

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



Introduction

to Pathology

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MBBS, MPhil, PhD, CHPE



Recommended Books for reading

- **Review of Medical Microbiology & Immunology**, Examination & Board Review. Warren E. Levinson, Ernest Jawetz. Prentice-Hall International Inc.
- **District Laboratory Practice in Tropical Countries**. Vol I & II. Monica Cheesbrough. ELBS.
- **Clinical Bacteriology, Mycology and Parasitology**. Illustrated Colored Text. W John Spicer, Churchill Livingstone.
- Bailey's & Scott's **Diagnostic Microbiology**. Betty A. Forbes, Daniel F Sahn, Alice S Weissfeld. Mosby.
- **Lippincott's Illustrated Review: Microbiology**. Richard A Harvey, Pamela CC, Bruce DF.
- Jawetz, Melnick, & Adelberg,s **MEDICAL MICROBIOLOGY**. Geo F Brooks, Jannet S Butel, Stephen A Morse. Appleton & Lange.

Lecture Objectives

At the end of lecture, students of 3rd year MBBS should be able to

- Define Pathology, microbiology and its major branches.
- Describe essential characteristics of 5 major groups of microorganisms.
- Differences between prokaryotic and eukaryotic cells based on their structure and complexity of their organization.

Pathology

- **Pathology** is the medical discipline that deals with process of diseases (their causes, pathogenesis, diagnosis and patient care).
- Pathologists are experts in illness and disease.
- Pathologists play a critical role in research, advancing medicine and developing new treatments to fight viruses, and resistant infections.

- **Clinical pathology or Laboratory medicine**, is a medical specialty that is concerned with the diagnosis of disease based on the laboratory analysis of bodily fluids such as blood and urine, and tissues using the tools of chemistry, microbiology, hematology and molecular pathology.

PATHOLOGY

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graph TD; Pathology[PATHOLOGY] --- ClinicalPathology[Clinical Pathology]; Pathology --- Heamatology[Heamatology]; Pathology --- Microbiology[Microbiology]; Pathology --- ChemicalPathology[Chemical Pathology]; Pathology --- AnatomicPathology[Anatomic Pathology]; Microbiology --- Immunology[Immunology]; Microbiology --- Virology[Virology]; Microbiology --- Mycology[Mycology]; Microbiology --- Parasitology[Parasitology];
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Clinical Pathology

Heamatology

Microbiology

Chemical Pathology

Anatomic Pathology

Immunology
Virology
Mycology
Parasitology

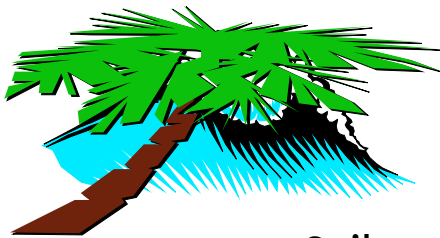
Medical microbiology



- Medical microbiology is the branch of medicine which deals with the role of microbial pathogens (bacteria, viruses, parasites, fungi) in human diseases.
- It studies microbial characteristics, taxonomy, pathogenesis and epidemiology and its related pathology and immunology.

MICROORGANISMES IN THE ENVIRONMENT

- Microorganisms have coated the biosphere.
- It is estimated that there are more than 10,000 microorganisms/gram of soil on the surface of the earth, including the Sahara desert.



Soil

Air

Water

Food



Normal Flora
= Commensal flora

Total cells of human body= 10^{14}

- 90% are of human origin.
- 10% belongs to **commensal flora**

- **Microbes are present everywhere**
- **Many beneficial aspects of this study.**
- **Prevent diseases and their spread,**
- **apply aseptic precautions**
- **Allows humans to prevent food spoilage,**



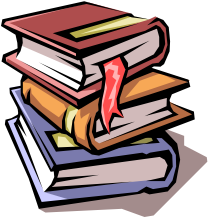
Emerging infectious diseases (EID's)

- Weapons of mass destruction,
- New evolutionary features in microbes
 - (MERS-CoV, Avian Influenza V, SARS, MRSA, Covid-19)



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Living Organisms



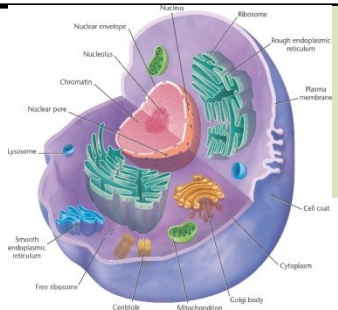
Kingdoms

- Prokaryote
- Protists
- Animal
- Plants

Five Major Groups of Microbes

- Microbial diversity is surprising,
- microbes can be grouped into five major types:
 1. Bacteria,
 2. Archaea,
 3. Fungi,
 4. Protists and
 5. Viruses,

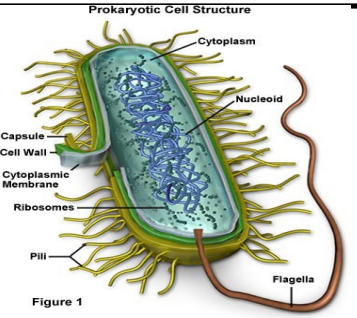
2. Eukaryotes



Protists
 Protozoa ← Fungi

~~**Multitzoa**~~
 Helminths

1. Prokaryotes



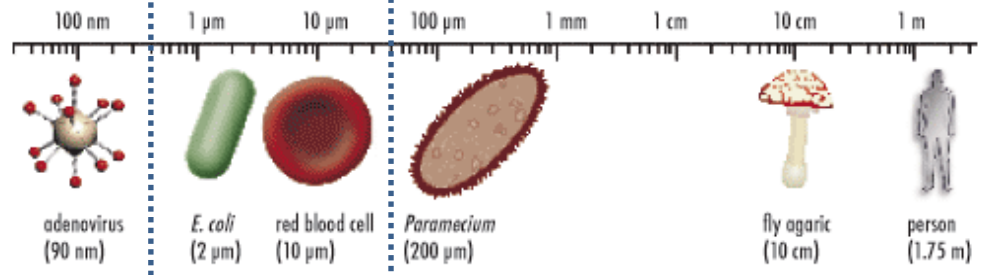
Bacteria

archaebacteria

Eubacteria

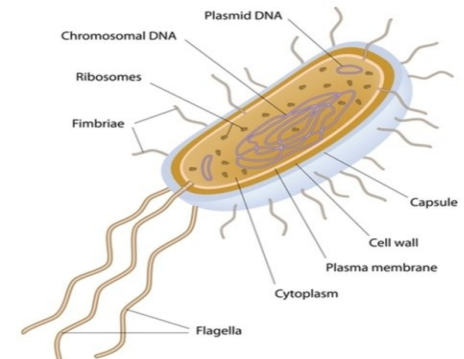
- Bacteria
- Chlamydia
- Rickettsiae
- Spirochetes
- Mycoplasma

3. Viruses



Prokaryotes

- Prokaryotes are **unicellular** with a circular DNA genome in the cytoplasm.
- Bacteria and archaea have a very similar cell structure
- They do not have a nucleus or membrane-bound organelles.
- Some have **flagella** for movement, or **fimbriae** for attachment to surfaces.



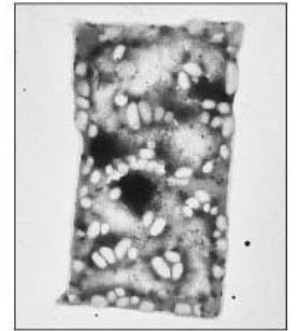
Prokaryotes

major groups:

1. **Eubacteria**: all bacteria of medical importance,
2. **Archaeobacteria**: unicellular microorganisms, which are

- genetically distinct from bacteria and eukaryotes,
- lack peptidoglycan
- often inhabit extreme environmental conditions.

(i.e. halophiles are present in extremely salty environments, methanogens produce methane, and thermophiles can grow in extremely hot environments.)



- Cells of prokaryotic & eukaryotic organisms differ in several significant structural features

Bacteria

- Prokaryotes & Lack nucleus,
- Rigid cell wall (Peptidoglycan),
- Metabolically active, Synthesize protein
- use organic & inorganic chemicals or photosynthesis for energy
- Can live independently,
- Reproduce or multiply by binary fission,

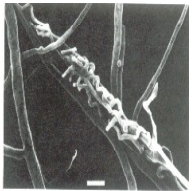
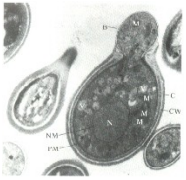
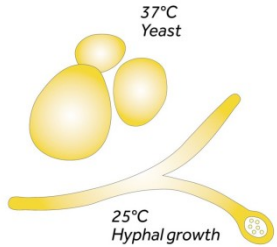
Atypical bacteria

(Mycoplasma, Chlamydia, and Rickettsia)

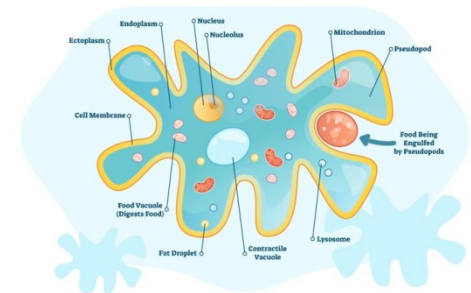
- Prokaryotic
- Lack significant characteristic structural components or metabolic capabilities, which separates them from the larger group of typical bacteria.

Fungi

- eukaryotic, & non-photosynthetic, (saprophyte or parasites),
- cell wall consists of chitin or cellulose □ resistant to antibiotics.
- sporing
- Heterotrophs (use only organic chemicals for energy)
 - Yeasts: unicellular & budding i.e. *Candida albicans* (vaginal yeast infections)
 - Molds (filamentous) mushrooms: simple \ multicellular, consist of masses of mycelia which are composed of filaments called hyphae.
- reproduce either sexually, asexually or both,
- Diseases vary from superficial skin infections to serious systemic infections

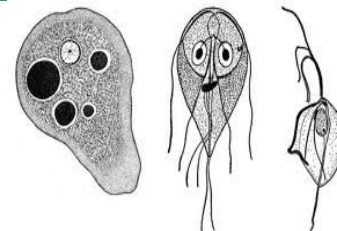


Protozoa



- Unicellular, eukaryotes, microscopic pathogens,
- Free living & independent for their nutrition, (trophozoites & cyst forms);
- Composed of clinically important parasites of humans that infect all major tissues and organs
 - Intracellular
 - Extracellular
- Transmission by Ingestion / insect bite
- reproduce mainly by mitosis (asexually) while many have a sexual stage.

1. Sarcodina (ameboid protozoa): *Acanthamoeba*
2. Mastigophora (flagellate): *Giardia lamblia*; *Trichomonas*; *Trypanosoma*; *Leishmania*
3. Ciliophora (covered by hairlike cilia): *Balantidium coli*
4. Sporozoa: *Plasmodium*; *Toxoplasma*; *Isospora belli*; *Sarcocystis*

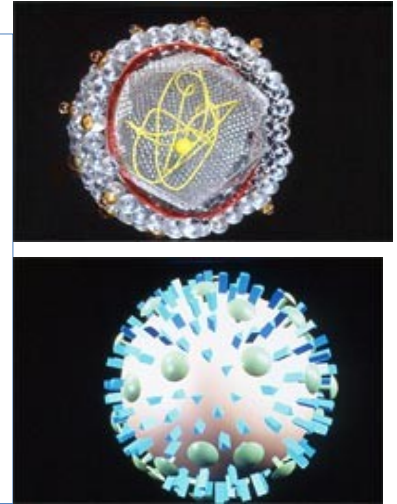


Viruses:

are the smallest known infective creature of the universe, obligate intracellular organisms

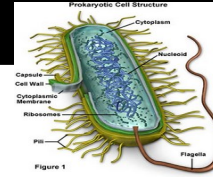
Main properties

- Small size (10-300 nm).
- Genome. DNA or RNA core packed inside protein coat (capsid).
- Metabolically inert
- May have an envelop

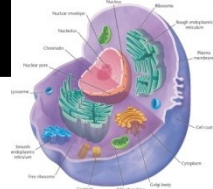


- infect a host cell and hijack its machinery to assemble new viruses.
- Visualized only by electron microscope
- Can cause disease in every living being including bacteria.
- Antibiotics do not work; / antiviral works.

Prokaryotes



Eukaryotes



DNA in nuclear membrane
(Nucleus)

No

Yes

DNA associated with histones

Protein spools

Naked closed loop, single stranded DNA with no protein

Multiple chromosomes. Protein are associated with DNA.

Chromosomal #

1

More than 1

Mitotic division

Absent

Present

Membrane bound organelles

(Mitochondria, endoplasmic reticulum)

Absent

Present

Ribosomal size

70 s (Svedberg unit), free & bound to mesosomes on cell membrane

80 s, bound to membrane

Cell wall containing peptidoglycans

Present

Not present (only in plant cells)

Reproduction

by binary fission

by mitosis

Example

Bacteria, rickettsia, Chlamydia

Fungus, protozoa, plants



Thank you