



# **General Microbiology**

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Welcome To-----



# Microbiology

It is the study of Microscopic Organisms, derived its name from Three Greek words:

Mikros (“small”),  
Bios (“life”),  
Logos (“science”).

which are very small and  
cannot be seen by unaided eye



**Microbiology** in its broadest meaning is the science which deals with

The study of all kinds of microorganisms in both plant and animal such as

### **Bacteria**



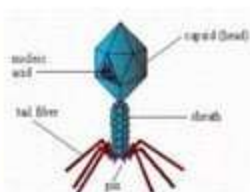
### **Fungi**



### **Protozoa**



### **Virus**



The term **Microbe** and **Germ** usually applied to pathogenic forms or referee to any microorganism but especially to disease producing bacteria

**Microbe** and **Germ** are synonymous with bacterial infection

# Characteristics of microorganisms



1. Their size is very small.
2. There is no cellular differentiation.
3. They are unicellular and one cell is capable of performing all the functions.
4. Some microorganisms are multicellular with little or no cellular differentiation.
5. Microorganisms are present everywhere on the bodies of animals and humans, on plant surfaces, in the air, water, dust, soil, and even inside the intestinal canal of all insects, birds, animals and human beings.

# History of Microbiology

## Le Petit Journal



LE CHOLÉRA

## Plagues in History

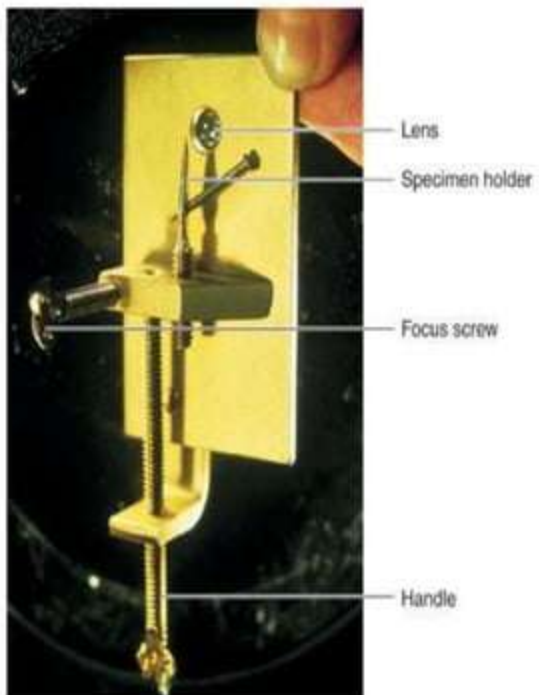


## Antony Van Leeuwenhoek (1632-1723)

1. As a draper (merchant who sells cloth and dry goods), he used lenses to examine cloth. This probably led to his interest in lens making.
2. He assembled hundreds of microscopes, some of which magnified objects 270 times.
3. As he looked at things with his microscopes, he discovered "micro" organisms - organisms so tiny that they were invisible to the naked eye.
4. He called these tiny living organisms "animalcules". He first described bacteria, protozoans and many cells of the human body









## Louis Pasteur (1822 - 1895)

1. Disproved **spontaneous generation** of microbes by preventing "dust particles" from reaching the sterile broth
2. Showed microbes caused fermentation and spoilage
3. He studied **alcoholic fermentation** and showed that the changes in fermentation process were not chemical process but by action of living yeast
4. He Put grape juice + yeast in open and in air-tight containers. Fermentation occurred in both.
5. He also, Took two flasks of sterile grape juice and introduced bacteria into one and yeast into another.

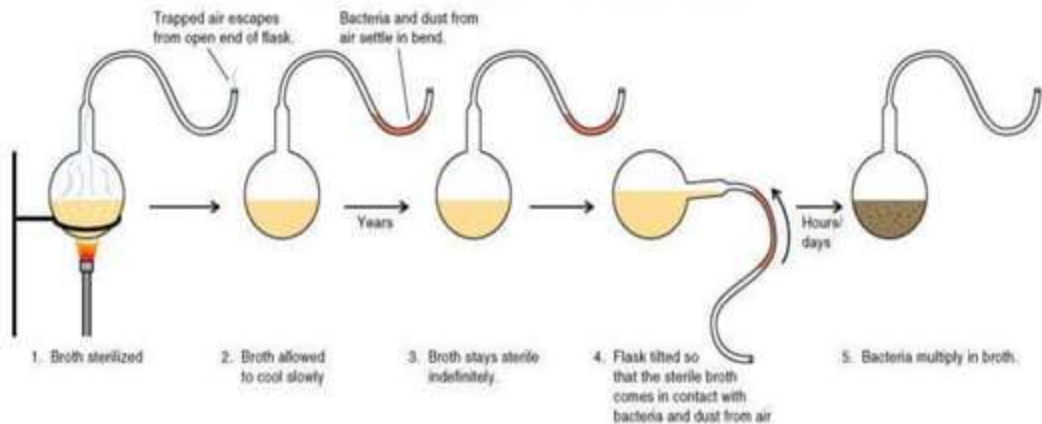
**Yeast + Grapes = yummy wine ☺ (ethanol)**

**Bacteria + Grapes = spoiled wine ☹ (lactic acid)**

- Undesirable fermentation could be prevented by heating the wine to 60 0 C without affecting the quality of wine this process of heating has called **Pasteurization**



# PASTEUR'S EXPERIMENT



**Trapped airborne organisms in cotton; he also heated the necks of flasks, drawing them out into long curves, sterilized the media, and left the flasks open to the air. In this way Pasteur disproved the theory of spontaneous generation**

# Louis Pasteur

## Vaccine against Rabies 1885

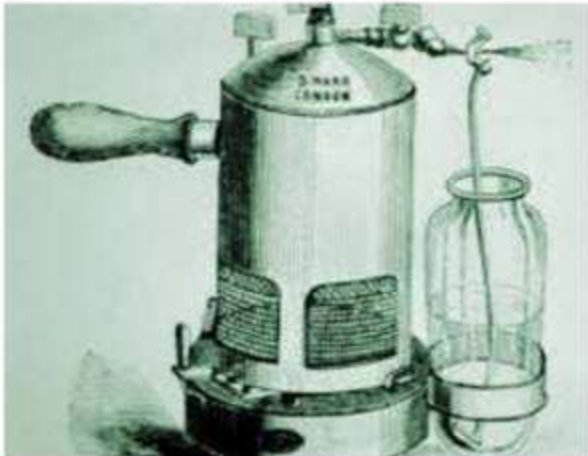


## Joseph Lister (1827-1912)

- He is the surgeon who introduced new principles of cleanliness which transformed surgical practice in the late 1800s.
- He was sure that bacteria would be kept of wound if he protect it by dressing saturated with substance which kill microbes
- This was the basic of antiseptic methods
- Finally he developed a routine for the use of carbolic acid at operations which became known as **Lister's antiseptic system**



# Lister's antiseptic system



# Robert Koch (1843 - 1910)

1. using criteria developed by his teacher, Jacob Henle (1809-1895), established the relationship between *Bacillus anthracis* and anthrax.
2. His criteria became known as **Koch's Postulates** and are still used to establish the link between a particular microorganism and a particular disease:



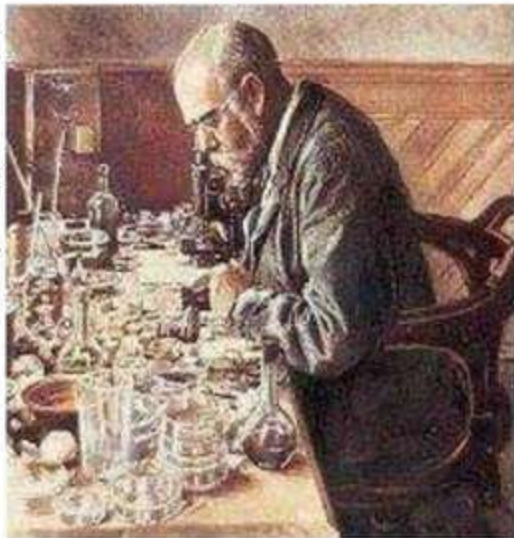
## **Koch's Postulates 1884**

- The organism must always be found in the diseased animal but not in healthy one
- The organisms must be isolated from diseased animal and growth in pure culture away from the animal
- The organism isolated in pure culture must initiate and reproduce the disease when re inoculated into susceptible animal
- The organism should be re isolated from the experimentally infected animals



- Koch introduced the method of making **smears of bacteria** on glass slides and stained them by **aniline dye**
- Also, he devised a method of growing bacteria in **solid medium** made with gelatin for examine pure culture
- In 1882 he discovered the microbe of tuberculosis with *Tubercle bacilli* and developed special stain to detect this microbe
- The 20 year period following Koch's work was

## **The Golden age of Bacteriology**



# Distribution of Microorganisms in

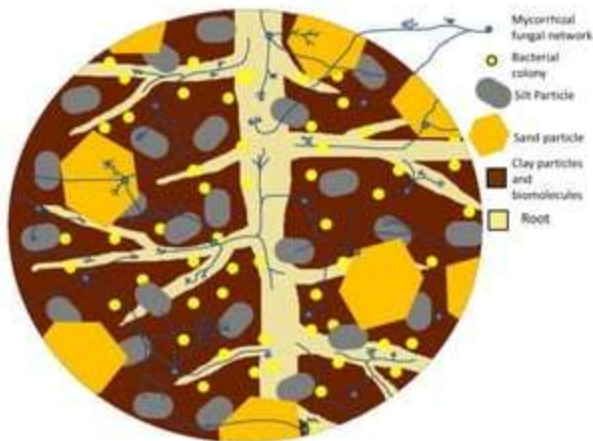
1. Soil
2. Air
3. Water
4. Food
5. Milk
6. Human



# 1- Distribution of Microorganisms in Soil

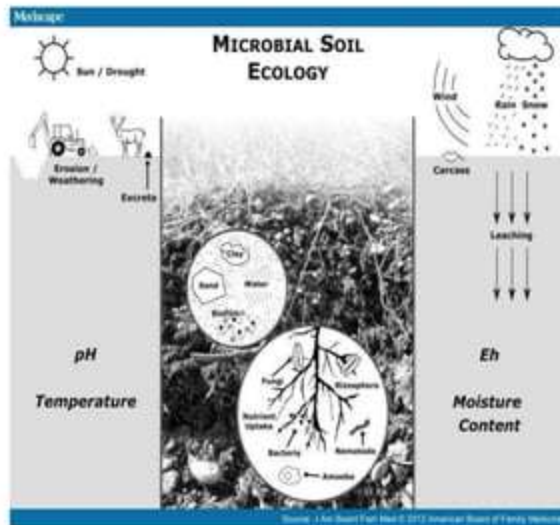
- The number and kinds of microorganisms present in soil depend on the

1. type of soil
2. Quantity of plant and animal humus acidity or alkalinity
3. Depth
4. Degree of aeration
5. Moisture contents
6. Temperature



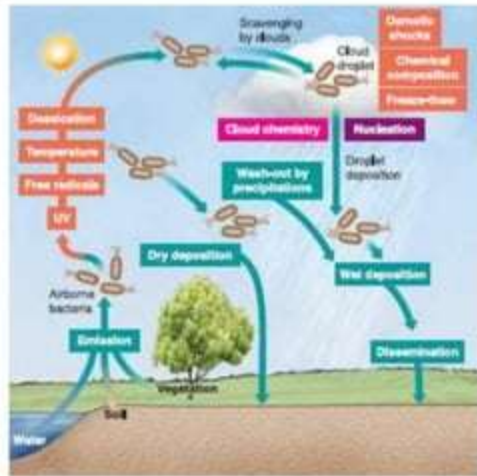
- The great majority of microorganisms are found in surface layer;
- the number decrease with
  1. Depth
  2. Owing to lack Oxygen and food materials

**The bacterial population of rich garden soil is greater than poor and uncultivated soil**



## 2- Distribution of Microorganisms in Air

- Microorganisms are found in air being carried there by wind current
- Microorganisms Do Not grow and multiply in air because conditions are not favorable for growth
- The number of microbial kinds depend upon:
- Location, Moisture, dust particles, presence of toxic gases

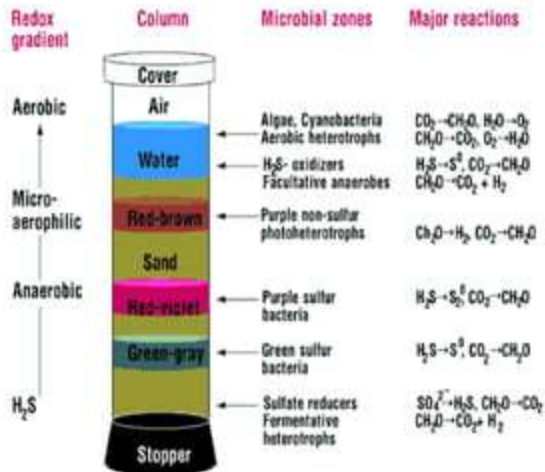


- In general marine air contains fewer microorganisms than dusty and desert air
- The air over higher mountains is usually free from organisms
- Dusty room usually show more organisms than room kept free from dust
- Bacteria in air usually adhering to particles of dust



# Distribution of Microorganisms in water

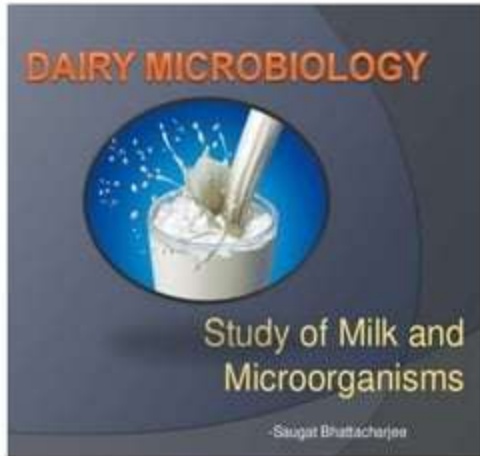
1. Most water contain large numbers of Bacteria this number depends on:
2. Source of water ( river, lakes, shallow wells, springs)
3. Water polluted with sewage contain thousands of organisms / ml
4. Practically all bacterial species found in soil may at time be present in water





# Distribution of Microorganisms in Milk

- Normal udders of cows are probably never free from bacteria which means Freshly drawn milk is not sterile
- The first milk drawn contains more organisms than milk collected in the close of operation because most of bacteria are washed away from the udder early in the process
- The important disease of cattle may be transmitted to human through raw milk as: *Bovine tuberculosis*
- some times the udder of the cow is infected by organisms of human origin by milker as: Typhoid fever and Dysentery



# Distribution of Microorganisms in Milk

## Sources



Microorganisms can enter milk from contact with the animal including teat, udder, faeces; also from the housing, bedding, feed, air and water. Contact with farm equipment and milking equipment as well as insufficient farm or personnel hygiene may influence the microbial content of milk.



**Milk-associated microorganisms**

## Role/ Significance



### Food Technologist

Lactococcus  
Lactobacillus  
Streptococcus  
Leuconostoc  
Enterococcus  
Propionibacterium

### Health Promotion

Lactococcus  
Lactobacillus  
Streptococcus  
Leuconostoc  
Enterococcus  
Some yeasts

### Spoilage

Pseudomonas  
Acinetobacter  
Chryseobacterium  
Clostridium  
Phage

### Sickness

Listeria  
Staphylococcus  
Escherichia coli  
Campylobacter  
Mycobacterium  
Fungi - Allergens

Once in the milk these microorganisms can play an important role in dairy product manufacture; they may contribute to promoting human health or enhancing food safety. On the other hand these microorganisms can lead to spoilage of milk and dairy products or they may contribute to disease and illness in humans.

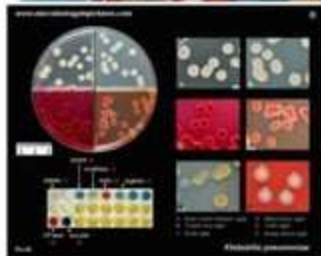
# Distribution of Microorganisms in body

1. The outer surface of the skin of the body always contain bacteria and respiratory passages and intestinal tracts
2. These environments contain normal flora which are harmless
3. Microbes may invade the body by penetrate the broken skin or mucous membrane
4. This microbes destroyed by the defense mechanism of host (immune system)
5. Sometimes the body cannot destroy this invaders or microbes under this condition disease will be established



# Differentiation of Bacteria

1. During the early years of bacteriology organisms were classified on the basis of **Morphology** but it was very simple matter
2. Physiological reactions were used also in classifications
3. Serological reactions Antigen- Antibody interaction
4. Molecular identification used now with morphological and physiological classification of bacteria



**16s rRNA**  
and its use



# Bacterial Morphology and culturing

- The morphology refer to the size, shape and physical features
- It is inherited trait derived from the organisms gene and passed a long from generation to generation
- It is observed by eye (Colony) or under microscope (bacterial cell) which appear vast variations

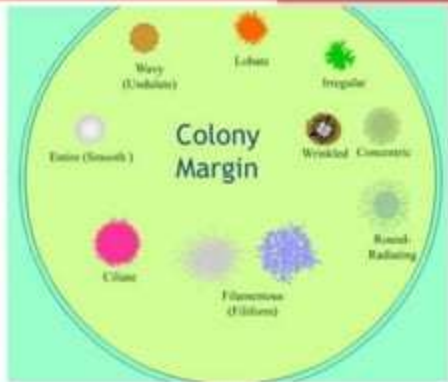






















# Bacterial colony morphology

## COLONIES - MAKE A OBSERVATION



- Shape
- Size
- Elevation
- Edge
- Surface
- Opacity
- Consistency



<b>Shape</b>	 Circular	 Rhizoid	 Irregular	 Filamentous	 Spindle	
<b>Margin</b>	 Entire	 Undulate	 Lobate	 Curled	 Rhizoid	 Filamentous
<b>Elevation</b>	 Flat	 Raised	 Convex	 Pulvinate	 Umbonate	
<b>Size</b>	 Punctiform	 Small	 Moderate	 Large		
<b>Texture</b>	Smooth or rough					
<b>Appearance</b>	Glistening (shiny) or dull					
<b>Pigmentation</b>	Nonpigmented (e.g., cream, tan, white) Pigmented (e.g., purple, red, yellow)					
<b>Optical property</b>	Opaque, translucent, transparent					

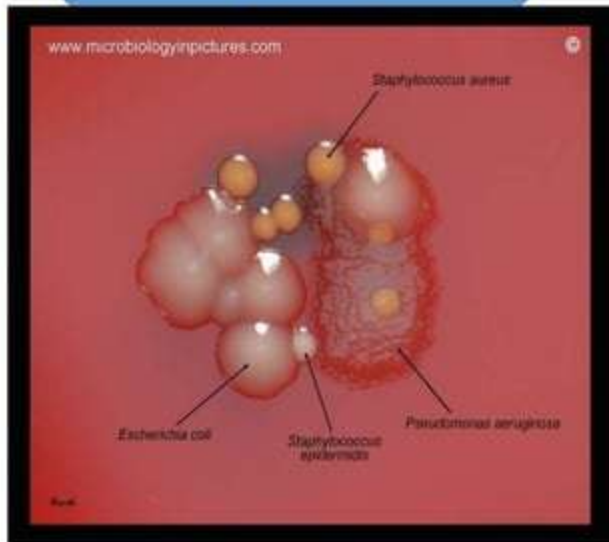
(a)



## Colony color



## Colony shape, margin and elevation



# Culturing Microbes

- The Five “I’s

1. **Inoculation:** Producing a pure culture
2. **Isolation:** Colony on media, one kind of microbe, pure culture
3. **Incubation:** growing microbes under proper conditions
4. **Inspection:** Observation of characteristics (data)
5. **Identification:** use of data, correlation, to ID organism to exact species

# Bacterial Cell morphology



- The bacterial cells appear under microscope in variation of three important shapes (Rod, Cocci and spiral)
- **Rod shape:** is known as Bacillus (Length 20 to 0.5  $\mu\text{m}$ ) it occur as slender rod as **typhoid fever** or rectangle with square ends as **anthrax** some are curved as *vibrio cholera* while others are club shaped as *diphtheria*
- Most occur in single form or diplo form and finally as chain
- The word bacillus is also, used in microbiology to denote one of the genera of rod shaped bacteria as *Bacillus anthracis*



SEM 2  $\mu\text{m}$



SEM 5  $\mu\text{m}$

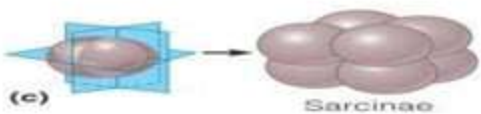
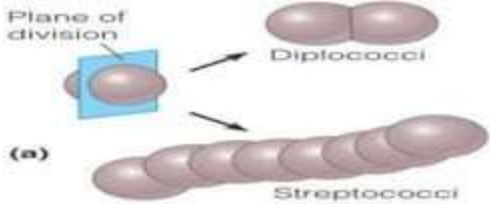


SEM 1  $\mu\text{m}$



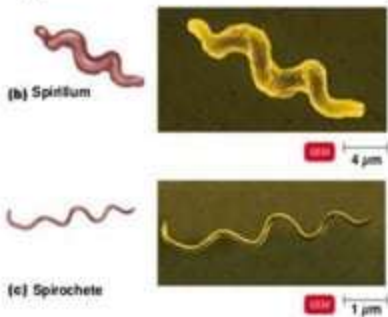
## Bacterial sphere Cocci

- It's length( 0.5 to 1  $\mu\text{m}$ ) in diameter and may pointed at the end
- Important variations in cocci arrangement as Pairs **Diplococcal** as *Neisseria*
- **Chain** streptococcus formation long chain of cocci as *streptococcus pyogens*
- Cocci that cling together in cubical packets of eight are **sarcinae**
- Irregular cluster of cells called **staphylococcus** mean (grape)



# Bacterial Spiral shape

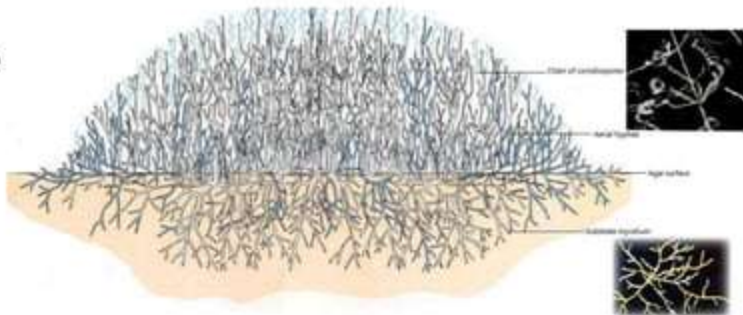
- Twisted rod that resemble a cork screw include true spiral end curved bacteria as *Spirochetes*
- It is rigid cell wall and move by flagella





# Filamentous bacteria Actinomycetes

- **Actino** means ray      **Mykes** means Fungi
- Actinomycetes (Mold like bacteria) they are elongated cells which have definite tendency to branch to produce branched mycilum and multiply by spores
- The cell structure like the proper bacteria



## Size of Bacteria

- Bacteria vary in size according to species, some are so small, other so large. The size of the majority bacteria occupy a range intermediate between these two extreme
- **Spherical form** is measured by its diameter whereas **rod and spiral form** by its length and width
- **Calculation of spiral organism** by these methods give apparent length not the true length
- The unit for measuring bacteria is the micron symbol ( $\mu\text{m}$ )
- Bacteria producing spore are generally larger than non spore producing bacteria