Gram +ve and Gram –ve BACTERIA

Objectives:

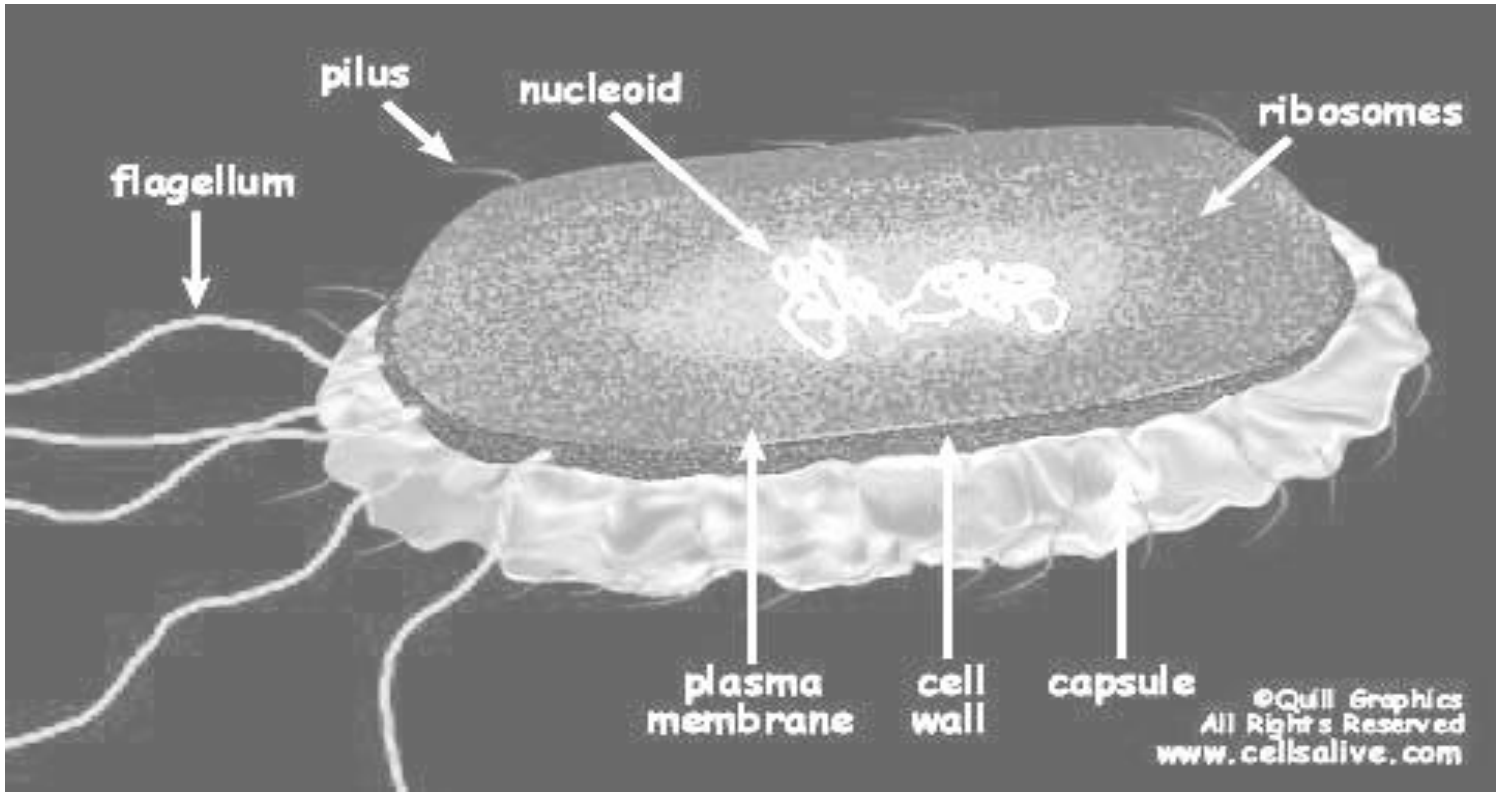
By the end of this lecture, the student should able to:

- 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.

LECTURE SIX

Red : Important
Blue : Definitions
Green : Examples
Gray : extra information

Bacterial structure



note that the vital component in gram staining is the cell wall, depending on the amount of peptidoglycan.

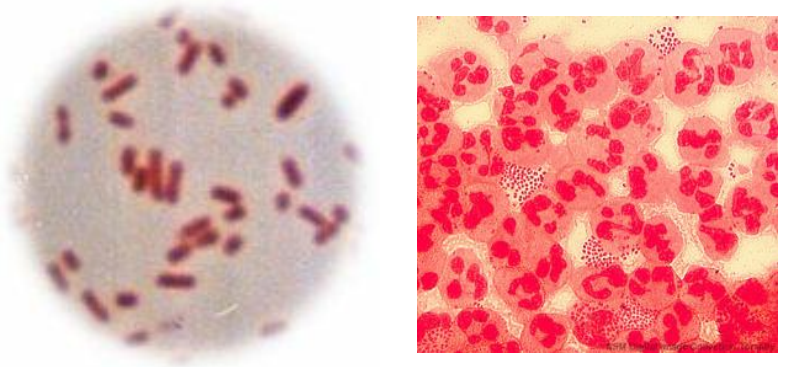
GRAM STAINING

Developed in 1884 by the Danish physician Hans Christian Gram

An important tool in bacterial taxonomy, distinguishing so-called **Gram-positive bacteria** (large amount of peptidoglycan), which remain coloured(violet) after the staining procedure, from **Gram-negative bacteria** (small amount of peptidoglycan), which do not retain dye(violet) and need to be counter-stained(red safranine).

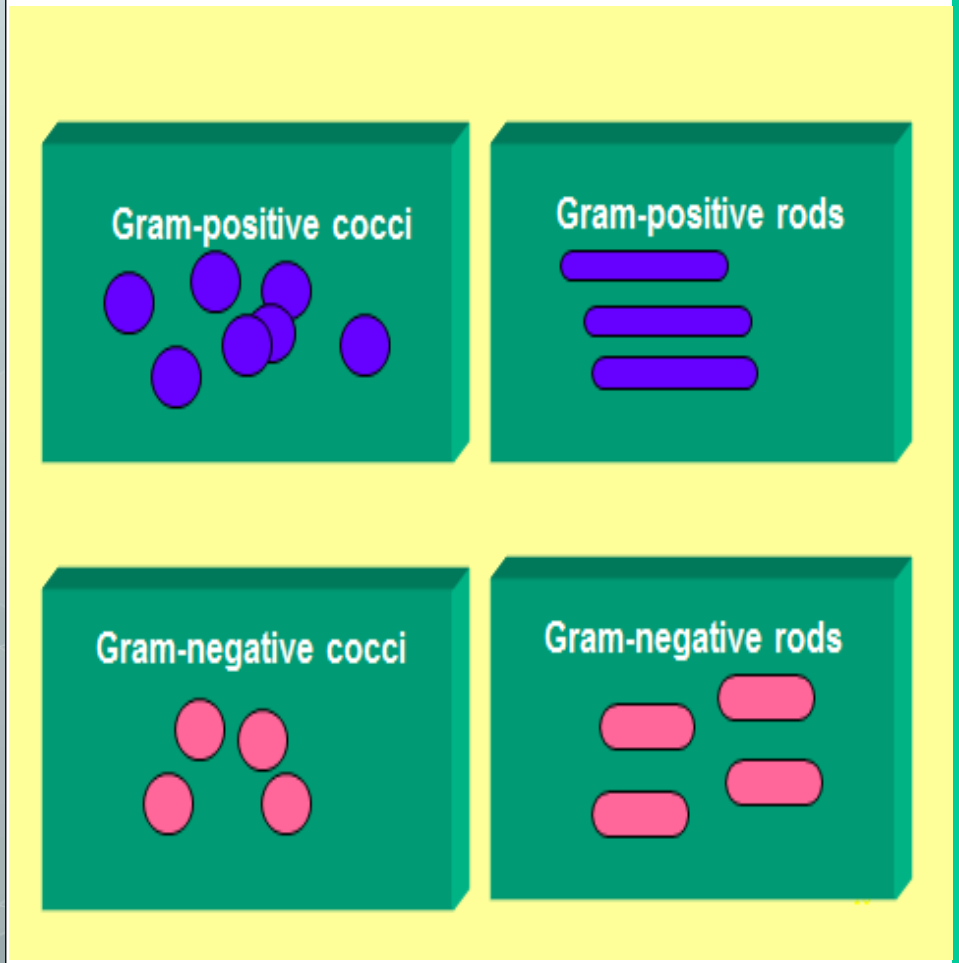
Can be applied to **pure cultures** (lab culture with a single specimen) of bacteria or to **clinical specimens(**swabs, feces, urine…..)

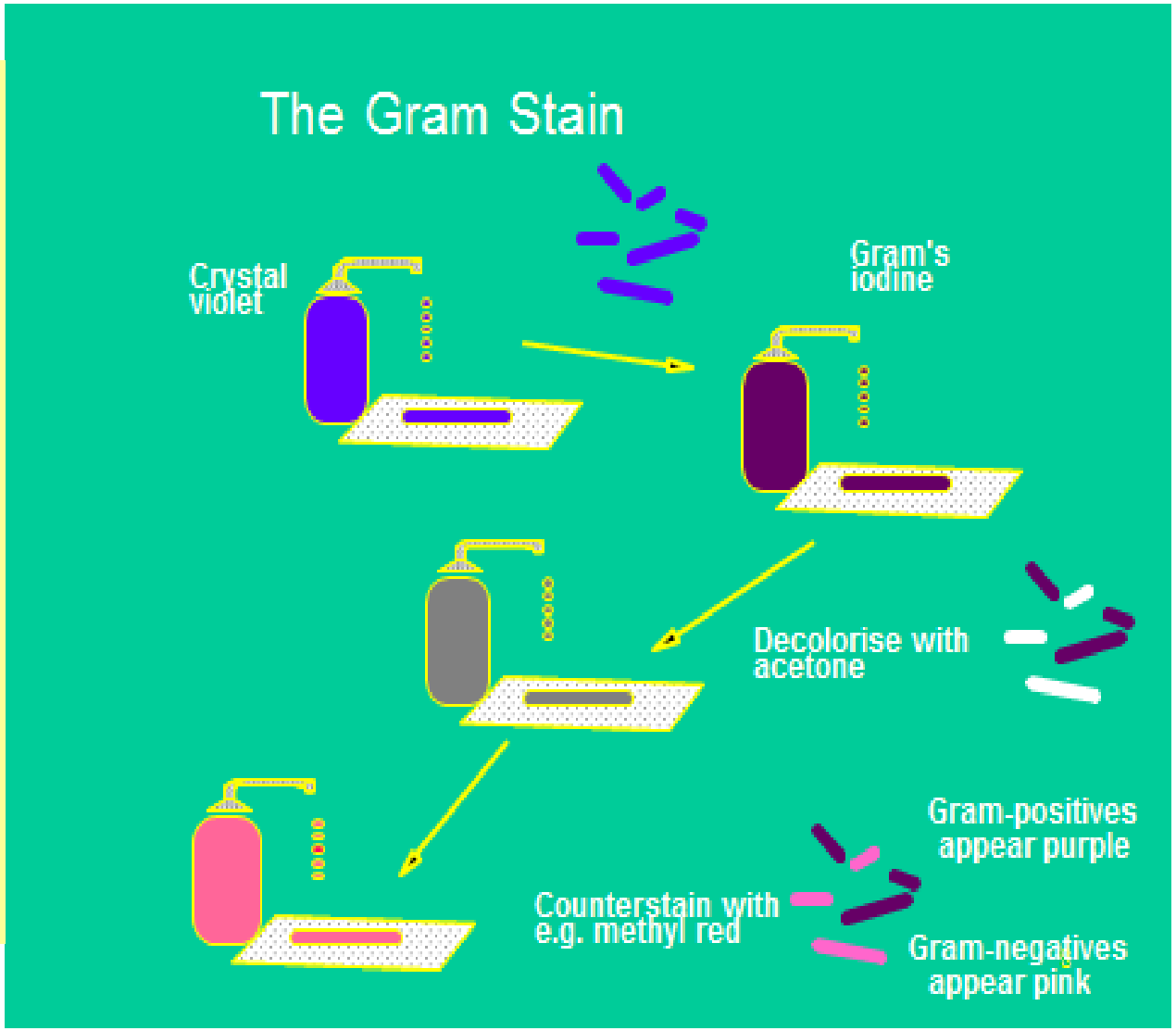
left: Pure culture of *E. coli*
(Gram-negative rods)
right: *Neisseria gonorrhoeae* in a smear of urethral pus
(*Gram-negative cocci, with pus cells*)
Note that they are both bright red (from safranine)

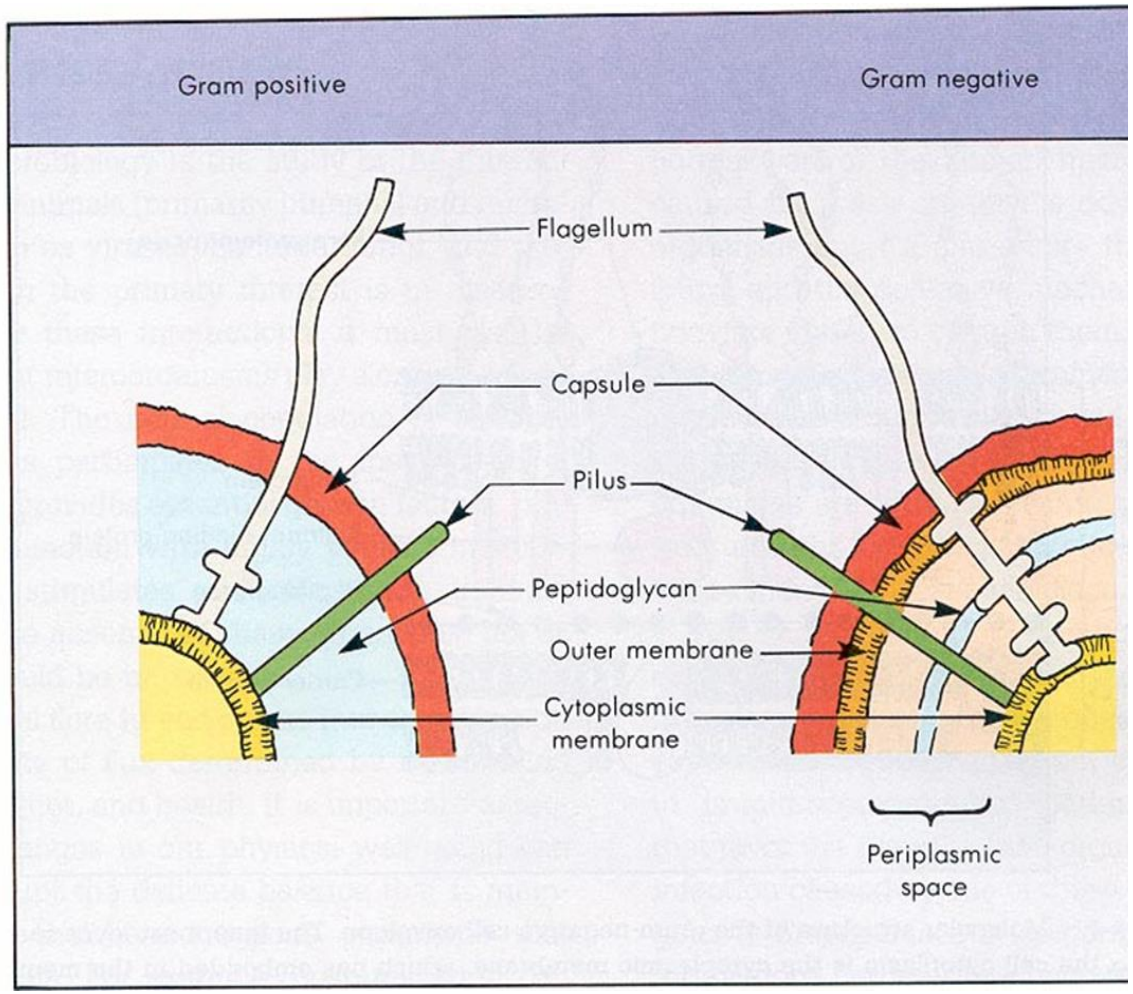


CELL WALL

Gram positive cell wall	Gram negative cell wall
a thick, homogenous sheath of peptidoglycan 20-80 nm thick	an outer membrane containing lipopolysaccharide (LPS)
tightly bound acidic polysaccharides, including teichoic acid and lipoteichoic acid	thin shell of peptidoglycan
	periplasmic space
	inner membrane
cell membrane	Lose crystal violet and stain pink from safranin counterstain
Retain crystal violet and stain purple	


Gram-positive cocci
Gram-positive rods
Gram-negative cocci
Gram-negative rods


The Gram Stain
Crystal violet
Gram's Iodine
Decolorise with acetone
Counterstain with e.g. methyl red
Gram-positives appear purple
Gram-negatives appear pink



	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 bacteria

-This is the most important slide. Know everything

Cocci

Aerobic/ Facultative Anaerobe:

Staphylococci
Streptococci
Enterococci

Anaerobe

Peptostreptococci

Bacilli

Anaerobic

Clostridium

Aerobic/ Facultative Anaerobe

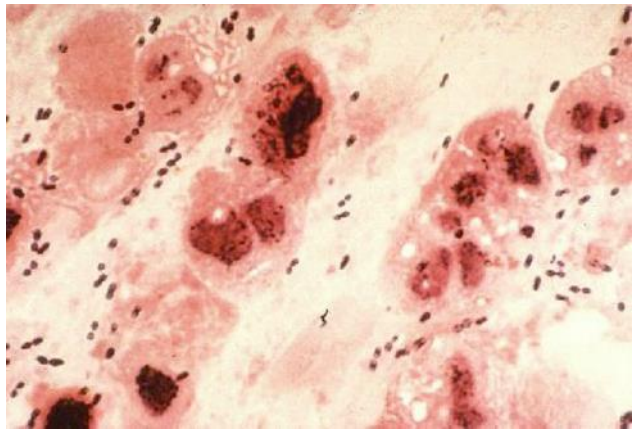
Nocardia
Latobacillus, Bacillus
Cornybacterium
Listeria

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**

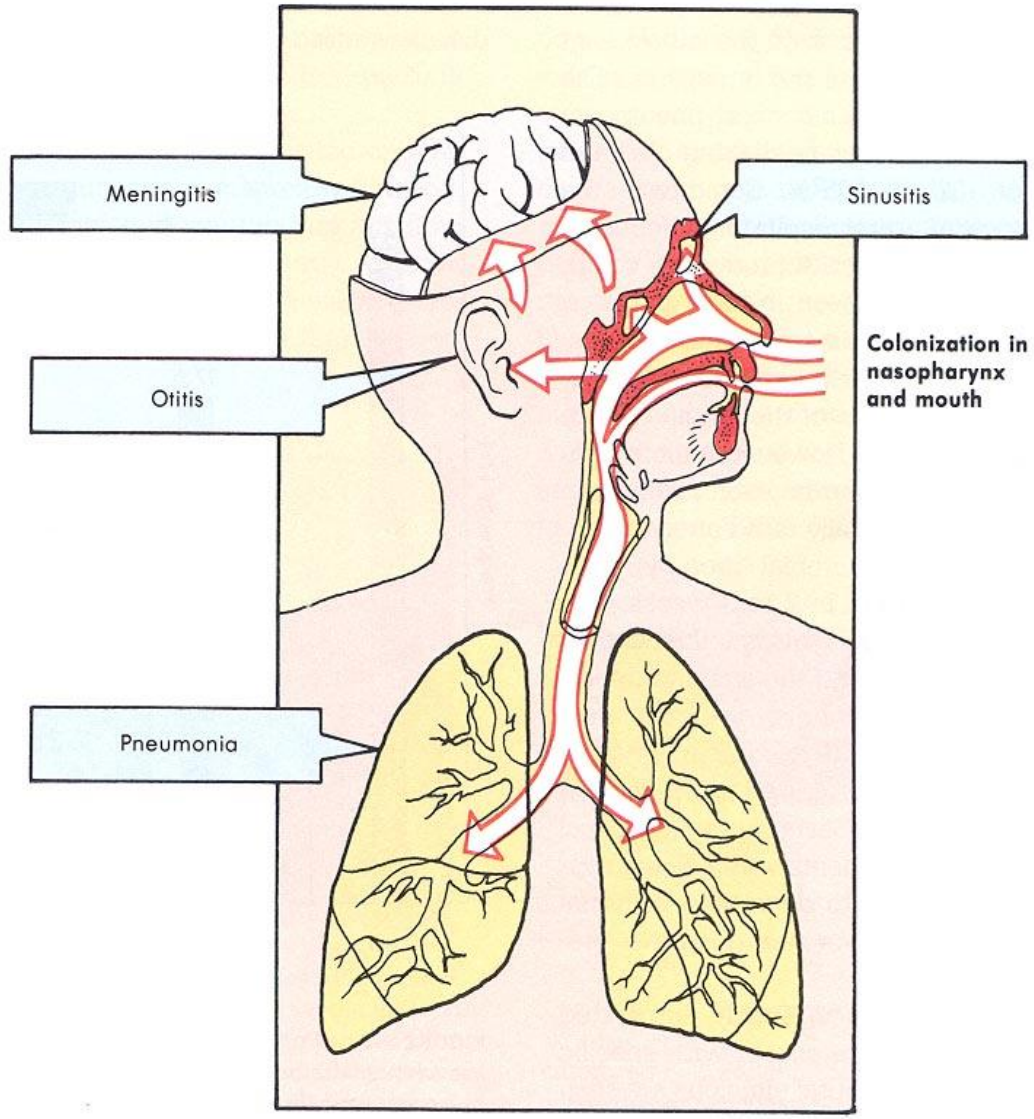


Streptococcus

-S. viridans-oral flora -infective endocarditis
-S. pyogenes divided by 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

- Spore forming:

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

- Non spore forming

-Gram +ve and Gram –ve bacteria

Anaerobic Gram Positive Bacilli

1-C.tetani: which causes tetanus (muscle spasm)

2-C.perifringens: causes gas gangrene and wound infection

3-C.butlinum: causes descending weakness (paralysis) and respiratory failure

4-C. diphtheriae: causes Fever, Pharyngitis, cervical LAD (disease in lymph node) ,and airway. obstruction

❖ **Gram-Negative Cocci:**

- *Neisseria gonorrhoeae (The Gonococcus)*
- *Neisseria meningitides (The Meningococcus) potential pathogen*
- Both Gram-negative intracellular diplococci
- Moraxella catarrhalis (infection of the respiratory system, middle ear, eye, CNS and joints

❖ **Gram-Negative Rods**

Enteric Bacteria they ferment sugars:

- *E. coli*
- *Salmonella*
- *Shigella*
- *Yersinia and Klebsiella pneumoniae*
- *Proteus*

❖ **Fastidious Gram-Negative Rods:**
- **Bordetella pertussis**
- **Haemophilus influenzae**
- **Campylobacter jejuni**
- **Helicobacter pylori**
- **Legionella pneumophila**

❖ **Anaerobic Gram-Negative Rods**
- *Bacteroides fragilis*
- *Fusobacterium*

❖ Oxidase positive non fermentative (they do not ferment sugars) e.g.
- ✓ pseudomonas (cause infection in patients with weak immunity)
- ✓ Oxidase negative non fermentative e.g. Acinobacter species

Clostridium spp. video

Vibrio cholerae :

- **Gram** (-) comma shaped,polar flagellae, **oxidase** (+), Alkaline growth.
- 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-negative*** organisms:
- Mycoplasmas:
  - Smallest free-living organisms
  - No cell wall

E.g.: M. pneumonia, M. genitalium

MCQ'S:

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

Thank you

Done by:

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- ريما هزازي
- اية الدايل
- حنان خشيم
- منال الحمدان
- وجدا الهذلان
- الجوهرة العمران
- امل افراح
- الهنوف المهنا

MCQ'S answers:
1)C
2)B
3)A
4)B