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COURSE NAME : 19GET277 - Biology for Engineers

IV YEAR/ VII SEMESTER

UNIT – II - BIODIVERSITY

Topic: Microbial System: history-types of microbes

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- Microbial evolution had been underway for at least 2 billion years before the emergence of the first eukaryotic cells, and multicellular organisms arose even later. Even now, most of the biodiversity of life on Earth is microbial. Many of the genes, molecular machines, regulatory, metabolic, and synthetic pathways found in all living organisms today evolved first in microorganisms. Understanding the early evolution of microorganisms will shed light on the origin of the machinery of life common to all organisms. The evolutionary process is ongoing in microorganisms, as it is in all life forms, and depends on genetic variation. Microorganisms have several ways to generate far more dramatic and rapid genetic variation than plants and animals, including genome reduction and horizontal gene transfer.
- Understanding the early evolution of microorganisms will shed light on the origin of the machinery of life common to all organisms.

- It is becoming clear that the microbial world must be taken into account when studying the evolution of all other life forms. All plants and animals evolved in environments filled with billions of interdependent microorganisms and all macroorganisms have a co-evolving community of microorganisms living in and on their bodies. From the microorganisms that allow termites to digest wood to those that produce essential vitamins in the human gut, the importance of microbial communities in the health and development of all other organisms raises a rich set of questions for evolutionary biologists.

Major types of microbes

- There are several types of microbes, which include bacteria, archaea, protozoa, fungi, algae, lichens, slime molds, viruses, and prions. Most of these organisms can survive outside of a host in the air or soil, with the exception of viruses, which can only survive for a brief time outside their host cells.

- **Bacteria**
- Bacteria are unicellular organisms with a much simpler cell structure than other organisms. A key difference between bacteria and other biological organisms is that they have no membrane-bound organelles and a lack of nucleus.
- The genetic material of bacteria is contained in a single loop of deoxyribonucleic acid (DNA). Notably, some bacteria have an extra circle of genetic material known as the plasmid. The plasmid is important for the bacteria that contain it, as it contains genes that confer an advantage, such as antibiotic resistance, over other species.

- Bacteria are classified into five types depending on their shape. These include bacilli (rod), cocci (spherical), vibrios (comma), spirilla (spiral), and spirochaetes (corkscrew.) Bacteria can exist as single cells, paired, in chains, or in clusters.
- Bacteria can be found in every habitat on Earth, from soil and the ocean to arctic snow. Bacteria also live inside the body, where they provide an essential function, as is evident by the gastrointestinal microflora.
- Bacteria also play an important role in several critical environmental processes such as the nitrogen cycle. Whereas some bacteria are involved in food production processes, others are pathogenic and have caused epidemics and pandemics over the course of human history.

Archaea

- Archaea are single-celled organisms that form the third domain of life. While these organisms are evolutionarily distinct from bacteria, they share several similarities to bacteria.
- There are some key biological differences between archaea and bacteria. These include a lack of peptidoglycan in the cell wall, as well as the presence of phytanyl instead of fatty acids on the cell membrane.

- The cell membrane of bacteria is always a lipid bilayer, whereas in archaea it can sometimes be a monolayer. Archaea also contain distinctive translation ribonucleic acids (tRNAs) and ribosomal RNAs (rRNAs).
- Archaea are obligate anaerobes that live in low-oxygen environments such as water or soil. Some examples of archaea include *Aeropyrum pernix*, *Ignisphaera aggregans,* and *Metallosphaera sedula*.
- Archaea can survive in some of the most inhospitable environments on Earth including salt deposits, deep-sea thermal vents, and hot springs. These are known as extremophiles.

Protozoa

- Protozoa are single-cell eukaryotic organisms that belong to the Kingdom Protista. These organisms are often considered to be more complex than bacteria and archaea.
- The reproduction of protozoa is asexual and achieved by budding, fission, or schizogony; however, some protozoa are capable of sexual reproduction. A key difference between protozoa and bacteria/archaea is the presence of a nucleus.
- Protozoa are motile and capable of moving by cilia, flagella, or amoeboid movement. Amoeboid movement is achieved through the use of pseudopodia, which are temporary protrusions of the cell.

Fungi

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- The group of eukaryotic organisms known as fungi includes mushrooms, yeast, and molds. These organisms can be either unicellular or multicellular and can range from micro- to macroscopic in size.
- Fungi do not contain chlorophyll and must instead absorb nutrients from their surrounding environment. Of the fungi that are classified as microorganisms, yeasts are unicellular, whereas molds are multicellular and produce microscopic filamentous structures.

Algae

- Algae are eukaryotes that, like plants, use chlorophyll to photosynthesize and have rigid cell walls. Occurring in moist environments like soil and aquatic environments, algae may be microscopic and unicellular or can be multicellular and large. In fact, some algae species may grow up to 400 feet in length.
- Multicellular algae can occur in a variety of forms and degrees of complexity. Some form colonies, which can be simple aggregates of cells or contain specialized cell types, much like higher forms of life.

Slime molds

- Slime molds are enigmatic, both taxonomically and biologically. These organisms are neither protozoa nor fungi, although they share features with both of these organisms at various stages in their life cycle.
- Slime molds can also be protozoan-like during their growth stage, as they lack cell walls and exhibit amoeboid movement. Comparatively, during their propagation stages, slime molds form fruiting bodies and sporangia like typical fungi.

Lichen

- Lichens are symbiotic organisms that consist of a photosynthetic microbe like a cyanobacterium or algae that is intimately associated with a fungus. The bacteria of lichen provide nutrients for the fungus, whereas the fungus provides protective cover for the microorganism, which proves mutually beneficial for both.
- The typical structure of a lichen is a top layer of fungal mycelium, a middle wherein the microbe lives, and a bottom layer of mycelium. One of the ecologically important roles of lichen is its ability to turn rock into soil.

Viruses

- Viruses are one of the main pathogenic agents that have been responsible for an enormous number of different diseases in humans, plants, and animals. These organisms are much simpler in structure as compared to other organisms, as they have no cells or organelles.
- Viruses can only replicate within a host cell. When not residing within the host, viruses exist as *virions*. Virions have a simple structure that consists of genetic material, a protein coat (capsid), and, in some cases, a lipid envelope.

Prions

- Prions are even simpler than viruses and thus much smaller. These organisms are obligate parasites that have been found to survive for up to 2 years in the environment.
- Prions possess no genetic material and are instead self-perpetuating proteins. These organisms have been implicated as the cause of various diseases such as bovine spongiform encephalopathy (BSE) and Creutzfeldt-Jakob Disease (CJD).


THANK
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