

Some disease requires cooperation between the pathogens (Impetigo).

Some organisms cannot culture as pure culture (*Treponema pallidum*).

Usefulness of Koch's Postulates

1. It is useful in determining pathogenic organisms.
2. To differentiate the pathogenic and nonpathogenic microorganism.
3. For the classification of organisms.
4. To detect the susceptibility, resistance of the laboratory animals.

Joseph Lister (1827 – 1912)

He was a pioneer of **antiseptic surgery**. Joseph Lister developed antiseptic method for preventing infection using carbolic acid to treat wounds in 1867. He developed “serial dilution technique” in liquid media. He identified the bacteria, *Bacterium lactis* from milk sample. Lister used bandages soaked in carbolic acid to dress wounds caused by compound fractures. His discovery of chemicals which prevent infections greatly increased survival rates of the wounded patients. His antiseptic principles guide today's modern surgical procedures.



Figure 3 Joseph Lister

Martinus W. Beijerinck (1851 – 1931)

Beijerinck isolated root nodule causing bacteria. He published the results on tobacco mosaic disease in 1898 and 1900. He proposed that the TMV disease was caused by an entity that is entirely different from bacteria. He called viruses are a filterable agents. Beijerinck observed that the virus would multiply only in living plant cells. Beijerinck showed that the viruses could survive for long periods in a dried state. He made fundamental contributions to microbial ecology. He isolated the aerobic nitrogen fixing bacterium *Azotobacter* and sulfate reducing bacterium. He developed enrichment culture technique and proposed the uses of selective media along with Winogradsky



Figure 4 Beijerinck

Elie Metchnikoff (1845 – 1916)

He found out the concept of Phagocytosis. His work on antitoxin, provided evidence that, immunity could result from soluble substances in the blood, now known as antibodies. He described that blood cells are important in immunity. He discovered that some blood leukocytes could engulf disease causing bacteria. He called these cells as phagocytes, which is an important process in immunology.

3. Microbiologists must find ways to stop the spread of established infectious diseases.
4. Microbiologists along with pharmacologist's and chemists have to create new drugs and find ways to slow or prevent the spread of drug resistance microorganisms.
5. New vaccines must be developed to protect against diseases such as AIDS. It will be necessary to use techniques in molecular biology and recombinant DNA technology.
6. Microbiologists should assess the association between infectious agents and chronic diseases such as autoimmune and cardiovascular diseases.
7. We are only now beginning to understand how pathogens interact with host cells and the ways in which diseases arise. There also is much to learn about how the host resists pathogen invasions.
8. Microbial diversity is another area requiring considerable research.
9. It is estimated that less than 1% of the earth's microbial population has been cultured. We must develop new isolation techniques for the isolation of microorganisms.
10. Much work needs to be done on microorganisms living in extreme environments. The discovery of new microorganisms may well lead to further advances in industrial processes and enhanced environmental control.
11. Microbial communities often live in biofilms, and these biofilms are of profound importance in both medicine and microbial ecology. Research on biofilms is in its infancy and it needs complete study.
12. The genomes of many microorganisms already have been sequenced, and many more will be determined in the coming years.
13. Microorganisms are essential partners with higher organisms in symbiotic relationships. Greater knowledge of symbiotic relationships can help improve our appreciation of the living world. It also will lead to improvements in the health of plants, livestock, and humans.

The future of microbiology is bright. Microbiology is one of the most rewarding of professions because it gives its practitioners the opportunity to be in contact with all the other natural sciences and thus to contribute in many different ways to the betterment of human life.

F. PROKARYOTES AND EUKARYOTES

Microorganisms and all other living organisms are classified as prokaryotes or eukaryotes. Prokaryotes and eukaryotes are distinguished on the basis of their cellular characteristics. Prokaryotic cells lack a nucleus and other membrane-bound structures known as organelles. Eukaryotic cells have both a nucleus and organelles.

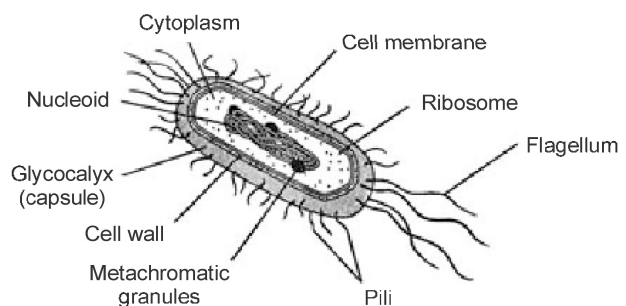


Figure 13 Prokaryotic Cell

Eight Kindom concept

The eight-kingdom system is proposed by Cavalier-Smith in 1987. This concept is based on cellular structure and genetic organization. He used ultrastructural characteristics as well as rRNA sequences. He divides all organisms into two empires and eight kingdoms. Two empires in this concept are bacteria and eukaryota. The empire *Bacteria* contains two kingdoms. They are the *Eubacteria* and the *Archaeobacteria*. The second empire, the *Eucaryota*, contains six kingdoms. They are Archezoa, protozoa, Plantae, Chromista, fungi and Animalia. The *Archezoa* are primitive eukaryotic unicellular organisms such as *Giardia* that have 70S ribosomes and lack Golgi apparatuses, mitochondria, chloroplasts, and peroxisomes. The kingdom *Chromista* contains mainly photosynthetic organisms that have their chloroplasts within the lumen of the rough endoplasmic reticulum. Eg. Diatoms, brown algae, cryptomonads, and oomycetes.

Three domain concept

Carl woese and his colleagues in 1990 used rRNA studies to group all living organisms. They grouped the organisms into three domains. They are archae, bacteria and eucarya. It is based on the phylogenetic system of classification. Archae and bacteria are fall under prokaryotic category. Archae are differ from bacteria and eucaryotes in some ways. The 3 domains are **Eukarya**-this includes all animals, plants, fungi, and eukaryotic microbes; **Bacteria**-these are the common, everyday bacteria; **Archaea**-unusual bacteria.

C. CLASSIFICATION OF BACTERIA

Many schemes were there for identification before 1923. During 1916-1918 -Robert Buchanan was the first to prepare a comprehensive scheme for the classification of bacteria. In 1920 - American society for microbiology submitted a report on various schemes which was the beginning of new outline for bacterial classification.

Bergeys manual

In 1923, David Bergey, Professor of bacteriology at the University of Pennsylvania, and four colleagues published a classification of bacteria called *Bergey's Manual of Determinative Bacteriology* from the society of American Bacteriologists. It contains descriptions of all procaryotic species. Second edition was published in 1925, third in 1930. Subsequently five editions were published. In 1974 8th edition was published with international contributions. This book is a collection of brief descriptions of bacteria and detailed tables of differential characteristics of bacterial species described and cultured as of January 1991. Now this book is in 9th edition. It was published in 1994. Information is arranged strictly based on phenotypic characteristics of bacteria. The bacteria are divided into 35 groups. These groups are not meant to be formal taxonomic ranks.

GROUP 1: THE SPIROCHETES

Important Genus: *Borrelia*, *Spirochaeta*, *Leptospira*, *Treponema*

GROUP 2: AEROBIC/MICROAEROPHILIC, MOTILE, HELICAL/VIBRIOID

Important Genus: *Campylobacter* and *Helicobacter*

Functions

- ⤴ It retains cytoplasm, particularly in cells without cellwall.
- ⤴ It serves as a selectively permeable barrier.
- ⤴ It allows the entry or release of ions either into or out of the cell.
- ⤴ It prevents leakage of ions and molecules.
- ⤴ It carries the functions like nutrient uptake, waste excretion and protein secretion.
- ⤴ It is the location of a variety of crucial metabolic process such as respiration, photosynthesis, the synthesis of lipids and cell wall constituents.
- ⤴ It is essential for the survival of the microorganisms.

Cytoplasmic Matrix

- ⤴ It is the substance lying between the plasma membrane and the nucleoid.
- ⤴ 70% of bacterial matrix is made up of water.
- ⤴ Cytoplasmic matrix is a major part of the protoplast.
- ⤴ It contains higher quantities of ribosomes.
- ⤴ It also contains inclusions bodies.

Inclusion Bodies

- ⤴ It is present in cytoplasmic matrix.
- ⤴ They are used for storage.
- ⤴ It also reduces osmotic pressure by tying up molecules in particulate form.
- ⤴ Some inclusions are available freely in the cytoplasm (poly phosphate, cyanophycin, some glycogen) and some are available with simple membrane (PHB, sulphur granules).

Glycogen

- ⤴ It is a carbon storage material.
- ⤴ It is a organic inclusion body.
- ⤴ It is a polymer of glucose units composed of long chains formed by α (1-4) glycosidic bonds, branched chains are connected by β (1-6) glycosidic bonds.
- ⤴ It is stained with iodine and turns reddish brown.
- ⤴ It is dispersed more evenly throughout the matrix.

PHB

- ⤴ It is expanded as Poly β Hydroxyl Butyrate.
- ⤴ It contains β hydroxyl butyrate molecules linked together by ester bonds between carboxyl and hydroxyl groups of adjacent molecules.
- ⤴ Size of PHB are 0.2 to 0.7 μ m in diameter.