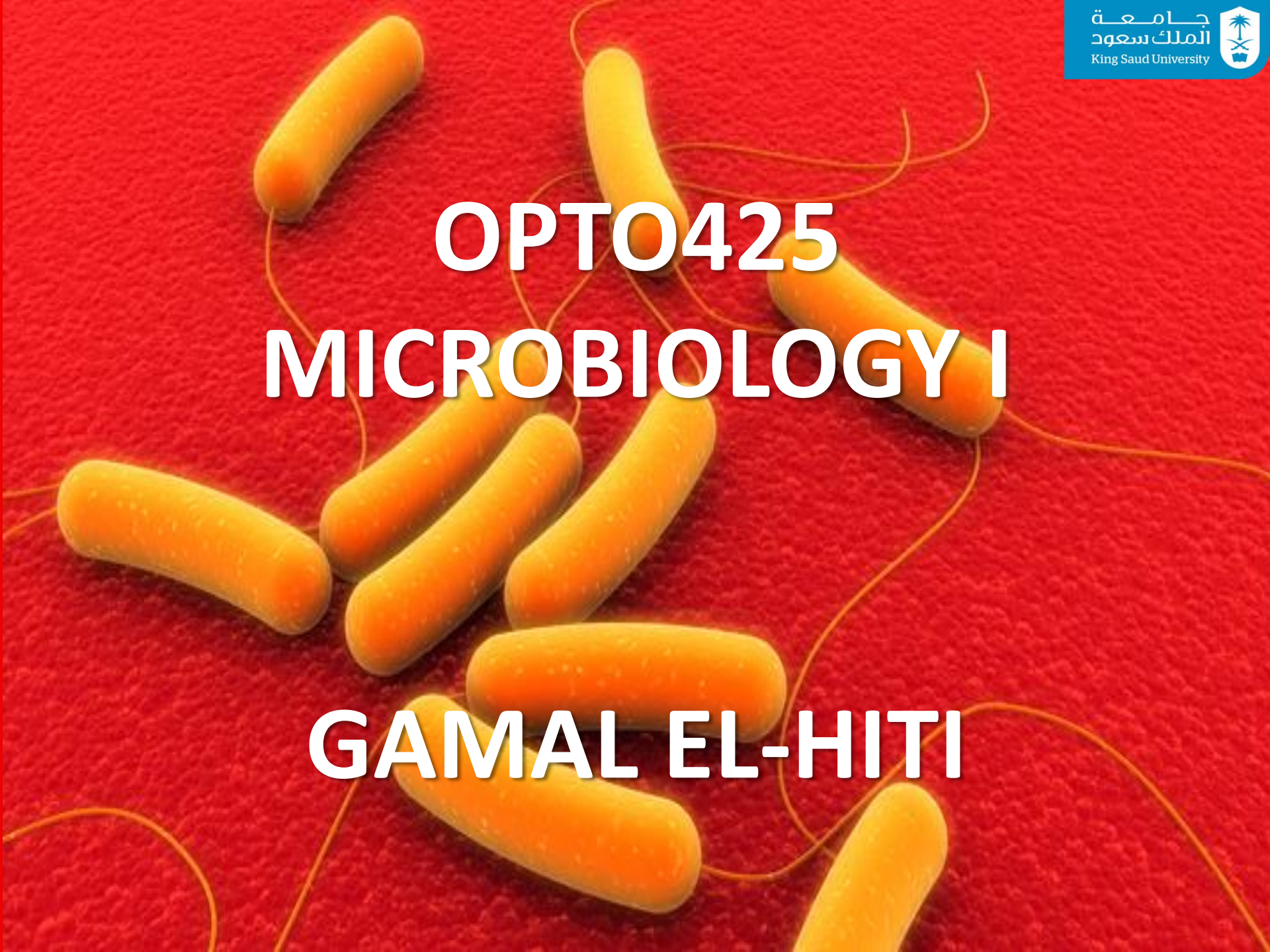
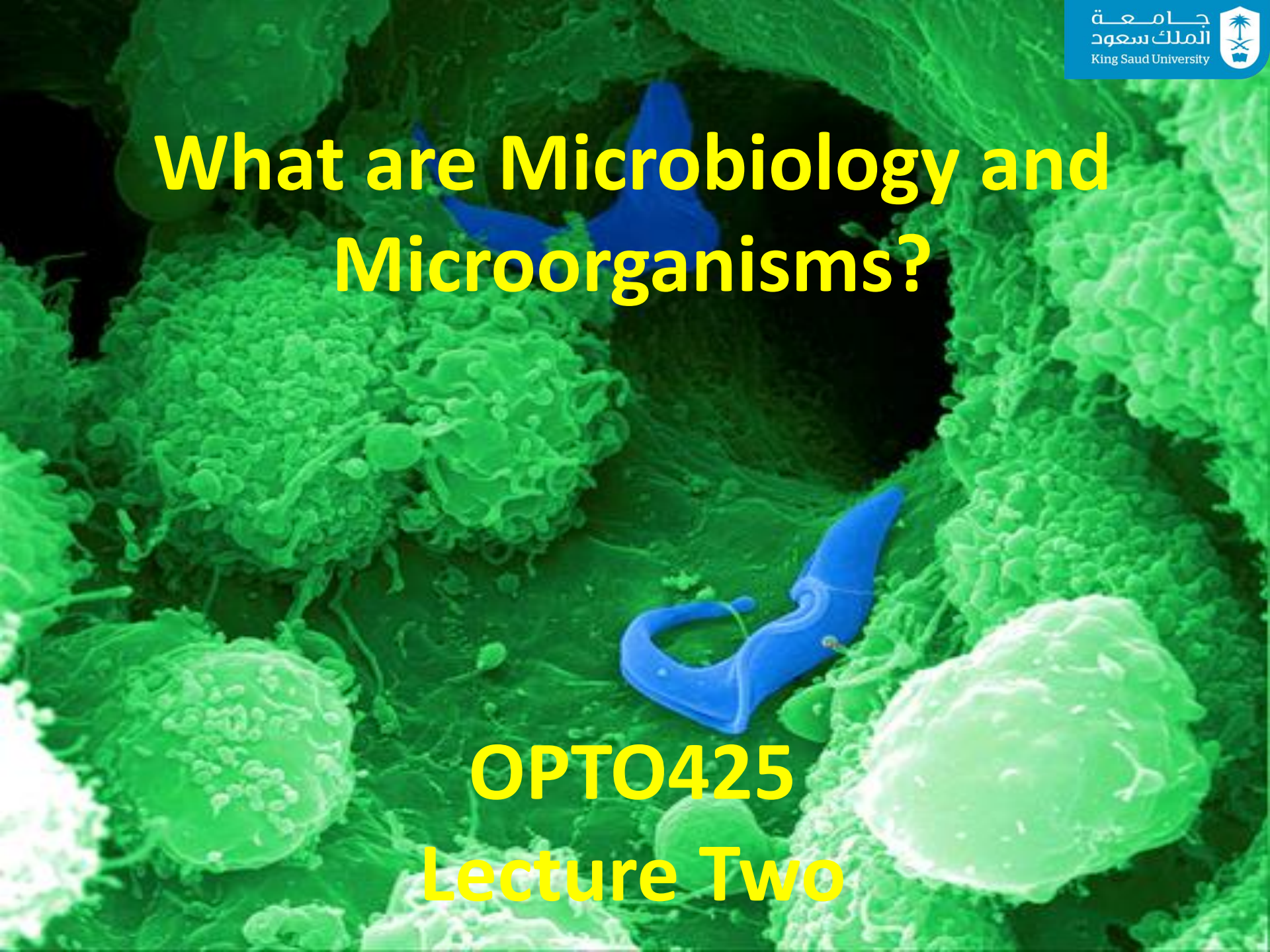
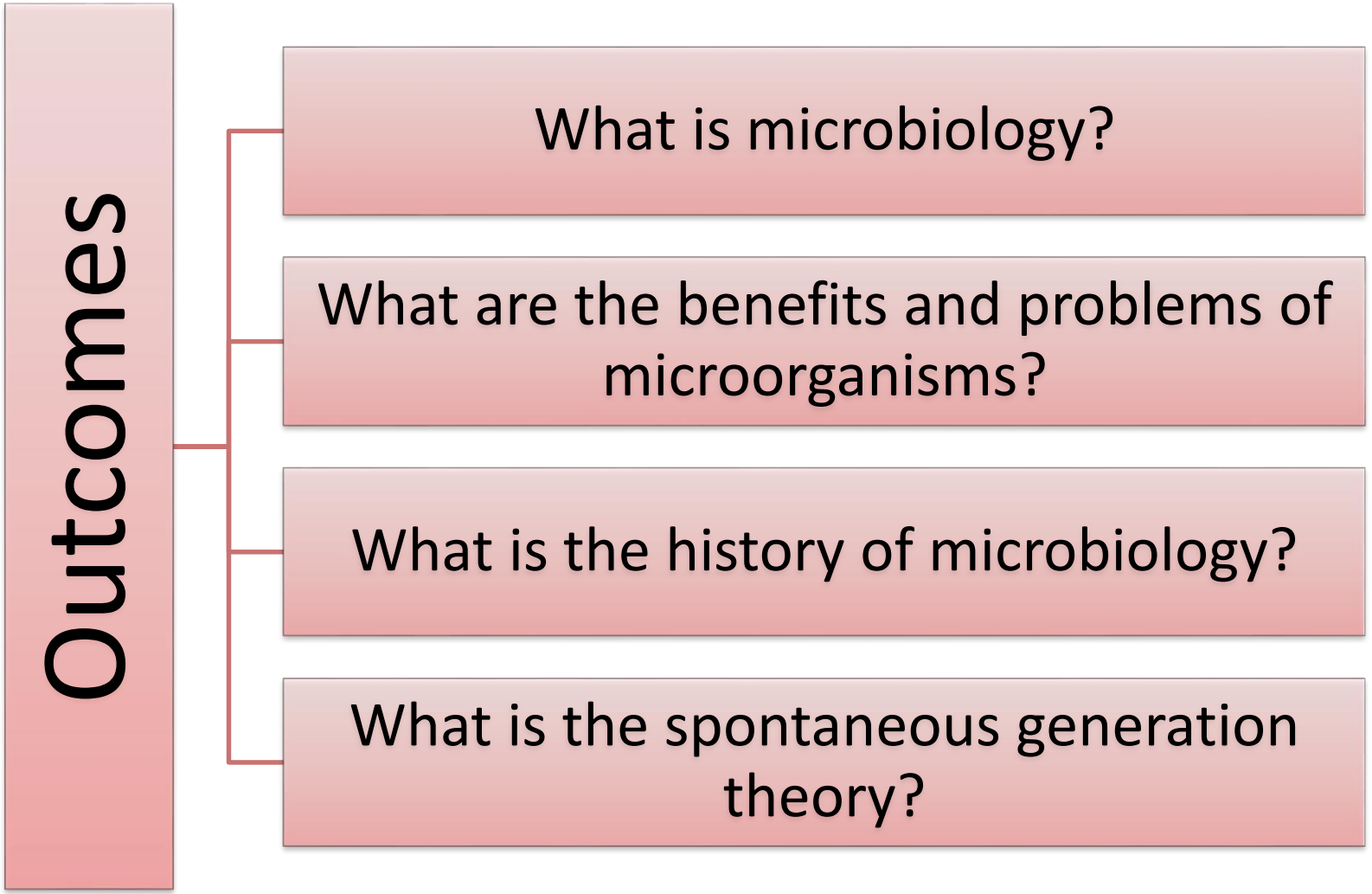

جامعة
الملك سعود
King Saud University
OPTO425
MICROBIOLOGY I
GAMAL EL-HITI


What are Microbiology and Microorganisms?
OPTO425
Lecture Two

Learning Outcomes



What is Microbiology?

- It is the science of microorganisms (*e.g.* bacteria, fungi, parasites and viruses).
- Microorganisms are very small organisms.
- Some organisms are pathogenic "germ" refers to a rapidly growing cell.
- Can only be seen under the microscope.
- Despite their size, microorganisms (germ or microbes) have a massive impact on our lives.
- It has been estimated that there are 5 trillion microbial cells, or even more, on earth.

What is Microbiology?

- The total amount of carbon in these cells (microscopic living organism) is equivalent to that of all of the plants on the planet.
- They are the largest mass of living materials on earth and play a critical role in shaping the environment that we live in.
- Humans, plants and animals are intimately tied to the activities of microbes.
- They can grow very fast and can work alone or in colonies.

What is Microbiology?

- Microorganisms are involved in cycling vital elements (*e.g*. carbon and nitrogen).
- Most microorganisms are harmless but some microbes, however, are pathogenic (capable of producing disease).
- The discipline is just over a century old (*i.e*. recently developed, 1910).
- Knowledge about microbes has given rise to the discovery of the science of Molecular Biology and Biotechnology.

Why We Study Microorganisms?

- It has only been in the last one hundred years that we have begun to win the age old battle with these microbes.
- Bacteria, fungi, parasites and viruses (microbes) are the leading cause of death in the history of mankind (*e.g*. tuberculosis, caused by *Mycobacterium tuberculosis*).
- Microbes have been responsible for the downfall of governments, famine and death on an almost incalculable scale.

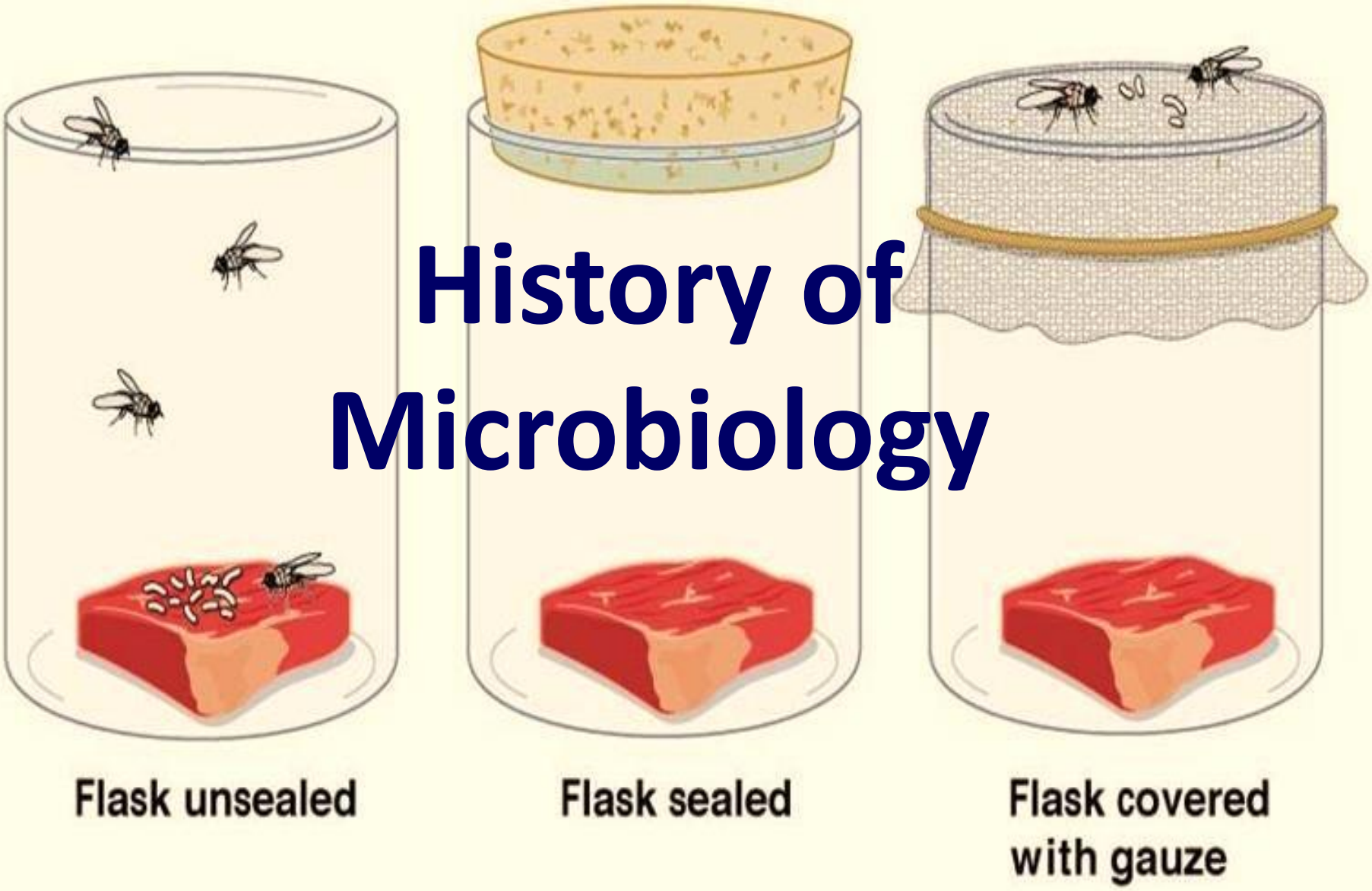
Why We Study Microorganisms?

- Many microorganisms are involved in the production of food or are edible.
- The presence of some bacteria in our bodies inhibits the growth of potentially pathogenic bacteria.
- Modern biotechnology is associated with the use of genetically altered microorganisms.
- *e.g. Escherichia coli* (*E. coli*) or *yeast* used to produce synthetic insulin or antibiotics.

Benefit and Problems

- Microbes used to digest oil from oil spills.
- Produce industrial chemicals such as ethyl alcohol (ethanol, C_2H_5OH) and acetone.
- Produce vinegar, cheese and bread.
- Produce antibiotics such as insulin.
- Knowledge of microbes allows us to prevent food spoilage and disease occurrence.
- Led to aseptic techniques to prevent contamination in hospitals and schools.

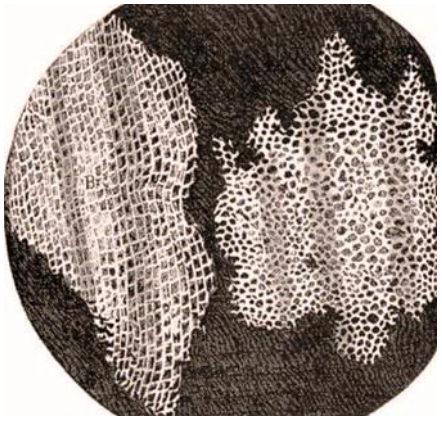
History of Microbiology



History of Microbiology

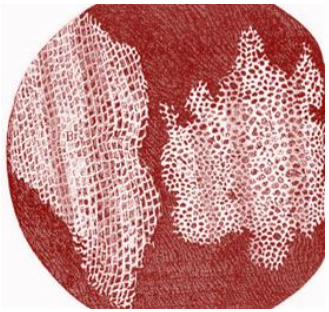
- Robert Hooke (English; 1635 – 1703)

- Hooke's reputation in the history of biology largely rests on his book Micrographia (1665).
- In 1665, he observed living plant tissues by magnifying lens (20×).
- The tissue appeared as little boxes or cells.
- He suggested that all living things are made of cells.



History of Microbiology

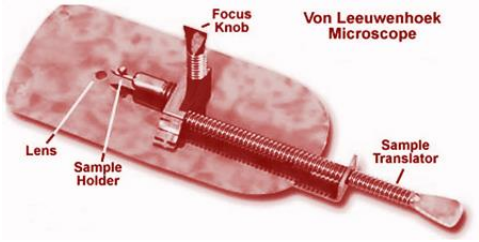
- He looked at a sliver of cork through a microscope lens.
- He noticed some pores or cells.
- He believed that the cells had served as containers for the fibrous threads of the once-living cork tree.



History of Microbiology

- Anton van Leeuwenhoek (Dutch; 1632 – 1723)

- The father of microscopy.
- He started in a dry goods store where magnifying glasses were used to count the threads in cloth.
- He taught himself new methods for grinding and polishing tiny lenses of great curvature.
- He made high magnifications lenses (270×) the finest at that time.



History of Microbiology

- These lenses led to the building of his microscopes.
- In 1674, he was the first to see bacteria, the teeming life in a drop of water and the circulation of blood corpuscles in capillaries.
- He made pioneer studies on both living and non-living organisms.
- He reported over a hundred letters to the Royal Society of England and the French Academy.

History of Microbiology

The discoveries of Anton van Leeuwenhoek:

- Green charophyte alga *Spirogyra* on lake water.
- Microscopic worms
- Bacteria
- Protozoa
- Sperm cells
- Blood cells

History of Microbiology

- Spontaneous generation theory is an obsolete body of thought on the ordinary formation of living organisms without descent from similar organisms (Aristotle's doctrine of spontaneous generation).
- Hypothesis that living organisms arise from nonliving matter; a "vital force" forms life.
- The hypothesis that the living organisms arise from preexisting life is known as biogenesis.

History of Microbiology

- Francesco Redi (Italian; 1626 – 1697)
- The first who debated over the Spontaneous Generation Theory in 1664.
- The Spontaneous Generation Theory proposed that life or living organisms could be "spontaneously generated" from non-living matter.

History of Microbiology

- In 1664, Redi showed that maggots do not spontaneously arise from decaying meat.
- He designed a simple controlled experiment known as Redi experiment.
- Two simultaneous tests are identical in every aspect except for one factor.
- The hypothesis is that this differing factor, called the manipulated variable, is the cause of the different results in each experiment.

History of Microbiology

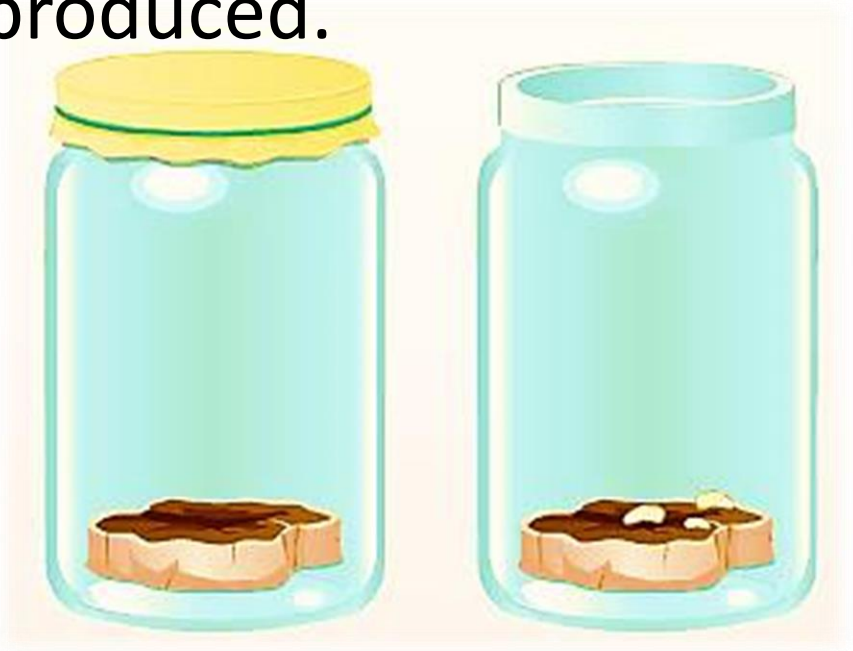
- Redi's Experiment
- Redi placed meat in two identical jars.
- He left one jar uncovered and allowed flies to come into contact with the meat.
- He covered the other jar with a cloth that allowed air to pass through.
- Hypothesis:
- Both pieces of meat would decay.
- But only the one that had physical contact with the flies would produce maggots.

History of Microbiology

- Therefore, the decay itself would be eliminated as the cause.

History of Microbiology

- After a short period of time Redi observed fly larvae (maggots) on the decaying meat of the open jar.
- No maggots on the meat in the covered jar were produced.



History of Microbiology

- Redi concluded that:
- The flies laid eggs on the meat in the open jar which caused the production of maggots.
- Because the flies could not lay eggs on the meat in the covered jar, no maggots were produced.
- Redi, therefore, proved that decaying meat did not produce maggots.

History of Microbiology

- John Needham (British; 1713 – 1781)
- In 1745, John Needham debated over the Spontaneous Generation Theory.
- He challenged Redi's findings and have conducted a different experiment using chicken broth.

History of Microbiology

- John Needham Experiment
- He placed a broth, or “gravy,” into a bottle.
- He heated the bottle to kill any living organisms inside.
- He then sealed the bottle.
- Few days later, he reported the presence of living organisms (life) in the broth.
- He announced that life had been created from non-life.

History of Microbiology

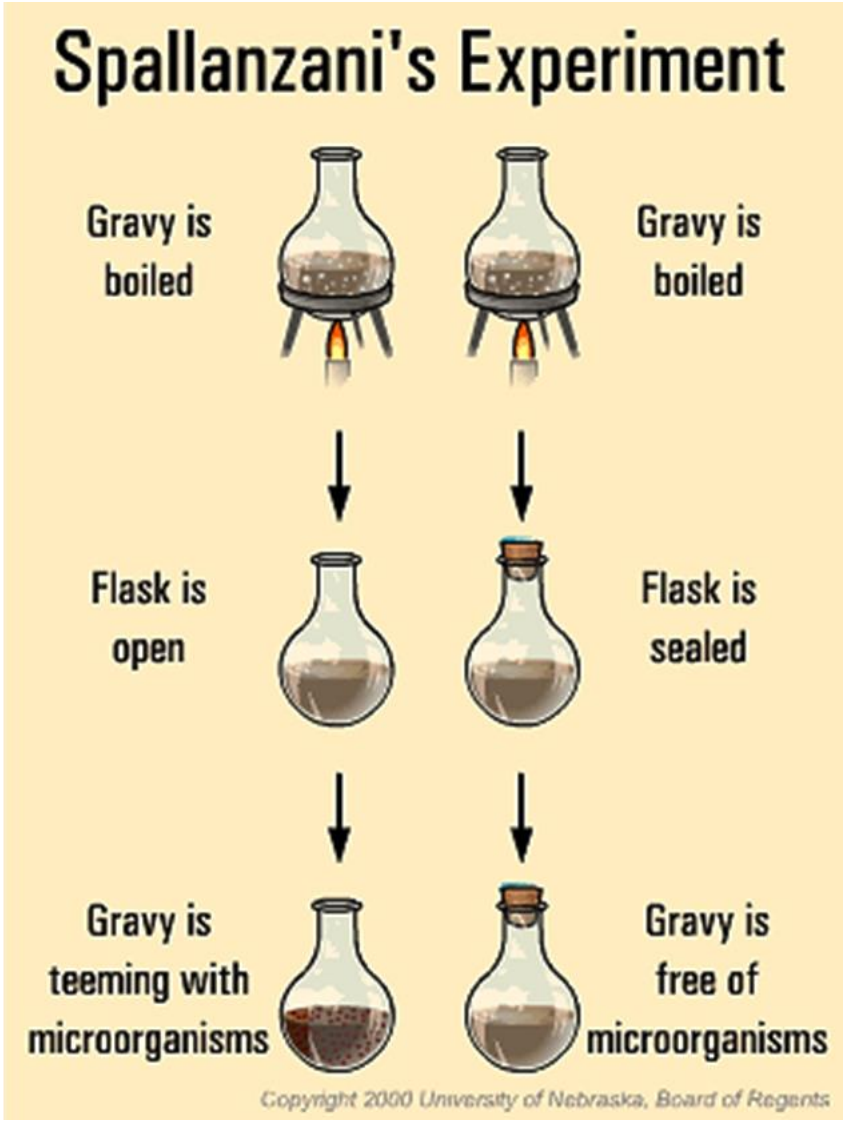
- Lazzaro Spallanzani (Italian; 1729 – 1799)
- In 1765, he debated over the Spontaneous Generation Theory.
- He reviewed both Redi's and Needham's data and experimental design.
- He concluded that perhaps Needham's heating of the bottle did not kill everything inside.

History of Microbiology

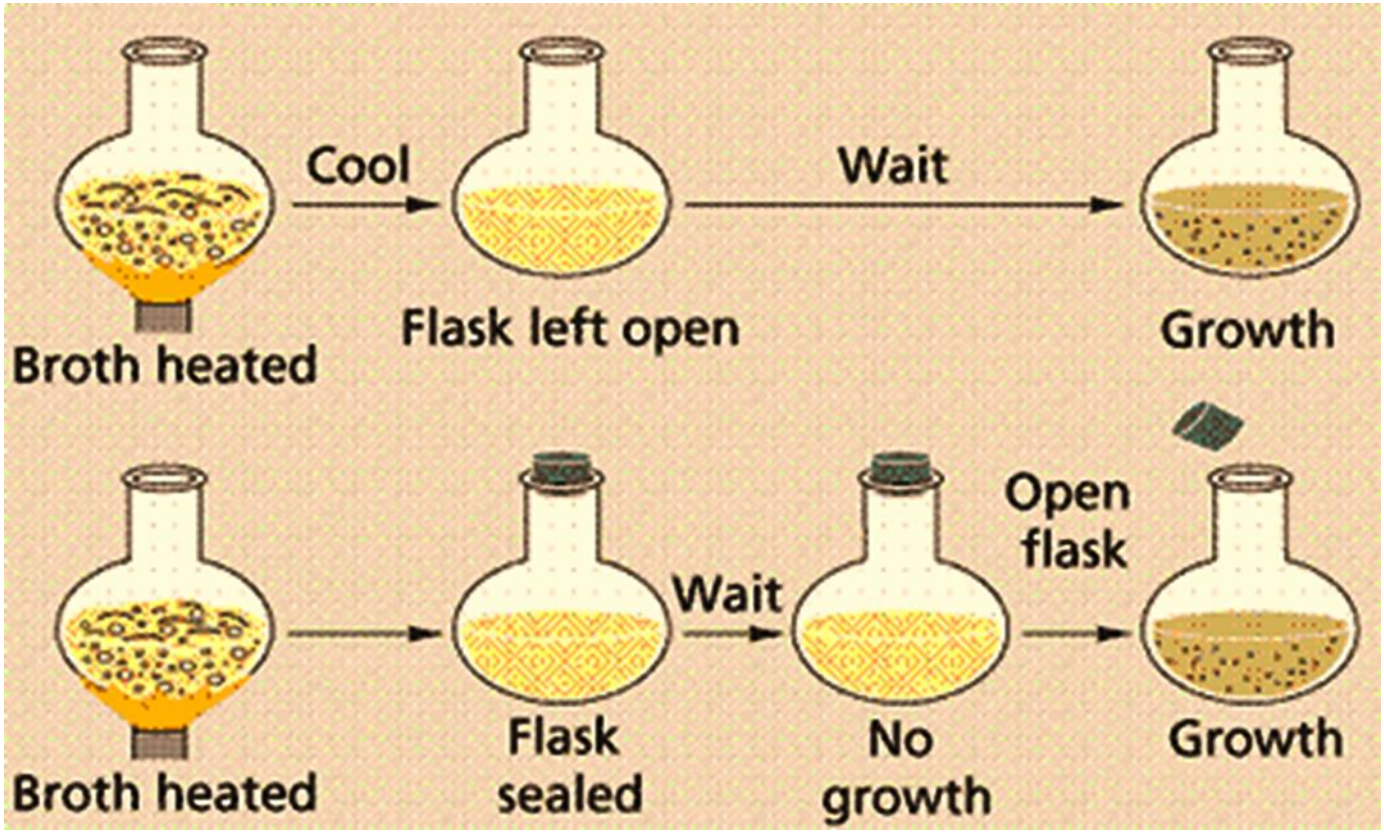
- Spallanzani's Experiment
- He placed broth in each of two separate bottles.
- Boiled the broth in both bottles.
- He sealed one bottle and left the other open.
- Days later, the unsealed bottle was teeming with small living things.
- The sealed bottle showed no signs of life.

History of Microbiology

Spallanzani's Experiment



History of Microbiology



- In reality, Needham did not heat the broth long enough to kill all the microbes.

History of Microbiology

- This certainly excluded spontaneous generation as a viable theory.
- Except it was noted by scientists of the day that Spallanzani had deprived the closed bottle of air, and it was thought that air was necessary for spontaneous generation.
- So although his experiment was successful, a strong rebuttal blunted his claims.

History of Microbiology

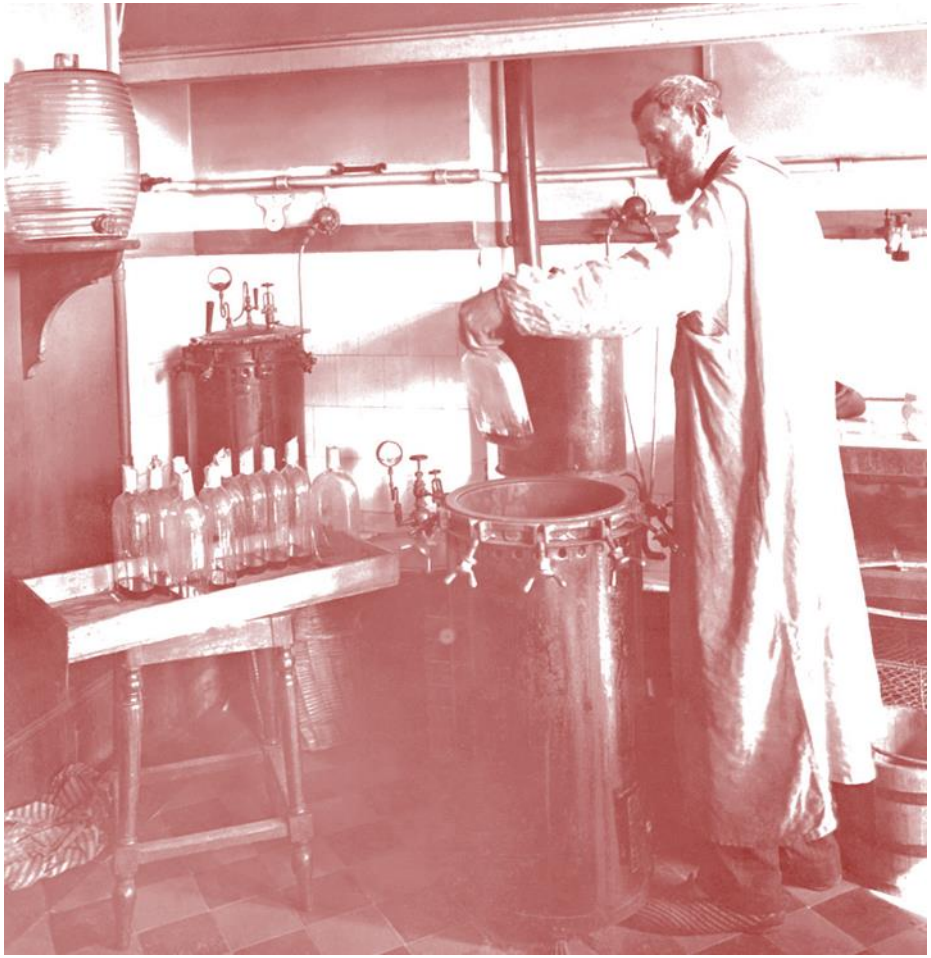
- Louis Pasteur (French; 1822 – 1895)
- He disproved the Spontaneous Generation Theory after many years of debate.

- The Golden Age of Microbiology (1857 – 1914).
- He accepted the challenge to re-create the experiment and leave the system open to air.

History of Microbiology

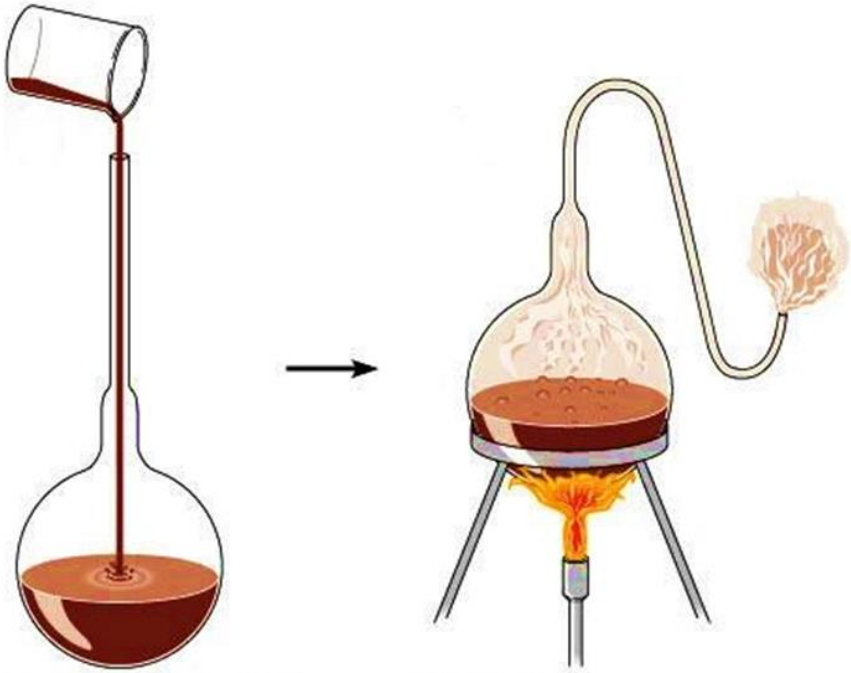
- Pasteur's Experiment

- Pasteur tested whether the sterile nutrient chicken broth could spontaneously generate a microbial life or not.



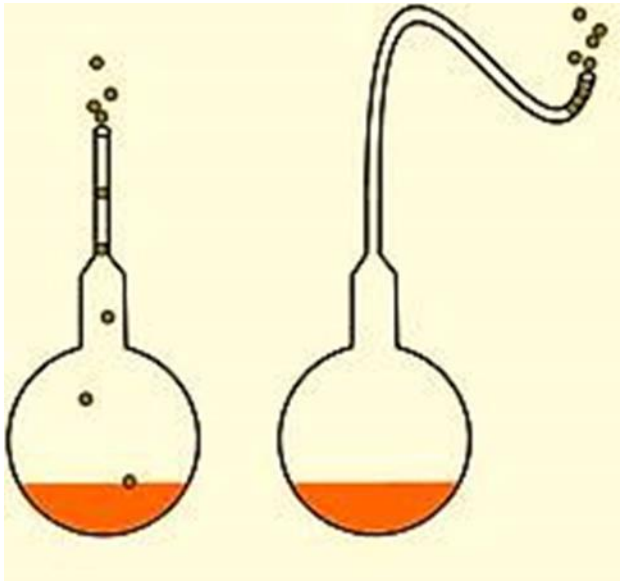
History of Microbiology

- He set up two experiments.
- He added nutrient broth to both flasks.
- He bent the necks of the flasks into S- shapes, and then boiled the broth to kill any microbes.

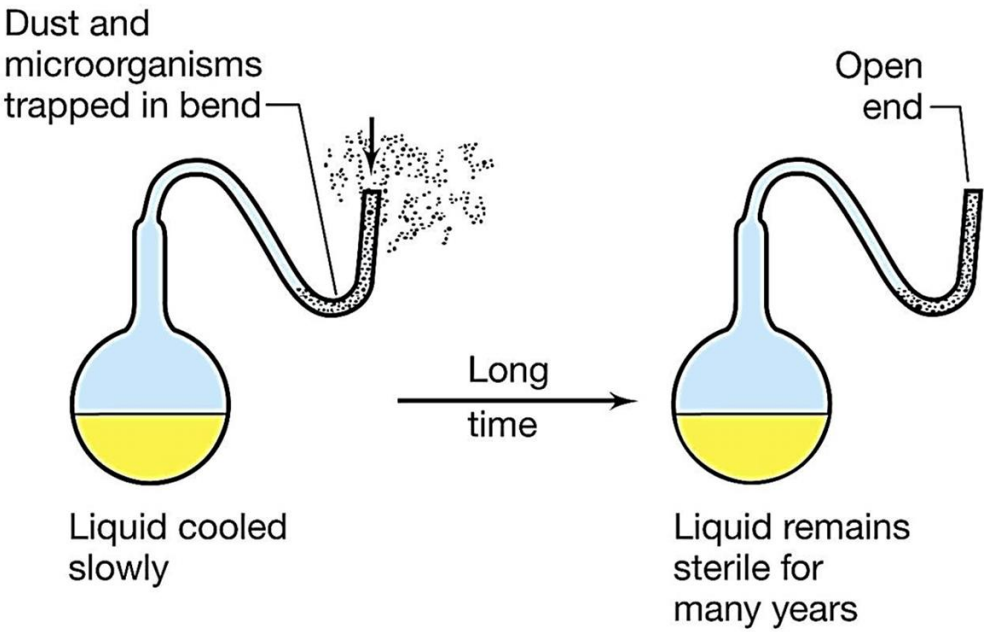


History of Microbiology

- Pasteur broke off the swan necks from the flasks in Experiment 1, exposing to air.
- The flasks in Experiment 2 were left alone.
- Over time, dust particles from the air fell into the broken flasks of Experiment 1.
- In Experiment 2, dust particles could not travel against gravity into the flasks, keeping the nutrient broth sterile.

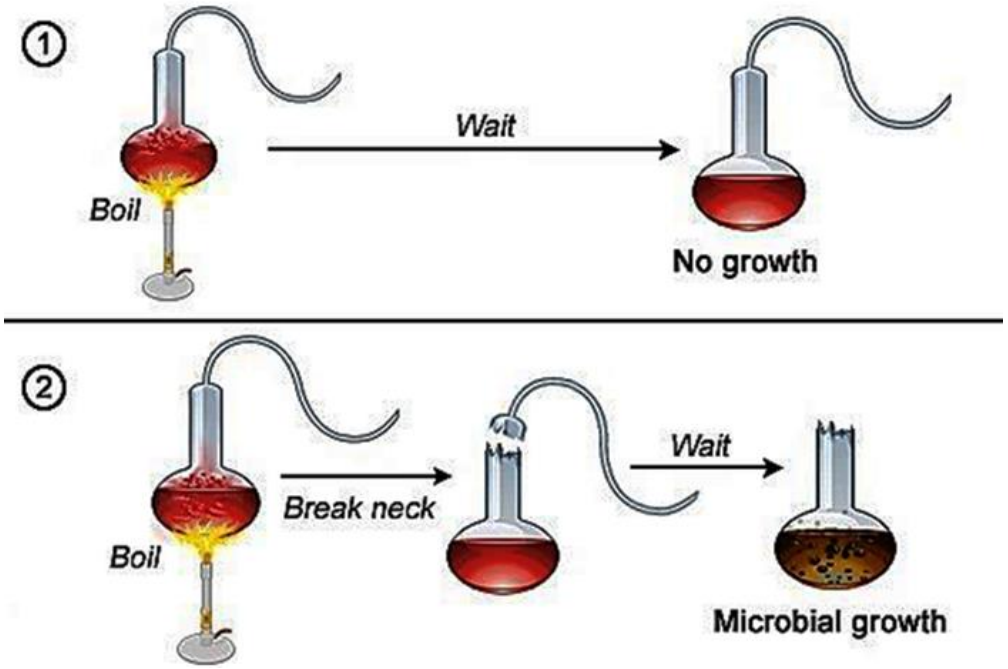


History of Microbiology



- The broth in the broken flasks quickly became cloudy.
- A sign that it teemed with microbial life.
- The unbroken flask broth remained clear.

History of Microbiology



- Without the introduction of dust, on which microbes can travel, no life arose.
- Louis Pasteur refuted the notion of the Spontaneous Generation Theory.