GRAM POSITIVE & GRAM NEGATIVE BACTERIA

(Foundation Block, Microbiology)

Lecturer name: *Dr. Fawzia Alotaibi*

Department of Pathology, Microbiology Unit

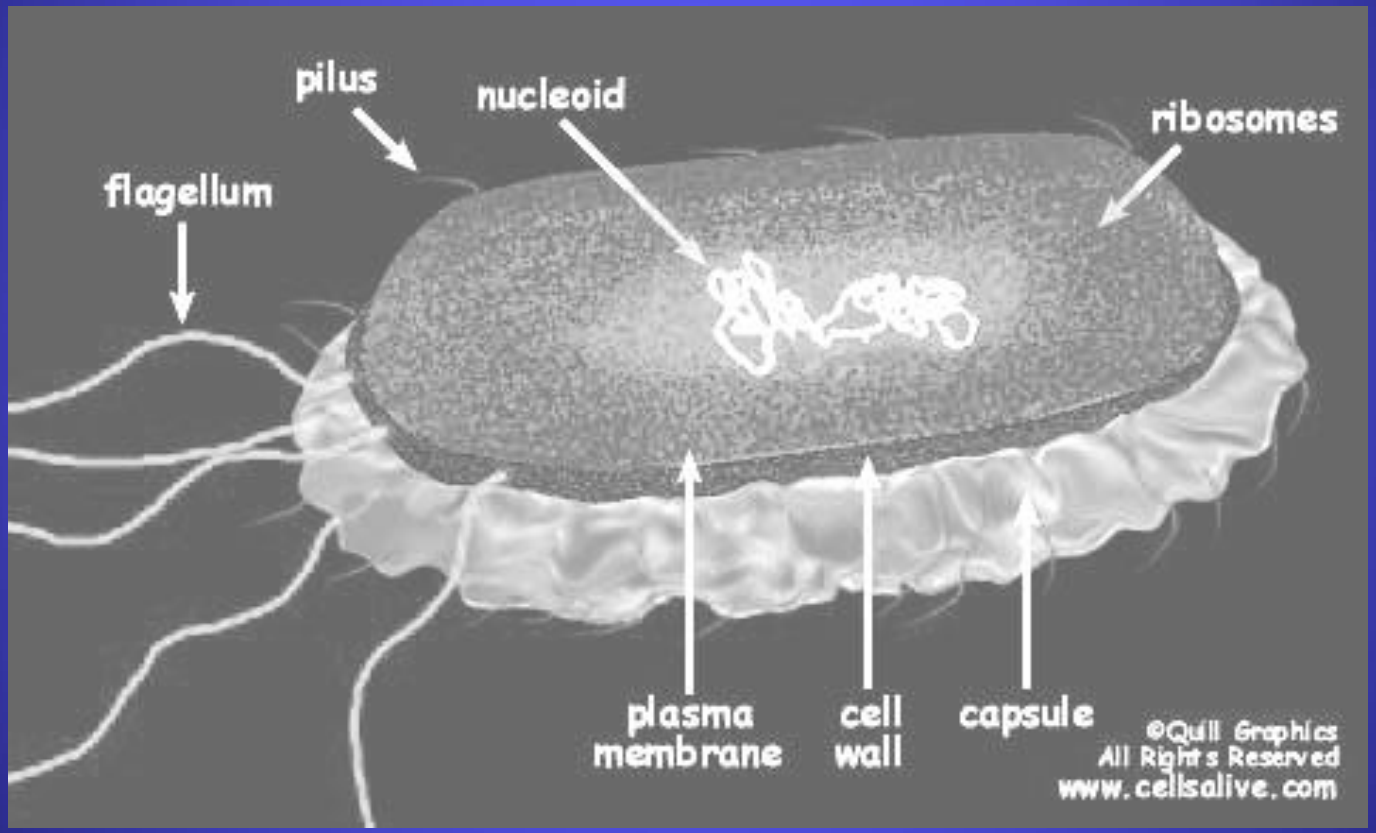
Objectives:

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

- Know the general basic characteristics of bacteria
- Differentiate between gram positive and gram negative bacteria characteristics.
- Know the classes and groups of gram positive bacteria, cocci and bacilli (rods)
- Know the common identification characteristic of these groups

- Know the common infections and diseases caused by these organisms and the antibiotics used for their treatment
- Know the classes and groups of gram negative bacteria, cocci and bacilli (rods)
- Know the common identification methods for These organisms
- Know the commonest infectious and diseases caused by these bacteria and the antibiotics used for their treatment

Bacterial cells

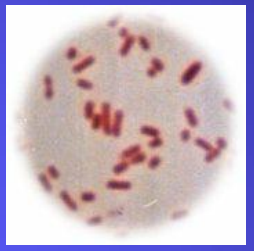


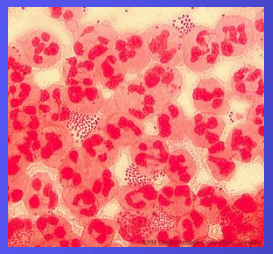
GRAM STAIN

- Developed in 1884 by the Danish physician Hans Christian Gram

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

- Can be applied to **pure cultures** of bacteria or to **clinical specimens**





Top: Pure culture of *E. coli (Gram-negative rods)*
Bottom: *Neisseria gonorrhoeae* in a smear of urethral pus
(*Gram-negative cocci, with pus cells*)

CELL WALL

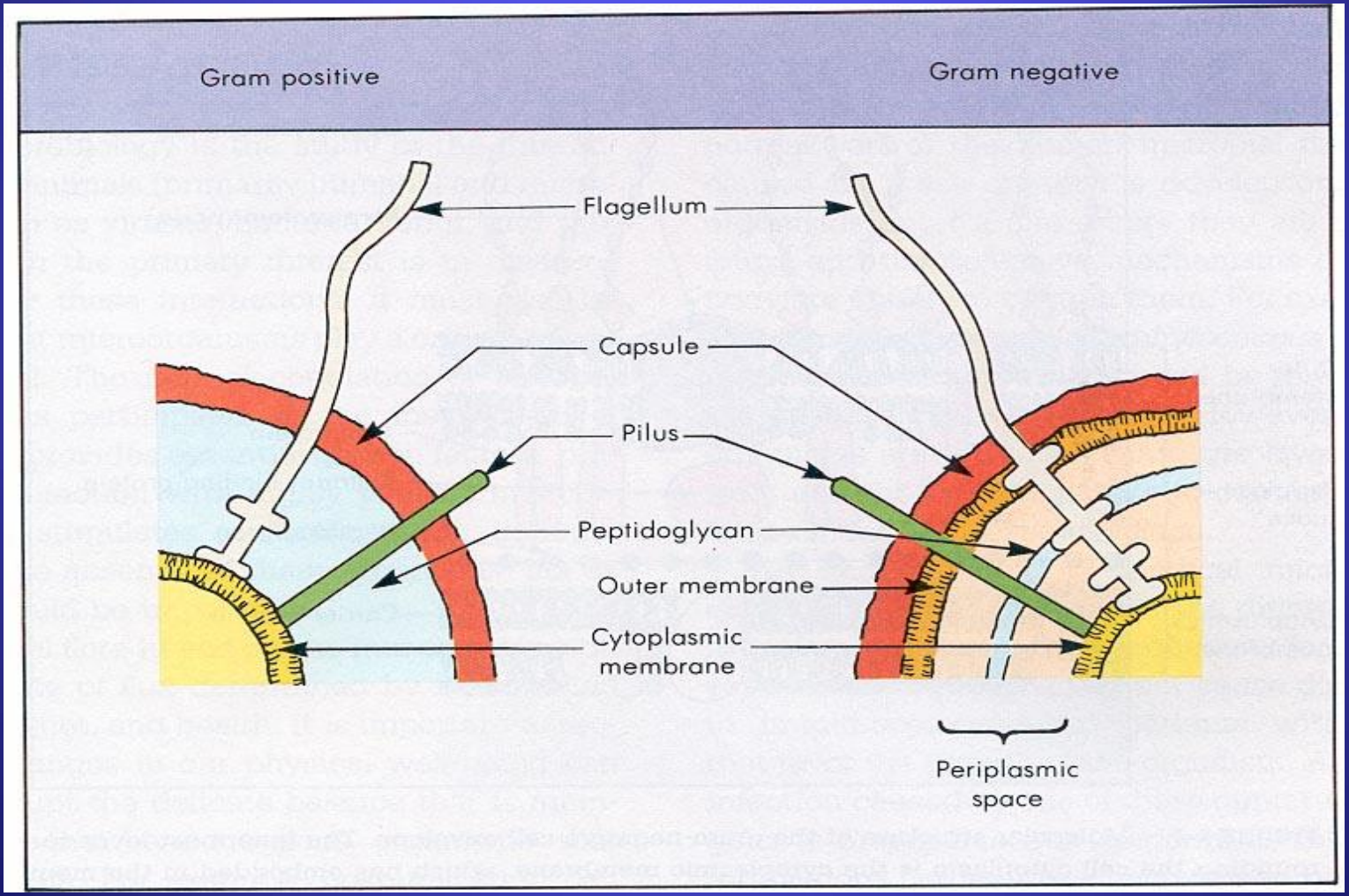
Gram positive cell wall

- Consists of
  - a thick, homogenous sheath of peptidoglycan 20-80 nm thick
  - tightly bound acidic polysaccharides, including teichoic acid and lipoteichoic acid
  - cell membrane
- Retain crystal violet and stain purple

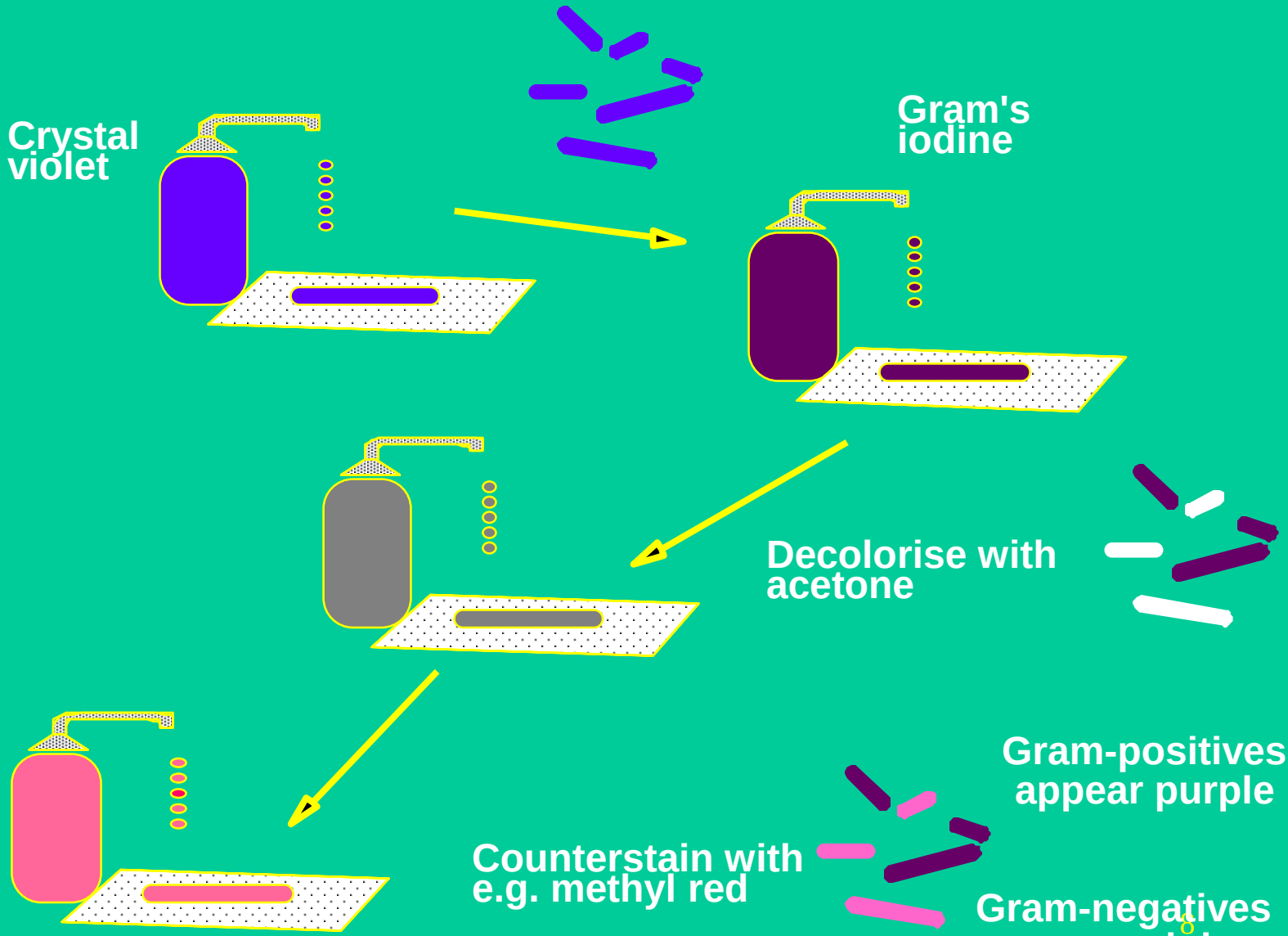
Gram negative cell wall

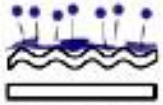
- Consists of
  - an outer membrane containing lipopolysaccharide (LPS)
  - thin shell of peptidoglycan
  - periplasmic space
  - inner membrane
- Lose crystal violet and stain pink from safranin counterstain

Gram Positive Gram Negative

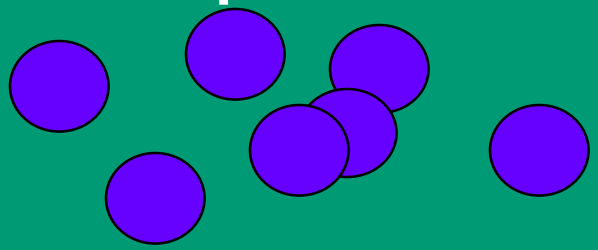


The Gram Stain



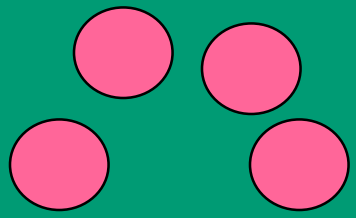
	Microscopic Appearance of Cell		Chemical Reaction in Cell Wall (very magnified view)	
Step	**Gram (+)**	**Gram (–)**	**Gram (+)**	**Gram (–)**
1. Crystal violet				
			Both cell walls affix the dye	
2. Gram's iodine				
			Dye crystals trapped in wall	No effect of iodine
3. Alcohol				
			Crystals remain 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

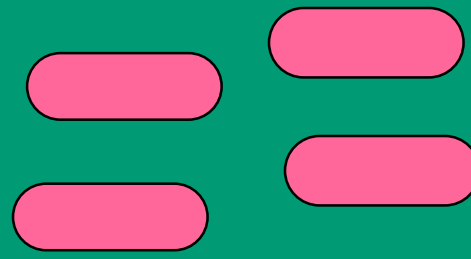


Gram-positive rods

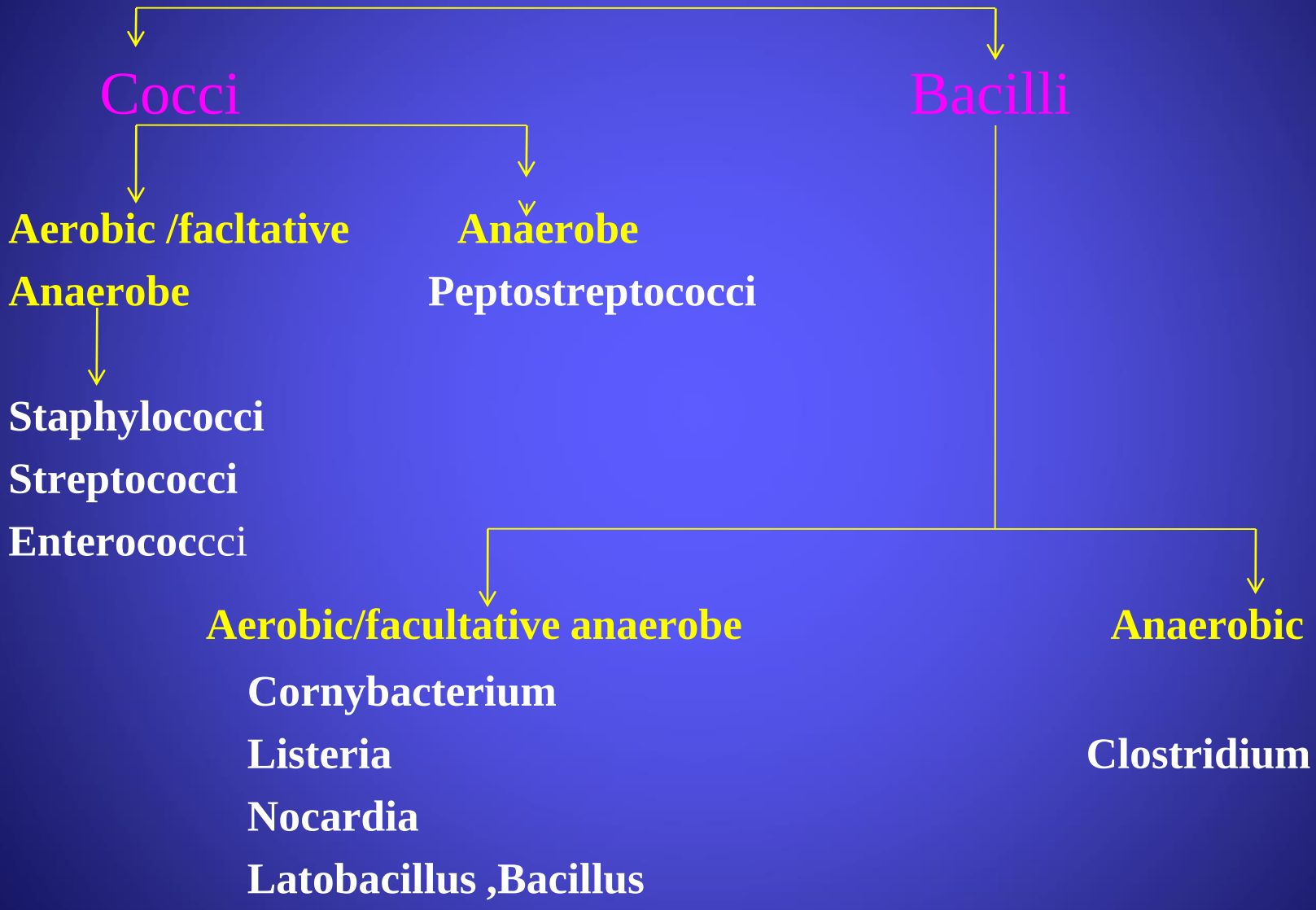
Gram-negative cocci



Gram-negative rods

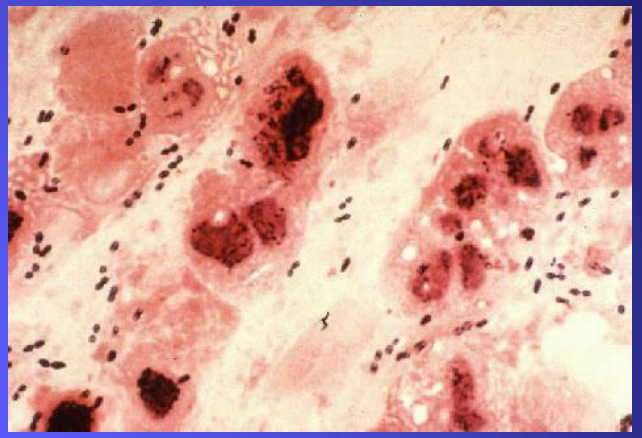


Gram positive bacteria



Gram-positive Cocci

- **Staphylococci**
  - **Catalase-positive**
  - **Gram-positive cocci in clusters**
- ***Staphylococcus aureus***
  - **coagulase-positive most important**
  - **pathogen**
- ***Staph. epidermidis***
- **and other coagulase negative staphylococci egS saprophiticus**

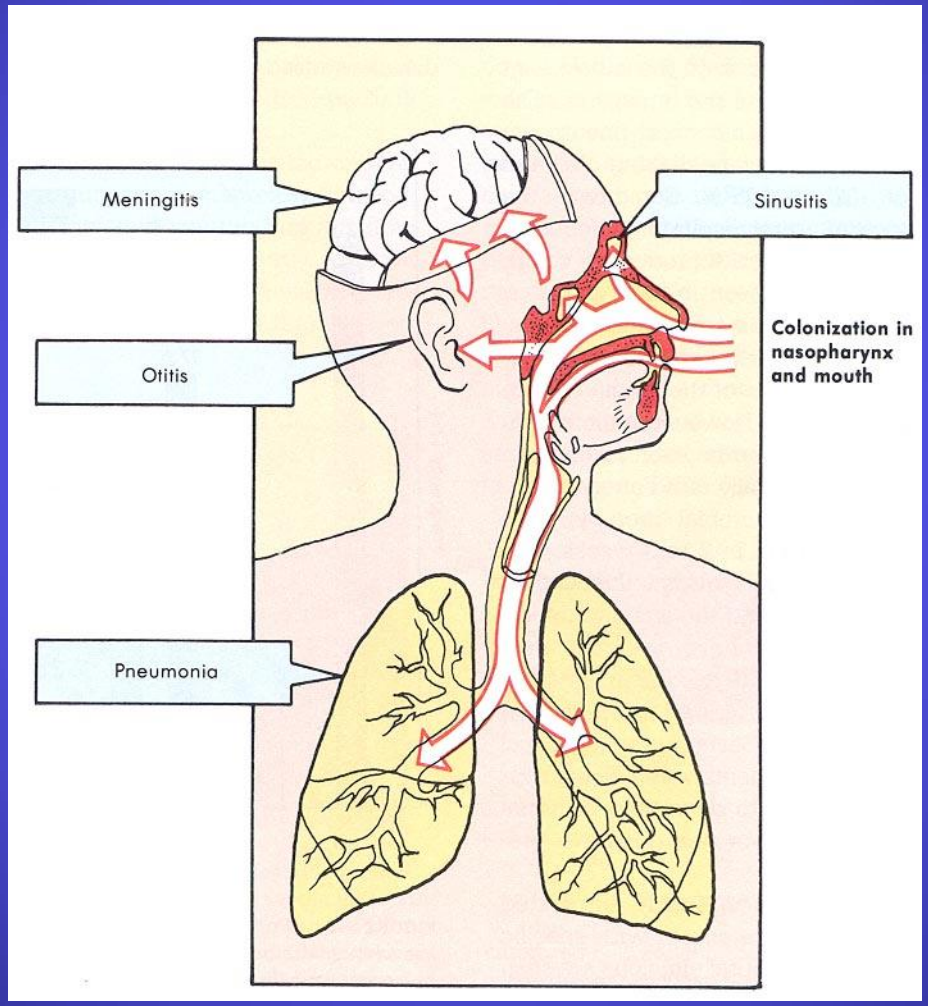


- Streptococci
  - **Catalase-negative**
  - **Gram-positive cocci in chains or pairs**
- ***Strep. pyogenes***
- ***Strep. pneumoniae***
- ***Viridans-type streps***
- ***Enterococcus faecalis***

Streptococcus

- S. viridans-oral flora -infective endocarditis
- S. pyogenes dividedby type of haemolysis
- **Group A, beta hemolytic strep**
- **pharyngitis, cellulitis**
- **rheumatic fever**
  - **fever**
  - **migrating polyarthritis**
  - **carditis**
  - **immunologic cross reactivity**
- **acute glomerulonephritis**
  - **edema, hypertension, hematuria**
  - **antigen-antibody complex deposition**

S. pneumoniae



GRAM POSITIVE BACILLI

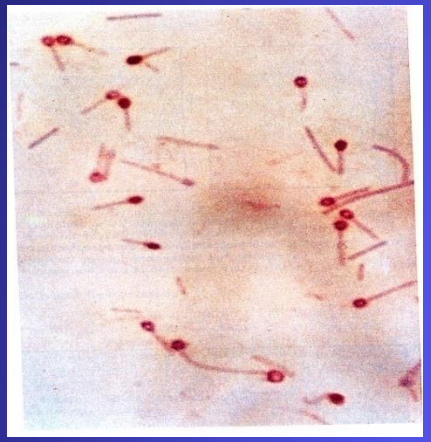
- A-Spore forming
- B-Non spore forming

Spore forming are divided into:-

Aerobic spore forming most important is *Bacillus anthracis,that causes anthracis*

Anerobic Gram Positive Bacilli

- C. tetani - **Tetanus**

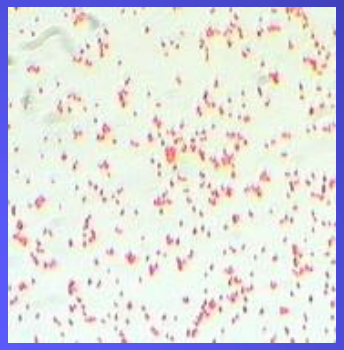


C. perfringens

Gas gangarene

- **C. botulinum - botulism**
- **Descending weakness-->paralysis**
- **diplopia, dysphagia-->respiratory failure**
- **C. diphtheriae - Fever, pharyngitis, cervical LAD**
- **thick, gray, adherent membrane**
- **sequelae-->airway obstruction, myocarditis**

Gram-Negative Cocci



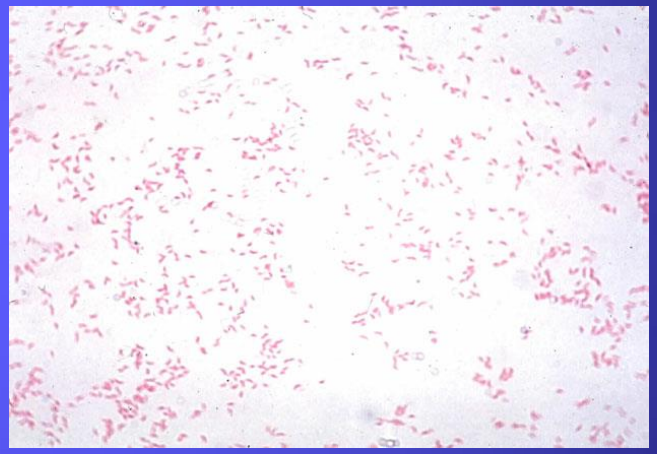
- *Neisseria gonorrhoeae*
  - *The Gonococcus*
- *Neisseria meningitidis*
  - *The Meningococcus*
- Both Gram-negative intracellular diplococci
- Moraxella catarrhalis

Gram-Negative Rods

- Enteric Bacteria they ferment sugars most important are;
  - *E. coli*
  - *Salmonella*
  - *Shigella*
  - *Yersinia and Klebsiella pneumoniae*
  - *Proteus*

Gram-Negative Rods

- Fastidious GNRs
  - *Bordetella pertussis*
  - *Haemophilus influenzae*
  - *Campylobacter jejuni*
  - *Helicobacter pylori*
  - *Legionella pneumophila*
- Anaerobic GNRs
  - *Bacteroides fragilis*
  - *Fusobacterium*



Oxidise positive non fermentative i.e. they do not ferment sugars e.g.

- Pseudomonas that causes infection in Immunocompromised patients
- Oxidise negative non fermentative e.g. Acinobacter species

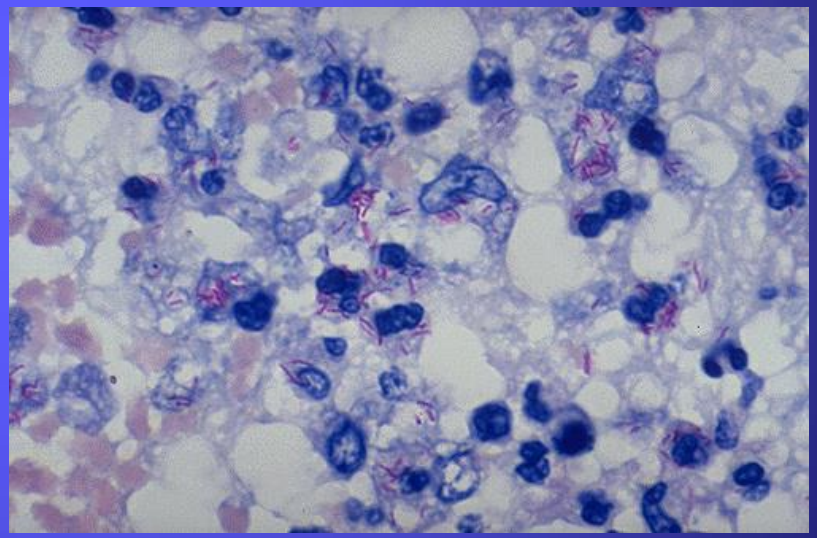
Oxidise positive comma shaped and also fermentative most important is *Vibrio cholerae* that causes cholera which is a disease characterized by severe diarrhea and dehydration

Non-Gram-stainable bacteria

- Unusual gram-positives
- Spirochaetes
- Obligate intra-cellular bacteria

Unusual Gram-positives

- Mycoplasmas
  - Smallest free-living organisms
  - No cell wall
  - *M. pneumonia, M. genitalium*



Reference book and the relevant page numbers..