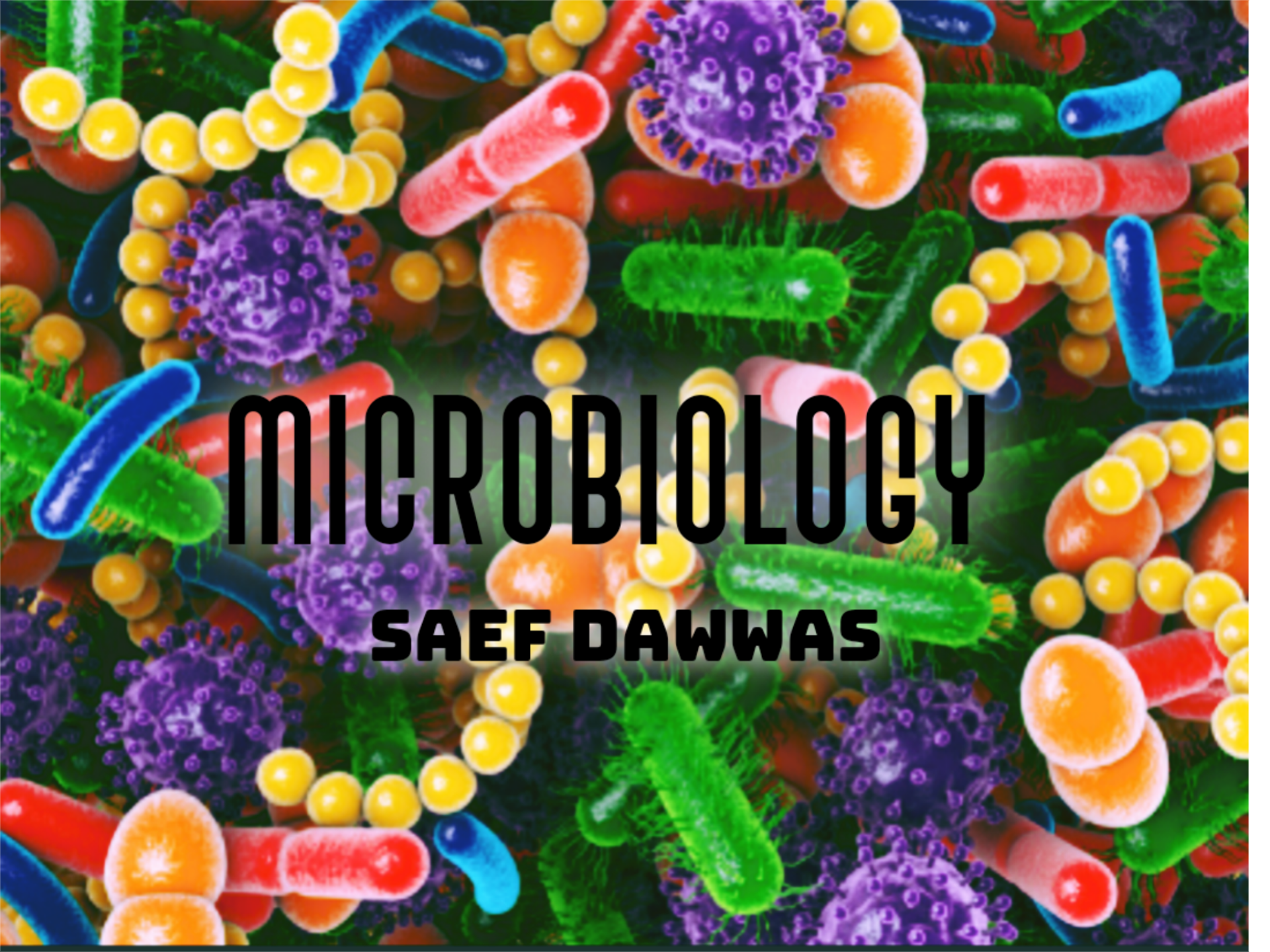
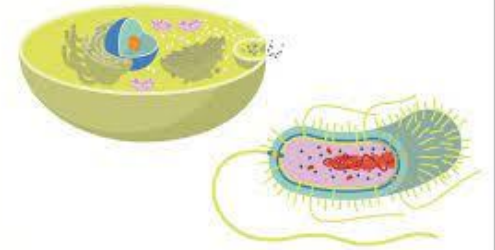




# **MICROBIOLOGY**

**SAEF DAWWAS**



# Prokaryotic & Eukaryotic cells

Lecture# 2

## **Pharmaceutical Microbiology**

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# EUKARYOTES & PROKARYOTES

- The names given to the two cell types derive from Greek words:

*Procaryotic* = 'before nucleus' (بدائية النواة (يعني ما عندها نواة عشان تتواجد فيها الرايبوسومات)

*Eucaryotic* = 'true nucleus'

- Similarities:*

1. Cell contents bounded by a plasma membrane

غشاء

الغشاء عشان يحمي الخلية  
ويحافظ عليهم وعلى مكوناتها  
على انها تضل مع بعض

2. Genetic information encoded on DNA double stranded

بكون

3. Ribosomes act as site of protein synthesis

# EUKARYOTES & PROKARYOTES

- *Differences*

**TABLE 1-3** Characteristics of Prokaryotic and Eukaryotic Cells

| Characteristic                                                | Prokaryotic Bacterial Cells | Eukaryotic Human Cells |
|---------------------------------------------------------------|-----------------------------|------------------------|
| DNA within a nuclear membrane                                 | No                          | Yes                    |
| Mitotic division                                              | No                          | Yes                    |
| DNA associated with histones                                  | No                          | Yes                    |
| Chromosome number                                             | One                         | More than one          |
| Membrane-bound organelles, such as mitochondria and lysosomes | No                          | Yes                    |
| Size of ribosome                                              | 70S                         | 80S                    |
| Cell wall containing peptidoglycan                            | Yes                         | No                     |

حجم الريبوسومات بهمني في الميكروبات عشان ال medical treatment ويقاس بوحدة  
اسمها sued berg ورمزها S



الخلايا بدائية النواة ما عندها nuclear membrane  
عشان تحفظ فيه ال dna فعشان هيك بكون مكان  
وجودوا في ال cytoplasm (السائل الخلوي) بس  
محاط ببروتين مغلف

وكمان هاذ ال dna ما بكون مربوط مع histone  
(عبارة عن protien structure) فالتكاثر تاعو بختلف  
بكون بأشي اسمو binary fushion  
(الانشطار الثنائي)

## Summary of differences between prokaryote and eukaryote cells

| Prokaryotic cells                                                                                                                    | Eukaryote cells                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Small cell ( $< 5\mu\text{m}$ )                                                                                                      | Larger cells ( $> 10\mu\text{m}$ )                                |
| Always unicellular                                                                                                                   | Often multicellular                                               |
| No nucleus or any membrane bound organelles                                                                                          | Always have nucleus and membranes bound organelles.               |
| DNA circular, without proteins                                                                                                       | DNA is linear and associated with proteins to form chromatin.     |
| Ribosomes are small 70S                                                                                                              | Ribosomes are large 80S                                           |
| No cytoskeleton                                                                                                                      | Always have cytoskeleton                                          |
| Motility by rigid rotating flagellum made from <u>flagellin</u> <span>الحفاظ على شكل الجسم مثل العظام</span> <span>بشبه الذيل</span> | Motility by flexible waving cilia or flagella made from tubulins. |
| Cell division is by binary fission                                                                                                   | Cell division is by meiosis and mitosis.                          |
| Reproduction is always asexual                                                                                                       | Reproduction is sexual and asexual.                               |

# EUKARYOTES & PROKARYOTES

- (1) Eukaryotic cells contain **organelles, such as mitochondria** and lysosomes, and larger (80S) ribosomes, whereas prokaryotes contain no organelles and smaller (70S) ribosomes.

- (2) Most prokaryotes have a **rigid external cell wall** that contains **peptidoglycan, a polymer of amino acids and** sugars

Whilst eukaryotic cells do not contain peptidoglycan. Either they are bound by a flexible cell membrane, or, in the case of fungi, they have a rigid cell wall with chitin, a homopolymer of *N-acetylglucosamine*

# EUKARYOTES & PROKARYOTES

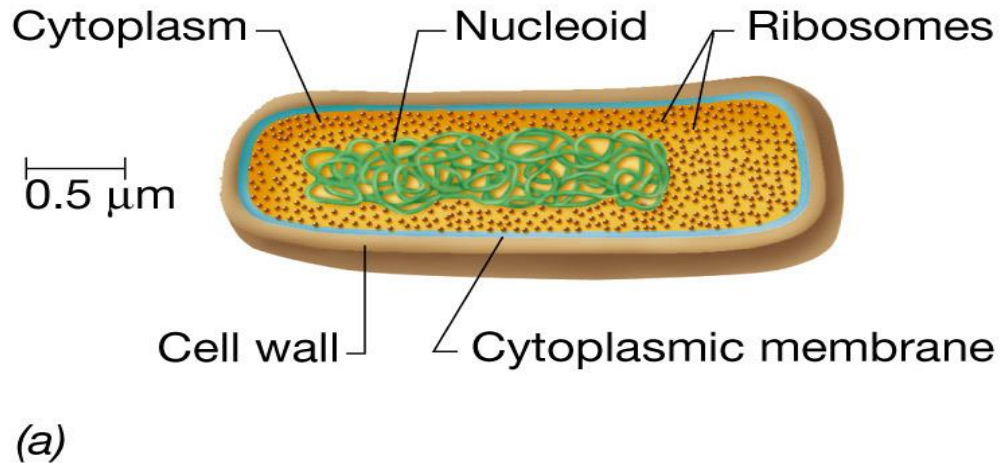
**(3) Motility is another characteristic by which these organisms**

can be distinguished. Most <sup>طفيليات</sup> protozoa and some bacteria are motile, whereas fungi and viruses are nonmotile. The protozoa are a heterogeneous group that possess three different organs of locomotion: flagella, cilia, and pseudopods. <sup>حركة</sup> اقدام كاذبة.

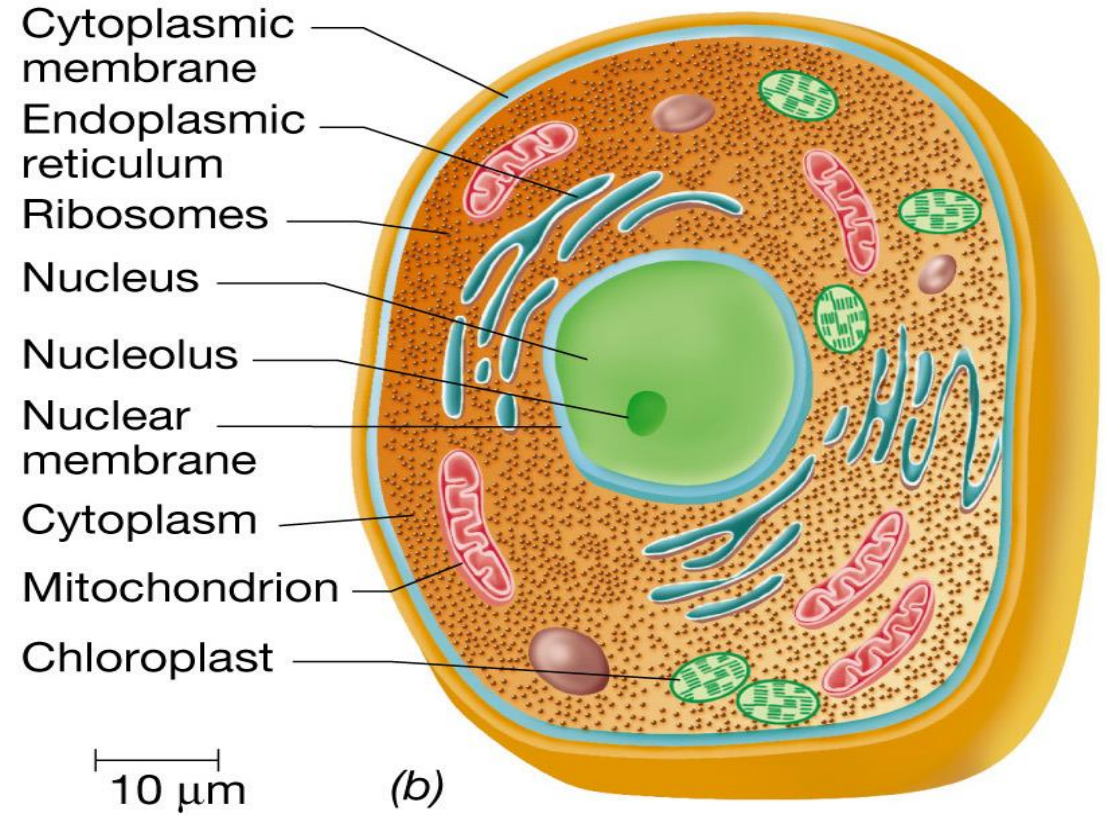
The motile bacteria move only by means of flagella



# EUKARYOTES & PROKARYOTES



**Prokaryote**



**Eukaryote**

# Comparison between organisms

**TABLE 1-2 Comparison of Medically Important Organisms**

دیدان

| Characteristic                                      | Viruses                                 | Bacteria                            | Fungi                           | Protozoa and <u>Helminths</u> |
|-----------------------------------------------------|-----------------------------------------|-------------------------------------|---------------------------------|-------------------------------|
| Cells                                               | No                                      | Yes                                 | Yes                             | Yes                           |
| Approximate diameter ( $\mu\text{m}$ ) <sup>1</sup> | 0.02–0.2                                | 1–5                                 | 3–10 (yeasts)                   | 15–25 (trophozoites)          |
| Nucleic acid                                        | Either DNA or RNA                       | Both DNA and RNA                    | Both DNA and RNA                | Both DNA and RNA              |
| Type of nucleus                                     | None                                    | Prokaryotic                         | Eukaryotic                      | Eukaryotic                    |
| Ribosomes                                           | Absent                                  | 70S                                 | 80S                             | 80S                           |
| Mitochondria                                        | Absent                                  | Absent                              | Present                         | Present                       |
| Nature of outer surface                             | Protein capsid and lipoprotein envelope | Rigid wall containing peptidoglycan | Rigid wall containing chitin    | Flexible membrane             |
| Motility                                            | None                                    | Some                                | None                            | Most                          |
| Method of replication                               | Not binary fission                      | Binary fission                      | Budding or mitosis <sup>2</sup> | Mitosis <sup>3</sup>          |

تکثیرها به‌عتمد علی

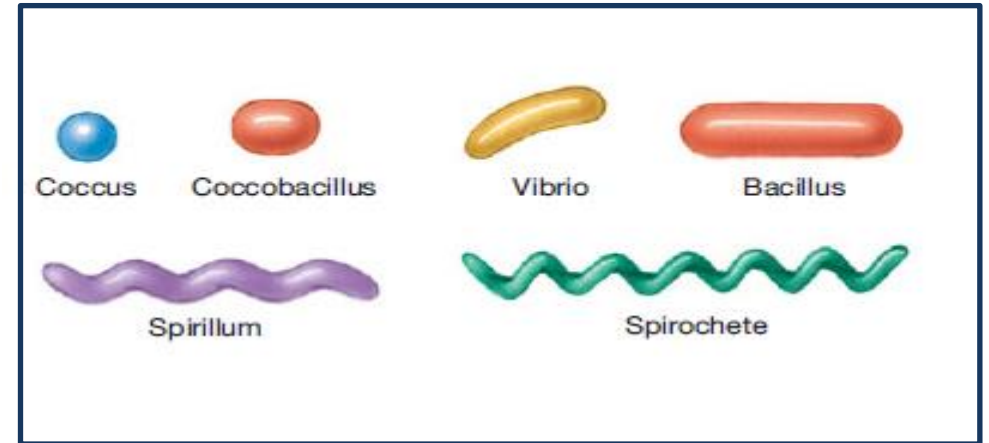
جسد المضيف

# Bacteria

- Most bacterial cells are 0.5-2.0  $\mu\text{m}$  (or 0.5-5.0  $\mu\text{m}$ ) in diameter
- They have a cytoplasmic membrane surrounded by a cell wall; a unique interlinking polymer called peptidoglycan makes the wall rigid.
- The simple prokaryotic cell plan includes no mitochondria, lysosomes, endoplasmic reticulum, or other organelles .
- Their cytoplasm contains only ribosomes and a double-stranded DNA chromosome.
- Bacteria have no nucleus, but all the chemical elements of nucleic acid and protein synthesis are present.

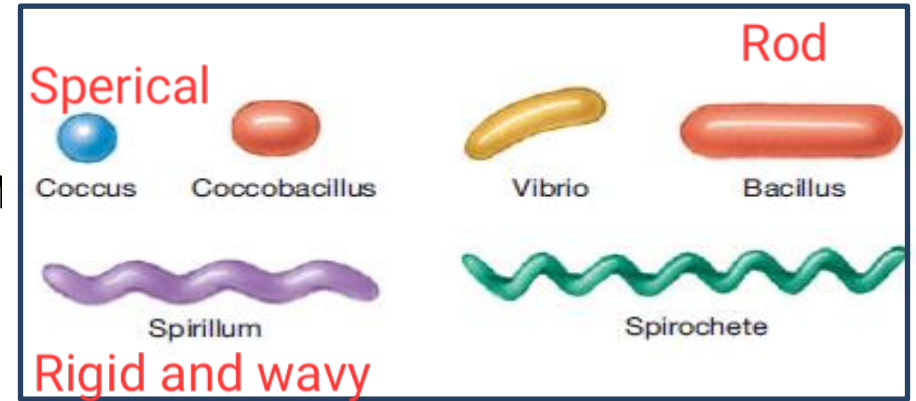
# Bacteria- Shape

- The major morphologic forms are spheres, rods, bent or curved rods, and spirals .
- Spherical or oval bacteria are called **cocci (singular: coccus)** and are typically arranged in clusters or chains.
- Rods are called bacilli (singular: bacillus) and may be straight or curved. Bacilli that are small and resembling cocci are often called coccobacilli.



# Bacteria- Shape

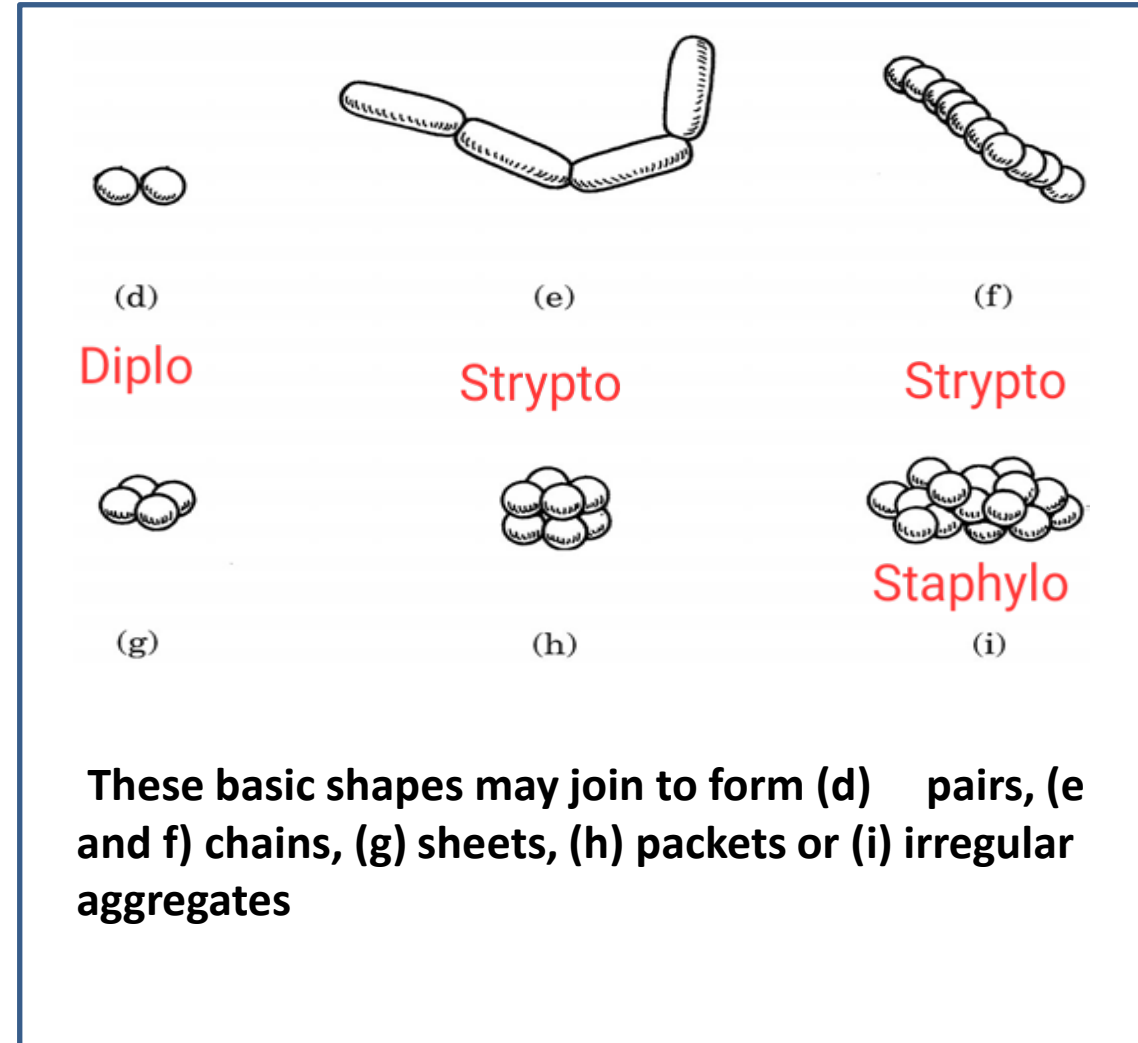
- Spiral bacteria have a variety of curved shapes.
- A comma-shaped bacterium is called **vibrio (vib're-o)**;
- **A rigid, wavy-shaped one, a spirillum** spiril'um; plural: *spirilla*); *and a corkscrew-shaped one, a spirochete (spi'ro-ket)*.
- Some bacteria do not fit any of the preceding categories but rather have spindle shapes or irregular, lobed shapes



زي مسننات  
ال دريل

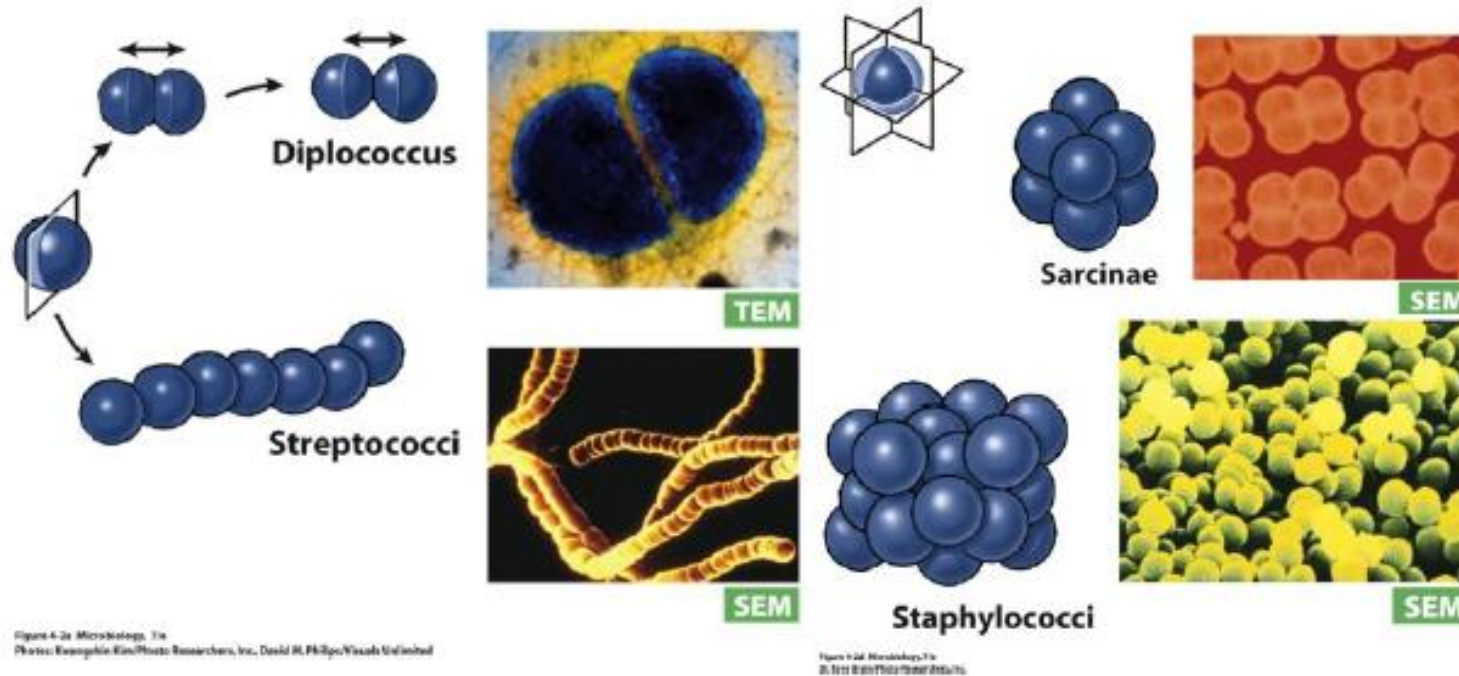
# Bacteria- Arrangement

- Cocci can divide in one or more planes, or randomly. Division in one plane produces cells in pairs (indicated by the prefix **diplo-**) or in chains (**strepto-**).
- Random division planes produce grapelike clusters (**staphylo-**
- Bacilli divide in only one plane, but they can produce cells connected end-to-end (like train cars) or side-by-side.
- Spiral bacteria are not generally grouped together





# Prokaryotes: Arrangement



# Bacteria- Cell structure

منميز فيه نوع البكتيريا

## 1. Cell wall

الفرق

- thick, rigid cell wall, which maintains the integrity of the cell.
- The major component of the cell wall is a substance unique to bacteria, called peptidoglycan (murein). موجود لدعم وحماية ال cell wall
- It maintains the characteristic shape of the cell
- It protects the cell from chemical and physical assault, while still permitting the rapid exchange of nutrients and metabolic by products required for rapid growth and division.

# Structure of Bacterial Cells: Cell Wall

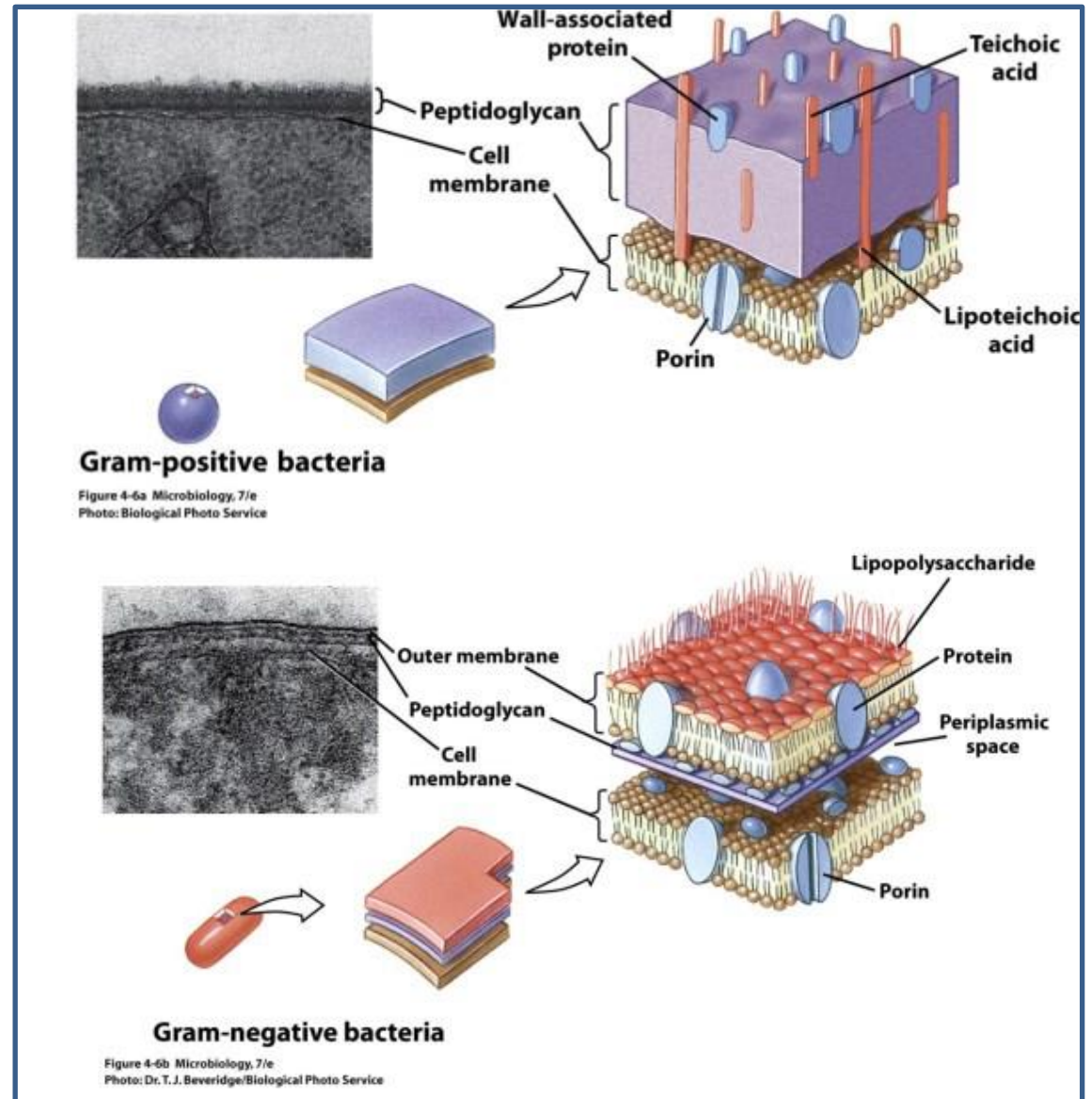
- Components of the bacterial cell wall:

1. Peptidoglycan

2. Outer membrane (G-ve)

3. Periplasmic space

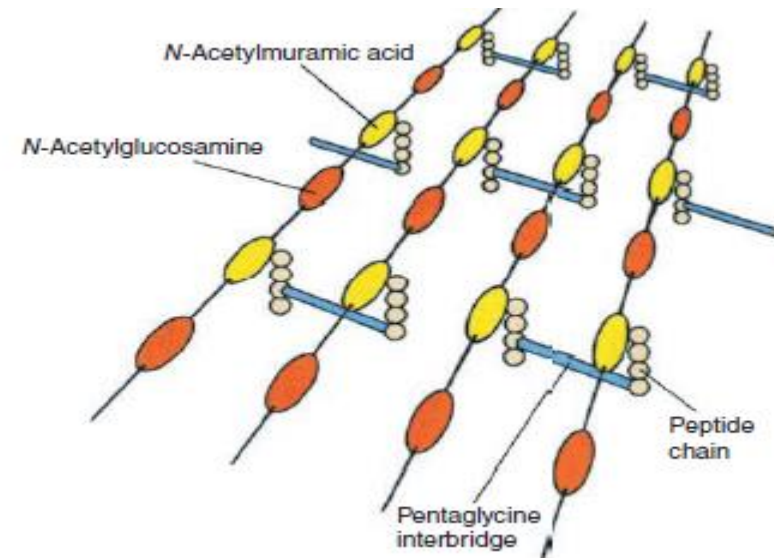
موجودین بس بال  
gram negative  
bacteria



# Bacteria-Cell wall component

- This is a high molecular weight polymer whose basic subunit is made up of three parts: *N-acetylglucosamine*, *N-acetylmuramic acid* and a *short peptide chain*

عشان ال n-acetyl يرتبطوا مع بعض  
بكون في بينهم peptide بتربطهم  
وبترتبهم ب sequences محدد

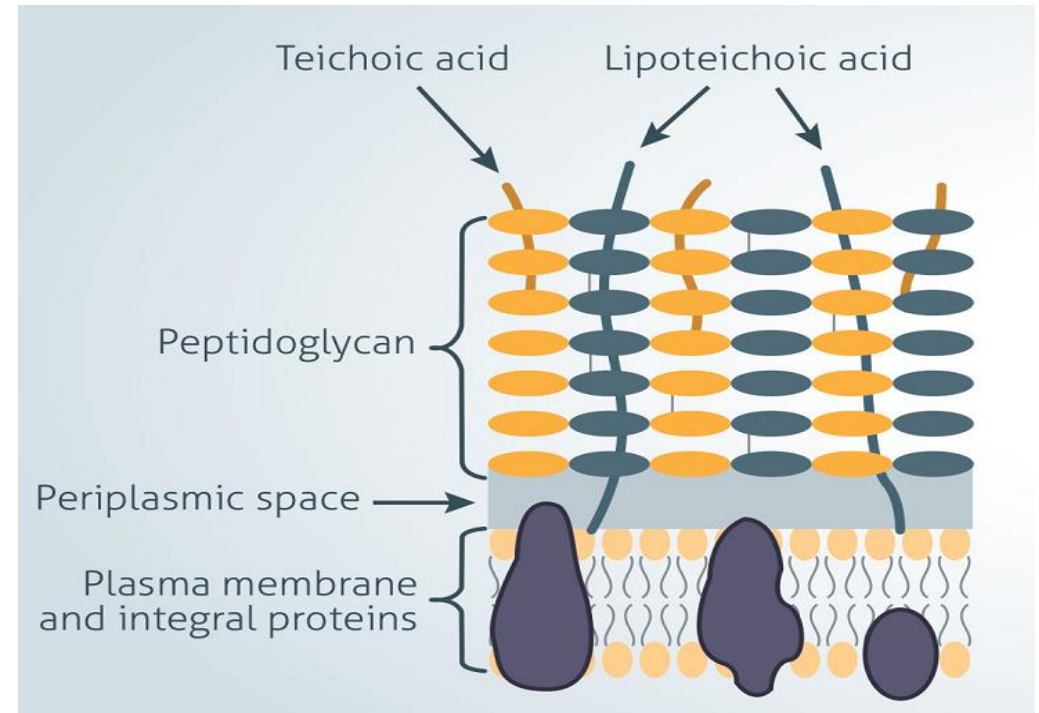


schematic diagram of one model of peptidoglycan. Shown are the polysaccharide chains.

# Gram positive cell wall

- Contains thick layers of peptidoglycan to support the cell membrane and provide a place of attachment for other molecules.
- The cell walls also contain chains of **teichoic acid** which helps in maintaining cell shape and play a role in proper cell division.

هناك acid موجود فقط في  
هذا النوع من البكتيريا

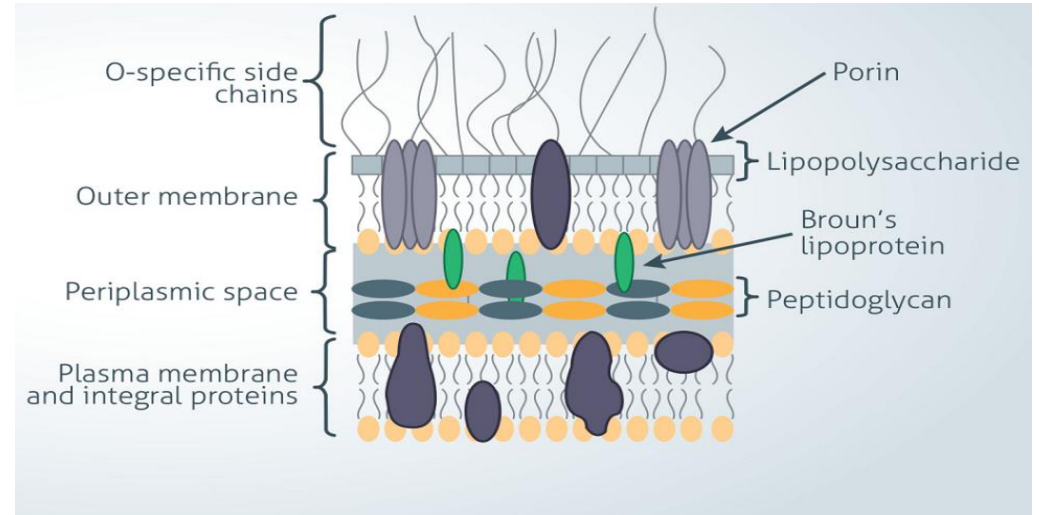


ال cell wall اذا صار thine يتخرب  
ال osmolarity للبكتيريا فبتصير اضعف وبتموت



# Gram negative cell wall

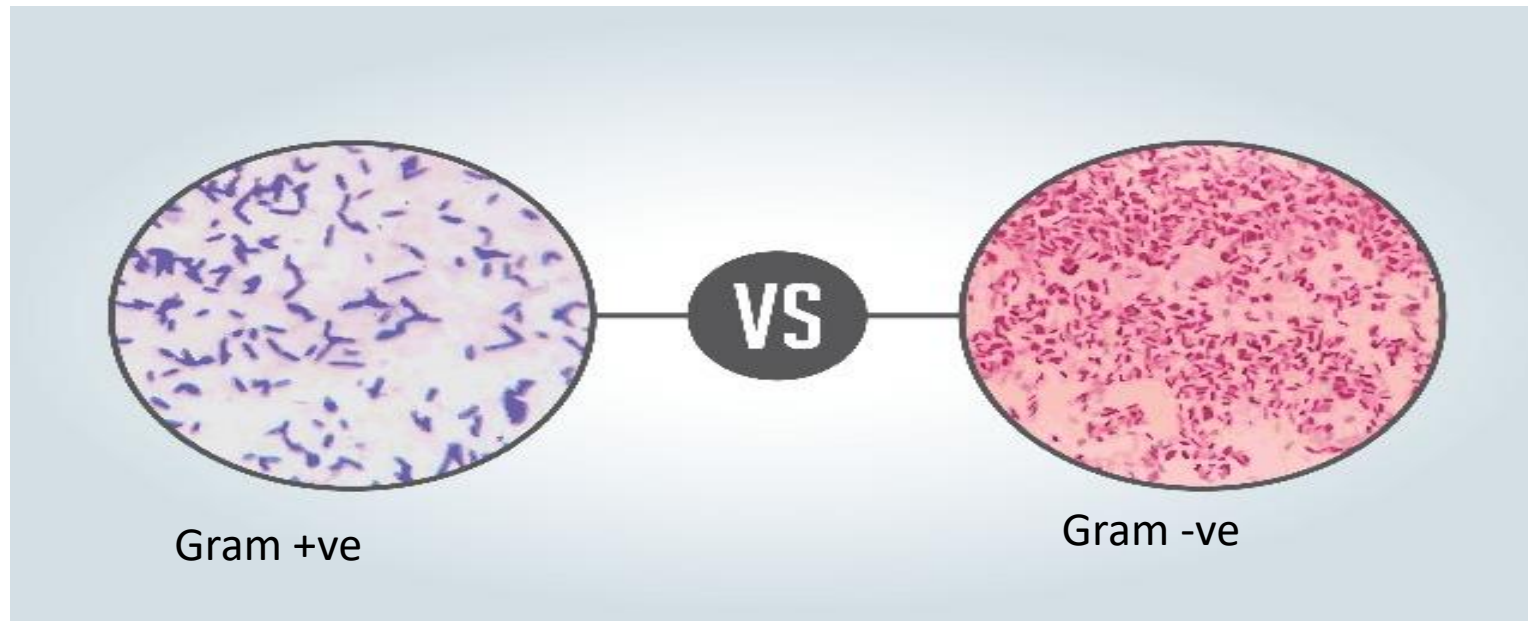
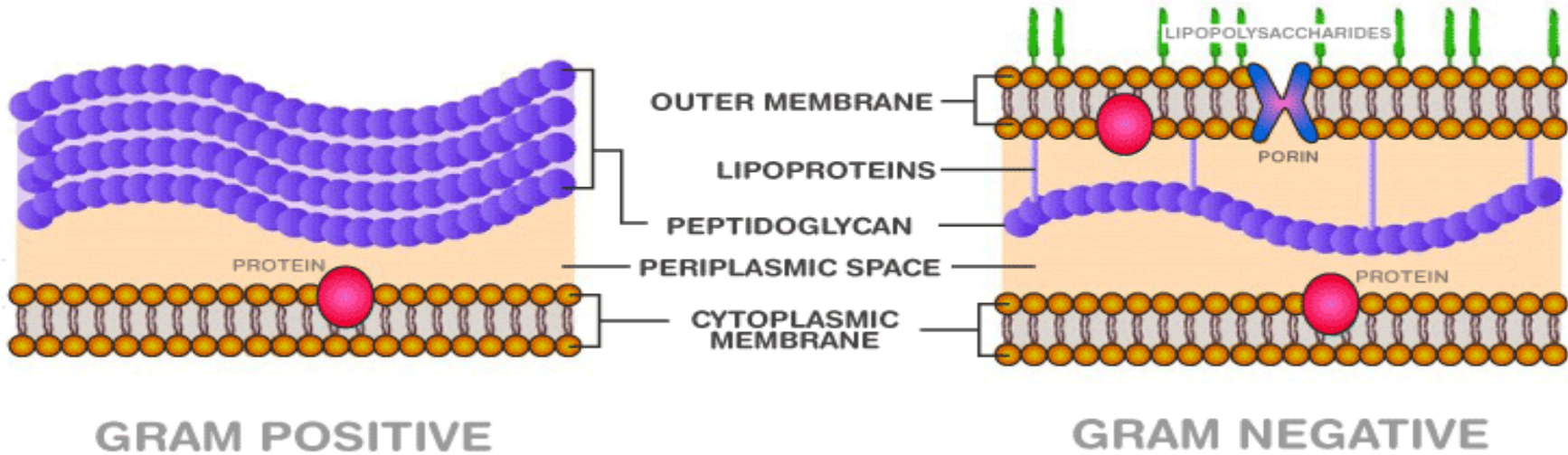
- The Gram negative bacterial cell wall is composed of a single thin layer peptidoglycan.
- A gel-like matrix called periplasmic space is presented بكون *thick* زي الجل
- An outer membrane containing lipopolysaccharide (LPS)



بحيط بال outer membran

موجود حوالين ال cell wall في هاذ النوع فقط بزيد حماية لل wall بهاذ يؤدي انو بتصير اصعب قتلها والتخلص منها

# GRAM-POSITIVE AND GRAM-NEGATIVE BACTERIA





# Gram stain

تصبغ  
للتفريق بين انواع البكتيريا



All purple

## 1. Crystal violet (1 minute)

Drain, rinse



All purple;  
iodine acts as mordant  
to set stain

## 2. Iodine (1 minute)

Drain, rinse



Gram + cocci = purple  
Gram - rods = clear

## 3. Decolorize with alcohol

(one quick rinse);  
immediately after, rinse with water

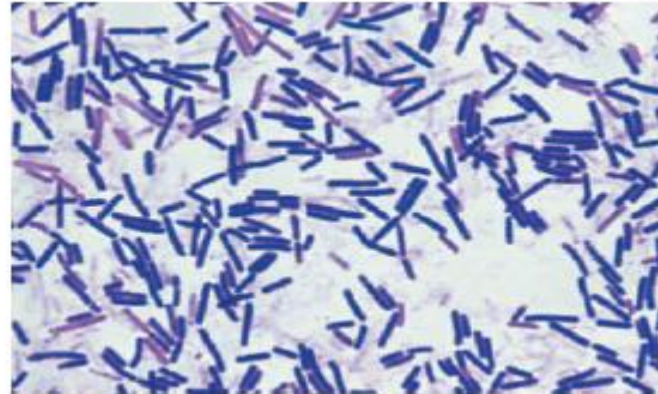


Gram + cocci = purple  
Gram - rods = red (pink)

## 4. Safranin (30–60 seconds)

Drain, rinse, blot

(a)



(b)

### + FIGURE 3.30 The Gram stain.

(a) Steps in Gram staining.

(b) Gram-positive cells retain the purple color of crystal violet, whereas Gram-negative cells are decolorized with alcohol and subsequently pick up the red color of the safranin counter-stain. (CNRI/Science Source)

**Gram status is important in medicine;  
the presence or absence of a cell wall  
will change the bacterium's  
susceptibility to some antibiotics.**

ملاحظة : الشرح الي عن الرسومات الي على اليسار مهم

1) بعد كل خطوة بنعمل drain and rinse

2) بستخدم ال iodine مثبت للون

3) بستخدم ال alcohol لل decolorize ( - gram ]  
بروح لونها )

4) بستخدم ال safarine ك other stain

لل ( - grame ) عشان يثبت عليها اللون لتسهيل  
تمييزها ( بصير لونها احمر )

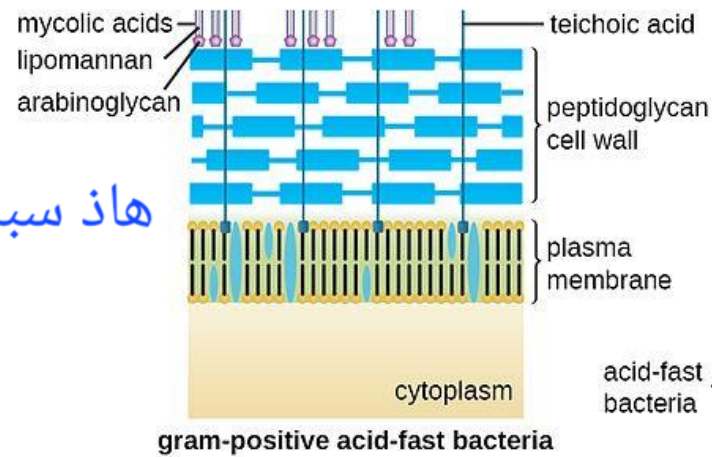
# Acid-Fast Bacteria

- Acid-fast cells contain a large amount of lipids and waxes in their cell walls

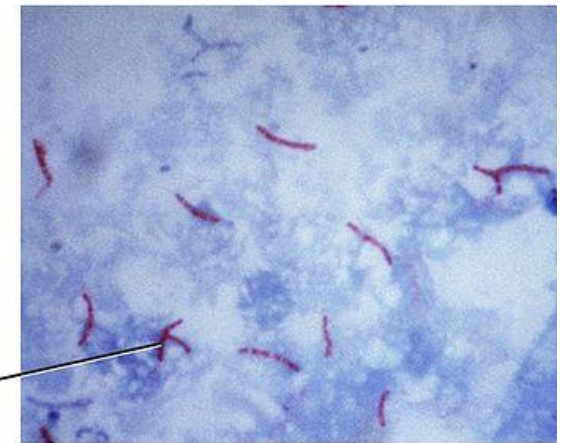
**primarily mycolic acid.**

هنا سبب مقاومتهم

- Acid fast bacteria are usually members of the genus *Mycobacterium* or *Nocardia*



(a)



(b)

# Ziehl-Neelsen staining

- It is used to stain species of *Mycobacterium tuberculosis* that do not stain with the standard laboratory staining procedures like Gram staining.



- The stains used are the red colored Carbol fuchsin that stains the bacteria and a counter stain like Methylene blue

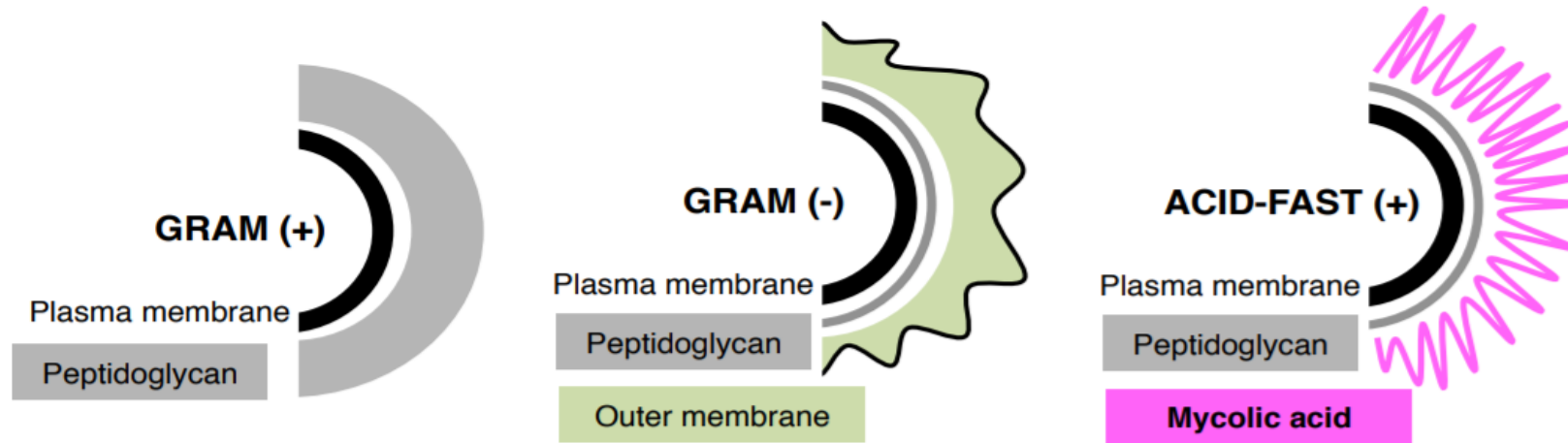
Fuchsin : primary stain

Methylene : secondary stain



# Acid- fast bacteria staining

- Primary stain binds cell wall mycolic acids
- Intense decolorization does not release primary stain from the cell wall of AFB
- Color of AFB-based on primary stain
- Counterstain provides contrasting background



| <i>Mycobacterium</i>                                                                | non-myc                                                                             |                                                                                                        |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
|    |    | 1. All bacteria are transparent prior to staining                                                      |
|    |    | 2. Steam is used to force the CARBOL FUCHSIN into all the bacteria                                     |
|  |  | 3. Decolorization with acid removes the CARBOL FUCHSIN from the bacteria that do not have mycolic acid |
|  |  | 4. Methylene blue is the counterstain                                                                  |



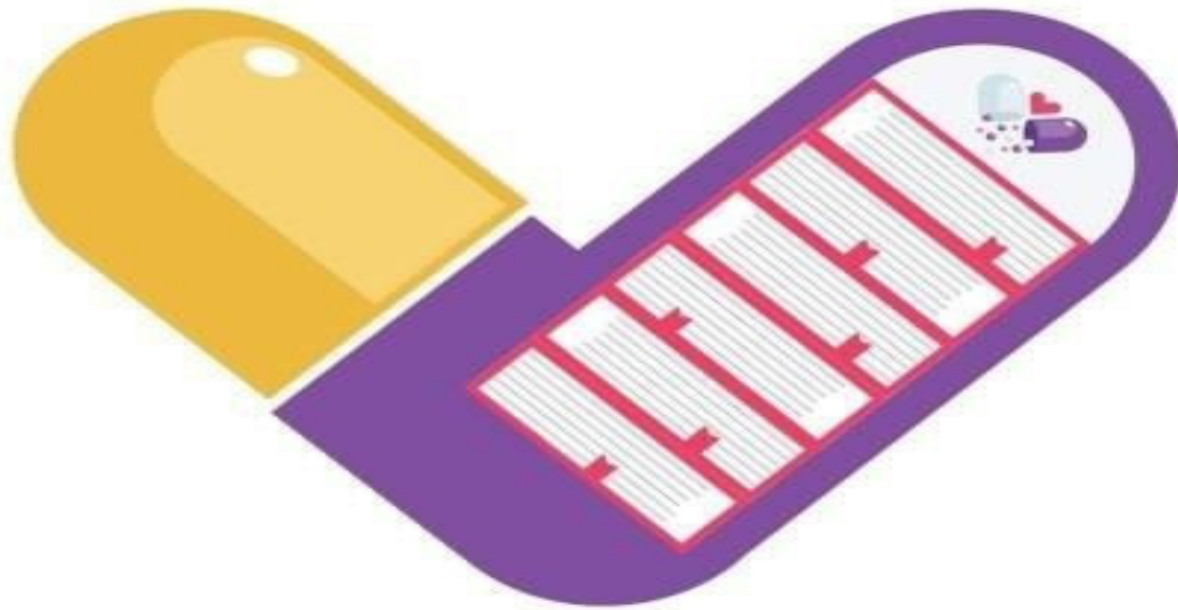
خطوة ٢ : بنعرض عينات البكتيريا الي عنا للحرارة  
عشان نقدر نمرر ال fuchisin لخلية البكتيريا

خطوة ٣ : بنستخدم الكحول لأزالة اللون **بس** اللون  
بروح من البكتيريا الي مافيها mycolic acid

fushin يرتبط بشكل قوي مع ال Mycolic  
فأزالة اللون صعب

آخر سلايد بالمحاضرة

بالتوفيق



**Artery Academy**