Introduction to Microbiology

CLS 212: Medical Microbiology

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Microbiology

Micro- means very small (that needs a microscope to see).

Microbiology is the study of very small living organisms.

Microorganism

A microorganism is a very small living organism found in every ecosystem (ubiquitous) and in close association with every type of multi-cellular organism.

- It can live within human and participate in body functions e.g. bacteria in the intestine (Normal flora).
- **Microorganisms are EITHER**

  Pathogens: microorganisms that cause disease (3% of all).

  OR

  Non-pathogens: microorganisms that do not cause disease.

Why Should We Study Microbiology?

1. Microorganisms living on and inside us are 10 times more than the no. of our cells. These microorganisms are called Normal Flora.
2. Microorganisms are essential for life on this planet as some produce oxygen **e.g.** algae and cyanobacteria. Others are involved in elemental cycles like carbon, nitrogen, sulfur…
3. Many microorganisms are involved in the decomposition of dead organisms and the waste product of living organisms. These are called **Saprophytes**.
4. Some microorganisms can decompose industrial waste like oil spills.
5. Microorganisms are part of the food chain as tiny animals feed on them.

Why Should We Study Microbiology?

6. Many microorganisms are essential in various food and beverage industries e.g. production of cheese.
7. Some microorganisms are used to produce certain enzymes, chemicals, and antibiotics.
8. Microorganisms are essential in the field of genetic engineering.
9. For many years, microbes have been used as “cell models” to study the structure and function of cells in general.
10. To understand disease caused by these microorganisms and their toxins.

Pioneers in the Science of Microbiology

- The first microorganisms to be seen by humans are bacteria and protozoa.
- The most significant events in the early history of microbiology were the development of microscopes, bacterial staining procedures, culture techniques for microorganisms.

- **Three major scientists were known:**

1. Anton van Leeuwenhoek.
2. Louis Pasteur.
3. Robert Koch.

Anton van Leeuwenhoek
(Holland 1632-1723)

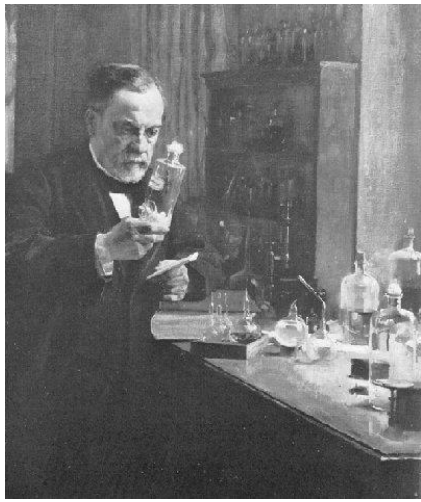
- He was the first to create what is known today as “single lens microscope” by grinding tiny glass lenses and putting them in metal frames.

- **The father of microbiology:** he is the first one to see live bacteria and protozoa.

- He used his microscope to examine almost anything around him then he called the small living organisms “animalcules”.

Louis Pasteur
(France 1822-1895)

1. He discovered the process of alcohol fermentation.
2. He discovered forms of life that can exist in the presence of oxygen called “aerobes” and ones that can exist in the absence of oxygen “anaerobes”.
3. Developed a process called **Pasteurization** ***i.e.*** heating liquids to kill pathogens.
4. He discovered the infectious agent that affect silk industry.
5. He made significant contribution to the germ theory of disease ***i.e.*** specific microorganism cause specific infectious disease.
6. He discovered a vaccine for chicken cholera.
7. He developed vaccine for dog and human rabies.

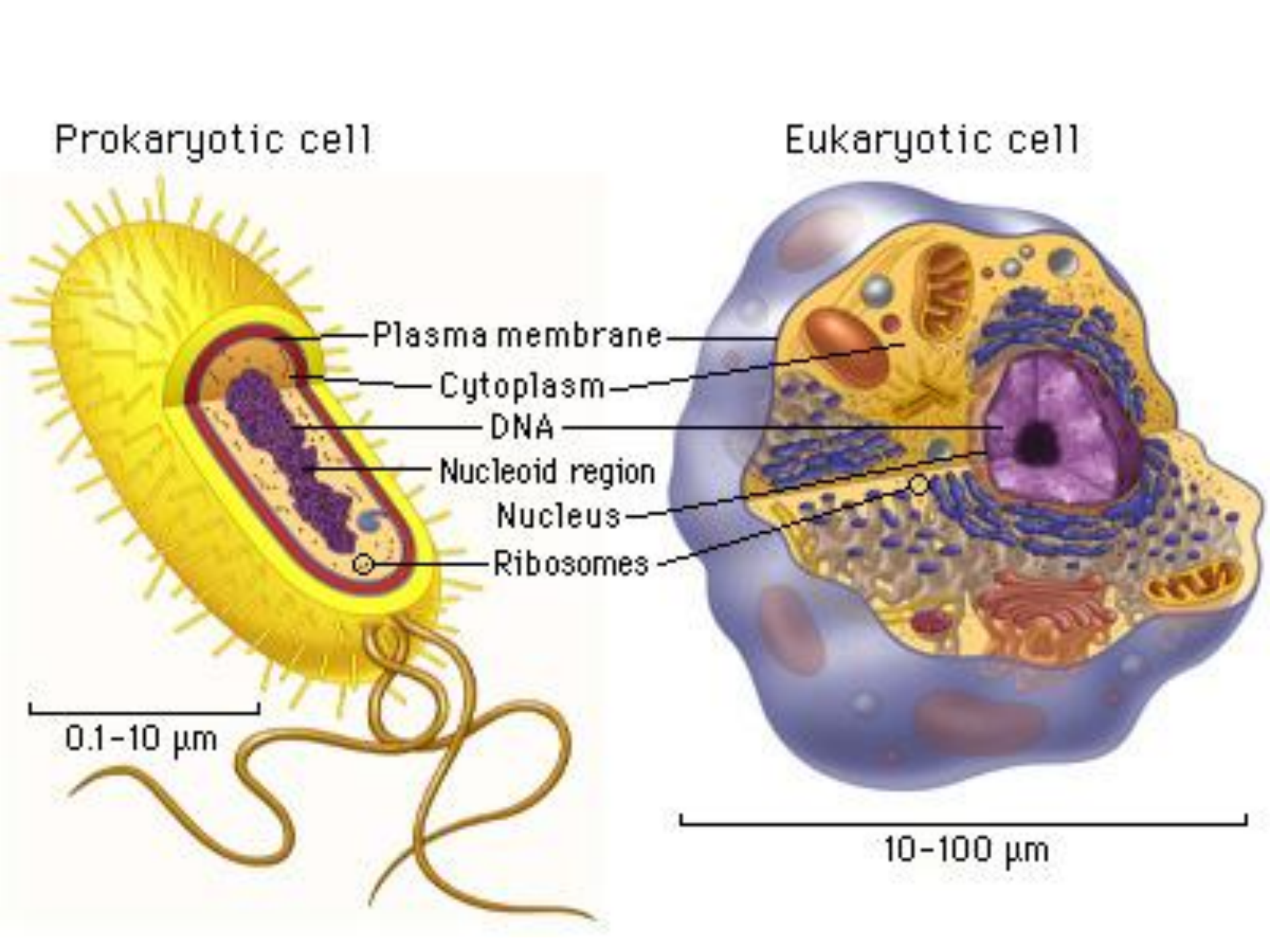


Robert Koch
(Germany 1843-1910)

1. He made significant contribution to the germ theory of disease.
2. He developed methods of fixing, staining, and photographing bacteria.
3. He developed methods for culturing bacteria on solid media.
4. He discovered the bacterium (*Mycobacterium tuberculosis*) that cause tuberculosis and Invented skin test to diagnose the Tb.
5. He discovered the bacterium (*Vibrio cholerae*) that causes cholera.

Cell Structure

- Cells in our world come in two basic types, **prokaryotic** and **eukaryotic.**
- "Pro" means "before" and "eu" means "true", or "good“. So "Prokaryotic" means "before a nucleus”, and "eukaryotic" means "possessing a true nucleus“.
- Prokaryotic cells have no nucleus and are less complex than eukaryotic cells. They include *Bacteria* and *Archaea*.
- Eukaryotic cells are more complex as they have true nucleus and many cell organelles. They include organisms like algae, protozoa, fungi, plants, animals, and humans.
- Viruses are not living microorganisms **(acellular)**.


Prokaryotic cell
Eukaryotic cell
Plasma membrane
Cytoplasm
DNA
Nucleoid region
Nucleus
Ribosomes
0.1–10 µm
10–100 µm

	Eukaryotic Cell	Prokaryotic Cell
Biological distribution	All animals and protozoa	All bacteria
Nuclear Membrane	Presents	Absent
Membranous structures other than cell membrane	Presents	Generally absents
Cytoplasmic ribosome's (density)	80s	70s
Cell wall	Absent	Present (complex chemical constitution)
Chromosomes	Composed of DNA and Proteins	Composed of DNA only

Taxonomy

- Taxonomy is the science of classification of living organisms.

- **According to *Bergey's Manual of Systemic Bacteriology* taxonomy consist of three areas:**

1. *Classification.*
2. *Nomenclature.*
3. *Identification.*

Classification

- The arrangement of organisms into taxonomic groups (*taxa*) on the basis of similarities or relationships.
- **The taxa include:**
    1. Kingdom or domain
    2. Divisions or phyla
    3. Classes
    4. Orders
    5. Families
    6. Genera
    7. Species

Nomenclature

- Nomenclature is naming the organisms according to the international rules.
- Each organism (species) is given two names: the first name is the genus and the second name is the specific epithet.
- To write the full name, capitalize the first name then underline or italicize the entire name **e.g.** *Escherichia coli* or Escherichia coli

Kingdom	**Bacteria**
Phylum	**Proteobacteria**
Class	**Gamma Proteobacteria**
Order	**Enterobacteriales**
Family	**Enterobacteriaceae**
Genus	**Escherichia**
Species	**Escherichia coli**

Identification

- Identification is the process of determining whether an organism belong to a known taxa or not.
- To identify an organism means to learn the organism's species name ***i.e.*** to speciate it and this is the job a microbiologist.

Relationships between Organisms

- **Symbiosis**

  Permanent association between two different organisms.

- **Neutralism**

  Two organisms living together, and neither is affected by that.

- **Commensalism:**

  Two organisms living together, one is benefited and the other is not been affected.

- **Mutualism**

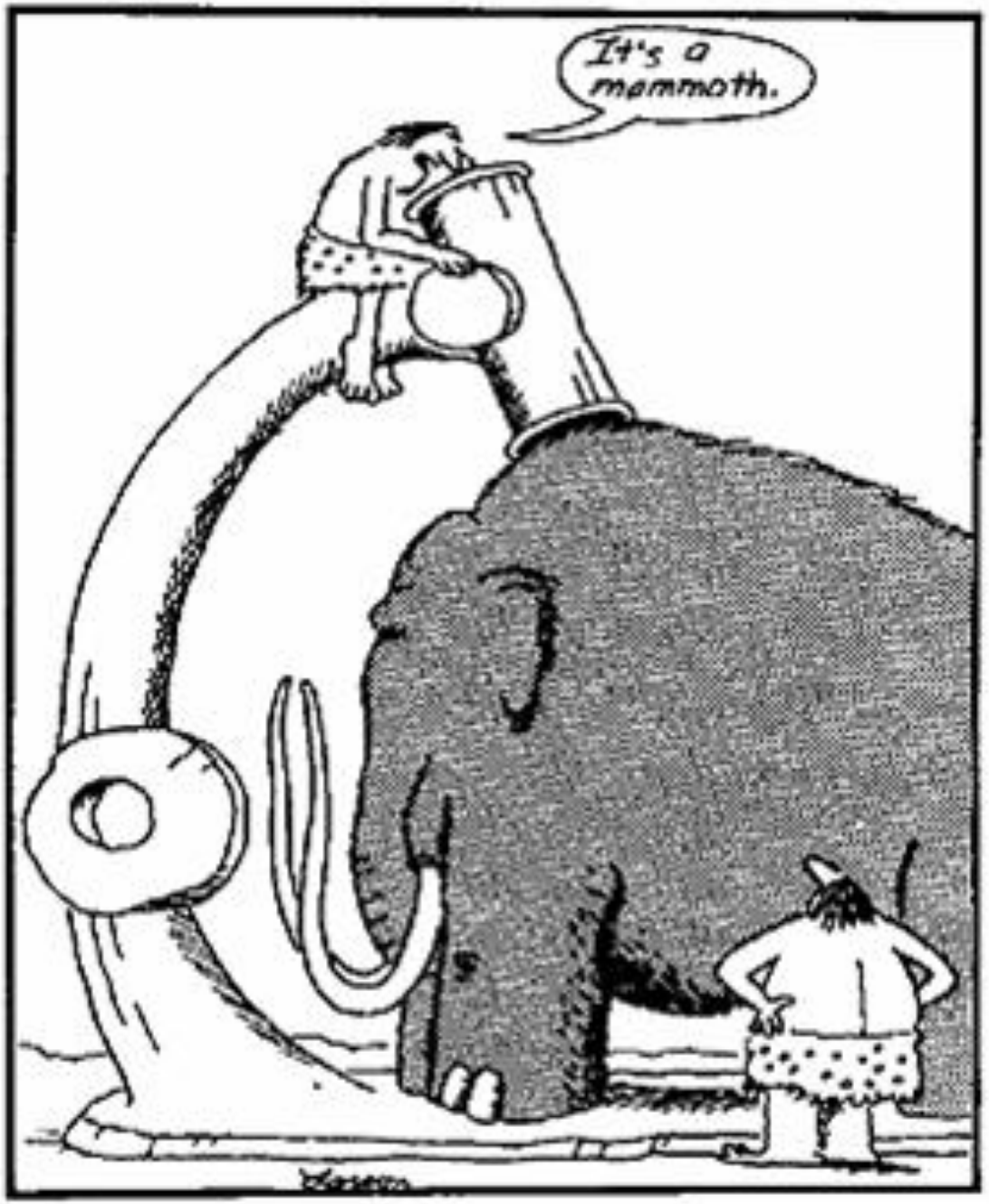
  Two organisms living together, and both benefit from that.

- **Parasitism:**

  Two organisms living together, one is benefited ‘’called parasite’’ and the other is harmed ‘’called host’’.

- **Synergism:**

  Sometimes, two (or more) microorganism may work together “team up” to produce a disease that neither could cause by itself.


It's a mammoth.