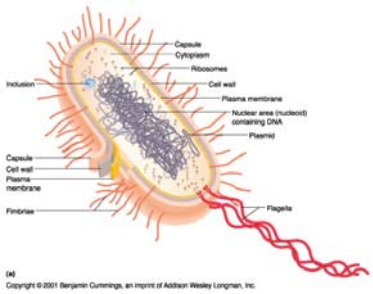
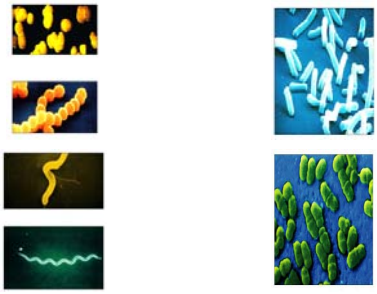
PROKARYOTIC	EUKARYOTIC
• One circular chromosome, not in a membrane • No histones • No organelles • Peptidoglycan cell walls • Binary fission	• Paired chromosomes, in nuclear membrane • Histones • Organelles • Polysaccharide cell walls • Mitotic spindle

Bacterial Structures



Average size: 0.2 -1.0 µm × 2 - 8 µm
Basic shapes:



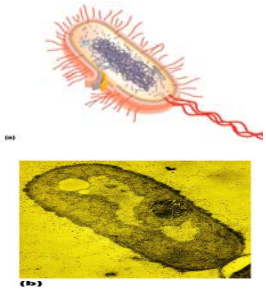
Capsule or Glycocalyx

Outermost layer

Polysaccharide or polypeptide

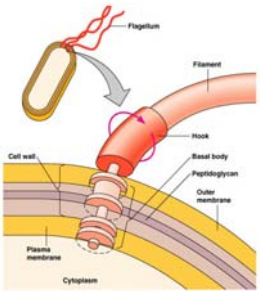
Allows cells to adhere to a surface

Contributes to bacterial virulence- avoid phagocytosis

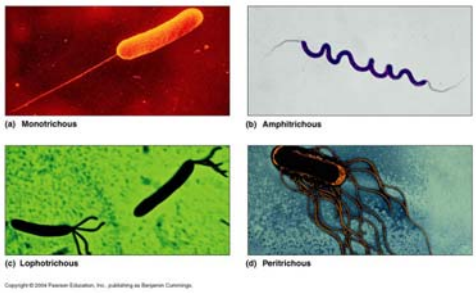


FLAGELLA

- Outside cell wall
- Made of chains of flagellin
- Attached to a protein hook
- Anchored to the wall and membrane by the basal body

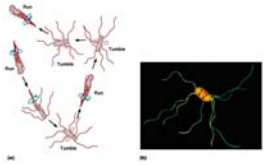


TYPES OF FLAGELLA



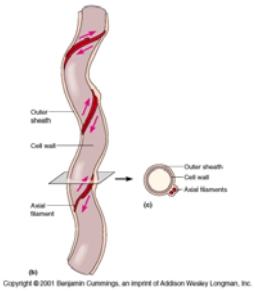
MOTILE CELLS

- Rotate flagella to run or tumble
- Move toward or away from stimuli (taxis)
- Flagella proteins are H antigens (e.g., *E. coli* O157:H7)



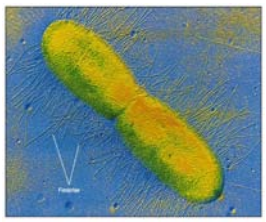
AXIAL FILAMENT

- Endoflagella
- In spirochetes
- Anchored at one end of a cell
- Rotation causes cell to move



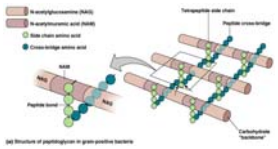
FIMBRIAE AND PILI

- **FIMBRIAE**: Consist of the protein pilin
- Used for attachment
- **Pili**: longer than fimbriae
- used for gene transfer; DNA transfer from one cell to another



CELL WALL PEPTIDOGLYCAN

- Polymer of disaccharide N-acetylglucosamine (NAG) & N-acetylmuramic acid (NAM)
- Peptide cross links to form lattice



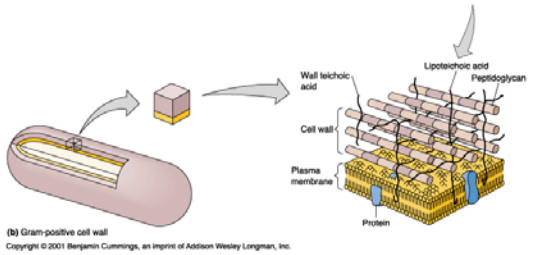
Cell Walls

GRAM POSITIVE	GRAM NEGATIVE
• Thick peptidoglycan	• Thin peptidoglycan
• Teichoic acids	• No teichoic acids
	• Outer membrane

GRAM POSITIVE CELL WALLS

- Teichoic acids:
  - Lipoteichoic acid links to plasma membrane
  - Wall teichoic acid links to peptidoglycan
- May regulate movement of cations
- Polysaccharides provide antigenic variation

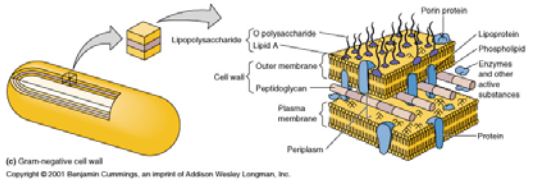
GRAM POSITIVE



GRAM NEGATIVE

- One (few) layers of peptidoglycan bonded with
- Lipopolysaccharides, lipoproteins, phospholipids in outer membrane
- Periplasm between the outer membrane and the plasma membrane.
- Protection from phagocytes, complement, antibiotics.
- O polysaccharide antigen, e.g., *E. coli* O157:H7.
- Lipid A is an endotoxin.
- Porins (proteins) form channels through membrane

GRAM NEGATIVE CELL WALL



GRAM STAIN MECHANISM

- Crystal violet-iodine crystals form in cell
- Gram-positive
  - Alcohol dehydrates peptidoglycan
  - CV-I crystals do not leave
- Gram-negative
  - Alcohol dissolves outer membrane and leaves holes in peptidoglycan
  - CV-I washes out

ATYPHICAL

Acid Fast Mycobacteria: Cell wall is 60% Mycolic acid (waxy lipid) and peptidoglycan

Mycoplasma

smallest known bacteria/no cell wall

sterols in plasma membrane

Archaea

- Wall-less, or
- Walls of pseudomurein
- No peptidoglycan

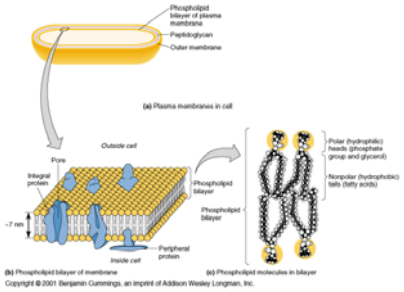
CELL WALL DAMAGE

- Lysozyme digests disaccharide in peptidoglycan.
- Penicillin inhibits peptide bridges in peptidoglycan.
- Protoplast is a wall-less cell.
- Spheroplast is a wall-less Gram-negative cell.
- L forms are wall-less cells that swell into irregular shapes.
- Protoplasts and spheroplasts are susceptible to osmotic lysis.

Plasma Membrane

- Phospholipid bilayer
- Peripheral proteins; integral proteins; transmembrane proteins
- Selective Permeability (semi-permeable)
- Enzymes for ATP production
- Photosynthetic pigments (chromatophores or thylakoids) in folds of membrane
- Damage to the membrane by alcohols, quaternary ammonium (detergents) and polymyxin antibiotics causes leakage of cell contents.

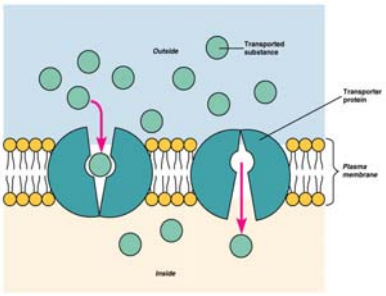
Plasma Membrane



MOVEMENT ACROSS THE MEMBRANE PASSIVE TRANSPORT

- No ATP required
- Movement along a concentration gradient
- Simple diffusion: Movement of a solute from an area of high concentration to an area of low concentration.
- Facilitative diffusion: Solute combines with a transporter protein in the membrane.

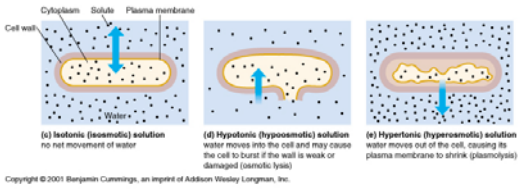
FACILITATED DIFFUSION



OSMOSIS

- Osmosis
  - Movement of water across a selectively permeable membrane from an area of high water concentration to an area of lower water.
- Osmotic pressure
  - The pressure needed to stop the movement of water across the membrane.

OSMOSIS



ACTIVE TRANSPORT

- Transport that requires use of ATP
- Movement is against a concentration gradient
- Active transport of substances requires a transporter protein in plasma membrane and requires ATP. Substance transported across not altered.

ACTIVE TRANSPORT

- Group translocation of substances requires a transporter protein and PEP (a high energy phosphate complex). Substance transported is altered. (eg. Phosphate is added to glucose and phosphorylated glucose cannot be transported back out of cell)
- Proton motive force: High concentration of H+ outside of membrane accumulates during metabolism and can be used to transport substances.

CYTOPLASM

- Cytoplasm is the substance inside the plasma membrane
- 80% water with proteins, enzymes, carbohydrates, lipids, ions.

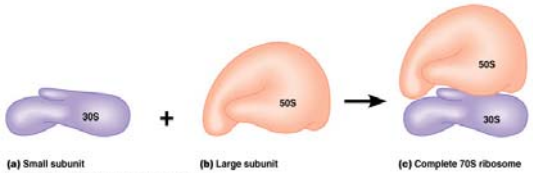
NUCLEAR MATERIAL

- Bacterial chromosome is single, long, continuous, circular, double-stranded DNA
- Plasmid:
  - small circular extrachromosomal DNA
  - Replicates independently
  - Carries genes not crucial for survival

RIBOSOMES

- Site of protein synthesis
- 2 subunits with ribosomal RNA (rRNA):
  - 30S + 50S → 70S
- Eukaryotic cells have 80S ribosomes
  - Site of selective toxicity

PROKARYOTIC RIBOSOMES

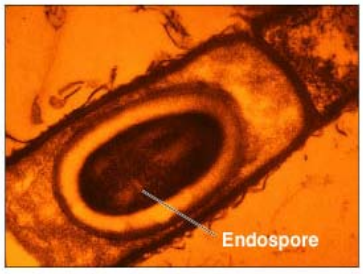


INCLUSIONS

- Metachromatic granules (volutin): phosphate reserves
- Polysaccharide granules: energy reserves
- Lipid inclusions: energy reserves
- Sulfur granules: energy reserves
- Carboxysomes: for CO_2 fixation
- Gas vacuoles
- Magnetosomes: Iron oxide (destroys H_2O_2)

ENDOSPORES

- Resting cells
- Resistant to desiccation, heat, chemicals
- *Bacillus, Clostridium*
- Sporulation: Endospore formation
- Germination: Return to vegetative state



ENDOSPORE FORMATION