General Microbiology Course

Lecture 1

(Microbiology: Introduction & history)

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Objectives

What to know?

- Some history Highlights.
- What are microbes?
- The classification of microbes.
- The structure of microbes.
- The physiology of microbes.

Distribution of microorganisms

- Omnipresent: nearly everywhere in nature
  - Air
  - Soil
  - Oceans
  - Food we eat
  - Surfaces of our body and inside alimentary canal
- Grow where they get food moisture and temperature suitable for growth

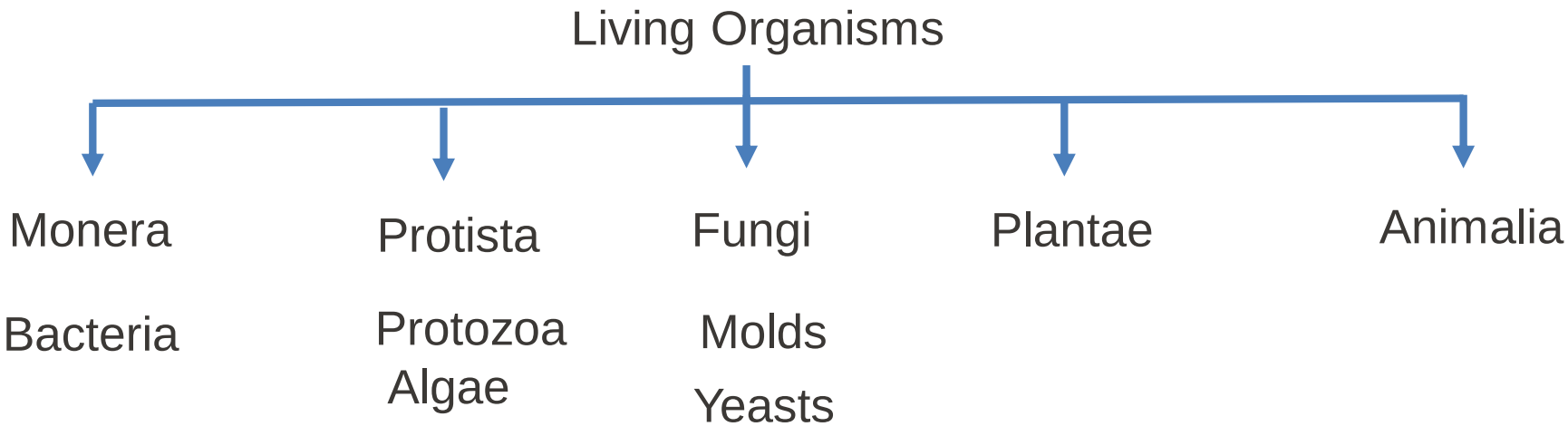
Why do we study Microbiology?

- Microbes are related to all life.
  - In all environments
  - Many beneficial aspects
  - Related to life processes (food chains, nutrient cycling)
  - Only a minority are pathogenic.
  - Most of our problems are caused by microbes

Branches of microbiology

Field	Some Applied Areas
Bacteriology	Study of bacteria
Mycology	Study of fungi
Protozoology	Study of protozoans
Virology	Study of viruses and viral diseases.
Algology or Phycology	Study of algae
Parasitology	Study of parasitism and parasites (include pathogenic protozoa, helminthes worms and certain insects)

Five Kingdom classification of Organisms



Effects on Human beings

Microorganisms

Beneficial

Agriculture

Recycling of elements, Nitrifying bacteria

Food

Bread, Cheese, Yoghurt, Vinegar

Industrial applications

Enzymes, Amino acids, Vitamins, Antibiotics, Vaccines, Pharmaceutical industries, Sewage treatment

Harmful

Food spoilage

Diseases

General Characteristics

Bacteria:

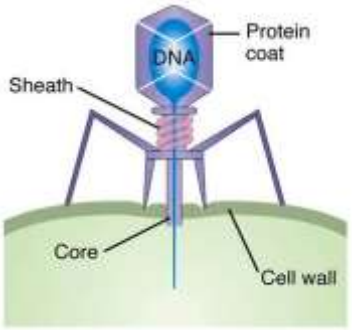
- Size: 0.2-1.5 by 3-5 µm
- Important Characteristics:
  - Prokaryotic
  - Unicellular
  - Simple Internal structure
  - Grow on artificial laboratory media
  - Reproduction asexual (mostly simple cell division)

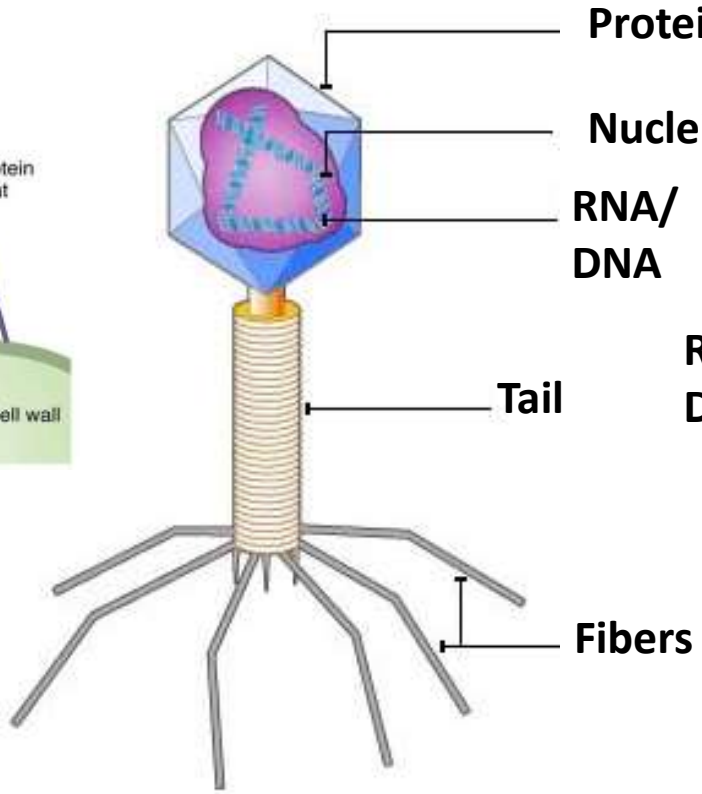
Viruses

- Size: 0.015-0.2 µm
- Important Characteristics:
  - Do not grow on artificial media require living cells within which they reproduce
  - Obligate parasites
  - Electron microscopy required to observe
  - Practical significance: Cause diseases in humans animals plants, also infect microorganisms

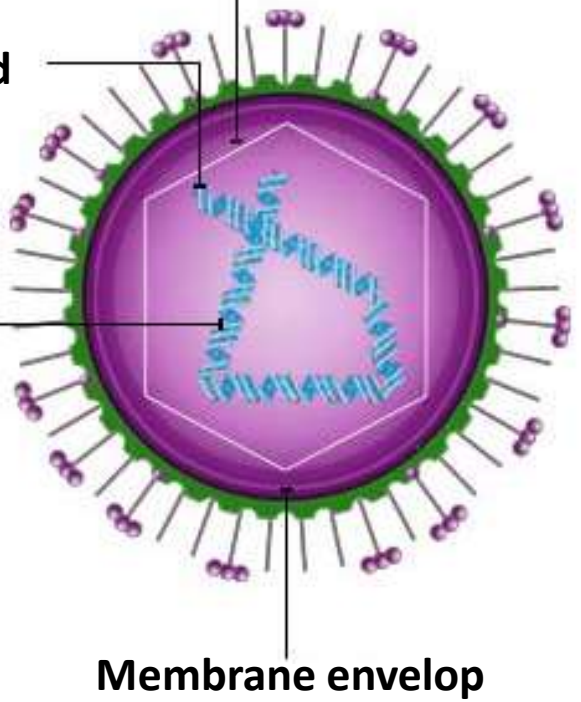
General Characteristics

Viruses





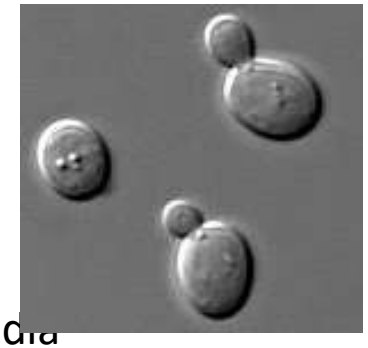
Viruses infects bacterial cells called Bacteriophage



Viruses infects human cells
Example: Influenza

General Characteristics

Fungi (Yeasts)



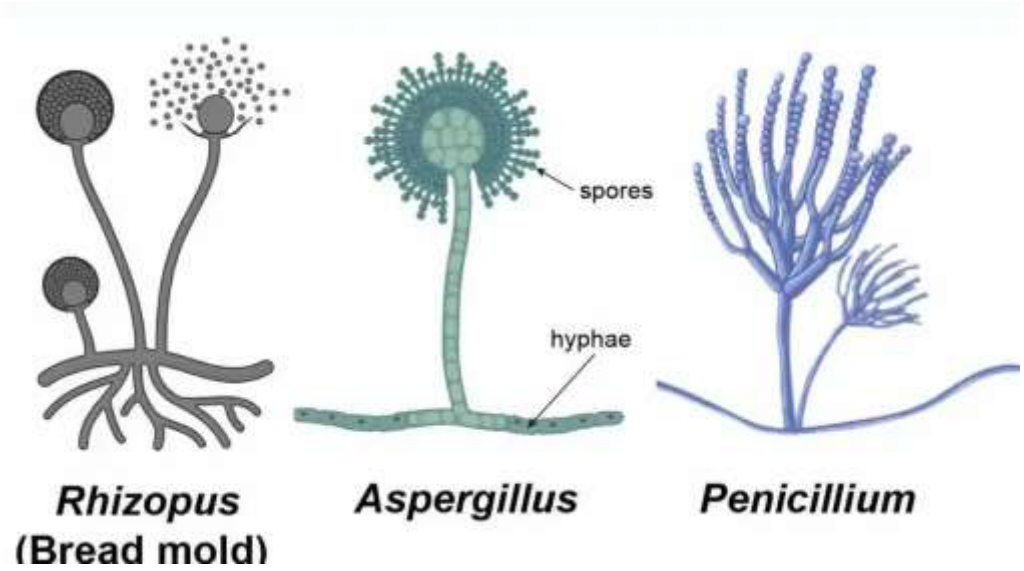
- Size: 5.0-10.0 µm
  - Eukaryotic
  - Unicellular
  - Grow on artificial laboratory media
  - Reproduction asexual (cell division/ budding) or sexual
  - Practical significance: Some cause diseases and some are used as food supplements , Manufacture of alcoholic beverages

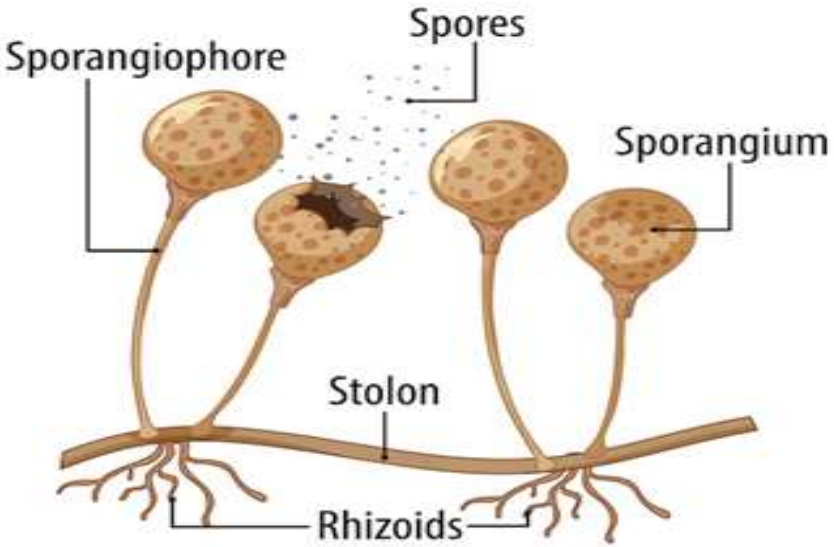
Fungi (Molds)

- Size: 2.0-10.0 µm by several mm
  - Eukaryotic
  - Multicellular
  - Many distinctive structural features
  - Cultivated on artificial laboratory media
  - Reproduction asexual or sexual
  - Practical significance: Decomposition of many materials, Industrial production of many chemicals like antibiotics.
  - Can cause diseases

General Characteristics

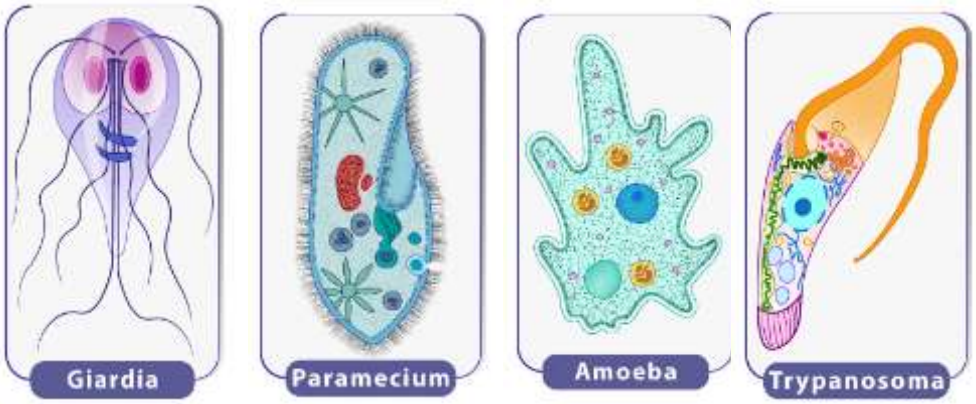
Fungi (Molds)





Structure and Physiology of Bread Mold

Protozoa



- Size: 2.0-200 µm
- Important Characteristics:
  - Eukaryotic
  - Unicellular
  - Some cultivated on laboratory media while some are intracellular parasites
  - Reproduction asexual or sexual
  - Practical significance: Some cause diseases, Food for aquatic animals.

Algae

- Size: 1.0 µm to several centimeters
- Important Characteristics:
  - Eukaryotic
  - Unicellular or Multicellular
  - Photosynthetic
  - Most occur in aquatic environments
  - Reproduction asexual or Sexual
  - Practical significance: Production of food in aquatic environments, Some produce toxic substances.

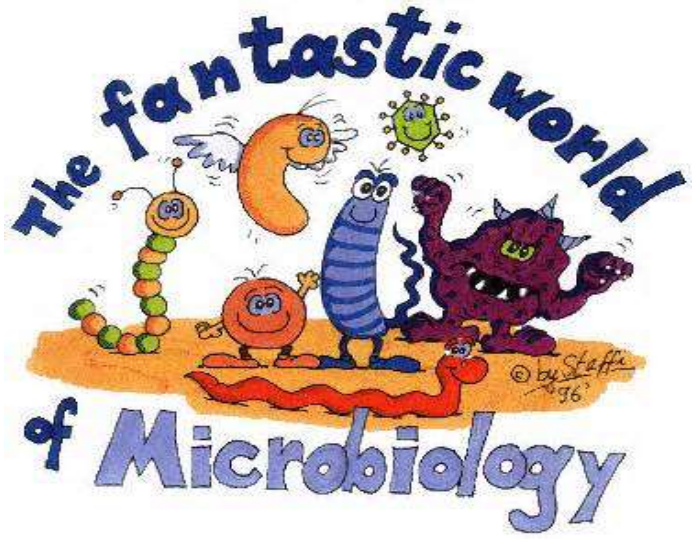
Definitions

- **Microbiology**

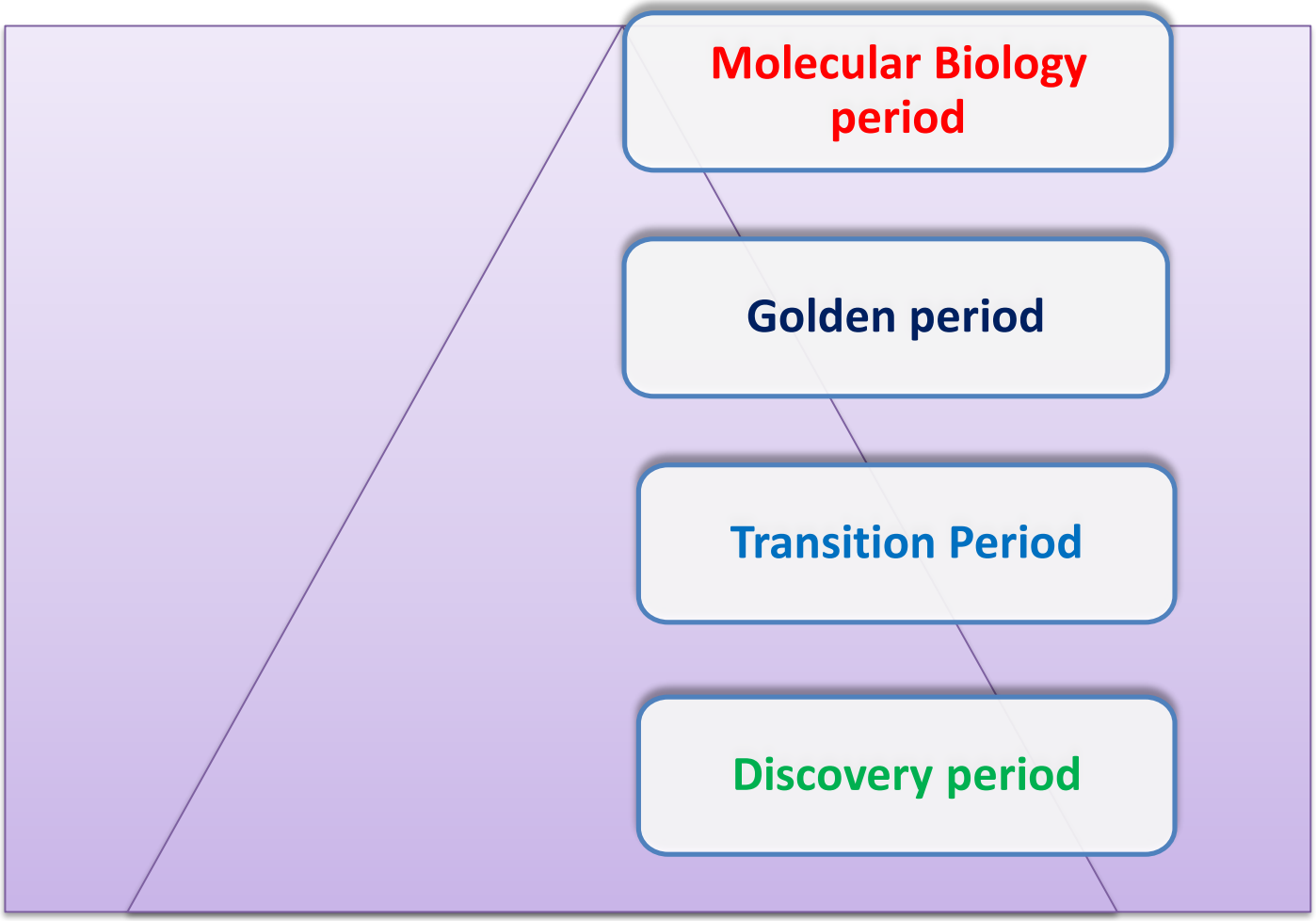
  Is the study of microorganisms which are of microscopic dimensions.

- **Microorganisms**

  Are living organisms that are usually too small to be seen clearly with the naked eye



The History of Microbiology

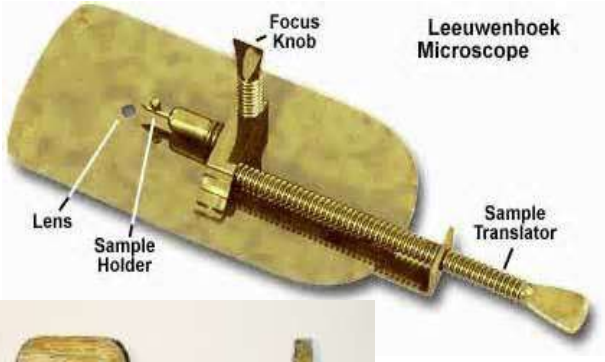


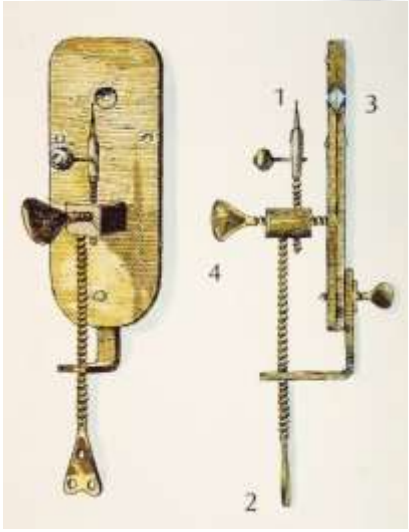
The History of Microbiology

Pioneers of Microbiology

Discovery period

- Dominated by **Antony Van Leeuwenhoek**
- As a tailor, used lenses to examine cloth.
  He assembled hundreds of microscopes, some of which magnified objects 50-300 times.
- As he looked at things with his microscopes, he discovered “micro” organisms
- He called these tiny living organisms “animalcules”.
- He first described bacteria and the protozoans.



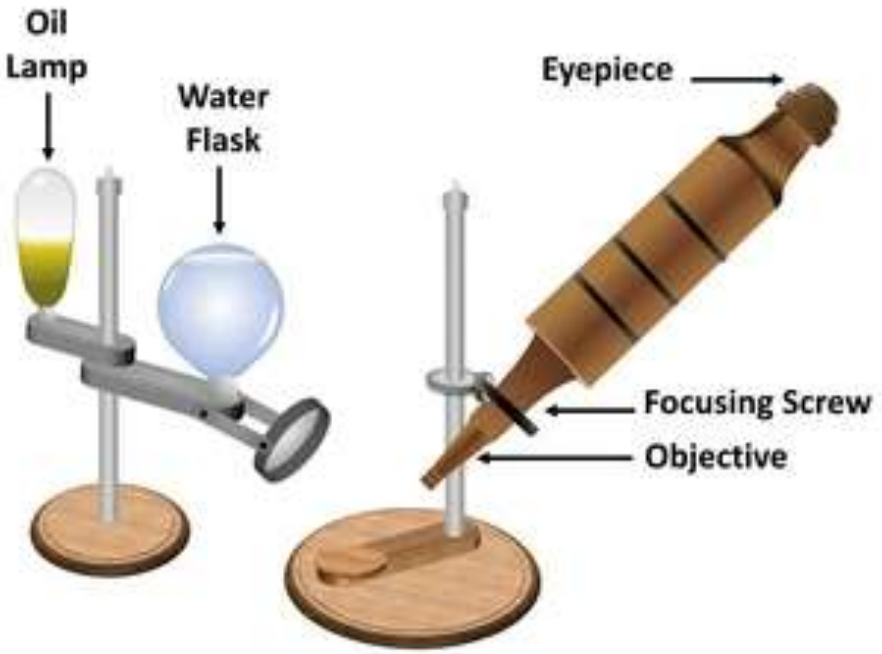


The History of Microbiology

Pioneers of Microbiology

Discovery period

- Robert Hooke [1678]:
  - Developed Compound microscope
  - 1st to use the term ‘Cell’
  - Proposed the Cell Theory
  - All living things are composed of cells



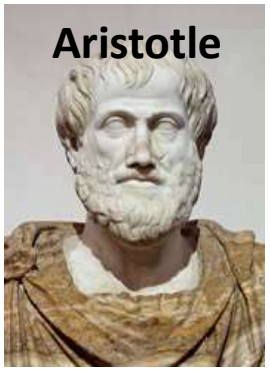
- **Ignaz Semmelweis [1846]:** Concluded that puerperial sepsis was transmitted by contaminated hands of obstetricians, nurses and medical students. This could be prevented by washing hands in antiseptic solutions.

The History of Microbiology

Transition Period

The scientists disapproved the theory of spontaneous generation

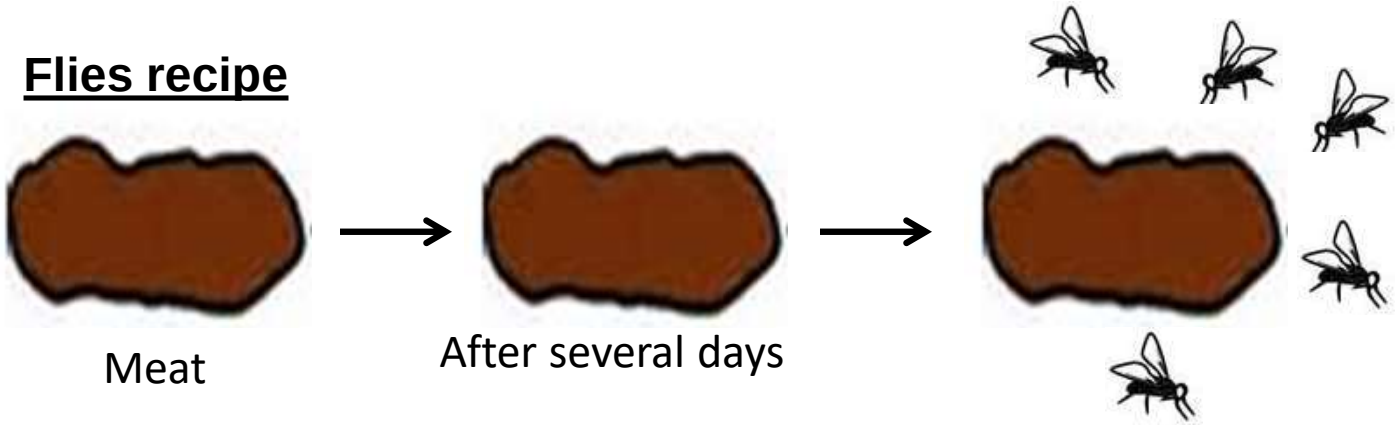
The History of Microbiology



spontaneous generation:

Is a body of thought on the ordinary formation of living organisms without descent from similar organisms

Flies recipe



The History of Microbiology

Transition Period

The scientists disapproved the theory of spontaneous generation (How)

- **Redi's Question:** Where do maggots come from?
- **Hypothesis:** Maggots come from flies.
- **Experiment:** Redi put meat into three separate jars.

Jar-1

- Left open
- Maggots developed
- Flies were observed laying eggs on the meat in the open jar

Jar-1

Jar-2

- Sealed
- No maggots developed

Jar-2

Jar-3

- Covered with netting
- Maggots appeared on the netting
- Flies were observed laying eggs on the netting

Jar-3

The History of Microbiology

Golden Period

Began with the work of Louis Pasteur and Robert Koch

The History of Microbiology

Golden Period

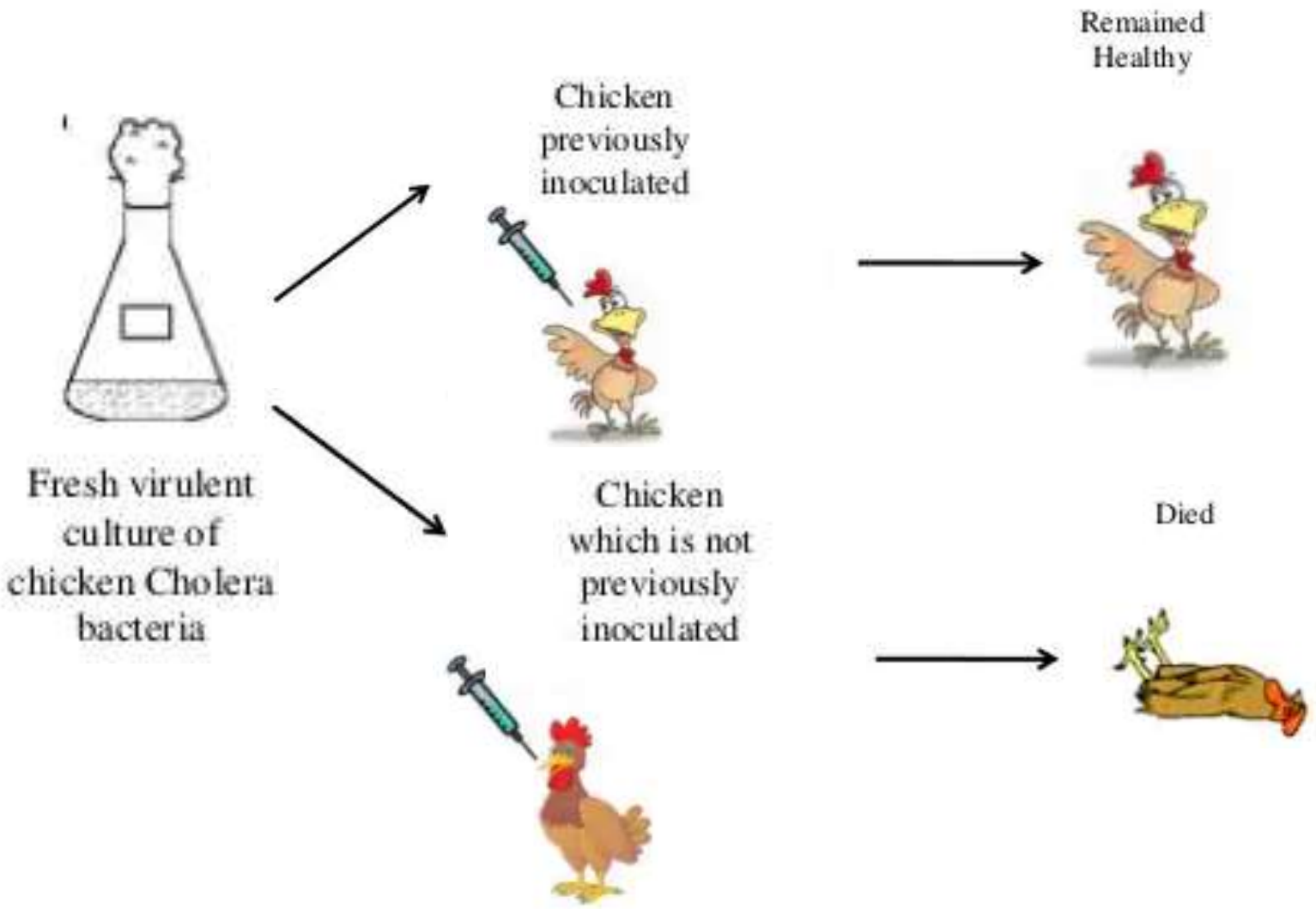
Louis Pasteur [1822-1895]: Father of Microbiology

- Demonstrated anaerobic fermentation by both bacteria and yeasts (bacteria produce acid and yeast produce alcohol)
- Developed pasteurization to prevent spoilage of wine by bacteria
- Introduction of sterilization techniques.
- Studies on Anthrax and Cholera
- Introduced live attenuated (weakened) vaccines [Accidental observation: chicken cholera bacillus cultures left for several weeks. They lost their pathogenicity but retained their ability to protect the chickens from infection. Chicken inoculated pure culture of Chicken Cholera bacteria 8 weeks old Remains Healthy **(Vaccine Concept)**

The History of Microbiology

Golden Period

- Louis Pasteur [1822-1895]: Father of Microbiology



The History of Microbiology

Golden Period

Robert Koch [1843-1910]:

- Introduced methods for isolation of pure culture
- Use of solid media for isolation of bacteria
- Bacterial staining techniques.
- Established what is known Kock's postulates.
- Discovered Anthrax bacillus (1876), Tubercle bacillus (1882) and cholera (1883).

The History of Microbiology

Golden Period

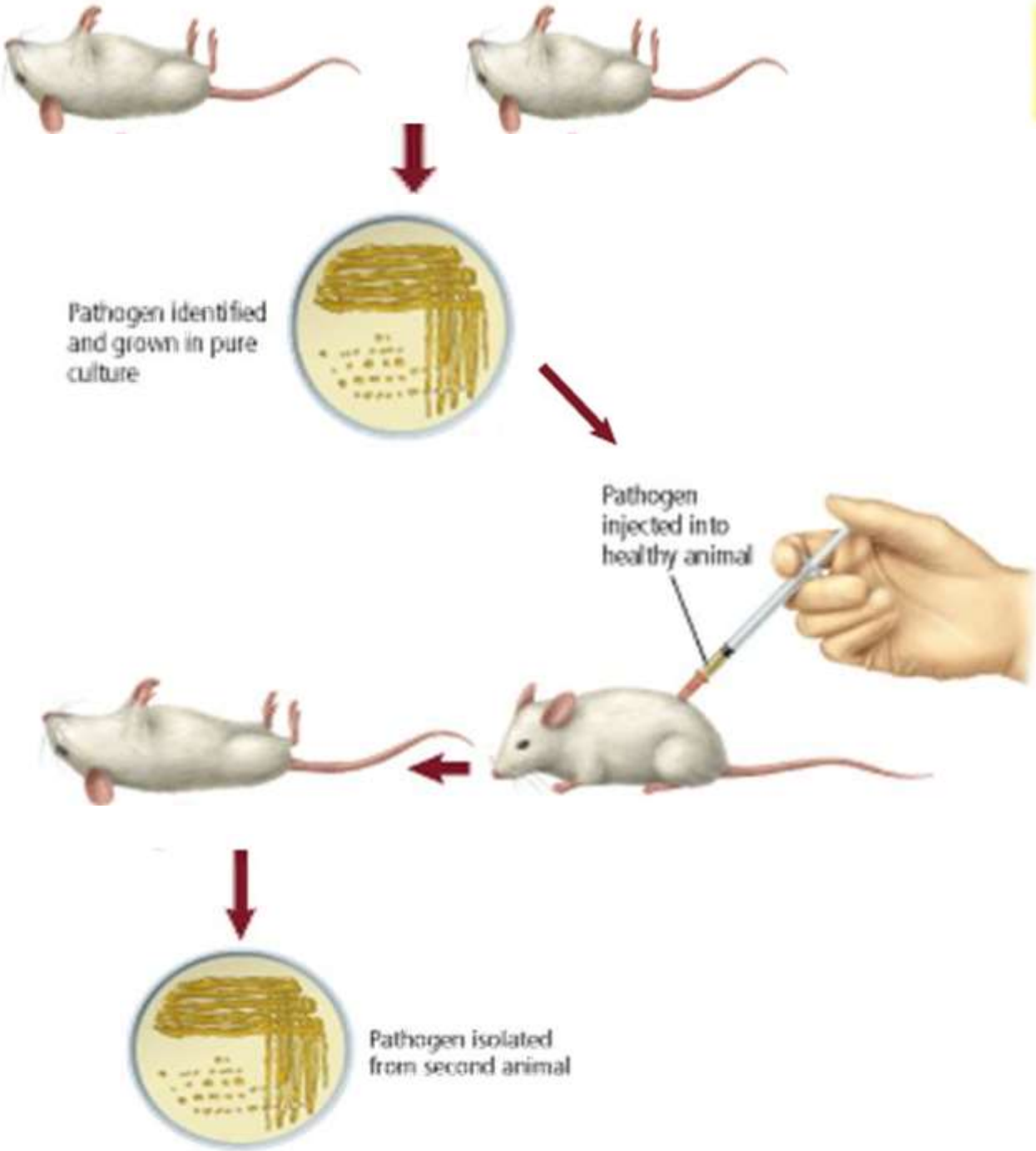
Kock's postulates

"One microbe, one disease"

- Robert Koch was the first who demonstrate that a specific disease was caused by a specific microorganism.

Four criteria designed to establish a causative relationship between a microbe and a disease

- The specific causative agent must be found in every case of the disease
- The disease organism must be isolated from the lesions of the infected case and maintained in pure culture
- The pure culture, inoculated into a susceptible or experimental animal, should produce the symptoms of the disease
- The same bacterium should be re-isolated in pure culture from the intentionally infected animal



Postulate 1

The suspected pathogen must be isolated from the diseased host in every case of the disease.

Postulate 2

The suspected pathogen must be grown in pure culture on artificial media in the laboratory.

Postulate 3

The suspected pathogen from the pure culture must cause the same disease when placed in a healthy new host.

Postulate 4

The suspected pathogen must be isolated from the new host, grown again in pure culture, and shown to have the same characteristics as the original pathogen.

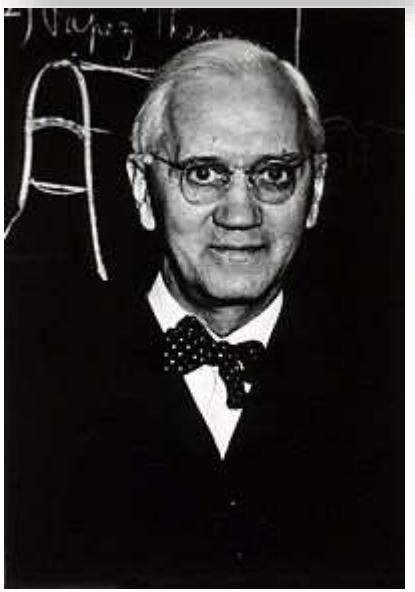
Timeline (Dmitri Ivanowski 1864-1920)

- Russian Botanist

- 1892: He publishes the first evidence of the filterability of a pathogenic agent, the **virus** of tobacco mosaic disease, launching the field of **virology.**

Timeline. (Alexander Fleming 1881-1955)

- 1929: Alexander Fleming publishes the first paper describing penicillin (produced from the mold *Penicillium*) and its effect on gram-positive microorganisms.



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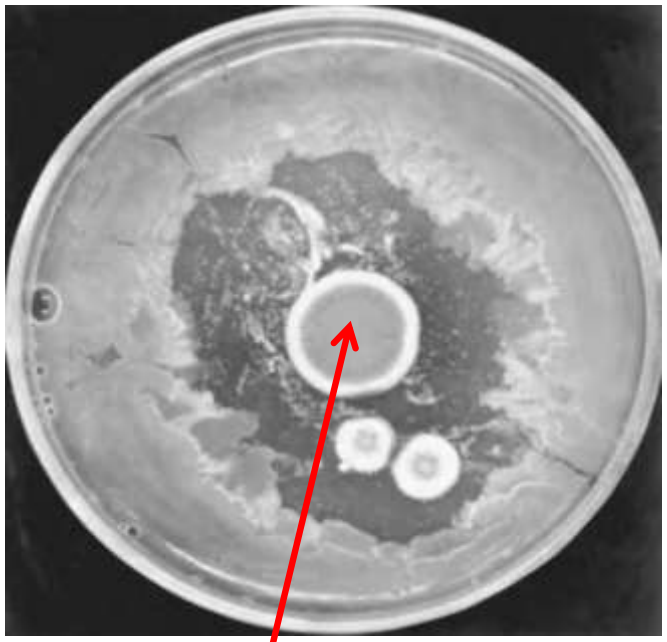
Timeline. (Alexander Fleming 1881-1955)

- Fleming kept his cultures 2-3 weeks before discarding them. When he looked at one set he noticed that the bacteria seemed to be dissolving and the mold was contaminating the culture.
- When penicillin is finally produced in major quantities in the 1940s, its power and availability effectively launch the "**Antibiotics Era**," a major revolution in public health and medicine



mold

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