MEDICINE
KING SAUD UNIVERSITY

microbiology

LECTURE:

GRAM POSITIVE AND NEGATIVE BACTERIA

IMPORTANT.
DOCTORS NOTES.
EXTRA INFORMATION.

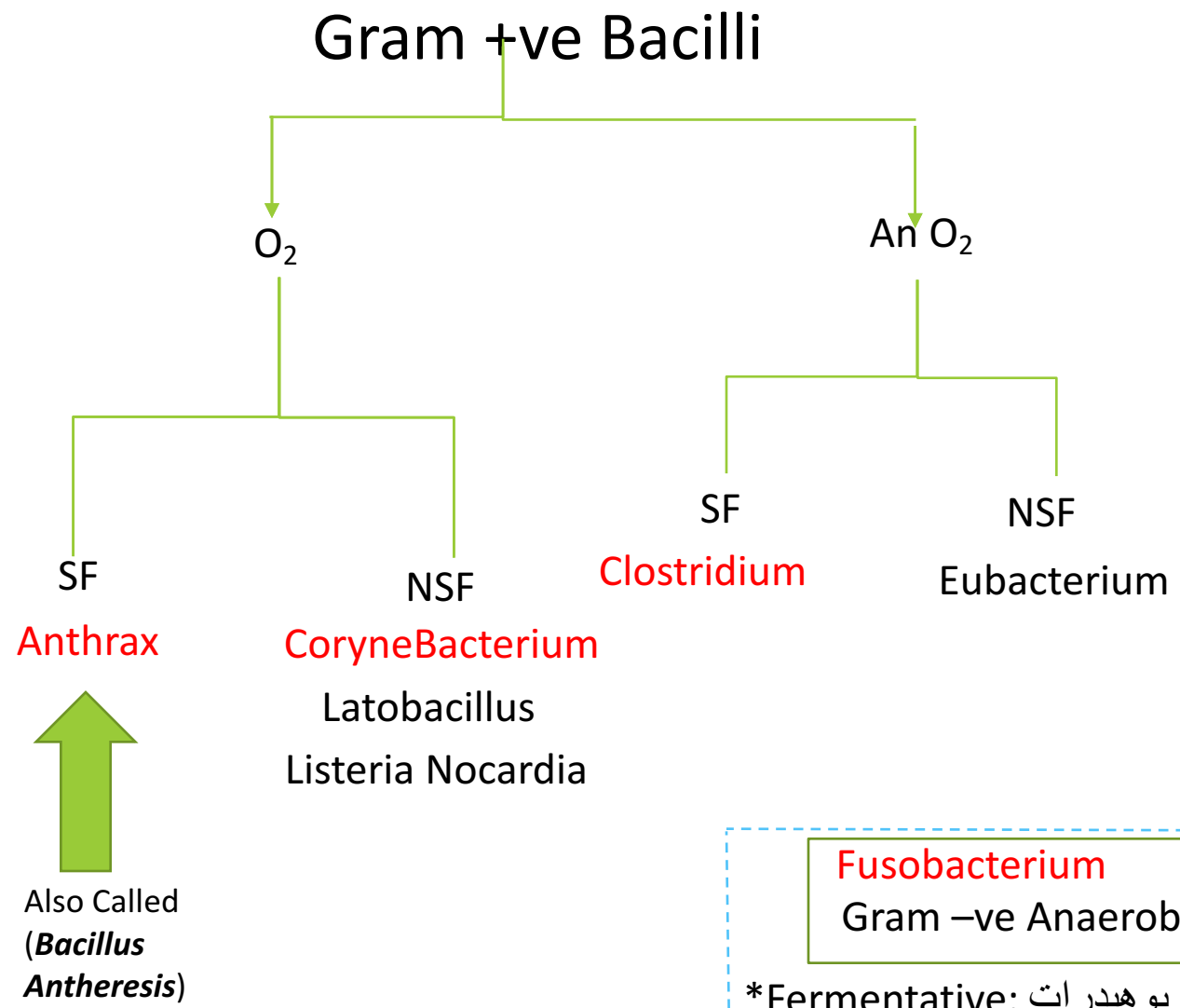
Objectives:

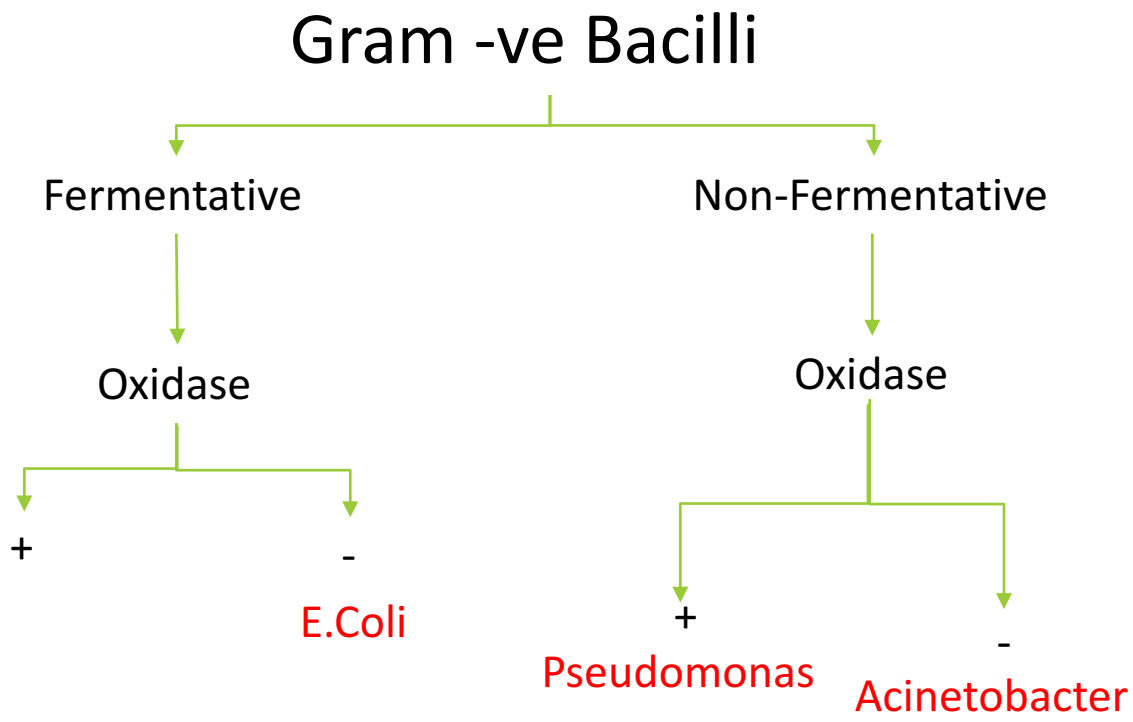
By the end of this lecture, the student should be able to:

1. Know the general basic characteristics of bacteria 5
2. Differentiate between gram positive and gram negative bacteria's characteristics. 6-7
3. Know the classes and groups of gram positive bacteria, cocci and bacilli (rods) 11-13
4. Know the common identification and characteristics of these groups 11-13
5. Know the common infections and diseases caused by these organisms 11-13
6. Know the classes and groups of gram negative bacteria, cocci and bacilli (rods) 14-16
7. Know the common identification methods for these organisms 14-16
8. Know the most common infections and diseases caused by these bacteria 14-16

*الأمثلة بالأحمر مهمة

قد تكون هوائية أو لا هوائية لكن الأفضل في طريقة التقسيم هنا هو الـ Fermentation





Fusobacterium
Gram –ve Anaerobic ما وضح الدكتور تصنيفها لكن اعرف انها

*Fermentative: تقوم بتكسير الكاربوهيدرات
*Non-Fermentative (Non-Fermenting): لا تكسر الكاربوهيدرات ولكن تستفيد من مواد أخرى

*O_2: Aerobic
* An O_2: Anaerobic
*NSF: Non Spore Forming
*SF: Spore Forming

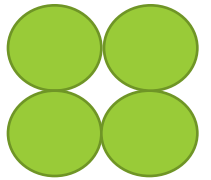
Cocci Bacteria

الاختبارات اللي تسويها
عشان تعرف نوع البكتيريا

Chain

StreptoCocci

Cluster



StaphyloCocci

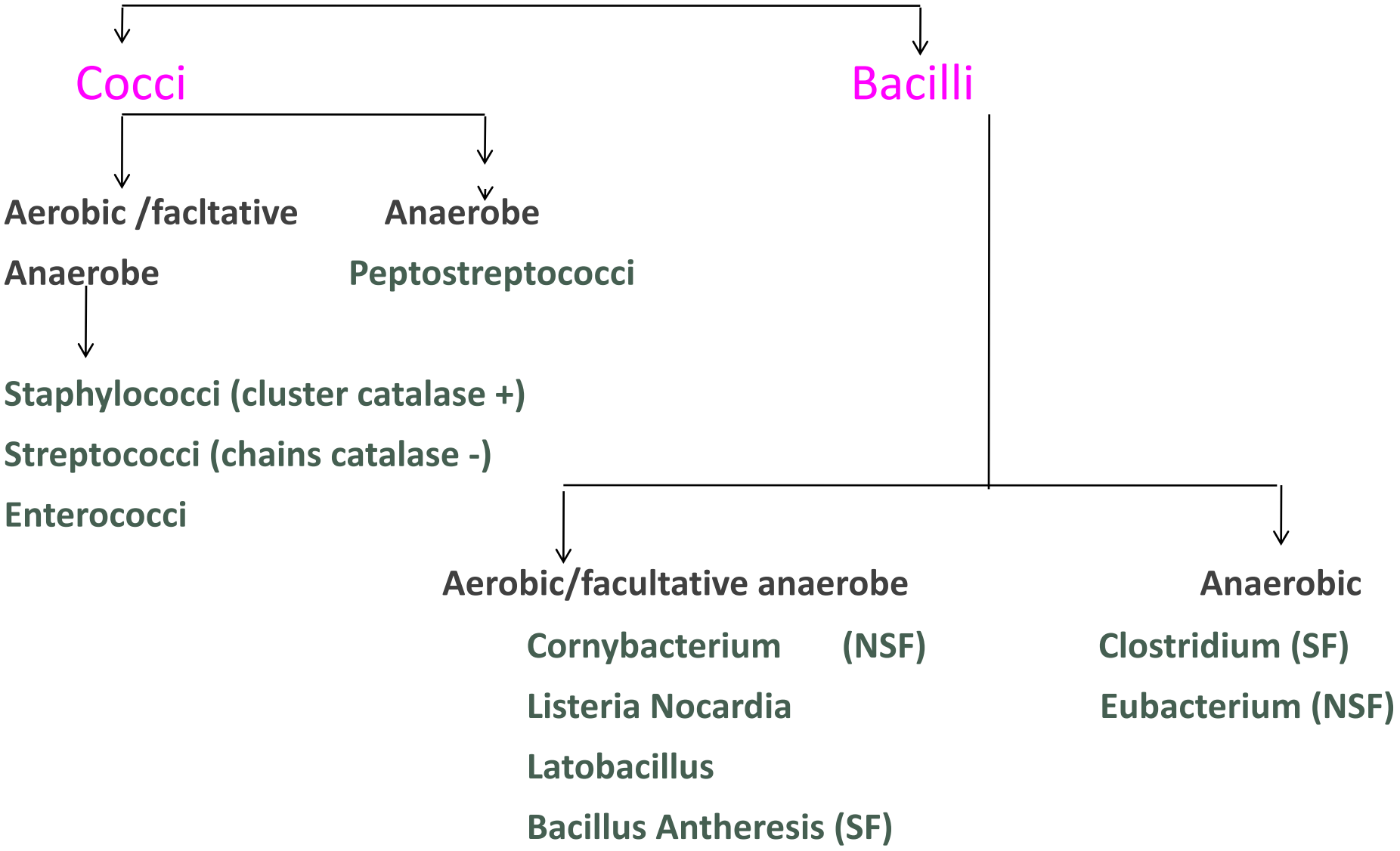
Catalase:	-	+	
Coagulase:	لا يوجد	+ StaphOrase	- Other Staph

Veillonella

Gram –ve Cocci Anaerobic

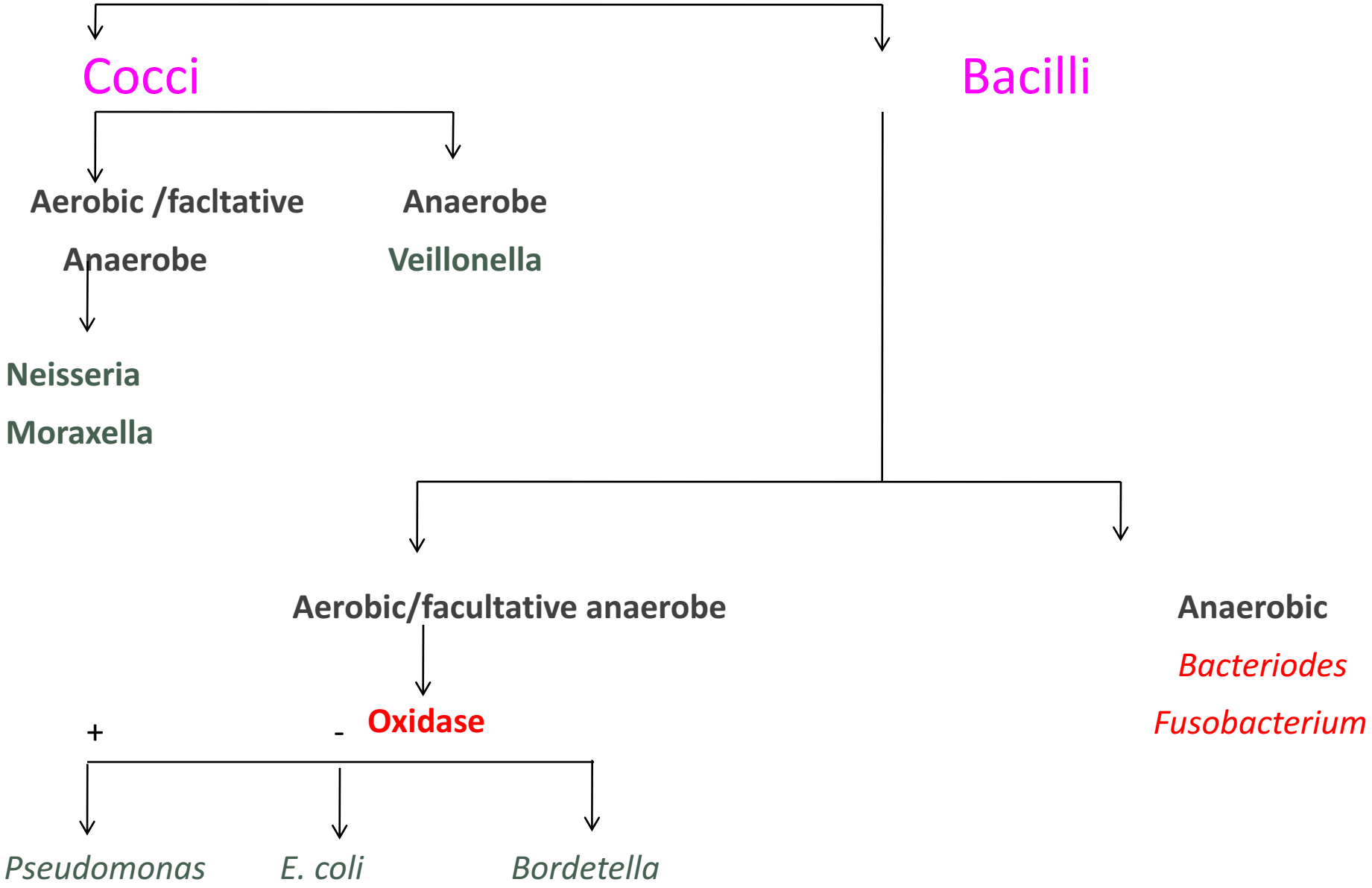
مالها دخل بالتصنيف فوق ، احفظ انها

Gram positive bacteria



NSF=non-spore forming SF=spore forming

Gram Negative bacteria



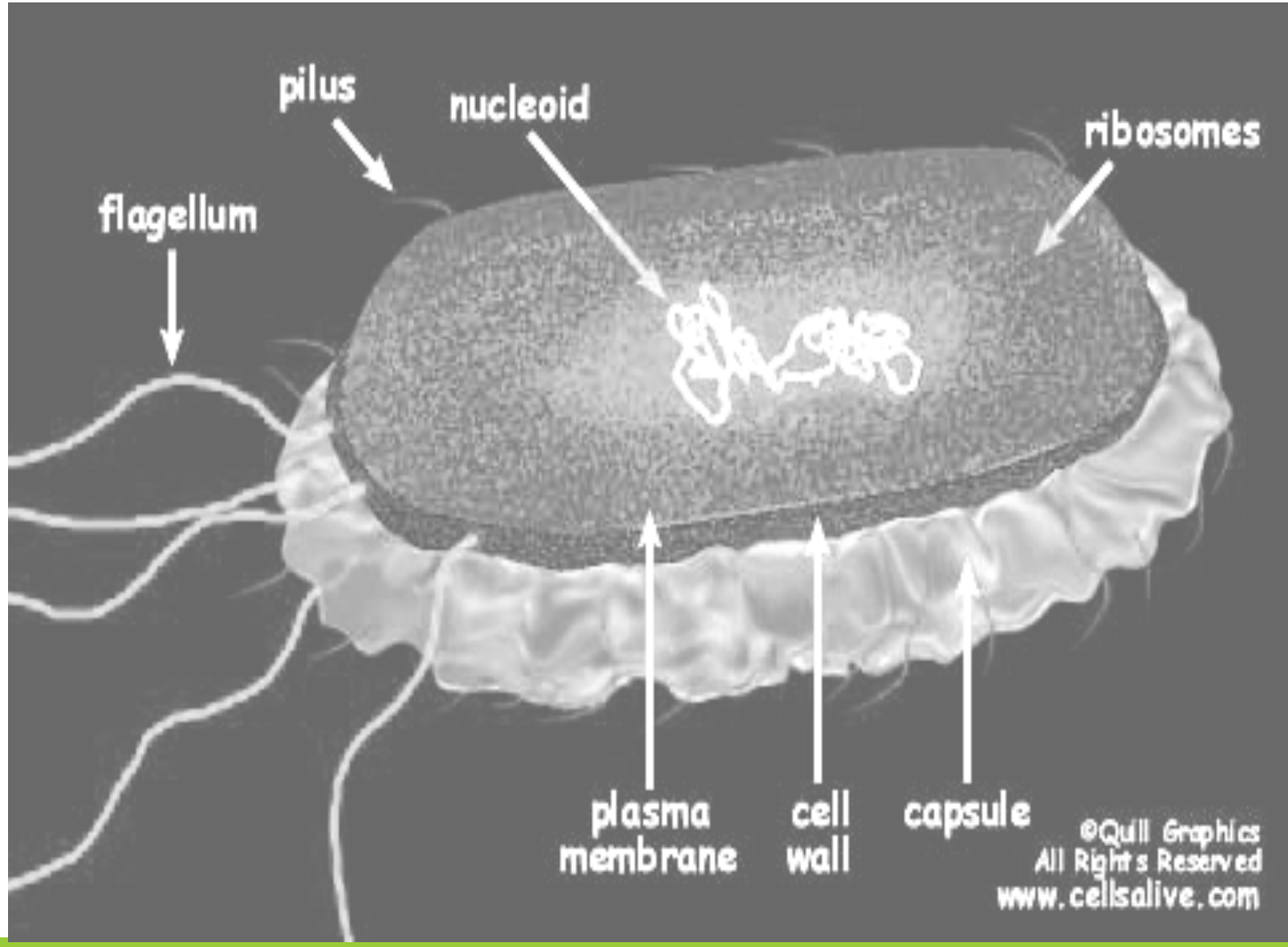
bacteria

1- bacteria are prokaryote

2- the DNA is floating and easily transport to another bacteria (so they easily get resistance to antibiotics)

3- capsule (antiphagocytic)

4- cell wall (is the site of some antibiotic action such as penicillin -> destroy the cell wall -> die)



Gram Staining

- Developed in1884 by the Danish physician Hans Christian Gram.

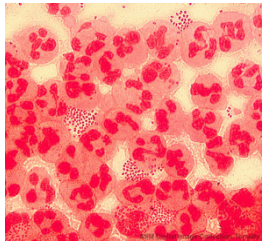
- An important tool in bacterial taxonomy* , distinguishing so called gram positive bacteria , which remain colored (violet) after the staining procedure, from gram negative bacteria *** which do not retain dye(violet) and need to be counter stained (safranin).

- Can be applied to pure cultures (lab culture with a single specimen) of bacteria or to clinical specimens (swaps, feces, urine…).

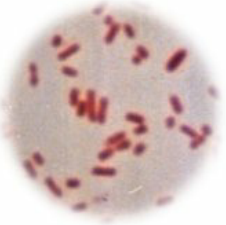
* Taxonomy : (the branch of science concerned with classification)

** gram positive bacteria : (large amount of peptidoglycan)

*** gram negative bacteria: (small amount of peptidoglycan)

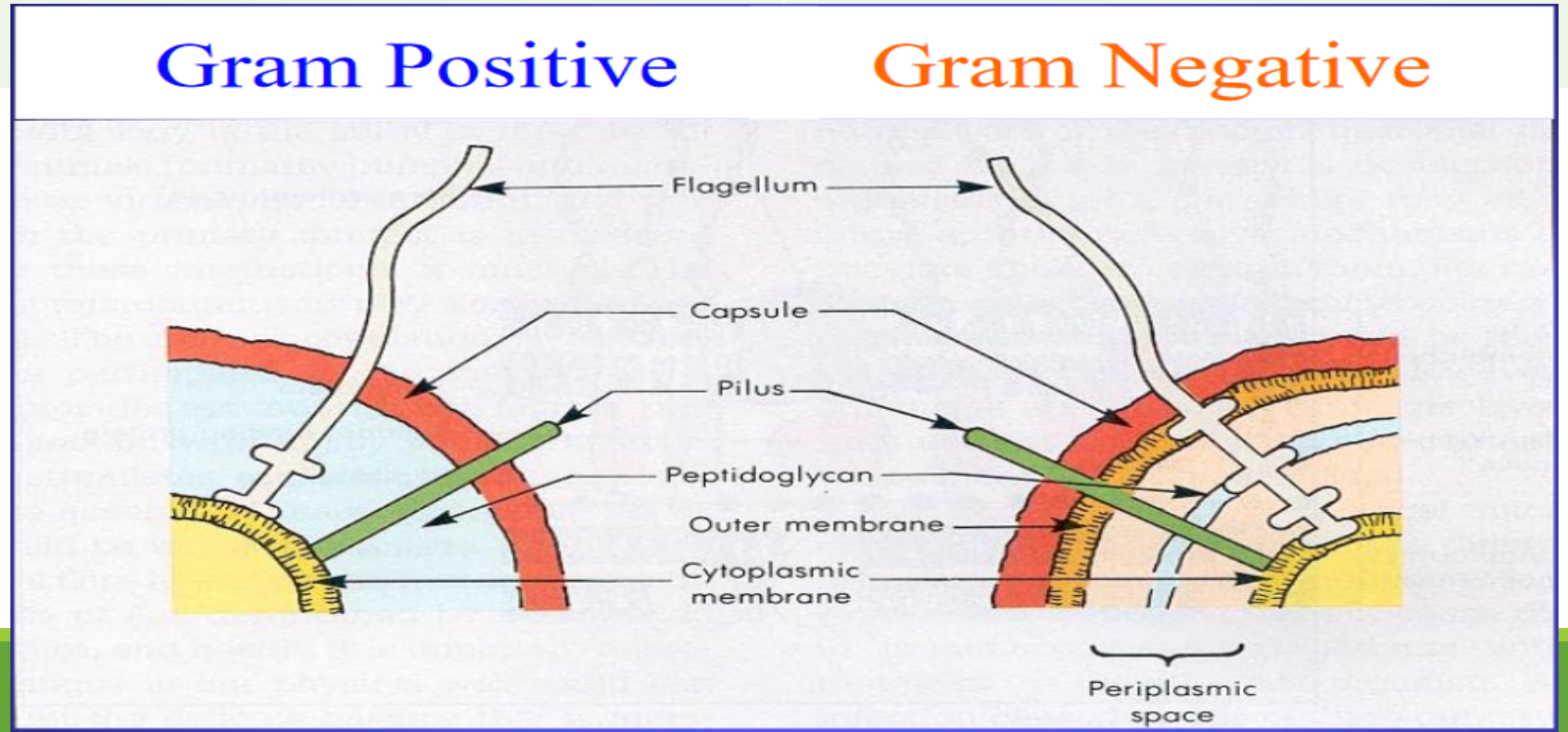


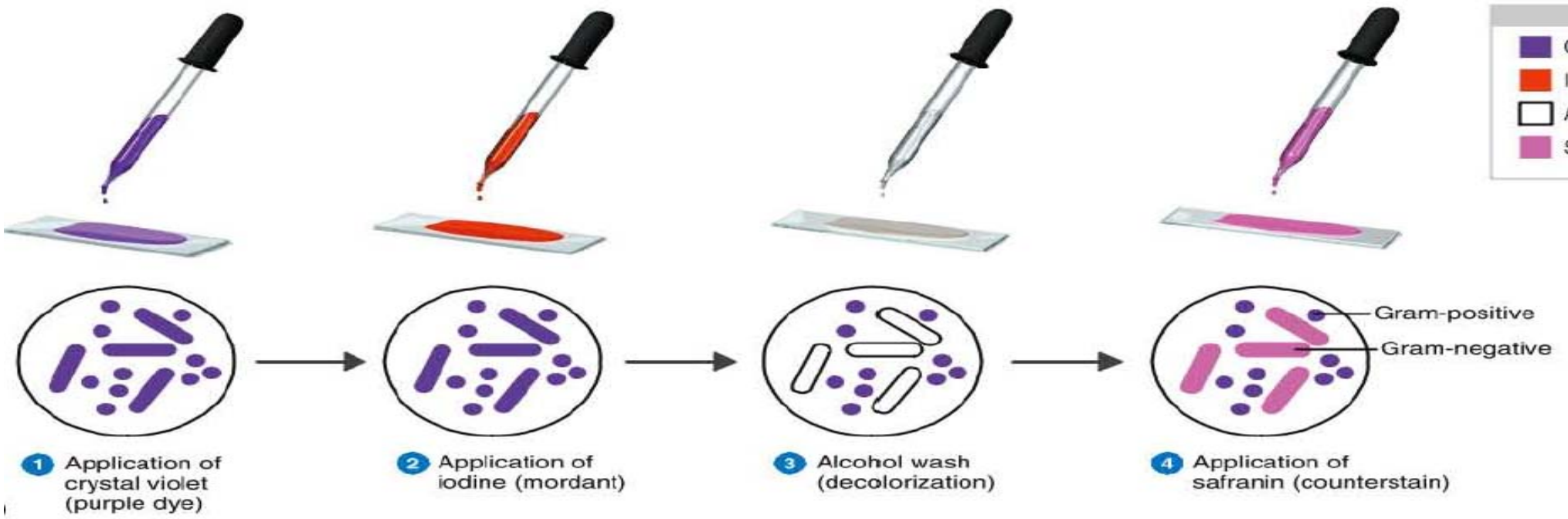
Neisseria gonorrhoeae in a smear of urethral pus (Gram-negative cocci, with pus cells)



Pure culture of *E. coli* *(Gram-negative rods)*

Gram positive cell wall	Gram negative cell wall
- Thick, homogenous sheath of peptidoglycan 20-80 nm thick. - Tightly bound acidic polysaccharides, including teichoic acid and lipoteichoic acid. - Cell membrane.	- Outer membrane containing lipopolysaccharide (LPS). - Thin shell of peptidoglycan. - Periplasmic space (between the cell wall & plasma membrane). - Inner membrane.
Retain crystal violet and stain blue or purple.	Lose crystal violet and stain pink or red from safranin counterstain.



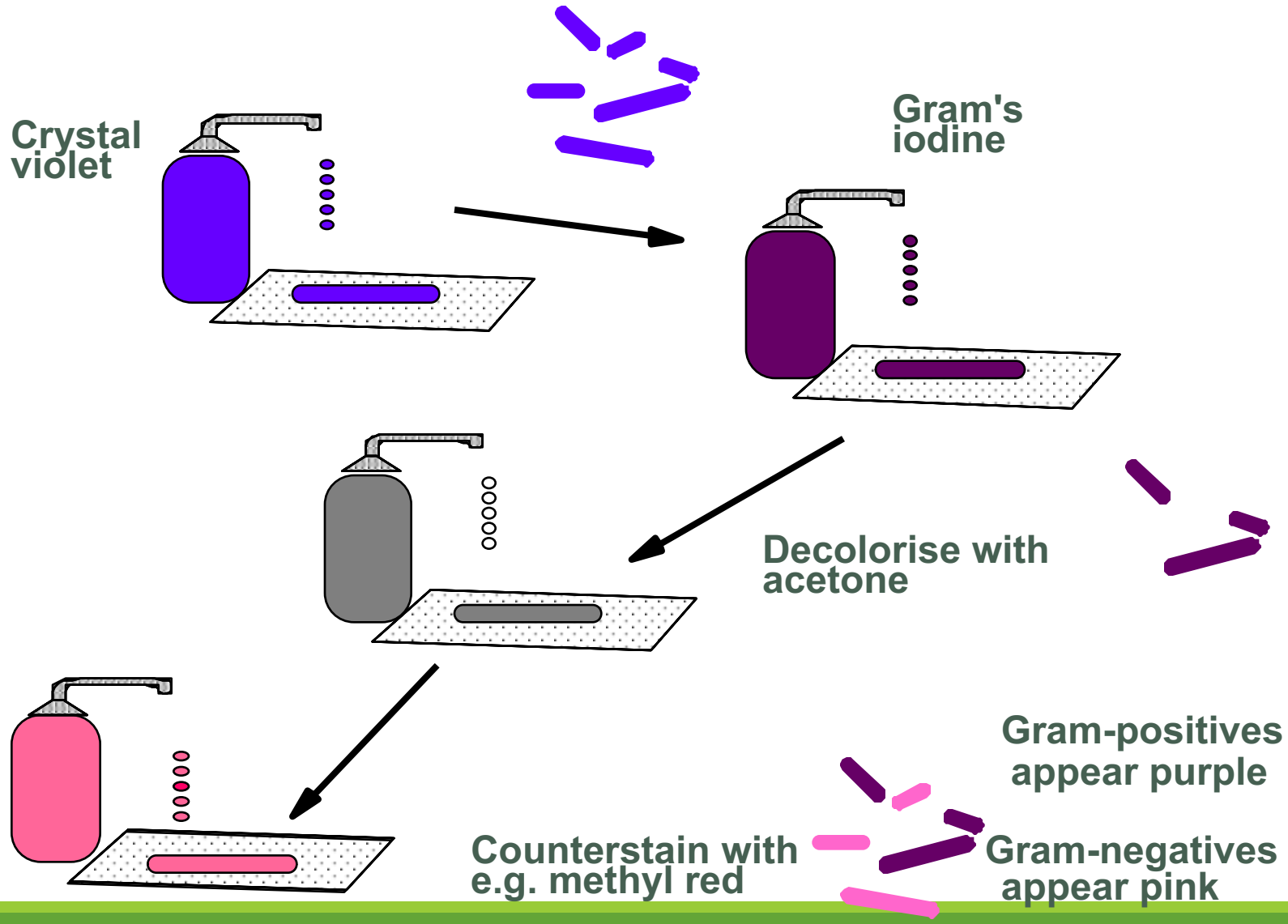


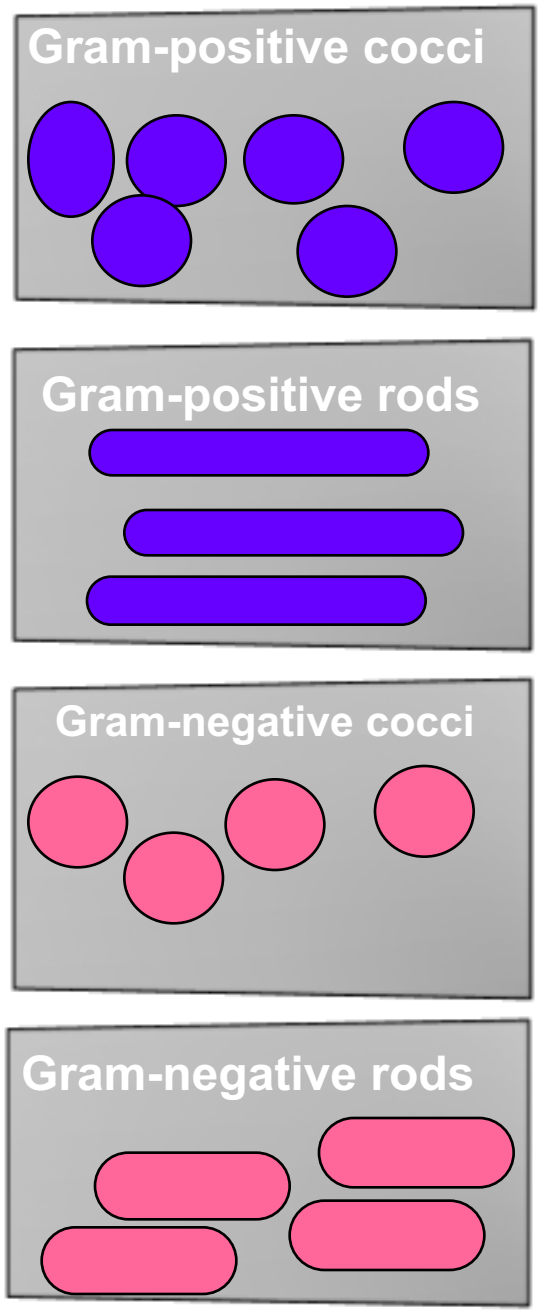
Note: the alcohol is applied to wash the crystal violet stain.

However, unlike the others, it is only applied for 3-5 seconds. So it is not enough time for it to wash the crystal violet out of the peptidoglycan of gram +ve bacteria, which is why they keep the crystal violet stain.

Note: iodine is applied to fix تثبتthe crystal violet inside the bacteria

The Gram Stain



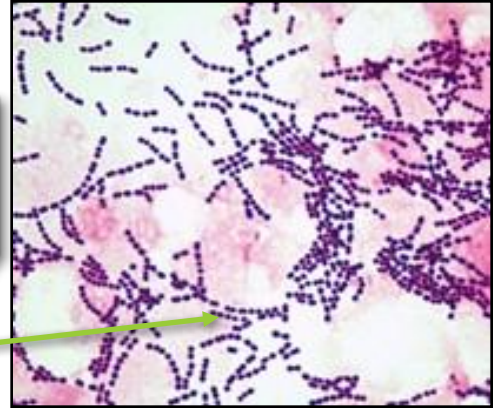


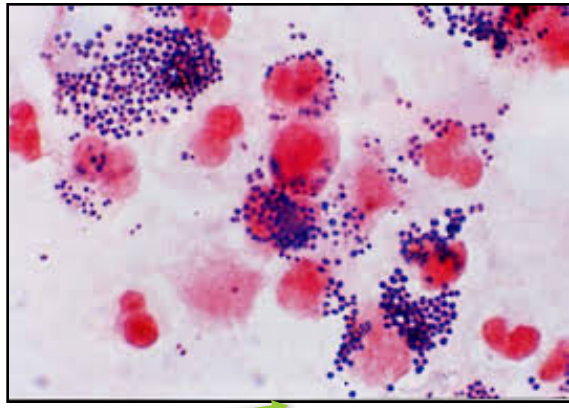
	Microscopic Appearance of Cell		Chemical Reaction in Cell Wall (very magnified view)	
Step	**Gram (+)**	**Gram (–)**	**Gram (+)**	**Gram (–)**
1. Crystal violet			Both cell walls affix the dye	
2. Gram's iodine			Dye crystals trapped in wall	No effect of iodine
3. Alcohol			Crystals remain in cell wall	Cell wall partially dissolved, loses dye
4. Safranin (red dye)			Red dye has no effect	Red dye stains the colorless cell

Gram positive Cocci :

Aerobic / facltative Anaerobe :

Note : **facltative Anaerobe**
Occurring optionally in response to circumstances rather than by nature





1) Streptococcus

Catalase (-)
Gram-positive cocci in chains or pairs

Streptococcus pyogenes	Viridans streptococci	Streptococcus pneumoniae
Divided by type of haemolysis: -Group A -Beta hemolytic (most important) -diseases: 1- Pharyngitis (most common) 2-Cellulitis (acute inflammation of subcutaneous tissue) 3-Rheumatic Fever Characterized by: Fever, Migrating polyarthritis , carditis and immunologic cross reactivity 4- Acute Glomerulonephritis Edema, hypertension, hematuria antigen-antibody complex deposition	Alpha haemolytic -oral flora They cause: -infective endocarditis (infection of the inner lining of the heart "endocardium")	Eg: Gamma haemolytic They cause: - Meningitis -Sinusitis -Otitis -Pneumonia

2) Staphylococci

Catalase : it's an enzyme produced by the bacteria

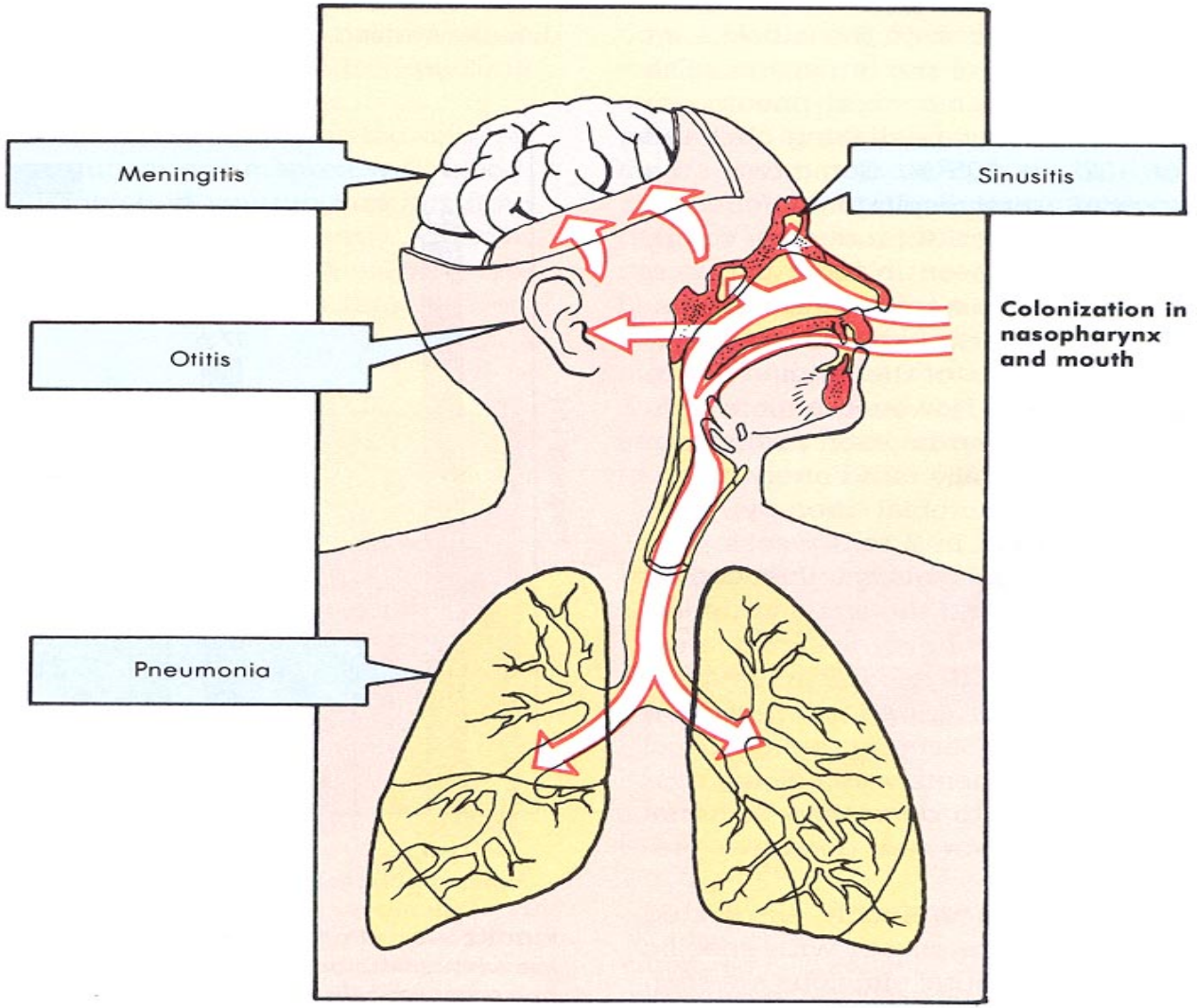
catalase (+)
Gram-positive cocci in clusters

Coagulase (+)	Coagulase (-)
-Staphylococcus aureus Most important pathogen	-Staphylococcus epidermidis -Staphylococcus saprophiticus

3) Enterococci

ex : Enterococcus faecalis

S. pneumoniae



Gram positive bacilli :

ملاحظة :القرام بوستف باسيلاي مقسمة تبعًا لوجود السبورز
بينما القرام بوستف كوكاي مقسمة تبعًا للاختبارات اللي ذكرناها كاتاليز وكواقليز..

Anaerobic

Spore forming (SF)	Non-spore forming (NSF)
C. -----Clostridium -**Clostridium. tetani** Causing Tetanus. - **Clostridium perfringens** Causing Gas gangarene -**Clostridium botulinum** Causing Botulism Descending weakness Leeds to Paralysis Diplopia and dysphagia Leeds to respiratory failure	**Eubacterium**

C.tetani

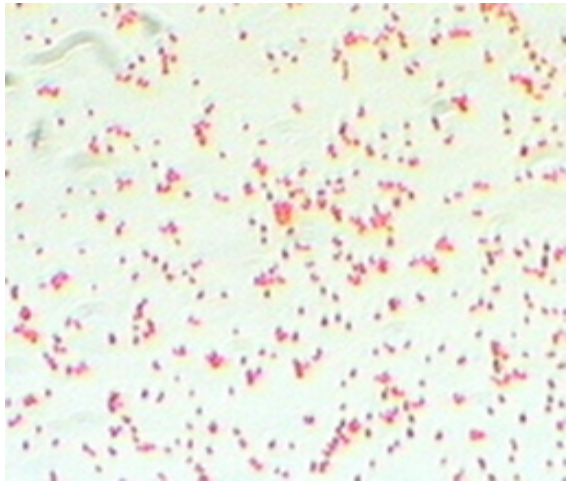
Gas gangarene

C. tetani and C. botulinum both anaerobes produce the same toxin but REMEMBER that tetani's toxin inhibits the inhibitory impulses in the brain otherwise botlulinum's toxin will inhibit the release of Ach.

Aerobic / facilitative Anaerobe

Spore forming (SF)	Non-spore forming (NSF)
Bacillus Antheresis causes anthracis	**C. --- Cornybacterium :** - **Corynebacterium diphtheria** WHICH CAUSE: Fever pharyngitis cervical LAD (disease of the lymph nodes). thick, gray, adherent membrane Sequelae: airway obstruction, myocarditis

Gram-Negative Cocci



- *Neisseria gonorrhoeae (السيلان)*
  - *-The Gonococcus*
- *Neisseria meningitidis* (It is considered as potential pathogen in the oropharynx)
  - *The Meningococcus*
  - Both Gram-negative intracellular diplococci
- *Moraxella catarrhalis* can cause infections of the respiratory system, middle ear, eye, central nervous system, and joints of humans

سلايد إضافيه توضيح للسلايد التالي

البكتيريا ال rods هي أحد أشكال ال Bacilli.

ايش معنى و ايش مقصود ب (التخمر) **fermentation**

Fermentation: *The metabolic process of converting carbohydrate into acid or alcohol* , This process occur in micro-organism such bacteria or fungi.

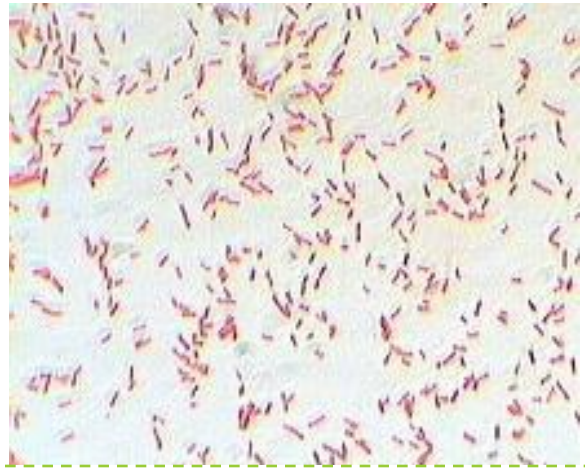
أهم تصنيف ل gram-negative bacilli هو انها تكون fermentative or not fermentative.

E.coli is oxidase negative

Gram-Negative Rods

Enteric Bacteria they ferment sugars most important are:

- *E. Coli* *(it's a normal flora potential pathogens most found in the GIT)*
- *Salmonella (not a normal flora)*
- *Shigella*
- *Yersinia and Klebsiella pneumoniae*
- *Proteus*



- Oxidise positive comma shaped and also ***fermentative*** most important is *Vibrio cholerae* that causes cholera which is a disease characterized by ***severe diarrhea*** and ***dehydration***.

- ***Non- fermentative*** i.e. they do not ferment sugars e.g.

  - Oxidase positive
    - Pseudomonas – causes infection in immunocompromised patient.
  - Oxidase negative
    - Acinetobacter species

*الدكتور قال بالنسبه ل gram- negative rods المهم منها fermentative هو E.coli .

Gram-Negative Rods

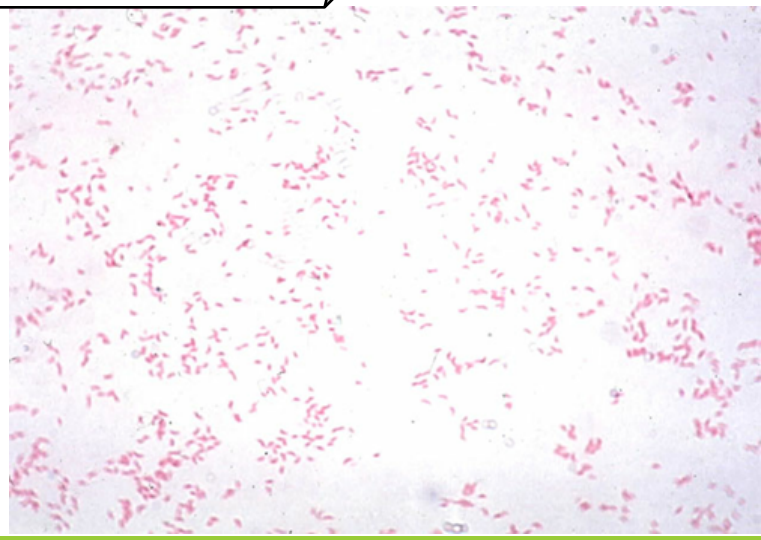
Fastidious GNRs

- *Bordetella pertussis*
- *Haemophilus influenza (most in children)*
- *Campylobacter jejuni*
- *Helicobacter pylori*
- *Legionella pneumophila*

Anaerobic GNRs

- *Bacteroides fragilis*
- *Fusobacterium*

الدكتور يقول مهمه



Non-Gram-stainable bacteria

Unusual gram-positives :

- **Spirochaetes.**
- **Obligate intra-cellular bacteria.**

-Mycoplasmas:

It lacks cell wall so we can't use antibiotics that destroy the cell wall such as penicillin

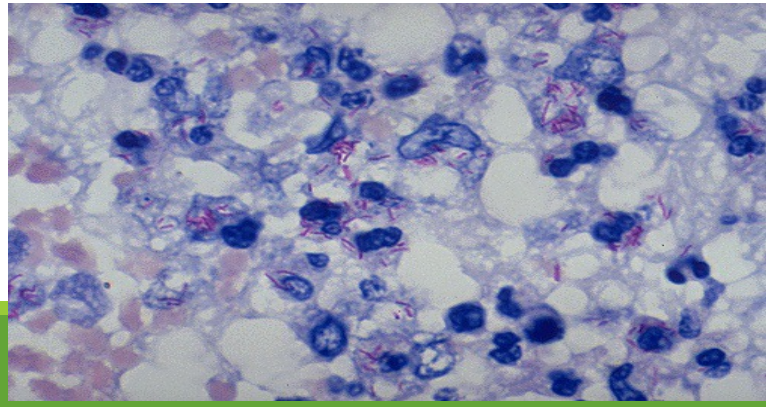
- No cell wall .

-Smallest free-living organisms.

-E.g.: M. pneumonia,

M.genitalium.

بعض البكتيريا لا نستطيع صبغها لأن لايوجد فيها جدارخلوي



Questions:

1)Which of the following is an Aerobic bacilli:

a) Nocardia

b) Latobacillus Bacillus

c) Clostridium

d) Cornybacterium

2)Gram negative has a thick, homogenous sheath of peptidoglycan:

a)True b)false

3)Gram negative has a Lose crystal violet and stain pink:

a)True b)false

4) Which of the following can be an example on gram-positive spore forming bacilli :

A) Clostridium perfringens

B) Bacillus anthracis

C) Clostridium tetani

D) Streptococci

5-what remains colored after staining:

A-gram positive B-gram negative

6-an example of gram positive cocci:

A-Corynebacterium B-lactobacillus C-entercocci

7- an example of a gram negative bacili:

A-fusobacterium B-bordetella C-moraxella

8-clostridium perfringens causes:

A-tetanus B-gas gangrene C-botulism

9-what causes clostridium botulism:

A-tetanus B-gas gangrene C-botulism

1)C
2)B
3)A
4)B
5)A
6)C
7)A
8)B
9)C

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