

PROKARYOTIC (BACTERIAL) CELL WALL

Cell Wall:

- made of peptidoglycan layers (proteins and sugars). Function—prevent water from rushing in to the cell and causing it to rupture.
- Gram negative bacterial cells have a fatty outer cell wall layer in addition to peptidoglycan.
- Penicillin and similar antibiotics block formation of the cell wall and so prevent bacterial cell division. Penicillin was originally isolated from a mold by the name *Penicillium* (Alexander Fleming, 1928).
 - Bacteria resistant to penicillin make an enzyme called penicillinase that deactivates the penicillin. Certain strains of *Staphylococcus aureus* contain plasmids that code for penicillinase. *Streptococcus* bacteria are generally quite sensitive to penicillin.
 - Methicillin also inhibits bacterial cell wall formation, but it is not deactivated by penicillinase. Certain strains of *Staph aureus* contain plasmids that can deactivate methicillin (MRSA). Note: Methicillin is not used clinically because it is not actually very effective; and causes more kidney damage than most currently used antibiotics. However, it is still used diagnostically to identify MRSA.

Gram Positive Cell Walls (bacteria such as *Staphylococcus* and *Streptococcus*)

- Thick peptidoglycan cell wall (many layers) – retains purple crystal violet when Gram stained
- *Mycobacterium* is considered Gram positive, but it has so much mycolic acid (waxy) that it doesn't stain very well. The acid-fast stain works better with it.

Gram Negative Cell Walls (bacteria such as *E. Coli* and *Klebsiella pneumoniae*)

- Thin peptidoglycan cell wall
- Outer lipid membrane (lipopolysaccharides (LPS), lipoproteins, phospholipids) – retains pink safranin when Gram stained
 - Negative charge inhibits phagocytosis (by WBCs) and damage by other antibacterial substances in our immune system (such as **complement**)
 - Blocks antibiotics such as penicillin from damaging the peptidoglycan layer
 - LPS:
 - contains O polysaccharides that help distinguish among Gram negative bacteria.
 - Lipid A is an **endotoxin** that is toxic to the blood and GI tract.

Damage to the Cell Wall

1. **Lysozyme**: part of our tears, saliva, and mucus. Most effective on Gram positive bacteria; break links between the sugars in the peptidoglycan cell wall.
2. **Penicillin, vancomycin and cephalosporin**: Block formation of peptidoglycan, most effective on Gram positive. Some staphylococci produce **penicillinase** and may be treated with **vancomycin**. **Cephalosporin** can be used against some penicillin-resistant strains.