

B.Sc. III Year (Theory)
Semester –VI
Paper XX (C)
Microbiology and Disease Management

Unit-1

1. Microbiology

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1. Microbiology

1. MICROORGANISMS

There are evidences to believe that microorganisms were the first of the multitude of biological forms to appear on this planet. The other biological forms are believed to have appeared on earth several million years later. By the time, man learnt to cultivate plants for his benefit, about 10000 years ago, microorganisms had already multiplied in number and spread universally. They became associated with both animate and inanimate objects. Their continuous association with various objects, particularly with other biological systems, has resulted in certain adaptation and special features among them. Such features have caused evolutionary changes to result in different forms and types of organisms.

The association between plants and microorganisms has become increasingly complex. In the process of evolution, such organisms which were not virulent enough to compete with others disappeared, while the most virulent ones survived. Such changes continue to take place in a never-ending sequence. One of the human activity is the domestication of plants and animals. When he had sown the seeds in soil, microorganisms are already there to influence them; when grains were harvested and stored, some of the organisms from the field accompanied them to the bins

- . Thus the continued association between microorganisms and plants in various stages of growth has created certain types of inter-relationship. Some examples of close association are the mycorrhiza-pine root relationship, the legume root nodule – bacteria relationship, and various types of pathogen- host plant relationships.

- **Taxonomy and Classification of Microorganisms:**

In the broadest sense the term microorganisms refers to all minute or microscopic organisms including fungi, bacteria, viruses, protozoa, microscopic algae and nematodes. The specific discipline governing the study of microorganisms is called microbiology, which has several specialized branches dealing with specific groups. Thus, mycology deals with the study of fungi, bacteriology with the study of bacteria, virology with the study of viruses, protozoology with the study of protozoa, algology with the study of algae and nematology with the study of nematodes.

The taxonomy of these diversified groups of microscopic organisms is not limited to either Plant or Animal kingdom, as some of them closely resemble plants while others resembles animals. For example, fungi are considered as lower plants while protozoa have animal-like characteristics. For the present purpose these organisms are listed under the existing international system of classification of plants and animals.

Whittaker (1969) proposed a five-kingdom system and placed fungi in a separate kingdom, coordinate with plants and animals. The two primitive kingdoms are the Monera (Prokaryotes) and Protista (Unicellular eukaryotes). Whittaker proposed that three nutritionally distinct lines have developed from the protista which characterized the three kingdoms. They are: 1) The Plant kingdom, characterized by photosynthesis, 2) The Animal kingdom, characterized by ingestive nutrition; and 3) The fungi, in which nutrition is absorptive.

Main Groups of Microorganisms:

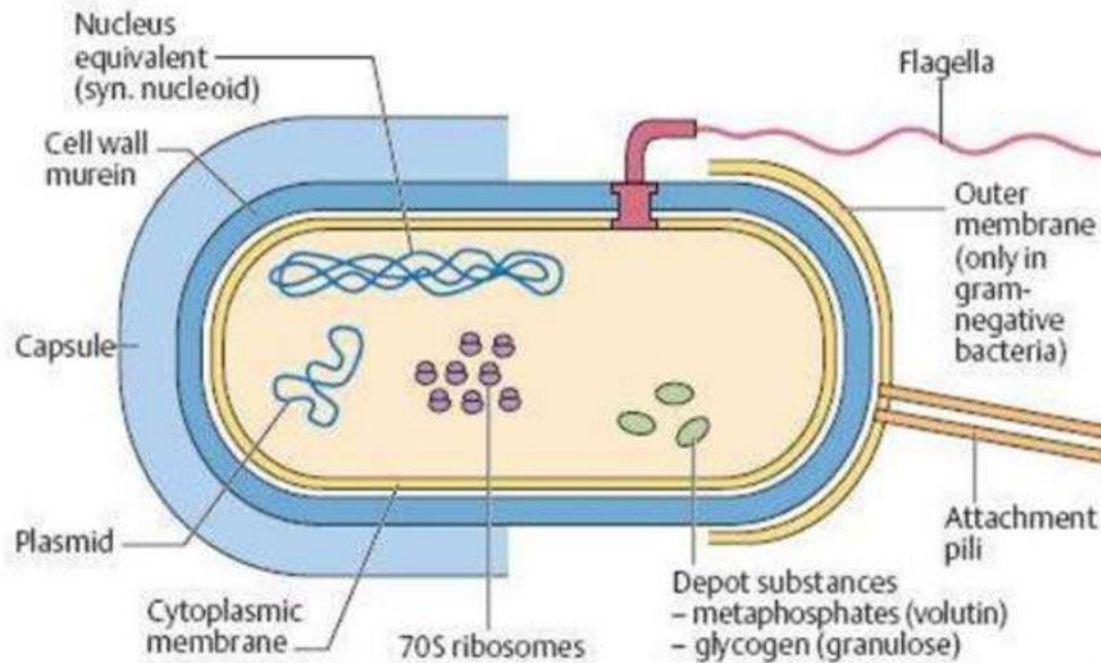
I) Bacteria: They are the true prokaryotes. The group include true bacteria (eubacteria) and related organisms i. e. archeobacteria, blue-green bacteria, mycoplasmas, rickettsiae and chlamydiae.

They are prokaryotes. Reproduction is by simple fission, nutritional processes are very diverse. Many can thrive in both oxygen rich and oxygen free environments. Growth occurs over a wide range of temperatures and usually at a neutral pH. They occur in almost every terrestrial and aquatic environment.

The rickettsiae, chlamydiae and mycoplasmas are also prokaryotes. The rickettsiae and chlamydiae are intercellular parasites of eukaryotes. The rickettsiae are tiny rods that are transmitted by arthropods and multiply only in living cells. The chlamydiae are among the smallest bacteria which were formerly considered viruses. The mycoplasmas are the smallest organisms that can be cultivated outside living tissues. Some are involved in lung disorders.

Intracellular parasites of prokaryotes is a group of small, highly motile bacteria, that adhere to the host wall, penetrate through to the periplasm where they replicate, causing eventual lysis of cell. Organisms of this type are called bdellovibrios and perhaps occur in soil.

Scheme of structure of bacterial cell



II) Actinomycetes: Majority of them are mycelia. They are Gram positive prokaryotes, a large group of filamentous bacteria which show branching pattern just like those of fungi. They produce spores when grow in culture. They are easily isolated from soil. Most of these produce antibiotics and so are of great value to the pharmaceutical industry.

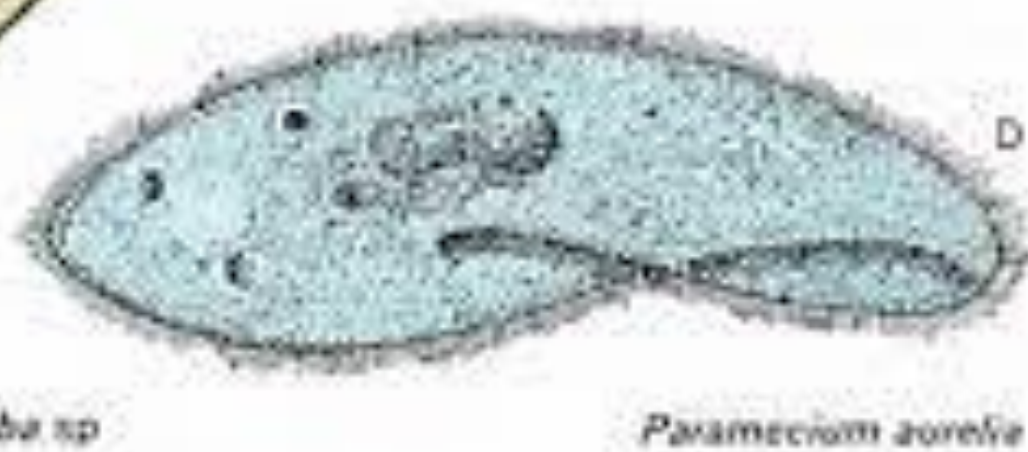
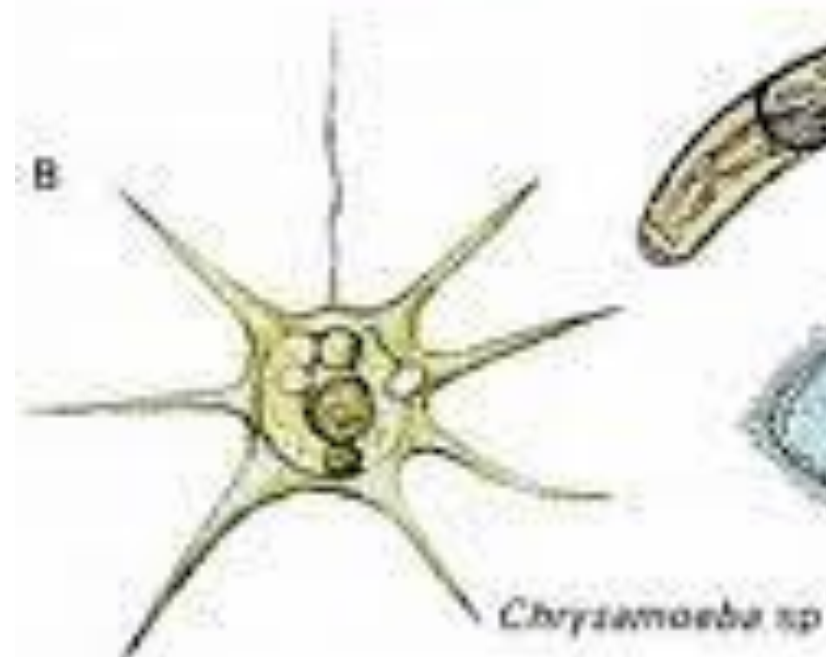
Ex. *Streptomyces*, *Micromonospora*, *Actinoplanes*, *Streptosporangium*, *Actinomyces*, *Streptococcus*, *Lactobacillus*, *Leucomonas*, *Staphylococcus*, *Micrococcus*, *Sarcina*.



III) Protozoa: They are unicellular, eukaryotic animals and are non photosynthetic. They obtain their food by phagocytosis and are without true cell wall. They are involved in many blood and tissue diseases. They are motile.

- 1. The Protozoa exhibits amoeboid movement or flagellar movement or ciliary movement.**
- 2. Food taken by phagocytosis of solid particles such as bacteria.**
- 3. Generally they lack cell wall.**
- 4. Degree of specialization in single cells.**

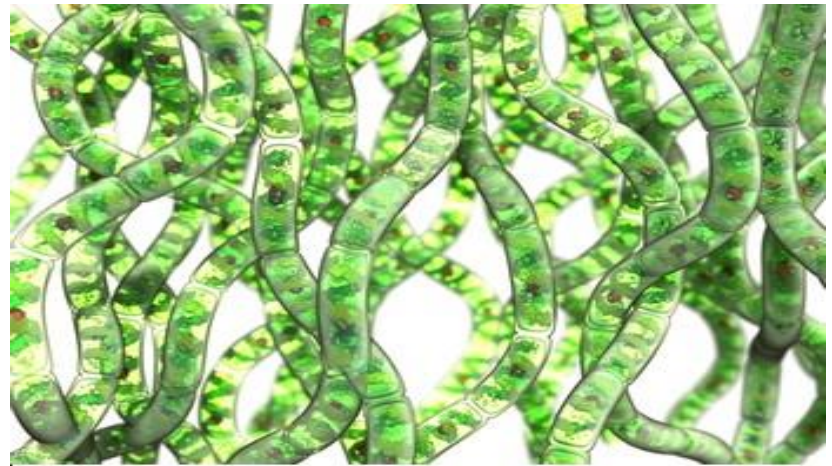
Some workers also study some slime molds and water molds along with protists. They have been traditionally studied by mycologists. However, they are protists phylogenetic ally. The slime molds form like fungi, macroscopic fruit bodies. But their feeding phase is amoeboid. They live on surface of decaying vegetation. There are two main groups: a) the cellular slime molds, and b) acellular slime molds.



IV) Algae:

They are pigmented eukaryotes microscopic to giant. The chief characters are as follows:

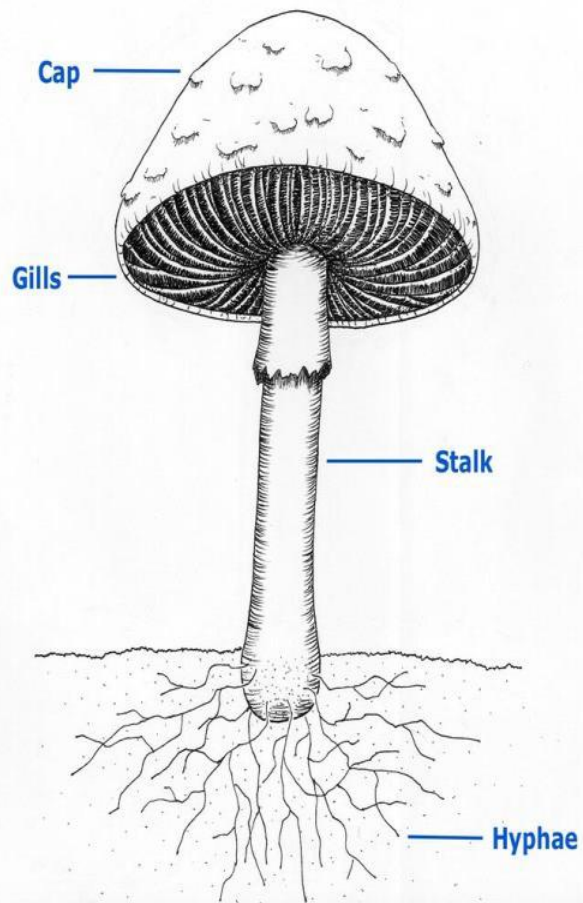
1. The process of photosynthesis occurring in chloroplasts. The pigments are variety of chlorophylls and carotenoids with chlorophyll a.
2. They exhibit a wide range of morphological types.
3. Many are motile by flagella.
4. Cell wall characteristically of polysaccharide made of components as pectin, cellulose or xylan. Wall of some red seaweeds contain the agar gel.
5. Reproduce sexually or asexually showing very rare complicated life cycles.



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V) Fungi:

1. Heterotrophic eukaryotic microbes obtaining their food in a soluble form by uptake through plasma membrane in a manner similar to prokaryotes.
2. Have thick cell wall made of polysaccharides with chitin.
3. Motile stages absent, never form flagella.
4. Mycelia may be coenocytic or septate.
5. Mycelium made up of individual filaments, the hyphae. Some are unicellular (Yeast).
6. Asexual reproduction by variety of spores.
7. Sexual reproduction is also produced. In some large fruit bodies are produced. Life cycles may be simple or complex.

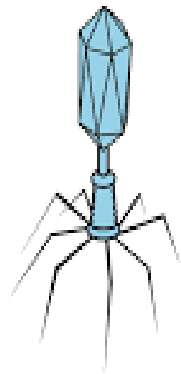


VI) Viruses: They are acellular, infectitious agents. They have no associated metabolism. They have no such activities except replication that takes place in cytoplasm of living cells. They consist of fragments of nucleic acid surrounded by a layer of protein. They causes important diseases.

Viroids are minute infectious agents of plants which are composed of single naked RNA molecules. Viroid RNAs are very unusual they are circular, uniquely folded and so small that the largest one so far described is only 371 nucleotides long about $1/10^{\text{th}}$ of the size of the smallest RNA virus. Viroids are known to cause diseases to plants only.

Prions or slow viruses are a group of recently discovered infectious particles. Prions appear to be proteins or glycoproteins with no associated nucleic acid of any kind. Since replication of prion-protein occurs by normal process, this implies that these proteins may be able to bring about the production of their own requisite mRNA.

Types of viruses



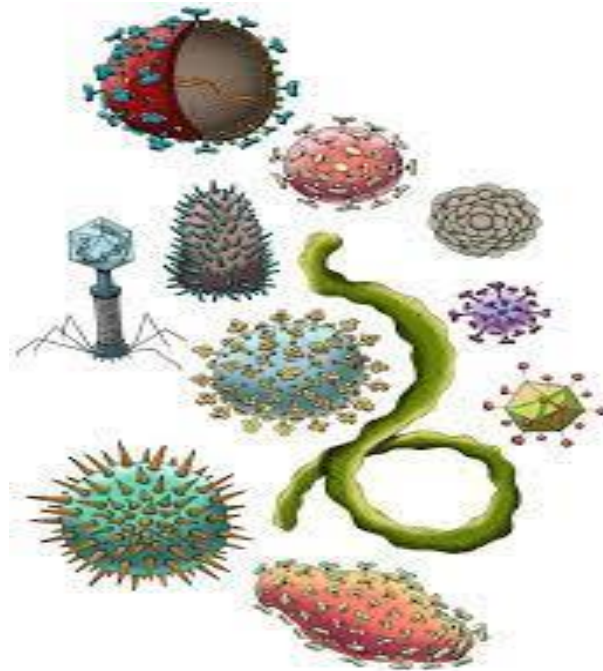
Bacteriophage



Adenovirus



Human Immunodeficiency Virus



Thank you