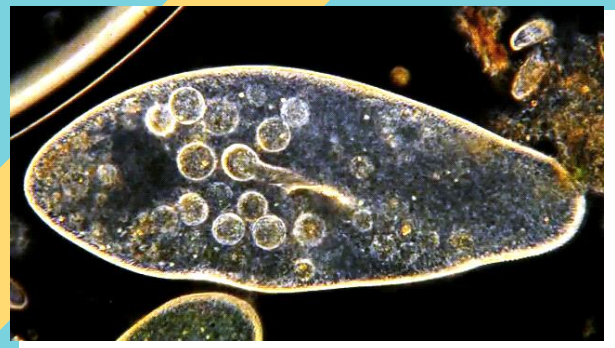
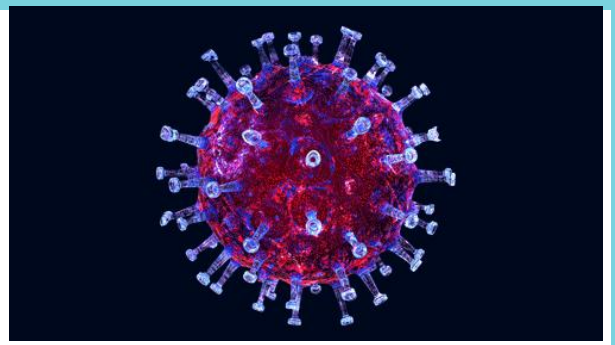




Alex

INTRODUCTION TO MICROBIOLOGY

Few reminders

- Attendance
- Q&A
- Listen Attentively
- Take down notes
- Quiz on Saturday

Before we start

Click here : What is the mood for today’s lecture?

Hello! I’m Sir ALEX

Let’s begin our lesson!

Learning Objectives

At the end of this chapter, the student should be able to :

1. Define Microbiology and give the importance of the study of Microbiology;
2. Discuss a brief discovery of the microorganisms
3. Name important persons with significant contributions to the field of Microbiology
4. Discuss the Golden Age of Microbiology and its significance

Summary of Topics

What is Microbiology?

Discovery of the microorganisms

Theory of Spontaneous Generation

Golden Age of Microbiology

Division and Major Field of Microbiology

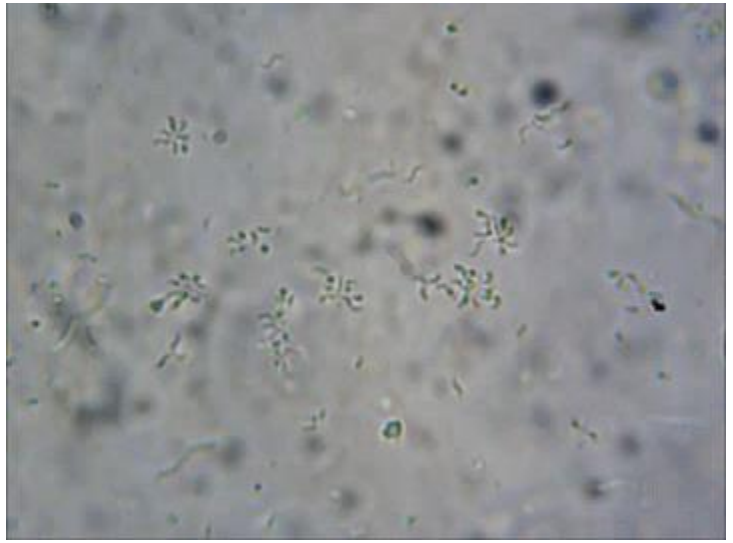
01

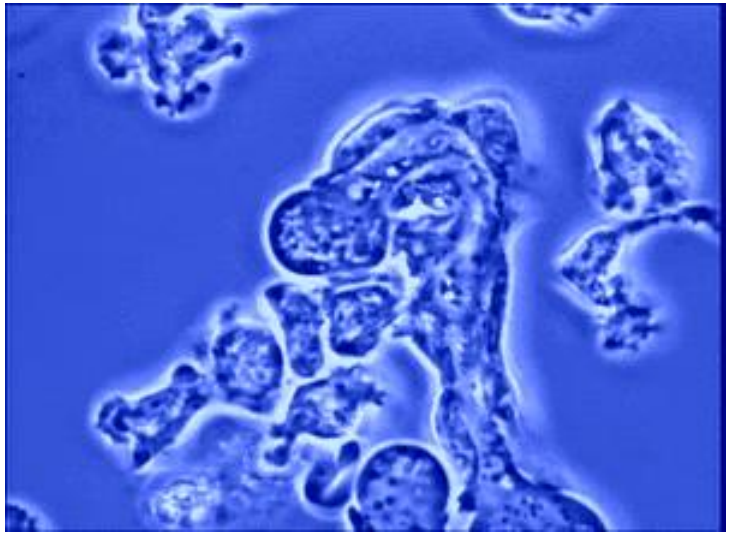
What is Microbiology

Microbiology

Definition

- Microbiology often has been defined as the study of organisms and agents too small to be seen clearly by the unaided eye—that is, the study of microorganisms.



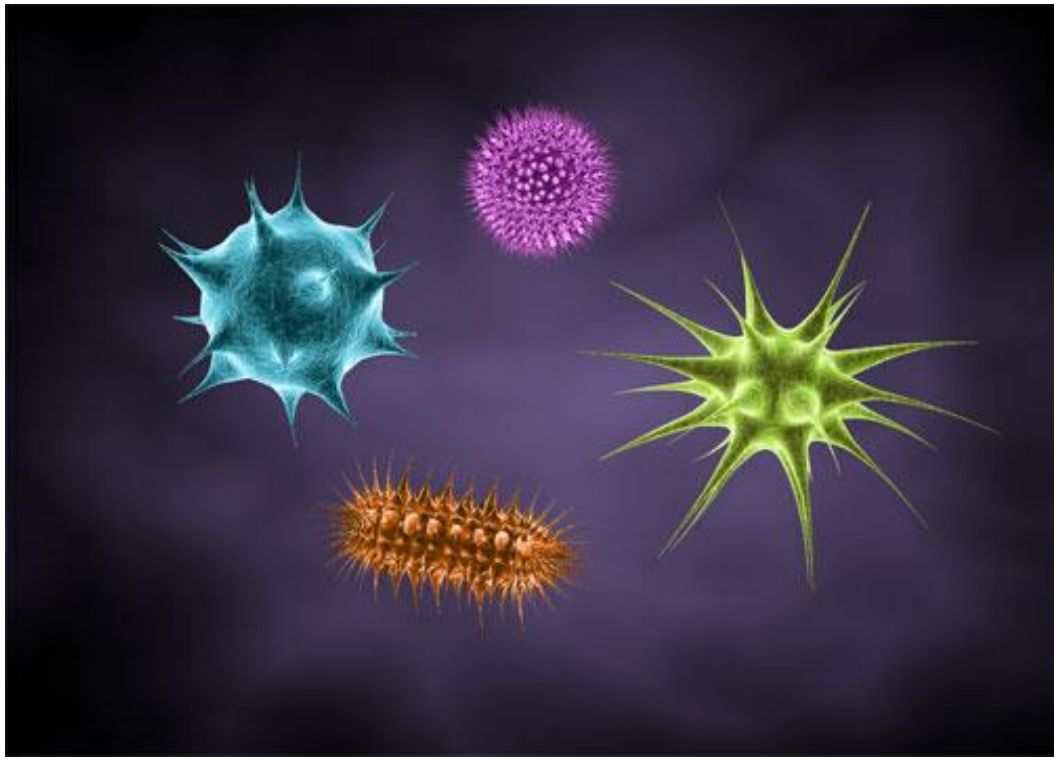


This is one of the biggest biomes on the planet.

— K.Lloyd

What do microbes do?

- Microbes are performing a huge range of functions – benign or beneficial roles.



WHAT DO MICROBES DO?

A 2011 study found that people with a high diversity of microbes on their skin were less attractive to mosquitoes.

Source - Healthline

WHAT DO MICROBES DO?

In the field of medicine, the discovery of Penicillin Antibiotics

By : Alexander Fleming

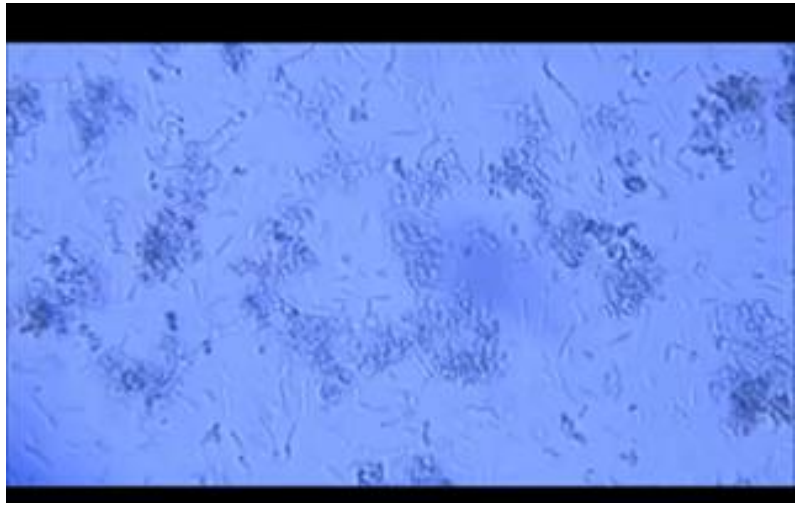
BRITISH JOURNAL OF EXPERIMENTAL PATHOLOGY, VOL. X, No. 3.

FIG. 1.—Photograph of a culture-plate showing the dissolution of staphylococcal colonies in the neighbourhood of a penicillium colony.

Hmmm... that's Funny!

WHAT DO MICROBES DO?

In digestion, break down some substances in food that cannot be digested

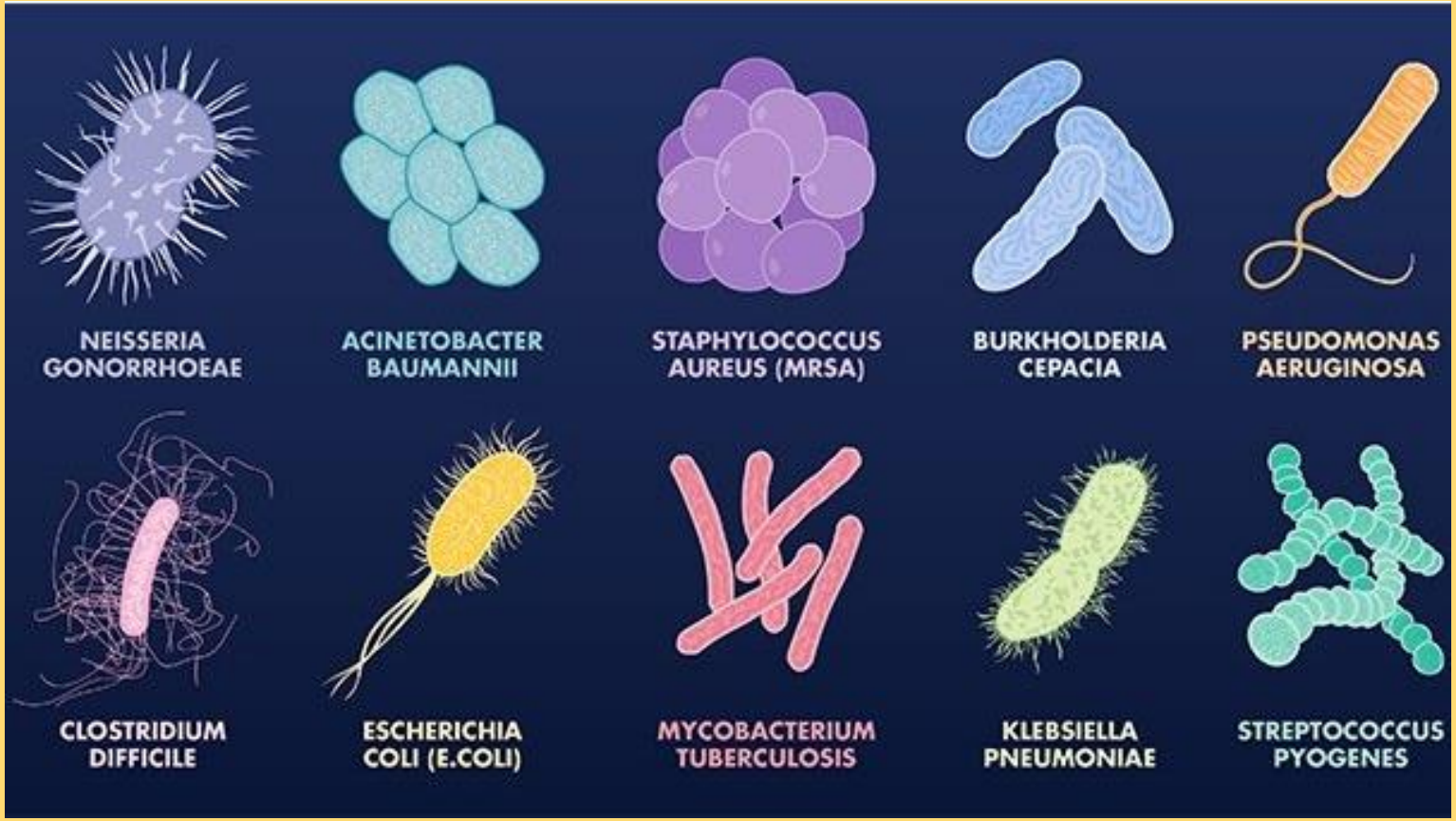


Lactobacillus Acidophilus

WHAT DO MICROBES DO?

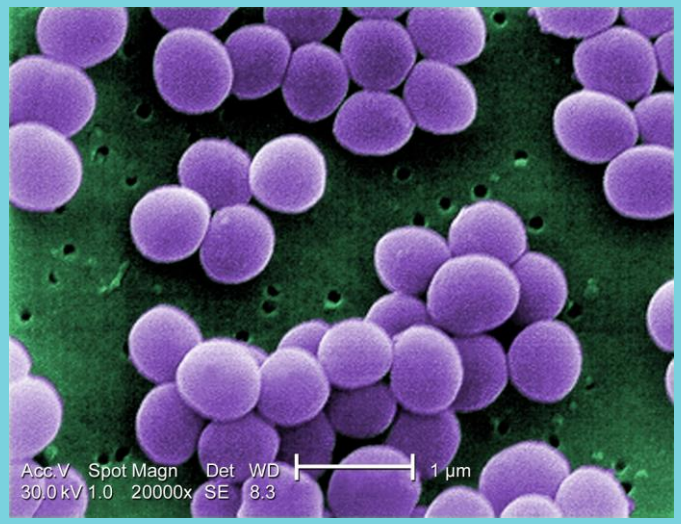
Production of milk and dairy products

Harmful Bacteria



Very interesting facts!

STAPHYLOCOCCUS AUREUS



STAPHYLOCOCCUS AUREUS (MRSA)

First documented : 1884

Illness caused : Pneumonia, Flesh Eating Disease

Antibiotic Resistance : Medium

Virulence : Dangerous

Effects of MRSA Infection to the HUMAN Skin

RETURN

02

History : Discovery of the Microorganisms

Whenever I found something remarkable, I have thought it is my duty to put down my discover on paper, so that all ingenious people be informed thereof.

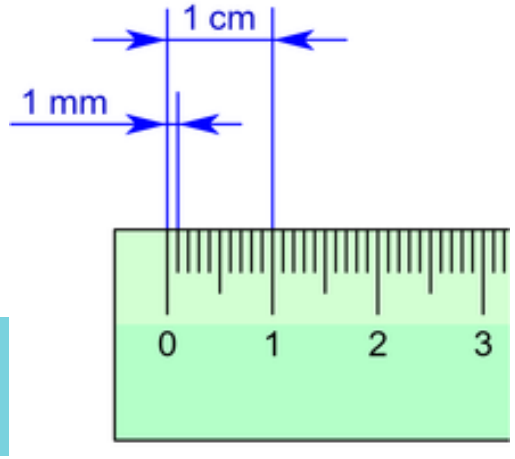
Antonie van Leeuwenhoek

Even before microorganisms were seen, some investigators suspected their existence and responsibility for disease.

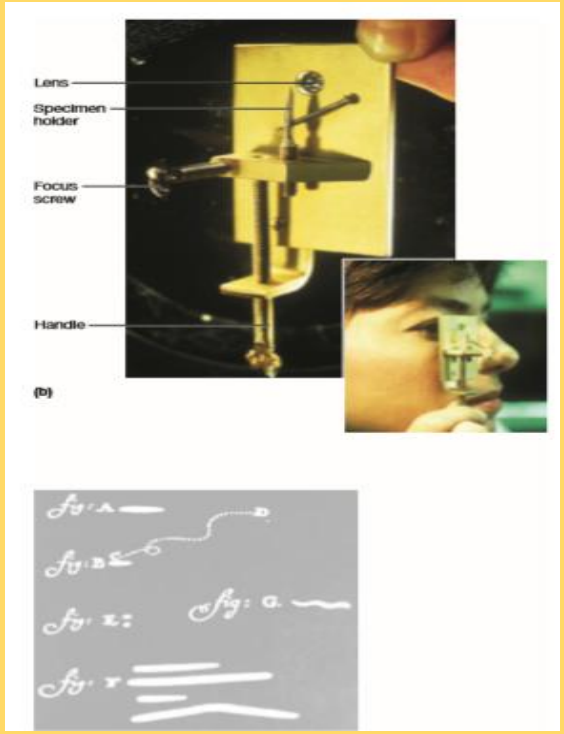
- Roman philosopher Lucretius (about 98–55 B.C.)

- Girolamo Fracastoro (1478–1553) suggested that disease was caused by invisible living creatures

The earliest microscopic observations appear to have been made between 1625 and 1630 on bees and weevils by the Italian ***Francesco Stelluti***, using a microscope probably supplied by Galileo.



- In 1665, the first drawing of a microorganism was published in ***Robert Hooke's*** Micrographia.



However, the first person to publish extensive, accurate observations of microorganisms was the amateur microscopist ***Antony van Leeuwenhoek*** (1632-1723) of Delft, The Netherlands (figure 1.3a).

Some facts!

- As important as Leeuwenhoek's observations were, the development of microbiology essentially languished for the next 200 years.
- ***Little progress*** was made primarily because microscopic observations of microorganisms ***do not provide sufficient information*** to understand their biology.
- For the discipline to develop, techniques for ***isolating and culturing microbes*** in the laboratory were needed.

200 years

Insufficient

Techniques

Many of these techniques began to be developed as scientists grappled with the conflict over the **Theory of Spontaneous Generation.**

This conflict and the subsequent studies on the role played by microorganisms in causing disease ultimately led to what is now called the **Golden Age of Microbiology.**

RETURN

03

Theory of Spontaneous Generation

The Conflict over Spontaneous Generation

- From earliest times, people had believed in spontaneous generation—that living organisms could develop from nonliving matter.

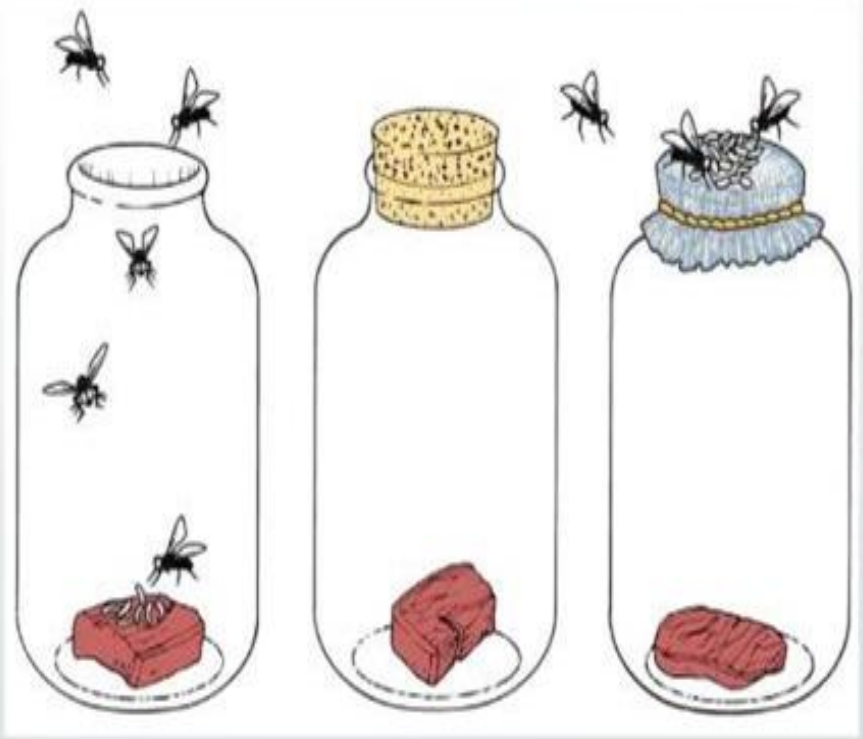
- Even ***Aristotle*** (384–322 B.C.) thought some of the simpler invertebrates could arise by spontaneous generation.

Example : maggots growing out of raw meat, mice being born out of hay

Francesco Redi

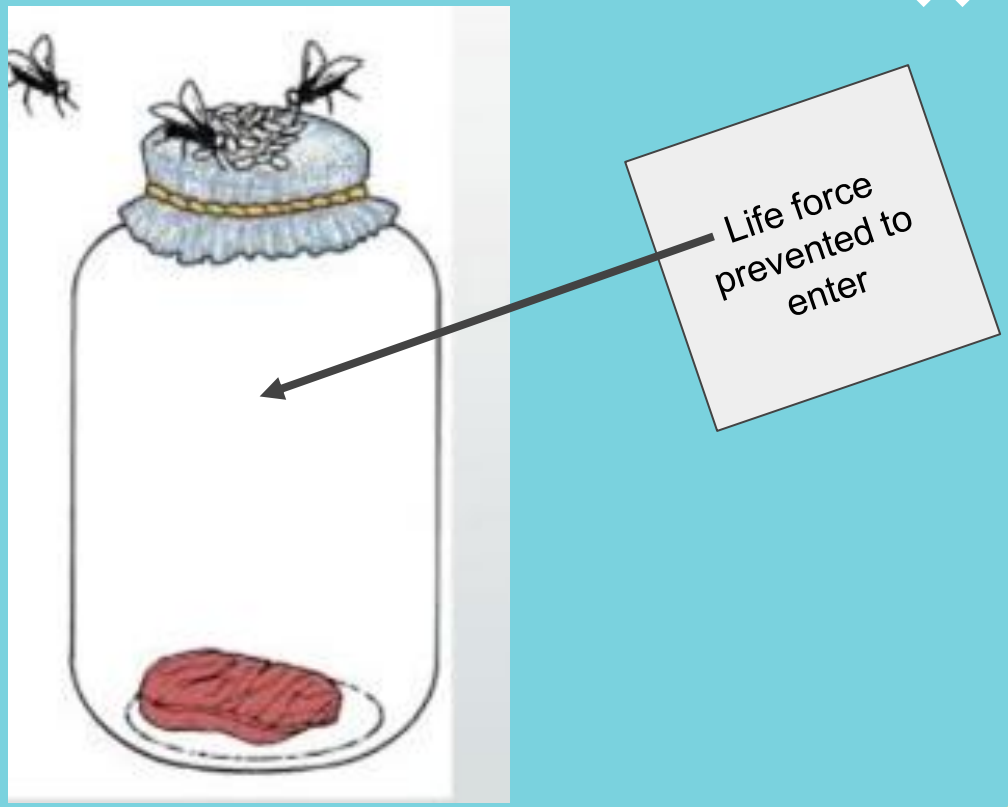
- This view finally was challenged by the Italian physician *Francesco Redi* (1626-1697)
- Carried out a series of experiments on decaying meat and its ability to produce maggots spontaneously.
- Redi placed meat in three containers. (Uncovered, paper, fine gauze)

Francesco Redi

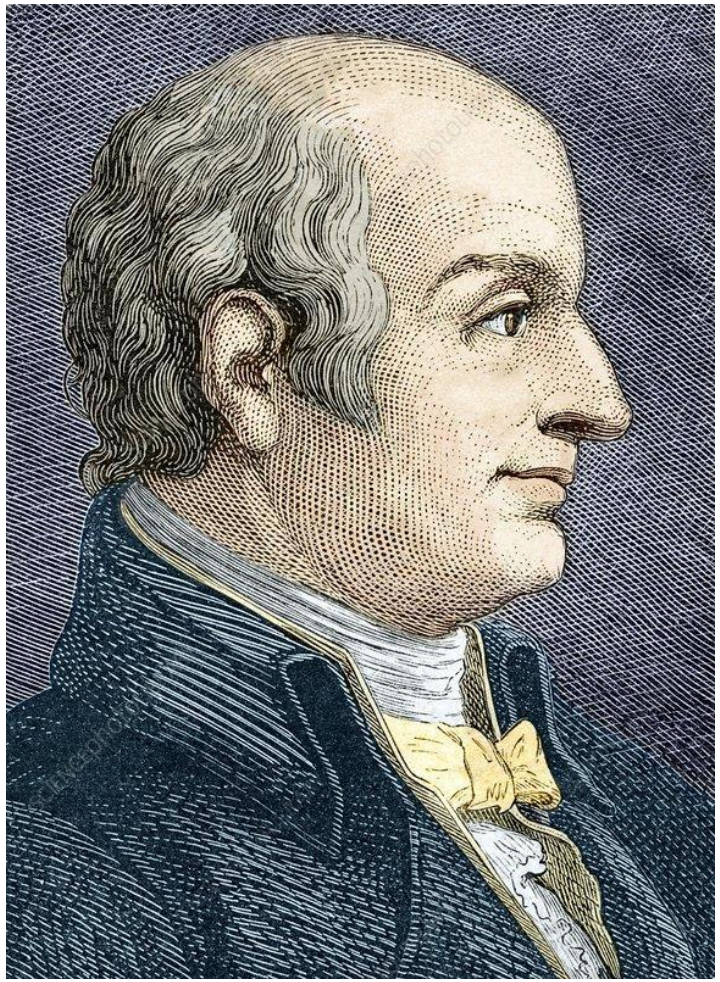


- The other two pieces of meat did not produce maggots spontaneously.
- However, flies were attracted to the gauze-covered container and laid their eggs on the gauze; these eggs produced maggots.
- Thus, generation of maggots by decaying meat resulted from the presence of fly eggs. And meat did not sponta-neously generate maggots as previously believed.

- But you know what? This didn't disprove Spontaneous Generation … there were SKEPTICS.
- Prevented **Life Force** from getting in… thus no generation of maggots.

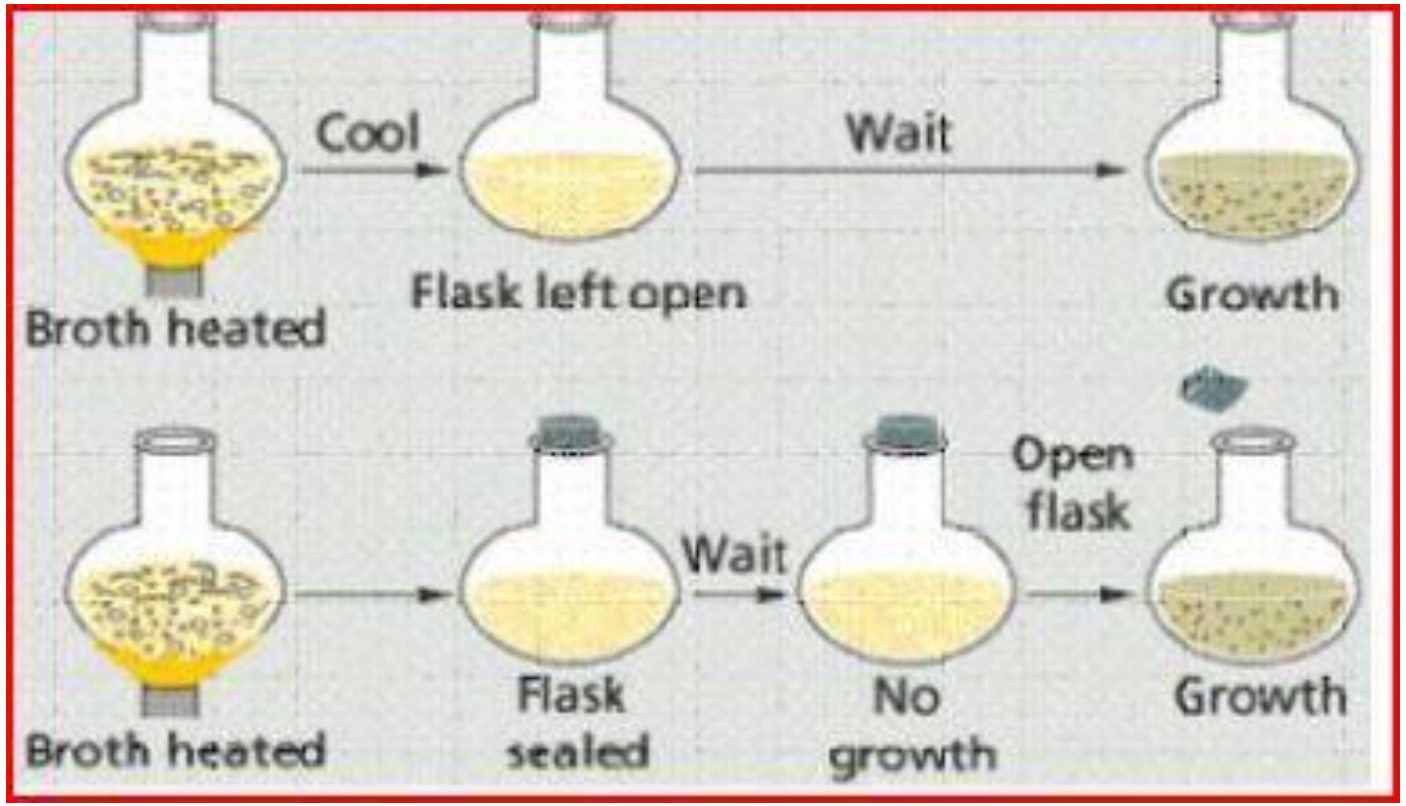


Lazzaro Spallanzani



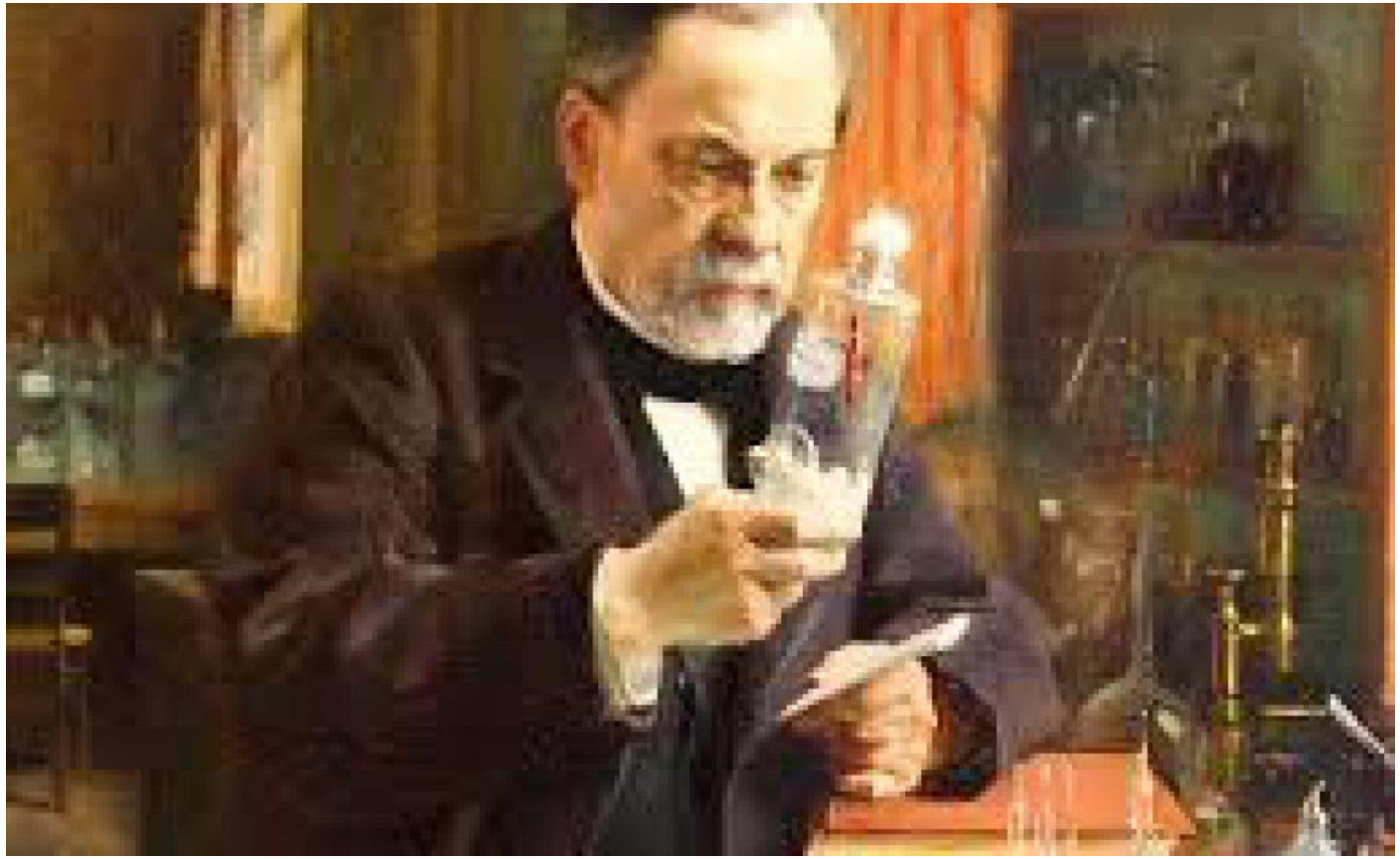
- A few years later, the Italian priest and naturalist ***Lazzaro Spallanzani*** (1729-1799)
- Improved on Needham's experimental design by first sealing glass flasks that contained water and seeds.

Lazzaro Spallanzani



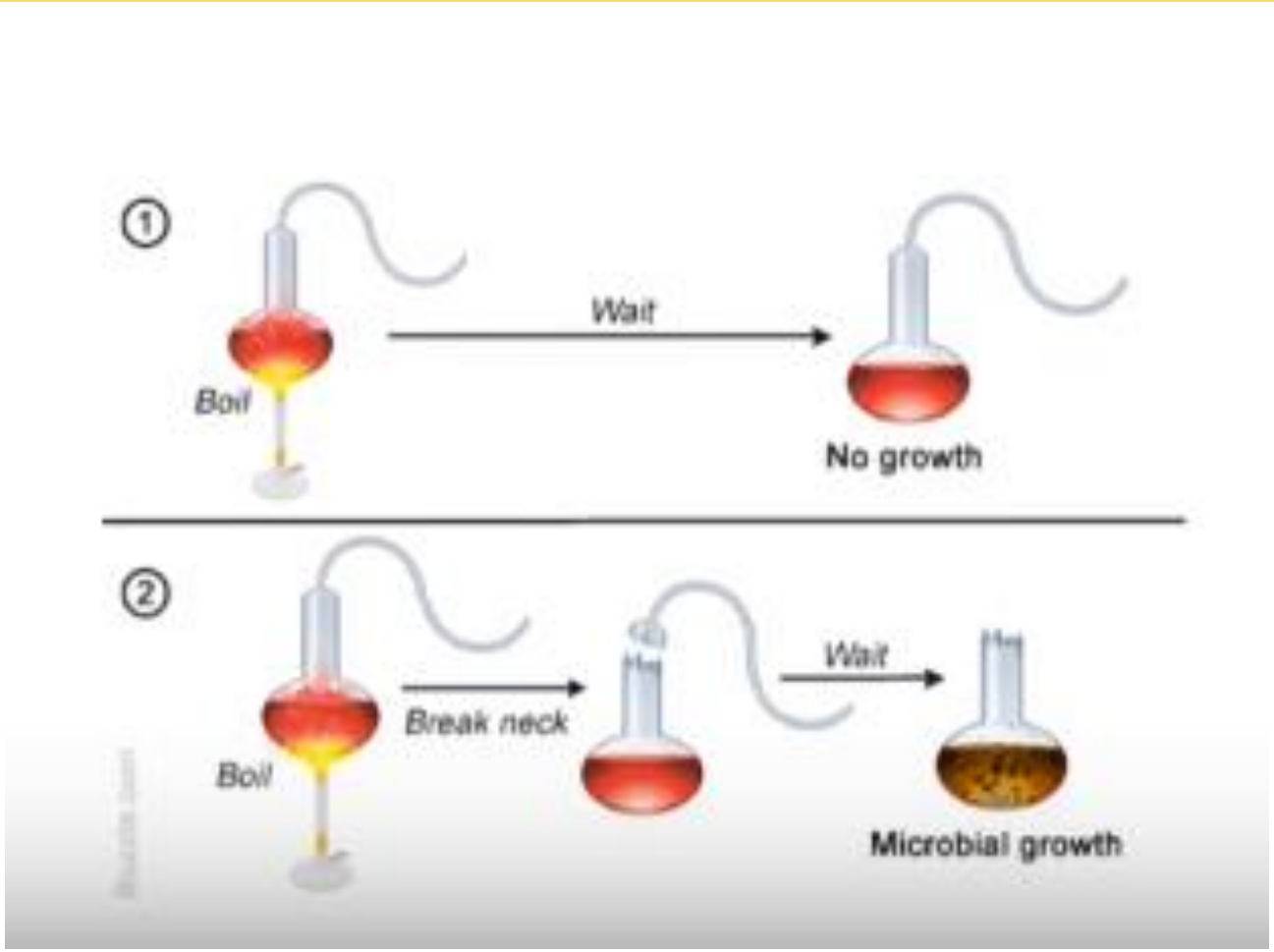
Although there were still skeptics, (life force again), but he showed that BOILING could definitely get rid / prevents the growth.

Louis Pasteur



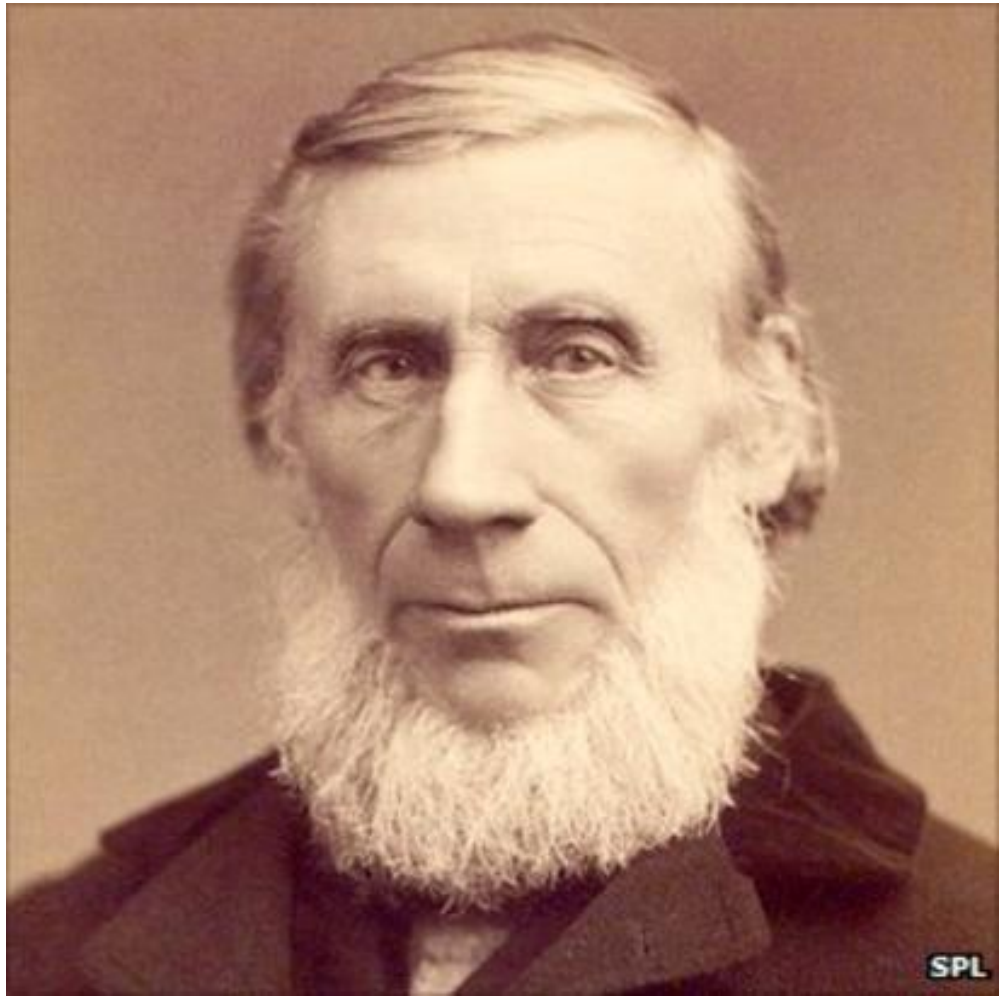
- This claim provoked Louis Pasteur (1822-1895) to settle the matter once and for all.
- 19th Century French scientists who officially disproved spontaneous generation (thanks to “germ theory)

Louis Pasteur



- His swan-necked flask was the key!
- Thanks to Louis Pasteur we have vaccines also, as well as **Pasteurization!**

John Tyndall



- The English physicist **John Tyndall** (1820-1893) dealt a final blow to spontaneous generation in 1877 by demonstrating that dust did indeed carry germs and that if dust was absent, broth remained sterile even if directly exposed to air.

RETURN

In conclusion, thanks to the work of these 4 scientists (and others), spontaneous generation was considered a myth and biogenesis is now the accepted idea.

Life makes life.

04

GOLDEN AGE OF MICROBIOLOGY

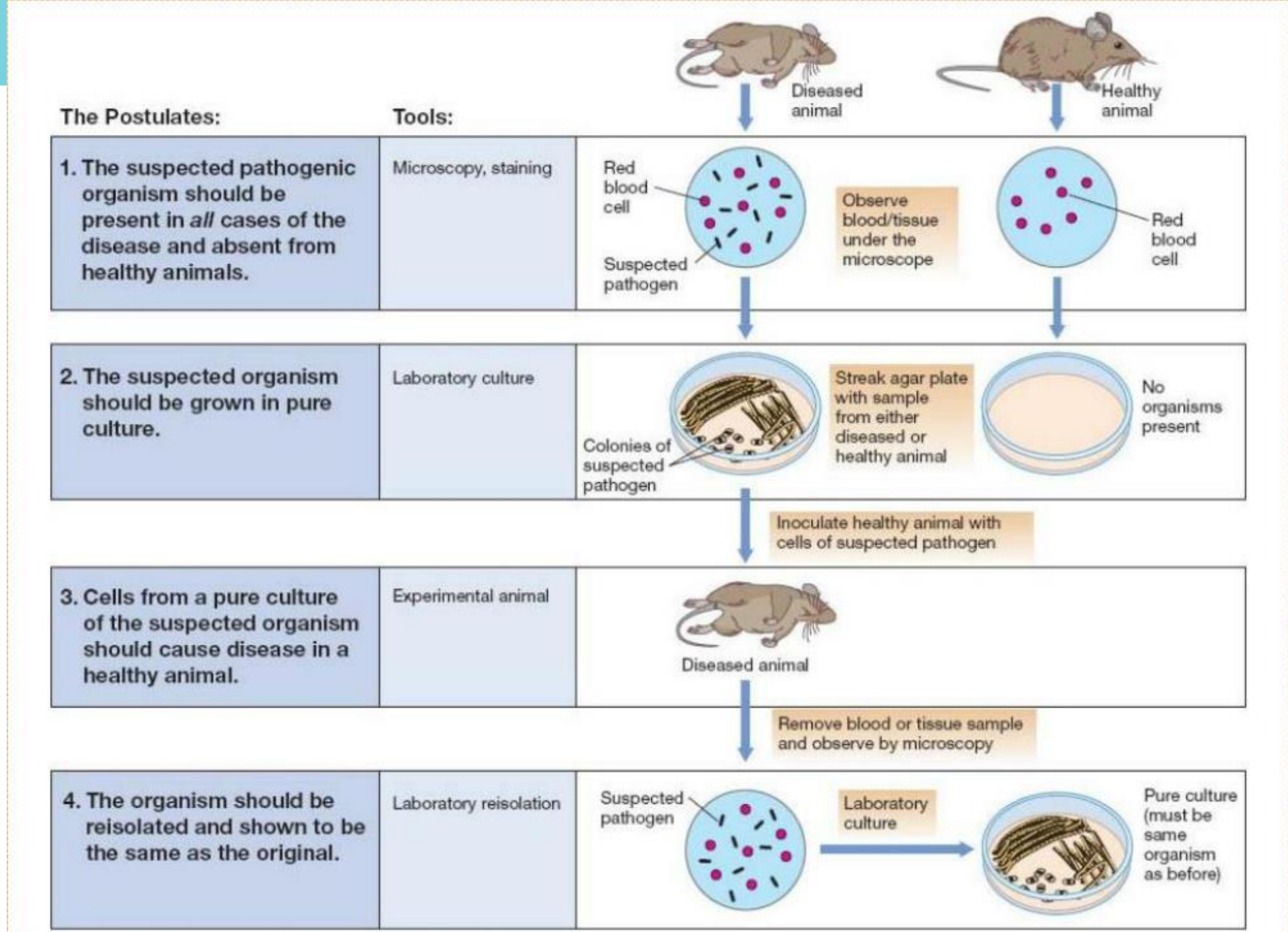
The Golden Age of Microbiology

- Pasteur’s work with swan neck flasks ushered in the Golden Age of Microbiology.
- Within 60 years (1857-1914), a number of disease-causing microbes were discovered.
- Understanding microbial metabolism were made, and techniques for isolating and characterizing microbes were improved.

Robert Koch

- The first direct demonstration of the role of bacteria in causing disease came from the study of anthrax by the German physician **Robert Koch** (1843-1910)

- His criteria for proving the causal relationship between a microorganism and a specific disease are known as **Koch's postulates.**



Source: Madigan, Martinko, Dunlap and Clark, p. 15 (2009).

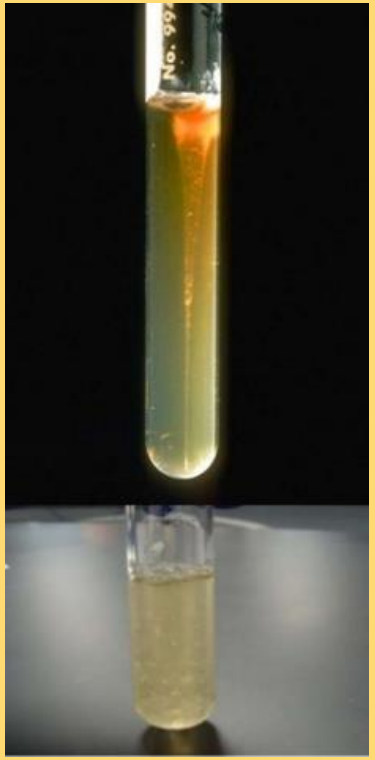
The Development Of Techniques For Studying Microbial Pathogens

During Koch's studies on bacterial diseases, it became necessary to isolate suspected bacterial pathogens in **pure culture**

- a culture containing only one type of microorganism.

- At first Koch cultured bacteria on the sterile surfaces of **cut, boiled potatoes**, but this was ***unsatisfactory*** because the bacteria would not always grow well.

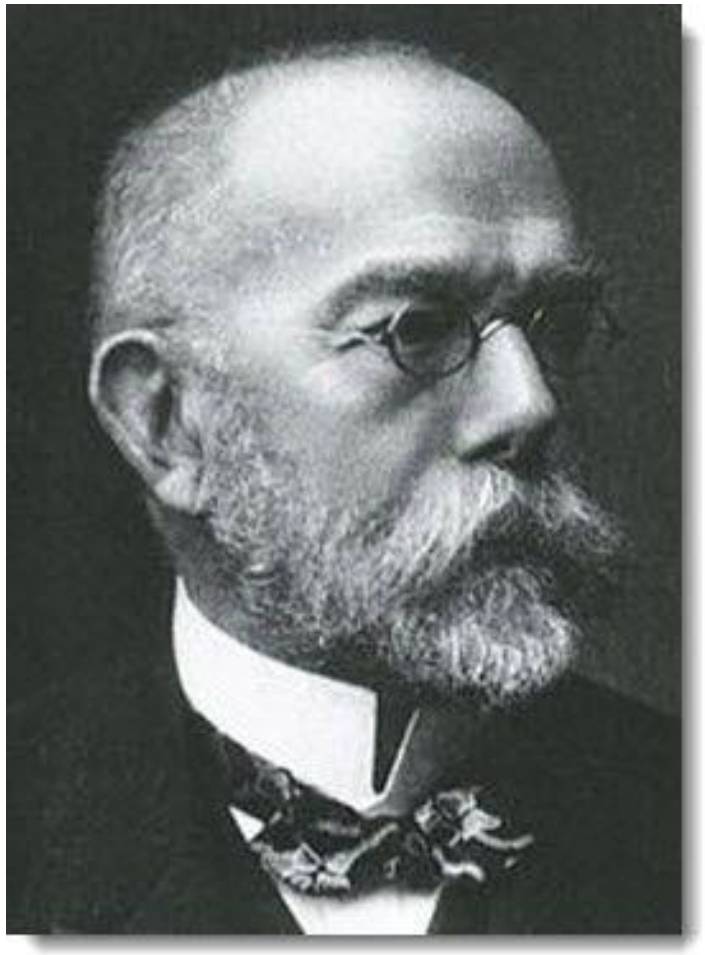
- Eventually he developed culture media using ***meat extracts and protein*** digests because of their similarity to ***body fluids***.



- A better alternative was provided by ***Fannie Eilshemius Hesse***, the wife of Walther Hesse, one of Koch's assistants. She suggested the use of ***agar*** as a solidifying agent.

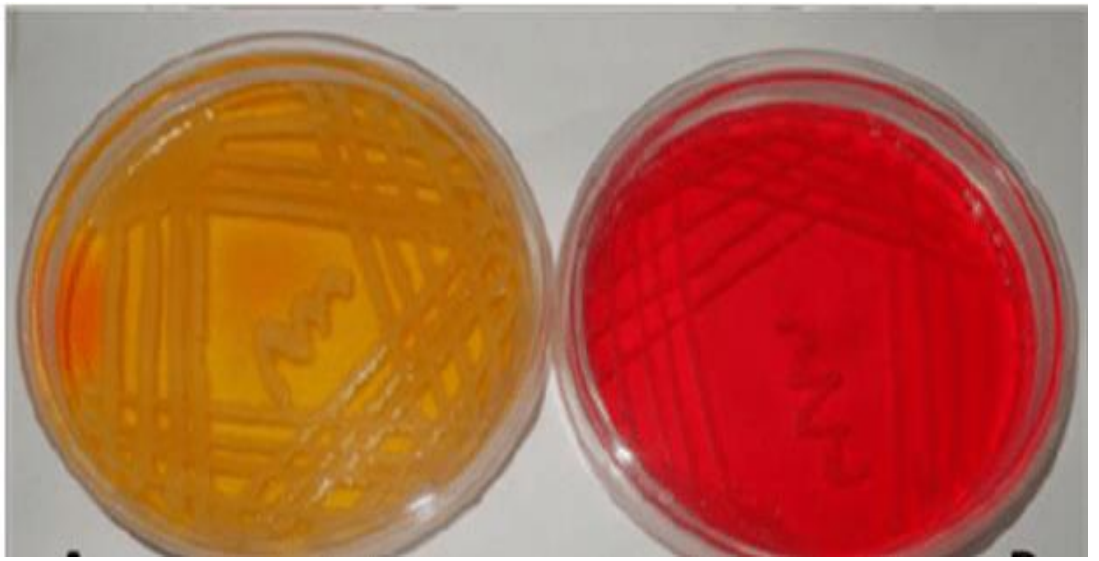
- Some of the media developed by Koch and his associates, such as ***nutrient broth*** and ***nutrient agar.***

Richard Petri



- Another important tool developed in Koch's laboratory was a container for holding solidified media- the petri dish (plate), named after ***Richard Petri***, who devised it.
- These developments directly stimulated progress in all areas of bacteriology.

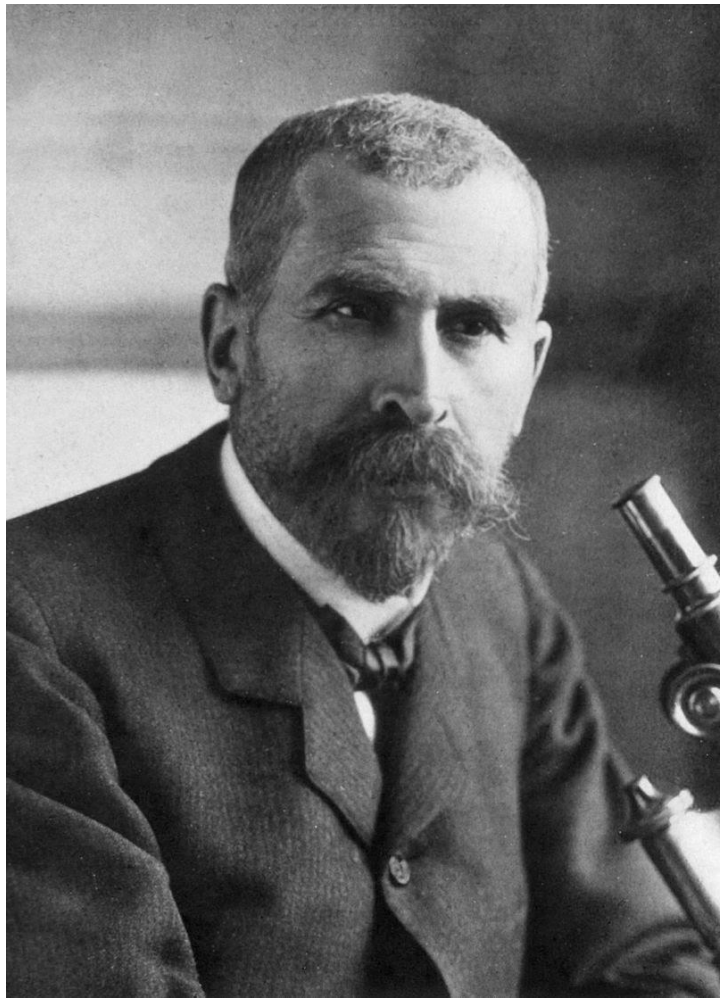
PETRI DISH



Immunological Studies

- In this period progress also was made in determining ***how animals resisted disease*** and in developing techniques for ***protecting humans and livestock against pathogens.***

Pierre Paul Émile Roux



*During studies on **chicken cholera**, **Pasteur and Roux*** discovered that ***incubating their cultures for long intervals*** between transfers would attenuate the bacteria, which meant they had lost their ability to cause the disease.

- RESULT : If the chickens were injected with these attenuated cultures, they ***remained healthy*** but developed the ability to resist the disease.

- He called the attenuated culture a **vaccine** [Latin vacca, cow] in honor of ***Edward Jenner*** because, many years earlier, Jenner had used material from cowpox lesions to protect people against ***smallpox.***

Rabies Vaccine

Pasteur next prepared rabies vaccine by a different approach.

The pathogen was attenuated by growing it in an abnormal host, the rabbit. After infected rabbits had died, their brains and spinal cords were removed and dried.

Joseph Meister, a nine-year-old boy who had been bitten by a rabid dog, was brought to Pasteur. Since the boy's death was certain in the absence of treatment, Pasteur agreed to try vaccination. Joseph was injected 13 times over the next 10 days with increasingly virulent preparations of the attenuated virus. He survived.

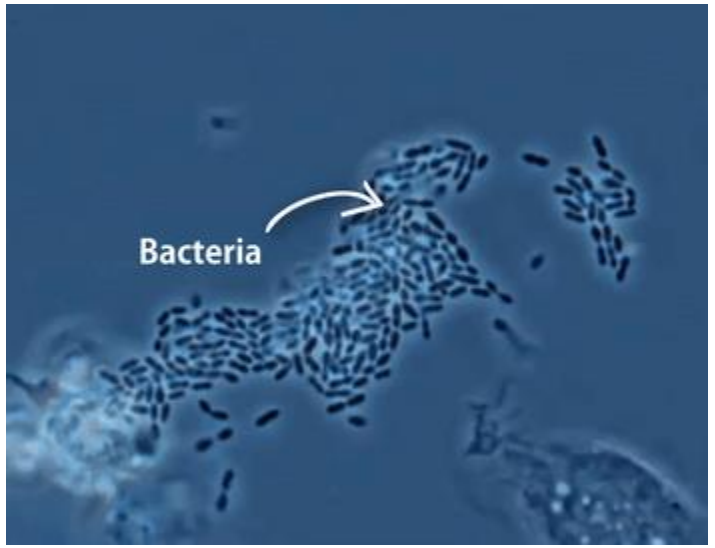
...Immunology....

- After the discovery that the **diphtheria bacillus** produced a toxin, Emil von Behring (1854-1917) and Shibasaburo Kitasato (1852-1931)

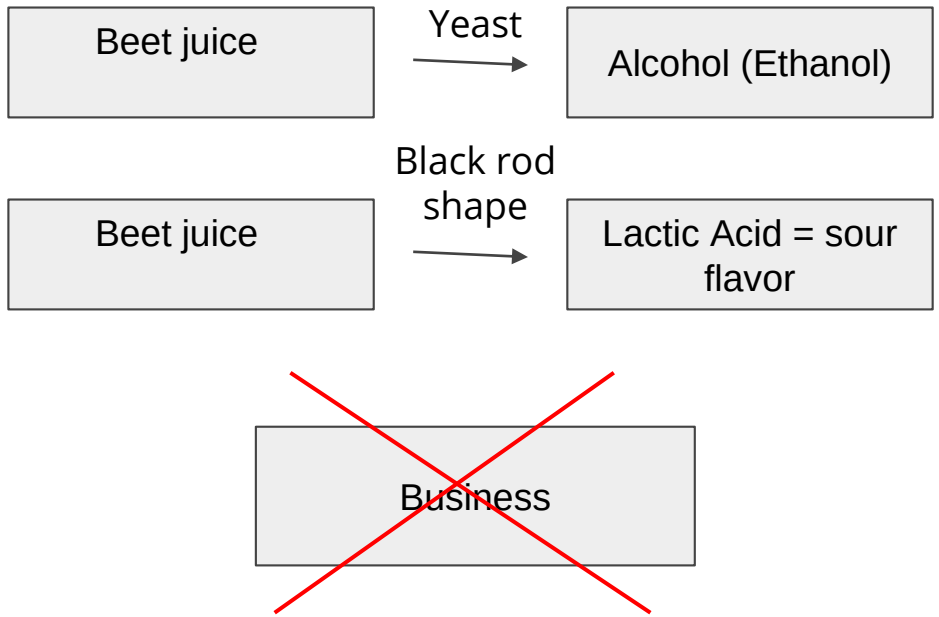
  - injected inactivated toxin into rabbits, inducing them to produce an antitoxin, a substance in the blood that would inactivate the toxin and protect against the disease.
  - A tetanus antitoxin was then prepared and both antitoxins were used in the treatment of people.

- The antitoxin work provided evidence that immunity could result from soluble substances in the blood, now known to be antibodies ***(humoral immunity)***.

- It became clear that blood cells were also important in immunity ***(cellular immunity)*** when **Elie Metchnikoff** (1845-1916) discovered that some blood leukocytes could engulf disease-causing bacteria - and called the cells **PHAGOCYTES** and the process **PHAGOCYTOSIS.**



The Development of Industrial Microbiology and Microbial Ecology



- Industrial microbiology developed in large part from the work of Louis Pasteur and others on the ***alcoholic fermentations*** that yielded wine and other alcoholic beverages.
- In 1837, when **Theodore Schwann** and others proposed that yeast cells were responsible for the conversion of sugars to alcohol.
- In 1856 M. Bigo, an industrialist in Lille, France, where Pasteur worked, requested Pasteur's assistance.
- His business produced ethanol from the fermentation of beet sugars, and the alcohol yields had recently declined and the product had become sour.
  (Yeast been replaced : ethanol vs lactic acid)
- His success led to a study of wine diseases and the development of pasteurization to ***preserve wine during storage.***

Microbial Ecology

- developed when a few of the early microbiologists chose to investigate the ecological role of microorganisms.
- In particular they studied microbial involvement in the ***carbon, nitrogen, and sulfur cycles*** taking place in soil and aquatic habitats.

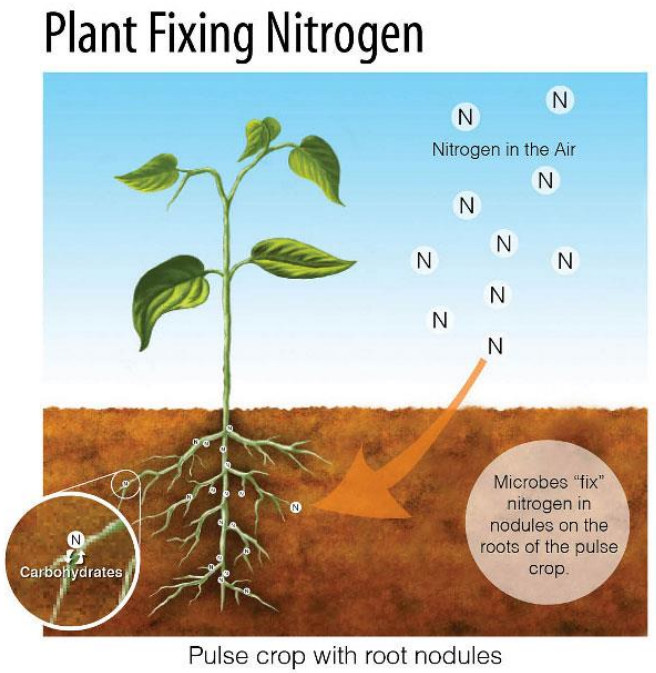
Microbial Ecology

- Let's take for example, the NITROGEN to soil microbiology.

Role of Nitrogen-fixing bacteria

Martinus Beijerinck (1851-1931) -

He isolated the aerobic nitrogen-fixing bacterium Azotobacter, a root nodule bacterium also capable of fixing nitrogen (later named Rhizobium), and sulfate-reducing bacteria.



Pulse crop with root nodules

RETURN

05

DIVISION AND MAJOR FIELD OF MICROBIOLOGY

Scope and Relevance of Microbiology

- Microbiology has the following divisions :

1. Basic

2. Applied

BASIC aspects are concerned with :

- Bacteriology - study of bacteria
- Mycology - study of fungi
- Protozoology - study of protozoa
- Phycology - study of algae
- Parasitology - study of parasites
- Immunology - study of immune system
- Virology - study of viruses
- Nematology - study of nematodes

APPLIED ASPECTS

- are concerned with practical problems such as disease, water and wastewater treatment, food spoilage and food production, and industrial uses of microbes.

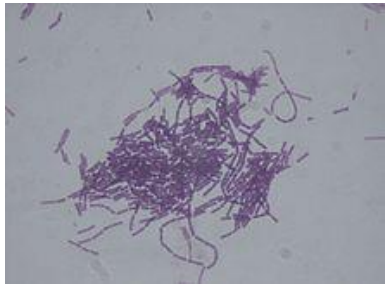
Major fields of microbiology and occupations

- **Medical microbiologists** identify the agents causing infectious diseases and plan measures for their control and elimination.
- **Public health microbiology** is closely related to medical microbiology. Public health microbiologists try to identify and control the spread of communicable diseases.

Major fields of microbiology and occupations

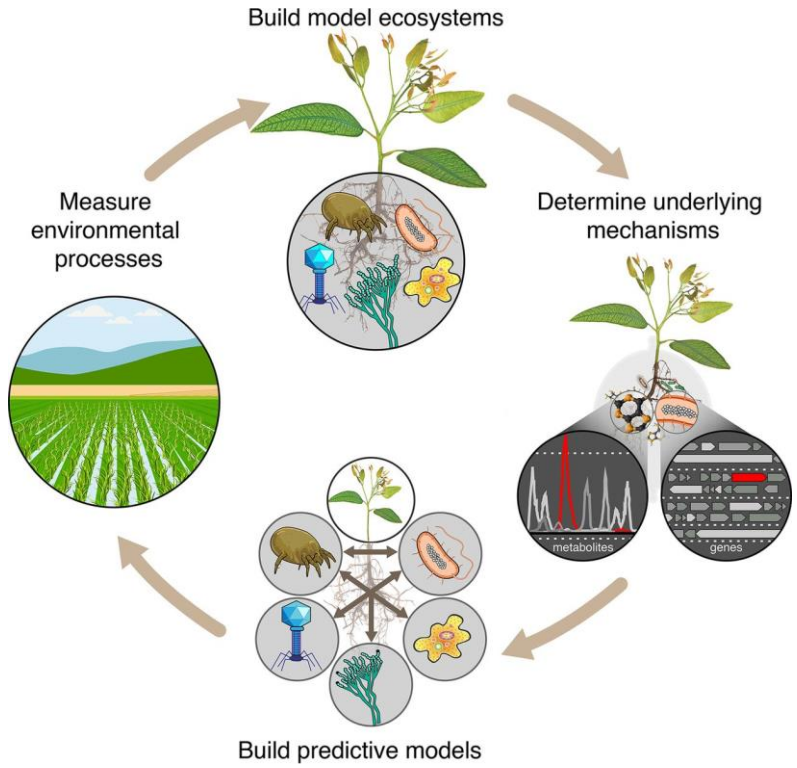
- **Immunology** is concerned with how the immune system protects the body from pathogens and the response of infectious agents.
- It is one of the fastest growing areas in science; for example, techniques for the production and use of monoclonal antibodies have developed extremely rapidly.

Major fields of microbiology and occupations



- **Agricultural microbiology** is concerned with the impact of microorganisms on agriculture.
- Agricultural microbiologists try to combat plant diseases that attack important food crops, work on methods to increase soil fertility and crop yields, and study the role of microorganisms living in the digestive tracts of ruminants such as cattle.

Major fields of microbiology and occupations



- **Microbial ecology** is concerned with the relationships between microorganisms and the components of their living and nonliving habitats.
- Microbial ecologists study the global and local contributions of microorganisms to the carbon, nitrogen, and sulfur cycles.

Major fields of microbiology and occupations

- Scientists working in **food and dairy microbiology** try to prevent microbial spoilage of food and the transmission of foodborne diseases such as botulism and salmonellosis.
- They also use microorganisms to make foods such as cheeses, yogurts, pickles, and beer.

Major fields of microbiology and occupations

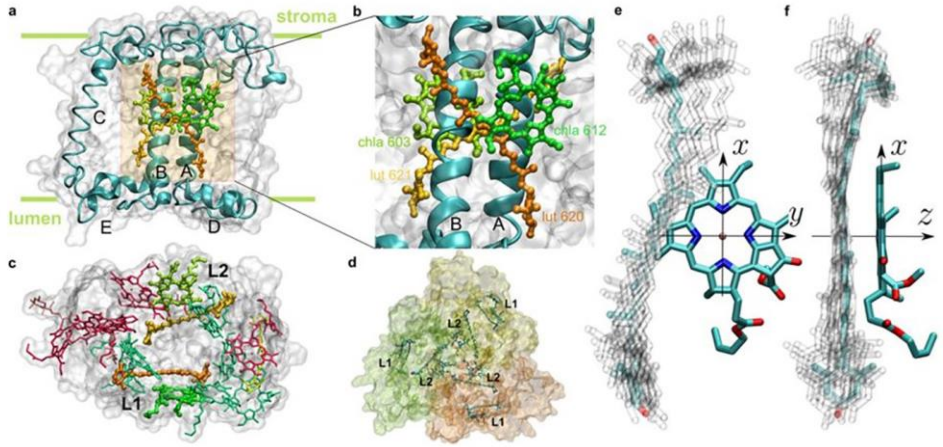
- Today, **industrial microbiologists** use microorganisms to make products such as antibiotics, vaccines, steroids, alcohols and other solvents, vitamins, amino acids, and enzymes.

Major fields of microbiology and occupations

- Microbiologists working in ***microbial physiology and biochemistry*** study many aspects of the biology of microorganisms.

They may study the synthesis of antibiotics and toxins, microbial energy production, the ways in which microorganisms survive harsh environmental conditions, microbial nitrogen fixation, and the effects of chemical and physical agents on microbial growth and survival.

Major fields of microbiology and occupations



- ***Microbial genetics and molecular biology*** focus on the nature of genetic information and how it regulates the development and function of cells and organisms.

Thank you!

Do you have any questions?

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Messenger @ :
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