HISTORY and SCOPE of MICROBIOLOGY

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LECTURES OUTLINES

- What is microbiology?
- Classification
- History of microbiology
- Spontaneous generation?

Microbiology?

- Study of Microorganisms
- Microorganisms are tiny creatures which can not be seen by the naked eye and can only be visualized under microscope

Subdivisions of Microbiology

- Bacteriology
- Mycology
- Phycology
- Virology
- Protozoology
- Immunology

Branches of microbiology

Applied Microbiology:

- Medical Microbiology
- Food and Dairy Microbiology
- Agriculture Microbiology Water/Aquatic Microbiology

  Microbial Biotechnology Biotechnology

Why Study Microbiology?

- Impact on Human Health
- Balance of Nature - food source, play a role in decomposition, help other animals digest grass (cattle, sheep, termites).

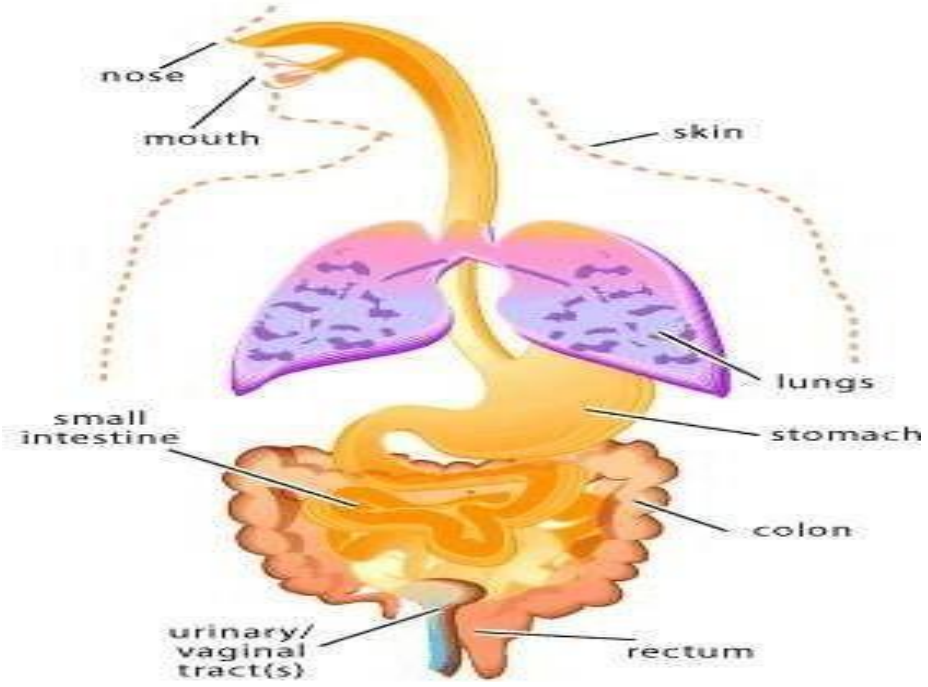
- Environmental – provide safe drinking water; development of biodegradable products; use bacteria to clean up oil spills, etc. – called bioremediation.

- Industrial – foodstuffs (beer, wine, cheese, bread), antibiotics, insulin, genetic engineering

- Agricultural - research has led to healthier livestock and disease-free crops.

Microbes make the universe

- Humans have intimate relation with Microbes > 90% of the cells in our Body are Microbes



History of Classification

In Aristotle's time, the living things were classified as either plants or animals.

This 2 kingdom classification system was also used by Linnaeus and other scientists through the middle of the twentieth century.

Today, a 5-kingdom classification system is generally accepted. It was proposed by

R. H. Whittaker in 1969.

However, this may not be the end of the story. Some scientists have proposed that organisms be divided into even more (maybe as many as 8) kingdoms!

Viruses are not included in any of the present 5 kingdoms WHY?

Five kingdoms

1- Monera simplest organisms, single-celled Cyanobacteria (blue green algae), heterotrophic

bacteria, archaea

2- Protista (Protoctista) single and multicelled with nucleus

Algae, protozoa (amoebas)

3- Fungi

Yeast Mold, lichen

4- **Plantae** multicelled photosynthetic plants

5- **Animalia** multicelled animals

Naming microorganisms

To identify all species of life on Earth

Linnaeus – (1707-1778) Father of modern taxonomy

Created Binomial nomenclature 2

names- *Genus-species*

Names are italicized or underlined. The genus is capitalized and the specific epithet is lower case.

Naming microorganisms

Names may be descriptive or honor a scientist:

Staphylococcus aureus

Describes the clustered arrangement of the cells (staphylo-) and the golden color of the colonies.

Escherichia coli

Honors the discoverer, Theodor Eshcerich, and describes the bacterium's habitat, the large intestine or colon.

Naming microorganisms

- After the first use, scientific names may be abbreviated with the first letter of the genus and the specific epithet:

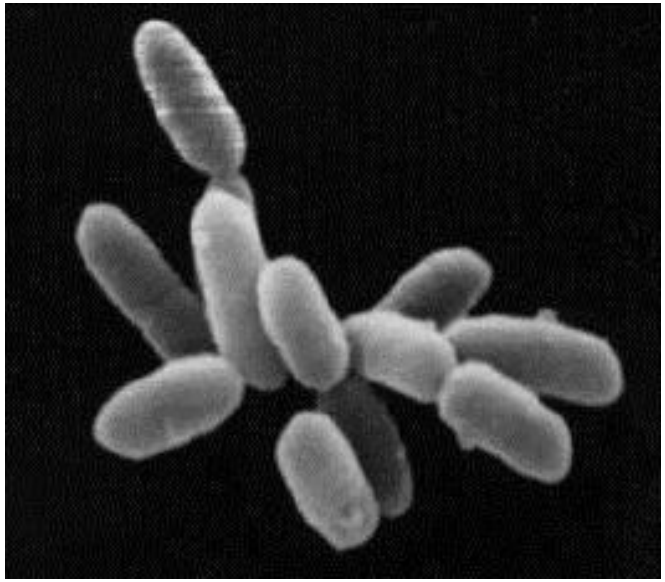
- *Staphylococcus aureus* and *Esherichia coli* are found in the human body. *Staphylococcus aureus* is on skin and *Escherichia coli*, in the large intestine.

Bacteria

- Prokaryotes
- Peptidoglycan cell walls
- Binary fission
- For energy, use organic chemicals, inorganic chemicals, or photosynthesis

Archaea

- Prokaryotic
- Lack peptidoglycan
- Live in extreme environments
- Include:
  - Methanogens
  - Extreme halophiles
  - Extreme thermophiles

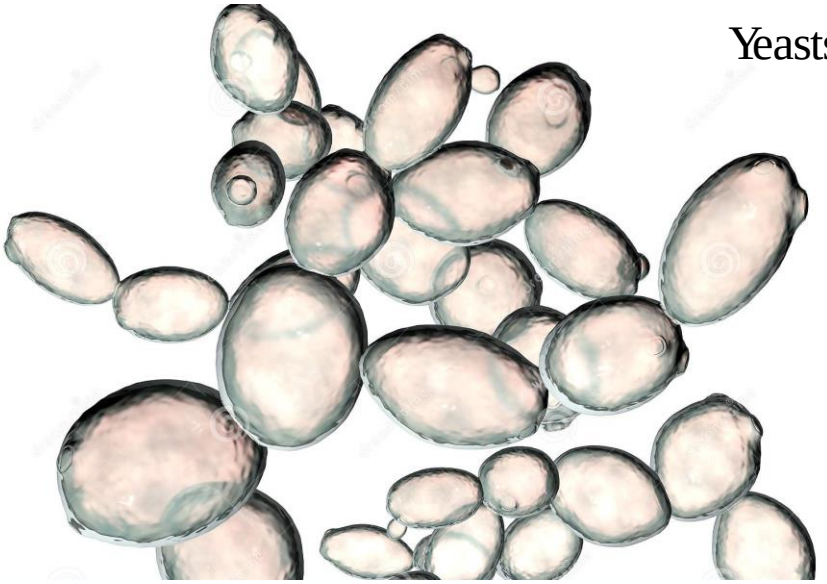


Fungi

- Eukaryotes
- Chitin cell walls
- Use organic chemicals for energy
- Yeasts are unicellular
- Molds and mushrooms

  Multicellular

  Hyphae



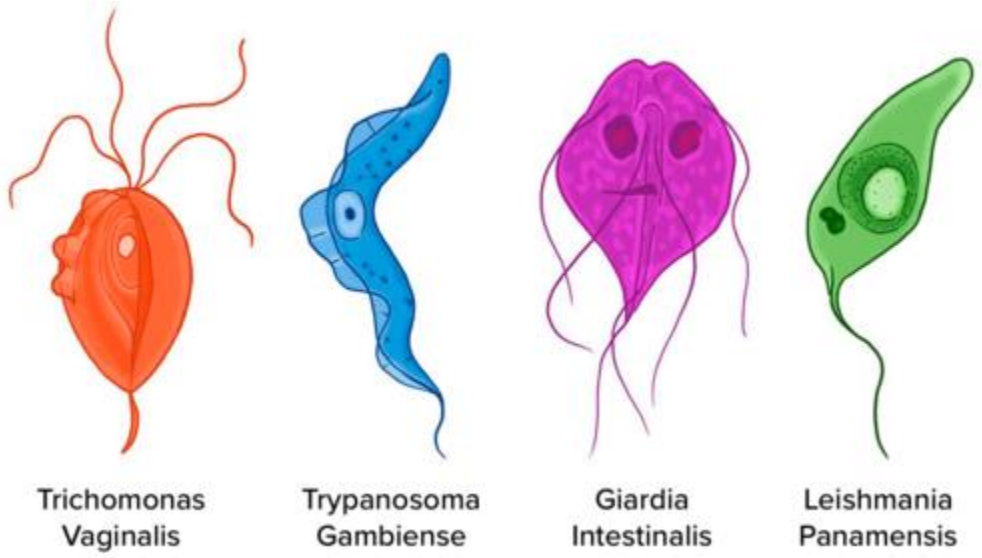
Yeasts

Hyphae

Molds

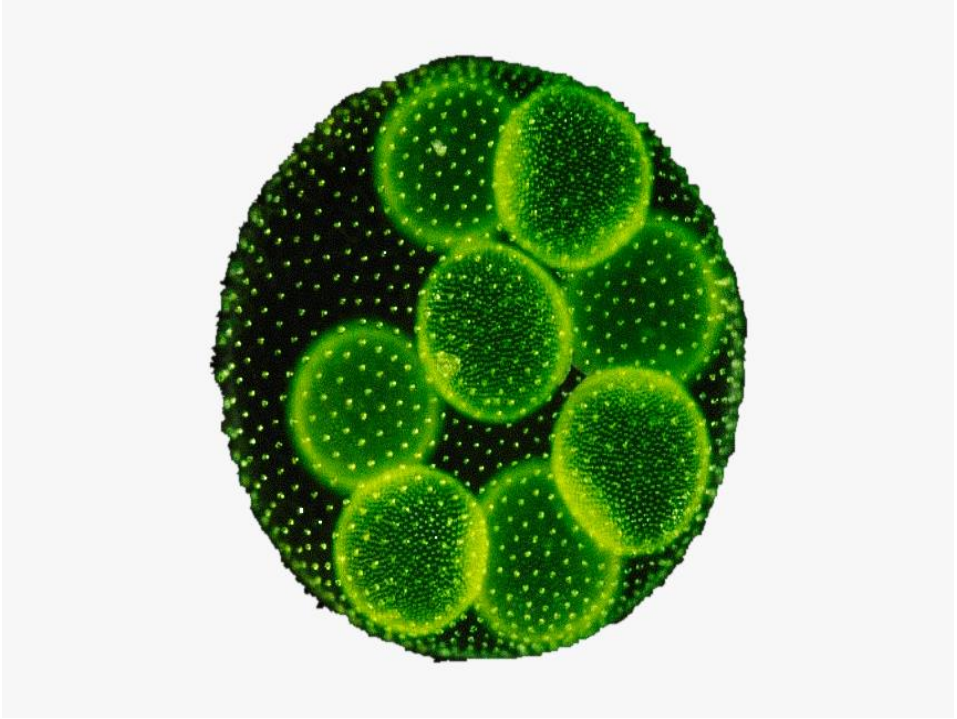
Protozoa

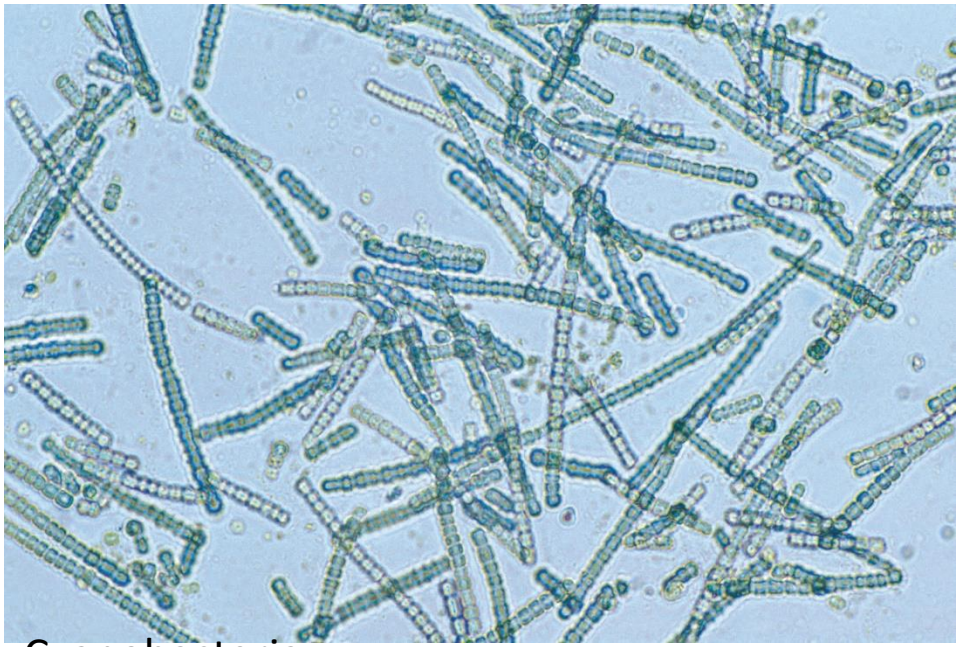
- Eukaryotes
- Absorb or ingest organic chemicals
- May be motile via pseudopods, cilia, or flagella



Algae

- Eukaryotes
- Cellulose cell walls
- Use photosynthesis for energy
- Produce molecular oxygen and organic compounds

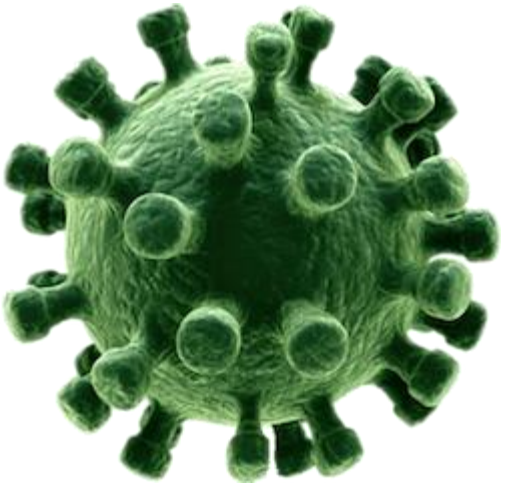




Cyanobacteria

Virus

- Acellular
- Consist of DNA *or* RNA core
- Core is surrounded by a protein coat
- Coat may be enclosed in a lipid envelope
- Viruses are replicated only when they are in a living host cell



Corona Virus

History of microbiology

- 1673-1723, Antoni van Leeuwenhoek described live microorganisms that he observed (Animalcules)

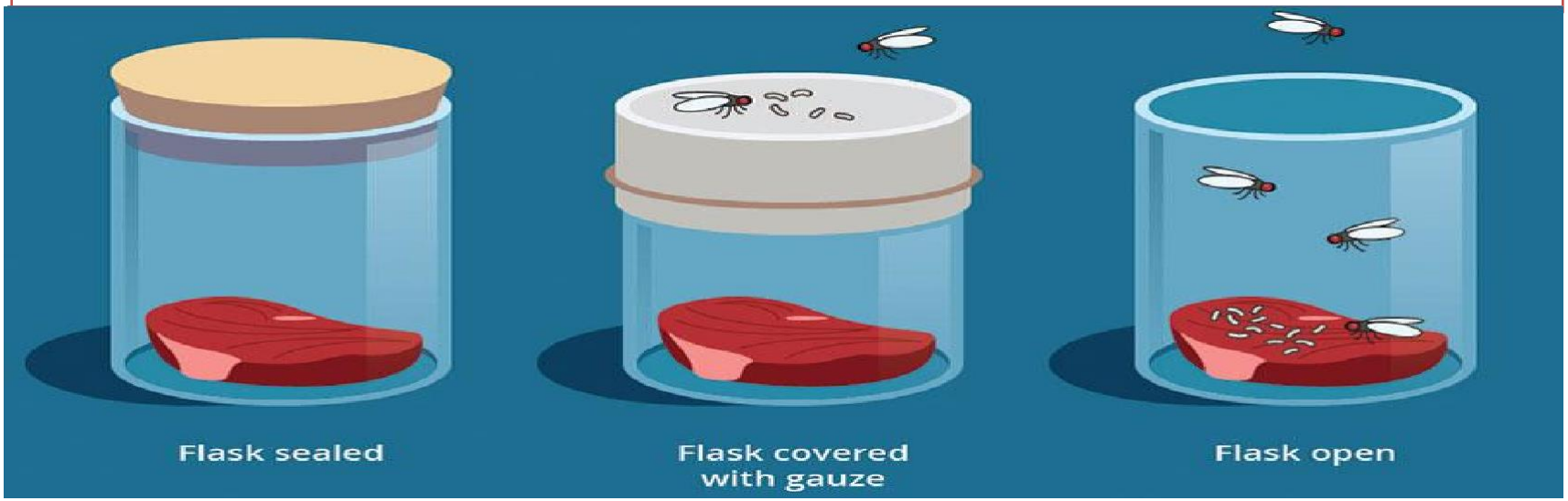
The debate over spontaneous generation

- The hypothesis that living organisms arise from nonliving matter is known as spontaneous generation. According to spontaneous generation

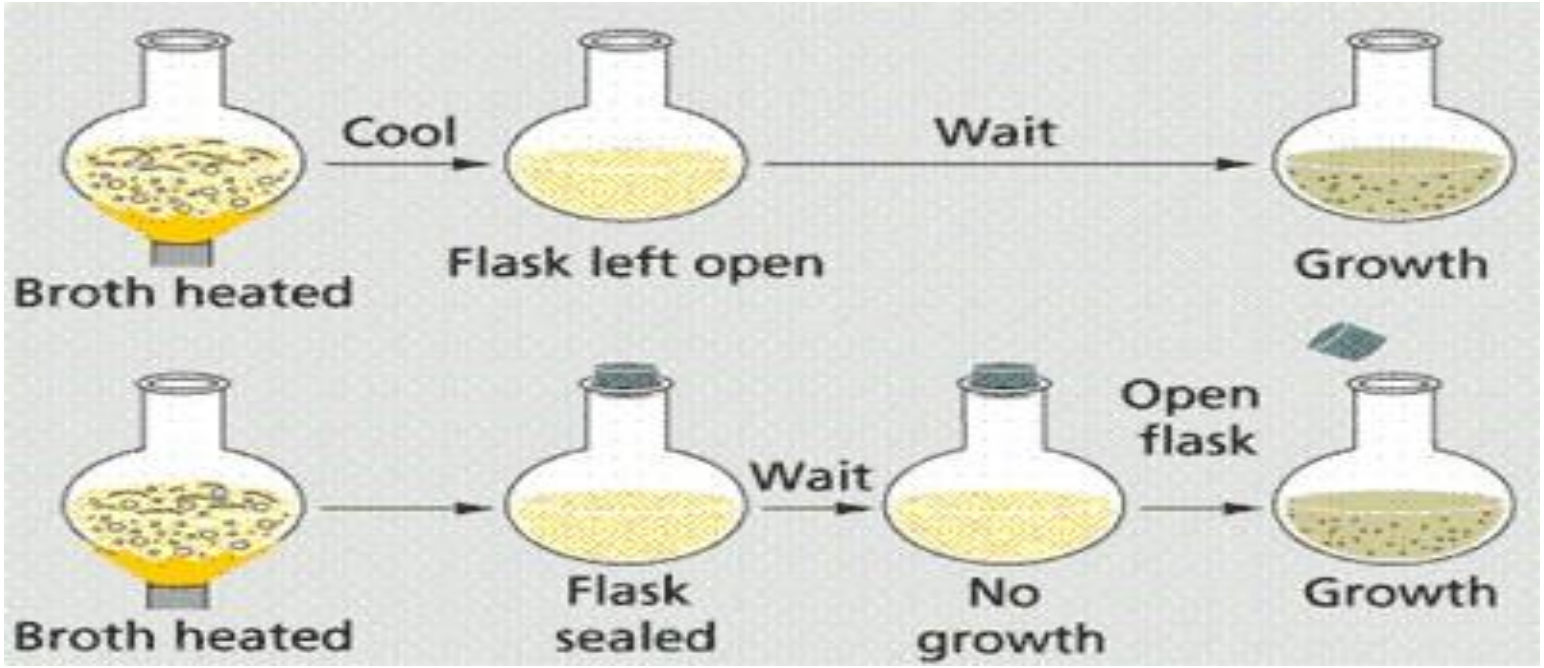
- The Alternative hypothesis, that the living organisms arise from preexisting life, is called biogenesis.

- 1668: Francisco Redi filled six jars with decaying meat.

Conditions	Results
3 jars covered with fine net	No maggots
3 open jars	Maggots appeared
From where did the maggots come? What was the purpose of the sealed jars? *Spontaneous generation or biogenesis?*	



- lazzaro spallanzani

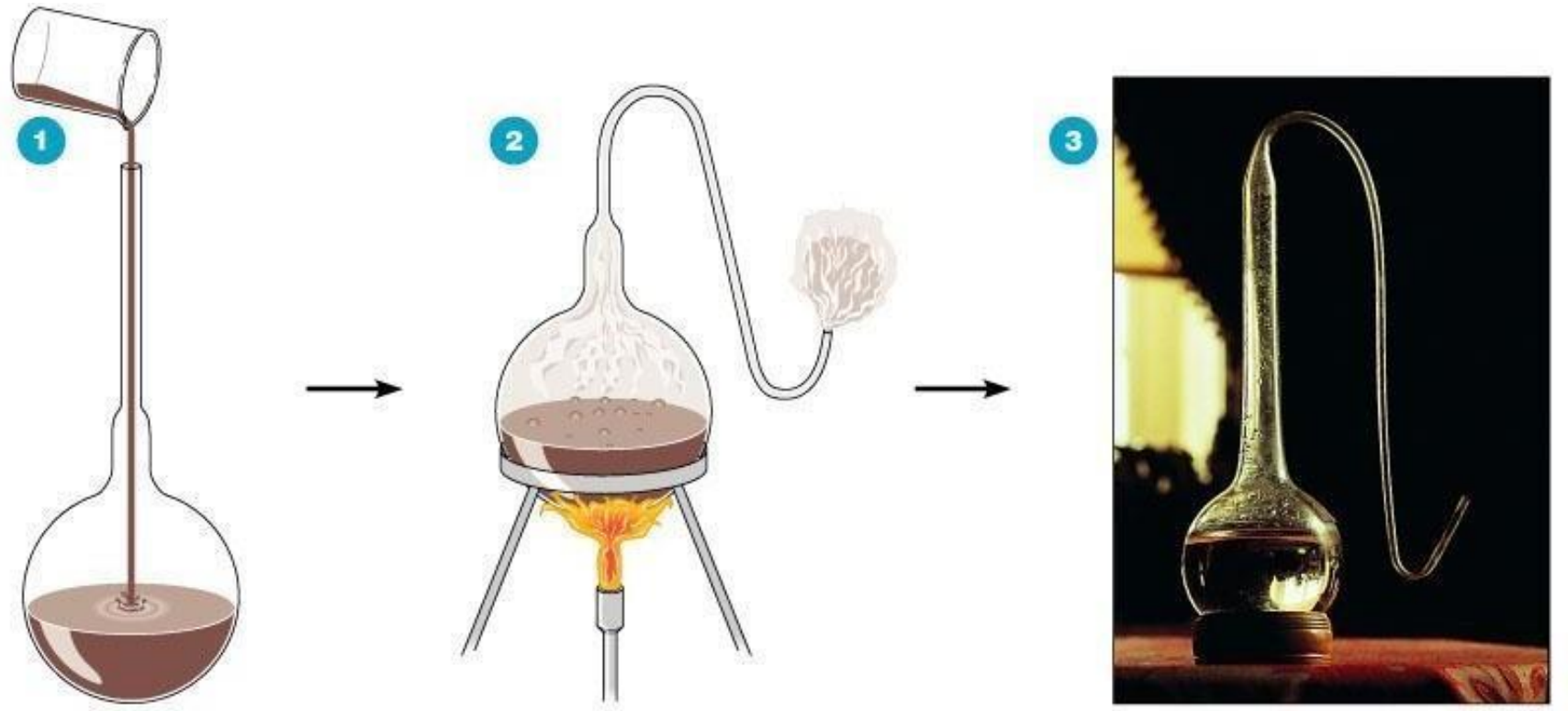


- 1861: Louis Pasteur demonstrated that microorganisms are present in the air.

Conditions	Results
Nutrient broth placed in flask, heated, not sealed	Microbial growth
Nutrient broth placed in flask, heated, then sealed	No microbial growth
Spontaneous generation or biogenesis?	

The Theory of Biogenesis

Pasteur's S-shaped flask kept microbes out but let air in.



Golden age of microbiology

- **1857-1914:** Beginning with Pasteur's work, discoveries included the relationship between microbes and disease, immunity, and antimicrobial drugs

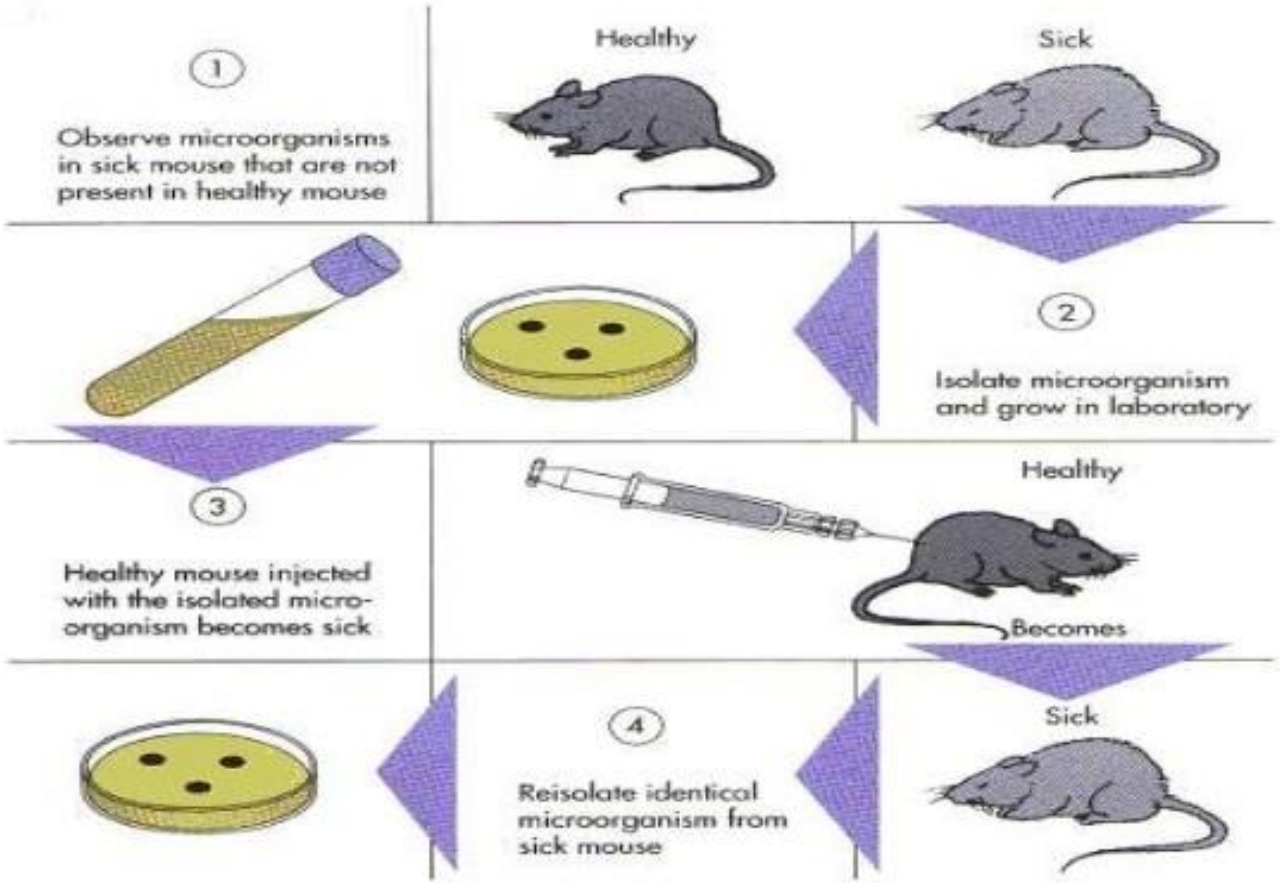
Fermentation and Pasteurization

- Pasteur showed that microbes are responsible for fermentation.
- Fermentation is the conversation of sugar to alcohol to make beer and wine.
- Microbial growth is also responsible for spoilage of food.

The germ theory of disease

Koch's postulates

- Pathogen must be present in all cases of disease
- Pathogen must be isolated and grown in lab in pure culture
- Pathogen from pure cultures must cause disease when inoculated into healthy, susceptible lab animal
- Same pathogen must be isolated from the diseased lab animal


1
Observe microorganisms in sick mouse that are not present in healthy mouse
Healthy
Sick
2
Isolate microorganism and grow in laboratory
3
Healthy mouse injected with the isolated micro-organism becomes sick
Healthy
Becomes
Sick
4
Reisolate identical microorganism from sick mouse

Fermentation and pasteurization

- Pasteur demonstrated that these spoilage bacteria could be killed by heat that was not hot enough to evaporate the alcohol in wine. This application of a high heat for a short time is called pasteurization.

What is Pasteurization?

The germ theory of disease

- Joseph Lister **1860s**:

used a chemical disinfectant to prevent surgical wound infections after looking at Pasteur's work showing microbes are in the air, can spoil food, and cause animal diseases.

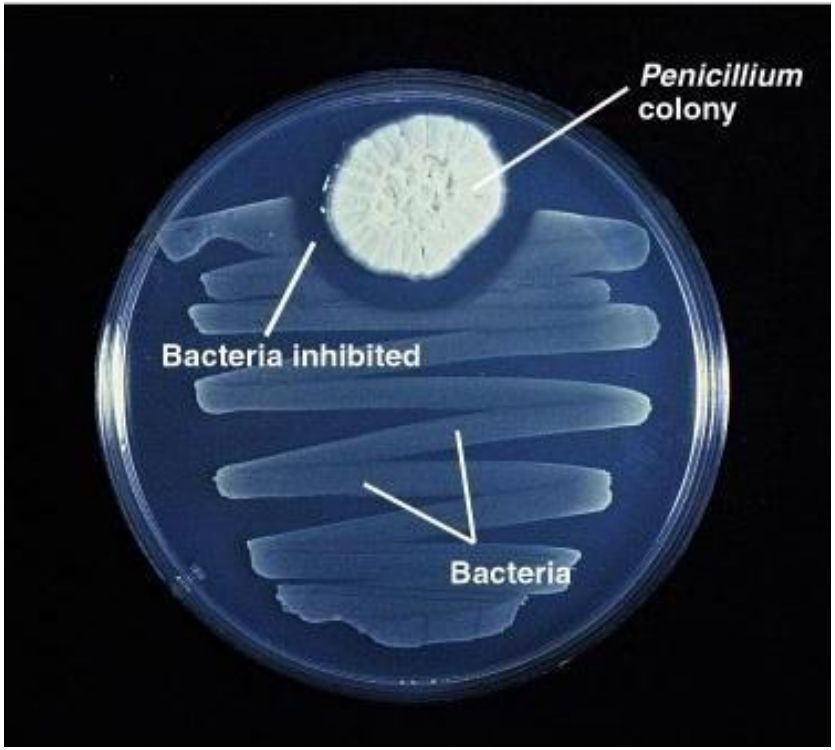
- Robert Koch **1876**:

provided proof that a bacterium causes anthrax and provided the experimental steps, Koch's postulates, used to prove that a specific microbe causes a specific disease.

Vaccination

- 1796: Edward Jenner inoculated a person with cowpox virus. The person was then protected from smallpox.

- 1940s: Penicillin was tested clinically and mass produced.



Next lecture

Bacterial cell structure and function