

## COURSE SYNOPSIS

MCB 112: INTRODUCTORY MICROBIOLOGY (2 UNITS)

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### 1. Prokaryotic and Eukaryotic Cells

#### ❖ Cell structure of prokaryotes and microbial eukaryotes

Prokaryotes are primitive cells whose nuclear membranes are not bounded by a nuclear membrane (nucleoid). Bacteria are typical examples of prokaryotic cells. Eukaryotes are “true” cells which have a true nucleus with nuclear membrane bounding the cells and their organelles. Examples include microscopic algae, fungi, protozoa, and macroscopic plants and animals.

Prokaryotes and Eukaryotes have some distinguishing features including: size of the organisms, location of genetic material in the cell, structure of the nucleus, nature of the cytoplasm and cytoplasmic structures, outer cell structures, metabolic mechanisms and DNA base (G+C %) ratio.

#### ❖ Survey of major groups of eukaryotic and prokaryotic protists

Whittaker (1969) proposed a five-kingdom classification system for protists. This is widely accepted because of the evolutionary relationships it puts into consideration and its compatibility with recent biochemical, genetic, and ultra-structural studies. This relationship is termed **Endosymbiotic Theory** which explains that eukaryotic cells developed from a variety of prokaryotes which have a common ancestry.

The five-kingdom classification system are given based on the three levels of cellular organization and principal modes of nutrition (photosynthesis, absorption, and ingestion). They include:

- Monera: Prokaryotes characterised by lack of ingestive mode of nutrition
- Protista: Unicellular eukaryotes which could ingest or be photosynthetic.
- Fungi: They are multinucleate higher fungi characterised by absorption of nutrients.
- Plantae: They include higher algae and multicellular green plants which could photosynthesize.
- Animalia: They are multicellular animals which feed by ingestion.

Microorganisms are found in three kingdoms: Monera (bacteria and blue-green algae), Protista (microalgae and protozoa) and fungi (yeasts and moulds).

### 2. History and Development of Microbiology

Contributions by the following scientists to the development of microbiology:

- a. Antoonie van Leeuwenhoek: designed the simple (one lens) microscope
- b. Robert Koch: isolated the organism causing anthrax and tuberculosis, developed the “germ theory of disease” known as Koch’s Postulates.
- c. Louis Pasteur: Discovered fermentation by yeasts (alcoholic) and lactobacilli (lactic), developed the process of fermentation; and a sterilization method called Pasteurisation, which has high application food and drinks industry.
- d. Alexander Fleming: Discovered penicillin produced by *Penicillium notatum*
- e. John Tyndall: Developed a method of sterilisation called Tyndallisation.
- f. Edward Jenner: Vaccination with substances from cowpox to immunise against smallpox
- g. Joseph Lister: Discovered and demonstrated antiseptics and disinfectants.

### **3. Scope of Microbiology**

Microbiology is concerned with the study of microorganisms and their activities including structure, reproduction, physiology and metabolism, and identification.

Microorganisms are ubiquitous in the environment ranging from mud, soil, water, air, in animals, plants, food products and even space.

Microorganisms are studied in the different aspects they affect human, plants and animals:

- a. Food Microbiology
- b. Medical Microbiology
- c. Aquatic Microbiology
- d. Microbiology of Domestic Water and Sewage
- e. Aero-microbiology
- f. Soil Microbiology
- g. Industrial Microbiology
- h. Agricultural Microbiology
- i. Environmental Microbiology and Biogeochemical transformation

### **4. Introduction to microorganisms as biological entities**

Microorganisms have many characteristics which make them ideal subjects for the study as biological entities. Microorganisms provide specific, systems for the investigation of the physiologic, genetic, and biochemical reactions that are the basis of life. The convenience of being grown in laboratory culture and high rate of reproduction. Basic life processes (metabolism, growth, reproduction, aging and death) found in microorganisms are similar to those found in higher plants and animals.

### **5. Distribution of Microorganisms in Nature**

Microorganisms are widely distributed in the different habitats available in nature. They are carried by air currents from the earth's surface to the atmosphere. They are found in seas and oceans and they can be transported to high altitudes. They are carried by streams and rivers and found at ocean depths and sea beds. Microorganisms are found abundantly in the soil too.

Microorganisms occur abundantly where they find nutrients, moisture and conditions conducive for their growth and reproduction. These conditions are prevalent everywhere around places humans inhabit and that's why microorganisms are found in the air we breathe, food we eat, on body surfaces, alimentary canal, mouth, nose etc.

Microorganisms can be found in very harsh environments where other life forms could not be found such as salt lakes which have high concentrations of salt and thermal vents which are characterised by exceptionally high temperature.

## **6. Brief survey of microbes as friends and foes**

Microorganisms play several roles they play in their relationship with plants, animals and man.

❖ Beneficial roles of microorganisms involve some of the following:

- a. In the production of antibiotics
- b. Production of fermented foods: improved flavours and texture in foods
- c. Bioleaching of metal from ores
- d. Production of alcoholic beverages
- e. Production of milk-based products
- f. Production of organic acids
- g. Production of amino acids and enzymes
- h. Remediation of oil spills
- i. Biodegradation of sewage
- j. Biogas production
- k. Production of biofertiliser
- l. Production of microbial pesticides
- m. Production of vaccines

❖ Detrimental roles of microorganisms

- a. Deterioration of food/Food spoilage
- b. Food borne diseases
- c. Degradation of food materials
- d. Cause animal diseases
- e. Cause plant diseases
- f. Degradation of industrial materials