

INTERNAL STRUCTURE

Cytoplasmic membrane

- Under the cell wall and generally same structure with bacteria
 - It consists of two layers
 - On the surface of periplasmic space and cytoplasm, protein and phospholipid
 - Hydrophobic ends of the phospholipid takes place in internal region
 - It exists in two forms as membrane proteins **peripheral** and **integral**

Cytoplasmic membrane

■ Function

- It surrounds and protects to cytoplasm
- It allows selective permeability and osmosis
- It includes enzymes:
 - Cytochrome enzymes
 - Official enzymes in lipid synthesis
 - Official enzyme in cell wall synthesis
 - TCA enzymes
 - DNA replicase enzymes
- Regulates the activities (hydrolytic and energy metabolism) of some enzymes
- Participate in DNA replication
- Constitutes the origin of mesosom
- Plays a role in cell division and sporulation

Cytoplasmic membrane

- **Selective permeability and transport**
 - **Passive transport (diffusion)**
 - Slow, no need for energy
 - Play a role the concentration, electrical and pressure differences
 - **Active transport**
 - The passage of large molecules
 - Need for energy
 - Carrier proteins are involved (enzymes, enzymes permease)
 - E.g. : β galactosidase system for lactose
 - Phosphotransferase system acts in transition membrane

■ **Cytoplasm**

- It consists of liquid, organic and inorganic materials

■ **Mesosom**

- It is originated from cytoplasmic membrane
- Vesicles or lamellar in style and opens periplasmic space
- Takes part in replication and some transport processes

■ **Ribosome**

- It consists of RNA and protein
- It sizes 70 S (50+30)
- Numerous in which growing bacteria
- It is involved synthesis of proteins and enzymes

■ **Nucleotide**

- DNA, double-stranded helix

Cytoplasmic granules

- **Volutin (Babes-Ernst) granules**
 - Structure in polymerized inorganic metaphosphate (polymetaphosphate)
 - Source of energy and phosphate
 - It is shown by Neisser and Albert staining
- **Lipid granules**
 - The structure in oil particles (polibetahidroksibütirat)
 - The source of Carbon and energy
 - It is shown with Sudan black
- **Polysaccharide granules**
 - Structure of glucose homo or heteropolymer
 - The source of carbon and energy
- **Sulfur granules**
 - It is found in Sulfur bacteria

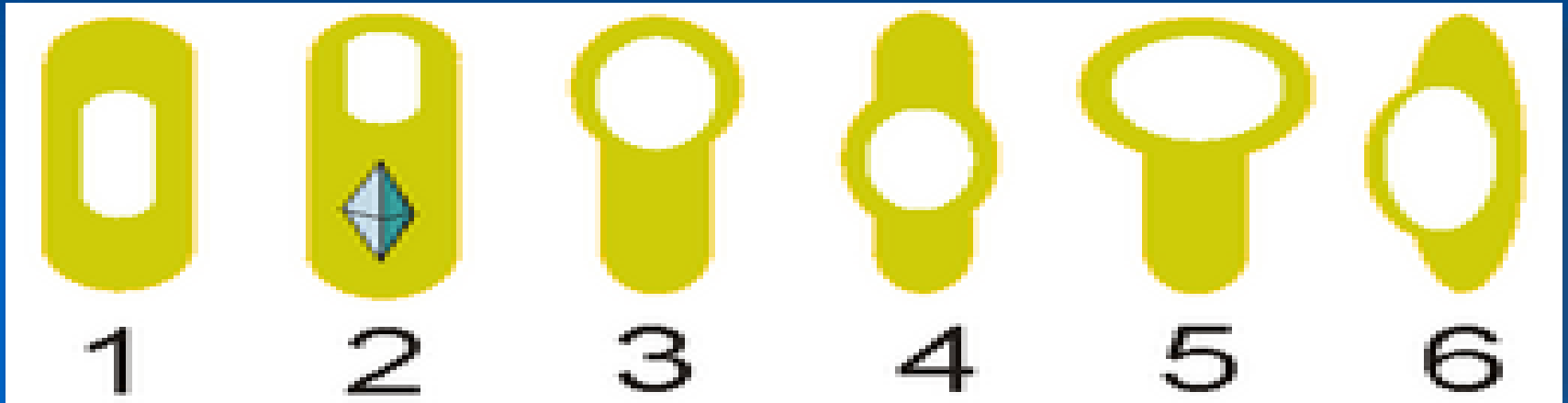
- **Extrachromosomal genetic elements**
(Plasmid, Episome, Transposon)
- **Phage**
- **Gas vacuoles**
- **Crystals**
- **Endospor**
- **Pigment**

Endospor

- When reduced food sources in their environment, some bacteria (e.g.; *B. anthracis*, *B. Subtilis*, *C. tetani*, *C. Botulinum*) occurs endospores which is resistant against physical (frost, dry, heat) and chemical effects (toxic substances) to protect themselves
- Spores structures is too durable that even isolated from 3000 years soil samples

- Endospores can be **oval** or **round**
- Spores may be appropriately sized to the diameter of the cell or may be greater than diameter of the cell (e.g.; Clostridium species, appear as the drumstick)
- Endospores are stained by special staining methods such as **Modified Ziehl-Neelsen**
- According to bacterial species endospores positions are shown in three ways :
 - Central
 - Subterminal
 - Terminal

Locations of endospores in bacteria



1: Central endospore (smaller than the diameter bacillus)

2-5: Terminal endospore

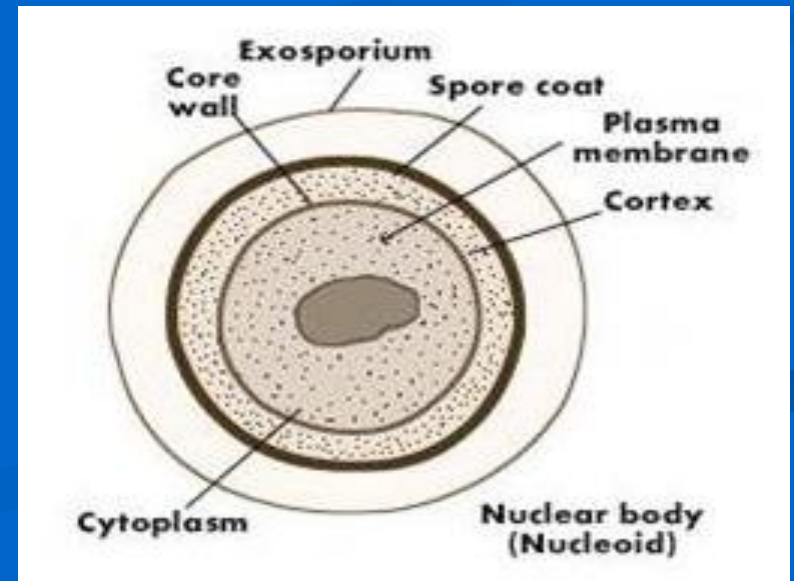
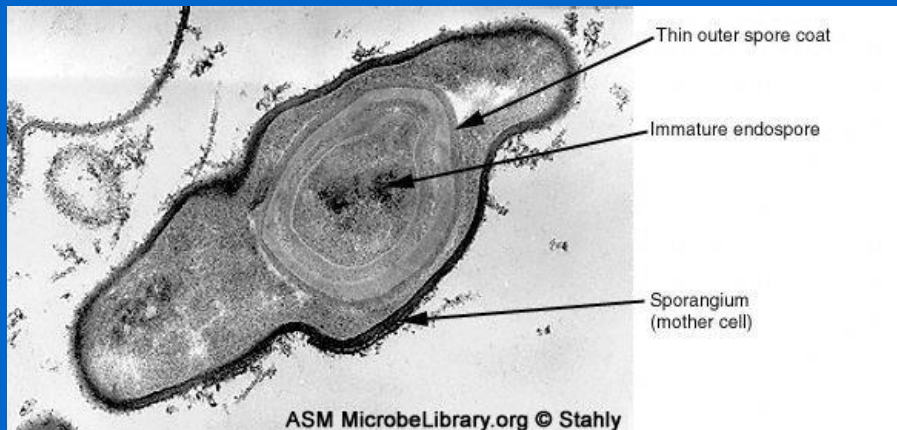
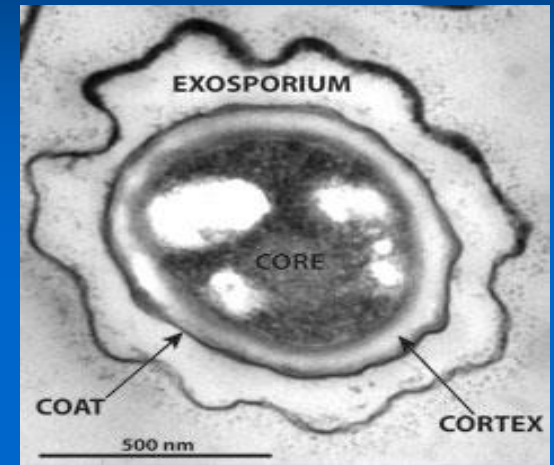
3: Subterminal endospore

4: Central endospore (greater than the diameter bacillus)

6: lateral endospore

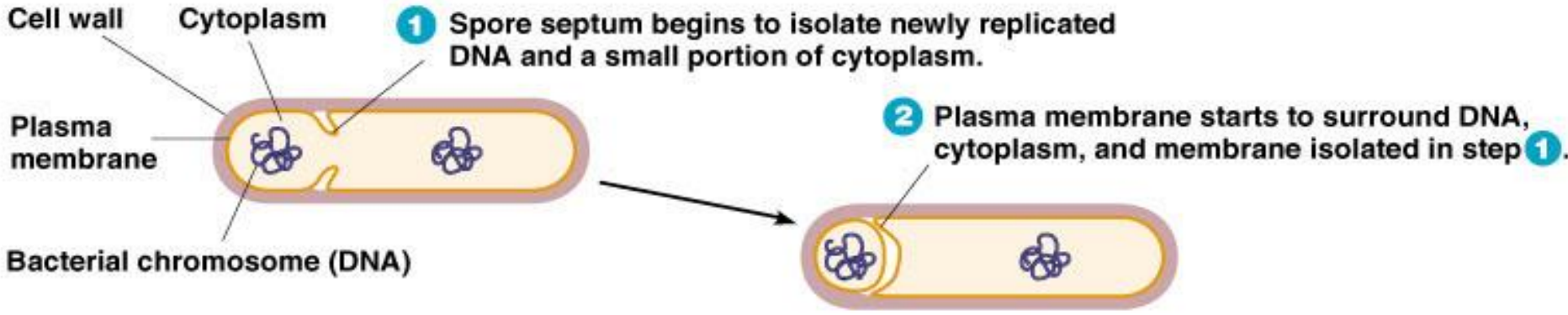
Endospore Structure (from inside to out)

- Cytoplasm
- Cytoplasmic membrane of spore
- Cell Wall of spore
- Cortex
- Outer membrane (dipicolinic acid, DPA)
- Exosporium

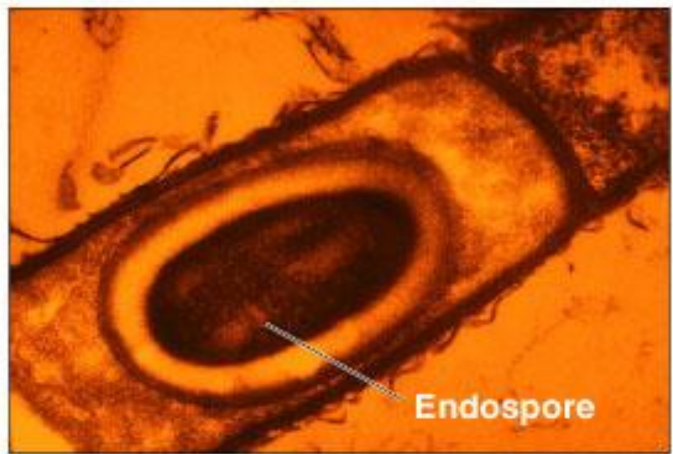


Sporulation

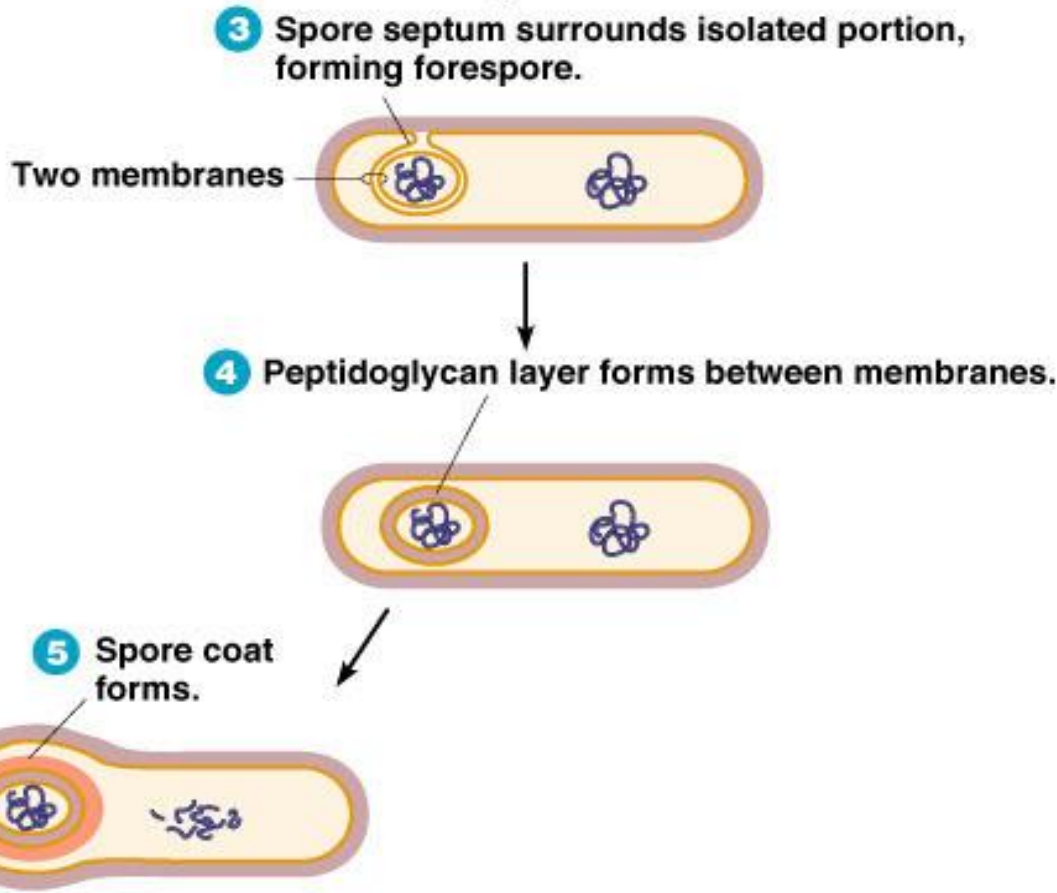
- Developing spores is called "Sporulization", and the developed spores' process to get vegetative forms are called "germination".
- Endotrophic and egotrophic sporulation
- Spor-vegetatif basil
 - Activation, germination, extending outward



(a) Sporulation, the process of endospore formation



(b) An endospore in *Bacillus anthracis*



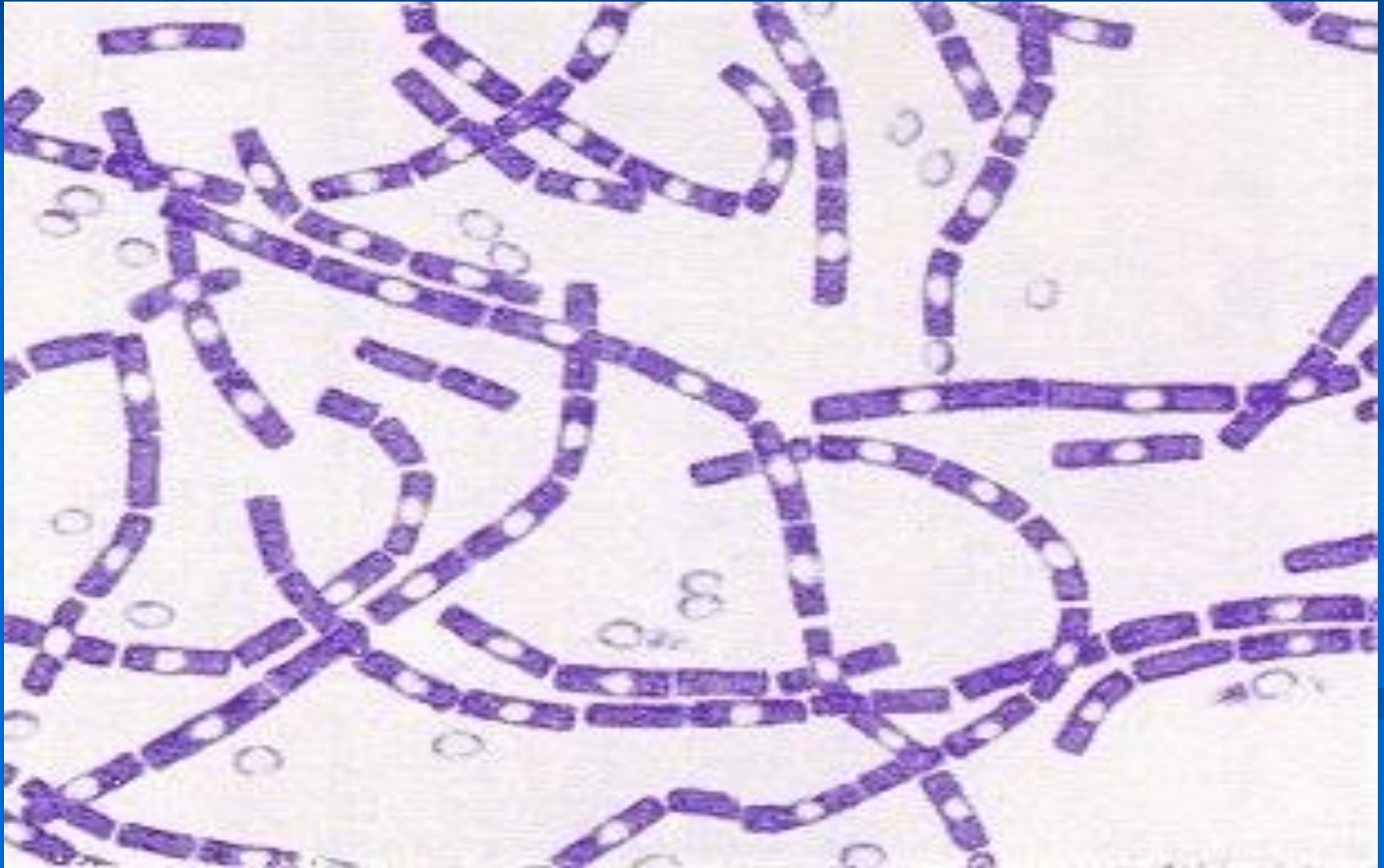
Clostridium botulinum(terminal)



Clostridium tetani(terminal)



Bacillus anthracis(central)



Pigment

- Photosynthetic pigments
- Non- Photosynthetic pigments
 - **Water soluble**
(*Pseudomonas aeruginosa*)
 - Pyosiyenin
 - Fluoresin
 - **Water insoluble**
(*Sarcina lutea*, *S.aureus*,
M.tuberculosis)
- **According to the structure;**
 - Carotenoids
 - Anthocyanins
 - Melanins
 - Phenazines
 - Quinones
 - Pyrroles
 - Others

Chemical Structure of Bacteria

- Inorganic Matters
 - Water- vegetative 70- 90%, spor 5- 20%
 - C, H, O, N, Cinder
 - Ca, P, K, Na, Mg, Mn, Fe, Co
 - Cu, Al, Zn, Mo
- Organic Matters
 - Protein
 - Carbohydrate
 - Lipid
 - NA
- Others