Introduction to Microbiology

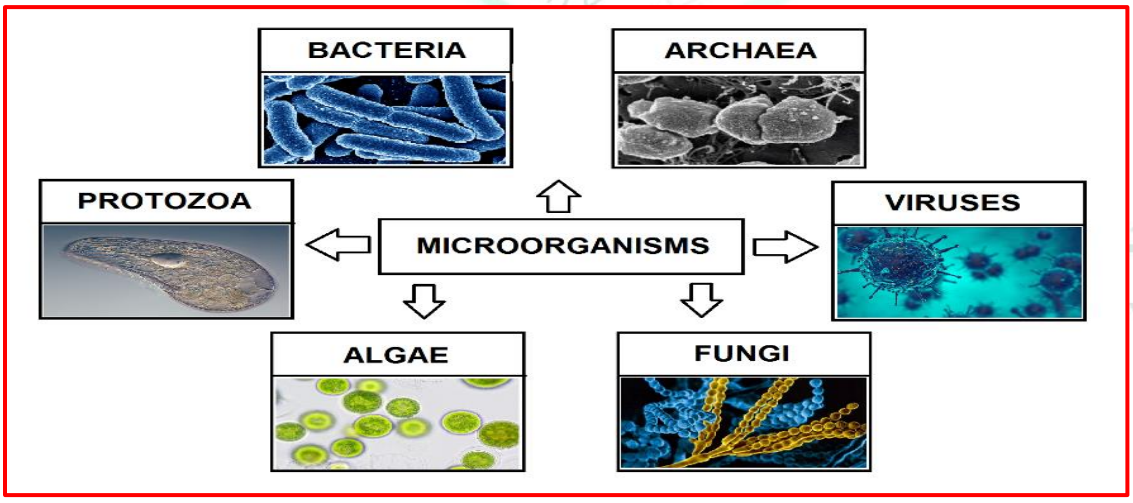
What is microbiology?

The branch of biology that studies microorganisms and their effects on humans.

Microbiology, the study of microscopic organisms, derived its name from three Greek words: mikros (“small”), bios (“life”), and logos (“science”). Taken together they mean the study of microorganisms (MOs) which are very small and cannot be seen by unaided eye.

Microorganisms a collection of organisms that share the characteristic of being visible only with a microscope

Microbiology is study of microorganisms, or microbes, a huge diverse group of generally minute (too small to be seen by naked eye) simple life-forms includes; bacteria, archaea, fungi, algae, protozoa, and viruses.



Organisms included in the study of Microbiology

1-Bacteria	**Bacteriology**
2 -Algae	**Phycology**
3- Parasites	**Parasitology**
4-Yeasts and Molds	**Mycology**
5- Viruses	**Virology**

Classification of Microorganism

1-Cellular

- **Prokaryotes:**
- **Pro ➡ Before (Before nucleus , cells without Nucleus)**

Have no nucleus, Have no membrane bond organelles and less complex like Bacteria & Archea

- **Eukaryotes:**
- Eu ➡ true or good (Cells that have nucleus)

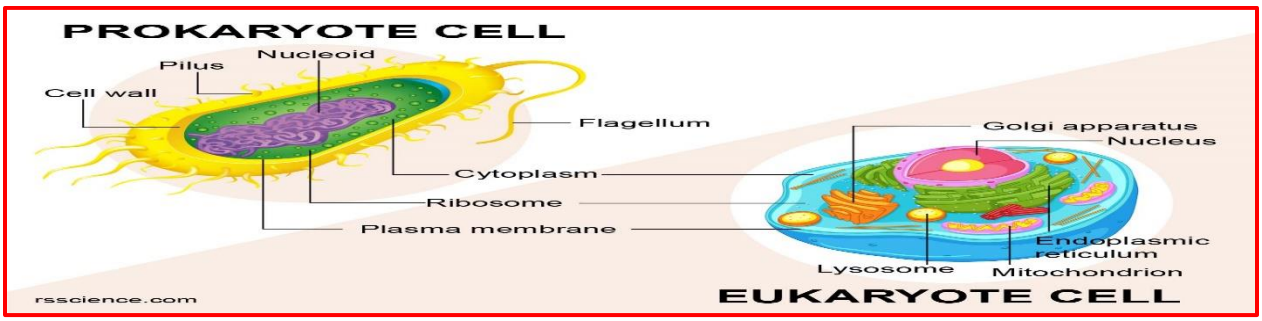
Have true nucleus, Many membrane bond organelles ex. Algae, protozoa, fungi, plants, animals and humans.

2-Acellular

They are not cells and have no cell membrane.

• They are composed of few genes protected by a protein coat ex. Viruses.

• They can live an reproduce only when inside a living cell.



Five (5) Kingdoms of Living Organisms

- 1-. Monera (unicellular prokaryotes)
- 2- Protista
- 3-. Fungi
- 4- Plantae
- 5- Animalia

Most microorganisms are measured in micrometers, with two exceptions.

- The helminths are measured in millimeters, and
- the viruses are measured in nanometres.

There are many differences among medical the important organisms; viruses (smallest MO), bacteria, fungi or mycosis, protozoa, and helminthes (Largest organism), therefore, the following table can be illustrates the comparison of medical important organisms.

Organism Nomenclature

-Established by Carolus Linnaeus (1735)

-Latinized

-Each organism has unique two parts Genus and species name: e.g. (*Escherichia coli*) (*Escherichia coli)*

-Written in italics or underlined

-Genus with capital first letter

-Species/specific epithet all lowercase

-After first use in documents can abbreviate genus: *E. coli*

-Name often describes organism: shape, habitat, name of discoverer, etc

The Microscope and Discovery of Microorganisms

Antonie van Leeuwenhoek (1632–1723) was one of the first people to observe microorganisms, using a microscope of his own design, and made one of the most important contributions to biology.

Robert Hooke was the first to use a microscope to observe living things. Hooke's 1665 book, Micrographia, contained descriptions of plant cells. Before Van Leeuwenhoek's discovery of microorganisms in 1675, it had been a mystery why grapes could be turned into wine, milk into cheese, or why food would spoil. Van Leeuwenhoek did not make the connection between these processes and microorganisms, but using a microscope, he did establish that there were forms of life that were not visible to the naked eye. Van Leeuwenhoek's discovery, along with subsequent observations by Spallanzani and Pasteur, ended the long-held belief that life spontaneously appeared from non-living substances during the process of spoilage.

John Needham (1731-1781), a Scottish clergyman and naturalist, showed that microbes grew in soups exposed to air. Claimed existence of a "life force" present in inorganic matter that could cause spontaneous generation. One of his more convincing demonstrations was to boil some soup (briefly), pour into clean flasks with cork lids, and show that microbes would soon arise

Lazzaro Spallanzani (1729–1799) claimed Needham's organisms came from heat-resistant microbes. If flasks were boiled long enough (1-2 h), nothing grew. But Needham countered that prolonged heating destroyed the "life force".

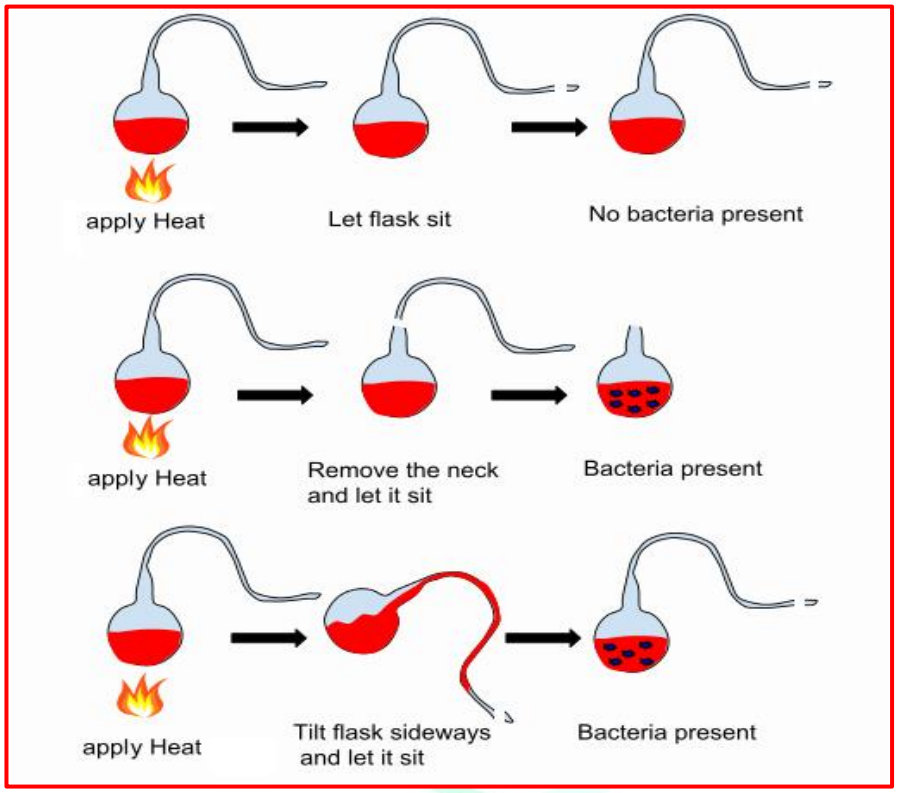
Spontaneous Generation Theory: Some forms of life could arise spontaneously from nonliving matter.

Spontaneous Generation theory:

From earliest times, people had believed in spontaneous generation—that living organisms could develop from nonliving matter. Even the great Aristotle (384–322 B.C.) thought some of the simpler invertebrates could arise by spontaneous generation. This view finally was challenged by the Italian physician Francesco Redi (1626–1697), who carried out a series of experiments on decaying meat and its ability to produce maggots spontaneously. Redi placed meat in three containers. One was uncovered, a second was covered with paper, and the third was covered with a fine gauze that would exclude flies. Flies laid their eggs on the uncovered meat and maggots developed. The other two pieces of meat did not produce maggots spontaneously. However, flies were attracted to the gauze-covered container and laid their eggs on the gauze; these eggs produced maggots. Thus the generation of maggots by decaying meat resulted from the presence of fly eggs, and meat did not spontaneously generate maggots as previously believed. Similar experiments by others helped discredit the theory for larger organisms.

Louis Pasteur (1822–1895) (father of biotechnology) expanded upon Spallanzani's findings by exposing boiled broths to the air in vessels that contained a filter to prevent all particles from passing through to the growth medium. He also did this in vessels with no filter at all, with air being admitted via a curved tube (swan-necked flasks) that prevented dust particles from coming in contact with the broth. By boiling the broth beforehand, Pasteur ensured that no microorganisms survived within the broths at the beginning of his experiment. Nothing grew in the broths in the course of Pasteur's experiment. This meant that the living organisms that grew in such broths came from outside, as spores on dust, rather than

spontaneously generated within the broth. Thus, Pasteur dealt the death blow to the theory of spontaneous generation and supported germ theory instead. He performed numerous experiments to discover why wine and dairy products became sour, and he found that bacteria were to blame.



Pasteur Swan-Neck flask experiment

Ferdinand Julius Cohn (1828 –1898) was a German biologist. His classification of bacteria into four groups based on shape (sphericals, short rods, threads, and spirals) is still in use today.

KOCH'S POSTULATES

 Three rules for experimental proof of the pathogenicity of an organism were presented in 1883 by the German bacteriologist, Robert Koch; a fourth was appended by E. F. Smith (1905). Briefly, these rules state:

1. The suspected causal organism must be constantly associated with the disease.
2. The suspected causal organism must be isolated from an infected plant and grown in pure culture.
3. When a healthy susceptible host is inoculated with the pathogen from pure culture, symptoms of the original disease must develop.
4. The same pathogen must be re-isolated from plants infected under experimental conditions.

The Difference Among Bacteria , Archaea and Eukaryotic

Features	Bacteria	Archaea	Eukaryotic
Cellularity	Unicellular	Unicellular	Multicellular
Cell type	Prokaryotic	Prokaryotic	Eukaryotic
Membrane-bound organelle	Absent	Absent	Present
Distinct nuclear membrane	Absent	Absent	Present
Chromosome	Circular	Circular	Linear
Reproduction	Fission	Fission	Mitosis/Meiosis (spore formation/budding/fission)
Cell wall composition	Peptidoglycan, protein, sugar	Polysaccharides	Cellulose/chitin
RNA polymerase	One kind	Several kinds	Several kinds
Introns in genes	Very rare	Present in some	Present
General response to antibiotic	Growth inhibited	Not inhibited	Inhibited
Initiator amino acid for polypeptide synthesis	Formyl-methionine	Methionine	Methionine
Pathogenic?	Some	None discovered yet	Some