

Introduction to Bacteria:

Classification, Morphology and Structures



Introduction

- **Prokaryotic organisms.**
- **Vary in sizes, measure approximately 0.1 to 10.0 μm**
- **Widely distributed. It can be found in soil, air, water, and living bodies.**
- **Some bacteria can cause diseases for human, animals and plants.**
- **Some bacteria are harmless (i.e. live in human bodies as normal flora)**

Size of Bacteria

- Unit of measurement in bacteriology is the micron (micrometre, μm)
- Bacteria of medical importance (0.2 – 1.5 μm) in diameter (3 – 5 μm) in length

Bacterial Morphology



- Rods – bacilli



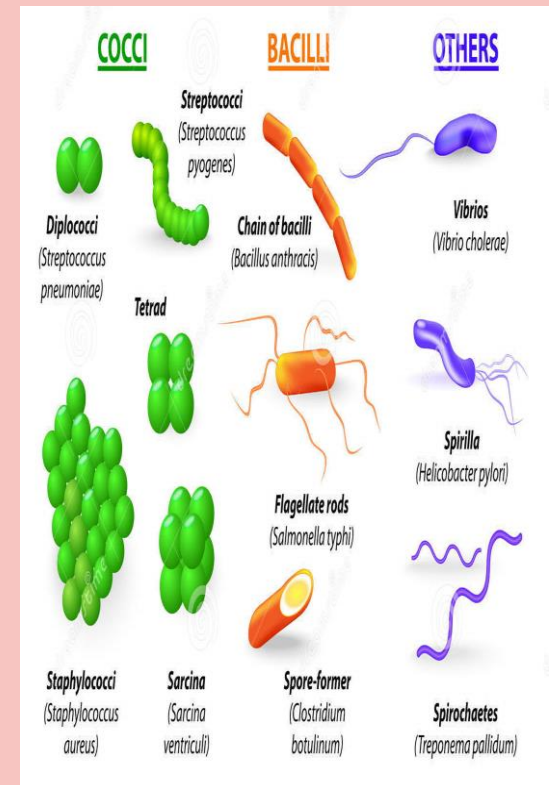
- Coccoid shaped



- spirilla

Bacterial Morphology

- Cocci – spherical / oval shaped major groups
- Bacilli – rod shaped
- Vibrios – comma shaped
- Spirilla – rigid spiral forms
- Spirochetes – flexible spiral forms
- Actinomycetes – branching filamentous bacteria
- Mycoplasmas – lack cell wall



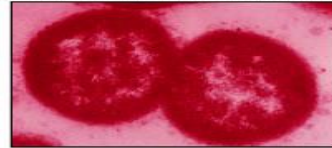
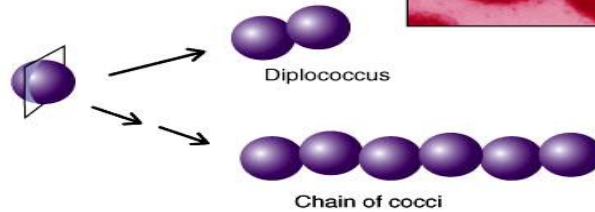
Reproduction

- Binary fission

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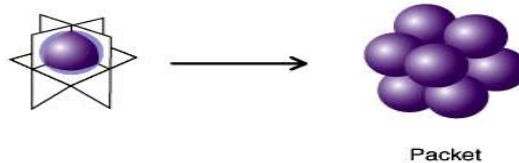
(a) Chains

Cell divides in one plane



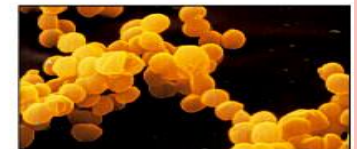
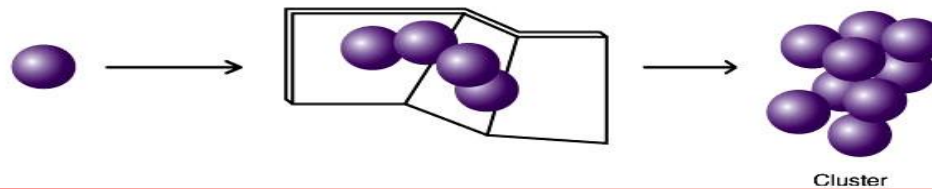
(b) Packets

Cell divides in two or more planes perpendicular to one another



(c) Clusters

Cell divides in several planes at random

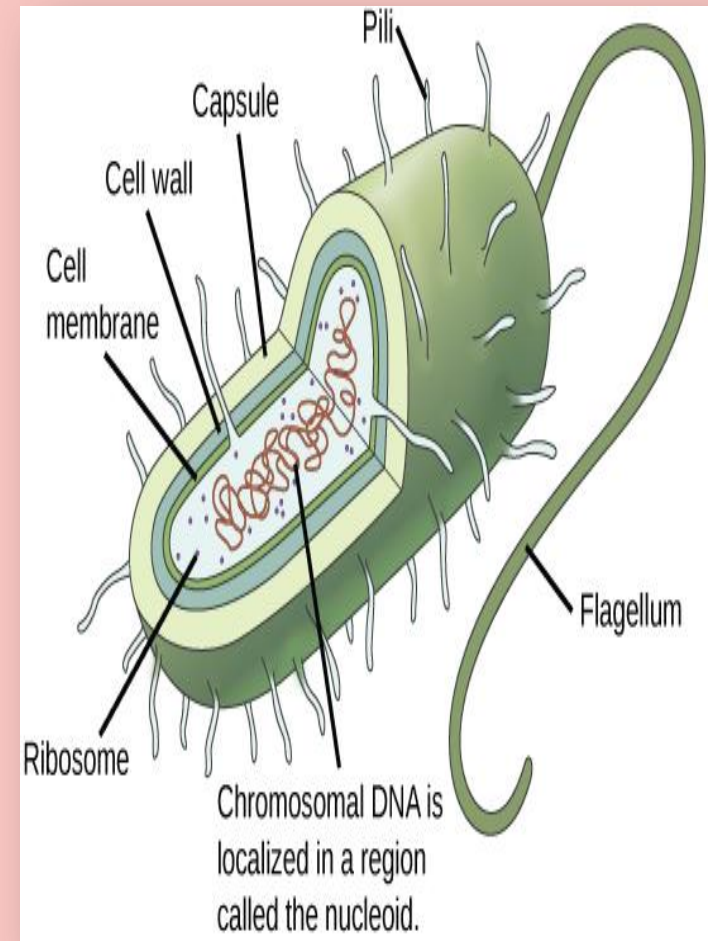


Bacterial Structure

A. The envelope:

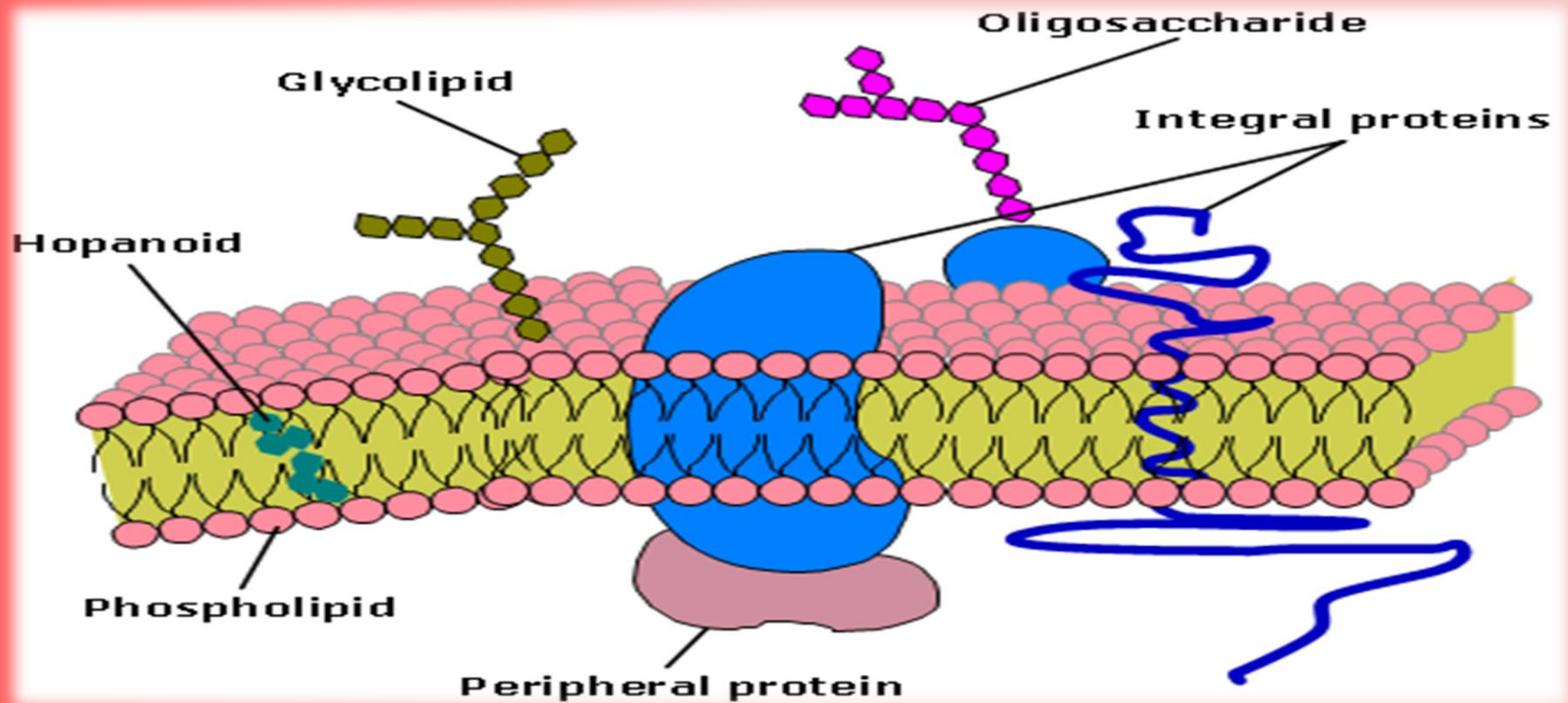
1. Cytoplasmic membrane
2. Cell wall (Peptidoglycan)
3. Extracellular polysaccharides: capsules, microcapsules and loose slime
4. Appendages
5. Antigenic variation

B. Cytoplasmic components



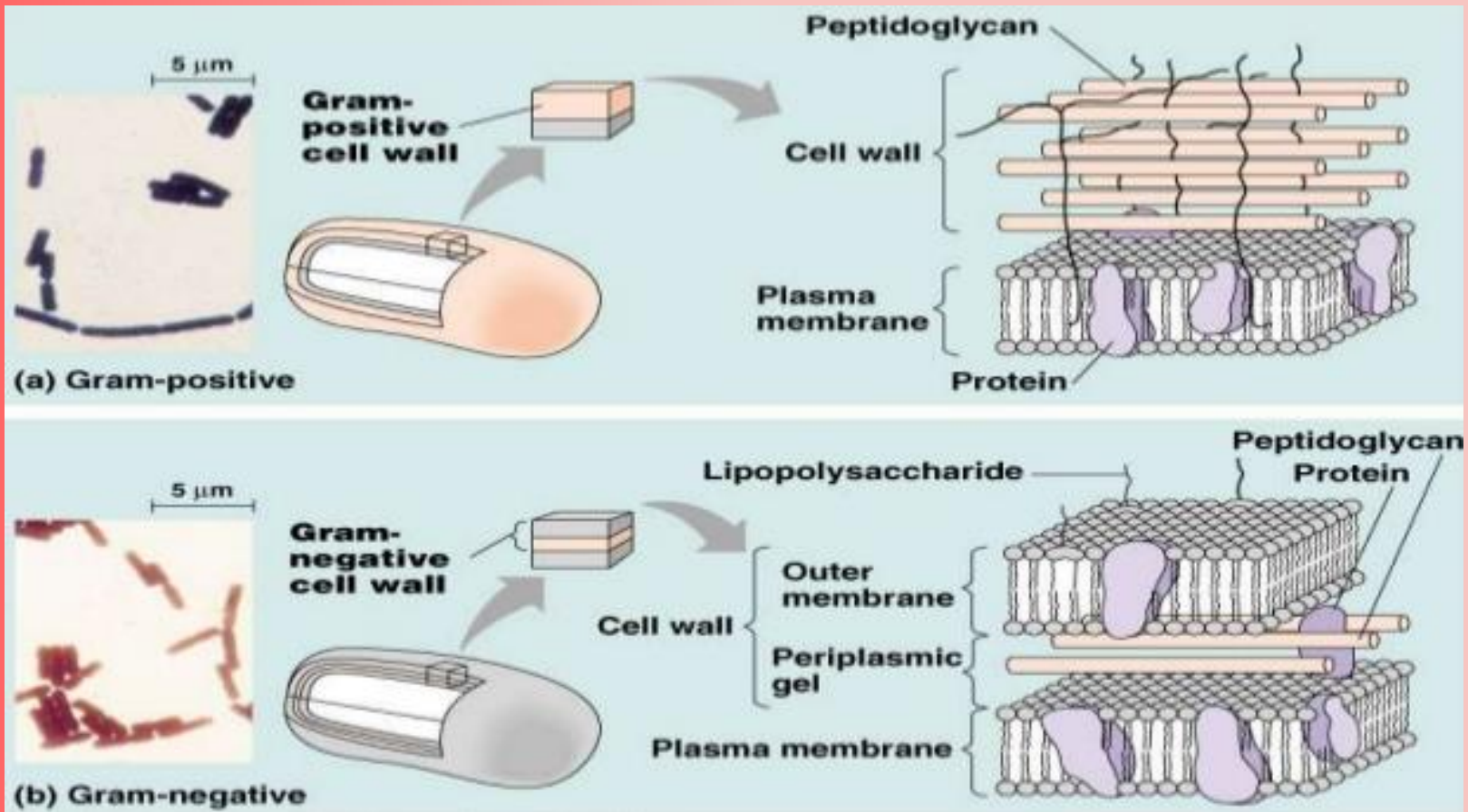
Bacterial Structure

1. Cytoplasmic membrane



Bacterial Structure

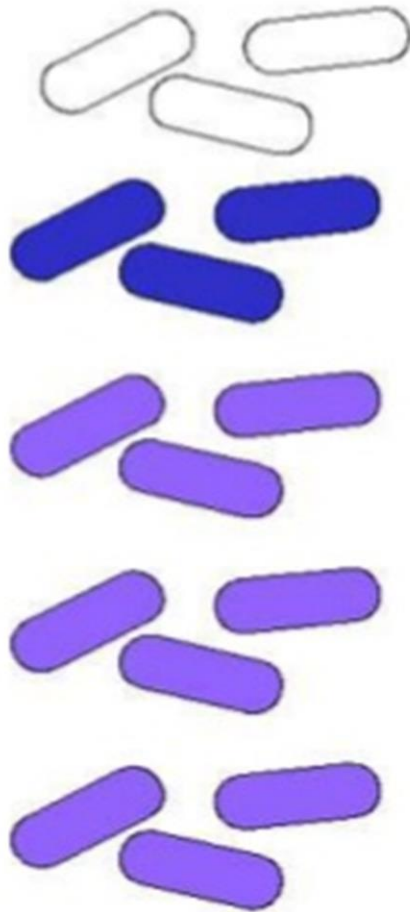
2. Cell wall



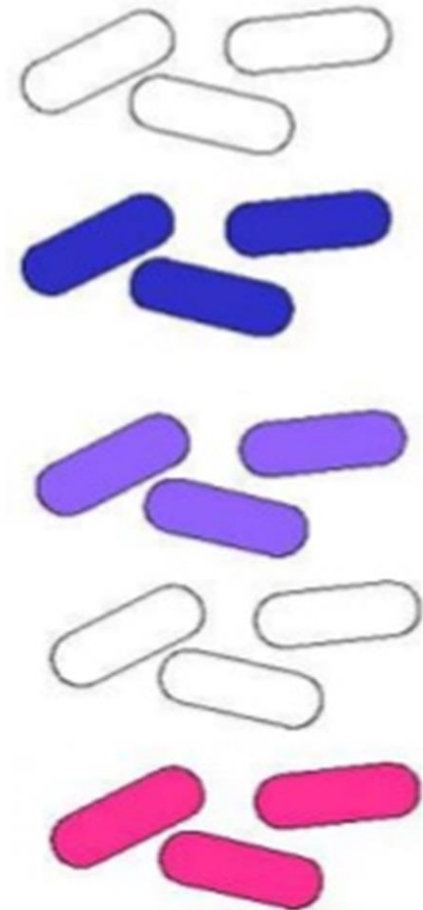
Characteristic	Gram-negative Bacteria	Gram-positive Bacteria
Wall Structure	They have a thin lipopolysaccharide exterior cell wall.	The peptidoglycan layer is thick
Effect of Dye	do not retain the crystal violet dye, and react only with a counter-stain, generally stain pink.	retain the crystal violet dye, and change into purple during staining identification.
Effect of Antibiotics	<ul style="list-style-type: none"> resistant to penicillin contain an endotoxin called LPS 	susceptible to the enzyme lysozyme and to penicillin
Flagellum	If present, the flagellum has four supporting rings, namely 'L' ring, 'P' ring, 'M' ring, and 'S' ring.	The flagellum has two supporting rings, in the peptidoglycan layer, and in the plasma membrane.
Teichoic Acids	absent.	present.
Lipoproteins	They are attached to the polysaccharide backbone.	absent.
Periplasmic Space	present.	absent.

Bacterial Structure

Gram Positive



Gram Negative



Fixation



Crystal violet



Iodine treatment



Decolorization



Counter stain
safranin

Bacterial Structure

3. Extracellular polysaccharides:

- Capsules
- Microcapsules
- Loose slime

4. Appendages

- Flagella
- Pili

5. Antigenic variation

- important in virulence & immunity

Bacterial Structure

B. Cytoplasmic components:

1. Cytoplasm

- Contains chromosomal DNA, ribosomes and various type of nutritional storage granules.
- Contains no organelles

2. Nuclear material (nucleoid or nuclear body)

- Consist of one long, double-stranded, circular DNA molecule
- R factor
- binary fission

Bacterial Structure

B. Cytoplasmic components:

3. Ribosomes

- function as the active center of protein synthesis

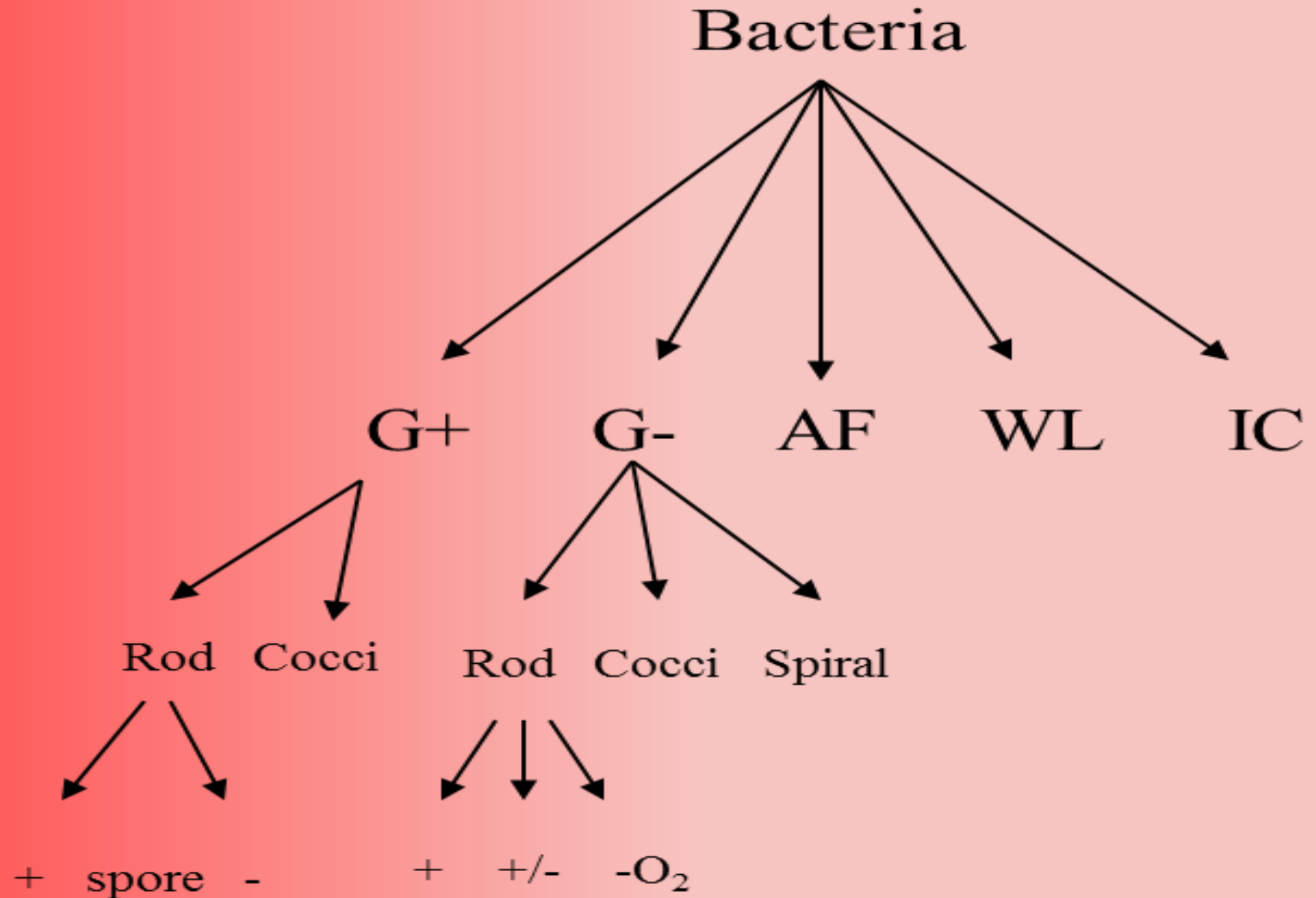
4. Cytoplasmic inclusion

- Sources of stored energy

SPORES AND SPORULATION

- Highly resistant resting stages formed during adverse environment (depletion of nutrients)
- Endospores
 - **Spore germination**
- **Medical significance of sporulation**
 - Bacillus species
 - Clostridium species

Bacterial classification



Bacterial classification

A. Wall structure

1. Gram +

- *Staphylococcus, Streptococcus, Clostridium, Bacillus*

2. Gram -

- Enteric, respiratory and others

3. Acid-fast

- *Mycobacterium*

4. Wall-less

- *Mycoplasma*

B. Unusual

– Obligate intracellular

- *Rickettsia, Chlamydia*

Bacterial classification

C. Cell morphology

1. Shapes

- Rod
- Cocci
- Spiral

2. Associations

- Individual
- Diplo-
- Staphylo-
- Strepto-

Bacterial classification

D. Growth characteristics

1. Oxygen requirement

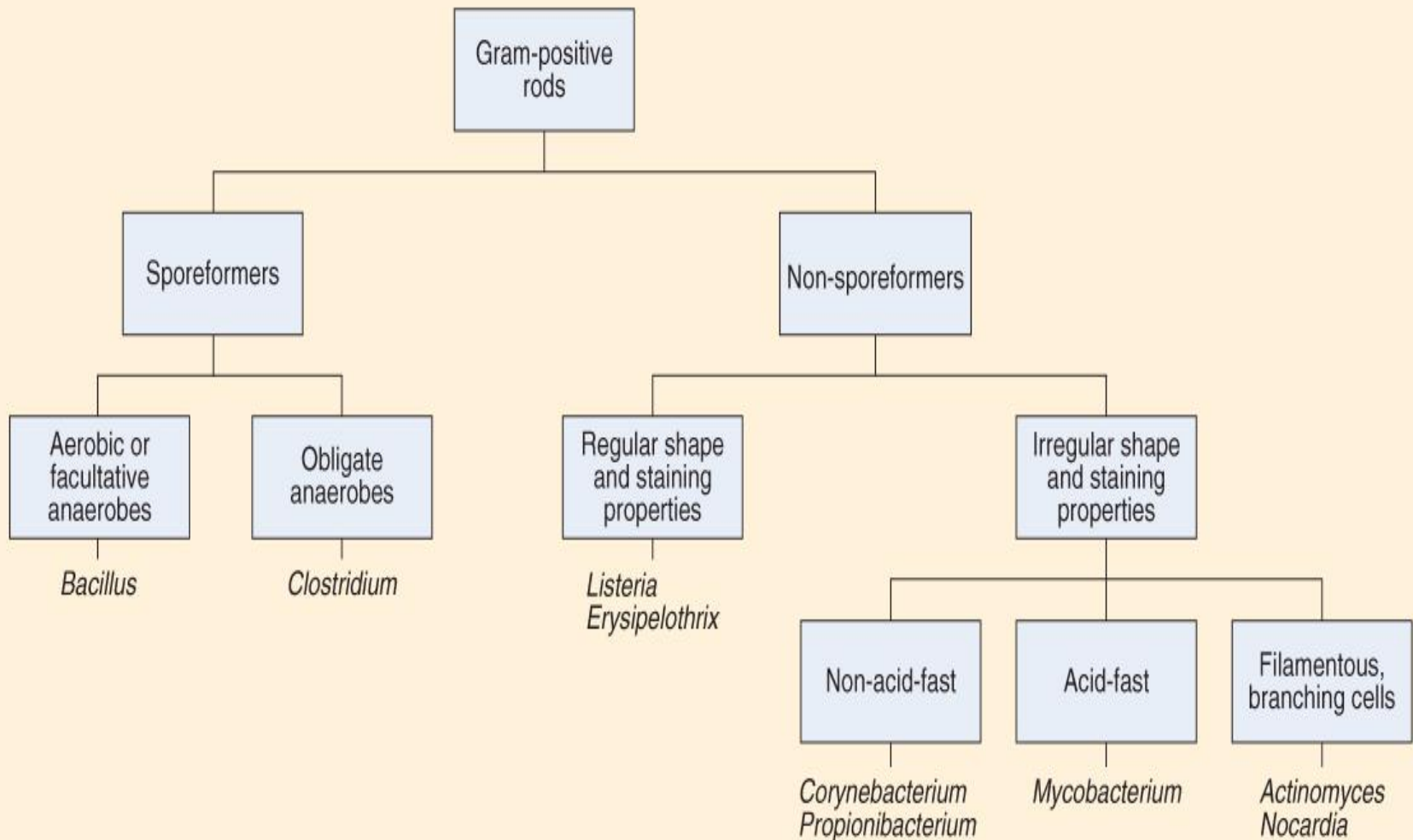
- Aerobic
- Anaerobic, Microaerophilic, aerotolerant
- Facultative

2. Spore formation

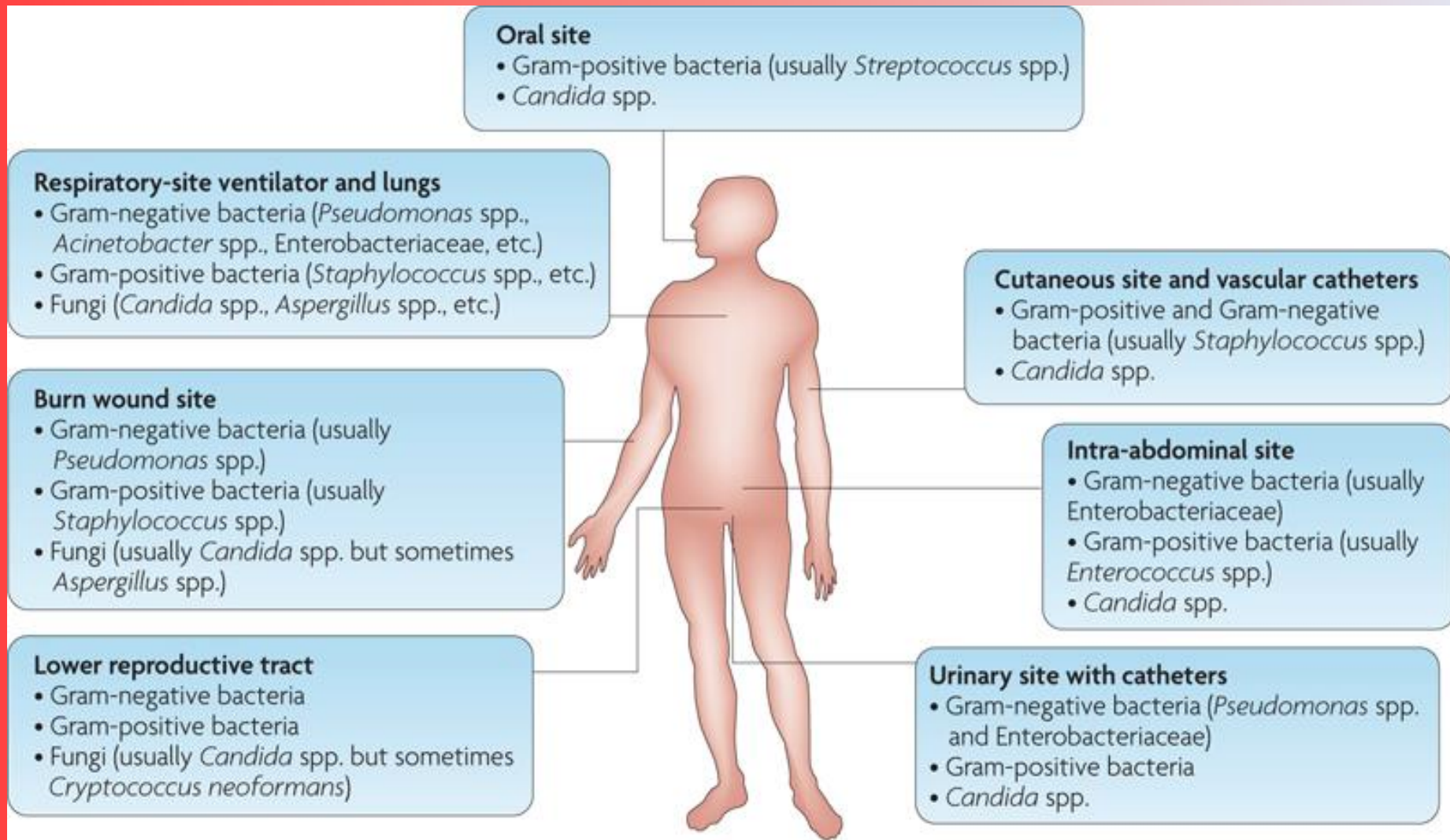
3. Intracellular/extracellular

4. Fastidious/non-fastidious

Bacterial classification



Medically important bacteria



Laboratory diagnosis

1. Specimen:

- Pus from abscesses, wounds, burns
- Sputum
- Faeces or vomit
- Blood
- Mid-stream urine
- Anterior nasal

Laboratory diagnosis

2. Culturing of specimens and Microscopy:

- Blood agar and MacConkey agar
- Mannitol salt agar
- Incubation at 37 °C for 24-48 h

3. Biochemical Identification:

- Gram stain
- Catalase test, Coagulase test, DNase test, Oxidase test

4. Rapid indirect identification:

- Latex Agglutination
- Quantitative (PCR)
- Antibody reactions (ELISA)