Microbiology

2025-2024

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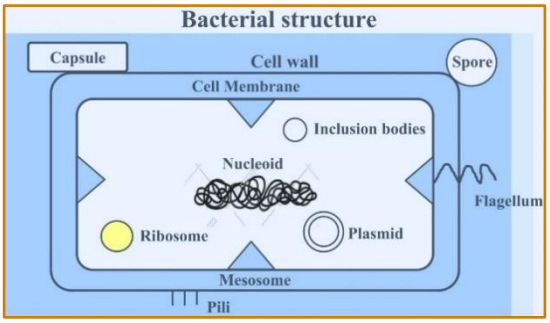
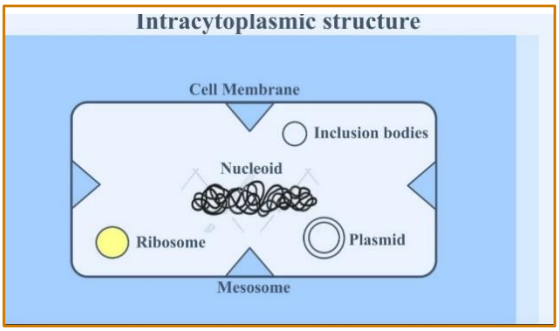
ARKAN
ACADEMY

Bacterial Structure

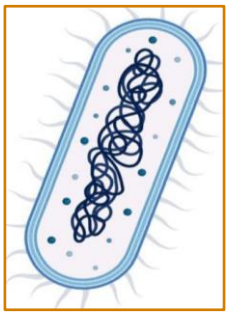
- **The importance:**
  - Understanding bacterial structure is important for *diagnosing* and *treating* infections



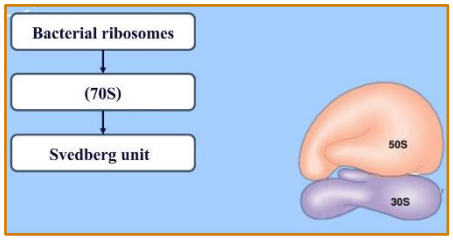
➢ Intracytoplasmic structure:

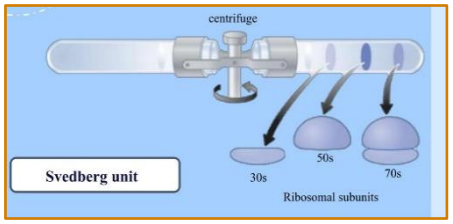


- ✓ **Nucleoid** (*Essential*), characteristic:
  - ✓ Single chromosome
  - ✓ Circular
  - ✓ dsDNA
  - ✓ 1mm in length
  - ✓ supercoiled
  - ✓ ***Function*:** carry genetic information for growth and survival



- ✓ **Ribosome** (*Essential*)
  - ✓ Ribo= ***RNA*** / Some= ***body***
  - ✓ Composed of <u>rRNA</u> , protein and consist of 2 subunit
  - ✓ Subunits (70S): 50S + 30S
  - ✓ ***Svedberg unit:*** is a unit used to measure the sedimentation rate of particles such as; ribosomes, during centrifugation.
    - The unit describe how fast a particle move in a centrifugal field and is a measure of its size, shape and density.
  - ✓ The benefit of the difference in density between bacterial and human cells is that antibiotics can degrade bacterial ribosomes <u>without affecting</u> human ribosomes
  - ✓ ***Function:*** site of Protein synthesis

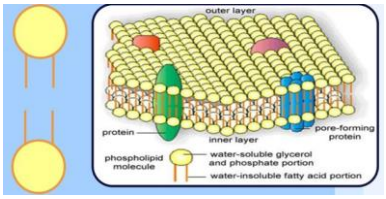




✓ Inclusion granules

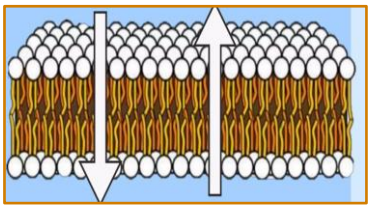
- ✓ ***Function:*** Store of nutrient; Glycogen, Starch, Phosphate
- ✓ *Example:* Corynebacterium diphtheriae stores phosphate in large amounts within inclusion granules, which are referred to as *volutin granules* or *metachromatic granules.*

✓ Cell membrane (*Essential*)

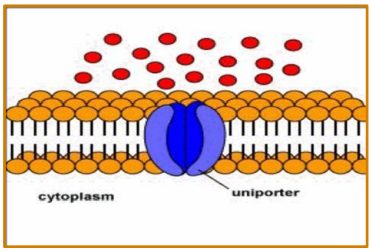


- ✓ Thin, fragile membrane
- ✓ Located just inside the cell wall
- ✓ ***Composition*:** Phospholipid bilayer + Protein (No sterols)
- ✓ ***Exception:*** *Mycoplasma* have sterol in cell membrane
- ✓ ***Function:***

1) Selective transport:

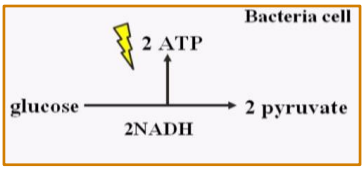


- Passive transport: *doesn't require* energy, molecule move down their concentration gradient [from high to low concentration]

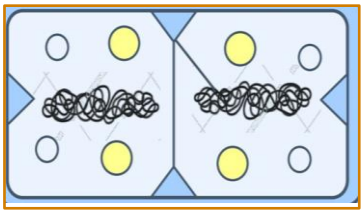


- Active transport: *require* energy (usually ATP) to move molecule against their concentration gradient [from low to high concentration]

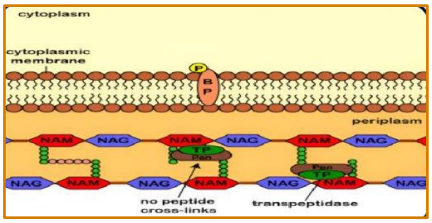
2) Mesosomes: are folded invagination in the plasma membrane of bacteria involved in processes such as:



- Respiration enzyme: to making energy Like Mitochondria.

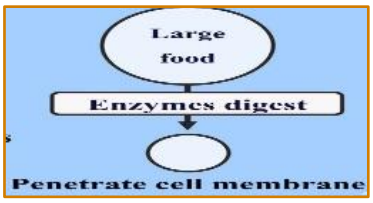


- DNA replication: assisting in the segregation of bacterial chromosome during ***cell division*** to produce *separate DNA* and *septal mesosome*.

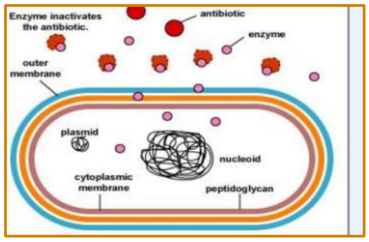


- Biosynthesis of cell wall

3) Excretion of extracellular enzymes

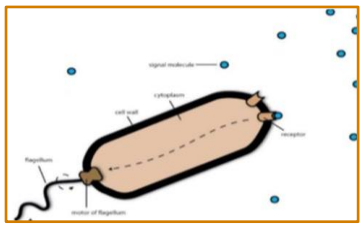


- Hydrolytic enzymes: the digestive enzyme helps the large molecule penetrate the cell membrane

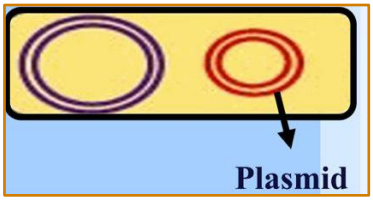


- Penicillinase: antibiotic resistance

4) Chemotactic system: is a biological mechanism that enables cells, motile bacteria, to sense and move in response to chemical stimuli in their environment



✓ **Plasmid** *(Not essential)*, characteristic:

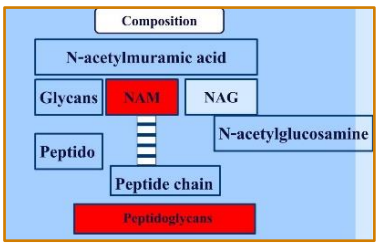


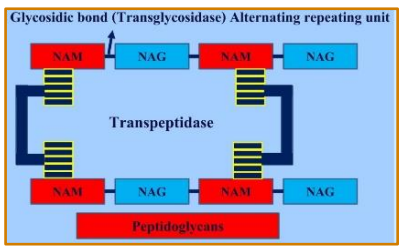
- ✓ Extra chromosomal dsDNA.
- ✓ *Replicate autonomously* (Independent of bacterial chromosome)
- ✓ ***Function:***
  - Toxin production
  - Drug resistance

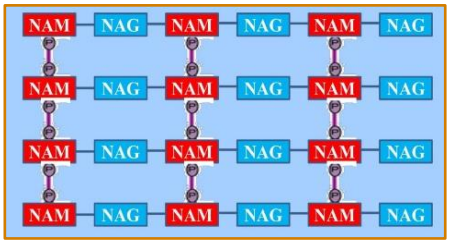
Periplasmic space: Space between cytoplasmic and outer membrane (Peptidoglycan layer and gel-like protein)

➢ Cell wall

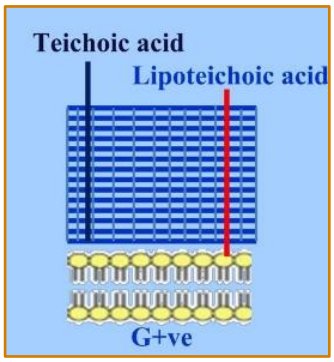
- ***Definition***
  - ✓ "Outermost layer"
  - ✓ Surrounds the cell membrane
  - ✓ Rigid
- ***Composition***
  - ✓ Peptidoglycan [Rigidity] composed of:
    - Glycan sugars (NAM and NAG) are alternating repeating units bound by glycosidic bonds, synthesized by the enzyme transglycosidase
    - Proteins (peptides) are bound to NAM, and this bond is synthesized by the enzyme\ transpeptidase.
- ***Synthesis***



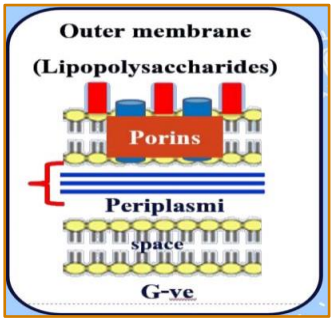




- ***Gram stain***



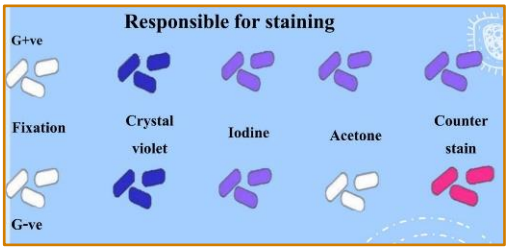
  - ✓ Gram positive, Composition:
    - Peptidoglycan (50%)
    - Polymers of glycerol or rbitol are:
      - **a)** Lipoteichoic acid (Cell membrane)
      - **b)** Teichoic acid (Cell wall) :
        - Major surface Ag of G+ve ,
        - ***A highly Immunogenic*** that induce immune system to produce cytokines such as: TNF-α/ IL-1



  - ✓ Gram negative, Composition:
    - Cell membrane: Bilayer phospholipids
    - Cell wall:
      - **a)** ***Peptidoglycan:*** a thin layer (5%)
      - **b)** ***Lipopolysaccharides:*** consist of Lipid A (Endotoxin) / Polysaccharides (somatic O Ag)
      - **c)** ***Porins*** (hydrophilic Protein) in the outer membrane and their function is *transportation*.

	Gram positive	**Gram negative**
Peptidoglycan	Thick	Thin
Teichoic acid/ Lipoteichoic acid	Yes	No
Outer membrane	No	Yes

- **Function**
  - ✓ Maintenance of the shape (Rigid)
  - ✓ Protection (Osmosis insensitive)
  - ✓ Target site for antibiotics: Penicillin/ Cephalosporines
  - ✓ Role in cell division
  - ✓ Responsible for staining:
    - Crystal violet: primary stain
    - Iodine: fixation
    - Acetone: decolonization
    - Safranin: counter stain



- **Cell wall Deficient** (*Bacteria without cell wall*)
  - ✓ Naturally: Mycoplasma (Sterol)
  - ✓ Induced: Cell wall inhibitors or Lysozyme
    - ***Completely:***
      Protoplast (+ve)/ Spheroplast (-ve)
    - ***Partially:***
      L-form bacteria

L-form & Mycoplasma:

Resist to Penicillin and Cephalosporines

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