

Bacterial Cell Structure ۲

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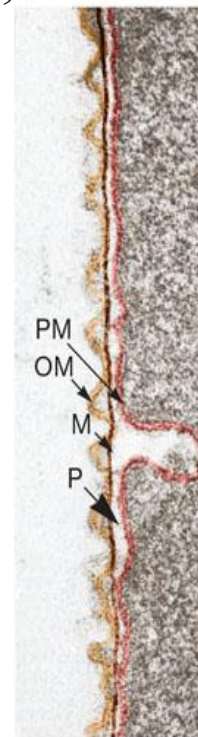
Dr. Hiyam Adil Altaii

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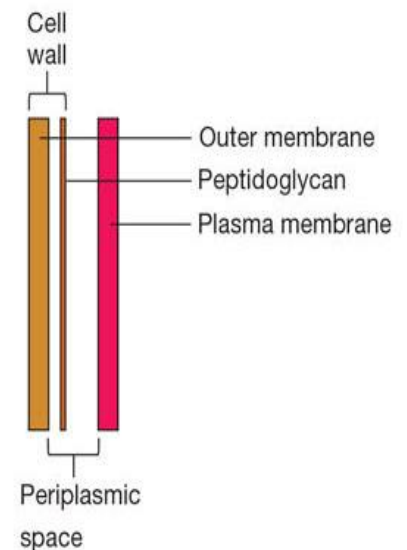
Gram-Negative Cell Walls

- More complex than Gram- positive
- Consist of a thin layer of peptidoglycan surrounded by an outer membrane
- Outer membrane composed of lipids, lipoproteins, and lipopolysaccharide (LPS)
- No teichoic acids

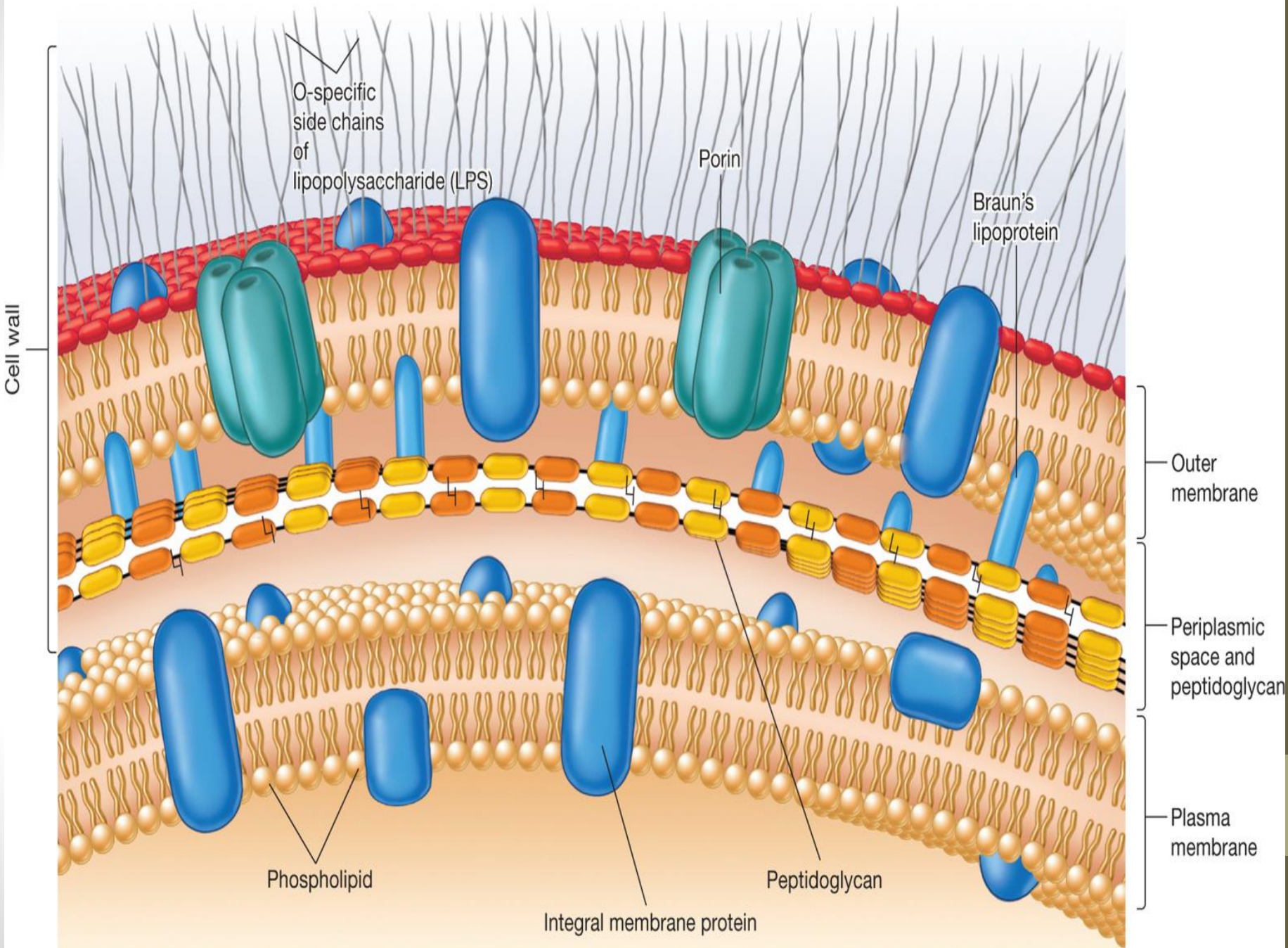
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The typical Gram-negative cell envelope



- Peptidoglycan is ~5-10% of cell wall weight
- Periplasmic space differs from that in Gram-positive cells
 - may constitute 2-4% of cell volume
 - many enzymes present in periplasm
- hydrolytic enzymes, transport proteins and other protein
- outer membrane lies outside the thin peptidoglycan layer
- Braun's lipoproteins connect outer membrane to peptidoglycan
- other adhesion sites reported



Lipopolysaccharide (LPS)

Consists of three parts:

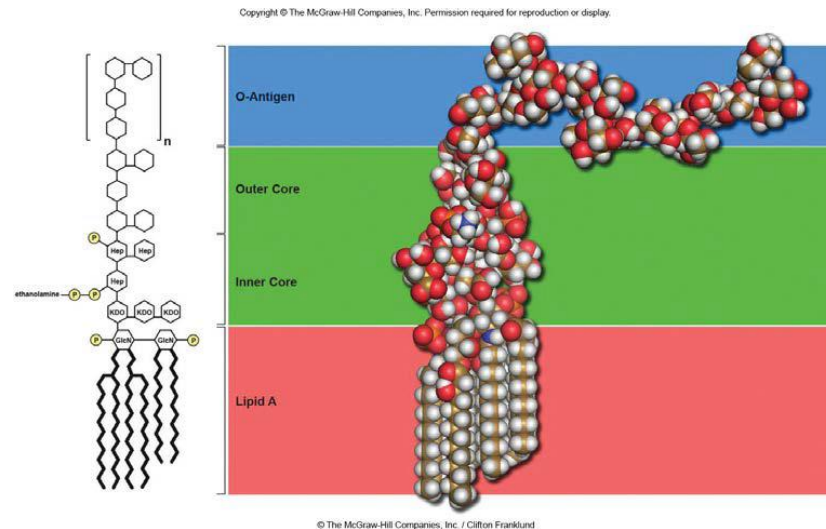
-lipid A

-core polysaccharide

-O side chain (O antigen)

- Lipid A embedded in outer membrane

- Core polysaccharide, O side chain extend out from the cell



Characteristics of LPS

- contributes to negative charge on cell surface
- helps stabilize outer membrane structure
- may contribute to attachment to surfaces and biofilm formation
- creates a permeability barrier
 - More permeable than plasma membrane due to presence of porin proteins and transporter proteins
- protection from host defenses (O antigen)
- can act as an endotoxin (lipid A)

Mechanism of Gram Stain Reaction

- Gram stain reaction due to nature of cell wall
- shrinkage of the pores of peptidoglycan layer of Gram-positive cells

constriction prevents loss of crystal violet during decolorization step

- thinner peptidoglycan layer and larger pores of Gram-negative bacteria does not prevent loss of crystal violet

Cells that Lose a Cell Wall May Survive in Isotonic Environments

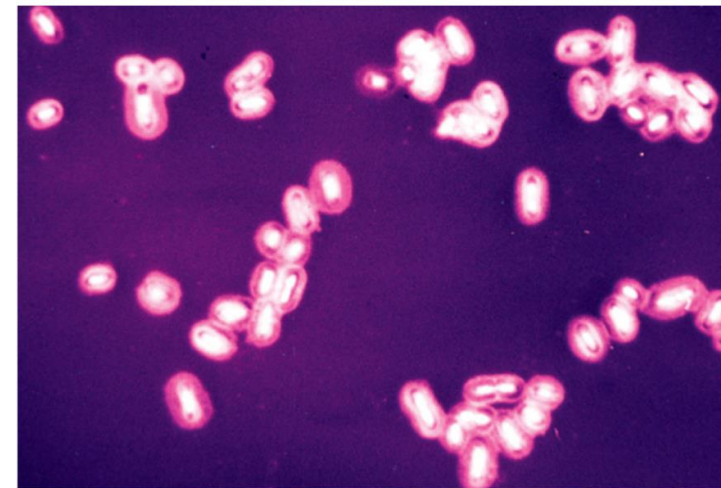
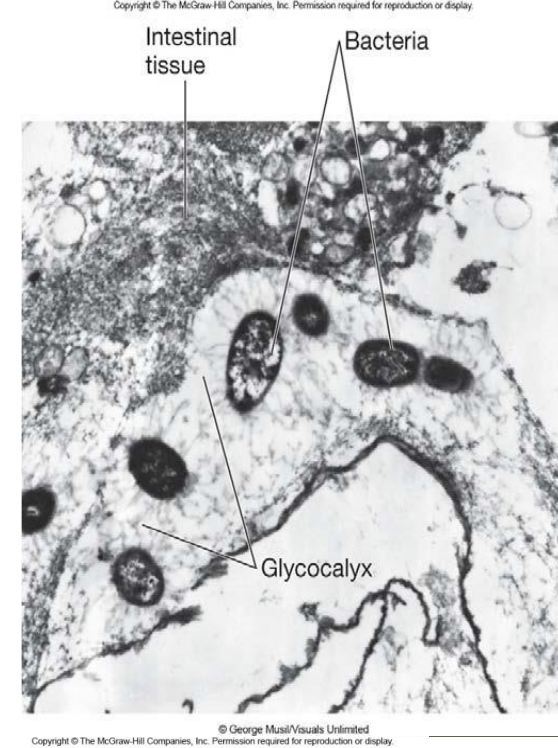
- Protoplasts
- Spheroplasts
- Mycoplasma
 - does not produce a cell wall
 - plasma membrane more resistant to osmotic pressure

Components Outside of the Cell Wall

- Outermost layer in the cell envelope
- Glycocalyx
 - capsules and slime layers
 - S layers
- Aid in attachment to each other and to other surfaces
 - e.g., biofilms in plants and animals
- Protection for the cell

Capsules

- Usually composed of polysaccharides
- Well organized and not easily removed from cell
- Visible in light microscope
- Protective advantages
 - resistant to phagocytosis
 - protect from desiccation
 - exclude viruses and detergents
- Associated with specific bacteria



K. pneumoniae

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Slime Layers

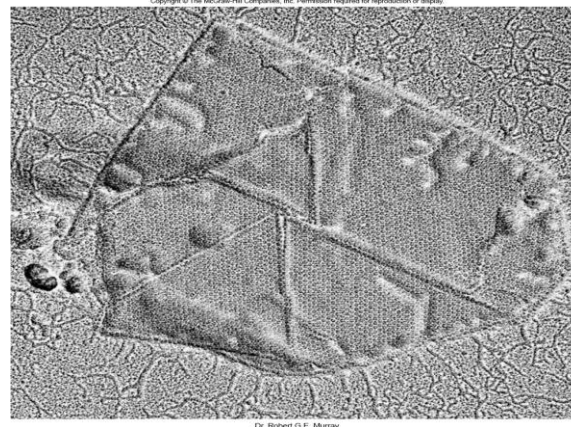
- similar to capsules except diffuse, unorganized and easily removed
- slime may aid in motility
- associated with most bacteria
- Regularly structured layers of protein or glycoprotein that self-assemble

in Gram-negative bacteria the S layer adheres to outer membrane

in Gram-positive bacteria it is associated with the peptidoglycan surface

S Layer Functions

- Protect from ion and pH fluctuations, osmotic stress, enzymes, and predation
 - Maintains shape and rigidity
 - Promotes adhesion to surfaces
 - Protects from host defenses
 - Potential use in nanotechnology
- S layer spontaneously associates



End