



اللهم وفقني في دراستي، ونور بالكتاب بصري، وشرح به
صدري، واستعمل به بدني، واطلق به لساني، وقوّ به عزمي
بحولك وقوتك، فإنه لا حول ولا قوة إلا بك يا أرحم الراحمين

كل ما في السلايدات مطلوب حفظه و الملخصات
المذكورة في الملف هي وسيلة لتسهيل ربط المعلومات و
تضمن ملاحظات حكتها الدكتورة

وفقكم الله...

Microbiology

عامة ٣ :-

* في المحاضرة السابقة حينا عن ال Differences between Prokaryotic & Eukaryotic

- ① No nucleus ① Has nucleus
- ② Ex: Bacteria & Archaea

في تشابه بينهم لكن

ال Archaea عندها

Capability to live in extreme condition

• ولما قارنا بين Bacteria و Viruses و Fungi

① Bacteria ← Cell wall with peptidoglycan

⑤ Fungi ← Cell wall with chitin

③ Protozoa و Fungi و Bacteria ← All have chromosome

but they have difference

in ribosomal size

→ Bacteria: 70S / Fungi & Protozoa: 80S

④ Virus is not consider as cells

- they either have DNA or RNA, not both
- they either involuted or capsid
- Non motile, viruses totally dependent on their living on invaded cell

← تعقد في بقاؤها عن الخلية التي تقوم بغوا حبتها

Bacteria Can be replicated by binary fission ⑥

Naming of bacteria depends on: ⑦

- ① Shape ② Arrangement

⑧ Why once G^{-ve} bacteria is stained by ... لان

Primary stain & then using decolorizing agent, it easily be removed?

→ because of cell wall thickness, G^{-ve} bacteria cell wall is thin

Target of Penicillin is Peptidoglycan ← Note

① Gi-ve bacteria more resistant to

antibiotics, especially penicillins groups

compared to G+ve bacteria

→ because of its outer membrane (extra structure), the thick periplasmic space making difficult to reach peptidoglycan

② Stain is very important in:-

→ Determine the identity of microorganism on order to select the best treatment

③ Acid Fast Bacteria → specific stain

Red colored Carbol fuchsin

→ This stain is specific to discovery acid fast bacteria to bind to mycolic acid (waxy layer) presented on acid fast bacteria cell wall

مع الشحنات Covalent binding مع بروتين ال $\oplus$ charge مع $\ominus$ charge الموجودة على Bacterial cell wall

④ LPS (Lipopolysaccharides) → Gi-ve

more pathogenic (more Antigenic)

يعني اذا سببت مرض بغير المسألة لها سموم

releasing of lipid A هو endotoxin

لما يصير resistant bacteria تنقل هذا ال resistant gene عن طريق

ال plasmoid لبكتريا ثانية وكل وحدة يصير لها replication يصير عدد

هائل من البكتريا كلها تنقل نفس ال plasmoid وهذا ال plasmoid يحتوي

على resistant-genes (يعني ينقل تكثر مع البكتريا بشكل طبيعي)

Cytoplasmic (Plasma) membrane

- Thin layer 5-10 nm, separates cell wall from cytoplasm.
- Acts as a semi-permeable membrane: controls the inflow and outflow of metabolites.
- Composed of lipoproteins with small amounts of carbohydrates.
- The main function of the cell membrane is to regulate the movement of materials into and out of a cell by transport mechanisms. It synthesizes cell wall components, assists with DNA replication, secretes proteins, carries on respiration, and captures energy as ATP. It also contains bases of appendages called flagella.

→ cell membrane يتكون من الـ flagella
من الداخل الـ cytoplasm يتكون من الـ

Other Cytoplasmic Components

1. Ribosomes : Are of RNA and protein. often grouped in long chains called polyribosomes and their main action is protein synthesis.

Long chain of ribosomes

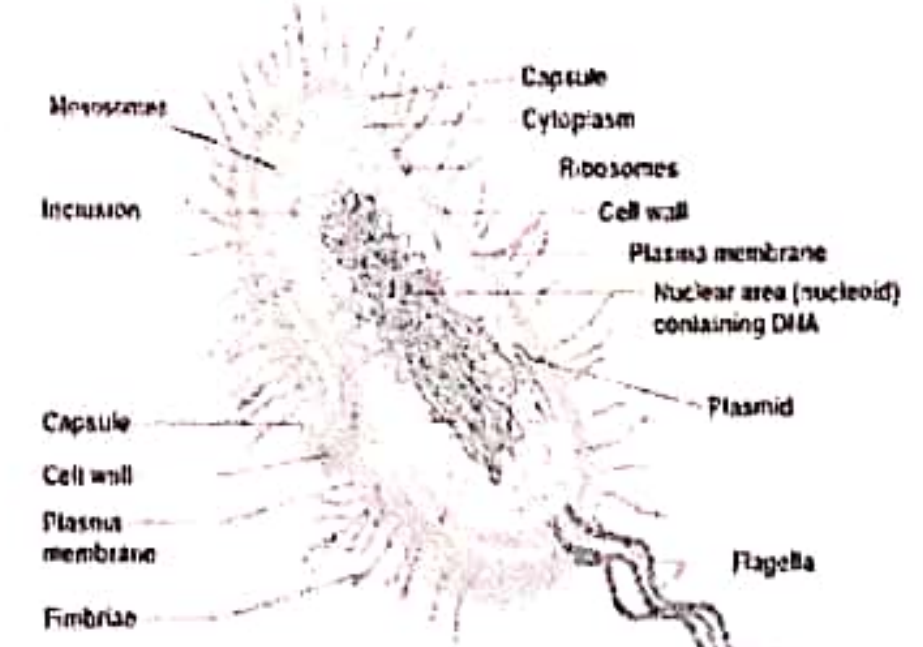
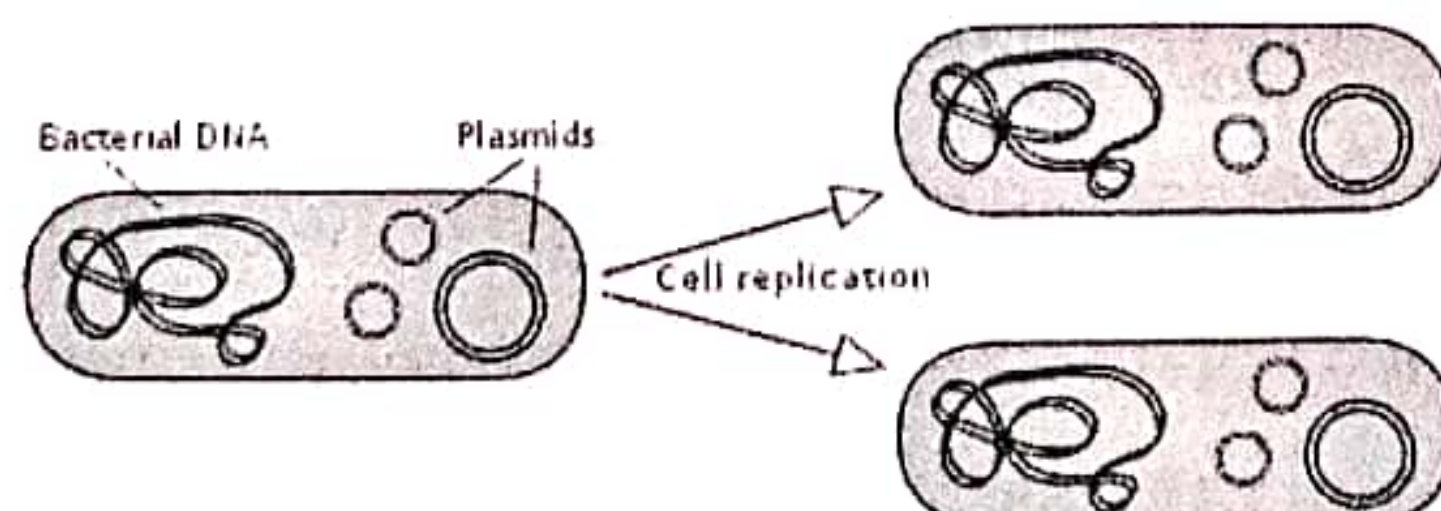
2. Nuclear Region : Polyribosomes

• No nucleolus- No nuclear membrane

• single, circular double stranded DNA

• Many bacteria exchange genetic information carried on plasmids
(small, specialized genetic elements capable of self-replication)

Circular DNA هو الـ Plasmoid
it carries extra genetic material
Important role يلعب
in bacterial resistance



* There is extra genetic (specialized genetic) presented in that plasmoid
هو الـ البكتيريا مع تساوي لارم تساوي

External Structure

- Bacteria also often have these features:

- flagella**-----movement

- pili**----- attachment not involved in movement.

اهداب

لتثبت حالها أكثر

- capsule**----- Protects bacteria from lytic enzymes and Inhibits phagocytosis

→ Extra Protection around bacteria

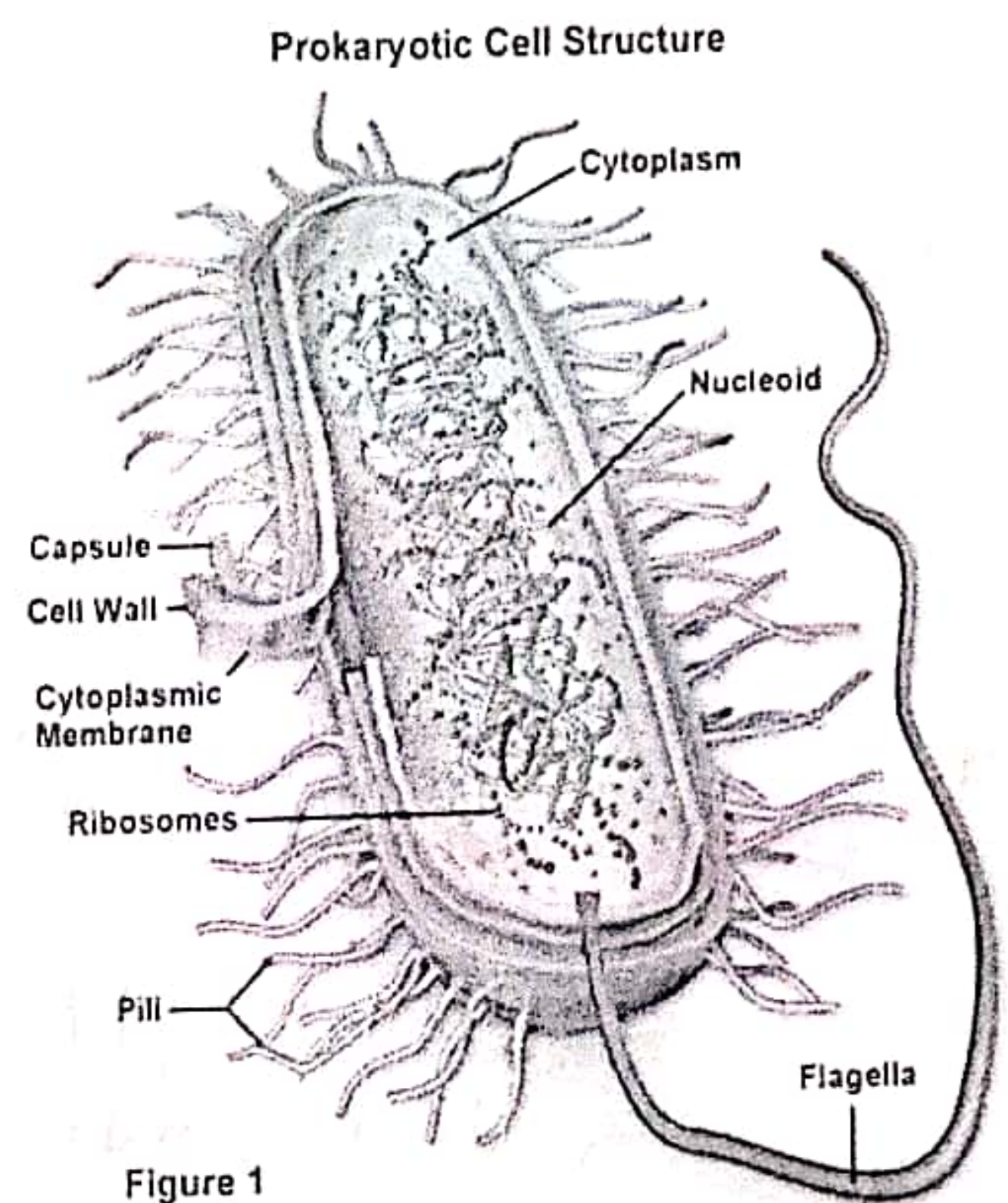


Figure 1

نوع ال Pili يكونوا Conjugation Pillus هي عبارة عن DNA بنقل من بكتيريا
خياره عن وسيلة تواصل بين 2 bacteria يلتصقا فال DNA بنقل من بكتيريا
ثانية ك بنية ال Sexual Production 6 هي كثير هذه Transferring of antibiotic
resistant gene

Types of pili

Bacterial Pathogenicity

لأنها تسببت حالها مع السطح خنقة أطول

1. Conjugation-pili: long pili, found in some groups of bacteria, attach 2 bacteria & DNA is transferred through them, a process called conjugation (like sexual reproduction). Results in transfer of antibiotic resistance among bacteria.

Pili for Conjugation Attachment

2. Attachment pili or fimbriae: short, attach bacteria to surfaces or air-water interface. Contributes to the pathogenicity of certain bacteria-ability to produce disease-by enhancing colonization on surface of cells of other organisms

قدرة البكتيريا على إلتصاق سطح
ال Disease

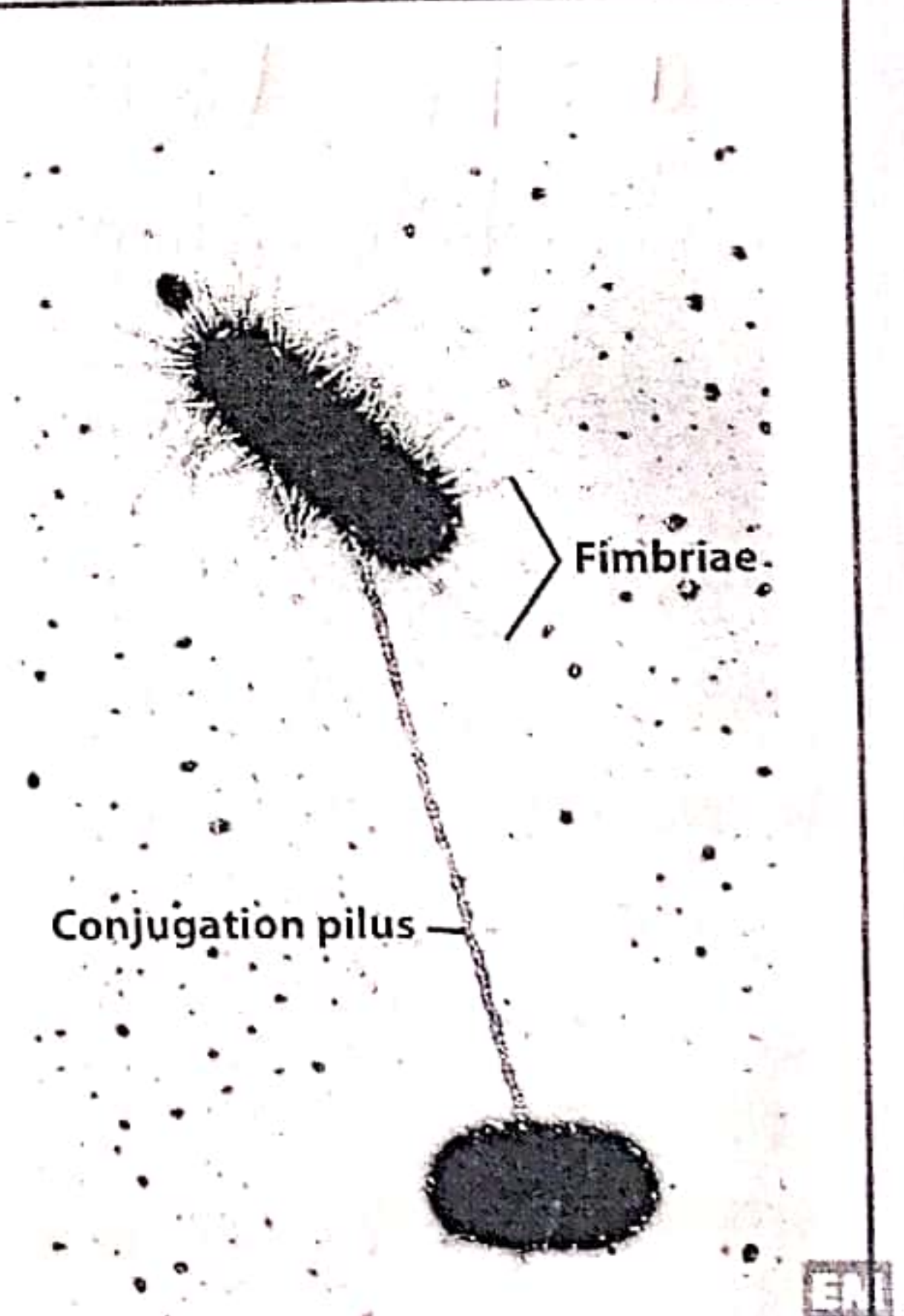


Figure 4-16 Microbiology, 7/e
Courtesy Charles C. Brinton, Jr., and Judith Carnahan

كيف البكتيريا تقاوم ؟ Different genes من بكتيريا A إلى
بكتيريا B ف مع تنقل معدن عن طريق Transfection (فيروسات)
او من بكتيريا لبكتيريا من خلال Conjugation و
هنا Conjugation Pili

Note

* البكتيريا بشكل عام المشكلة ما يتجني من البكتيريا (itself) البكتيريا ذات نفسها
 هي يتجني من الـ **Sporulation** مكنيا للبكتيريا في DNA فلما البكتيريا
 بدما تحافظ على المادة الوراثية التي فيها لما تتعرض لـ extreme condition فتألف
 بنشوة خاصة بـ **Gram +ve bacteria**

Structure of Bacterial Cells: SPORES

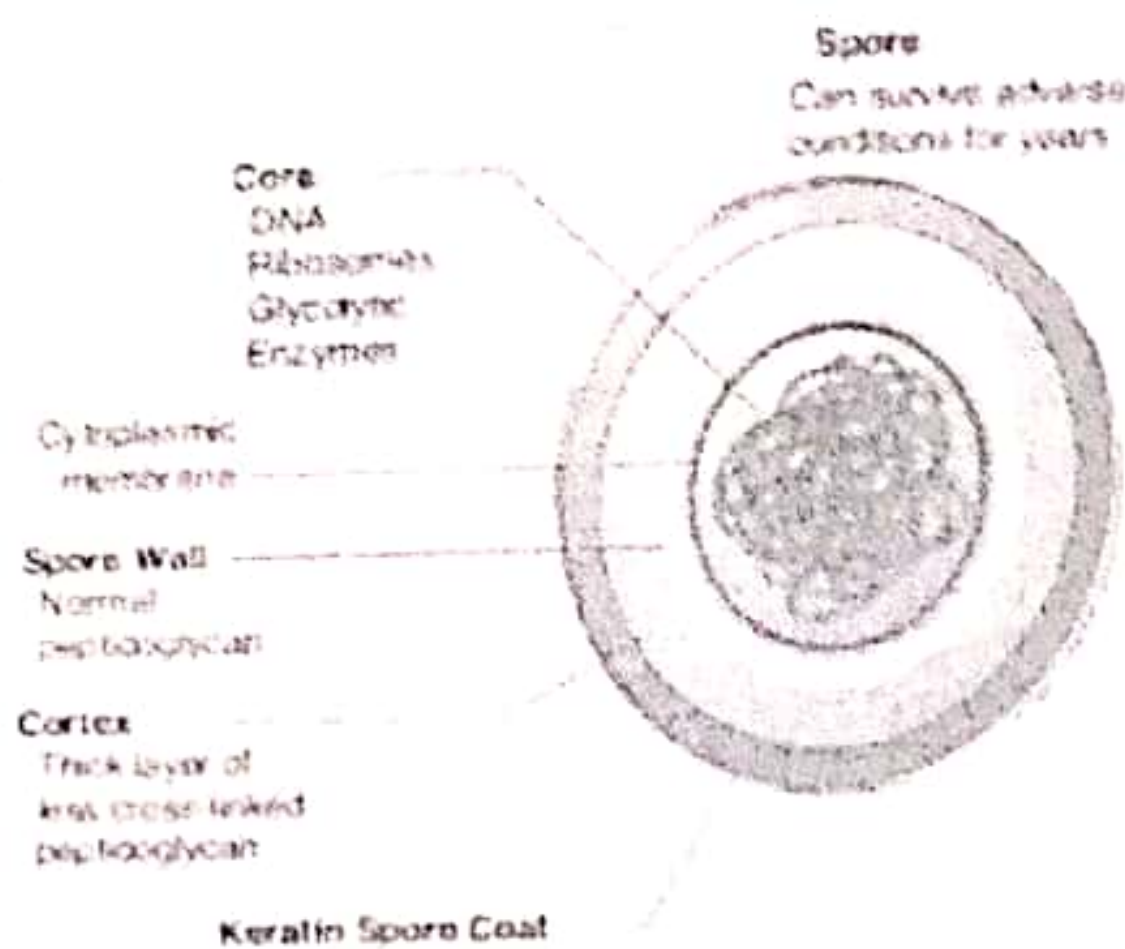
- To enhance survival during periods of environmental hostility some gram-positive rods form of a dormant cell called an endospore inside the original cell.

Species of *Clostridium* bacteria ⑤ *Bacillus* bacteria ①
 Endospores can be released from the original cell as free spores.

- Endo → لأنه طلع من الداخل
 it is capable to live in extreme environment
- Spores are the most resistant life forms known.

Can't be Killed by antibiotics
 Can't be Killed by disinfectant or antiseptic

- Sporulation: a process where bacteria prepare for the possibility of future adverse conditions



Dormant endospore

طور سكون تفعله
 البكتيريا عند الشعور
 بالخطر

What is the medical important for this condition?

① Spores highly resistant for antibiotics (not any solution can kill this spores)

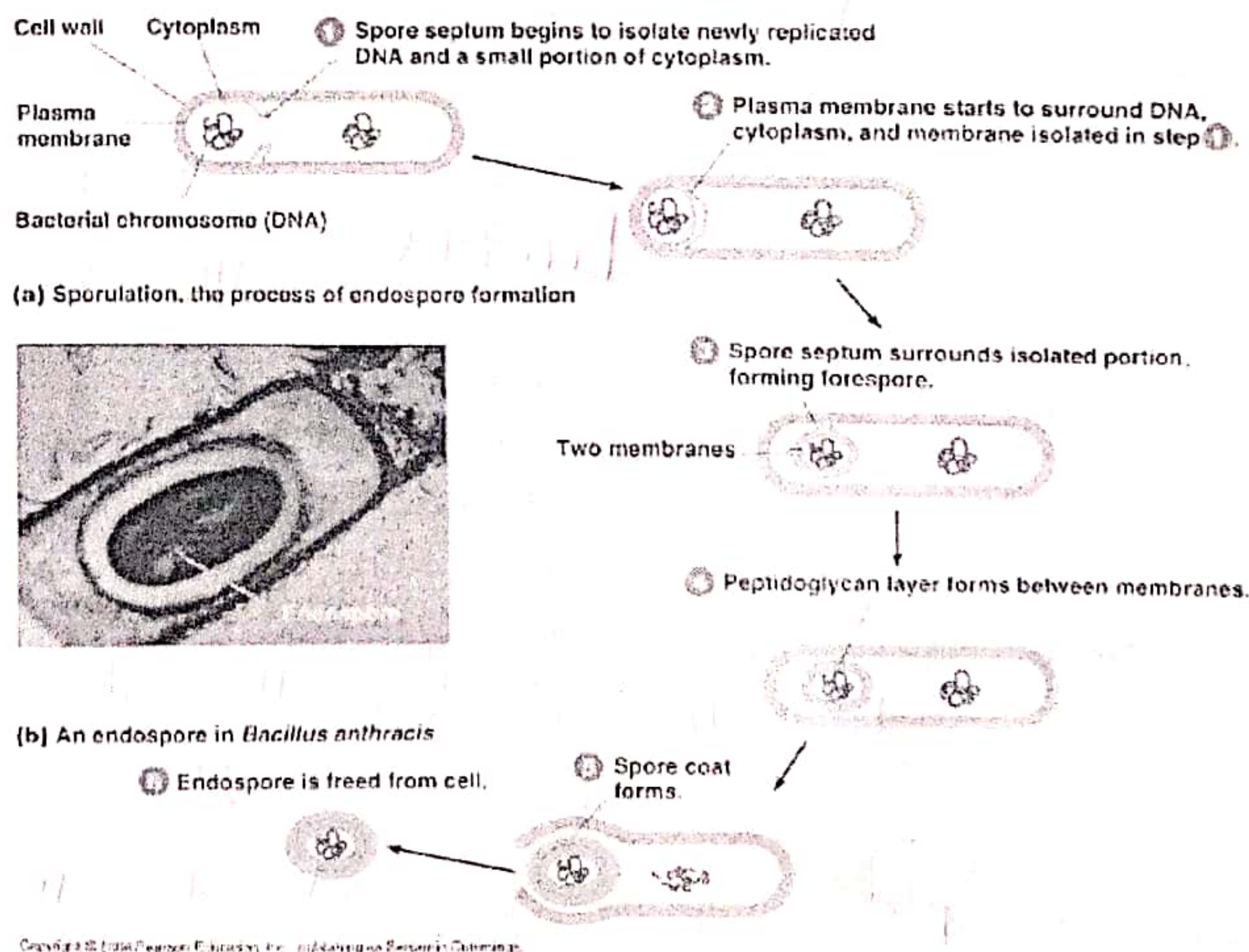
② sterilization should be by autoclave → instrument أي
 عن طريق الحرارة العالية
 والضغط العالي

Sporulation Process

Examples of Spore forming Bacteria-

Spores formed by only two genera of Gram-positive rods are of medical importance.

Bacillus spp
Clostridium spp



Medical significance of sporulation

- Spores can survive for many years in soil and other inanimate objects.

- Wound contaminated with soils can be infected with spores and cause diseases such as tetanus, gas gangrene.

- Spores are highly resistant to many chemicals, including most disinfectants and antibiotics.

- Only solution designated as sporicidal will kill spores.

Kill Spores:-

- Antibiotic
- disinfectants
- sporicidal solution

- Spores of these organisms can remain viable for many years and are generally not killed by boiling, but they can be killed by autoclaving (that is, subjecting the spores to temperatures above 120°C at elevated pressure).

← الـتـعـقيم تحت حرارة عالية و ضغط عالي

كيف تحت الـ Sporulation ؟ المادة الوراثية يتم نسخها وتحتوي بها

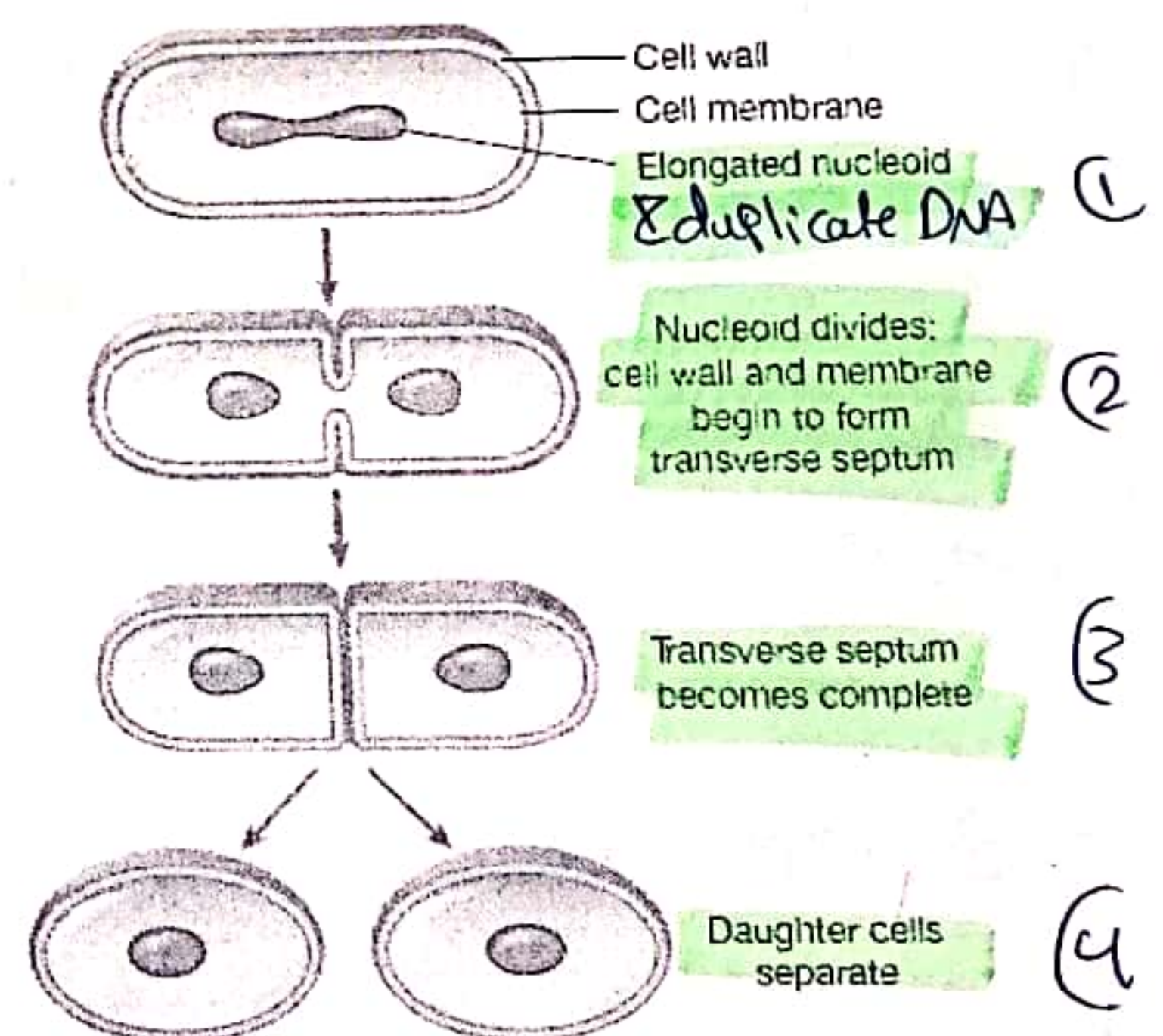
تحتل Septums (فواصل) يتم زياد طول الفواصل ومن ثم تحت حاليًا بـ Plasma membrane
يعني تضاف نسخة عنها بحمها عتس بشرط الشدة تكون Highly Protected

لأنها حالة بـ Extra Spores وتحتوي Peptidoglycan وكثي تحت يـ الـ Spore جـلـز

Cell Division

- In binary fission, a cell ① duplicates its components and ② divides into two cells.

- In continuously dividing cells, DNA synthesis also is continuous and replicates the bacterial chromosome shortly before the cell divides.



① Duplicate DNA

② forming transverse septum

③ complete transverse septum

④ Here there is two cells

هــون الاختلاف في كـر و حـو و حـا
ولا حـو و حـا

Types of bacteria

A. Typical bacteria → ①

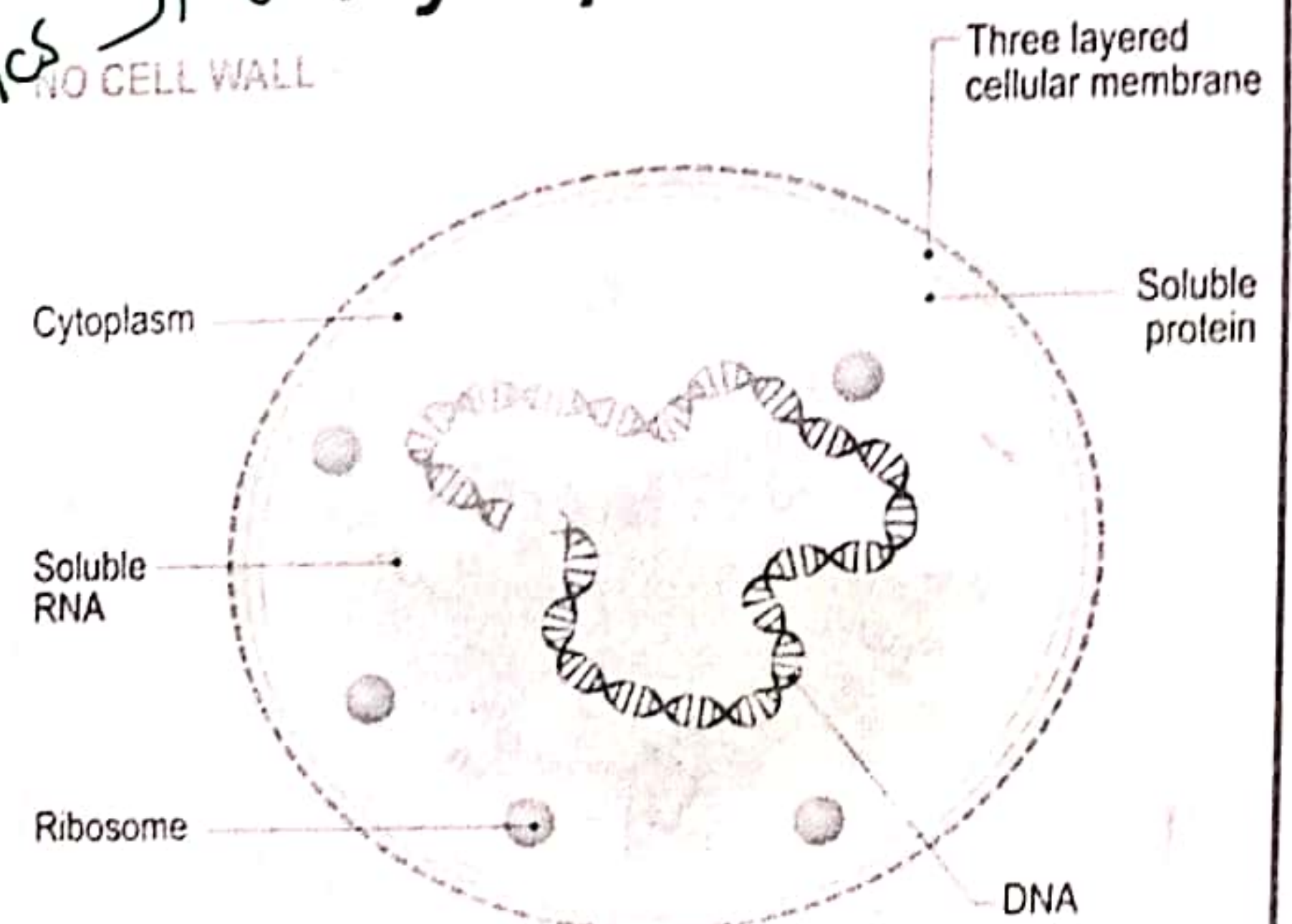
B. Atypical bacteria: → ②

include groups of organisms such as Mycoplasma, Chlamydia, and Rickettsia that, although prokaryotic, lack significant characteristic structural components or metabolic capabilities that separate them from the larger group of typical bacteria

Atypical bacteria

→ Prokaryote Bacteria, they don't have cell wall
(there is something missed in this bacteria)

لا تسحب لاسي نوع
Antibiotics Mycoplasma
NO CELL WALL



Types of bacteria – energy production

• حسب الحاجة للكسجين :-

- 1. **Aerobic bacteria: needs oxygen for survival and energy production.**

Example: *Pseudomonas aeruginosa*.

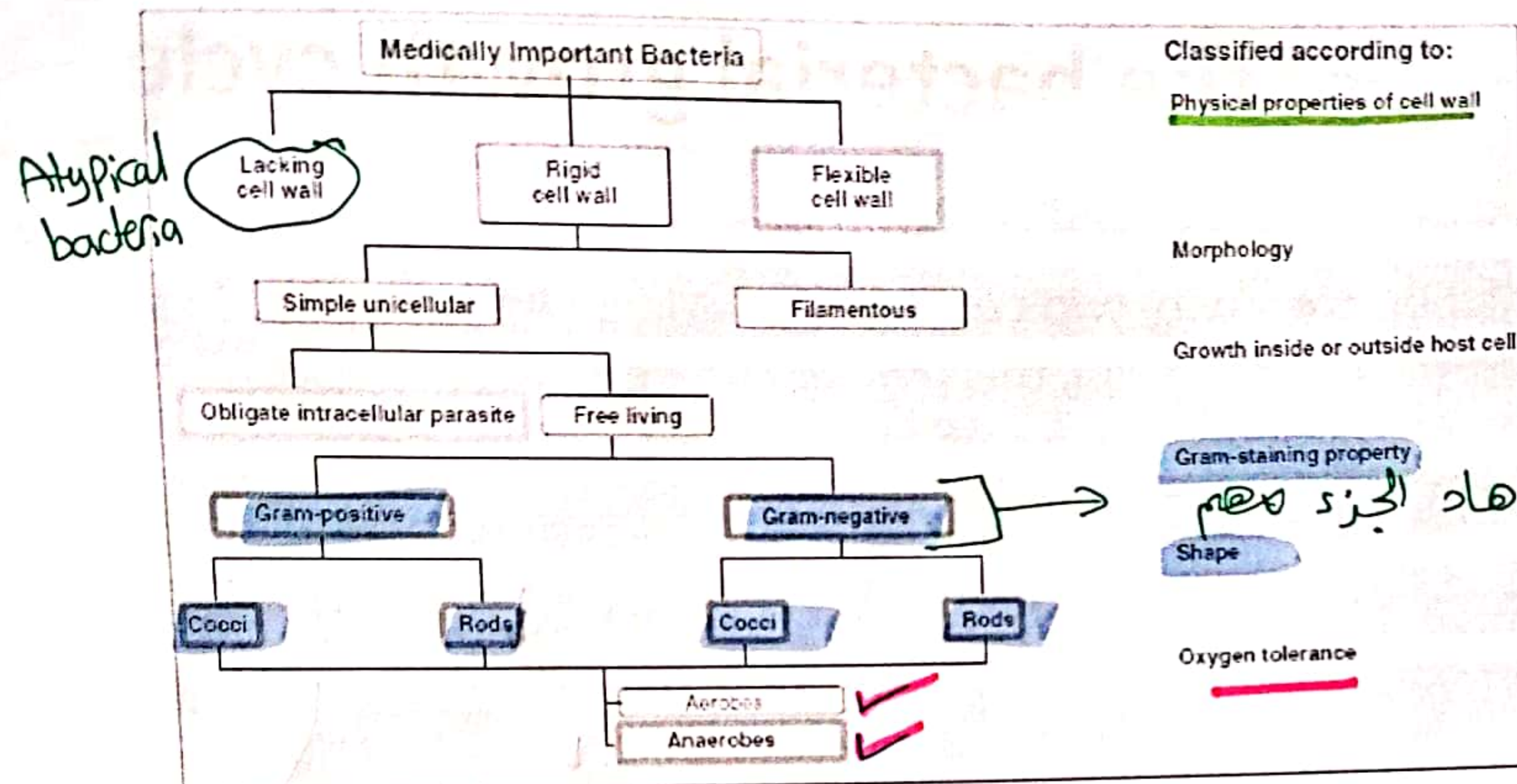
- 2. **Anaerobic bacteria: cannot live in the presence of oxygen.**

Example: *Clostridium tetani*

→ Oxygen is toxin for this type of bacteria
(can't live in presence of oxygen)

خاصة البكتيريا التي تعيش في الـ GI

Hierarchical classification of clinically important bacteria according to six distinguishing characteristics.



Classification of Microbes:

Classification of Bacteria:

Medically important Bacteria are divided into three groups:

1-Lacking Cell Walls: Example: *Mycoplasma*

2-Flexible (have Cell Walls):

Example: Spirochetes (*Treponema*).

3-Rigid Cell Walls:

A- Filamentous bacteria: (antibiotic producers).

Example: *Streptomyces*.

B- Simple Unicellular:

1-Obligate intracellular parasite:

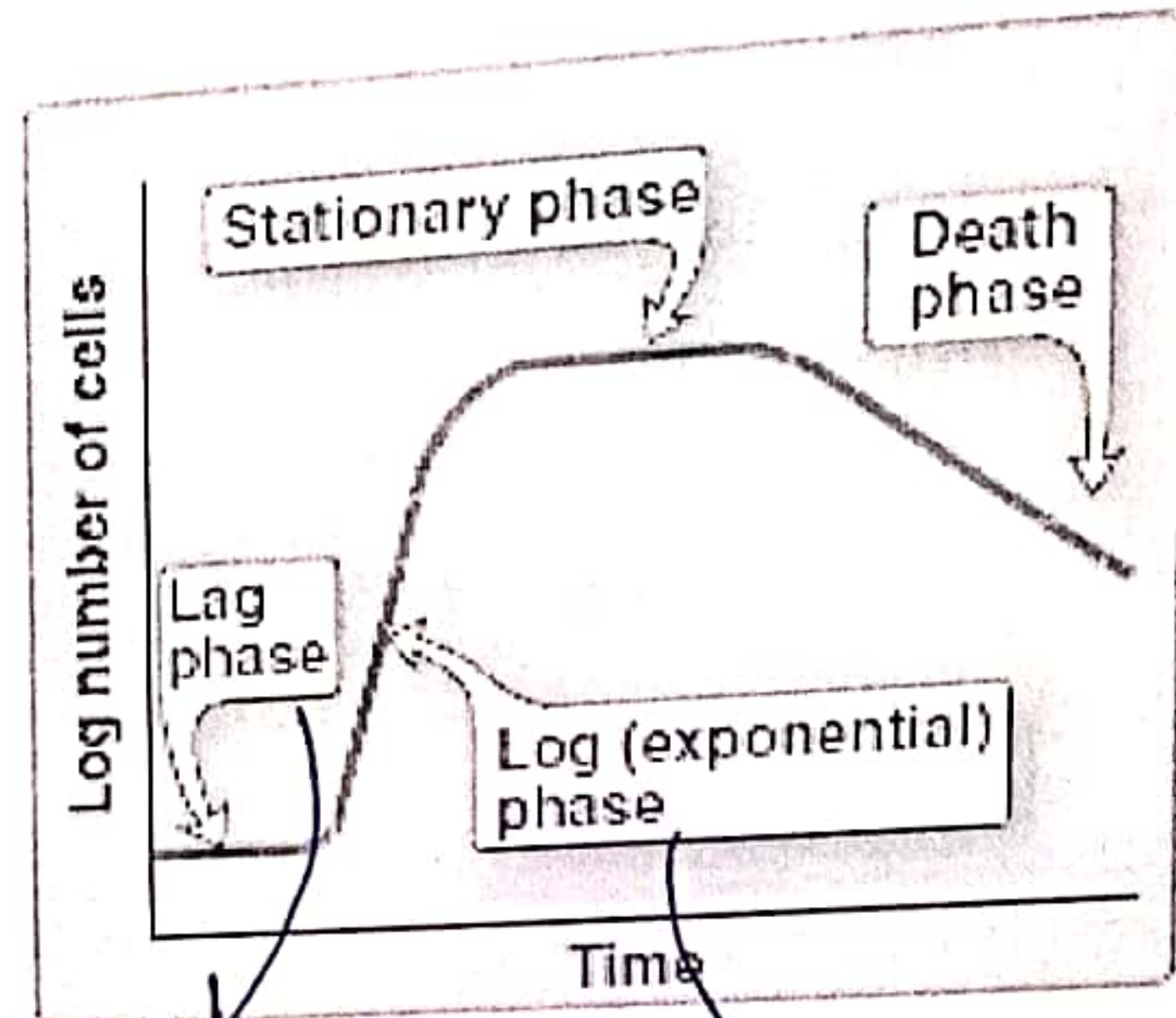
Example: (*Rickettsia*, *Chlamydia*).

2-Free-living bacteria:

Examples

Stages of the bacterial growth cycle

- Because bacteria reproduce by binary fission (one becomes two, two become four, four become eight, etc.), the number of cells increases exponentially with time (the exponential, or log, phase of growth).
- Eventually, growth slows and ceases entirely (stationary Phase) as nutrients are depleted, and toxic waste products accumulate. Most cells in a stationary phase are not dead



شبه في
Lag
في
Log

* زيادة الوقت يعني ← زيادة عدد البكتيريا

لكن لحد معين ... ليس ؟

هنا أول Phase
اسمها Lag Phase

فرضاً عدد البكتيريا 2×10^3 (يعني صون ثابت) كدونا نعرف في هي

Prepare itself for
replication Phase

ال Phase هي metabolically active

هنا Log Phase يزيد عدد البكتيريا هنا مع زيادة الوقت

لحد ما نوصل Stationary Phase هنا يثبت عدد البكتيريا
مع الوقت بسبب :- ① في من البكتيريا يقل فبسبب قلة العدد مع الزيادة
فلا يلاحظ الفرق أن زيادة بسبب وفاة بكتيريا أخرى

لكن لا حار nutrients totally lacking دخلت البكتيريا في
ال Death Phase

Summary of Previous Slides

لجاء العودة في الدراسة
الى السجلات و هذا
الملاحظ كوسيلة مساعدة
لتسهيل ربط وحفظ المعلومات
ولا يسهل جميع المعلومات
فقط من يصعب ربطها

Structure of bacterial cells

Lipopolysaccharide (LPS)

- Are endotoxins
- Important part of the outer membrane
- Used to identify G-ve
- an integral part of cell wall
- not released until cell wall of bacteria is dead & broken down
- Contain: Polysaccharides & Lipid A

Periplasmic Space

- most easily observed by electron microscopy of G-ve
- Very active area of cell metabolism
- Contain: Peptidoglycan, digestive enzymes, transport protein

Cytoplasmic membrane

Functions

- ① Thin layer (5-10nm)
- ② Separate cell wall from cytoplasm

③ Composed of :-

- lipoprotein with carbohydrate
- Ribosomes RNA & Protein (Protein synthesis)

Nuclear region

- no nucleus & nuclear membrane
- single, circular double stranded DNA
- Has Plasmid

Flagella

- ① Control inflow & outflow of metabolites Semi permeable
- ② regulate movement
- ③ synthesis cell component
- ④ Assist DNA replication
- ⑤ Secret Proteins
- ⑥ Carries on respiration
- ⑦ Capture energy as ATP

note

Transport Protein:- Destroy Potentially harmful metabolites & transport metabolites into cytoplasm

External Structure

Flagella → movement

① Capsule → Extra protection around the bacteria from lytic enzyme

② Inhibit Phagocytosis

Pili → Attachment, not movement

Conjugation pili

Fimbriae

- Long pili

- make Conjugation

like sexual reproduction

results in transfer of antibiotic

resistance among bacteria

by attach 2 bacteria & DNA transfer between them

- Short

- attach bacteria to surfaces or air-water interface

- increase pathogenicity

Spores

Structure of bacteria
Structure is قتل of bacteria

علاجه يكون شرج

Sporulation

A process where bacteria prepare for the possibility of future adverse condition

✓ Enhance survival of Give rods form of dormant endospores inside cell original cell

✓ Spores are most resistant life form known

Genera that forms Spores are

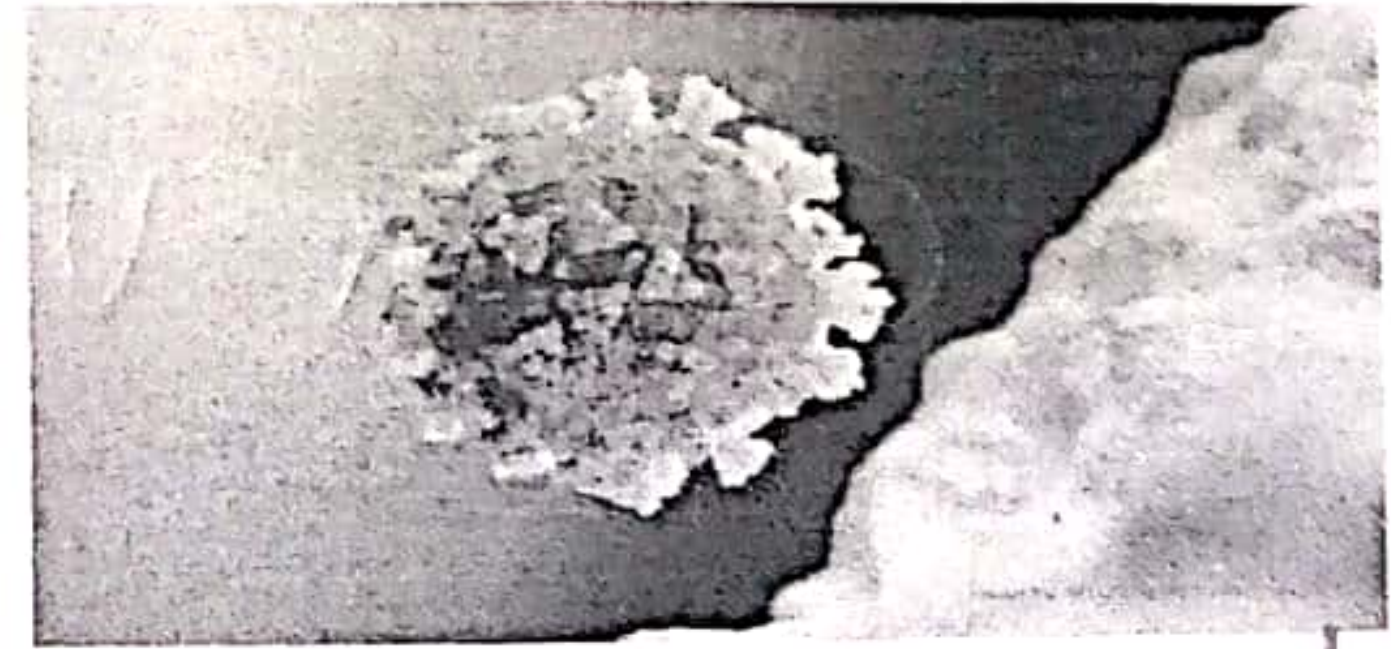
→ Bacillus spp

→ Clostridium

ذكرناهم بالأسفل
بعض هيكل عظام
كثيرات تكون
حقيقيات العالكة

✓ Spores not killed by boiling or Alcohol
Can be killed by Sporicidal Solution

Antibiotic
من البكتيريا
أو وسيلة قتل
لها



Viruses

Lecture #3

Pharmaceutical Microbiology

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What Are Viruses?

- **Viruses** are infectious agents that are too small to be seen with a light microscope and that are not cells.
- They have no cell nucleus, organelles, or cytoplasm.
- **Viruses can** replicate, or multiply, only inside a living host cell. As such they are called **obligate intracellular parasites**.
→ Totally dependent on host cell
→ because it is can't be divided unless it is Presented in host cell
- Viruses don't grow or replicate alone, they infect host cell & program it to synthesize the components of new viruses

Viruses

→ No nucleus

→ No ribosomes

→ it is DNA or RNA surrounding by an enveloped or a capsid **Extracellular**

DNA → Double stranded
RNA → single stranded

Corona Viruse → RNA Viruse
Corona Viruse → Envelope

Components of Viruses

note

• Nucleic Acids

- a virus consists of molecule(s) of DNA (DNA virus) or RNA (RNA virus) but not both.

RNA فيروس

- Viral nucleic acid can be single-stranded or double-stranded, and linear, circular, or segmented (existing as several fragments).

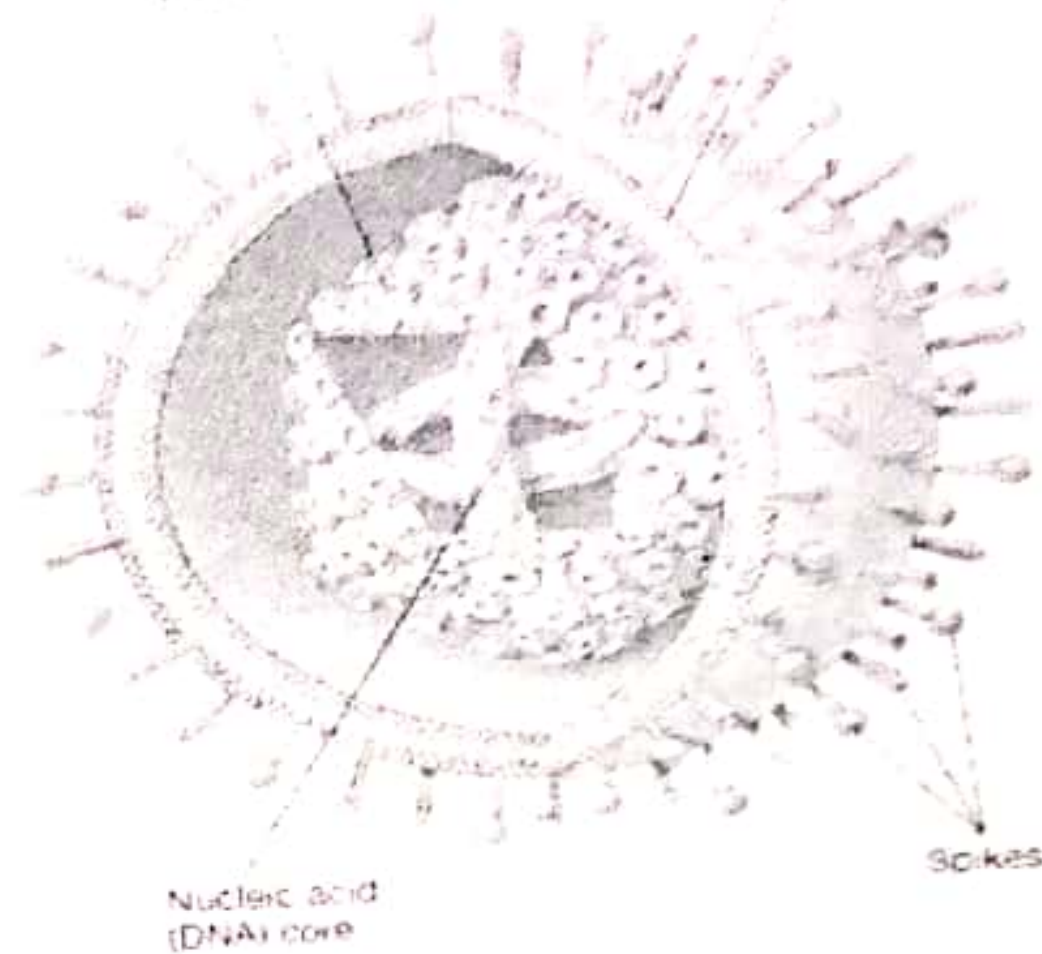
- All genetic information in RNA viruses is carried by RNA. RNA genomes occur only in viruses and a virus-like agent called the viroid.

DNA material

RNA material

باعتبار الفيروس

سكن حكي نفع أكثر
DNA single stranded
DNA double stranded
RNA single stranded
RNA double stranded



عنا يضل الفيروس على
capsid

Components of Viruses

- Capsid:** a protein-containing structure (capsid) designed to:

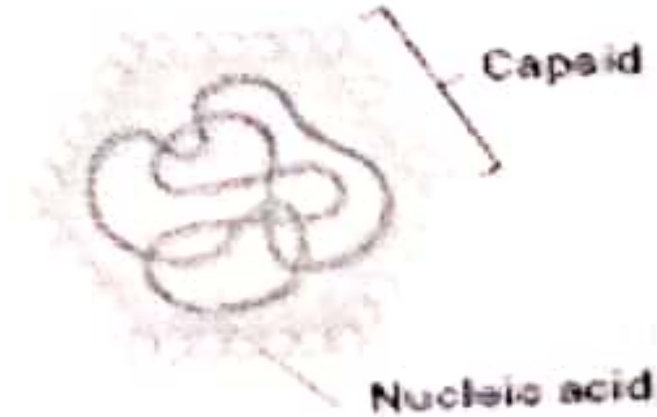
1. protect the genome.
2. Capsids also play a key role in the attachment of some viruses to host cells. & to protect genetic material inside virus

- Each capsid is composed of protein subunits called capsomeres

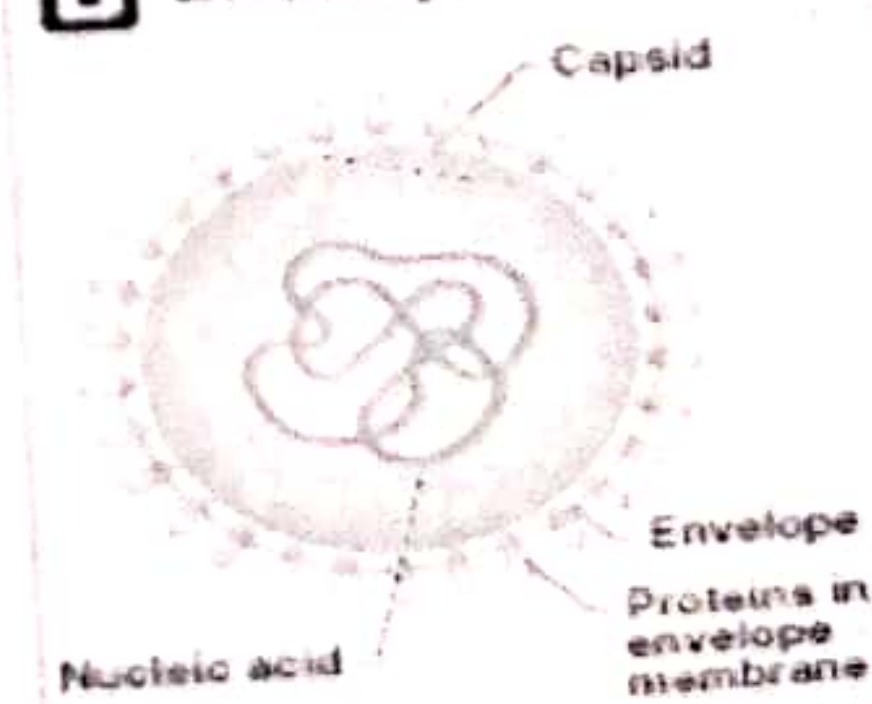
Polymer of capsomeres to make capsid

capsid ← [O O O] → capsomeres

A Nonenveloped virus



B Enveloped virus



General structure: A. nonenveloped; B. enveloped virus.

Envelope → Lipids مع بروتين bilayer

Extra Protection for viruses

Components of Viruses-Envelope

- Many viruses have additional structural features, for example, an envelope composed of a protein-containing lipid bilayer.

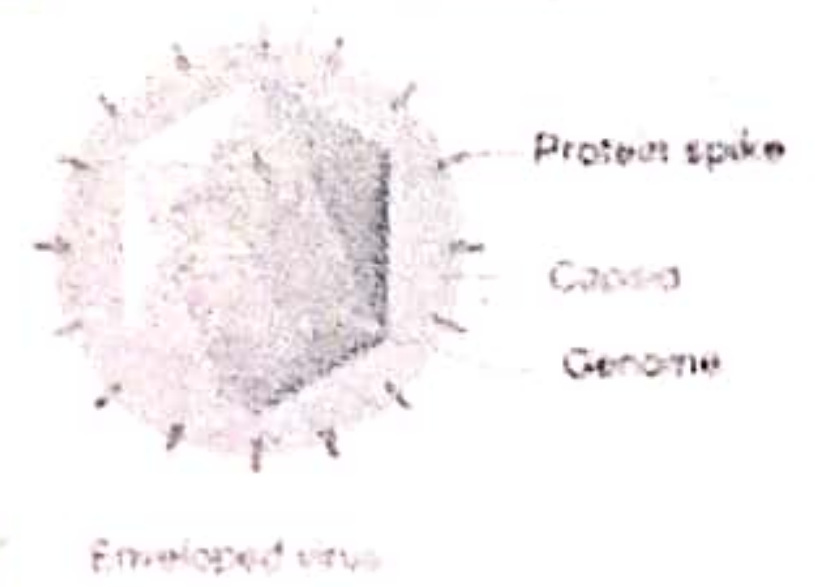
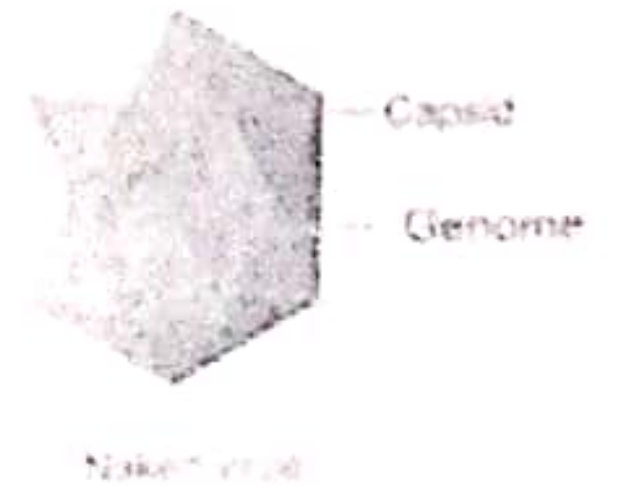
Advantages: *الفيروسات التي تحتوي على غلاف* *تستطيع الدخول داخل خلية المضيف وتكرار نفسها*

- Because derived from host cell membrane, virus can be **hidden from attack by host immune system.**

- Help virus infect new cells by **fusion of envelope with host cell membrane**

Disadvantages:

- Enveloped viruses are **damaged easily by any environmental condition that destroys biological membranes**



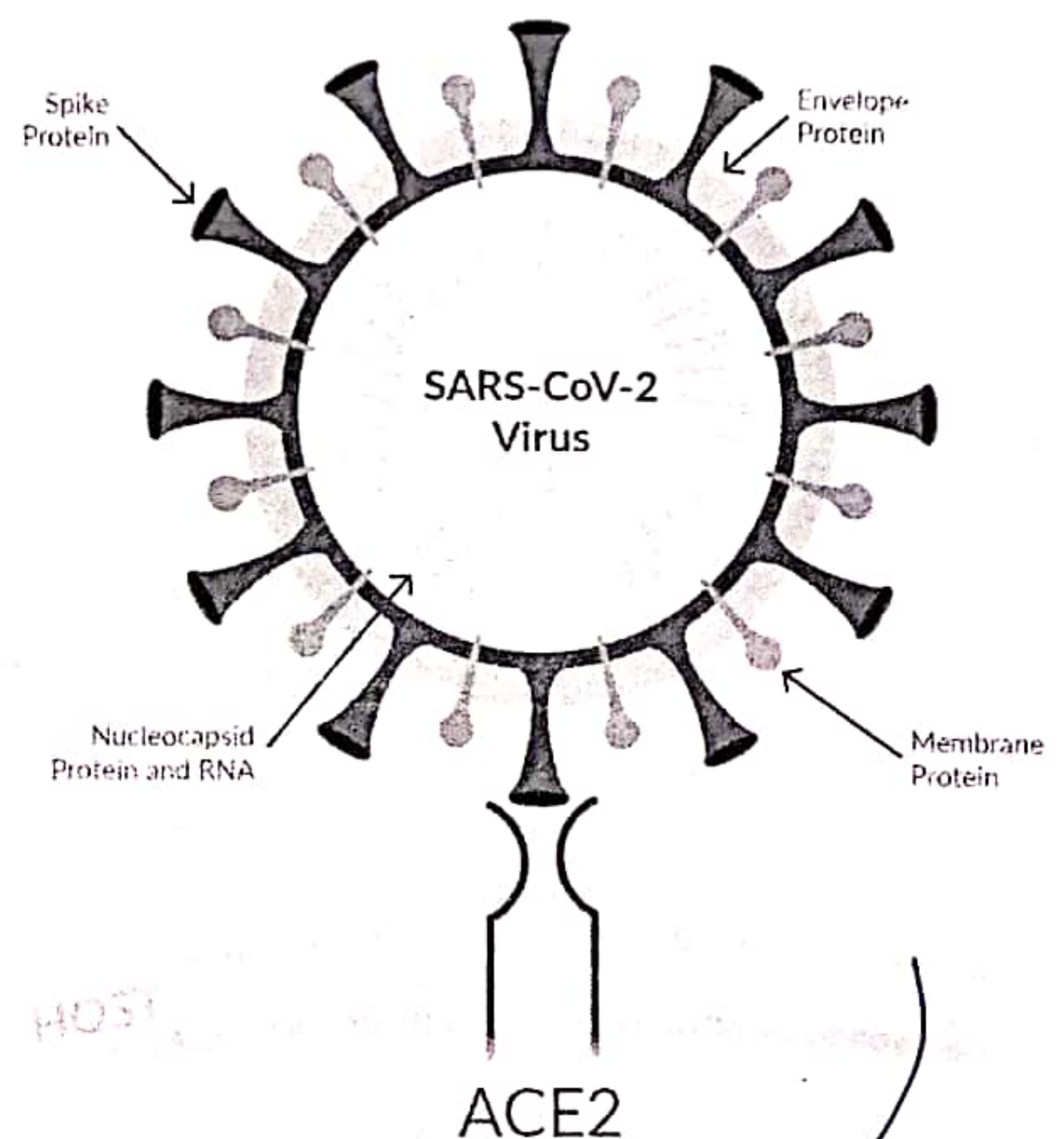
الفيروسات التي تحتوي على Envelope تسبب

الأعراض (Diseases) أكثر من التي لا تحتوي

على envelope لأنها الـ envelope تحمي بـ Capsid + envelope
فالجهاز المناعي يصعب يميزها ويهاجمها

Components of Viruses

- Some viruses have **spikes** on their envelope which are **glycoprotein** projections that may extend outside the envelope.
- Spikes help to attach the virion to host cell.
- Spikes play a role to determine antigen characteristics of the enveloped virus.



Corona Viruse
is enveloped
protein