Objectives

Structures outside the cell wall

1) Capsule

2) Flagella

3) Pili

4) Spore formation

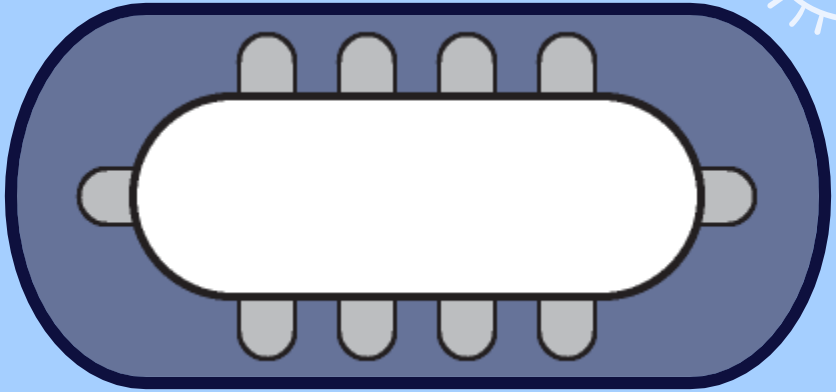
Capsule - Definition

Glyco → **carbohydrate**

calyx → **enveloped**

Capsule - Definition

Gelatinous (Viscous) layer covering cell wall of some bacteria



Extra layer

Not all Bacteria have it

Capsule - Composition

made of ↓

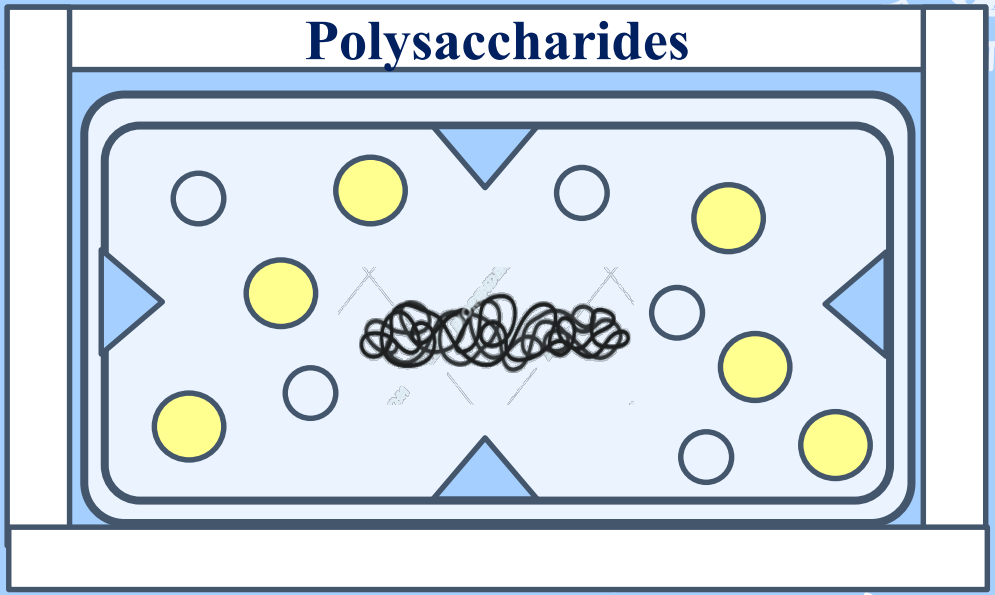
Usually Polysaccharides

Except:

Polypeptides

(B. anthracis)

↳ it's capsule made of polypeptides



Capsule - Composition

Variation of Capsule

↓ because of

(Arrangement of Polysaccharides)

Sucrose	Mannose	Lactose
Mannose	Sucrose	Mannose
Lactose	Sucrose	Mannose

e.g. 91 types of

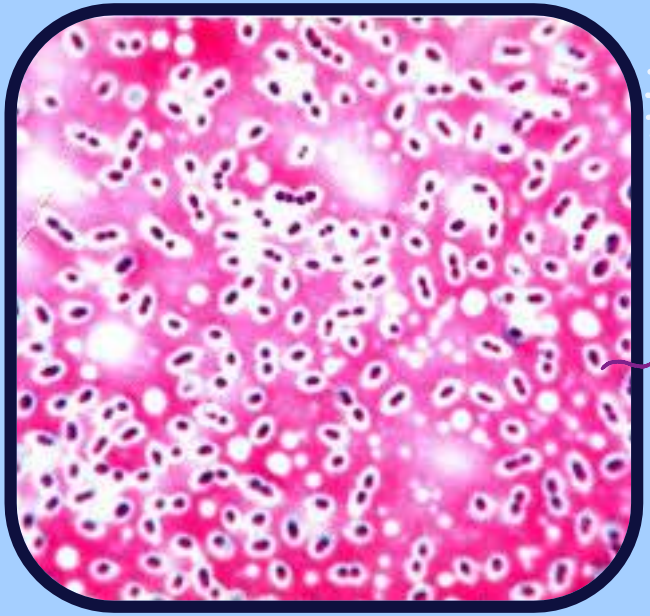
Str. pneumoniae

has 91 types cuz of diff arrangmnt of sugar in its capsule.

Capsule - Composition

Do Not stained by

Gram stain

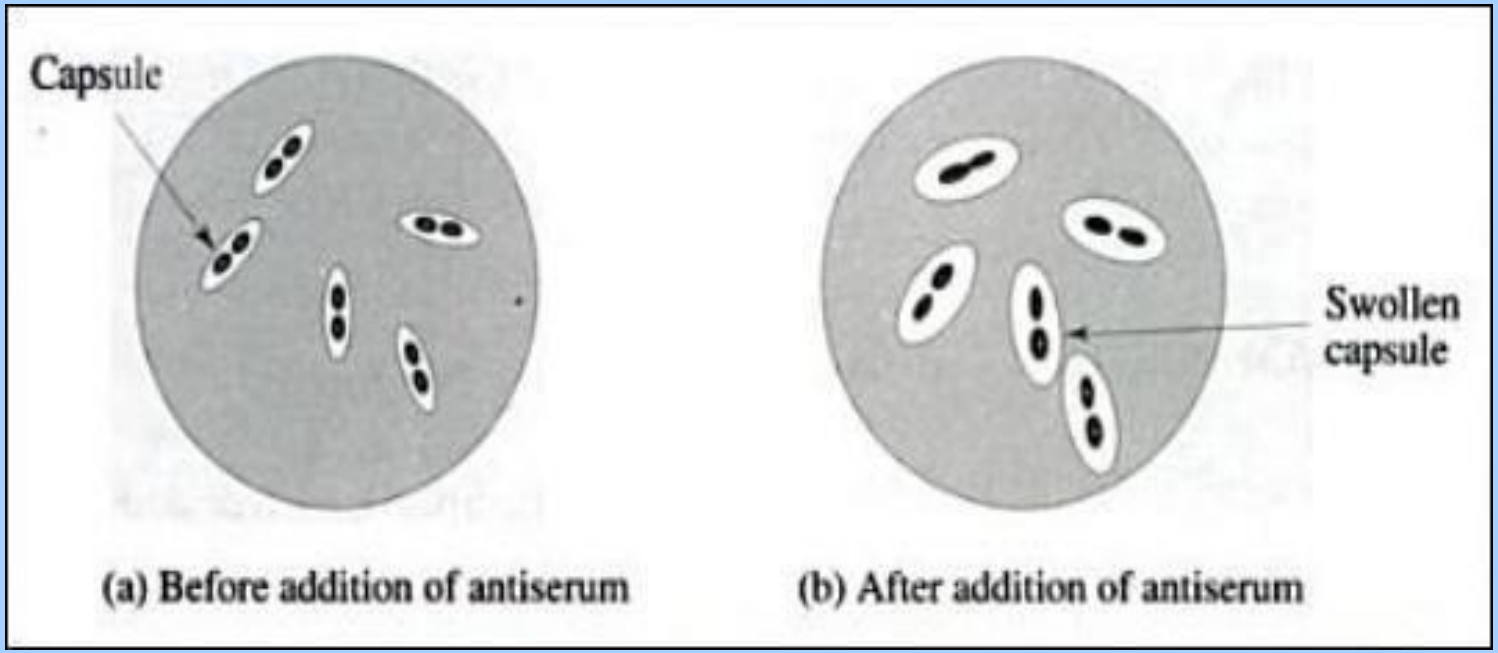


Unstained halo around the organism

Capsule - Composition

Quellung reaction (swelling)

*Antibodies specific to the Capsule bind to the Capsule → when it bind to it, the Capsule swell.
(one of methods used in identification of Capsulated bacterias)

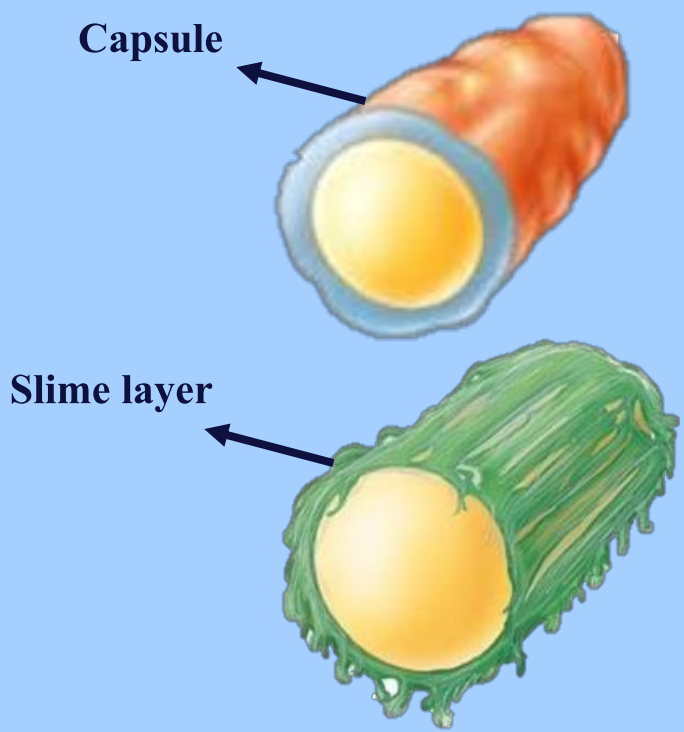


Capsule - Composition

Capsule

Glycocalyx

Slime layer



Capsule - Composition

Capsule

Tightly, organized bound around all cell wall

Firmly adherence to surface organism

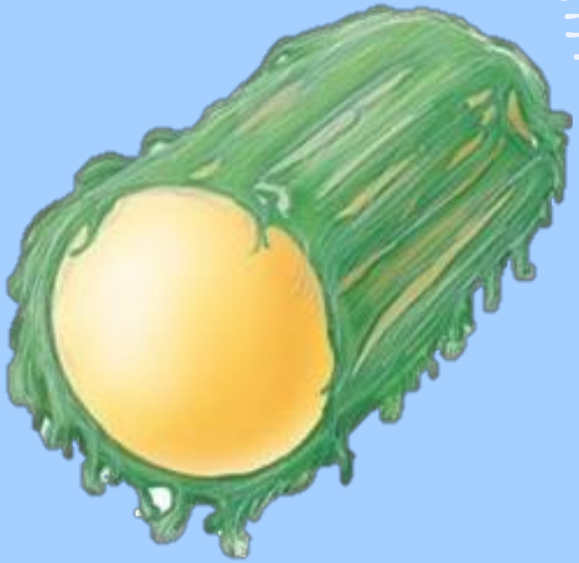
Capsule - Composition

Glycocalyx

and (Slime layer)

* glycocalyx & Slime layer share the same property of being ↓

Loosely & unorganized attached



Capsule - Composition

Glycocalyx

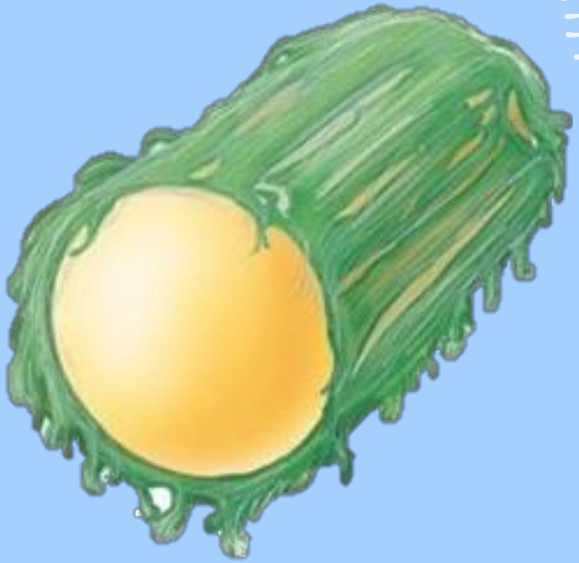
↓ what makes it diff from the Slime layer

it has **Fibrils extending**

It adhere firmly to skin, heart, etc

↳ it adhere firmly to the Host cell Not to the Capsule of the bacteria

e.g. *Strept. mutans*



Loosely & unorganized attached

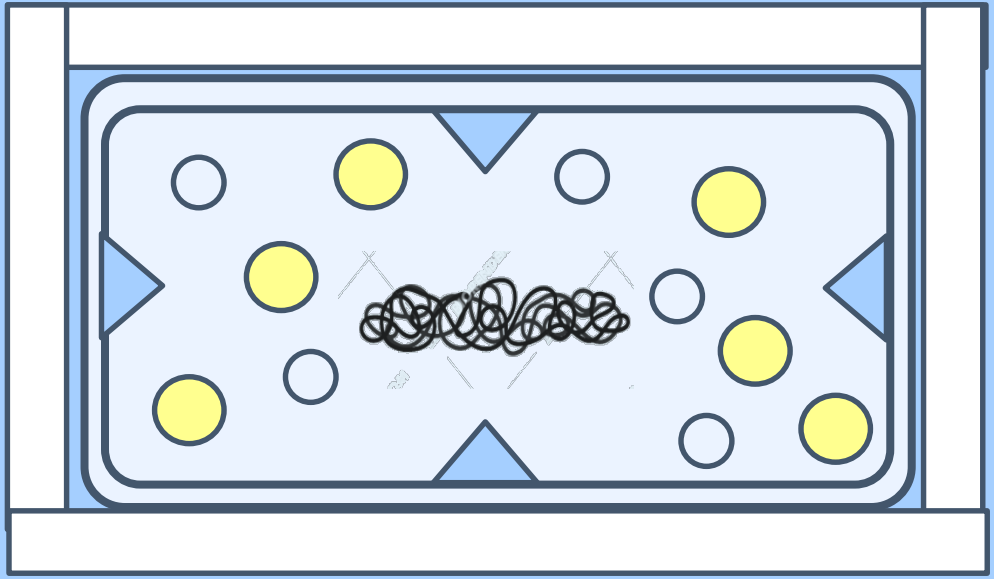
Capsule - Function

A

Protect Cell wall

↓ from

Bacteriophage → Virus can infect the bacteria cuz it has receptors for it on bacterial cell wall However, cuz the capsule is there it won't be able to bind to the cell wall & this protects the bacteria



Complement

↳ Complement system in immunologic responses

↳ the Complement components in alternative Electin pathway bind to cell wall of bacteria to work on it & destroy it. However, the presence of capsule prevent them from binding protecting the Bacteria.

lysozyme

↳ lysozymes break bacterial cell wall. Presence of Capsule Prevent lysozymes from destroying it.

Capsule - Function

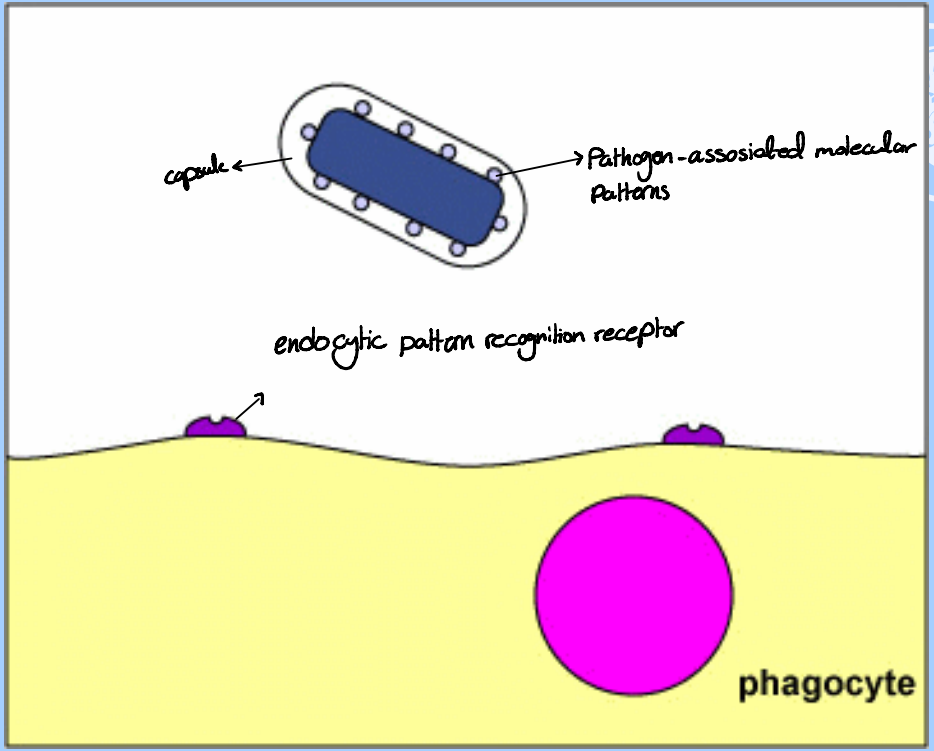
B

Prevent phagocytosis

(Virulence)

* Protect Bacteria from phagocytic cells. whenever they try to engulf the bacteria, they won't be able cuz of the prescens of the Capsule.

* So the Capsule is Considered a virulence factor → it's like self-defense



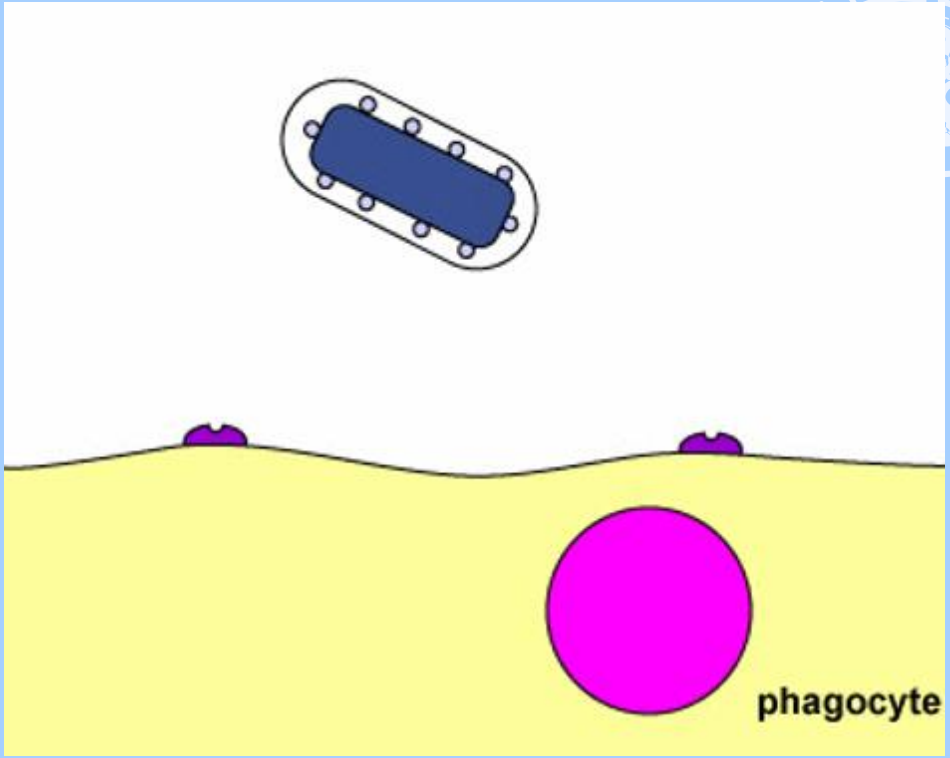
Capsule - Function

Capsules are formed

in VIVO ONLY

(within living organism)

* Capsules are formed when bacteria enters the host-cell. cuz it needs it to protect itself from Host's immune system & to protect itself from any phagocytic cell.



Capsule - Function

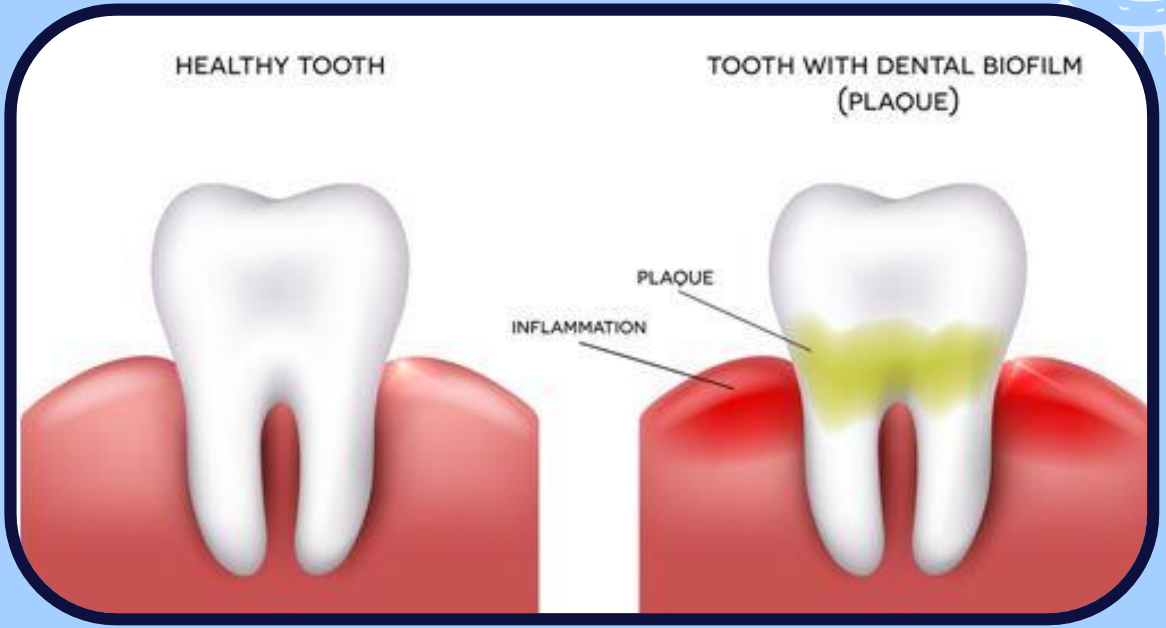
C

Attachment

(Glycocalyx)

Dental caries

fibral extendings of the glycocalyx bind to Place they wants giving the bacteria the Chance to do Fermentation of the sugars producing Acids resulting in dental caries in teeth for example.



Capsule - Function

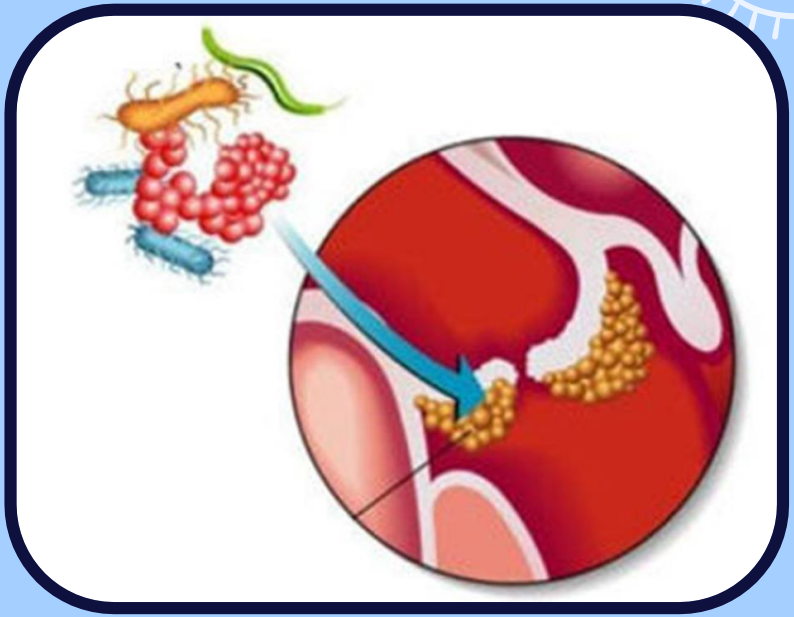
C

Attachment

(Glycocalyx)

Fibral extendings could also bind to Prosthetic heart valves resulting in diseases.

- **Prosthetic heart valves**

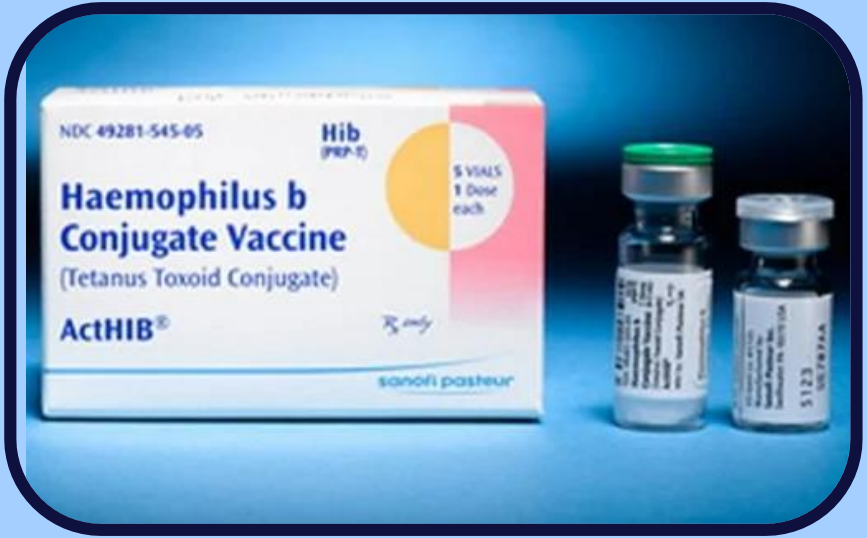


Capsule - Function

D

Development of vaccine

* for ex Bacteria Called Haemophilus influenzaeb bacteria has Capsule is we can take this capsule → Bind it to a protein → creat vaccine to Protect human from this bacteria.



Flagella - Definition

Seen by EM

(20nm) ~> very small in size (seen in EM)

~> this slide was in the recorded lec

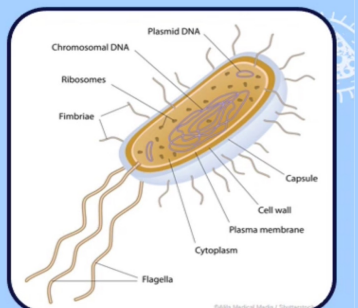
Flagella - Definition

Long thick threads like (filamentous),

formed from protein (flagellin)

(H Ag)

<u>H Ag</u>



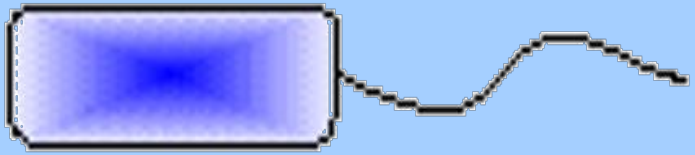
~> any flagella on bacteria named (H Antigen)

Destribution of flagella:

Flagella - Definition

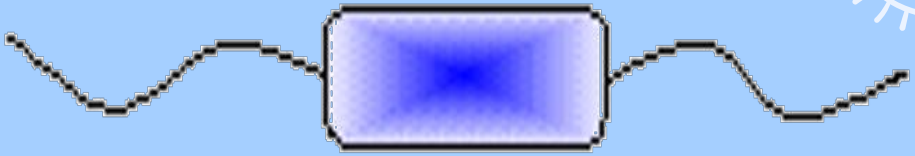
Polar

Spiral Shaped



1. monotrichous

(one flagella, polar)



2. amphitrichous

(two flagella/polar) ↑ name

3. lophotrichous

(multiple flagellas on each pole)

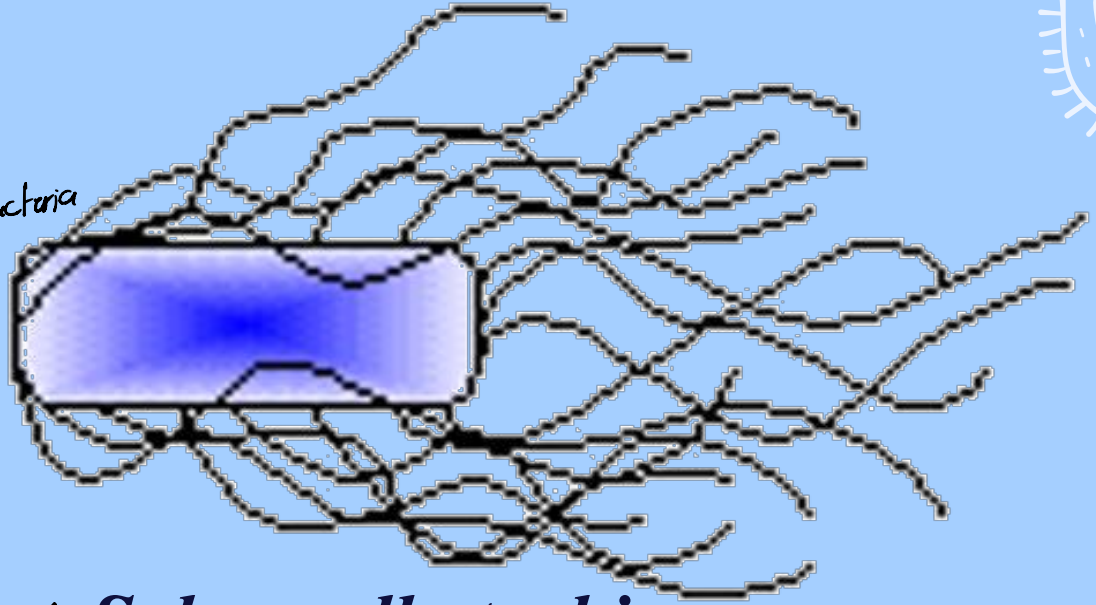
Flagella - Definition

3. **Peri/trichous**

around

all **around** the bacteria

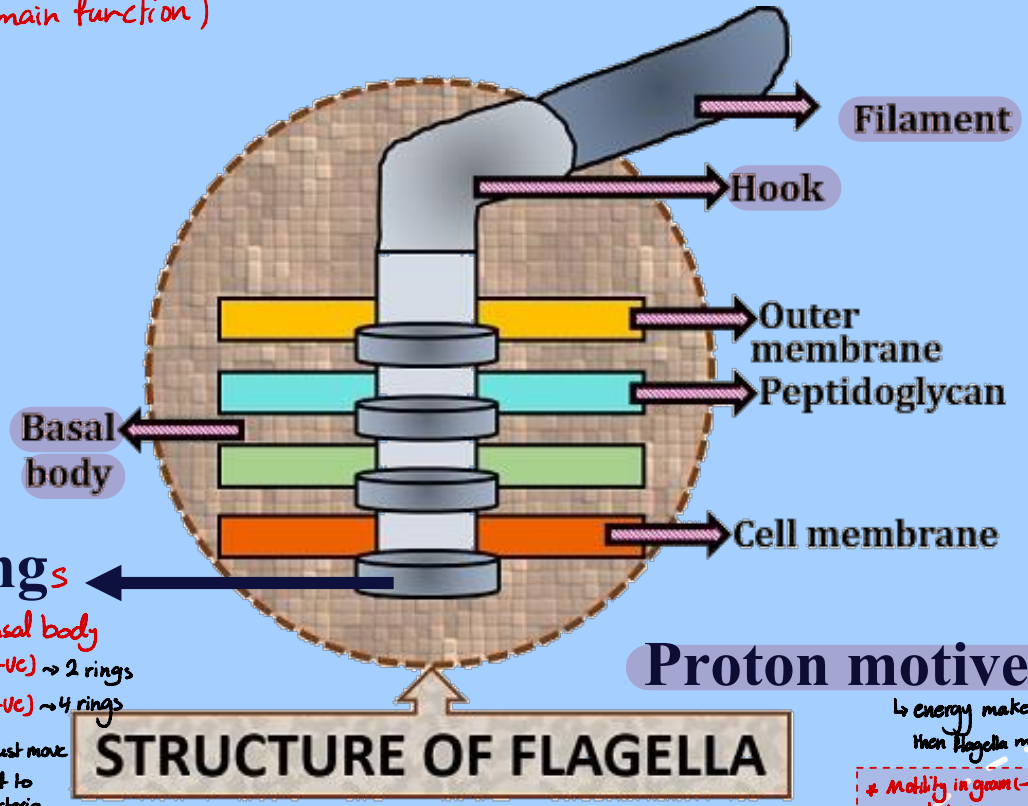
named 4. peritrichous



example ***Salmonella typhi***

Flagella - Function

Motility (main function)
of the bacteria



↳ these rings must move for the filament to move & then bacteria moves.

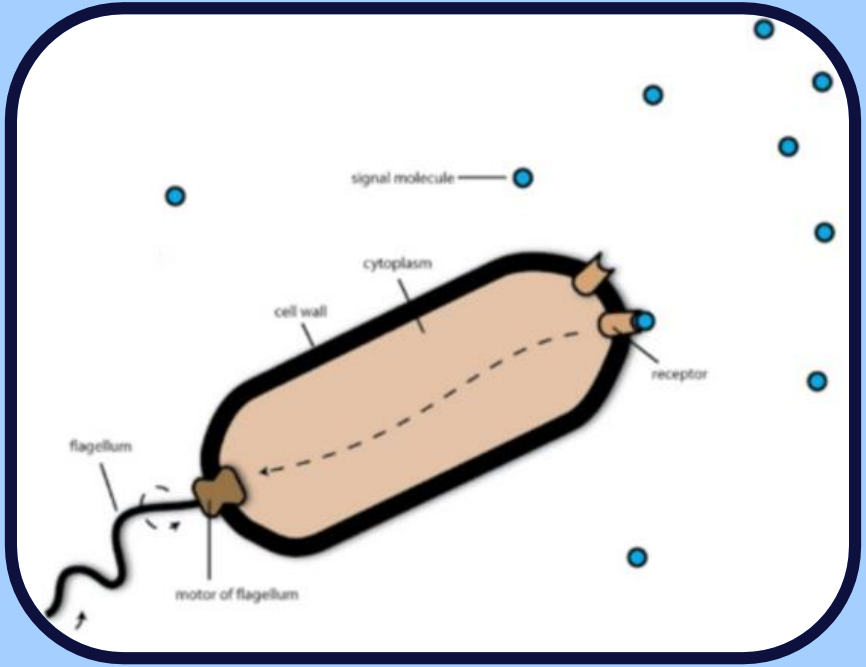
Proton motive force

↳ energy makes the rings move then flagella move then the bacteria.

* Motility in gram (-ve) higher than gram (+ve) cuz it have more rings (4 rings while gram + has 2)

Flagella - Function

The organs of motility



Flagella - Function

Tactic response (Taxis)

(Stimulus)

* Cell wall has receptors → agents bind to it
Wil was good agent it send signal to flagella to go toward it & if it was bad it send signal to flagella to go away from it.

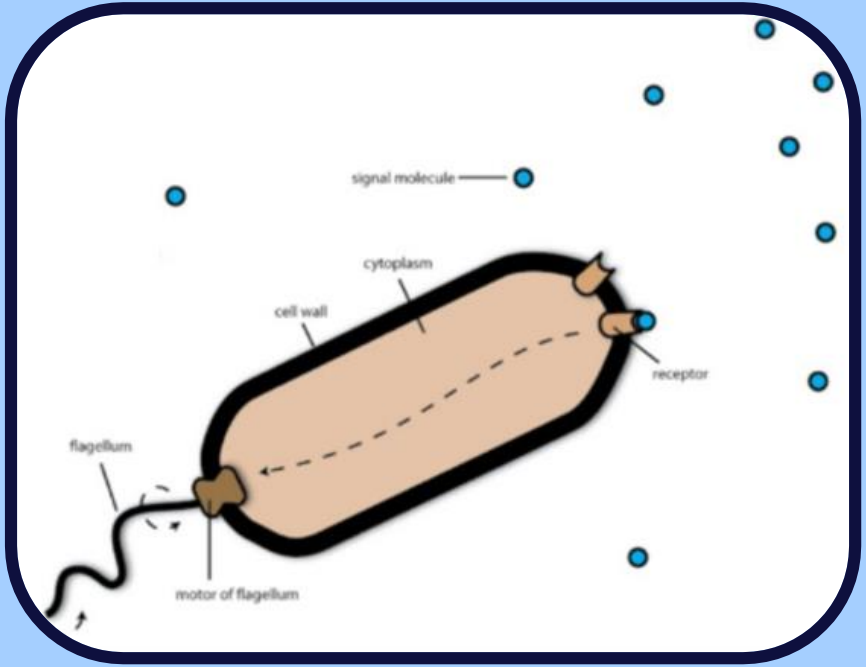
(movement of bacteria to

toward (+ve) or away (-ve)

+ve Chemotactic response — -ve Chemotactic response

depending on the agent

from stimulating agent)

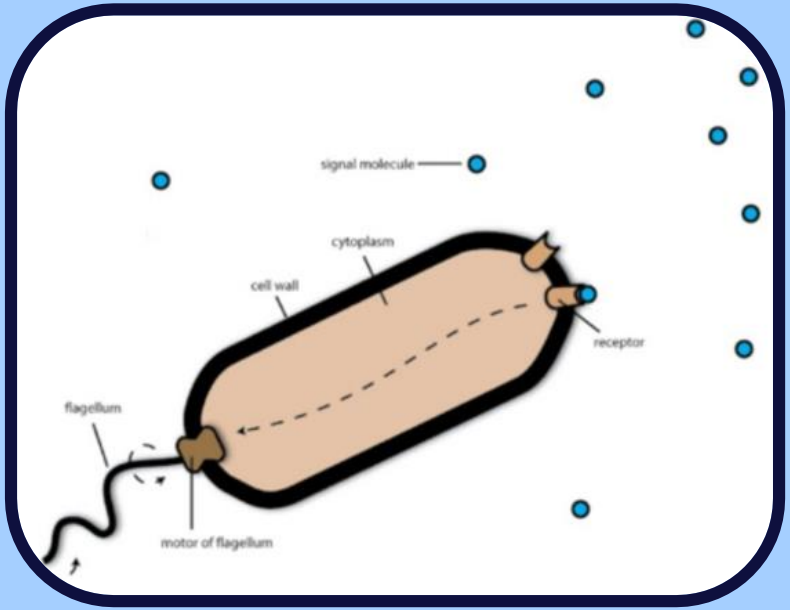


Flagella - Function

Tactic response (Taxis)

Chemo Taxis
↳ as a result of chemical

Photo Taxis
↳ as a result of the light



Stimulating agent

Light ⇝ phototaxis

Chemical ⇝ chemotaxis

Axial Filaments

Mostly flagella is outside the Bacteria, but some bacteria has flagella inside them (Endoflagella) → ex: spirochetes bacteria

Endoflagella (Axial filament)

In spirochetes

Pili (Fimbriae)

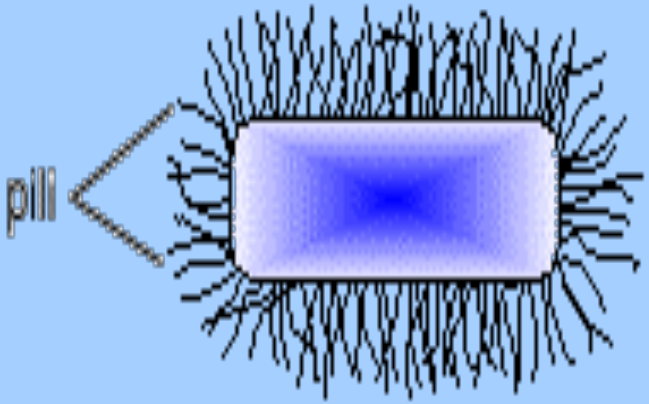
Short and thin

Hair like formed from

protein

↓

(Pilin)



Pili

Seen by EM

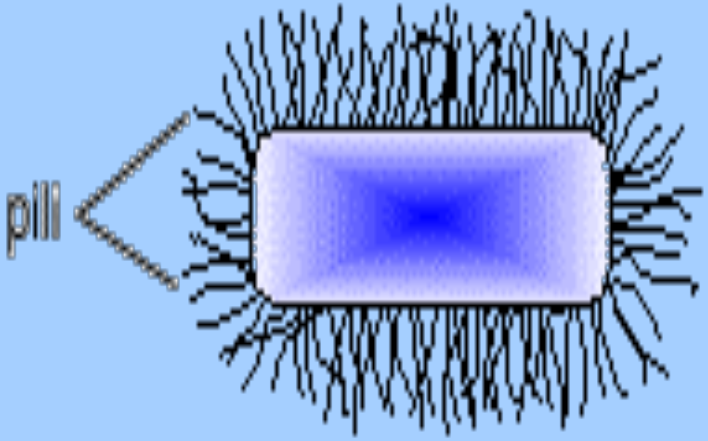
Small in size

Pili

* Types of Pili:

A) Ordinary pili

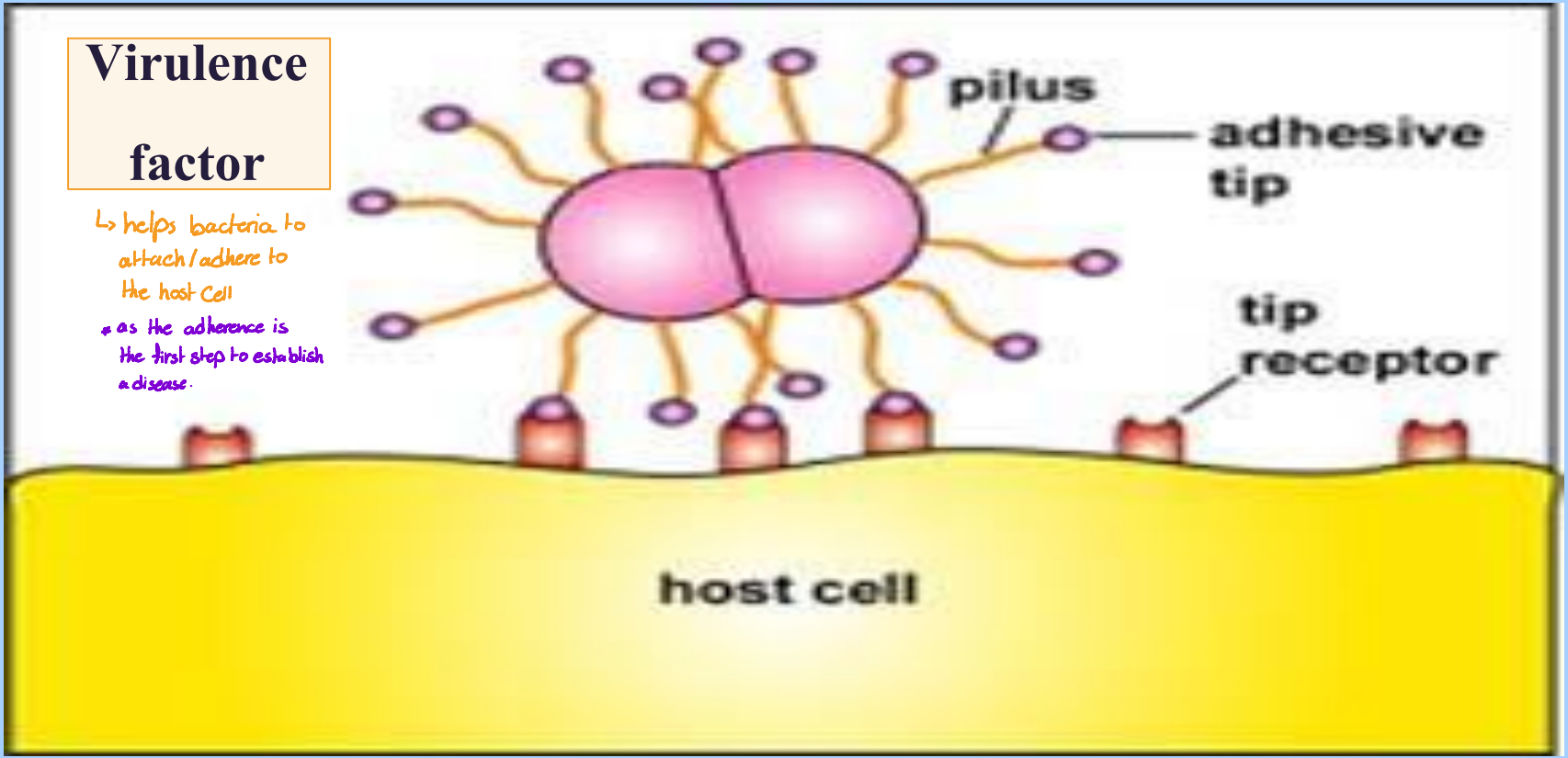
for (Attachment)



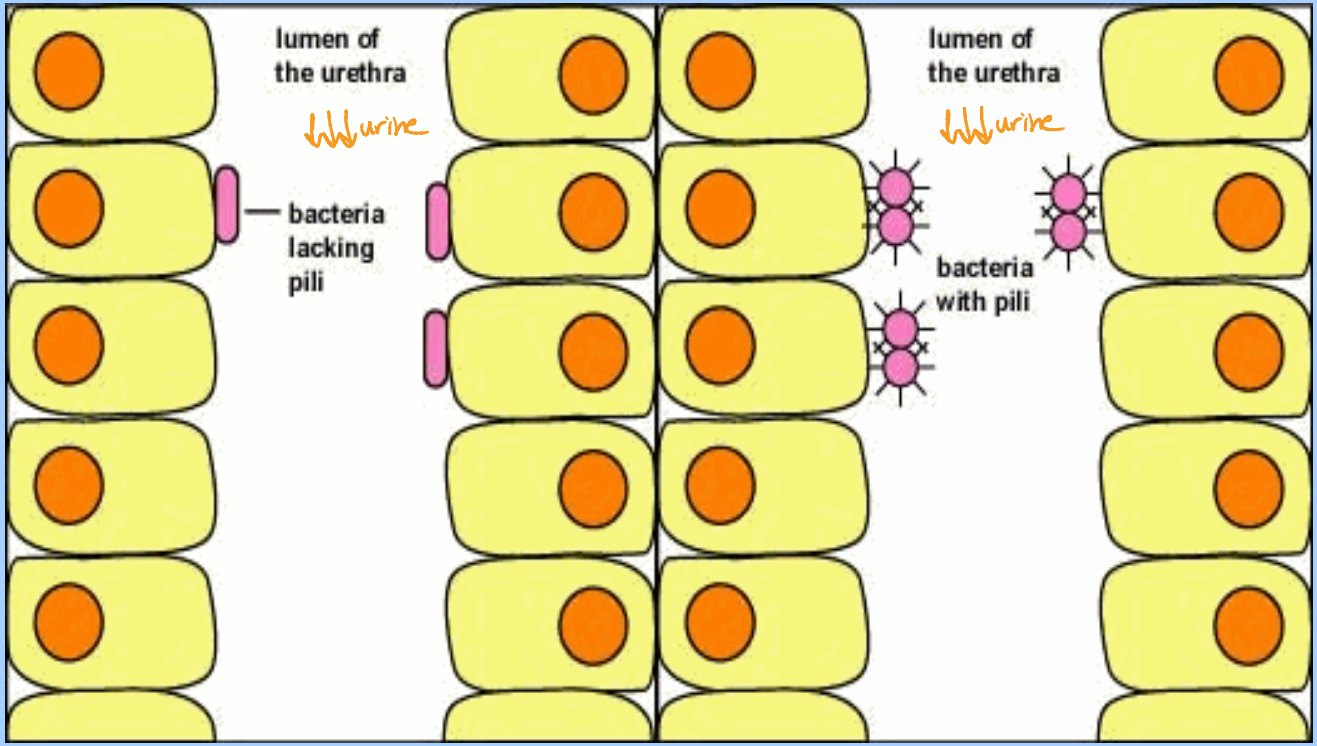
B) Sex pili

for (Genetic transfer)

Ordinary Pili



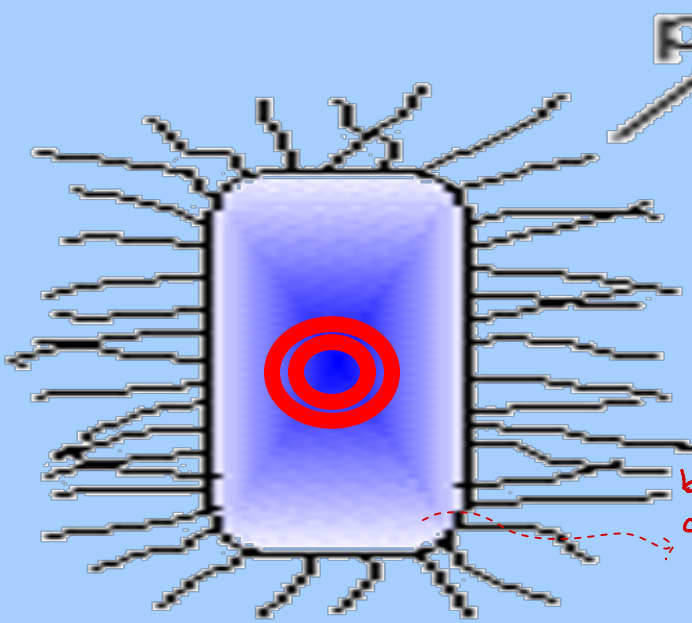
Ordinary Pili



↳ can't resist urine get out with it

↳ resist urine cuz it's adhered to cell by pili.

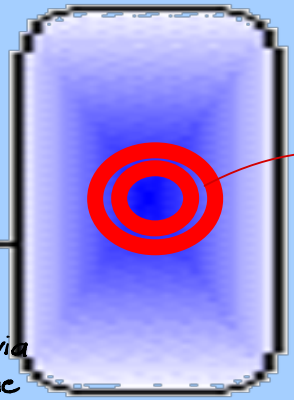
Sex Pili



Long pili

Sex pili!!

bacteria has genetic material with certain properties like drug resistance, toxin production --- makes a copy of these genetic information & give it to other bacteria that doesn't have these properties & then the Bacteria that received the gentic info carrys the same properties



→ was carried by the Pili.

F+

Donor

Conjugation

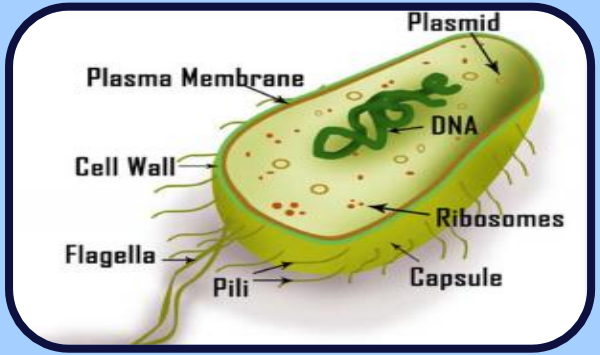
F-

Recipient

Spore formation

* Bacteria in host cell devide, reproduce....
at this point it's in vegetative phase

Vegetative bacteria

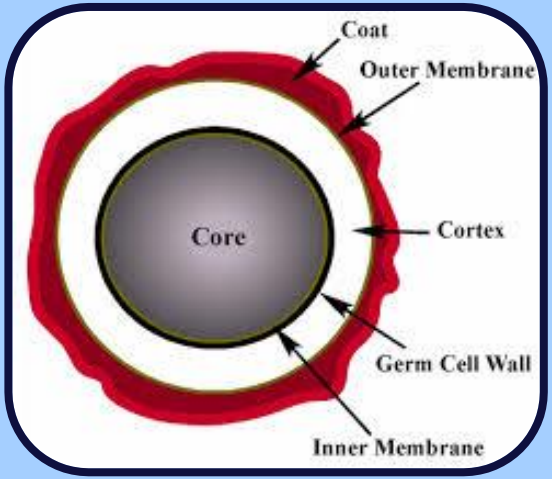


once out of the cell, Bacteria faces harsh conditions

Unsuitable condition

↑ temprature
↓ nutrients

to protect itself it makes the spores (outsid the host cell)



Spore formation (Not All bacteria can form it)

(Outside)

the host Cell

Spore formation

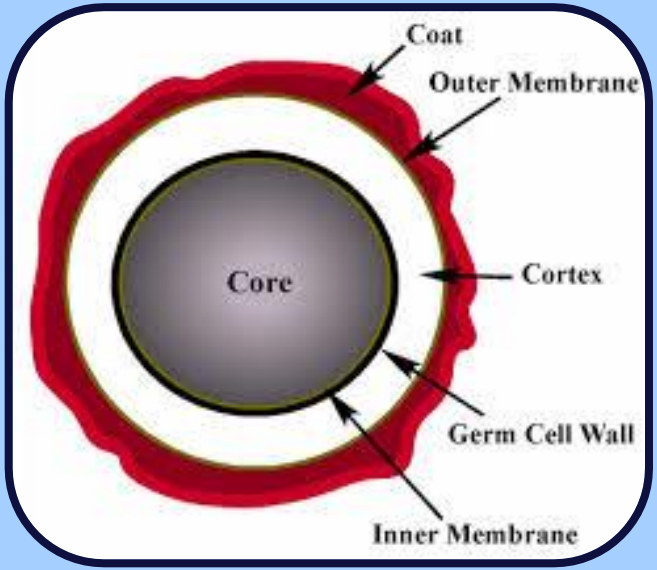
Forming highly resistant resting phase (Endospores) in VITRO

→ Bacteria in Dormant state
No Division, No reproduction ....

out side host Cell

* Only two familys of Bacteria can form spors & protect them selves.

1. ***Bacillus***
2. ***Clostridium***

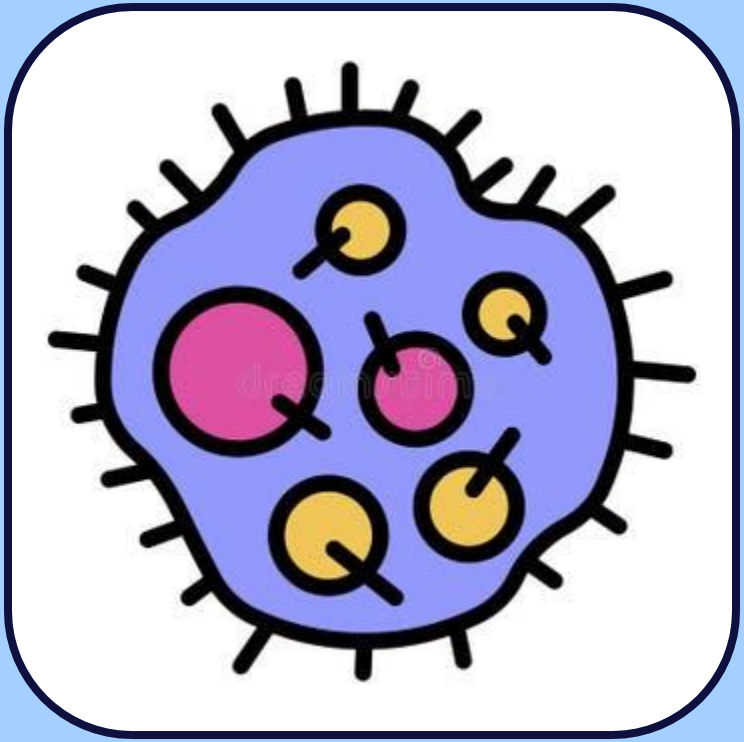


Spore formation

Occur to unfavorable conditions e.g.

Conditions that make Bacteria form spores :

1. **High temp.**
2. **Drying**
3. **Depletion of nutrition**



Spore formation

Formed outside the body (in VITRO)

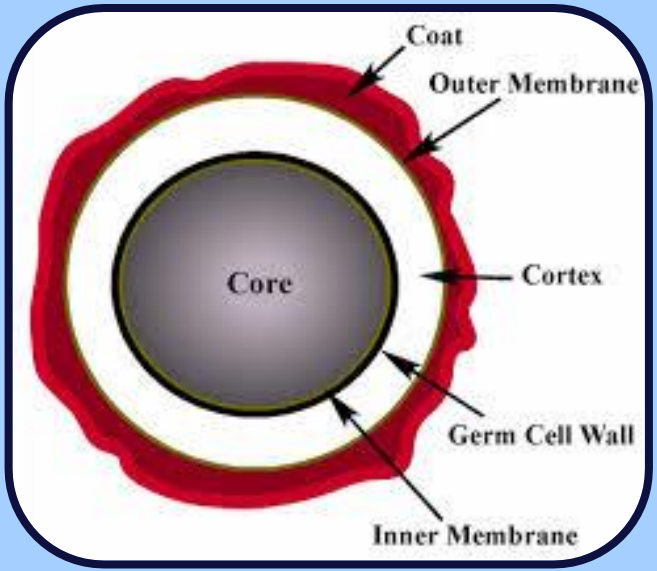
outside of host cell

Can not stained by ordinary stain (has special stains)

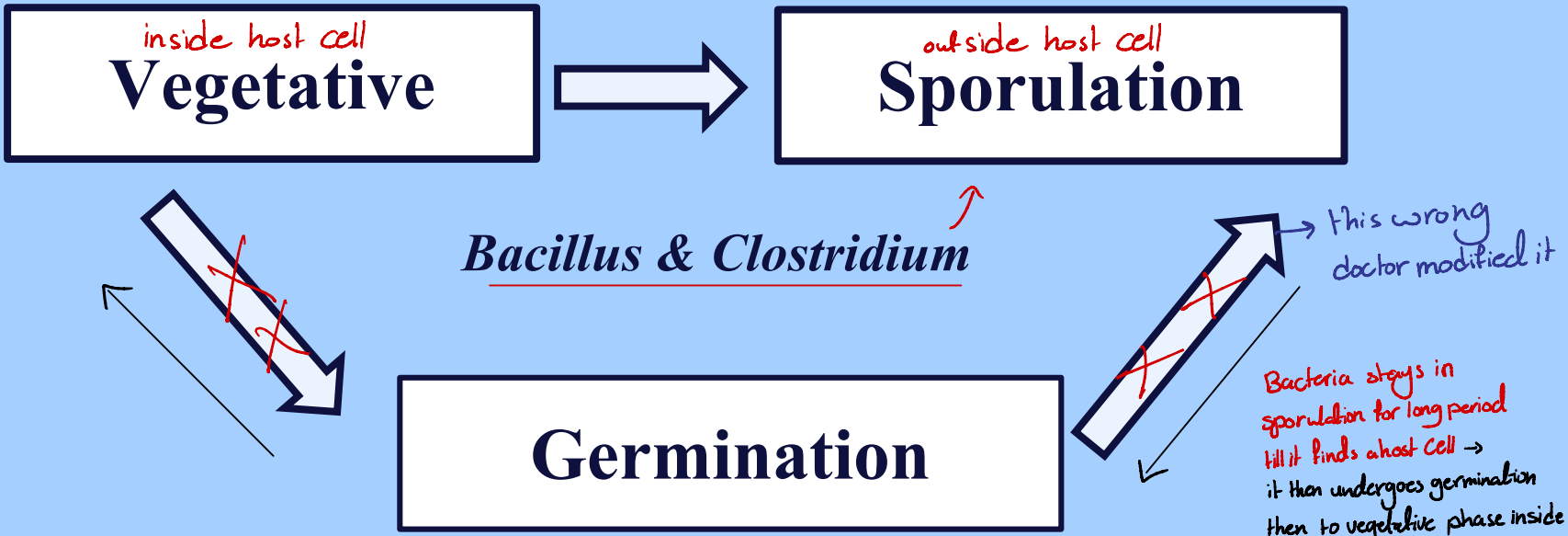
Spore formation

Highly resistant to dryness,

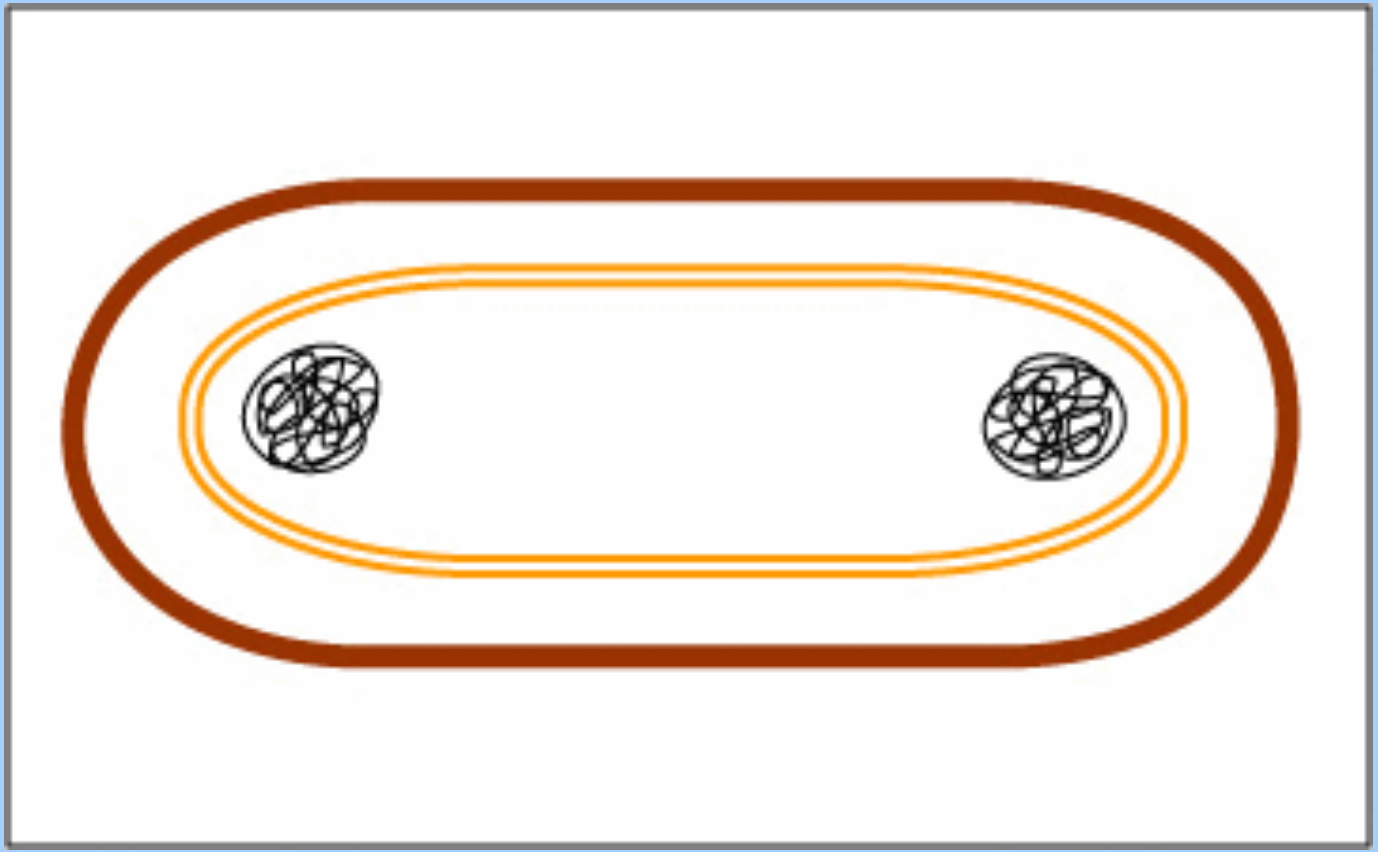
heat & Disinfectant



Spore formation



Spore formation



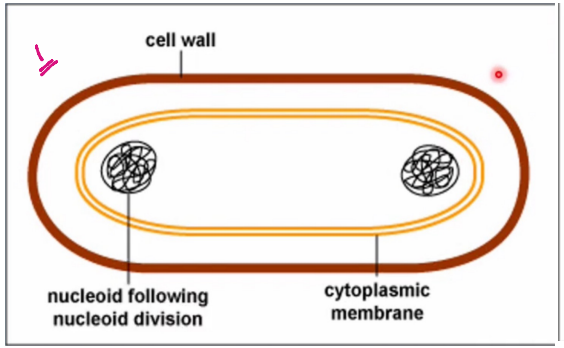
Ca+2 &

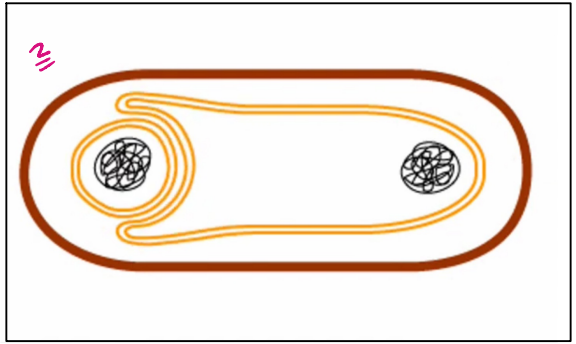
Diplconic acid

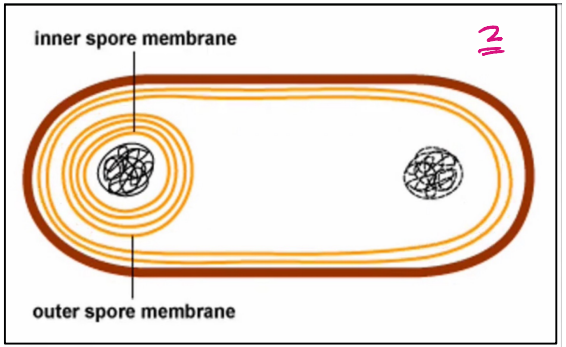
Steps of spore formation:

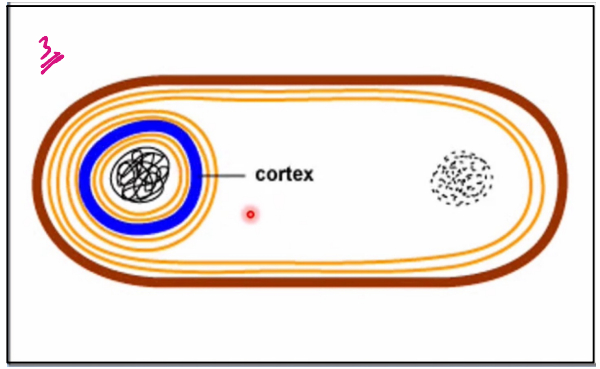
1. DNA replication each on one side
2. formation of layers of cell membranes & peptidoglycans
3. able to produce Ca+2 dipclonic acid (hard layer protecting it) named Cortex
4. formation of spore coat (formed from more than 80 types of proteins).
5. formation of exosporium (collagen like glycoprotein)
6. gets outside the cell & can live for many years

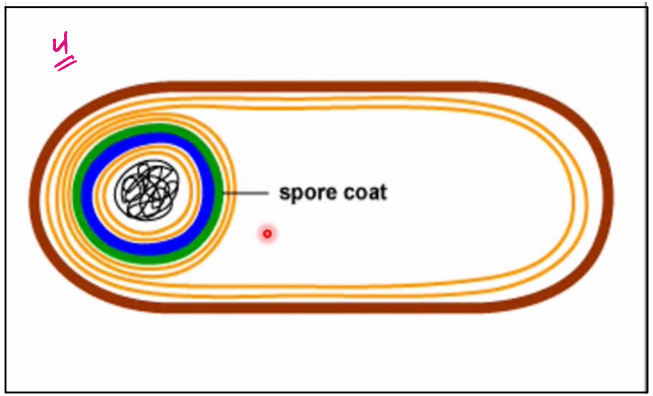
Multiple membranes

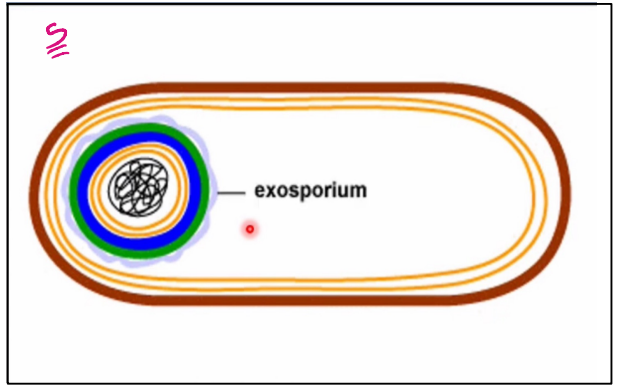

1
cell wall
nucleoid following
nucleoid division
cytoplasmic
membrane

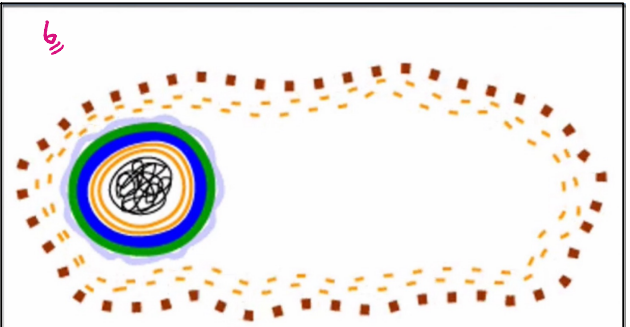

2


inner spore membrane
2
outer spore membrane


3
cortex

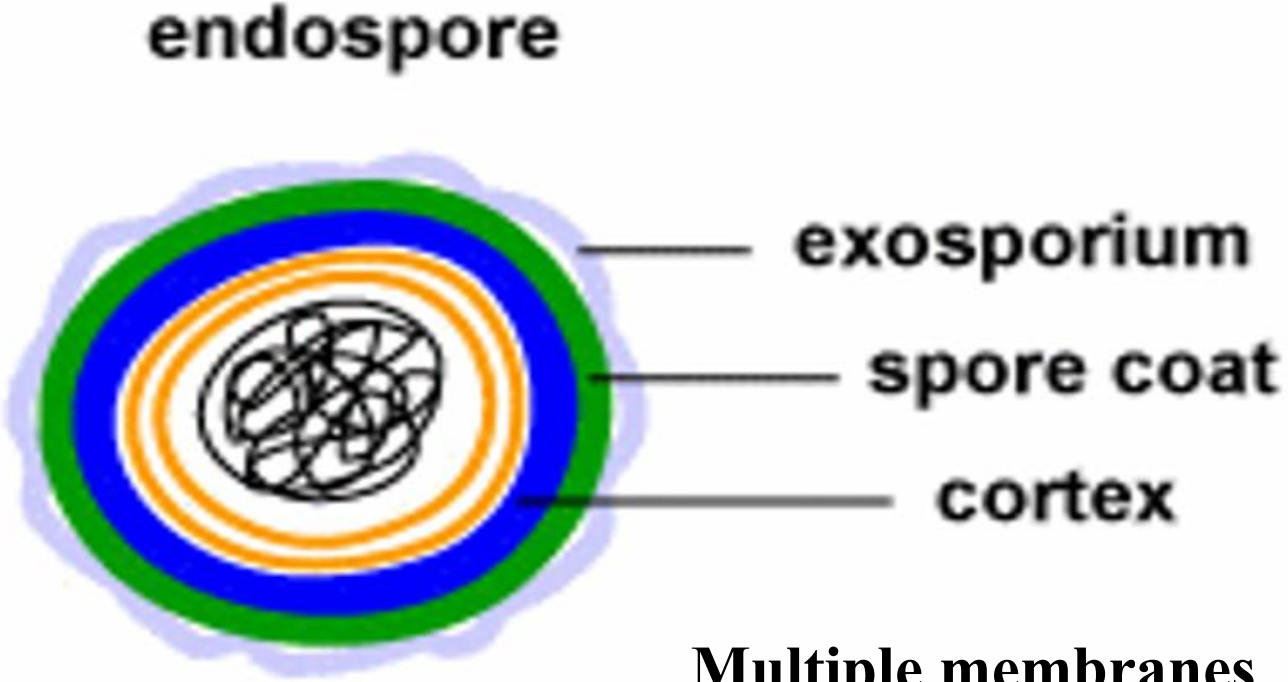

4
spore coat


5
exosporium


6

steps

Spore formation

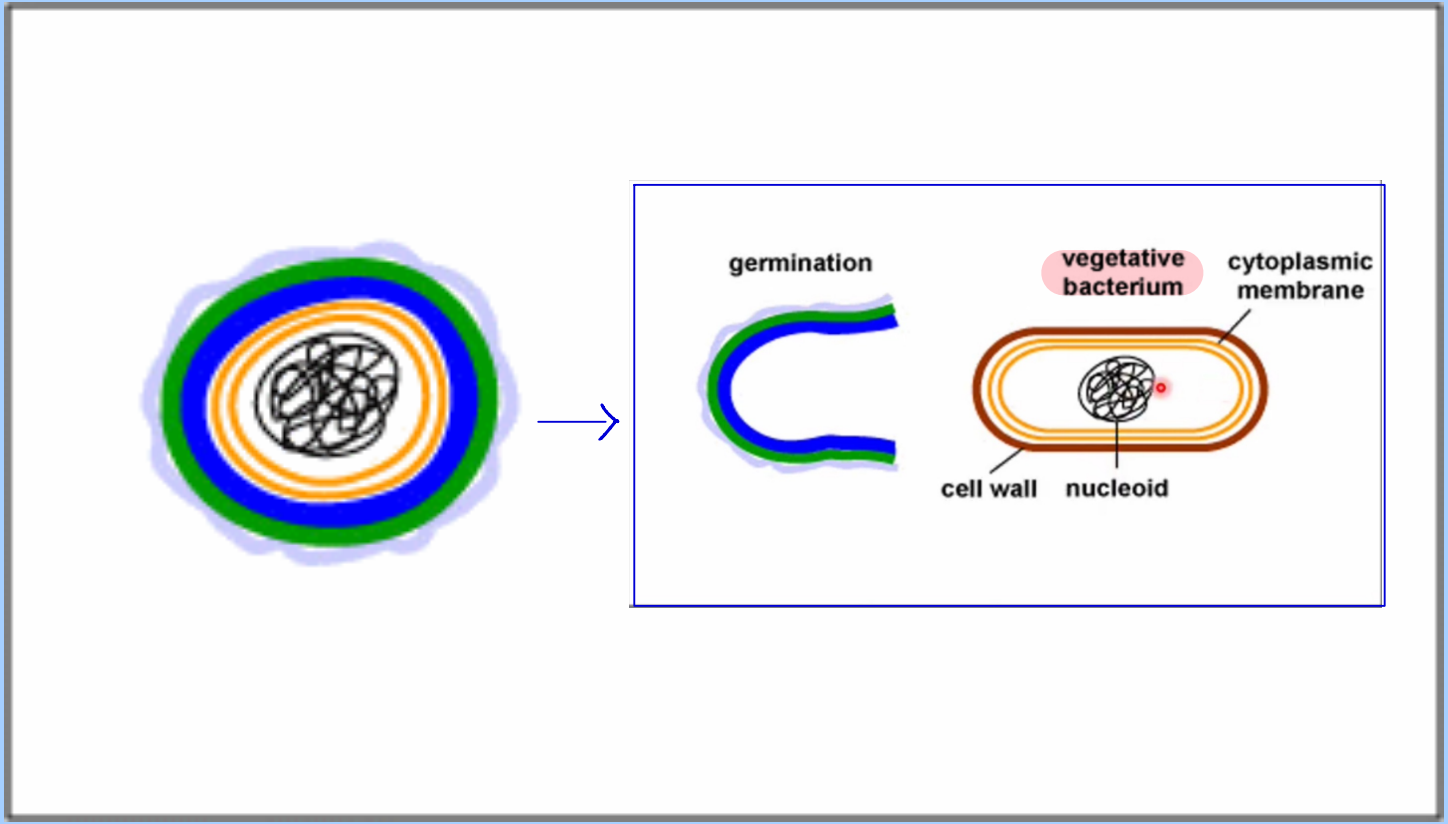


Multiple membranes

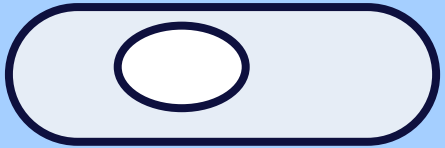
Germination

if found a host
it gets rid of cortex + spore coat + exosporium

& enter vegitative phase inside host cell



Position of spores



ex → *B. anthracis*

Central & Oval

location shape

ex → *Cl. perfringens*

Sub-terminal & Oval

ex → *Cl. Tetani*

Terminal & Spherical