InterProfessional Laboratory Team: Laboratory Scientist, Clinician, Pharmacologist, Nurse, social scientist, communication expert

Course: MLS 333 BASIC MICROBIOLOGY (3 units)

Topics: HISTORY OF MICROBIOLOGY

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LESSON OBJECTIVES

At the end of the class students should be able to;

- Understand the meaning of Microorganism and differnt shapes
- Mention at least five early scientists internationally and locally
- List they group of microorganism relvant in medical field
- Understand Spontaneous generation and the theory behind it.
- Differnetiate between Sterile and Non sterile environment and how they predisposes to disease
- List Koch5's Postulate

MICROBIOLOGY

Microbiology (from Greek mīkros, "small"; βίος, bios, "life"; and -λογία, -logia): This is the study of microorganisms, those being:

Unicellular (single cell)

Multicellular (cell colony)

Acellular (lacking cells)

Study of Unseen microbiological life

MICROBIOLOGY

Microbes or microrganisms are living organisms. They are found everywhere (ubiquitus). In air, water, human body, ocean etc.

Why we study microganisms in medical field;

1. To educate ourselves on how we can play our role in Infection Prevention and Control (IPC).

2. Prevent health care-associated infections (HAI)

3. Reduce antimicrobial resistance (AMR).

MICROBIOLOGY

Microbes that can be beneficial, neutral or harmful to humans.

The harmful ones are called pathogens

Pathogens are microbes that cause disease—but not all microbes are pathogens

Beneficial microbes are essential for humans to live and function.

Many microbes are normal human flora

There are 10 trillion human cells and 100 trillion bacteria , protozoa, and fungal cells in the human body.

When these microbes appear in parts of the body where they do not belong, they can cause **infection**.

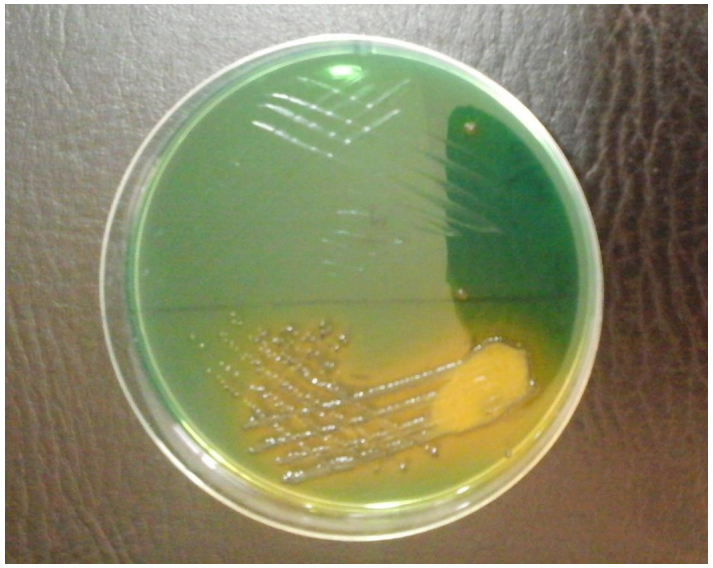
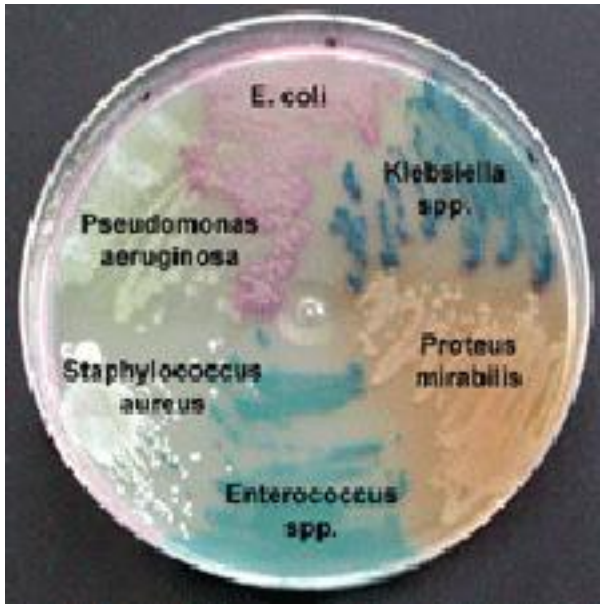
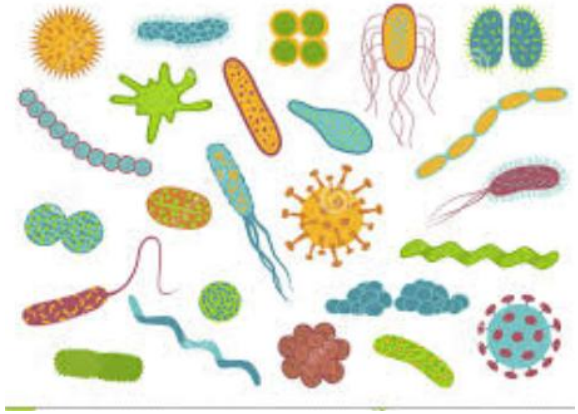
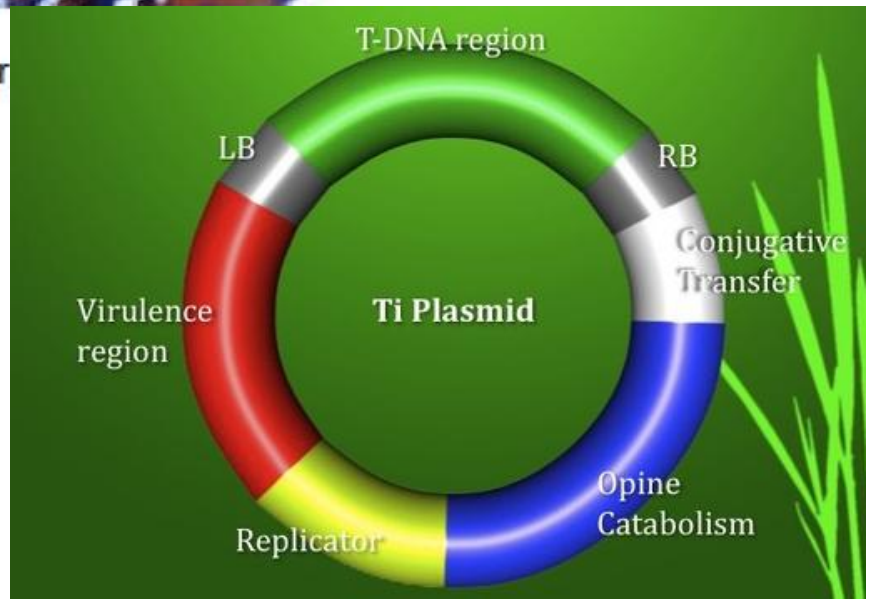


Figure 1 *E. coli* on ECC Agar



They bacteria and fungi can be grown in the laboratory

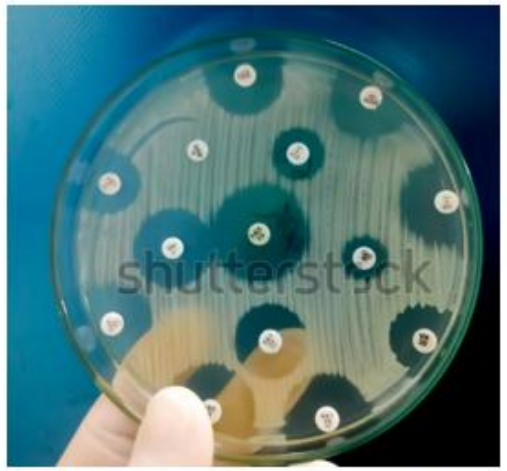




HISTORY OF MICROBIOLOGY IN NIGERIA

Class Interaction

Mention the names of 5 Nigerians that are Microbiologists?



https://www.istockphoto.com/photos/antimicrobial-susceptibiity-test

History of Microbiology

Existence of unseen Microbiological life was postulated by **Jainism.**

It was based on **Mahavira's** teachings as early as 6th century BCE

Mahavira asserted the existence of unseen microbiological creatures living in earth, water, air and fire.

In the olden days, diseases were seen to be caused by **Wrath of God** or **myth**

Other proposed that diseases where cause by bad Air: This lead to **Miasmatic theory:**

Which started in early to mid-nineteenth century and felt that diseases like cholera was caused by bad air, arising from decayed organic matter or miasmata. This theory has been Disproved

Miasmatic theory

The **Miasma theory** (also called the **Miasmatic theory**): an obsolete medical theory

Accepted by Europe and China: Believe that diseases— cholera, chlamydia, Black Death—were caused by a *miasma* (Greek: "pollution"), a noxious form of "bad air", **night air**.

The theory held that the origin of epidemics was due to a miasma, emanating from rotting organic matter.

Miasma theory is typically associated with the spread of disease, some academics in the early nineteenth century suggested that the theory extended to other conditions as well,

e.g. An individual could become obese by inhaling the odor of food

The theory was dropped by scientists and physicians after 1880

Replaced by the germ theory of disease: specific germs, not miasma, caused specific diseases. However, cultural beliefs about getting rid of odor made the clean-up of waste a high priority for cities

History of Microbiology

Other theories in addition to Miasmatic theory are

The theory of spontaneous generation: Disproved

Germ Theory of DISEASE: Proved

There are also concepts like

- **Golden age of Microbiology**
- **Second golden age of microbiology**

Current Era of Microbiology

Spontaneous generation

- Spontaneous generation and prove of theory
- Spontaneous generation was the idea that living organisms can come into existence from non-living matter.
  - Ex: Toads and Mice could arise from soil
  - Until the 18th century this believe existed

Francisco Redi, Lazzaro Spallanzani, **Louis Pasteur** disproved the theory of spontaneous generation

Spontaneous generation

- **Franscesco Redi** disprove it using meat
- Disproved that maggot did not come from the meat but from contact with flies that deposited the maggot

➢**Invention of Microscope:** This was done to see cells and structures

➢**Zacharia Jensens:** First to produce compound Microscope

History

Girolamo Fracastoro in 1546, proposed that epidemic diseases were caused by transferable seed like entities that could transmit infection by direct or indirect contact, or vehicle transmission.

1665 Robert Hooke discovered cells by observed living plant tissues (20X mag.)

He saw and described cells as “Little boxes” or Cells

Used simple magnifying lens

Suggested all living things are made of cells

1675: He was named the father of microbiology because he observed the first motile microorganism. He discovered the first **bacteria**

MICROGRAPHIA:

OR SOME

Physiological Descriptions

OF

MINUTE BODIES

MADE BY

MAGNIFYING GLASSES.

WITH

OBSERVATIONS and INQUIRIES thereupon.

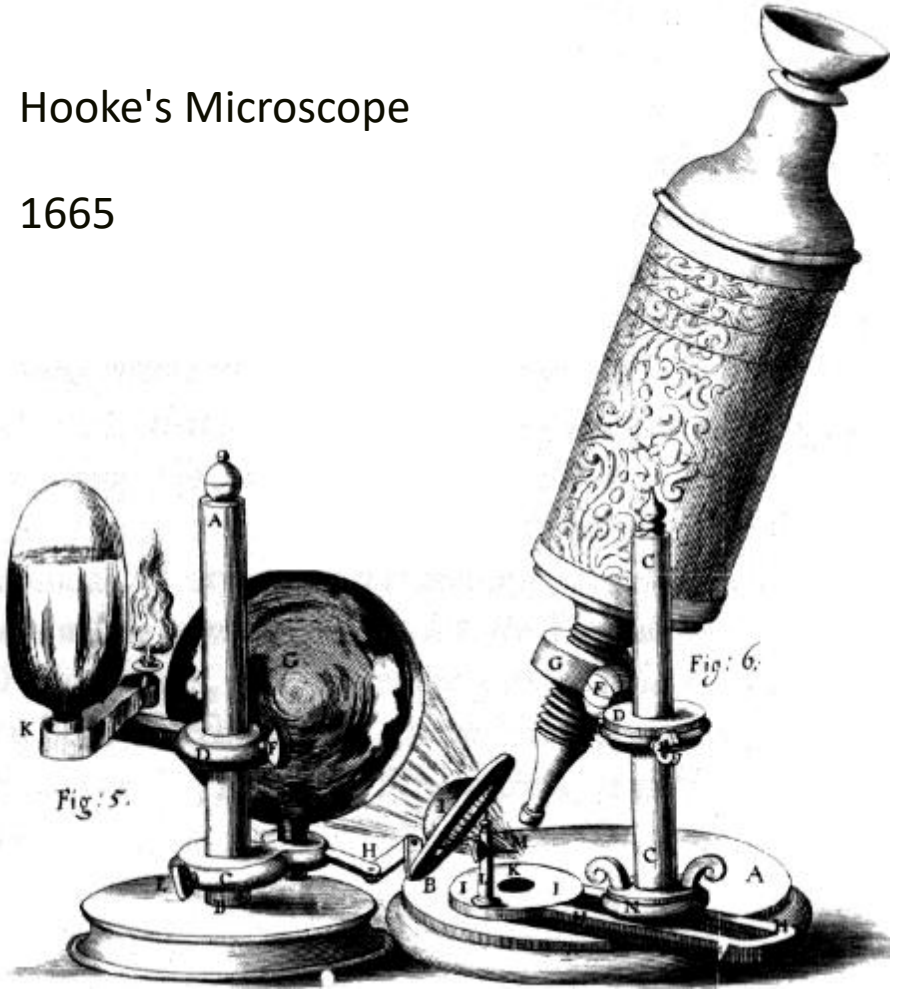
By *R. HOOKE*, Fellow of the ROYAL SOCIETY.

Non possis oculo quantum contendere Lincus,
Non tamen idcirco contemnas Lippus inungi. Horat. Ep. lib. 1.

LONDON, Printed by *Jo. Martyn*, and *Ja. Allestry*, Printers to the ROYAL SOCIETY, and are to be sold at their Shop at the *Bell* in S. *Paul's* Church-yard. M DC LX V.

Hooke's Microscope

1665



Antonie van Leeuwenhoek was inspired by this publication

Antonie van Leeuwenhoek (1677)

- First observation of living cells (200-300X mag.)
- “Animalcules”
- Single lens Microscope (Self made)—simple microscope
- Tooth plaque
- Rain water
- Diarrheal feces

- **Pioneer microbiologist, was born in Delft, Holland and learned the art of making lenses in Amsterdam. On his return to Delft in 1652, he developed an interest in microscopy. He announced the discovery of protozoa in 1677 in the *Philosophical Transactions.* He was the first to distinguish bacteria and he published his drawings in the same journal in 1683. He is esteemed as the first protozoologist and bacteriologist. He also observed canals in bone in 1675,later called the Haversian canals. Following his death, his 248 microscopes were auctioned by his daughter Maria" (A Dictionary of the History of Medicine, Anton Sebastian).**

Antonie van Leeuwenhoek's microscope

3-4" microscope

Required good lighting and patience

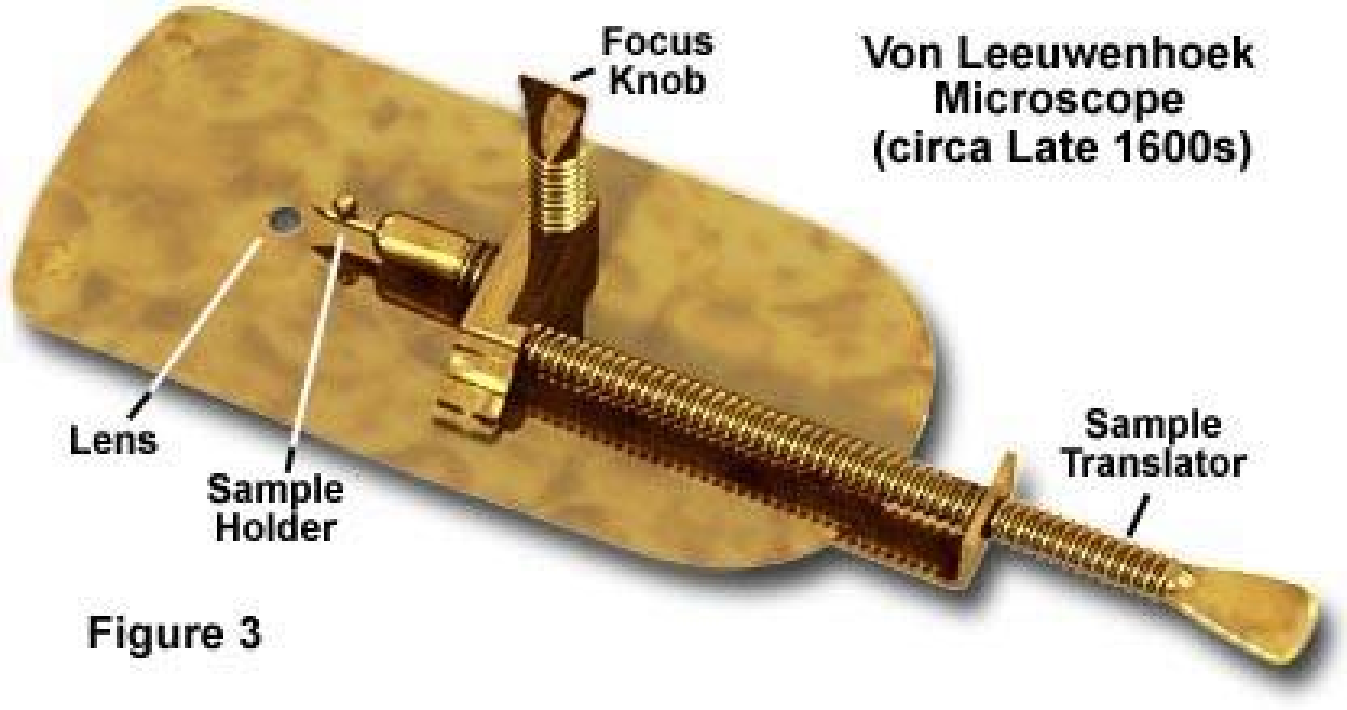
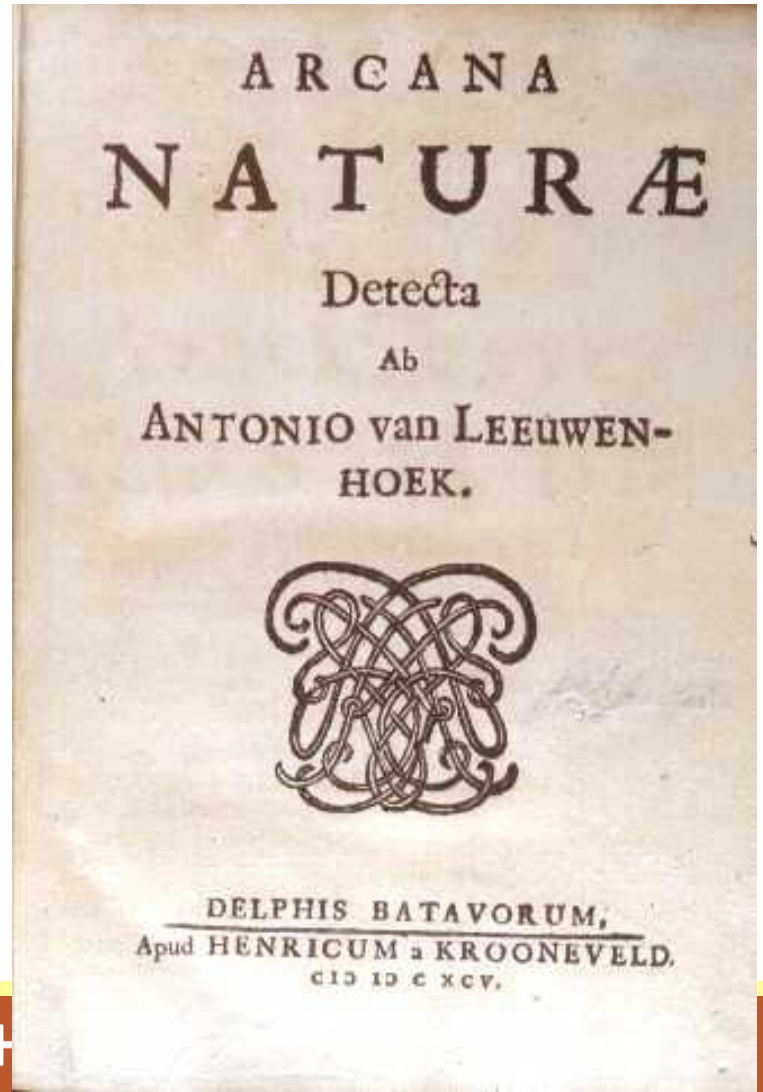


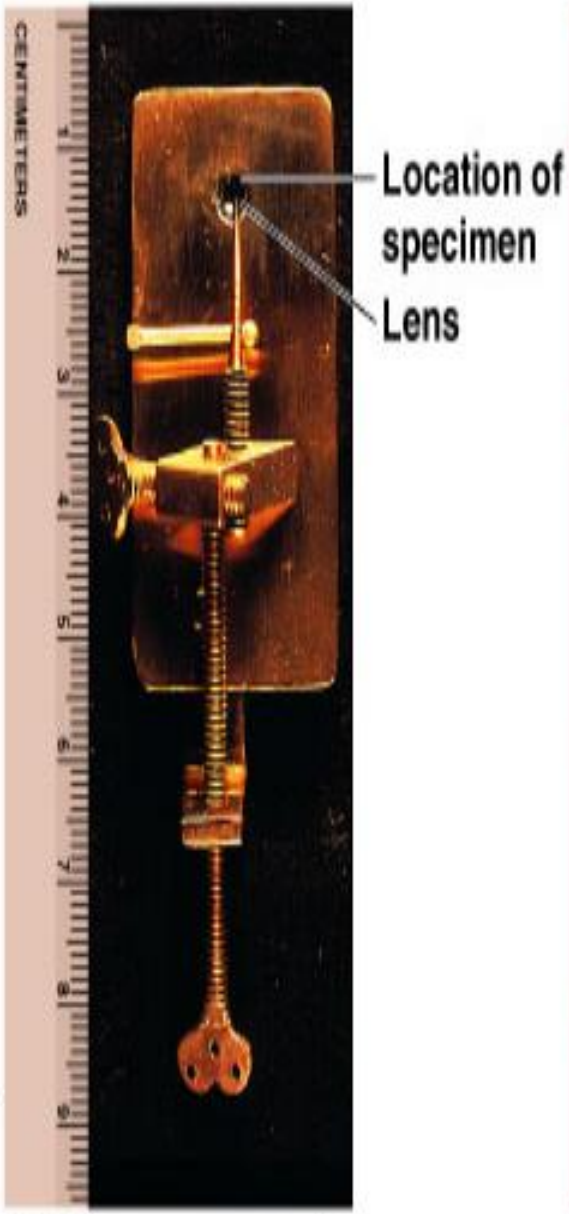
Figure 3

Antonie van Leeuwenhoek

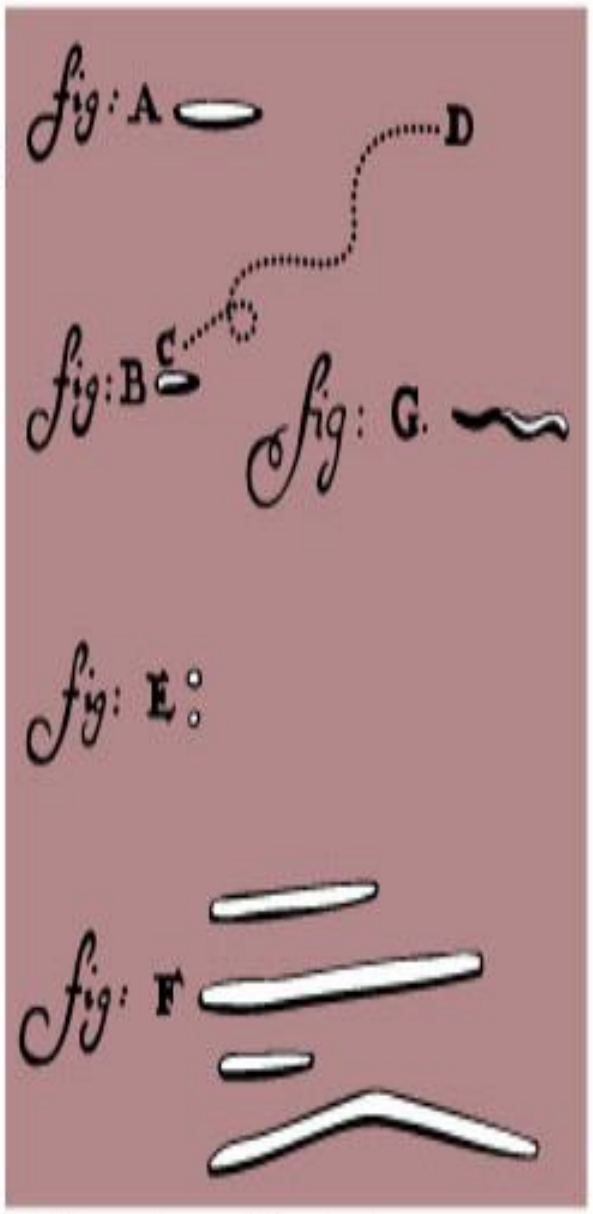
Bacteria
Protozoa
Sperm cells
Blood cells
Microscopic worms


ARCANA
NATURÆ
Detecta
Ab
ANTONIO van LEEUWEN-
HOEK.
DELPHIS BATAVORUM,
Apud HENRICUM a KROONEVELD.
CIↃ IↃ C XCV.

(a) Van Leeuwenhoek using his microscope.



(b) Microscope replica

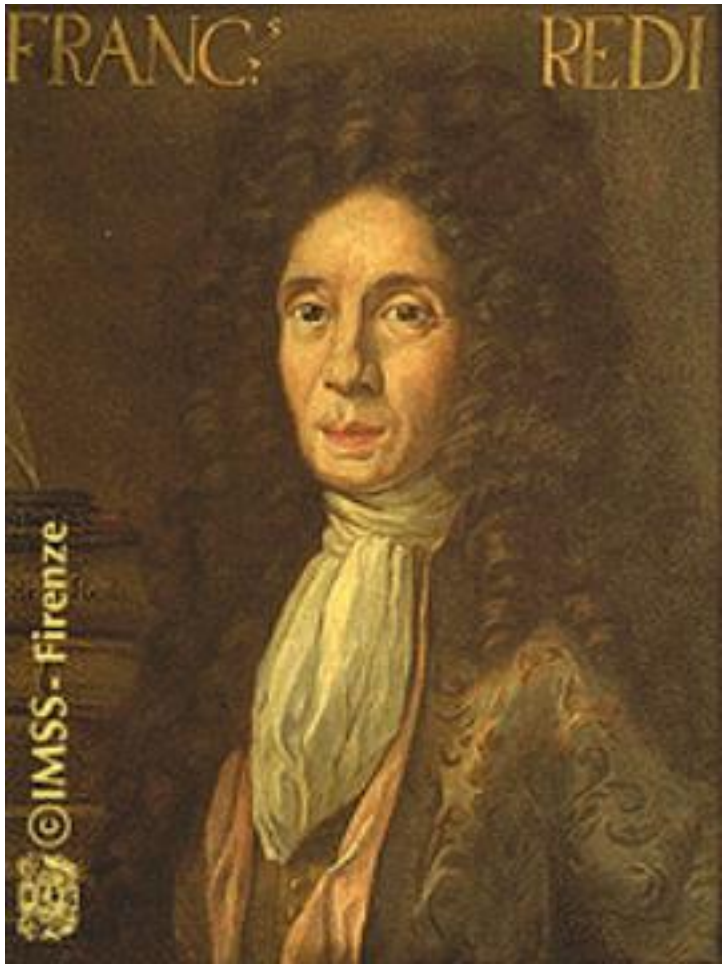


(c) Drawings of bacteria

History (cont.)

1668 Francesco Redi

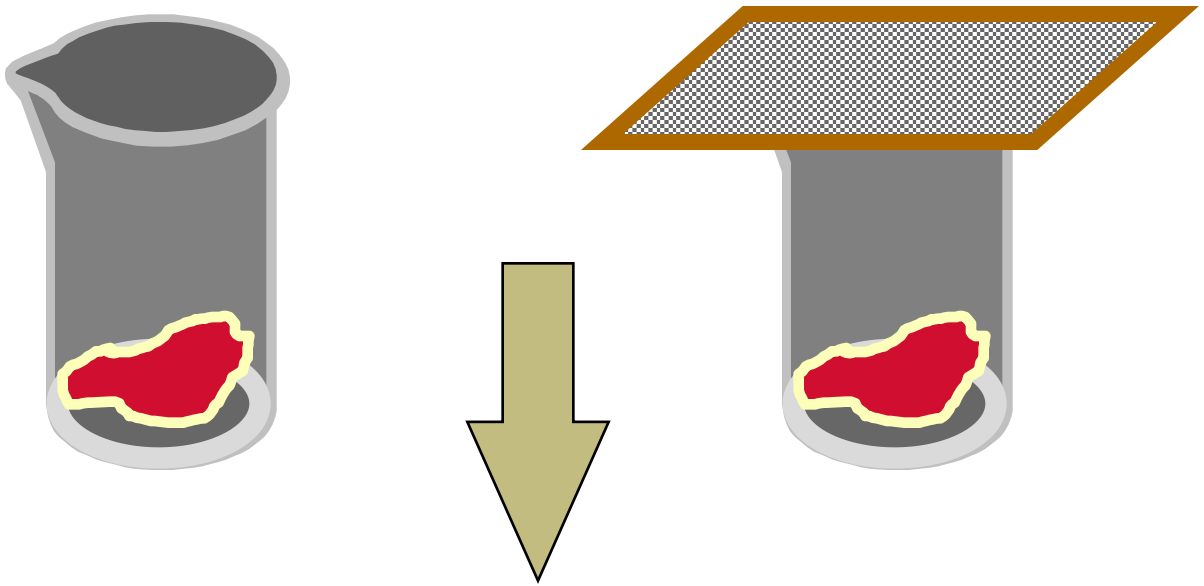
- 1st one to disprove spontaneous generation



Francesco Redi's experiments with meat

uncovered

covered



Maggots

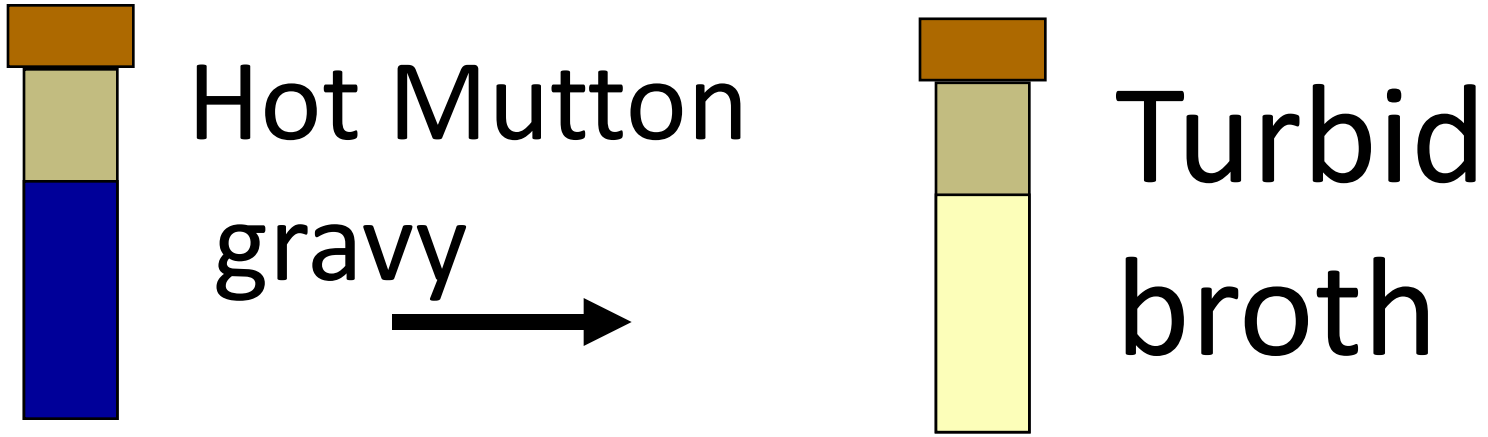
No maggots

Disproved that maggots arise from decaying meat!!

British clergyman John Needham's experiments (1745)

Proved (??) spontaneous generation in chicken broth

Heated Nutrient Fluids and poured them into covered flasks



Italian priest Lazzaro Spallanzani (1765)

Similar to Needham's Experiments **Lazzaro** showed that heating a sealed flask of meat broth prevented growth of organism

Thus Skeptics claimed that the lack of O_2 prevented growth!!

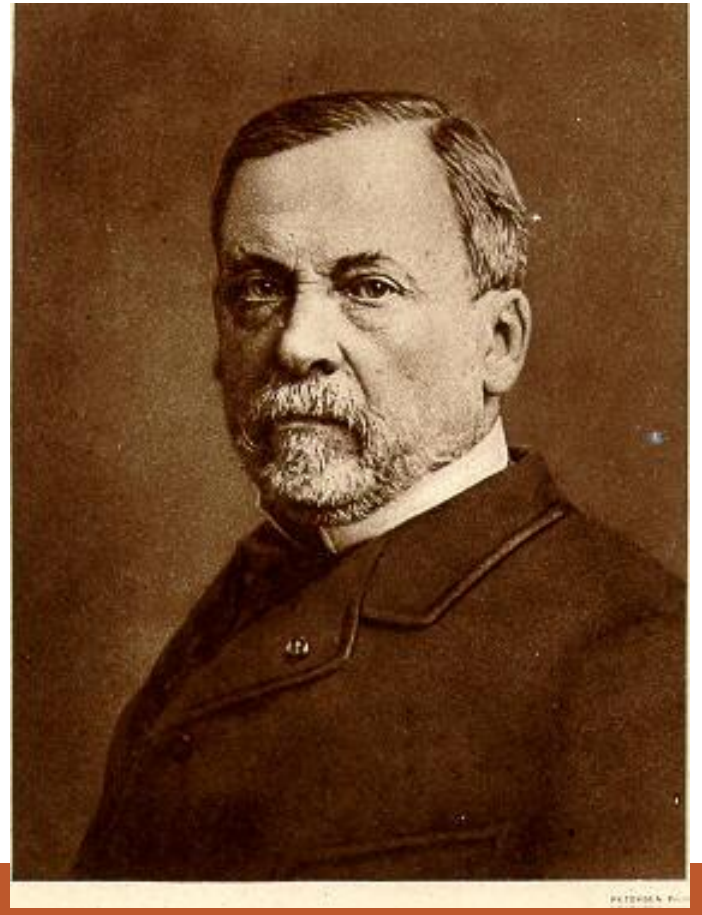
The Golden Age of Microbiology!

- Louis Pasteur (finally disproved spontaneous generation after many years of debate)
- Robert Koch (proof of germ theory)
- Other pioneers in Microbiology

Pasteur—Father of microbiology

- 1857- Louis Pasteur saves France's wine industry
- Napoleon III begged Pasteur (a chemist by training) to help solve a problem
- Sailors were revolting because their wine was spoiling after only a few weeks at sea
- Pasteur armed with his trusty microscope accepted the challenge

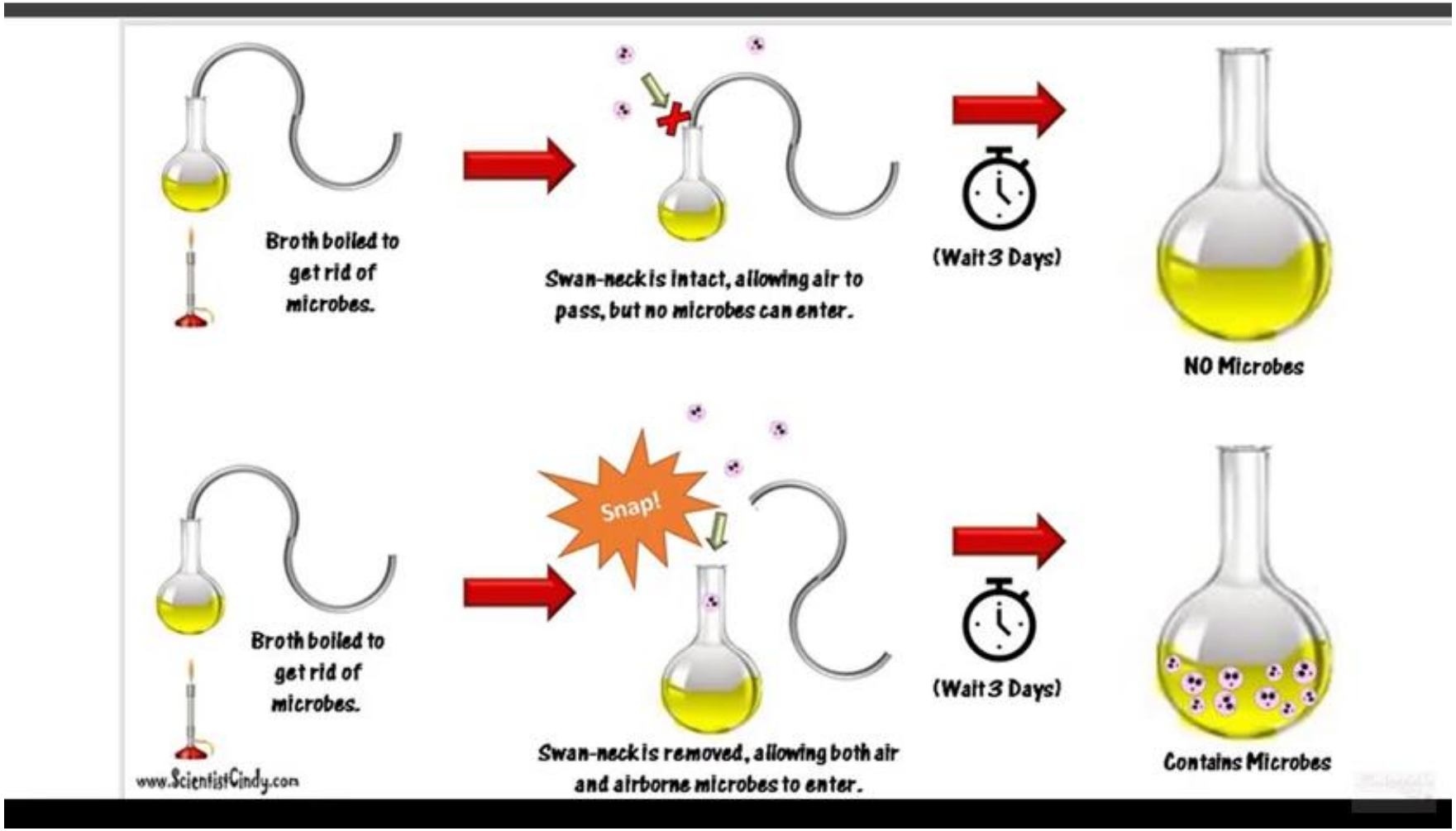
Louis Pasteur



Louis Pasteur (1861)

- Spontaneous Generation finally disproved
- Boiled broth in long-s-shaped necked flasks (unsealed)
  - The broth remained sterile
  - He use this to proved that microorganisms are present in air, but air does not *create* microbes
- This lead to the beginning of the *golden age of microbiology*

Swan neck flask experiment disproved spontaneous generation(1861)



History (cont.)

1861 Pasteur

- Proved that microorganisms are present in nonliving matter
- That microbes can be destroyed by heat
  - *This describes the idea of Aseptic Technique*

- He proved that fermentation is mediated by yeast, not air.

- He showed that to prevent wine and beer spoilage (by bacteria) microbes present can be destroyed by heat

1857-Louis Pasteur saves France's wine

1) Good wine contained yeast

2) Sour wine contained bacterium (Bacteria that use alcohol and produce acetic acid spoil wine by turning it to vinegar (acetic acid).

3) He reasoned that if wine is heated to destroy the harmful bacteria it wouldn't spoil

4) This process is known as **Pasteurization**

Pasteur's Tomb in the Crypt of the Pasteur Institute in Paris

PASTEUR'S TOMB IN THE CRYPT OF THE PASTEUR INSTITUTE, PARIS

Germ Theory of Disease

Pasteur proposed that wine spoiling in an analogy for disease (bacterial growth made the wine “sick”)

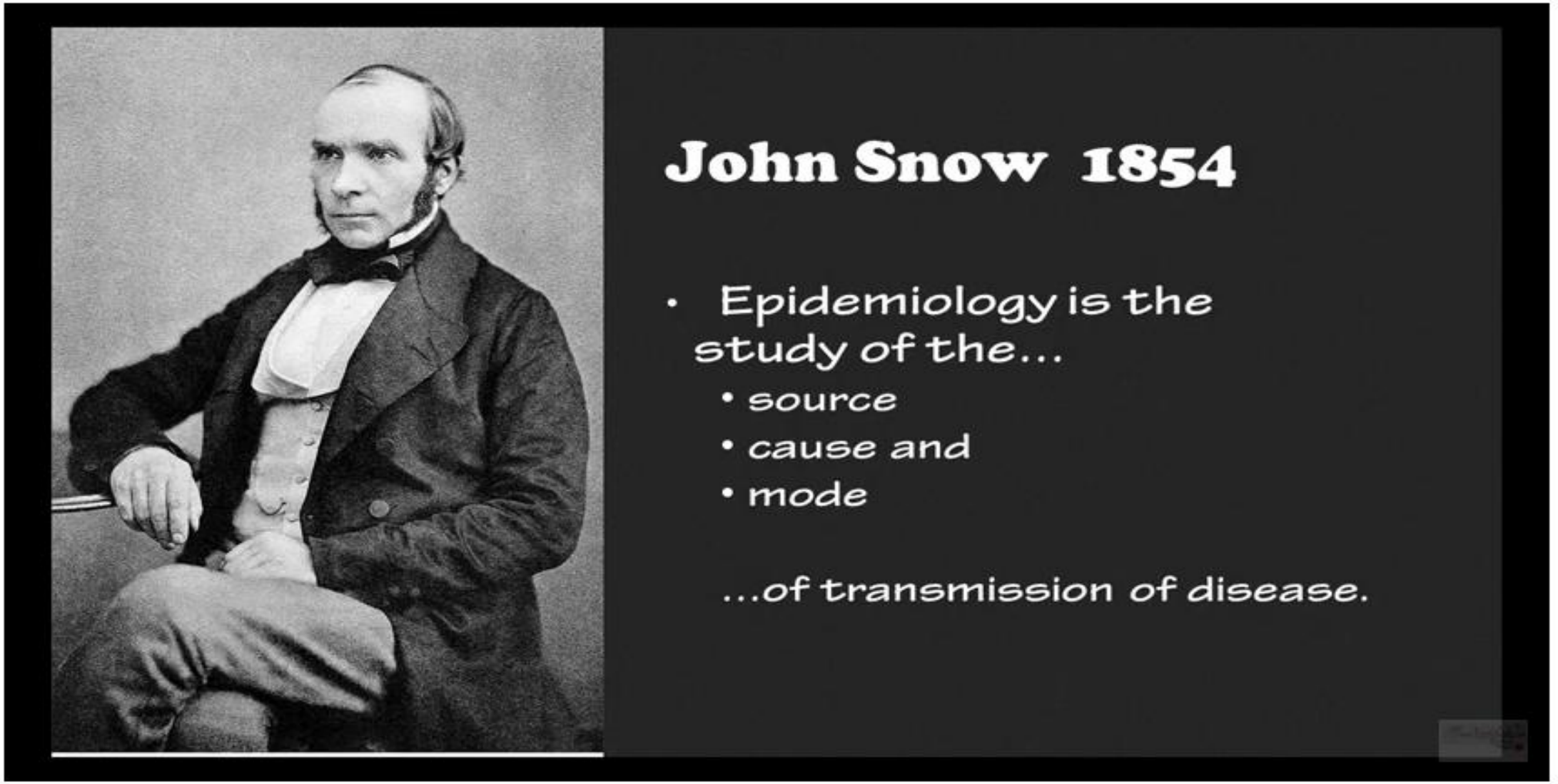
He hypothesized in 1857 that microorganisms are responsible for infectious diseases

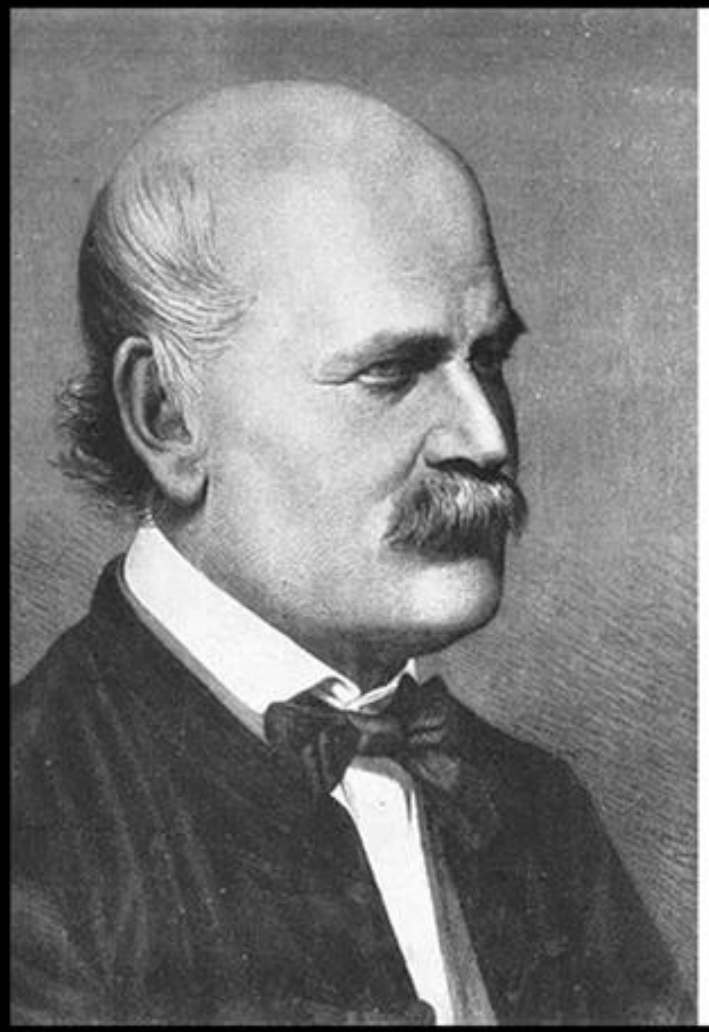
The Father of Epidemiology

In 1854, John Snow determined the cause of cholera transmission in London was due to a contaminated well.

This was the first EPIDEMIOLOGICAL STUDY~

John Snow is known as "The Father of Epidemiology"


John Snow 1854
• Epidemiology is the study of the...
• source
• cause and
• mode
...of transmission of disease.



"Golden Age of Microbiology" began 1857

Ignaz Philipp Semmelweis (1818 – 1865)

- Ignaz Philipp Semmelweis was instrumental in the development of aseptic techniques as a defense against the germs.
- Believed in "Germ Theory"; the idea that germs were the cause of disease.

HANDWASHING

- **Semmelweis discovered that handwashing in obstetrical; clinics drastically reduced the incidence of "childhood fever", or puerperal fever *(post-partum infection).***

Most scientist did not believe that simple hand washing can prevent disease
Many felt insulted and offended, The believe of Maismatic theory was so strong

Semmelweis and "Ward Fever"

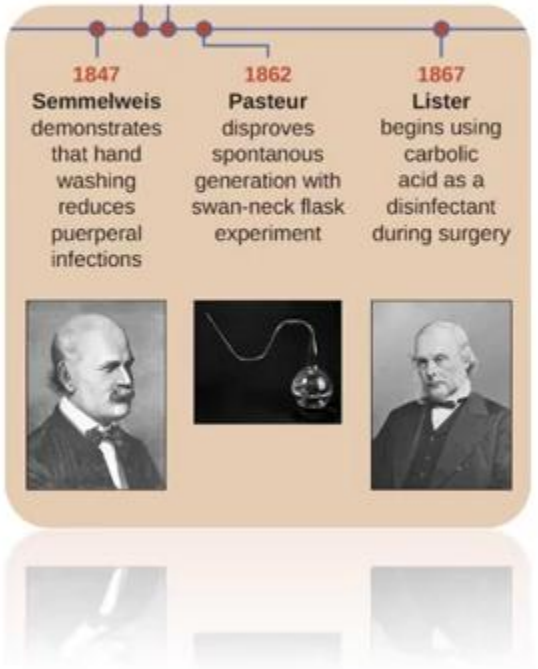
- Post-operative infections were so common, they were termed "ward fever".
- Unfortunately, Semmelweis's ideas were not popularized until after his death....

  when Lister and Pasteur continued the work in antisepsis.

http://www.workhouses.org.uk/MAB-NWFever/

Semmelweis's Work Continued with Pasteur and Lister

- Semmelweis's ideas were finally popularized after his death, due (in part) to a series of experiments performed by Louis Pasteur and Joseph Lister
- Louis Pasteur confirmed the germ theory was real.
- Joseph Lister, who practiced and operated, using hygienic methods, with great success.



Semmelweis work was unpopular until after his death following the prove of Spontaneous generation by **Louis Pasture**

Non sterile environment predisposes to disease

Lead to adoption of aseptic techniques and is use till today
Pasteurization of food products

Joseph Lister (1865) Reinforced the Germ Theory

- He developed the practice of antisepsis.
  - Antisepsis is the chemical disinfection of external living surfaces.
- Lister used a carbolic acid spray during surgery, and wounds healed without infection.

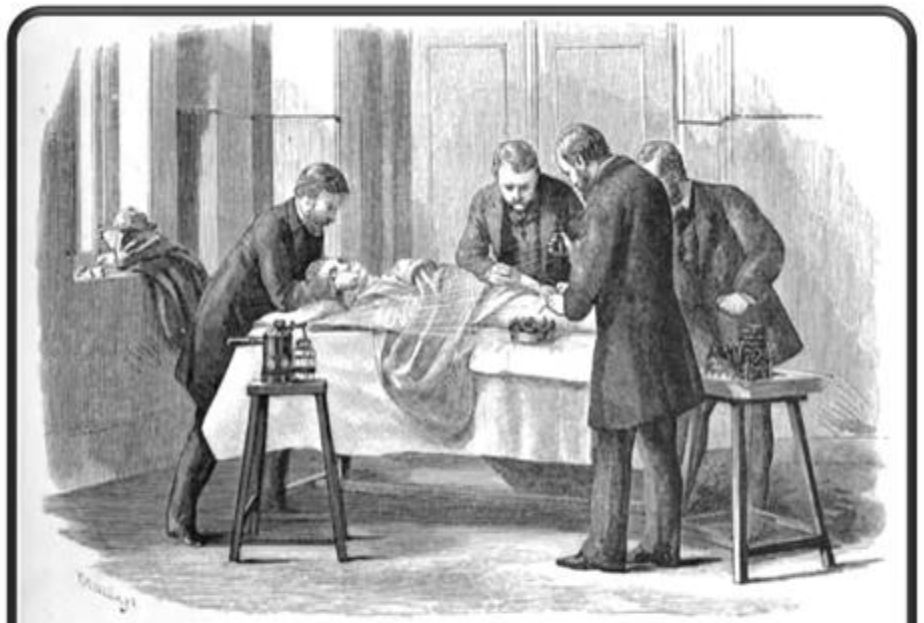
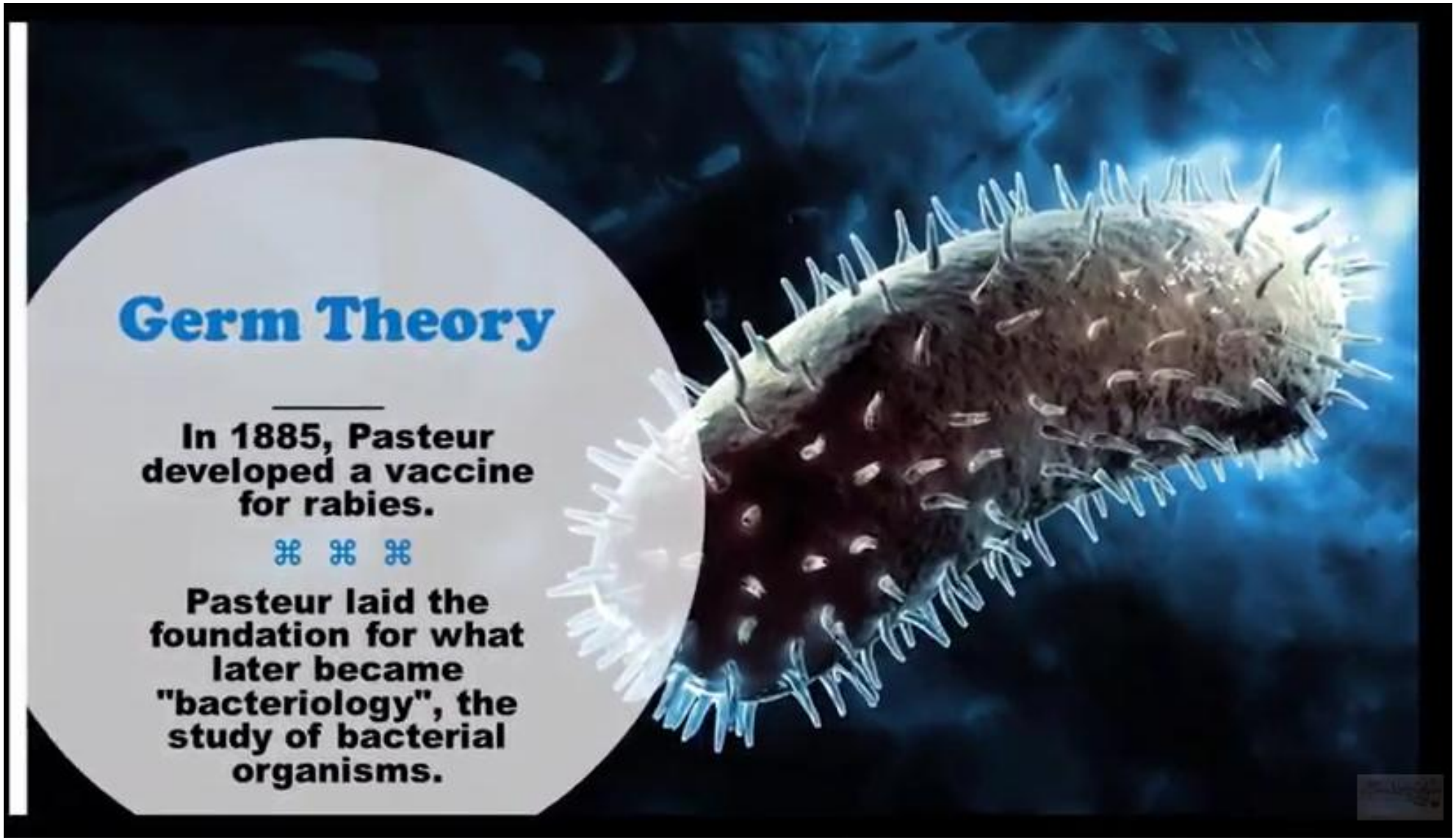


FIG. 23.

This figure represents the general arrangement of surgeon, assistants, towels, spray, &c., in an operation performed with complete aseptic precautions. The distance of the spray from the wound, the arrangement of the wet towels, the position of the trough containing the instruments, the position of the small dish with the lotion, the position of the house surgeon and dresser, so that the former always has his hands in the cloud of the spray, and the latter hands the instruments into the spray and various other points, are shown.

Developed in the 1779 by Joseph Lawarences and was named after Joseph Lister for his contribution to antiseptic surgery


Germ Theory
In 1885, Pasteur developed a vaccine for rabies.
⌘ ⌘ ⌘
Pasteur laid the foundation for what later became "bacteriology", the study of bacterial organisms.

Edward Jenner (country doctor)

- Milkmaid didn't get smallpox b/c they contracted the milder form of cowpox
- Immune system cannot distinguish btw cowpox/smallpox
- Scratched a farmboy w/ a needle bearing fluid from cowpox
- Developed first vaccine: Small pox Vaccine

- -*Vacca*-cow Vaccine: **Small pox of cow**
- Vaccination w/ cowpox provided immunity for smallpox

Vaccines

In the late 1700s, Edward Jenner, who was working with small pox, discovered the principle of Vaccination

- Vaccinations can prevent disease by exposing the subject to a milder form of the disease-causing agent.

Robert Koch (1843-1910)

- German country physician who developed microbiology into a science
- Developed pure culture techniques (used potato slices to grow bacteria) later developed agar
- Proof of the germ theory
- Work with anthrax
- developed the Koch's postulates

Koch's postulates

1) Specific microorganism is present in all cases of the disease
2) Organism can be obtained in pure culture outside of the host
3) Organism when re-inoculated into host causes the same symptoms
4) Organism can be isolated in pure culture from experimentally infected host

Koch's findings

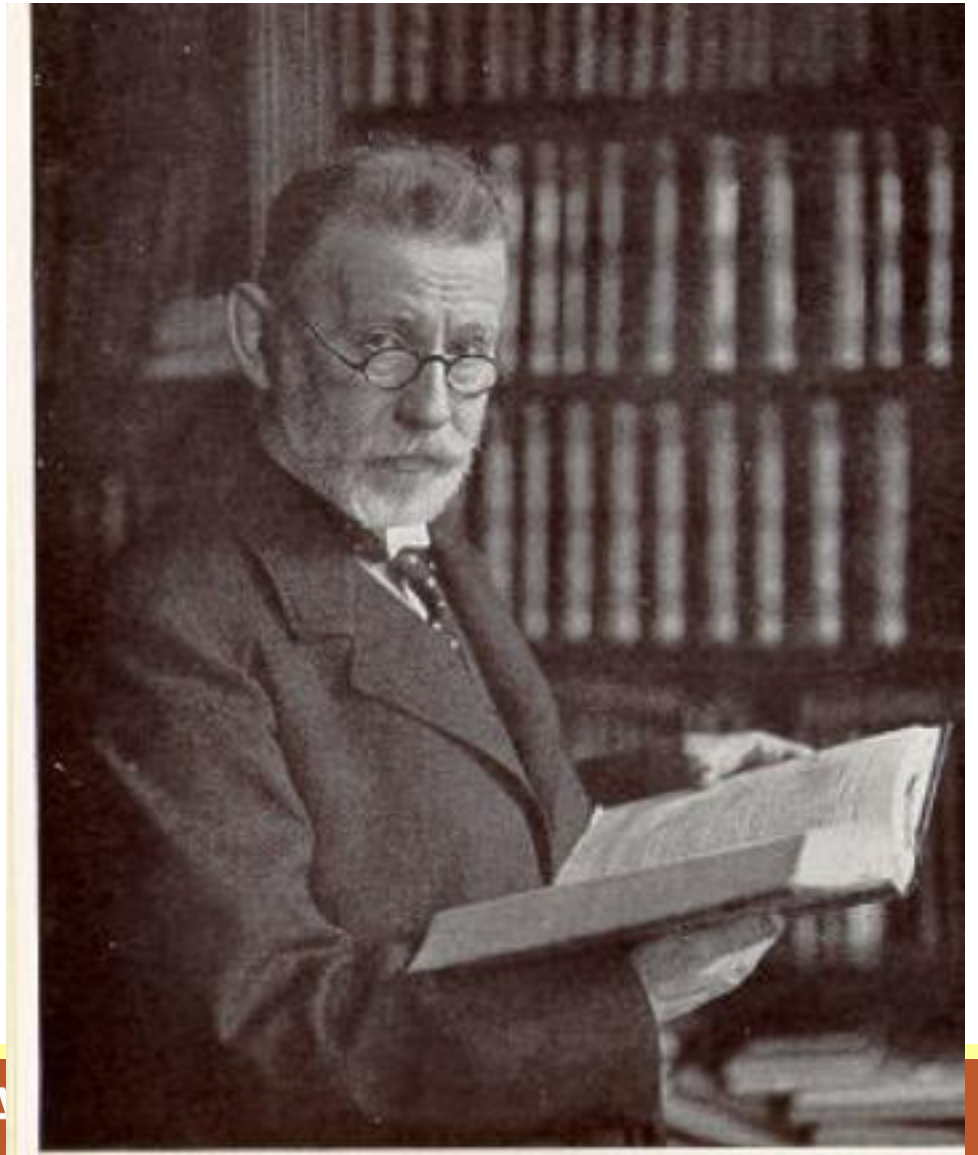
Koch and his coworkers discovered that bacteria caused

- TUBERCULOSIS: Got a noble price for this
- CHOLERA
- DIPTHERIA
- TYPHOID FEVER
- GONORRHEA
- PNEUMONIA

Paul Ehrlich-hospital dermatologist

Chemotherapy-Treatment using chemical substances

1910 Paul Ehrlich



AGAR

- Is a complex polysaccharide derived from seaweed
- Was suggested by Fannie Hesse wife of Koch's co-worker Walther Hesse

- AGAR-AGAR had been used as a gelling agent in Asia for centuries

- Fannie learned to use AGAR-AGAR from a Dutch neighbor in New York who spent time in Asia

Alexander Fleming –scottish researcher--1928

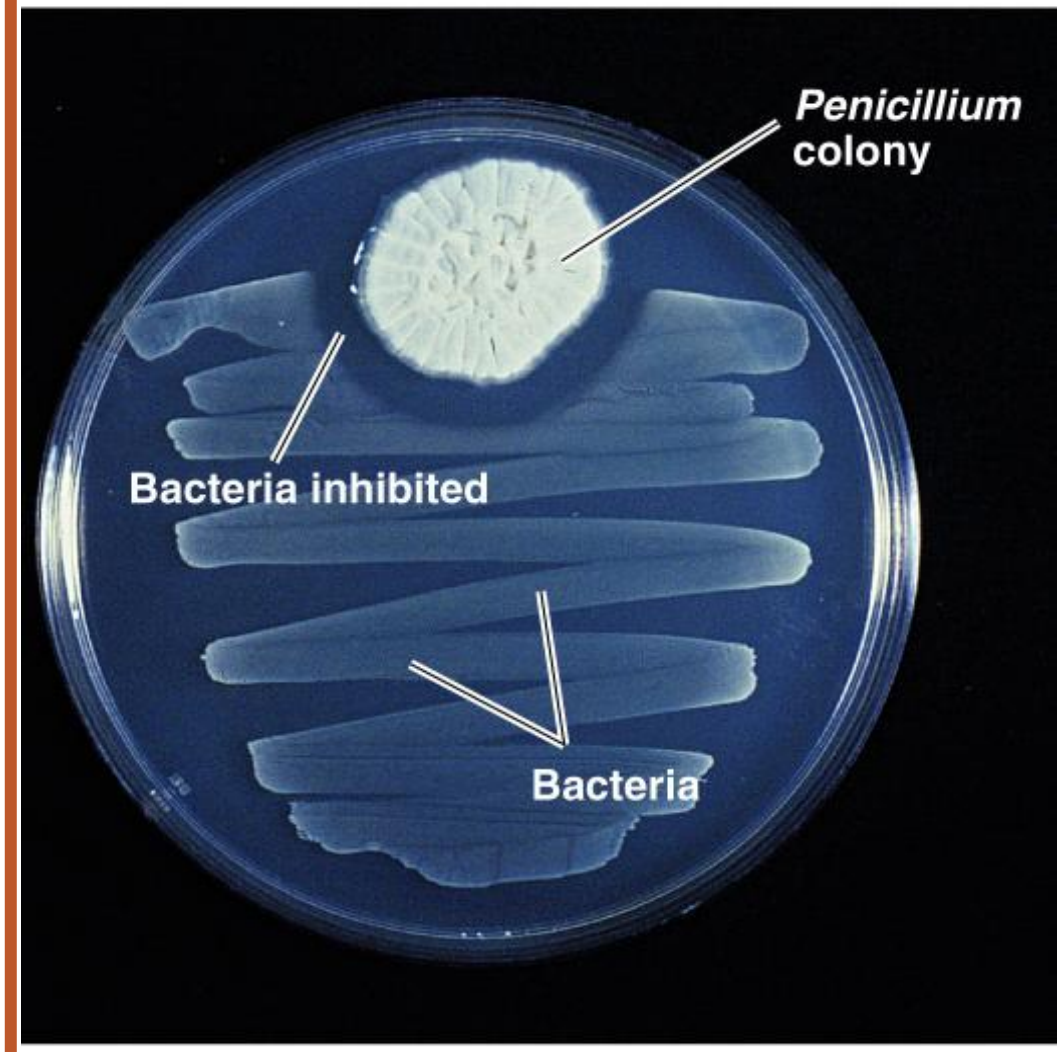
Discovered Penicillin (fungus) by accident

Was convinced that nasal mucus had antibacterial effects

Left his *Staphylococcus* culture on an agar plate for 2 weeks-went on vacation-came back &found mold on his plate which prevented bacterial growth.

Showing that the mold produced substance that inhibited the growth of a bacteria. that is an antibacterial substance

And that microganism can be crown on an artificial or natural medium



ublishing as Benjamin Cummings.

Pure Culture

Pure culture: This is a population of organism, all of which are the progeny of a **single organism**

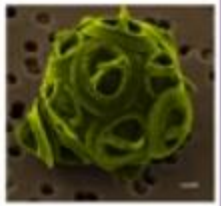
-In nature, microbes almost never occur as **pure cultures. They are polymicrobial in nature**

Founders of Microbiology (Review)

- First observed microbes—Leeuwenhoek
- Proved living cells can arise only from other living cells---Pasteur
- Confirmed the Germ Theory of Disease –Koch

SUBDISCIPLINES OF MICROBIOLOGY

BACTERIOLOGY	PARISITOLOGY	VIROLOGY	PROTOZOOLOGY	MYCOLOGY	PHYCOLOGY
The Study of Bacteria	The Study of Parasites	The Study of Viruses	The Study of Protozoans	The Study of Fungi	The Study of Algae



SECOND GOLDEN AGE OF MICROBIOLOGY

Using microorganisms as Models

Was ushered in in 1940s

As a result of genetic research

The used *E. coli* to study gene expressions and genetic mutations

Brought out Major advances

1944 discovered DNA

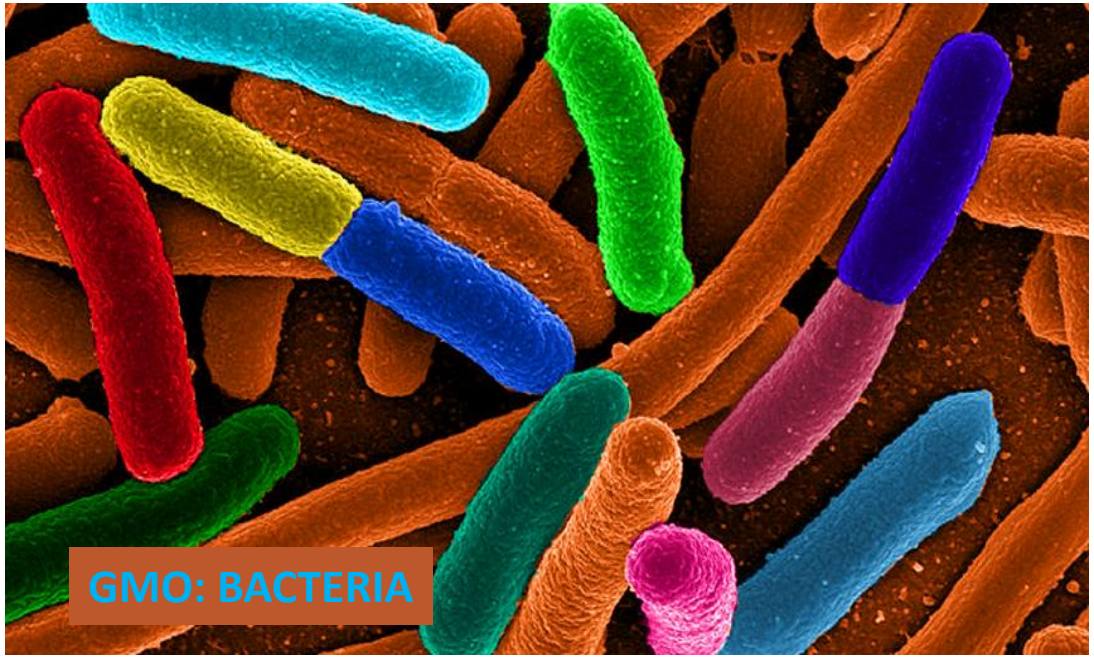
Biofuel Production

Algae bags hanging in the Burkart/ Mayfield labs' greenhouse at UC San Diego

To engineer and optimize such pathways in microalgae for the robust expression of fatty acids and polyketides with the aim of creating renewable biofuels and co-products from microalgae

GMO: INSULIN

GMO: MEAT



GMO: BACTERIA

GMO FOOD

DO WE MAKE USE OF THESE PRODUCTS: MAYBE WHEN WE TRAVEL OUT OF NIGERIA?

In 1944, Oswald Avery, Colin MacLeod, and Maclyn McCarty, were the first to identify deoxyribonucleic acid (DNA) as the genetic material found in cells.

They used viruses to infect bacteria cells

Notable discoveries in Microbiology

Reference

https://www.youtube.com/watch?v=S17_yg3dkqw

https://www.youtube.com/watch?v=A-qJHJoZ1b0

https://openwho.org/courses