# Bacterial Cell Structure Microbiology For Nurses

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# OBJECTIVES

- Define Bacteria
- Give characteristics of bacterial cell
- Classify Bacteria on the basis of:
  - Morphology
  - Nutrition
  - Temperature
  - PH
- Give some examples of Gram +ve and Gram–ve bacteria

# CHARACTERISTICS OF BACTERIA

- Bacteria are prokaryotic unicellular organisms
- DNA and RNA both are present
- Division (reproduction) by Binary fission
- No mitochondria and nuclear membrane
- Rigid cell wall containing peptidoglycan

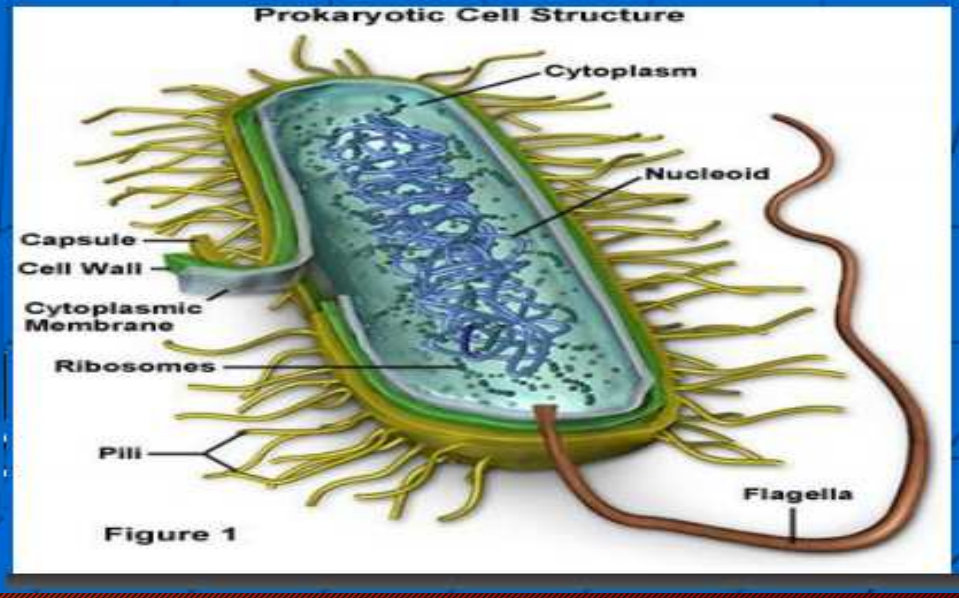

Figure 1

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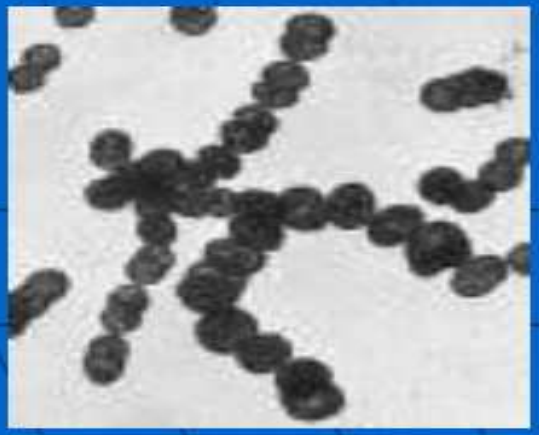
# Shape and size

Three principal shapes of bacteria exist:

- **Round** (cocci; singular, coccus)
- **Rods** (bacilli; singular, bacillus)
- **Curved or twisted rods** (spirilla; singular, spirillum)

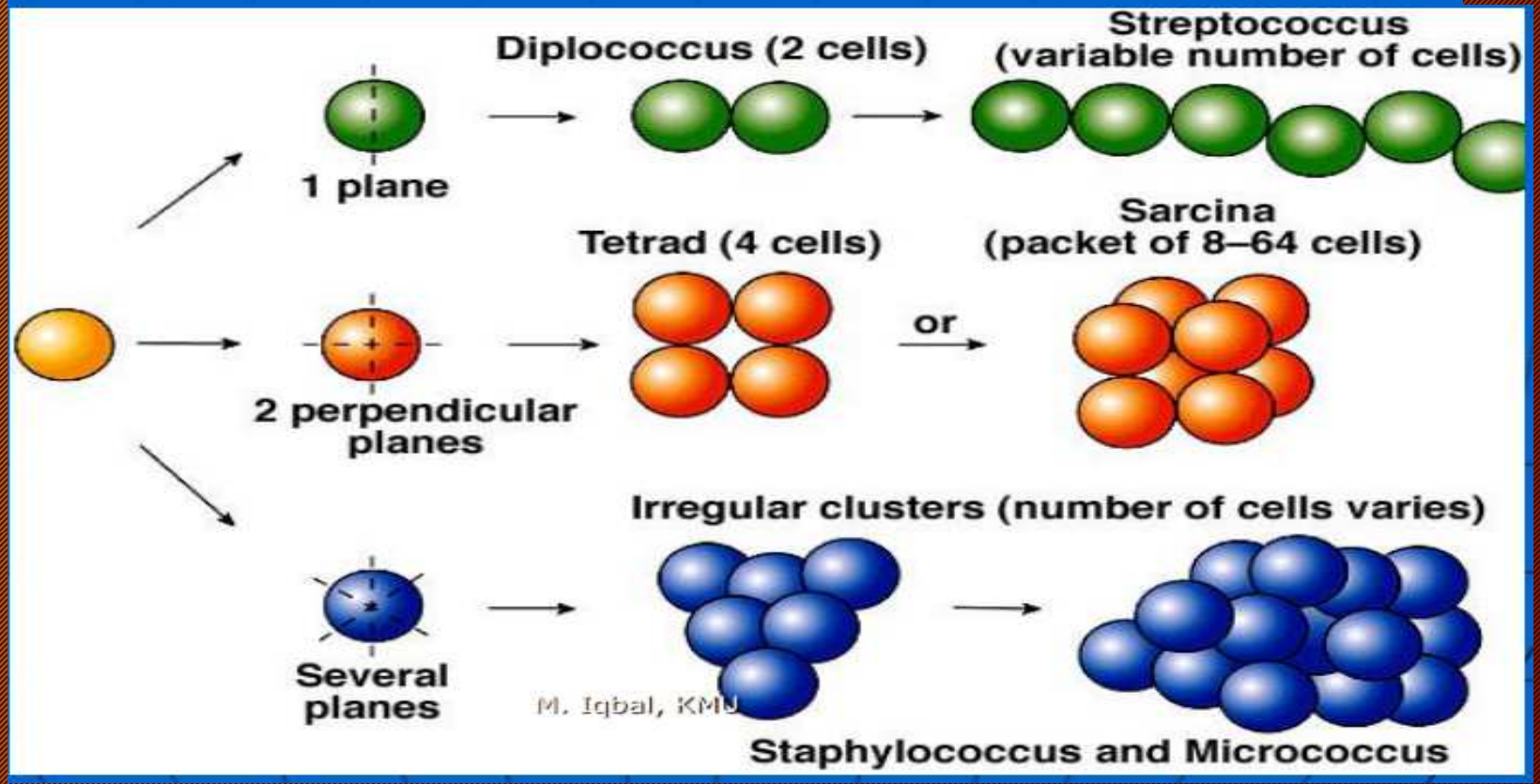


Cocci

Bacilli

Spirilla

- Typical bacteria measure 2-8 μm in length and 0.2-2 μm in width.
- Form associations such as chains, clusters, and tetrads.



# Aerotolerance

- **Strict Aerobes:** Bacteria that grow only in the presence molecular oxygen.

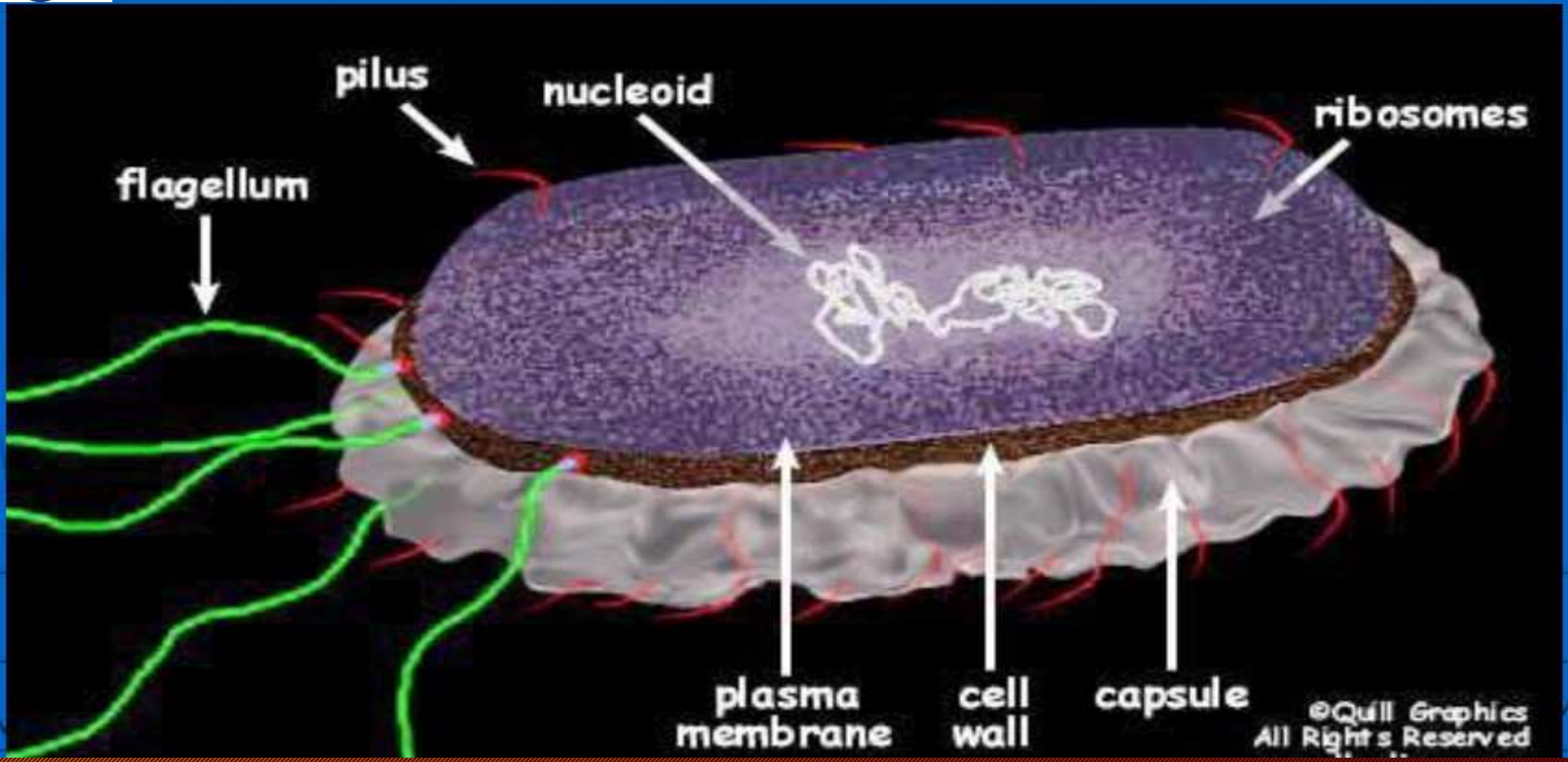
e.g. *Mycobacterium tuberculosis*

- **Strict Anaerobes:** are which can grow only in the absence of molecular oxygen.

e.g. *Clostridium tetani*

- **Facultative anaerobes:** They can grow both in the presence as well as absence of molecular oxygen. E.g. Escherichia coli

# Bacterial Structure



# A typical bacterial features

- **Flagella** (Singular: flagellum) are thread like structures for locomotion in most motile bacteria.
- **Pili** (singular: pilus) Appendages on bacterial cell Shorter than flagella used for transfer of genetic material from one to another (sex pilli)
- **Fimbriae** (singular: Fimbria) Appendages on bacterial cell Shorter than pili used for attachment to contact surfaces

- **Capsule** - Made of polysaccharides which protects bacteria from phagocytes.
- **Cell wall:**
  - Made up of peptidoglycan.
  - Responsible for the rigidity of bacterial cell.
- **Cell Membrane:**
  - Inner to cell wall, there is a delicate cytoplasmic membrane which surrounds the cytoplasm.

- **Ribosome** made up of RNA and protein. It is a factory of protein synthesis.
- **Mesosome** An invagination of cell membrane which helps in cell division.
- **Nucleoid** (Genetic material) Unlike virus, bacteria have both DNA and RNA. It contains genetic charateristics.
- **Periplasm** is the space between cytoplasmic membrane and cell wall which contains hydrolytic and Beta lactamase enzyme to degrade substances like penicillin.
- **Plasmid** A fragment of extrachromosomal DNA segment which contains different genes for resistance to antibiotic.

- **Endospore** – The process of formation of spore is known as sporulation.

  Bacillus species can form spores.

  It is produced within the cell, one spore is formed within a single bacterial cell.
- It is resistant to heat, UV light, most chemicals and desiccation.
- When conditions are favorable, the spore germinates and produces a fresh vegetative cell.

## Endotoxin

Toxin which is released only upon lysis of bacterial cell. Found only in G –ve.
It is heat-resistant

## Exotoxin

Toxin released by Viable bacterial cells.
Found mostly in G +ve but in some G –ve as well.
It is heat-labile

# Morphology Based Classification

Three principal shapes of bacteria are:

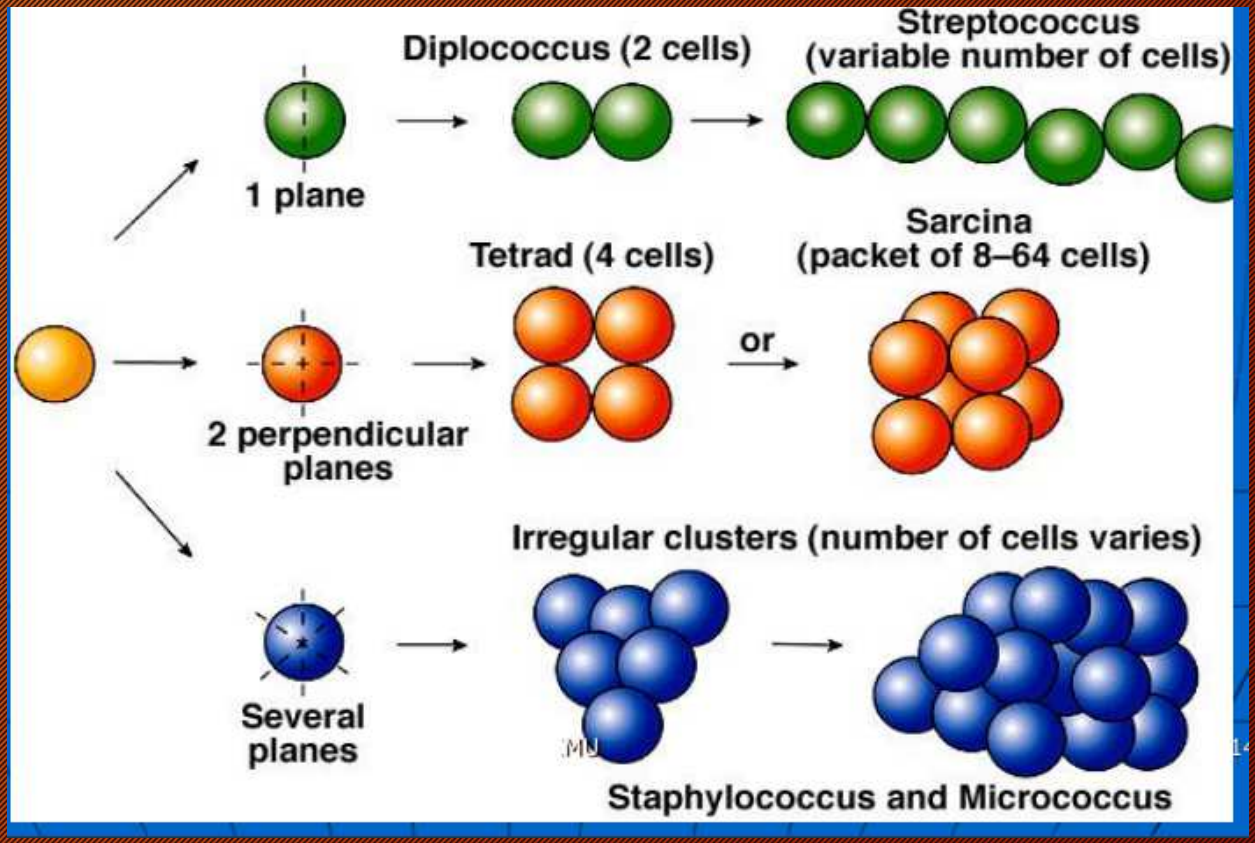
- **Coccus:** (Round shape)
- **Bacillus:** (Rod shape)
- **Spirillum:** (Curved or twisted rod)

Cocci

Bacilli

Spirilla

two cocci (diplococcus), chains (streptococcus), clusters (staphylococcus), tetrads, and sarcina as shown below.



# Nutrition based Classification

- **Carbon Source:**

Microorganisms are classified into two groups on the basis of sources of carbon as **autotrophs** and **hetrotrophs.**

**Autotrophs** are the microorganisms which derive carbon from inorganic compounds like CO2.

**Hetrotrophs** are the microorganisms which derive carbon from different organic compounds like sugar, alcohol etc.

## Energy Source:

Microorganisms depend upon different sources of energy. The organisms which depend on sunlight as a major source of energy are called **phototrophs.** Other organisms which use chemicals as a source of energy are called **chemotrophs.**

Autotrophs may either use sunlight or chemical compouds as energy source; they are called **photoautotrophs** and **chemoautotrophs** respectively.

Likewise, hetrotrophs may either use sunlight or chemical compouds as energy source; they are called **photohetrotrophs** and **chemohetrotrophs** respectively.

# Temperature Based Classification

Regarding temperature they are grouped into three categories

1- **Psychrophiles** Live to grow in the range of **0 ºC - 25 ºC**

2- **Mesophiles** Live to grow between **25 ºC - 40 ºC**

3- **Thermophiles** Live to grow in the range of **40 ºC - 85 ºC**

Some species even grow at **98 ºC** as in hot sulfur spring

# PH Based Classification

Regarding PH they are grouped into three categories

1- **Acidophiles** L ive to grow in the range of PH between **0-6**

2- **Neutrophiles** L ive to grow between **6-8 PH**

3- **Alkalophiles** L ive to grow at PH above **8**

# Beneficial and Harmful Bacteria

- Truly speaking, all of the bacteria are potentially harmful. Any how, about 97 % bacteria are beneficial and 3 % harmful. Beneficial bacteria include normal flora and other industrial and environmental bacteria.

# Some Medically Important Bacteria

## 1- Gram Positive:

- Streptococcus—causes pneumonia, pharyngitis, cellulitis
- Staphylococcus—abscess of skin and other organs, Food poisoning
- Bacillus (spore forming rods)—causes Anthrax
- Clostridium (spore forming rods)— Tetanus, botulism
- Corynebacterium—diphtheria
- Listeria—Meningitis
- Actinomyces— Actinomycosis

## Cont…

**2- Gram Negative:**

- Neisseria—Gonorrhea, Meningitis
- Yersinia—Plague
- Escherichia—Urinary tract infection, diarrhea
- Salmonella—Typhoid fever
- Vibrio—Cholera
- Shigella—Enterocolitis
- Haemophilus—Meningitis
- Bordetella—Whooping cough
- Pseudomonas—Pneumonia, UTI
- Bacteroides—Peritonitis

**3- Acid Fast**

- Mycobacterium—Tuberculosis, Leprasy

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THE END


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# THANK YOU