

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ





العنوان

# **Introduction to microbiology**

## **Two modular unit**







المقدمة

# Introduction





# **HISTORICAL SURVEY**

**1590 – Zacharias Janssen ———First compound light microscope**

**1676 – Anton Von Leeuwenhoek——first observation of bacteria —animalcules||**

**1796 – Edward Jenner—— First vaccine (smallpox)**

**1867 – Joseph Lister ———Antiseptic Surgery**

**1857 – Louis Pasteur ——— Germ Theory of Disease**

**And in 1885 discovered Vaccine against Rabies**

**1884 – Robert Koch : Koch's Postulates of Disease Transmission**

**1929 - Alexander Fleming —— Discovered Penicillin (first antibiotic)**

**1938 – First Electron Microscope discovered**





**1953 Watson & Crick**———**Structure of DNA discovered**

**Antony van Leeuwenhoek (1632-1723)**

A draper living in Holland, in 1675 **described "little animals"** he found when examining stagnant rainwater under his home-made **microscope making of lenses. Many of the first "animalcules"**, as he called them, were **protozoa**, but later experiments yielded the first recorded account of **microorganisms**. After his death, very little progress was made in determining the relation between bacteria and disease, until towards the end of the eighteenth century.





**Edward Jenner (1749-1825)** substantiated the belief **that cow-pox gave protection to people against small-pox**. He introduced the term **vaccine** (from the **Latin vacca-cow**) and established the idea of **immunity**. The quality of microscopes was rapidly improving and many more micro-organisms were being discovered, but it was still not generally accepted that they were the cause of disease.

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**Barri in 1836** helped to establish that micro-organisms could cause disease when, using a **heat-sterilized**. Even after evidence such as this, the real science of bacteriology did **Louis Pasteur (1822-1895)** a French chemist much credit must be given to him. It was through his work on

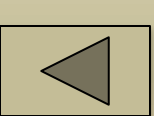
- **Sterilization of liquids.**
- **Fermentation proved that the breakdown of sugar to alcohol was the result of the activity of micro-organisms.**
- **He learned how to isolate and cultivate bacteria and how to study their effect on animals.**
- **In 1878 he read a paper on the germ theory of disease which helped to establish that specific**  
not begin until the middle of the nineteenth **organisms can give rise to specific diseases.**  
century.





**Robert Koch (1843-1910)** was making enormous contributions to bacteriology in a practical way .He developed

- **methods of fixing and staining bacteria**
- **he discovered the tubercle bacillus**
- **he isolate the anthrax bacillus in pure culture**
- **he discovered the cause of cholera**
- and in 1881 he published a method of producing **pure cultures** of bacteria by growing them on the surface of a solid medium. The medium he devised was a **meat infusion broth** solidified with gelatin, and poured onto a glass plate. This was the beginning of our present-day culture media. Agar soon superseded gelatin and later Petri introduced his masterpiece dish.





Many others, such as **Lister**, with his introduction of **antiseptic** and aseptic techniques, contributed to the vast amount of knowledge after discovering the electron microscope which has developed into the science of **Microbiology**. And after Today, with our ever-increasing knowledge of bacteria, fungi and yeasts, rickettsia, viruses, and protozoa .





# CLASSIFICATION OF MICRO-ORGANISMS

## Animal

**Protista:-** First or primitive

**Pro:-** primitive

**Eu:-**true

**Microbiology:-**

\* **Micro:-**small

\* **bio:-**life

\* **logy:-**since

**Higher protistas (Eukaryotic)**

## Plant

**Protista** [ Heakle (1866)]

**All living things**

**Lower protistas (Prokaryotic)**

1- Algae

2- Fungi & molds

3- Protozoa

1- Bacteria

2- Rickettsia

3- Mycoplasma

4- Viruses

5- Bactriophage

6- Chlamydiae

7- bacteriophage.....





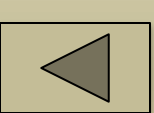
**Protozoa:-** These are **small, single-cell animals** belonging to the lowest division of the animal kingdom. **They consist of protoplasm**, which is differentiated into **nucleus and cytoplasm**, and **they are non-photosynthetic**. There are four classes of protozoa:

1-**Class I rhizopoda** **move by means of protoplasm production called pseudopodia**. An example *Entamoeba histolytica* which causes amoebic dysentery.

2-**Class II mastigophora** **move by means of undulating membranes or flagella**. An example *Trichomonas vaginalis*, which causes a **vagina**

3-**Class III ciliate** : **move by the beating of numbers of cilia**, An example *Balantidium coli*, which causes **balantidial dysentery**

4-**Class IV sporozoa** are **non-motile organisms** that **live parasitically within the cells of host animals**. An example *Plasmodium vivax*, which causes **malaria**. Many protozoa when placed under unfavorable conditions pass into a resting phase, often with the formation of a distinctive **cyst** which can be used in identification





**Fungi:** - like protozoa, fungi are non-photosynthetic organisms. They grow either as single cells, e.g. yeasts, or as colonies of multicellular filaments (hyphae), e.g. moulds. They reproduce by means of spores and the recognition of these spores is often an aid to identification.

Some species cause disease in man and animals. For example, *Candida albicans*, a type of yeast, causes thrush.

**Viruses:-**These are minute organisms which can only multiply within living cells. Consist in their simplest form of an outer coat of protein and an inner core of nucleic acid which may be either Ribonucleic acid (RNA) or deoxyribonucleic acid (DNA) (no virus has been shown to contain both).





**Rickettsia:-** are **small micro-organisms** which are in some ways **intermediate between viruses and bacteria**. They are **similar to bacteria in that they contain both RNA and DNA, possess metabolic enzymes and reproduce by binary fission; they resemble viruses by being able to multiply only within living cells.**

Although we are mainly concerned with bacteria, a brief description of other micro-organisms will be helpful





**Bacteria:-** Bacteria are **a microscopic simple unicellular organism** whose structure shows little difference and whose main function is apparently simple, **dividing and growing by simple binary fission.**

**Size of bacteria:** Most bacteria are so **small** that **their size is measured in units called micron.** The unit of measurement is the **micro-meter, written  $\mu\text{m}$  (Greek mu).** The **micrometer is 1/1000 of a millimeter (0.001 mm) =  $10^{-3}$  or 1/25000 of an inch.**  
[one micron ( $\mu$ ) or micrometer ( $\mu\text{m}$ ) = 1/1000 of millimeter]

Generally **bacteria is sized about 1-10  $\mu$  in length and 0.2-0.5 in width,** and can be **visualized only under magnification.** The smallest having a **diameter of about 0.5  $\mu\text{m}$ ,** and **Viruses, being smaller than bacteria,** are generally **measured in millimicrometers (1/1000 of a micrometer, or 0.001  $\mu\text{m}$  or 1.0 m $\mu\text{m}$ ), now correctly called nanometers (nm).**

### Units of Measurement

- **1  $\mu\text{m}$  =  $10^{-6}$  m =  $10^{-3}$  mm**
- **1 nm =  $10^{-9}$  m =  $10^{-6}$  mm**
- **1000 nm = 1  $\mu\text{m}$**
- **0.001  $\mu\text{m}$  = 1 nm**





# Bacterial Nomenclature(Name of bacteria):

Bacteria classify under the national taxonomy like an other microorganisms by :

**Kingdom→Phylum→ Class→Order→Families→ Genus→Species**

**Types Strains Varieties**

And the name of bacteria writes according to:

Genous name species name

e.g. *Salmonella typhi* Salmonella typhi

A *Salmonella paratyphi* A Salmonella paratyphi

B *Salmonella paratyphi* B Salmonella paratyphi

**Bacteria are present in**

- **all types of environments**

**water \*animals \*frozen mud\* soil \*plants \* inside us\* air \*hot springs \*on our skin**

- **Our Food (Cheese, Bread)**

- **Industry (Molecular Biotechnology, Beer: product of thousands of years of experimentation)**

- **Deep Sea Vents, Volcanoes**

- **Hospitals (super bugs!!!)**

- **Deep Underground**





Representation of a bacterial cell showing some of the essential constituents

- 1. The cytoplasmic membrane** consists of a layer of **lipoprotein** and is 5-10 nm thick. It encloses the Cytoplasm
- 2. The cell wall** is complicated lattice structure of **lipoprotein, lipopolysaccharide and peptidoglycan, which gives the bacterial cell its shape and also protects the cytoplasmic membrane.**
- 3. Capsule:** The cell wall of certain bacteria is covered with a capsule, which is usually a loosely attached slime layer consisting of **polymerized sugars and amino sugars** that are secreted by the organism. In many cases, possession of a **capsule correlate**
- 4. Cytoplasm** which **contains soluble metabolites** and precursors of **macromolecules** together with **organelles such as**
  - a) **ribosomes.** Lying within the cytoplasm is the bacterial chromosome-usually a single
  - b) **closed ring of double-stranded DNA** .At binary fission a duplicate copy of the chromosome passes to the new cell
  - c) **circles of DNA, called plasmids,** which often **carry genes that confer antibiotic resistance** on the cells carrying them. Of greater current interest is the fact that these plasmids may be **transferred between cells of different type (e.g. non-pathogen to pathogen).**





5- **pili** (common **pili or fimbriae**) (**Latin** for 'hair'; plural : *pili*) are often **found on bacterial cells**. These may be important in the **attachment of pathogens to host tissue cells**.

*fimbria* (Latin for 'thread' or 'fiber'; plural: *fimbriae*)

6- **Motile organisms** possess **flagella**, which are **thread-like appendages** composed of **protein called flagellin**, and are about 20 nm thick. Their rotation enables bacteria to travel at speeds of up to 50  $\mu\text{m}$  per s. some organisms possess one flagellum, others more than one. The arrangement of the flagella may be as in figure

of bacterialExample **flagella arrangement** schemes. **A-Monotrichous; B-Lophotrichous; C-Amphitrichous; D-Peritrichous**





7- Some general of bacteria produced a highly resistant dormant state **called spores like *Bacillus* and *Clostridium***, they make bacterial **survival possible under unfavorable conditions, spores are resistant to heat, drying, freezing and toxic chemical. They are killed by autoclaving (15 b pressure at 121oC for 20 min.). Spores may oval or spherical found as free or central or sub-terminal or terminal in the cells.**

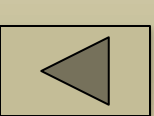
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## Morphology of bacteria

### Bacterial shape:

**Bacteria** can be **classified** into the following types according to their **shape** of the cells:

- a. **Oval** or **spheroid** called **coccus** → **cocci**.
- b. Rod or **cylindrical** called **bacillus** → **bacilli**.
- c. **Curved** or comma shape → **vibrio**
- d. **Spiral and coil** shaped (**spirochetes**).





After **binary fission** the daughter cell remains attached to the parent cell and fission occurs again before separates so the bacterial can be **classified due to their shape and aggregation and arrangement to:**

I. **Cocci** (coccus)

(0.5-1  $\mu\text{m}$  diameter):

1. a. **Single** like *Micrococcus*.
- b. **Pairs** like *Diplococcus*.
- c. **Chains** like *Streptococcus*.
- d. Groups of **four** (tetra) like *Peptococcus tetracocci*.
- e. Groups of **eight** (cubical packet) like *Sarcina*.
- f. **Clusters** (random clumps) like *Staphylococcus*.
2. **Kidney shape** like *Neisseria*.
3. **Cocco-bacilli** like *Brucella*.





II. **Rod or cylinder** (1-10  $\mu\text{m}$  length 0.2-1  $\mu\text{m}$  width):

1. **Bacilli (bacillus):**

a. **Single**  $\rightarrow$  *Salmonella*

b. **Pairs**  $\rightarrow$  *Diplobacilli*

c. **Chains**  $\rightarrow$  *Bacillus*.

2. **Chinese letter**  $\rightarrow$  *Corynebacterium*

3. Group of **cigarettes**  $\rightarrow$  *Mycobacterium*

4. **Curved end** (pole)  $\rightarrow$  *E. coli*.

5. Cuneiform **bundle**  $\rightarrow$  *Mycobacterium*

With or with out spores.

III. **Comma shape (curved)** (4 $\mu\text{m}$  length -0.5 $\mu\text{m}$  width)

**Single**  $\rightarrow$

**Pairs**  $\rightarrow$  *Vibrio*

**Small chains**  $\rightarrow$

IV **Spiral**

(4 - 0.2 $\mu\text{m}$  width \* 10 - 20  $\mu\text{m}$  length)

$\rightarrow$  *Borrelia*

$\rightarrow$  *Leptospira*

$\rightarrow$  *Treponema*





شكرآ  
لأصغائكم

