Introduction

Microorganisms (or microbes):

A microorganism, or microbe, is a microscopic organism, which may exist in its single-celled form or a colony of cells.

They can be found around us and even inside our bodies. The category 'Microbes' includes a massive range of organisms including bacteria, fungi, viruses, microscopic algae, archaea and protozoa. Some of these, such as bacteria and fungi, are well known, but others such as archaea are so much less. Viruses represent another special case; they are most certainly microscopic but by most accepted definitions they are not living.

What is microbiology?

Microbiology: The science (*logos*) of small (*micro*) life (*bios*) is the study of living things so small that they cannot be seen with the naked eye.

Why is microbiology important?

following list of some of the general sciences in which the expertise of a microbiologist might be used:

- Medicine
- Environmental science
- Food and drink production
- Agriculture
- Pharmaceutical industry
- Genetic engineering

History of Microbiology

Humans knew how to deal with germs before even knowing about their existence :-

1- Storing food in cooler temperatures.

2- Salting, drying, smoking.

3- Use of spices.

4- Cremation of dead.

5- Burying dead in a distant area.

The most important scientists who contributed to the development of microbiology:

Antonie van Leeuwenhoek (1632 – 1723):

- A Dutch scientist, he is commonly known as "the Father of Microbiology".

- He invented the first simple optical microscope and checked a drop of pond water, so he was the first who did an experiment with microbes.

- He was also the first to document microscopic observations of muscle fibers, bacteria, spermatozoa, and red blood cells.

Van Leeuwenhoek's microscope:

- Composed of one lens.
- Light shines objects at a45˚angle.
- Worked like a dark field microscope.
- Magnification: 50-300 fold.

Louis Pasteur (1822–1895):

- A French microbiologist and chemist knew as the "father of microbiology".

- He discovered the principles of **vaccination, microbial fermentation and pasteurization**.

-He reduced mortality from **puerperal fever**,

- He created the first vaccines **for rabies and anthrax**.

- His medical discoveries provided direct support **for the germ theory of disease** and its application in clinical medicine.

- He invented the technique of treating milk and wine to stop bacterial contamination, a process now called **pasteurization.**

- He was responsible for disproving the doctrine of **spontaneous generation** (Although Pasteur was not the first to propose the germ theory, his experiments indicated its correctness).

Ferdinand Julius Cohn (1828 –1898):

- A German biologist. He is one of the founders of modern bacteriology and microbiology.

- Cohn was the first to classify **algae as plants**, and to define what distinguishes them from green plants.

- His classification of **bacteria into four groups based on shape (spherical, short rods, threads, and spirals)** is still in use today.

Robert Koch (1843 – 1910):

- A German physician and microbiologist. He is one of the main founders of modern bacteriology.

- He identified the specific causative agents of **tuberculosis, cholera, and anthrax** and gave experimental support for the concept of infectious disease.

- Koch created and improved laboratory technologies and techniques in the field of microbiology, and made key discoveries in public health.

- His research led to the creation of **Koch's postulates**, a series of four generalized principles linking specific microorganisms to specific diseases that remain today the "gold standard" in medical microbiology.

Koch's postulates

- The microorganism must be present in every instance of the disease and absent from healthy individuals.
- The microorganism must be capable of being isolated and grown in pure culture.
- When the microorganism is inoculated into a healthy host, the same disease condition must result.
- The same microorganism must be re-isolated from the experimentally infected host.

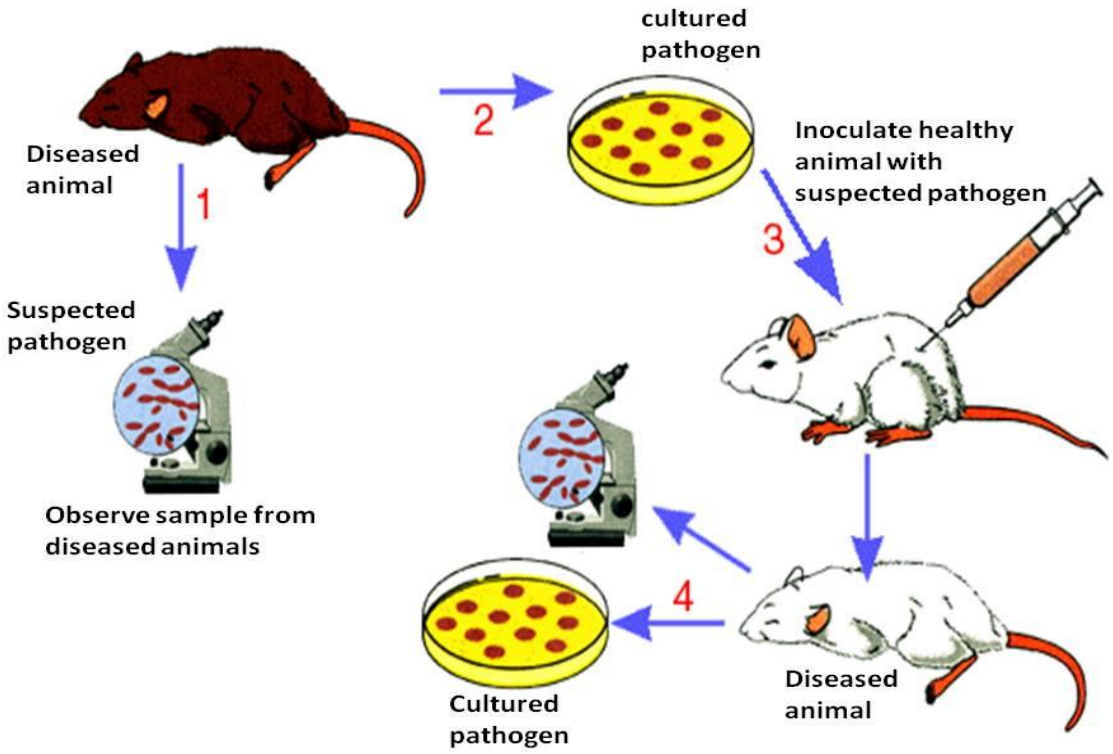

Figure 1: Schematic diagram illustrating Koch's postulates

Cell Structure and Organizing

The basic unit of all living things is **the cell**.

Prokaryotic and Eukaryotic

The most fundamental difference between prokaryotic and eukaryotic cells is reflected in their names; *Eukaryotic cells* possess a true nucleus and several other distinct subcellular organelles that are bounded by a membrane. *Prokaryotes* have no such organelles.

The differences between prokaryotes and eukaryotes:

	Prokaryotes	**Eukaryotes**
DNA	DNA is naked (no histones)	DNA associated with histones
	DNA is circular	DNA is linear
	Genes do not contain introns	Genes may contain introns
	DNA found in cytoplasm (nucleoid)	DNA found in nucleus
Internal Structures	No membrane-bound organelles	Have membrane-bound organelles
Ribosomes	Have 70S ribosomes	Have 80S ribosomes
Reproduction	Asexual (binary fission)	Asexual (mitosis) or sexual (meiosis)
	DNA is singular (haploid)	DNA is usually paired (diploid or more)
Average Size	Smaller (≈1 – 5 μm)	Larger (≈10 – 100 μm)

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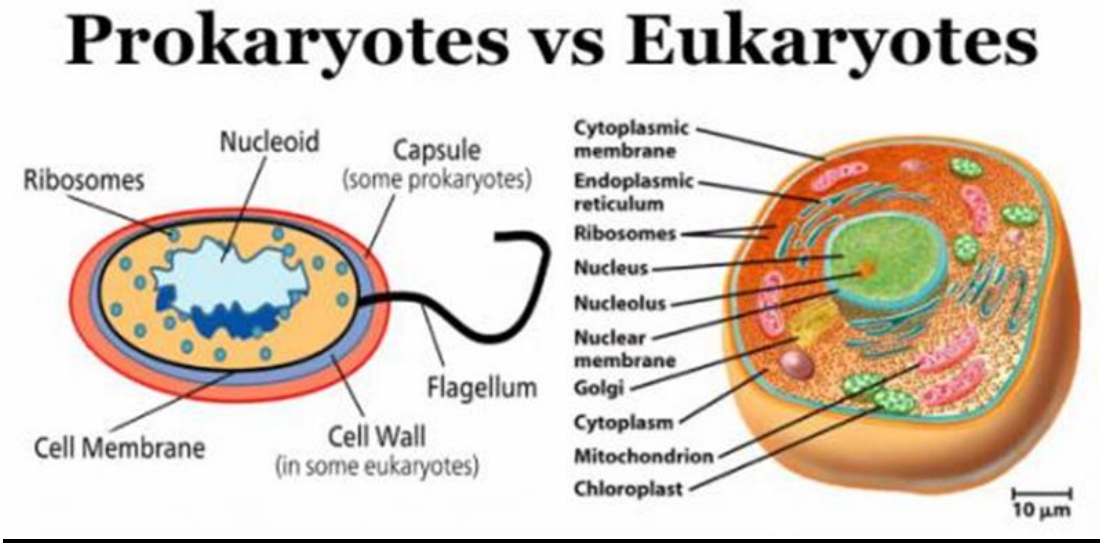

Bacteriology

Bacteriology is the branch of microbiology that focuses on the study of bacteria. It involves understanding the structure, function, and classification of bacterial species, as well as their roles in various ecosystems, including their interactions with humans, animals, plants, and the environment. Bacteriology is crucial for fields like medicine, agriculture, and biotechnology, as it helps in the development of antibiotics, the study of infectious diseases, and the use of bacteria in industrial processes.

Bacterial cell

Bacteria are prokaryotic, unicellular microorganisms, they lack membrane-bound organelles like those found in eukaryotes, and are much smaller than eukaryotic cells. Bacteria fall into one of two groups, **Archaebacteria** (ancient forms thought to have evolved separately from other bacteria) and **Eubacteria** (bacteria).

Bacteria (also known as eubacteria or "true bacteria"): are prokaryotic cells that are common in human daily life. Eubacteria can be found almost everywhere and kill thousands of people each year, but also serve as antibiotics producers and food digesters in our stomachs. The bacteria possess the following.

Characteristics of bacteria:

1- Bacteria are prokaryotic cells (have no membrane bounded nucleus).

2- Generally small size (the size range between 0.5-5 micrometers).

3- Have single chromosome as genetic material.

4- Except for ribosomes, there are no cytoplasmic organelles (mitochondria, chloroplasts, and the other organelles present in eukaryotic cells, such as the Golgi apparatus and endoplasmic reticulum).

5- Enclosed in a rigid cell wall made up of peptidoglycan. Cell wall may be surrounded by a capsule.

6- Reproduce by amitosis (binary-fission / asexual form of reproduction).

7- Many bacteria form spores.

8- May have flagella for movement.

Size of bacteria

In general, bacteria are between 0.2 and 2.0 um - the average size of most bacteria. **Mycoplasma** is a type of bacteria that is considered the smallest organism, and measures size of 0.25 µm.

Research studies have shown their size **to play an important role in survival over time** (Bacteria have a high surface area to volume ratio that allows them to take up as many nutrients as possible for survival. In the process, they are able to continue growing and reproducing at a steady rate). The small size of bacteria **is also beneficial for parasitism and oligotrophic** (Bacteria can continue relying on a range of hosts for their nutrition. In addition, they can also live and survive in environments that contain a low concentration of nutrients; for instance, a group of bacteria known as oligotrophic bacteria).

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