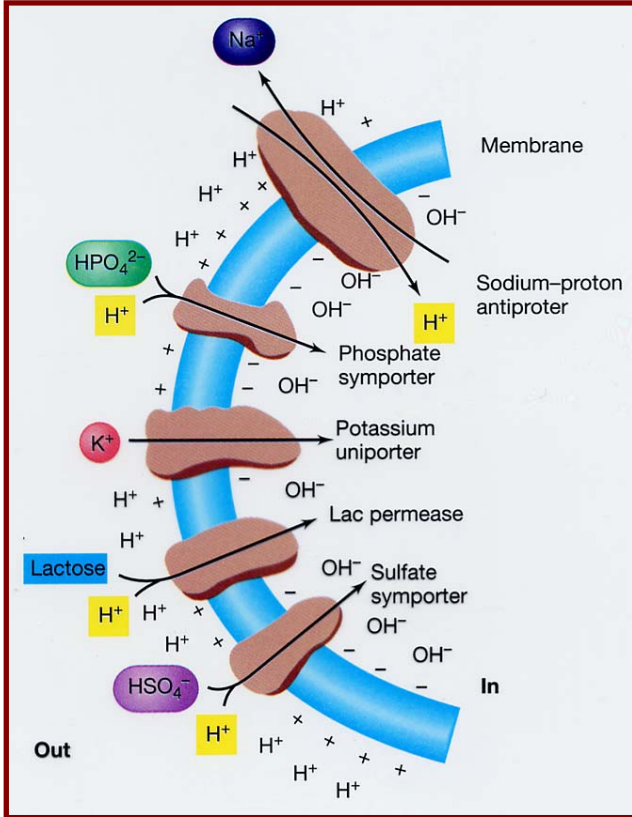
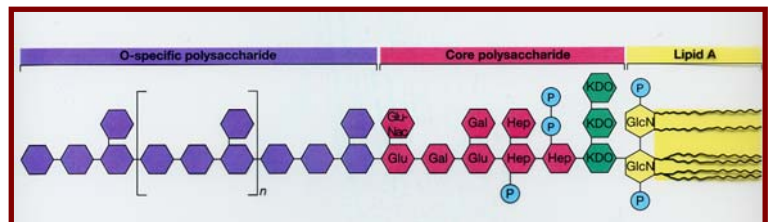
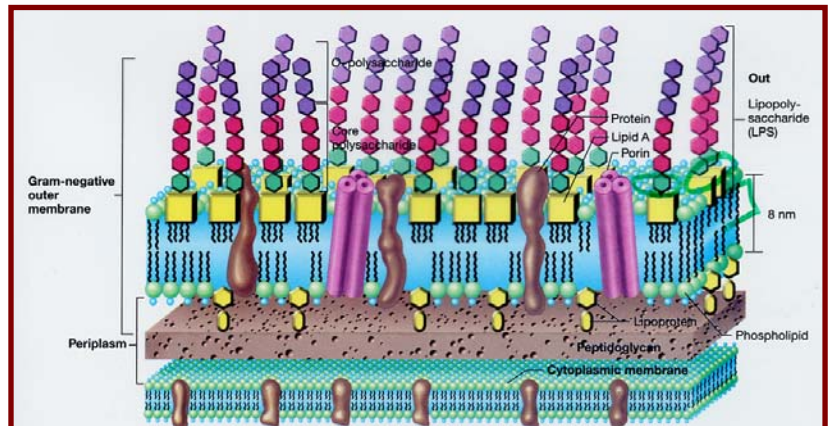


Figure 4.24 Structure of membrane-spanning transporters and types of transport events. In prokaryotes, membrane-spanning transporters typically contain 12 alpha helices that align with each other in a circle to form a channel through the membrane. Shown here are three individual transporters, each showing a different type of transport event. For antiporters and symporters, the cotransported molecule is shown in yellow.

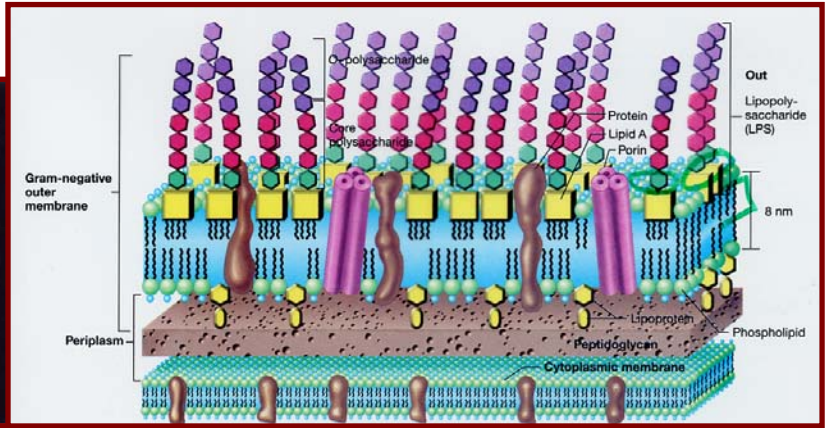
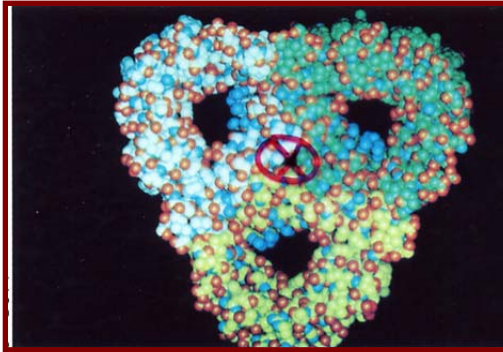
(Source of figures: Madigan et al. 2002)

Outer membrane of Gram Negative Cells

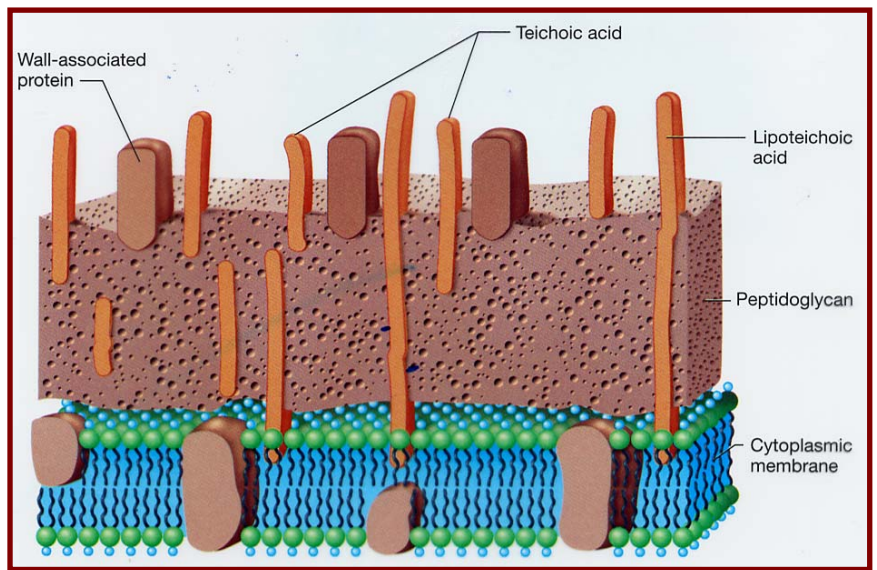
- Lipid bilayer very similar to cell membrane
- Outer half of the the membrane is not phospholipid but Lipopolysaccharide (LPS)
- Composition of LPS
 - Species specific
 - 3 distinct regions
 - lipid A (highly esterified n-acetyl glucosamine)
 - core polysaccharide
 - o-specific side chains



- Permeability aspects
 - Porins



- Lipoproteins
 - Anchor the outer membrane to the cell wall



Other issues in cells walls

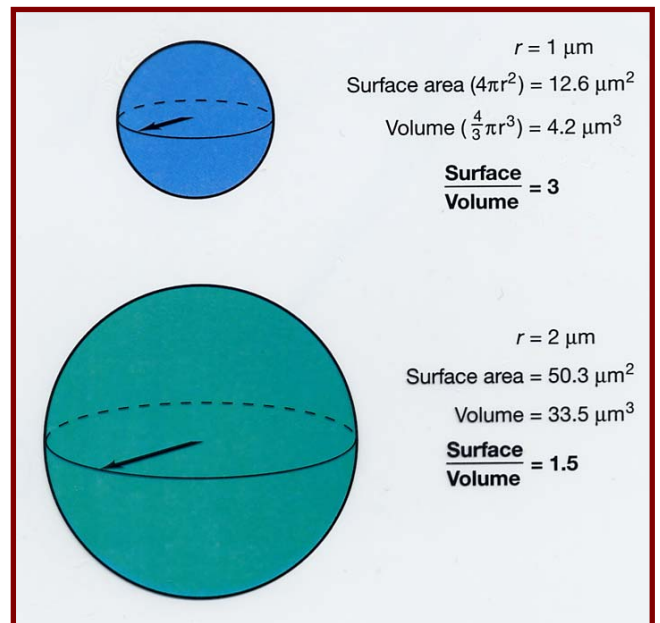
- Teichoic acids in Gram Positives

Why are cells so small?

Review area – volume relationships

- Area = $4 \pi r^2$
- Volume = $\frac{4}{3} \pi r^3$
- So...what happens to the volume of the cell as the ratio increases? And the surface area? Where are the transport proteins?

(Source of figures: Madigan et al. 2002)



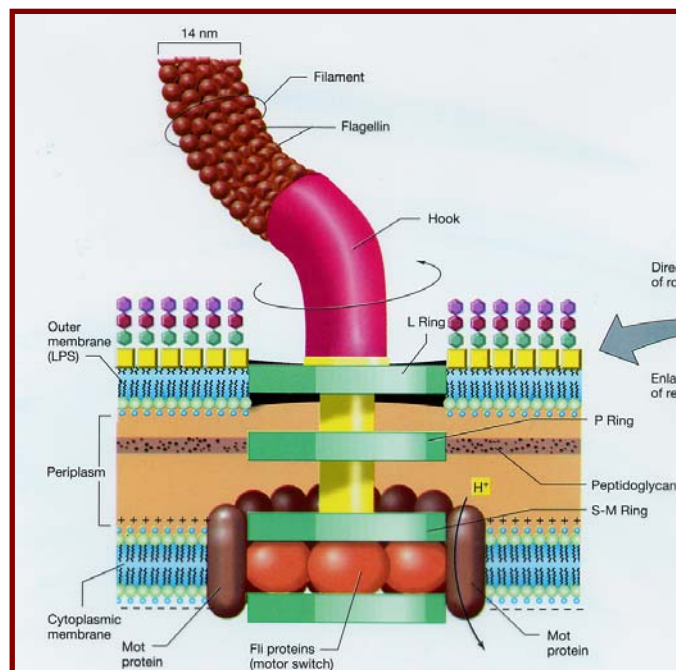
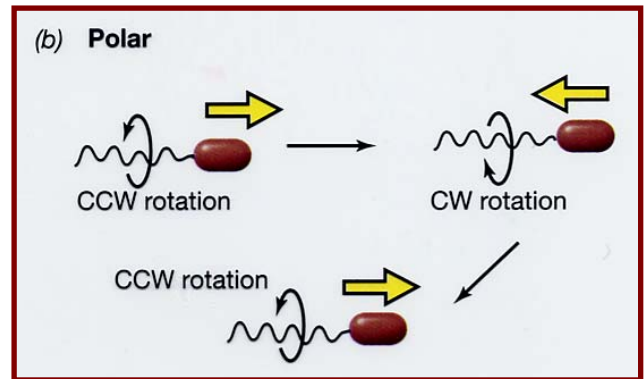
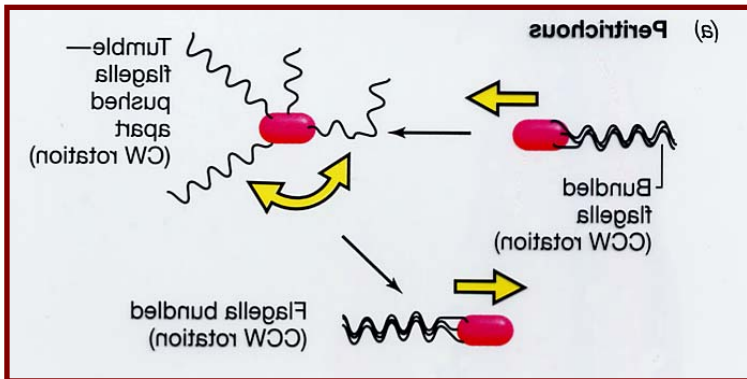
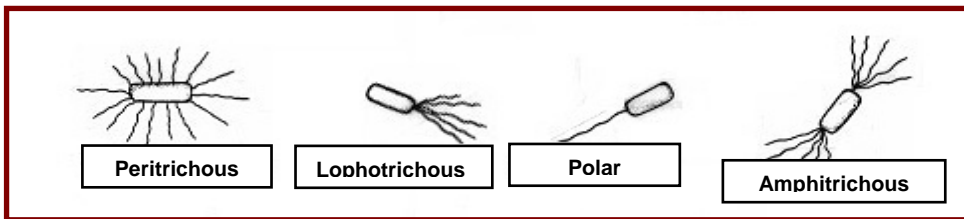
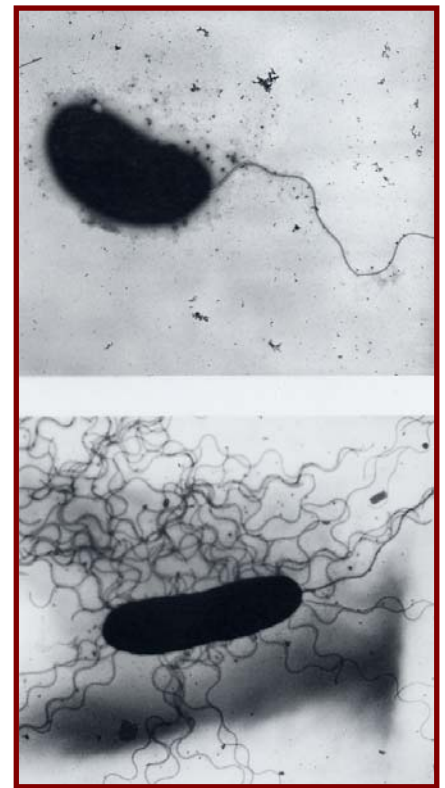
Motility

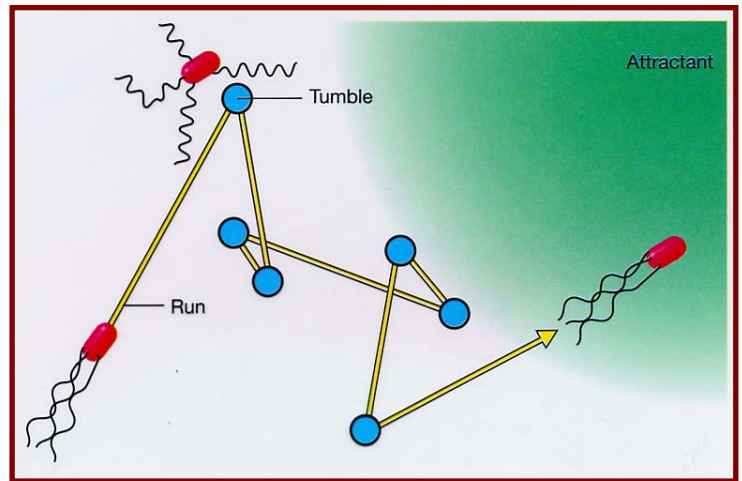
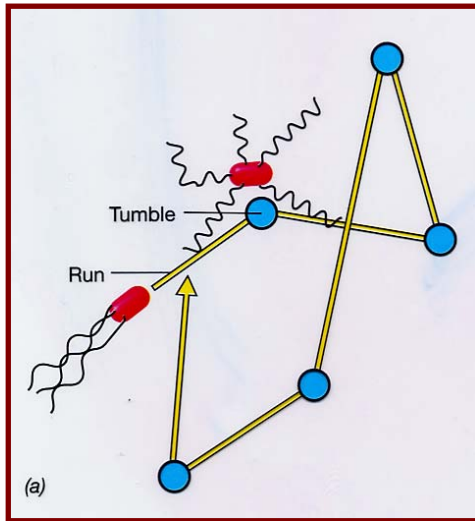
Mechanisms

- Flagella (Source of figure to right: Madigan et al. 2002)
- Gliding
- Gas vacuoles

Flagella

- Description
 - Long, thin rigid hollow
 - Composed of protein (flagellin)
- Orientation of flagella (Source of figure below: <http://www.textbookofbacteriology.net/structure.html>)
- Structure
- Nature of rotation and chemotaxis (Source of figure to right: Madigan et al. 2002)

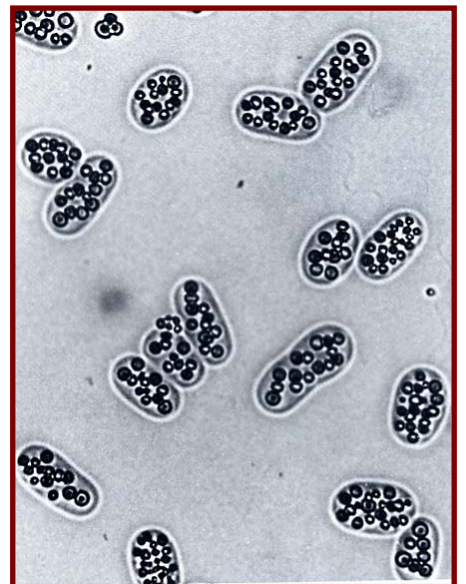
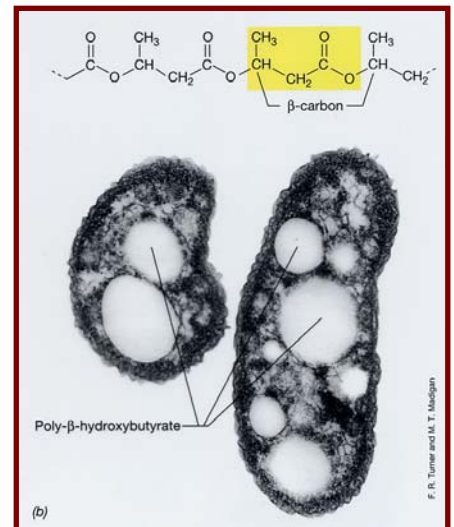




Other inclusions in cells

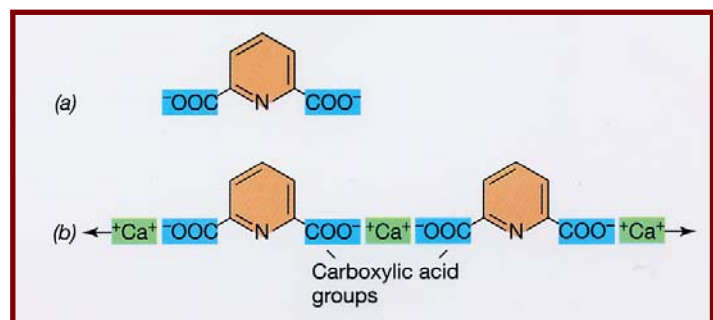
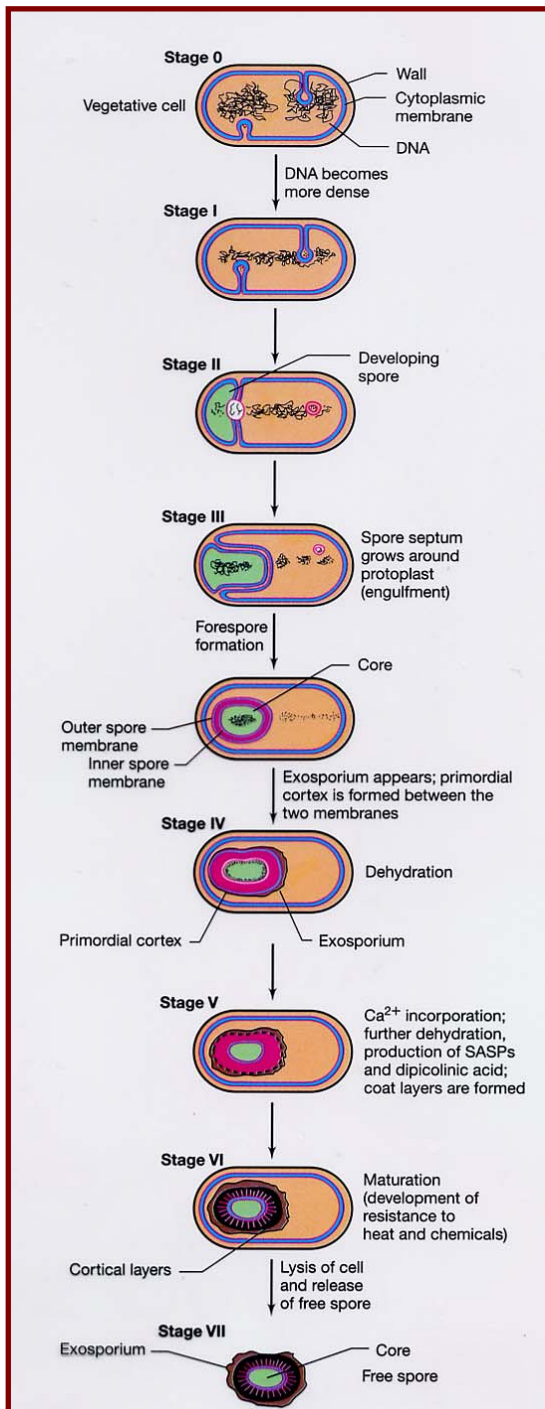
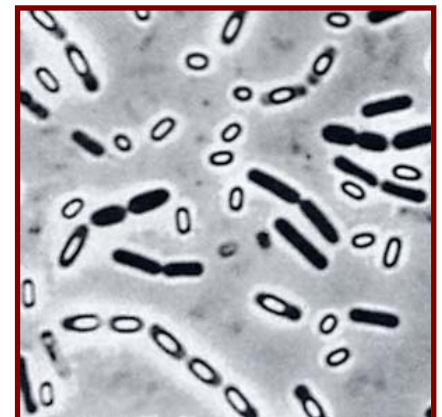
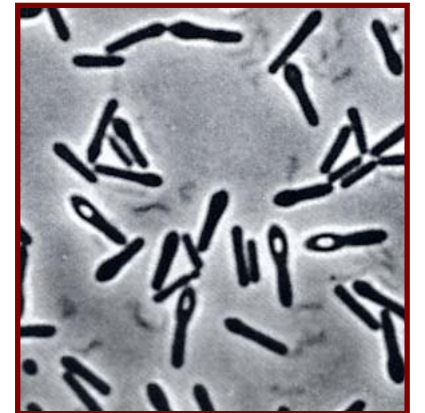
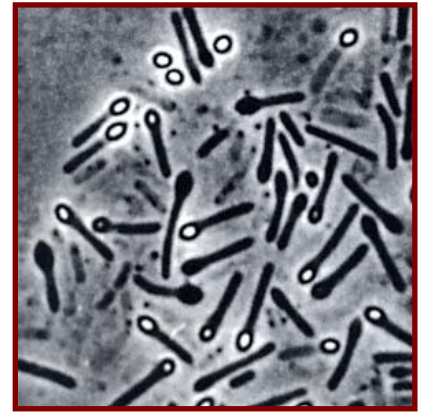
Storage products (Source of figures to right: Madigan et al. 2002)

- Function as energy reserves or structural building blocks
 - Lipid forms
 - Poly betahydroxybutyric acid
 - Carbohydrate forms
 - Glycogen
 - Phosphate
 - Polyphosphates (volutin or metachromatic granules)
 - Sulfur
 - Gas Vesicles
 - Found in some aquatic organisms
 - Constructed of protein, hollow hydrophobic



Endospores

- A survival mechanism (Source of figures: Madigan et al. 2002)
 - Review survival vs. reproduction
- Not produced by all cells
 - Feature of some gram positives and some archaeobacteria
- Features
 - No obvious metabolic signs of life
 - Excellent resistance to thermal stress
 - Excellent resistance to dessication (dipicolinic acid)
 - How long can one survive?



References:

Madigan, M.T., J.M. Martinko, and J. Parker. 2002. Brock Biology of Microorganisms, 10th ed. Prentice Hall.

Pelczar, M.J., R.D. Reid and E.C.S. Chan. 1977. Microbiology. McGraw-Hill. New York.

Prescott, L.M., J.P. Harley, and D.A. Klein. 1993. Microbiology 2nd ed. Wm C.Brown, Dubuque.