Microbiology 1

2025-2024

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Scope and history of microbiology

- **Microbiology:**
  - Micro small /bio Life/ logy Science
  - The science study of *Microorganisms* which can be eukaryotic, prokaryotic or subcellular.
  - Microbiology has many areas of specialization including:
    - ✓ Bacteriology, Mycology (fungi), Virology, Medical microbiology, Immunology, Food microbiology, Biotechnology, Microbial genetics. Industry. Agriculture Veterinary.

- **Medical Microbiology:**
  - It is the science of studying micro-organisms that are associated with *human diseases*
  - Medical microbiology deals with pathogenic organism that is capable of causing disease in its host.

- Microbes and human:
  - ***Normal Body Flora****:*
    - ✓ Is the term used to describe the various bacteria & fungi that are *permanent residents* of certain body sites especially; the *skin*, colon, *oropharynx* and *vagina*.
    - ✓ Passing them around to others esp. immunocompromised people.
    - ✓ One wrong organism in the wrong place may kill.
    - ✓ Resident:
      - ❖ part of our 10^{14} e.g:
        *CoNS (Coagulase Negative staphylococci), Micrococci, diptheroid species
        *low pathogenic potential

- **Portals of entry for pathogens:**
  - *Respiratory:* Inhalation
  - *Alimentary (GIT):* Ingestion
  - *Genital Tract:* Sexual contact
  - *Skin:* abrasions or bites
  - *Others:*
    - ✓ Conjunctiva, blood transfusion, injections, organ transplants
    - ✓ *Congenital Infections:* vertical transmission from mother ***to*** fetus

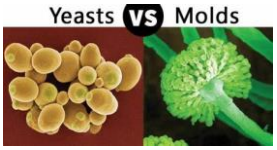
- Classification of Microorganisms

  - ***Prokaryotes****:*
    - ✓ (Pro: Primitive karyotic: Nucleus) / Uni.
    - ✓ Not true nucleus
    - ✓ **Single** chromosome suspended **(Nucleoid)**
  - ***Eukaryotes****:*
    - ✓ (Eu: True karyotic: Nucleus) / Uni. Or multi.
    - ✓ True nucleus
    - ✓ DNA in the form of several chromosomes.

Characteristic	Eukaryotic	Prokaryotic
Nucleus	Yes	No
Nuclear membrane	Yes (Nucleus)	No (Nucleoid)
Membrane-bound organelles Mitochondria Golgi apparatus Endoplasmic reticulum	Present	Absent No membrane bound organelles.
Chromosome Number	Multiple (linear)	One (circular)
Ribosome	**80S** (40S and 60S)	**70S** (30S and 50S)
Cell wall	Absent Has no peptidoglycan	Present Has peptidoglycan.
Cell membrane	Has sterols	No sterols
Division	Mitosis	Binary fission
Include	Fungi Protozoa Algae	Bacteria

- **Viruses***:* not classified as prokaryotes or eukaryotes
  - ✓ *Acellular* : A virus is not a cell
  - ✓ One of the *smallest* infectious agent
  - ✓ They replicate *only* in living cells [Cell dependent]
  - ✓ only seen by electron microscope
- **Viroid's**
  - ✓ ssRNA, circular *Without* protein coat
  - ✓ *Smaller* than virus
  - ✓ Infect Plants
- **Prion**
  - ✓ Protein *without* nucleic acid (Infectious)
  - ✓ Proteinaceous infectious organism. (*Misfolded* protein)
  - ✓ It causes 'transmissible spongiform encephalopathies' is a brain disease (dementia, sensory, motor, psychic signs and symptoms).
  - ✓ Mechanism: Aggregation of Prion in CNS Spongiform in the brain
  - ✓ infectious particle causing diseases like:
    - ❖ Creutzfeldt-Jakob disease (CJD) seen in humans
    - ❖ Mad cow disease Bovine spongiform encephalopathy (BSE or mad cow disease) seen in cattle
  - ✓ Can't be grown in culture.
  - ✓ Transmitted by:
    - ❖ Ingestion.
    - ❖ Sometimes iatrogenic route e.g blood transfusion, dura mater transplants and surgery (brain, tonsills, appendix and spleen).

- There are 4 classes of organism that can cause disease:
  - *Viruses*
  - *Bacteria*
  - *Fungi:*
    - ✓ Yeasts: unicellular (Uni: One / cellular: Cell)
    - ✓ Molds: *large*, multicellular organisms

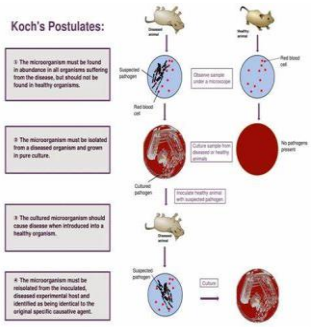


  - *Parasites: these can be of two classes:*
    - ✓ Protozoa: unicellular, varying in ***size:***
      - *small* causing *intracellular* infections
      - *large* causing *extracellular* infections
    - ✓ Helminths(worms): multicellular, can grow up to *several meters* in length

- **Common epidemiological terms:**
  - ***Incubation Period:*** the *time* between acquisition of the organism ***and*** the beginning of symptoms, it varies from hours to days to weeks.
  - ***Period of Communicability*** *(infectious period)**:*** the *time* during which an ***infectious agent*** may be transmitted
    - ✓ Important for infection control.
  - ***Incidence Rate:*** refers to the number of *new cases* that develop in a given period of time.
  - ***Prevalence:*** a statistical concept referring to the number of *cases of a disease* that are present in a *particular population at a given time*.
  - ***Mortality Rate:*** *ratio of number of deaths* from a disease in given year to the total population at mid-year..
  - ***Case Fatality Rate:*** the *proportion* of the patients with the disease who die from *it*.
  - ***Endemic:*** a disease that exists *permanently* in a particular region or population.
    - ✓ Malaria is a constant worry in parts of Africa.
  - ***Epidemic:*** An *outbreak* of disease that attacks many peoples at about the same time & may *spread* through one or several communities.
  - ***Pandemic:*** when an *epidemic* spreads throughout the *world*.

- Contribution of the scientist in the field of Microbiology
  - Antonie van Leeuwenhoek (17^{th} c):
    - ✓ Observed live *microorganisms* (animalcules) in water mud and saliva.
  - John Hunter (18^{th} c):
    - ✓ Syphilis and Gonorrhea can be *transmitted*.
  - Edward Jenner (18^{th}-19^{th} c):
    - ✓ Established *vaccination* concept, Cow pox and Small pox.
  - John Snow (19^{th} c):
    - ✓ Physical measures to *limit* and *inhibit transmission* of Cholera in London epidemic (sewage leaking into drinking water).

- Ignas Semelweis (19th c):
  - Puerperal sepsis can be *prevented* if the attending nurses apply hygienic measures.
- Louis Pasteur (19th c):
  - *Fermentation* of alcohol by microorganisms.
  - *Pasteurization*: heat liquid is enough to kill bacteria.
  - *Vaccine development* – rabies, Bacillus anthrax.
- Robert Koch
  - Developed *microbiological media* & streak plates for pure culture.
  - Germ theory (Koch's postulates):
    - Microorganism must be present in every case of the disease.
    - Organism must be grown in pure culture from the diseased host.
    - Inoculation of above into host must give same disease.
    - Organism must be recovered from experimentally infected host.



- Alexander Fleming – 1945 :
  - *Penicillin*, Penicillium notatum (beta lactam ring in outer layer of a bacteria is inhibited, making cell wall synthesis impossible.
- Kary Mullis 1986:
  - Polymerase Chin Reaction (*PCR*).
- Zur Hausen 1970s-2008:
  - HPV = *cervical cancer* -> <u>vaccine</u>.

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