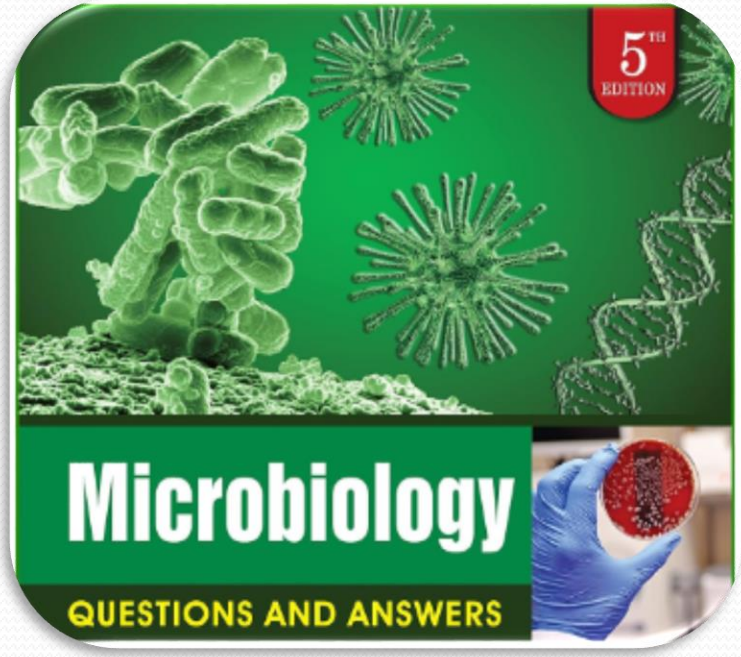
Basrah University
Al-Qurna Education College
Biology Department: 4th Stage

1st Course , Lecture #.1
Introduction
Brief History of Microbiology



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Wed. 04.Oct.2023

Microbiology Syllabus

1. Introduction:
   Brief history of microbiology
   Golden age of microbiology
2. Microbiology & human welfare ,
   Relationship of microbiology & other fields of science
3. Classification of microorganisms ,
   Five domain system
   Three domain system
4. Comparison between prokaryotes and eukaryotes.

5. Structures of prokaryotes:

Cell wall, Gram stain, cell wall less bacteria ,Mycoplasma , L- form bacteria ,Acid-fast bacteria , cytoplasmic membrane , cytoplasm, nucleoid , Ribosomme, endospores .

5. Microbial metabolism ,glycolysis, metabolic pathway.

6. Microbial growth

7.Microbial genetics

8. Viruses (virion, viriod , prion)

Viral properties

Viral replication

Viral classification

Viral infection & diagnosis

9. Antimicrobial agents

What is Microbiology?

Microbiology is the science that deals with the study of biological organisms that are too small to be seen with the naked eye (without using microscope).in order to not only determine how they live in their environment, but also how they impact their respective surroundings and thus other organisms around them (human beings, animals, etc).

Microorganisms or **microbes-** these microscopic organisms Commonly called “germs”.

Bacteria, Archaea, Fungi, Protozoans, Algae, Viruses

Some organisms are large though – Helminths – worms

* Not all cause disease and many more are useful or essential for human life

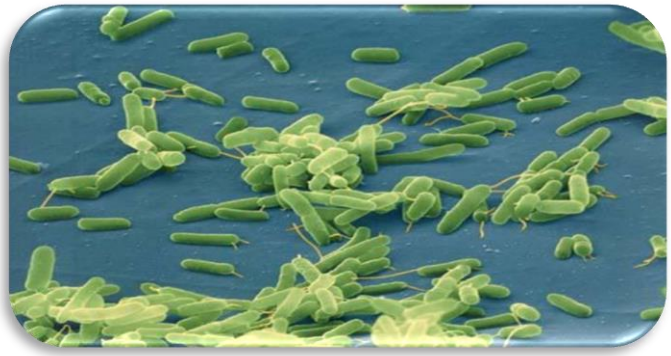
- **Microbiology may be interested in specific types of organisms:**
  - **Virology - viruses**
  - **Bacteriology – bacteria , Archaea**
  - **Phycology - algae**
  - **Mycology - fungi**
  - **Protozoology - protozoa**

- **Microbiologists may have a more applied focus:**
  - **Medical microbiology, including immunology**
  - **Food and Dairy microbiology**
  - **Public Health microbiology (Epidemiology)**
  - **Industrial microbiology**
  - **Agricultural microbiology**
- **Microbiologists may be interested in various characteristics or activities of microorganisms:**
  - **Microbial morphology**
  - **Microbial cytology**
  - **Microbial physiology**
  - **Microbial ecology**
  - **Microbial genetics and molecular biology**
  - **Microbial taxonomy**

Table 1.3 Fields of Microbiology

Disciplines	Subject(s) of Study
Applied Microbiology	
Medical Microbiology	
Serology	Antibodies in blood serum, particularly as an indicator of infection
Immunology	Body's defenses against specific diseases
Epidemiology	Frequency, distribution, and spread of disease
Etiology	Causes of disease
Infection control	Hygiene in health care settings and control of nosocomial infections
Chemotherapy	Development and use of drugs to treat infectious diseases
Applied Environmental Microbiology	
Bioremediation	Use of microbes to remove pollutants
Public health microbiology	Sewage treatment, water purification, and control of insects that spread disease
Agricultural microbiology	Use of microbes to control insect pests
Industrial Microbiology (Biotechnology)	
Food and beverage technology	Reduction or elimination of harmful microbes in food and drink
Pharmaceutical microbiology	Manufacture of vaccines and antibiotics
Recombinant DNA technology	Alteration of microbial genes to synthesize useful products

Bacteria

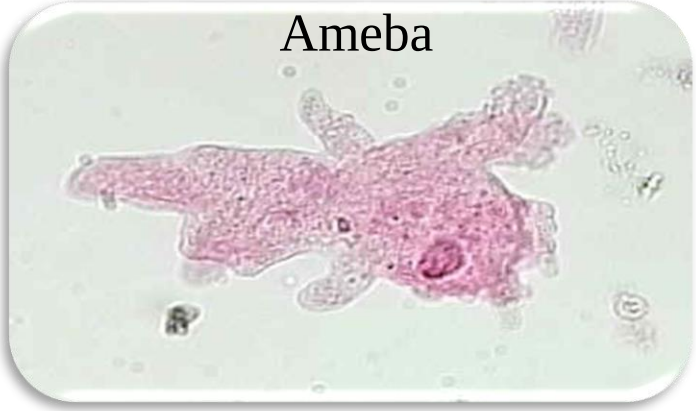


Fungi

Protozoans

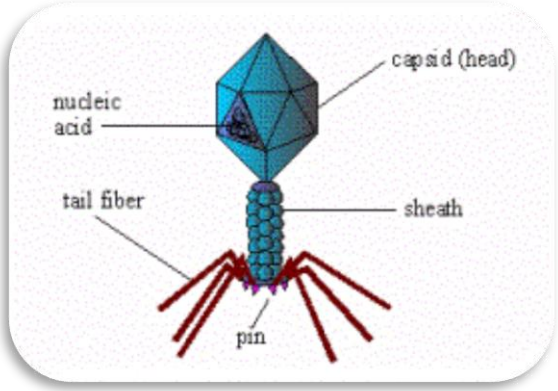
Giardia

Ameba

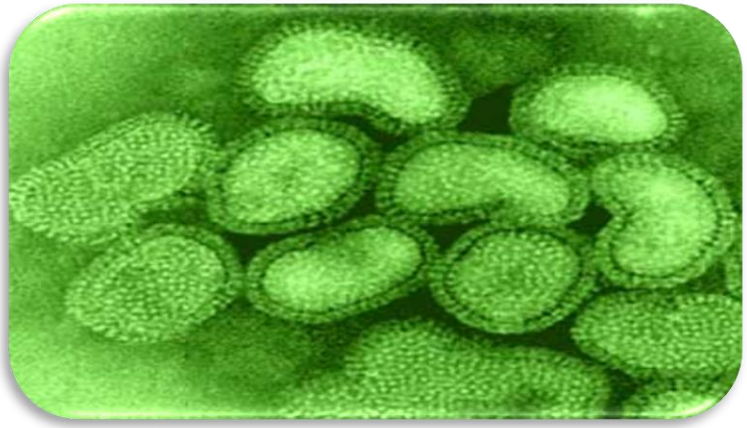


Viruses

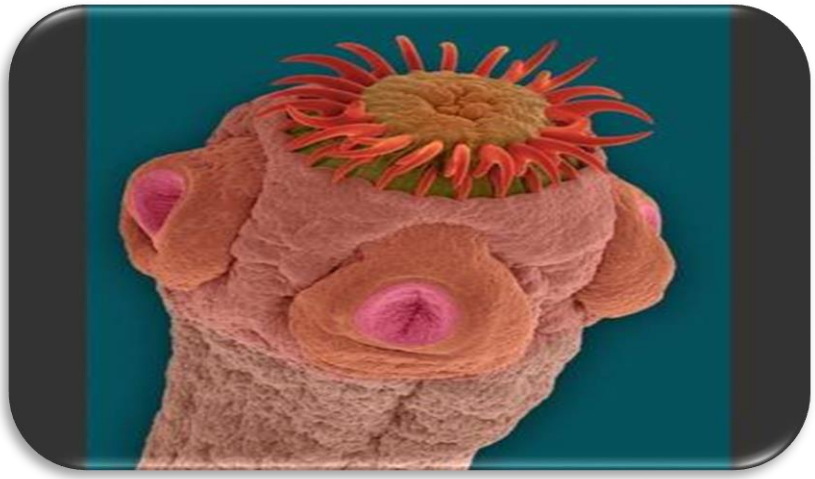
Bacteriophage



Avian Flu



Helminth ; Tapeworm



Why Do We Study Microorganisms?

- We study microbiology because bacteria, viruses and fungi are the leading cause of death in the history of mankind.
- Some Microorganisms have benefit to Man:

  Many microorganisms are involved in the production of food or are directly edible.

  The presence of bacteria (normal flora) in our bodies inhibits the growth of potentially pathogenic bacteria helping to keep us healthy.
- Modern biotechnology is often associated with the use of genetically altered microorganisms such as E. coli or yeast for the production of substances like synthetic insulin or antibiotics.

Why Do We Study Microorganisms?

- Biotechnological advances in agriculture also require the help of microorganisms to form Transgenic Plant with increased yield, reduced vulnerability to environmental and pathogenic stresses, and improved taste.
- Microbes are involved in cycling vital elements such as carbon and nitrogen.
- In aquatic ecosystems microbes are even used to digest oil from oil spills.

CONTRIBUTIONS OF RENOWNED SCIENTISTS IN MICROBIOLOGY

ROBERT HOOKE

One of the most important discoveries of biology occurred in 1665, with the help of a crude microscope, when Robert Hooke stated that life's smallest structural units were cells.

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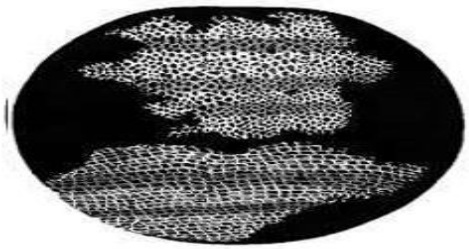
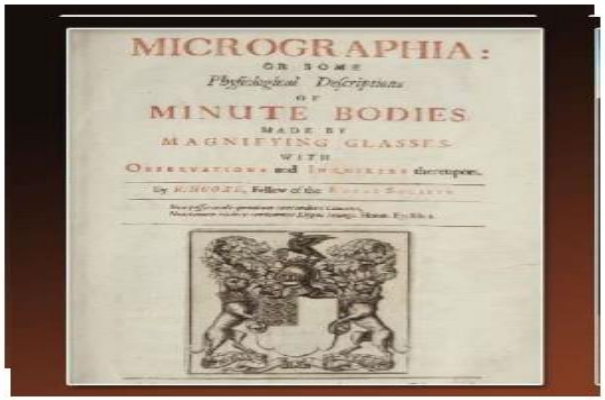




He observed the microscopic honeycomb cavities in cork. Coined the term ''cell'' and published his findings in *Micrographia*

Antonie van Leeuwenhoek

"Father of Bacteriology"

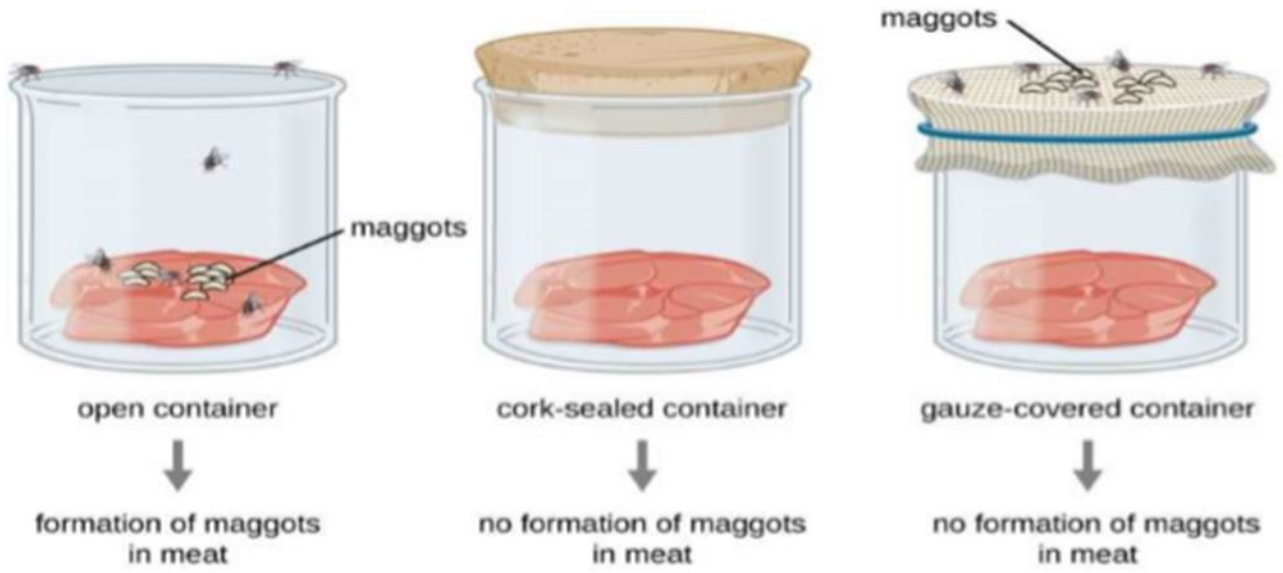
- First to observe living microbes
- His single-lens magnified **50-300X magnification**
- Between 1674-1723 he wrote series of papers describing his observations of bacteria, algae, protozoa, and fungi **(Animalcules)**

➢ , he was able to isolate from different sources, such as rainwater, pond and well water, and the human mouth and intestine.

Spontaneous Generation (Abiogenesis)

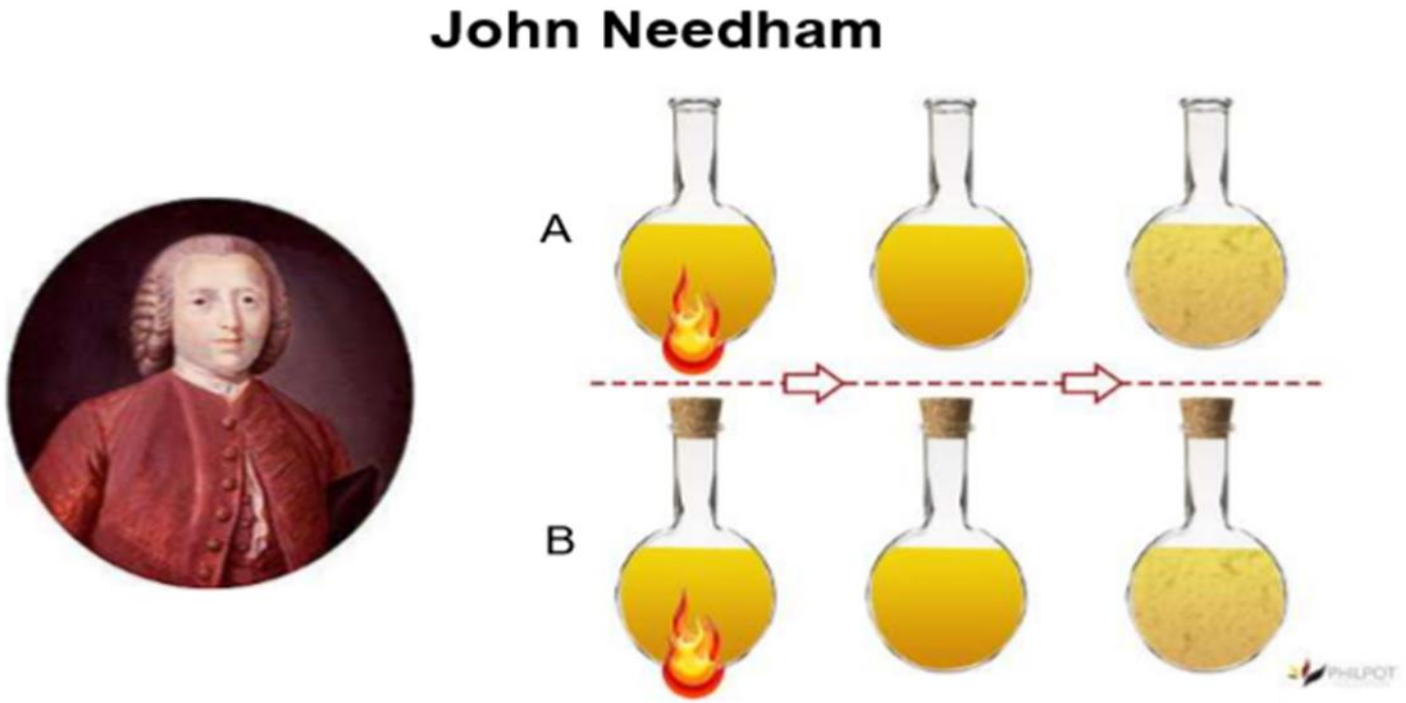
- From earliest times, people had believed and supported spontaneous generation (abiogenesis); **states** that living organisms could develop from nonliving matter. Many supported this theory.

Francesco Redi (1668) – Strong opponent of spontaneous generation. He demonstrated that maggots appear on decaying meat only when flies are able to lay eggs on the meat.



Francesco Redi's spontaneous generation experiment using jars of meat.
In the first jar, with the meat sealed inside by a stopper, maggots did not appear on the meat;
in the second jar, covered with mesh, maggots also did not appear on the meat;
but in the third jar, without a cover, maggots did appear on the meat and developed into flies.

John Needham (1745) – claimed that microorganisms could arise spontaneously from heated nutrient broth.

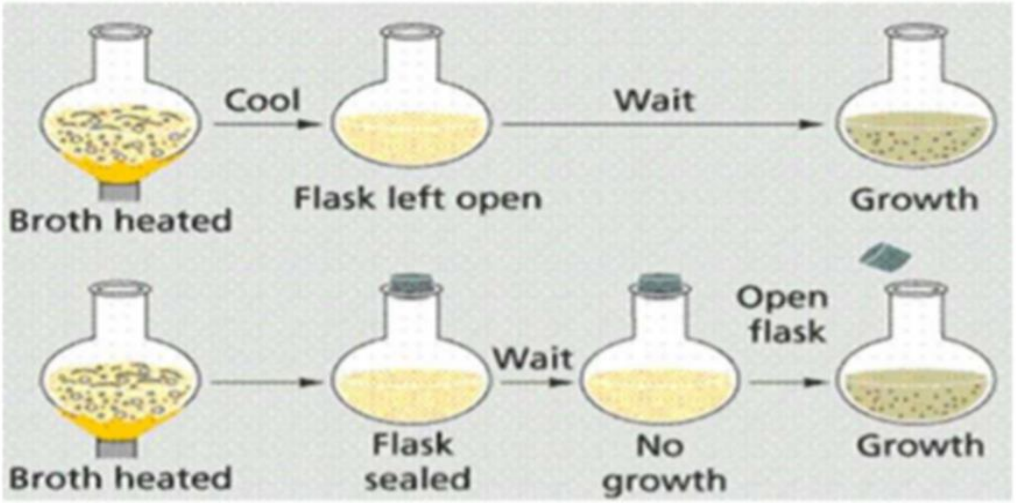


Needham's experiment on spontaneous generation :

A. Needham heated the broth, let it sit uncovered for several days, then observed microorganisms in the fluid.
B. Needham heated the broth, let it sit covered for several days, then observed microorganisms in the fluid which may be because the cork and flask were not sterile.

- **Lazzaro Spallanzani** (1765) – repeated Needhams experiments and suggested that Needham's results were due to microorganisms in the air entering the broth.

Spallanzani's Experiment



He boiled broth in two bottles, left one bottle open and one closed,
He found that new microorganisms appeared only in the open bottle.
His conclusion: the microorganisms entered the bottle through the air; they were not generated spontaneously in the broth.

Louis Pasteur (1822-1895)

- Pasteur's experiments on swan shaped necks resolved the controversy of spontaneous generation. His discoveries led to the development of aseptic techniques used in the laboratory and medical procedure to prevent contamination by microorganisms that are in the air.
- In 1861 completes experiments that lays to rest spontaneous generation.
- Showed microbes caused fermentation and spoilage

Overview of Pasteur's Experiment into Biogenesis

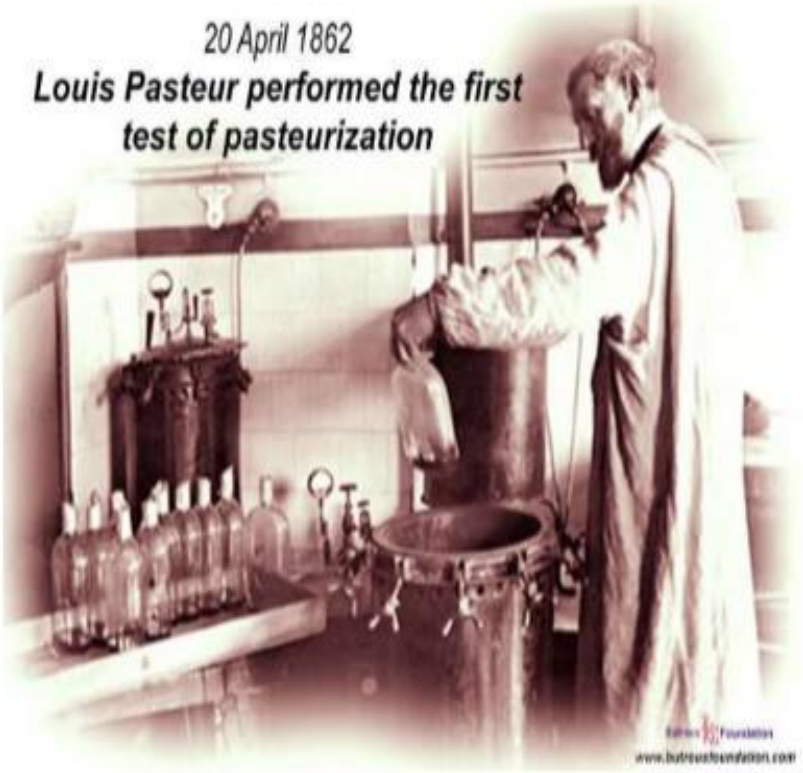
Methodology	Control Results	Experimental Results
		
Broth in flask is boiled to kill pre-existing micro-organisms (create a sterile environment)	As broth cools, condensing water collects, sealing mouth of flask (no growth will occur)	If neck is broken, outside air can carry micro-organisms into broth (contamination)

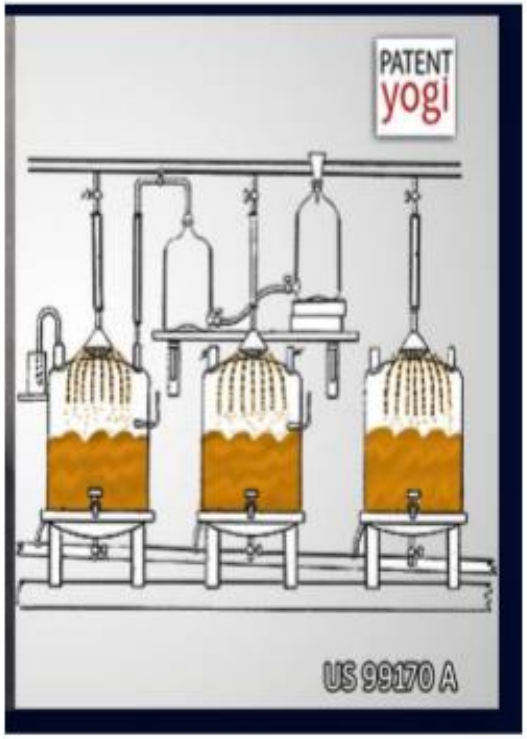
Conclusion

Cells can ***only*** arise from pre-existing cells

The Golden Age of Microbiology

- 1857-1914
- Beginning with Pasteur’s work, discoveries included the relationship between microbes , Fermentation and Pasteurization





Pasteurization of milk, beer and wine.

Heating process used to kill bacteria in some alcoholic beverages and milk.

Fermentation by microorganisms

Yeast ferments sugars to alcohols and that bacterium can oxidize the alcohol to acetic acid.

Joseph Lister
"Father of modern surgery"

- 1860s, the use of disinfectant to clean surgical dressings in order to control infection in humans
- Developed a system of antiseptic surgery— designed to prevent microorganisms from entering wounds. The approach was remarkably successful and transformed surgery after Lister published his findings in 1867. It also provided strong evidence for the role of microorganism in disease because phenol, which killed bacteria, also prevented wound infections.

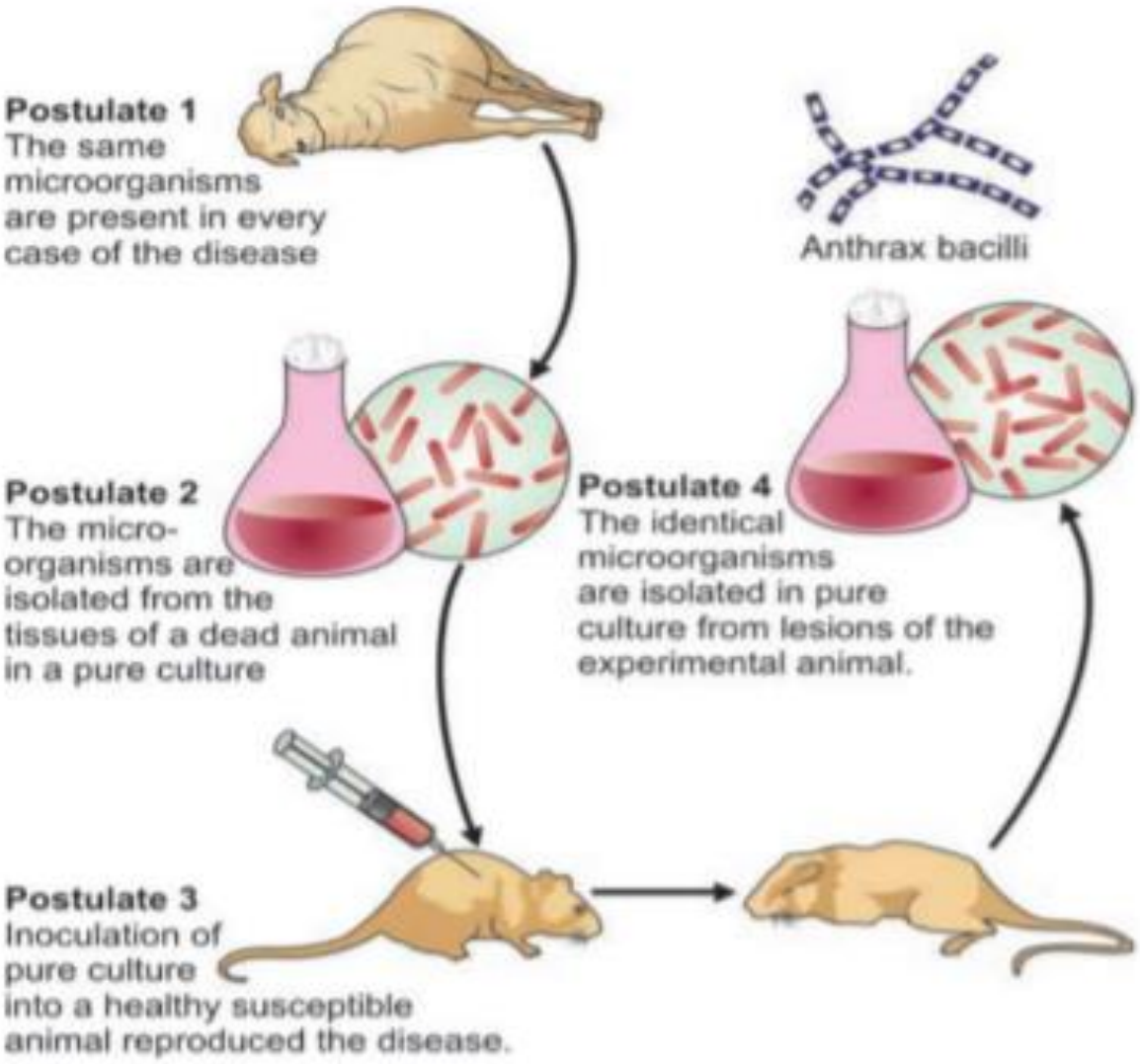
Germ Theory of Disease

- Germ theory of disease **states** that certain diseases are caused by the invasion of the body by microorganisms, organisms too small to be seen except through a microscope.

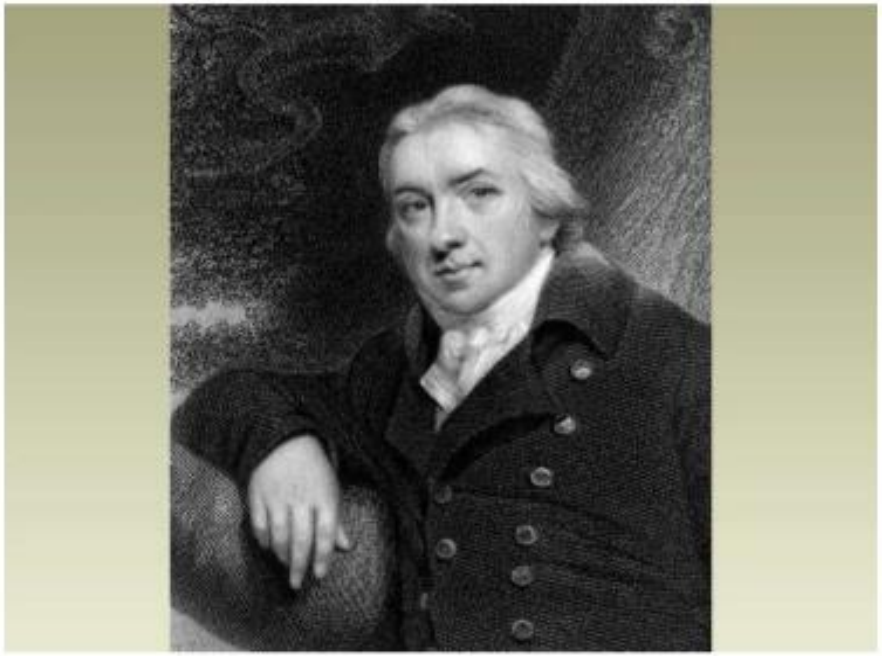
1876 - Robert Koch provided proof that a bacterium causes anthrax using experimental steps now called the Koch's Postulates

- **Koch's Postulates**
- The microbe must always be present in every case of the disease
- It must be isolated in pure culture on artificial media
- When inoculated into healthy animal host it should produce the same disease
- It must be isolated from the diseased animal again

Koch's Postulates



Edward Jenner
Father of Immunology



Immunity is conferred by inoculation with a vaccine.
Demonstrated that inoculations with cowpox material provides humans with immunity from small pox

VIROLOGY

- **Martinus Beijerinck** (1851-1931 characterized viruses as pathogenic molecules that could take over a host cells mechanisms for their own use.

- **Knoll and Ruska-** Viruses were first observed with an Electron Microscope in 1939

- **James Watson and Francis Crick** (1953) -determined the structure of DNA

The Birth of Modern Chemotherapy

- 1928: Alexander Fleming discovered the first antibiotic.
- He observed that *Penicillium* fungus made an antibiotic, penicillin, that killed *S. aureus*.
- 1940s: Penicillin was tested clinically and mass produced.