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Subject: - Advanced laboratory techniques..
Lecture-No. 1.
Microbiology.

Introduction

❖ **Medical microbiology**: - is the study of microbes that infect human, the diseases they cause, and their diagnosis, prevention and treatment.

The agents of human infectious diseases belong to **five** major groups of organisms: **bacteria**, **fungi**, **protozoa**, **helminthes**, and **viruses**.

The bacteria belong to the **prokaryote** kingdom, the fungi (yeasts and molds) and protozoa are members of the kingdom of protists, and the helminthes(worms) are classified in the **animal** kingdom (Table 1–1).

The protists are distinguished from animals and plants by being either unicellular or relatively simple multicellular organisms. In contrast, **helminthes** are complex multicellular organisms. Taken together, the helminthes and the protozoa are commonly called parasites. Viruses are quite distinct from other organisms, they are not cells but can replicate only within cells.

❖ **IMPORTANT FEATURES OF MICROBES: -**

Many of the essential characteristics of these organisms are described in Table 1–2.

One salient feature is that bacteria, fungi, protozoa, and helminthes are cellular whereas viruses are not. This distinction is based primarily on three criteria:

(1) **Structure.** Cells have a nucleus or nucleoid (see below), which contains DNA; this is surrounded by cytoplasm, within which proteins are synthesized and energy is generated. Viruses have an inner core of genetic material

(either DNA or RNA) but no cytoplasm, and so they depend on host cells to provide the machinery for protein synthesis and energy generation.

TABLE 1–1 Biologic Relationships of Pathogenic Microorganisms

Kingdom	Pathogenic Microorganisms	Type of Cells
Animal	Helminths	Eukaryotic
Plant	None	Eukaryotic
Protist	Protozoa	Eukaryotic
	Fungi	Eukaryotic
Prokaryote	Bacteria	Prokaryotic
	Viruses	Noncellular

TABLE 1–2 Comparison of Medically Important Organisms

Characteristic	Viruses	Bacteria	Fungi	Protozoa and Helminths
Cells	No	Yes	Yes	Yes
Approximate diameter (μm)[1]	0.02–0.2	1–5	3–10 (yeasts)	15–25 (trophozoites)
Nucleic acid	Either DNA or RNA	Both DNA and RNA	Both DNA and RNA	Both DNA and RNA
Type of nucleus	None	Prokaryotic	Eukaryotic	Eukaryotic
Ribosomes	Absent	70S	80S	80S
Mitochondria	Absent	Absent	Present	Present
Nature of outer surface	Protein capsid and lipoprotein envelope	Rigid wall containing peptidoglycan	Rigid wall containing chitin	Flexible membrane
Motility	None	Some	None	Most
Method of replication	Not binary fission	Binary fission	Budding or mitosis[2]	Mitosis[3]

1-For comparison, a human red blood cell has a diameter of 7 μm.

2-Yeasts divide by budding, whereas molds divide by mitosis.

3-Helminthes cells divide by mitosis, but the organism reproduces itself by complex, sexual life cycles.

(2) **Method of replication.** Cells replicate either by binary fission or by mitosis, during which one parent cell divides to make two progeny cells while retaining its cellular structure. Prokaryotic cells (e.g., bacteria) replicate by binary fission, whereas eukaryotic cells replicate by mitosis.

In contrast, viruses disassemble, produce many copies of their nucleic acid and protein, and then reassemble into multiple progeny viruses. Furthermore, viruses must replicate within host cells because, as mentioned previously, they lack protein-synthesizing and energy-generating systems.

With the exception of rickettsiae and chlamydiae, which also require living host cells for growth, bacteria can replicate extracellular.

(3) **Nature of the nucleic acid.** Cells contain both DNA and RNA, whereas viruses contain either DNA or RNA but not both.

EUKARYOTES & PROKARYOTES

Cells have evolved into two fundamentally different types, **eukaryotic** and **prokaryotic,** which can be distinguished on the basis of their structure and the complexity of their organization. Fungi and protozoa are eukaryotic, whereas bacteria are prokaryotic.

(1) The eukaryotic cell has a true **nucleus** with multiple chromosomes surrounded by a nuclear membrane and uses a mitotic apparatus to ensure equal allocation of the chromosomes to progeny cells.

(2) The **nucleoid** of a prokaryotic cell consists of a single circular molecule of loosely organized DNA, lacking a nuclear membrane and mitotic apparatus.

(Table 1–3).

In addition to the different types of nuclei, the two classes of cells are distinguished by several other characteristics:

(1) Eukaryotic cells contain organelles**,** such as mitochondria and lysosomes, and larger (80S) ribosomes, whereas prokaryotes contain no organelles and smaller (70S) ribosomes.

(2) Most prokaryotes have a rigid external cell wall that contains peptidoglycan**,** a polymer of amino acids and sugars, as its unique structural component. Eukaryotes, on the other hand, do not contain peptidoglycan.

TABLE 1-3 Characteristics of Prokaryotic and Eukaryotic Cells

Characteristic	Prokaryotic Bacterial Cells	Eukaryotic Human Cells
DNA within a nuclear membrane	No	Yes
Mitotic division	No	Yes
DNA associated with histones	No	Yes
Chromosome number	One	More than one
Membrane-bound organelles, such as mitochondria and lysosomes	No	Yes
Size of ribosome	70S	80S
Cell wall containing peptidoglycan	Yes	No