Lecture: 1

**History of Microbiology**

* **Experience phase**
* **Experimental phase**
* **Modern phase**

Experimental phase:

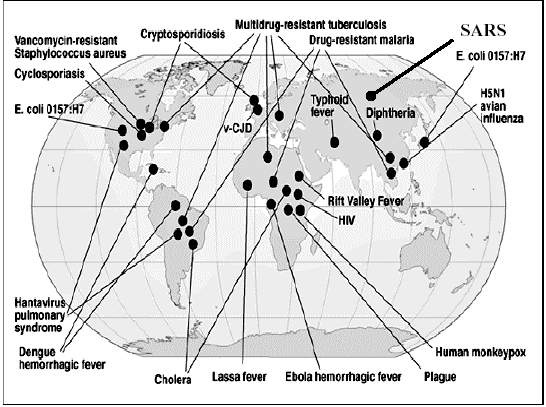
**Leeuwenhoek, Pastur, Koch, Lister.**

* 1674, Antony van Leeuwenhoek discovers microorganisms.
* 1796, Edward Jenner develops a vaccine for small pox.
* 1859, Louis Pasteur disproves the spontaneous generation of m.os.
* 1865, Joseph Lister introduces antiseptic techniques.
* 1876, Robert Koch proves that specific m.os. cause specific diseases.

**Koch’s postulates**

* The microbe must be found in the body in all cases of the disease.
* It must be isolated from a case and grown in a series of pure culture in vitro.
* It reproduce the disease on the inoculation of a late pure culture into a susceptible animal.
* The microbe must be isolated again into pure culture from such experimentally caused infection.
* 1892, Dmitri Iwanowski discovers viruses.
* 1894, Paul Ehrlich articulates the principles of chemotherapy.
* 1929, Alexander Fleming discovers penicillin.
* 1970s, Bacteria-based recombinant DNA technology is developed.
* 1977, Carl Woese discovers the archaea.
* 1977, Small pox is eradicated worldwide.
* 2000, Polio virus eradicated worldwide according to projections by the World Health Organization.

Modern phase:



Medical Microbiology  
**Introduction & Classification of Microorganisms** :

**Microbiology** (from [Greek](https://en.wikipedia.org/wiki/Ancient_Greeks), *mīkros*, "small"; *bios*, "[life](https://en.wikipedia.org/wiki/Life)"; and [*-logia*](https://en.wikipedia.org/wiki/-logy)) is the study of [microscopic](https://en.wikipedia.org/wiki/Microscopic) [organisms](https://en.wikipedia.org/wiki/Organisms), those being [unicellular](https://en.wikipedia.org/wiki/Unicellular) (single cell), [multicellular](https://en.wikipedia.org/wiki/Multicellular) (cell colony), or [acellular](https://en.wikipedia.org/wiki/Acellular) (lacking cells). Microbiology encompasses numerous sub-disciplines including [virology](https://en.wikipedia.org/wiki/Virology), [mycology](https://en.wikipedia.org/wiki/Mycology), [parasitology](https://en.wikipedia.org/wiki/Parasitology), and [bacteriology](https://en.wikipedia.org/wiki/Bacteriology).

The medical microbiology is one of the essential basic sciences for medicine. It is the study of biological characteristics of microorganisms and their relationships with human hosts.

**Branches:**

The branches of microbiology can be classified into pure and applied sciences.Microbiology can be also classified based on taxonomy, in the cases of bacteriology, mycology, protozoology, and phycology. There is considerable overlap between the specific branches of microbiology with each other and with other disciplines, and certain aspects of these branches can extend beyond the traditional scope of microbiology.

* [Bacteriology](https://en.wikipedia.org/wiki/Bacteriology): The study of bacteria.
* [Mycology](https://en.wikipedia.org/wiki/Mycology): The study of fungi.
* [Protozoology](https://en.wikipedia.org/wiki/Protozoology): The study of protozoa.
* [Phycology](https://en.wikipedia.org/wiki/Phycology)/algology: The study of algae.
* [Parasitology](https://en.wikipedia.org/wiki/Parasitology): The study of parasites.
* [Immunology](https://en.wikipedia.org/wiki/Immunology): The study of the immune system.
* [Virology](https://en.wikipedia.org/wiki/Virology): The study of viruses.
* [Nematology](https://en.wikipedia.org/wiki/Nematology): The study of nematodes.
* [Microbial cytology](https://en.wikipedia.org/wiki/Microbial_cytology): The study of microscopic and submicroscopic details of microorganisms.
* [Microbial physiology](https://en.wikipedia.org/w/index.php?title=Microbial_physiology&action=edit&redlink=1): The study of how the microbial cell functions biochemically. Includes the study of microbial growth, microbial [metabolism](https://en.wikipedia.org/wiki/Metabolism) and [microbial cell structure](https://en.wikipedia.org/wiki/Bacterial_cell_structure).
* [Microbial ecology](https://en.wikipedia.org/wiki/Microbial_ecology): The relationship between microorganisms and their environment.
* [Microbial genetics](https://en.wikipedia.org/wiki/Microbial_genetics): The study of how [genes](https://en.wikipedia.org/wiki/Gene) are organized and regulated in microbes in relation to their cellular functions. Closely related to the field of [molecular biology](https://en.wikipedia.org/wiki/Molecular_biology).
* [Cellular microbiology](https://en.wikipedia.org/wiki/Cellular_microbiology): A discipline bridging microbiology and [cell biology](https://en.wikipedia.org/wiki/Cell_biology).
* [Evolutionary microbiology](https://en.wikipedia.org/w/index.php?title=Evolutionary_microbiology&action=edit&redlink=1): The study of the evolution of microbes. This field can be subdivided into:

**-**[Microbial taxonomy](https://en.wikipedia.org/w/index.php?title=Microbial_taxonomy&action=edit&redlink=1): The naming and classification of microorganisms.

**-**[Microbial systematic](https://en.wikipedia.org/w/index.php?title=Microbial_systematic&action=edit&redlink=1): The study of the diversity and genetic relationship of microorganisms.

* [Generation microbiology](https://en.wikipedia.org/w/index.php?title=Generation_microbiology&action=edit&redlink=1): The study of those microorganisms that have the same characters as their parents.
* [Systems microbiology](https://en.wikipedia.org/w/index.php?title=Systems_microbiology&action=edit&redlink=1): A discipline bridging [systems biology](https://en.wikipedia.org/wiki/Systems_biology) and microbiology.
* [Molecular microbiology](https://en.wikipedia.org/wiki/Molecular_microbiology): The study of the molecular principles of the physiological processes in microorganisms.

**Other:**

* [Nano microbiology](https://en.wikipedia.org/w/index.php?title=Nano_microbiology&action=edit&redlink=1): The study of those organisms on nano level.
* [Exo microbiology](https://en.wikipedia.org/w/index.php?title=Exo_microbiology&action=edit&redlink=1) (or [Astro microbiology](https://en.wikipedia.org/w/index.php?title=Astro_microbiology&action=edit&redlink=1)): The study of microorganisms in outer space (see: [List of microorganisms tested in outer space](https://en.wikipedia.org/wiki/List_of_microorganisms_tested_in_outer_space))
* [Biological agent](https://en.wikipedia.org/wiki/Biological_agent): The study of those microorganisms which are being used in weapon industries.

**Applied microbiology:**

* [Medical microbiology](https://en.wikipedia.org/wiki/Medical_microbiology): The study of the [pathogenic microbes](https://en.wikipedia.org/wiki/Pathogenic_microbes) and the role of microbes in human illness. Includes the study of microbial [pathogenesis](https://en.wikipedia.org/wiki/Pathogenesis) and [epidemiology](https://en.wikipedia.org/wiki/Epidemiology) and is related to the study of disease [pathology](https://en.wikipedia.org/wiki/Pathology) and [immunology](https://en.wikipedia.org/wiki/Immunology). This area of microbiology also covers the study of [human microbiota](https://en.wikipedia.org/wiki/Human_microbiota), [cancer](https://en.wikipedia.org/wiki/Cancer), and the [tumor microenvironment](https://en.wikipedia.org/wiki/Tumor_microenvironment).
* [Pharmaceutical microbiology](https://en.wikipedia.org/wiki/Pharmaceutical_microbiology): The study of microorganisms that are related to the production of antibiotics, enzymes, vitamins,vaccines, and other pharmaceutical products and that cause pharmaceutical contamination and spoil.
* [Industrial microbiology](https://en.wikipedia.org/wiki/Industrial_microbiology): The exploitation of microbes for use in industrial processes. Examples include [industrial fermentation](https://en.wikipedia.org/wiki/Industrial_fermentation) and [wastewater treatment](https://en.wikipedia.org/wiki/Wastewater_treatment). Closely linked to the [biotechnology](https://en.wikipedia.org/wiki/Biotechnology) industry. This field also includes [brewing](https://en.wikipedia.org/wiki/Brewing), an important application of microbiology.
* [Microbial biotechnology](https://en.wikipedia.org/w/index.php?title=Microbial_biotechnology&action=edit&redlink=1): The manipulation of microorganisms at the genetic and molecular level to generate useful products.
* [Food microbiology](https://en.wikipedia.org/wiki/Food_microbiology): The study of microorganisms causing food spoilage and foodborne illness. Using microorganisms to produce foods, for example by fermentation.
* [Agricultural microbiology](https://en.wikipedia.org/wiki/Agricultural_microbiology): The study of agriculturally relevant microorganisms. This field can be further classified into the following:

**-**[Plant microbiology](https://en.wikipedia.org/wiki/Plant_microbiology) and [Plant pathology](https://en.wikipedia.org/wiki/Plant_pathology): The study of the interactions between microorganisms and plants and plant pathogens.

**-**[Soil microbiology](https://en.wikipedia.org/wiki/Soil_microbiology): The study of those microorganisms that are found in soil.

* [Veterinary microbiology](https://en.wikipedia.org/w/index.php?title=Veterinary_microbiology&action=edit&redlink=1): The study of the role of microbes in [veterinary medicine](https://en.wikipedia.org/wiki/Veterinary_medicine) or animal [taxonomy](https://en.wikipedia.org/wiki/Taxonomy_(biology)).
* [Environmental microbiology](https://en.wikipedia.org/wiki/Environmental_microbiology): The study of the function and diversity of microbes in their natural environments. This involves the characterization of key bacterial habitats such as the [rhizosphere](https://en.wikipedia.org/wiki/Rhizosphere) and [phyllosphere](https://en.wikipedia.org/wiki/Phyllosphere), [soil](https://en.wikipedia.org/wiki/Soil) and [groundwater](https://en.wikipedia.org/wiki/Groundwater) [ecosystems](https://en.wikipedia.org/wiki/Ecosystem), open [oceans](https://en.wikipedia.org/wiki/Oceans) or extreme environments ([extremophiles](https://en.wikipedia.org/wiki/Extremophile)). This field includes other branches of microbiology such as:
* [Microbial ecology](https://en.wikipedia.org/wiki/Microbial_ecology)
* Microbially mediated [nutrient cycling](https://en.wikipedia.org/wiki/Nutrient_cycle)
* [Geomicrobiology](https://en.wikipedia.org/wiki/Geomicrobiology)
* [Microbial diversity](https://en.wikipedia.org/w/index.php?title=Microbial_diversity&action=edit&redlink=1)
* [Bioremediation](https://en.wikipedia.org/wiki/Bioremediation)
* [Water microbiology](https://en.wikipedia.org/w/index.php?title=Water_microbiology&action=edit&redlink=1) (or Aquatic microbiology): The study of those microorganisms that are found in water.
* [Aeromicrobiology](https://en.wikipedia.org/w/index.php?title=Aeromicrobiology&action=edit&redlink=1) (or Air microbiology): The study of airborne microorganisms.

**The most important branches in the scope of medicine:**

* Medical Bacteriology.
* Medical Viriology.
* Medical Mycology.
* Parasitology.
* Immunology.
* Genetics.

**Classification of Microorganism:**

Organisms have traits that are similar to and different from other organisms. Scientists organize organisms into groups by developing taxonomy. A taxonomy is based on scientists’ ability to characterize organisms into a classification system.

***Taxonomy****:*is classification or ordering into groups based on degree of relatedness.

**Taxonomy has three components:**

* Classification. The arrangement of organisms into groups based on similar characteristics, evolutionary similarity or common ancestry. These groups are also called taxa.
* Nomenclature. The name given to each organism. Each name must be unique and should depict the dominant characteristic of the organism.
* Identification. The process of observing and classifying organisms into a standard group that is recognized throughout the biological community.

**Nomenclature of Taxonomy: (Name Calling)**

In 1969 **Robert H.** , proposed a new taxonomy that consisted of five kingdoms:

* Monera are organisms that lack a nucleus and membrane-bounded organelles, such as bacteria.
* Protista are organisms that have either a single cell or no distinct tissues and organs, such as protozoa. This group includes unicellular eukaryotes and algae.
* Fungi are organisms that use absorption to acquire food. These include multicellular fungi and single-cell yeast
* Animalia and plantae include only multicellular organisms.

**Woese’s six-kingdom taxonomy consists of:**

* Eubacteria (has rigid cell wall)
* Archaebacteria (anaerobes that live in swampsمستنقعات , marshesأهوار , and in the intestines of mammals)
* Protista (unicellular eukaryotes and algae)
* Fungi (multicellular forms and single-cell yeasts)
* Plantae
* Animalia

Woese used three major criteria to define his six kingdoms. These are:

* ***Cell type****.* Eukaryotic cells (cells having a distinct nucleus) and prokaryotic cell (cells not having a distinct nucleus)
* ***Level of organization****.* Organisms that live in a colony or alone and one-cell organisms and multi cell organisms.
* ***Nutrition***. Ingestion (animal), absorption (fungi), or photosynthesis (plants).

Microbiologists use a microbial taxonomy, which is different from what biologists, who work with larger organisms, use. Microbial taxonomy is commonly called prokaryotic taxonomy. The widely accepted prokaryotic taxonomy is **Bergey’s Manual of Systematic Bacteriology,** first published in 1923 by the **American Society for Microbiology**.

In the taxonomy of prokaryotes, the most commonly used rank (in order from most general to most specific) is:

* Domainمجال او حقل
* Kingdomمملكة
* Phyla شعبة
* Class صنف او طبقة
* Order رتبة
* Family عائلة
* Genusجنس
* Species نوع

The basic taxonomic group in microbial taxonomy is the species. Taxonomists working with higher organisms define their species differently than microbiologists. Prokaryotic species are characterized by differences in their **phenotypeالطراز المظهري and genotypeالطراز الوراثي** .

* ***Phenotype***is the collection of visible characteristics and the behavior of a microorganism.
* ***Genotype***is the genetic make up of a microorganism. The prokaryotic species are collections of strains that share many properties and differ dramatically from other groups or strains.
* ***A strain*** is a group of microorganisms that share characteristics that are different from microorganisms in other strains.

Microorganisms are given a two-part name.

1-The first part is the *Latin name for the genus*.

2-The second part is the **epithet** الصفة أو الكنية.

Together these parts uniquely identify the microorganism.

* The first part of the name is always **capitalized**
* the second part of the name is always lowercase.
* Both parts are italicized.
* For example, *Escherichia coli* is a bacterium that is a member of the Escherichia genus and has the epithet *coli*. Sometimes the name is abbreviated such as *E. coli*.

The most widely used classification system is called the natural classification.

**The *natural classification:*** requires that an organism be grouped with organisms that have the same characteristics

In the mid-eighteenth century, **Linnaeus** developed the first natural classification using anatomical characteristics of organisms. Other natural classifications use classical characteristics to group organisms. These characteristics are:

Morphological:Morphological characteristics classify organisms by their structure, which normally remain the same in a changing environment and are good indications of phylogenticالتطور النوعي relatedness.

Ecological characteristics classify organisms by the environment in which they live. For example, some microorganisms live in various parts of the human intestines and others live in marine بحرية environments. Ecological characteristics include the ability to cause disease, temperature, pH, and oxygen requirements of an organisms, as well as an organism’s life cycle.

In the early 1990s, **T. Cavalier-Smith** developed the two-empire and eight kingdom taxonomy based on phentic and phylogenetic characteristics.

* Phentic: measures the physical characteristics of an organism using a process called numerical taxonomy.
* Numerical taxonomy: is a phentic classification based on physical measurements of an organism.
* Phylogenetic: measures the evolutionary relationship among organisms.

The two empires are bacteria and eukaryota. The bacteria domain contains two kingdoms. These are eubacteria and archaeobacteria. The eukaryota empire contains six kingdoms

|  |  |
| --- | --- |
| **Empire** | **Kingdom** |
| Bacteria | Eubacteria—Large group of bacteria that have  rigid cell walls |
|  | Archaeobacteria—nonrigid cell walls. |
| Eukaryota | Archezoa—Primitive one-cell eukaryotes. |
|  | Chromista—Photosynthetic organisms that  have chloroplasts within the lumen of the  rough endoplasmic reticulum |
|  | Plantae—Photosynthetic organisms that have  chloroplasts in the cytoplasmic matrix. |
|  | Fungi—Absorb nutrients. |
|  | Animalia—Ingest nutrients. |
|  | Protozoa—Single-cell organism |