The outer membrane

The Gram-negative cell wall is composed of an outer membrane, a peptidoglygan layer, and a periplasm.

The outer membrane of Gram-negative bacteria is a bilayer membrane acts as **a protective barrier and excludes many toxic compounds.**

The outer membrane is composed of phospholipids, lipoproteins, lipopolysaccharides (LPS), and proteins.

Lipopolysaccharides (LPS), also known as **endotoxins** and **lipoglycans** act as **virulence factor** and causes disease in animals.

The LPS are large molecules consisting of three parts; two of them are medically significant:-

1. Lipid A: embedded in membrane, this portion is also referred as an endotoxin since it is a toxic to a host.

2. Core Oligosaccharide (glycoside part): located on the surface of membrane. Is highly- charged (negative charge).

3. O antigen (or O polysaccharide): which are short polysaccharides extended out from core. This O-antigen portion is the primary site of gram negative bacteria, recognized by antibodies. The variability of the O-antigen chain can cause problems with the immune response.

Porins: are barrel proteins form channels (pores) through both sides of the outer membrane of gram-negative bacteria, through which molecules can diffuse.

Periplasm: The region between the cytoplasmic membrane and the outer membrane is filled with a gel-like fluid called periplasm**.** The periplasm consists of **the peptidoglycan, proteins** (that are involved in various cellular activities, including nutrient degradation and transport), and metabolites found in the periplasmic space.

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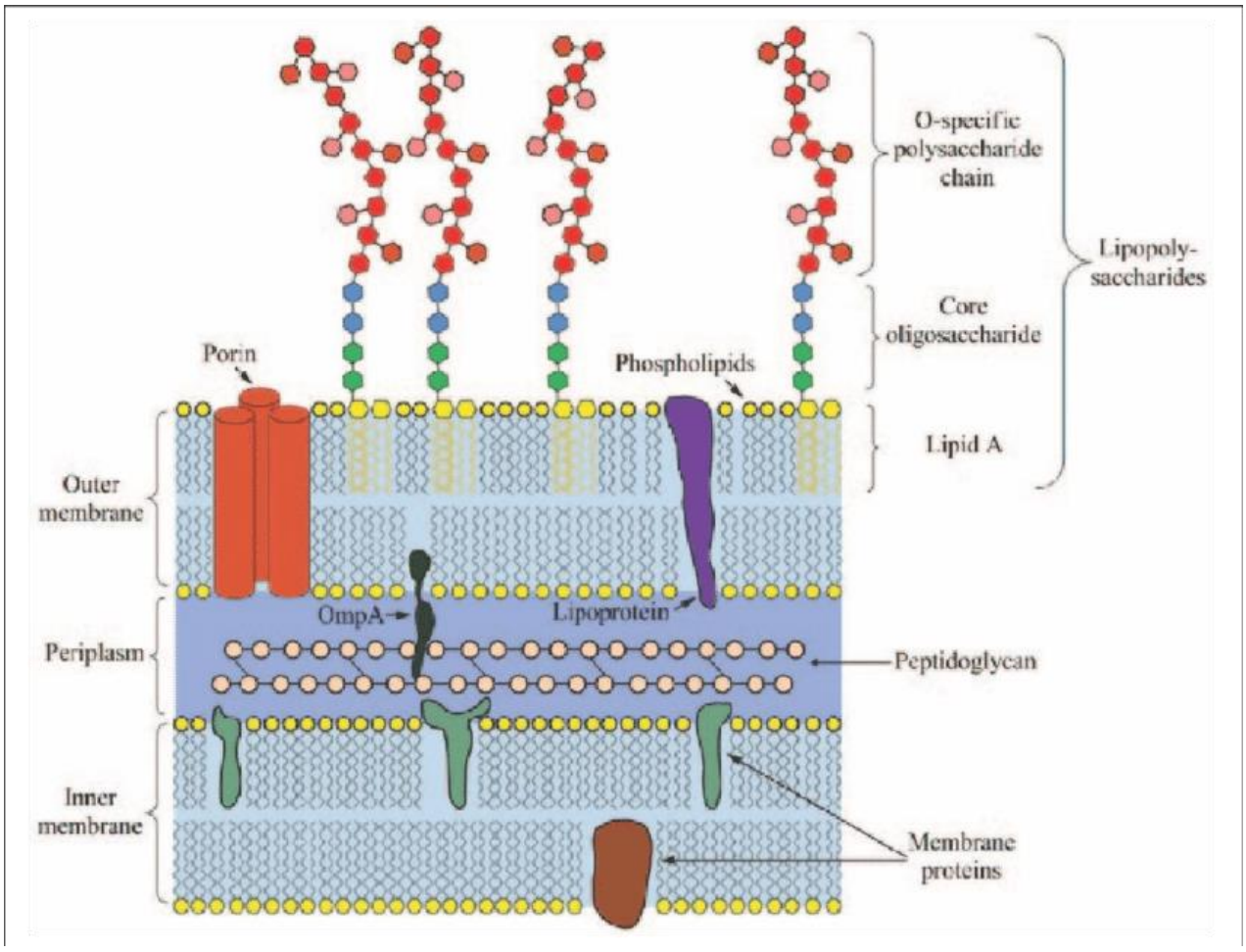
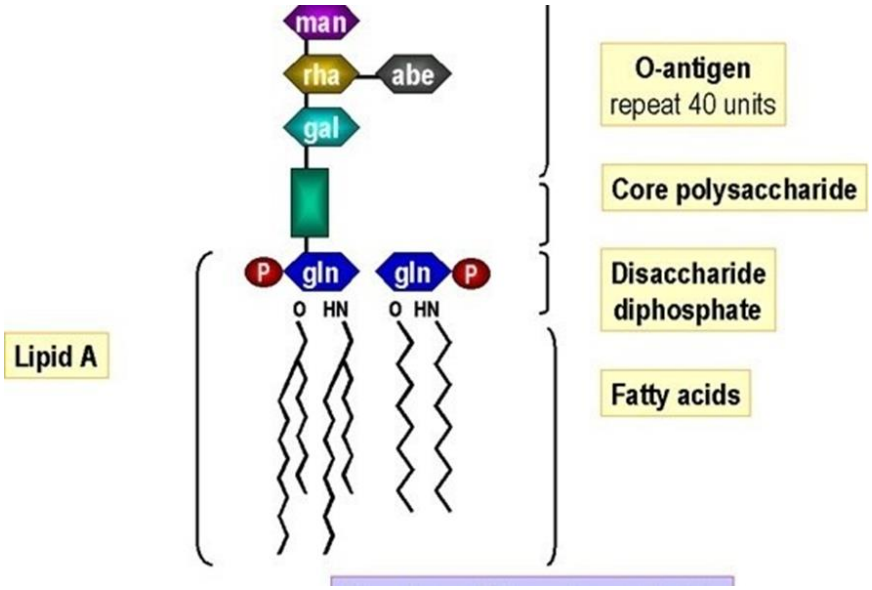


The outer and inner membranes of Gram-negative bacteria



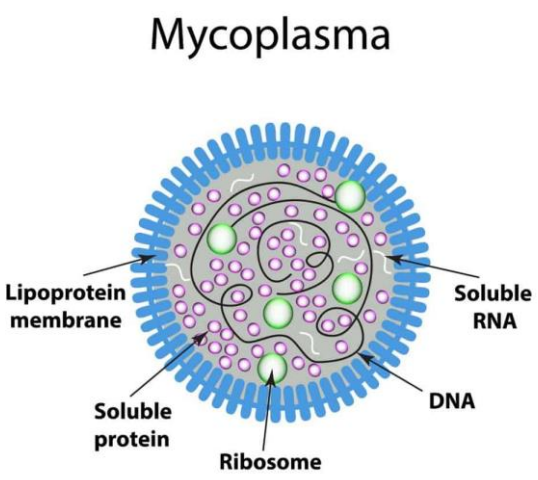
Chemical structure of lipopolysaccharides

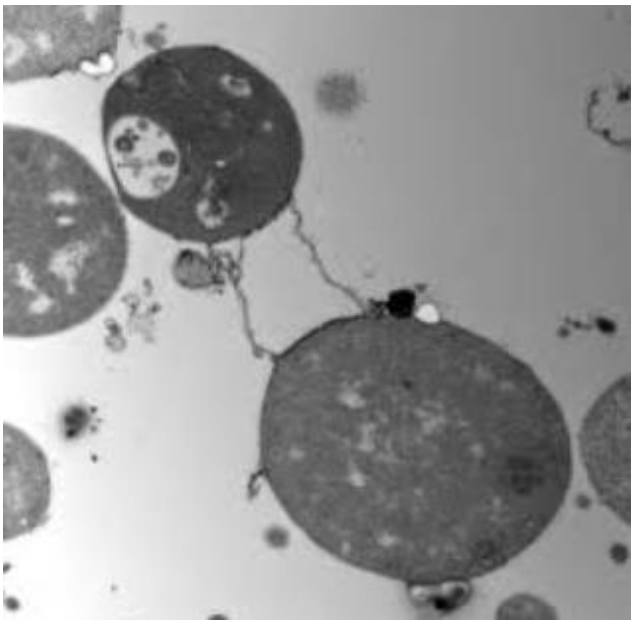
Cell-Wall-Deficient Bacteria (Bacteria without cell wall)

Some bacteria lack a cell wall but retain their ability to survive by living inside another host cell like **Mycoplasma species.**

Mycoplasma is a genus of bacteria that lack a cell wall around their cell membranes. This characteristic makes them naturally resistant to antibiotics that target cell wall synthesis (like the beta-lactam antibiotics). They can be **parasitic or saprotrophic**. Several species are pathogenic in humans. Mycoplasma species are the smallest bacterial cells yet discovered, can survive without oxygen, and come in various shapes.

ملاحظة :الشكل للاطلاع فقط





L-form bacterial lack a cell wall structure

Other bacterial species occasionally mutate or respond to extreme nutritional conditions by forming cells lacking walls, termed **L-forms (also known as Sam Cannon, L-phase variants, and cell wall-deficient (CWD) bacteria)**. This phenomenon is observed in both gram-positive and gram-negative species.

*Mycoplasma are not considered L-forms since they are not derived from bacteria that normally have cell walls.

Cell Walls of Archaea (singular archaeon)

Archaeal cell walls differ from bacterial cell walls in their chemical composition and lack of peptidoglycans. Archaeal cell walls are composed of different polysaccharides and proteins, with no peptidoglycan. Many archaea have cell walls made of the polysaccharide pseudomurein.

The most striking chemical differences between Archaea and other living things lie in their cell membrane. There are four fundamental differences between the archaeal membrane and those of all other cells: **(1) chirality of glycerol, (2) ether linkage, (3) isoprenoid chains, and (4) branching of side chains.**

Cluster of *Halobacterium* (archaea)

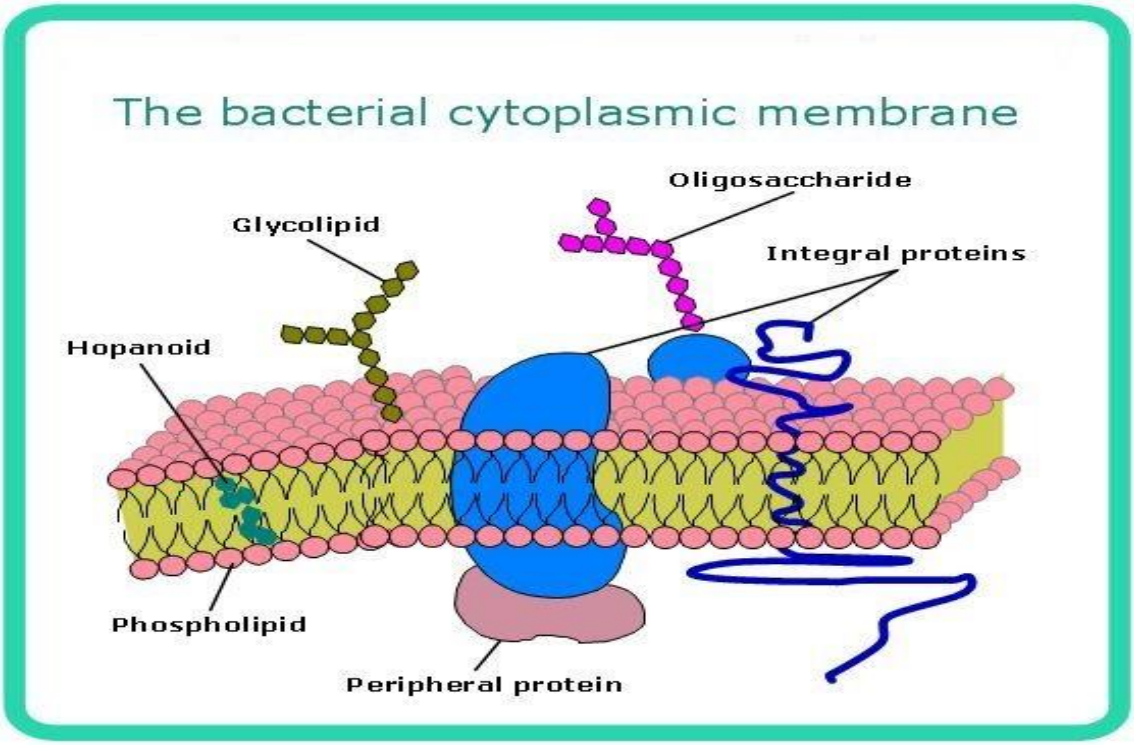
The cell membrane

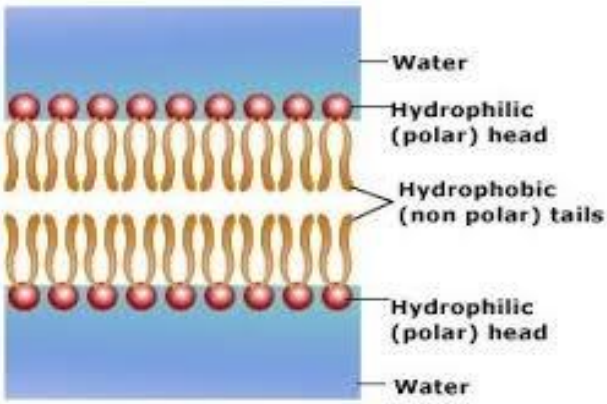
The cell membrane (also known as the plasma membrane (PM) or cytoplasmic membrane) is a biological membrane that separates the interior of all cells from the outside environment.

Plasma Membrane Composed of:-

- Phospholipid bilayer asymmetric (the phosphate group called the “head” is negatively charged, making the head polar and hydrophilic, or “water loving” and the lipid called the “tails. ” nonpolar, and hydrophobic, or “water fearing”).
- Protein molecules (integral proteins & peripheral proteins).

- Hopanoids - embedded in bilayer (Sterol-like (similar to cholesterol) which stabilize membrane. ملاحظة: الشكل للاطلاع فقط





Plasma membrane functions:-

1- Separates cell from the outside environment.
2- Selectively permeable barrier.
3- Captures energy as ATP.
4- Location of metabolic reactions.
5- Synthesizes cell wall components and DNA.
6- Responds to chemical substances in the environment (Chemotaxis).

Internal Structure

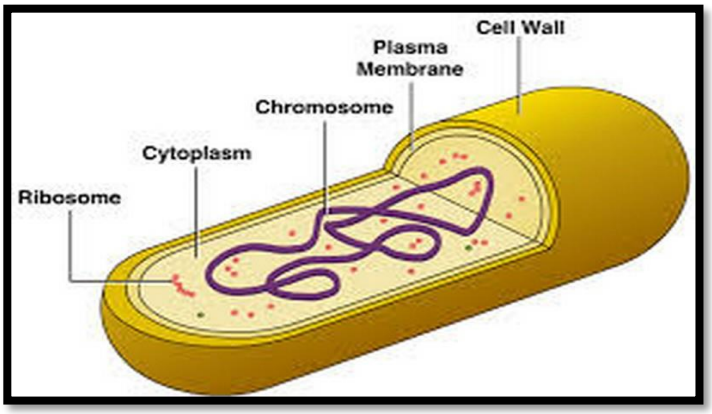
1- Cytoplasm

The cytoplasm, or protoplasm, of bacterial cells is where the functions for cell growth, metabolism, and replication are carried out. It is a gel-like matrix composed of water, enzymes, nutrients, wastes, and gases and contains cell structures such as ribosomes, a chromosome, and plasmids. The cell envelope encases the cytoplasm and all its components.

2- Ribosomes

Ribosomes are microscopic "factories" found in all cells, including bacteria. They are composed of a complex of protein and RNA, and are the site of protein synthesis in the cell.. Bacterial ribosomes are similar eukaryotes ribosomes (80S), but are smaller (70S) and have a slightly different composition and molecular structure. They are never bound to other organelles as in eukaryotes, but are free structures in the cytoplasm. There are sufficient differences between bacterial ribosomes and eukaryotic ribosomes that some antibiotics will inhibit the functioning of bacterial ribosomes, but not a eukaryote's, thus killing bacteria but not the eukaryotic organisms they are infecting.

S = the Svedberg unit (Symbol S or Sv): is a measure of the sedimentation rate of a particle when centrifuged.



Composition of bacterial cell

3- Inclusions and granules

- Intracellular storage bodies within the cytoplasm of certain bacteria act as food reserves.
- Vary in size, number, and content
- Bacterial cell can use them when environmental sources are depleted.

Examples:

- **Glycogen granules:** storage of glucose polymers (starch).
- **Gas vesicles:** provide buoyancy (floatation) in aquatic environment.
- **Magnetosomes:** Particles of iron oxide (magnetite), Provide orientation in magnetic field.
- **Volutin granules (or metachromatic granules):** a storage form for inorganic phosphate and energy.
- **Poly β-hydroxybutyrate (PHB):** For lipid storage.

الاشكال للاطلاع فقط