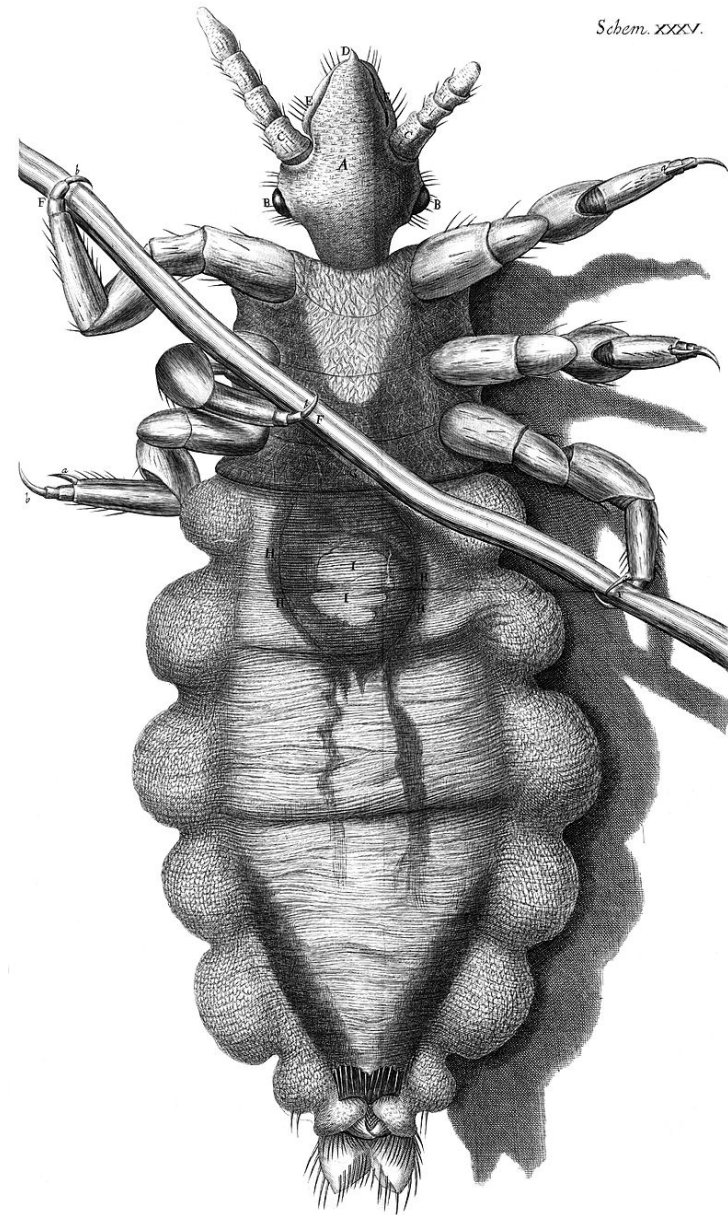


A History of Microbiology



Miasmatic Theory

- The Miasmatic Theory postulates that disease is caused by "bad air" or "mal'aria", known as "miasmatic odors."
- It was thought that these miasmatic odors arose from decaying organic matter and was the cause of diseases like cholera, chlamydia and the Bubonic Plague.



The idea started about around 200 AD and was persistent until germ theory finally dominated in the late 1800's.

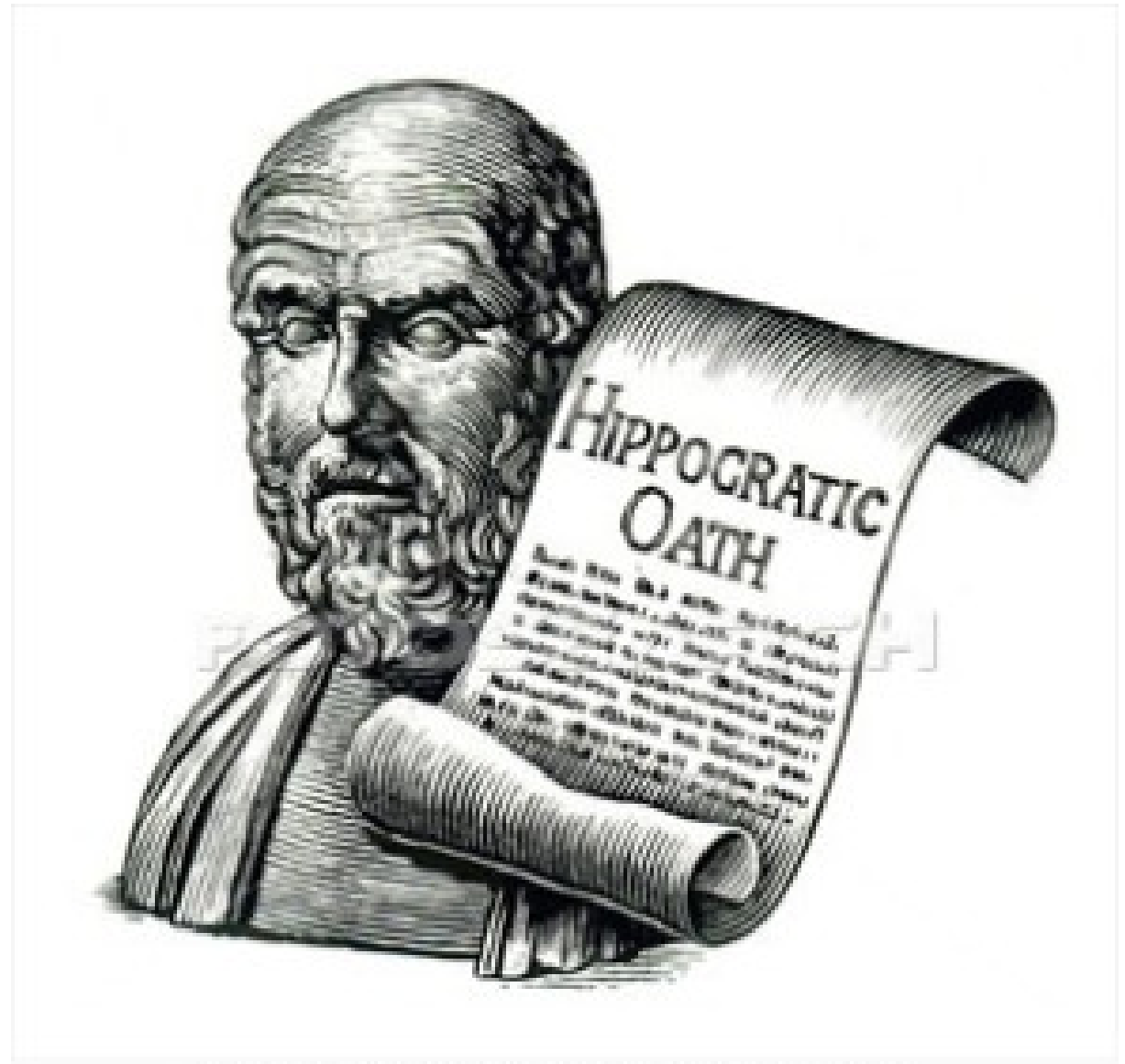


Miasmatic Theory

- Although incorrect, the *Miasmatic Theory* spurred the development of better sanitation and hygiene practices.
- Aqueducts were built that brought in fresh water. Sewers were built that carried away waste and sewage.
- This practice protected the Romans from many waterborne diseases.

Hippocrates
460 - 370 BC
**“the Father of Western
Medicine”**

The Hippocratic Oath is also known as the Physician's Oath. It is the oath that each physician takes before becoming a medical practitioner. It is an oath to uphold ethical standards, to refrain from judgement or bias and to "do no harm".

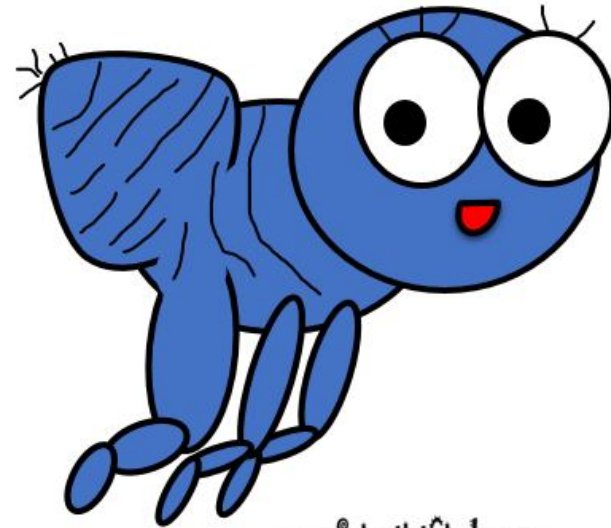


dayala0332c images.google.com

Spontaneous Generation



Dust Particle



www.ScientistCindy.com

Phoebe the Flea

Spontaneous Generation is the theory that living things can come from non-living things!

This idea is so old, that we are unable to trace the theory back to when it started, where it started, or who started it.

The Theory of Spontaneous Generation

- *As odd as the idea may seem, we need to remember that they only knew what they knew.*
 - *They made OBSERVATIONS*
 - *They came to CONCLUSIONS based on those OBSERVATIONS*
- *Not only was this idea somewhat universal, but it took centuries to convince even some of the most creative scientific minds of the fallacy (untrue nature) of the theory of Spontaneous Generation.*



Observations that lead to the Theory of Spontaneous

- There Were Observations that lead to the Theory of Spontaneous Generation - Without microscopes, it did APPEAR as though animals or insects were spontaneously appearing out of non-living things!

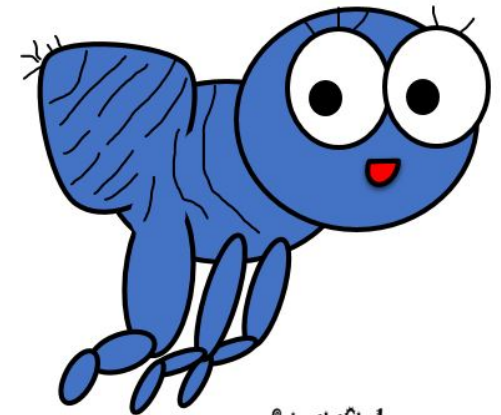
For example,

- Fleas would appear out of dust

Spontaneous Generation



Dust Particle



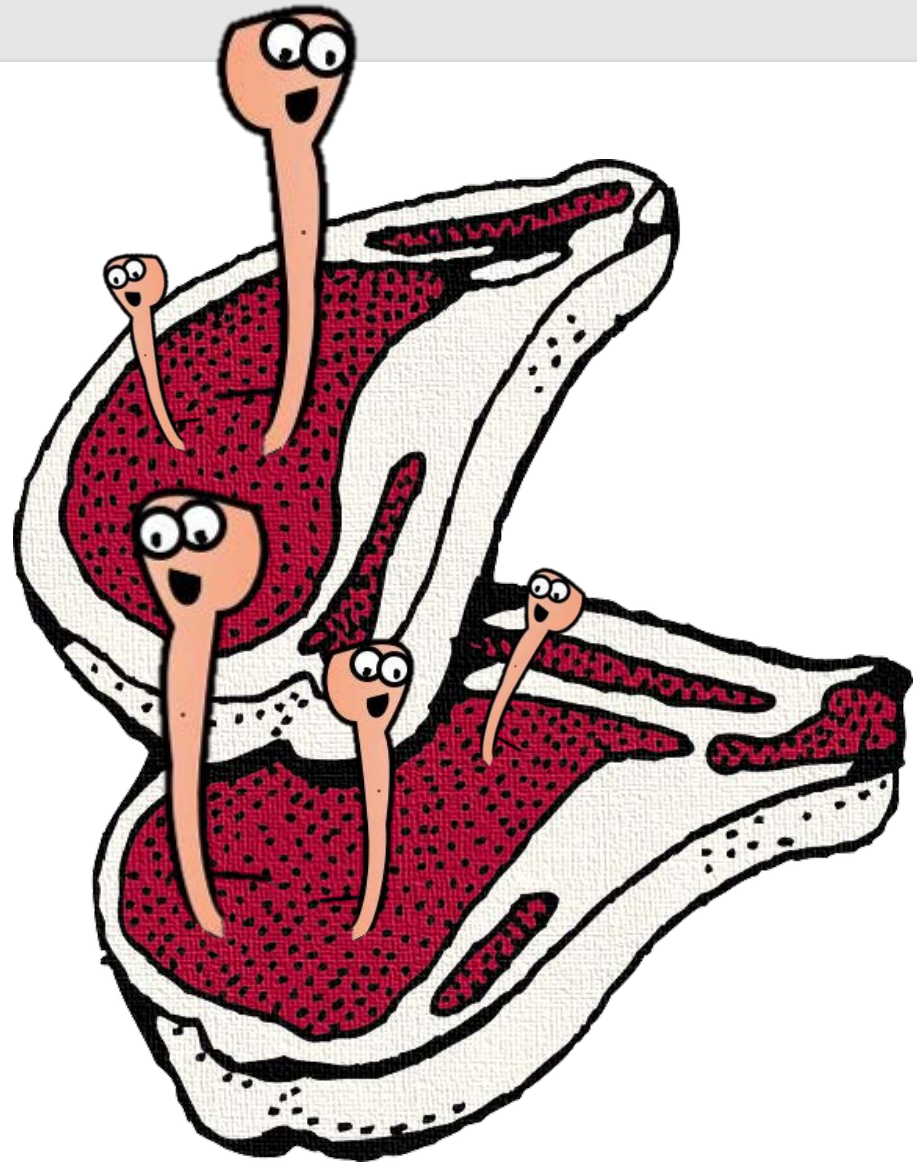
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Phoebe the Flea

Observations that Supported the Idea of Spontaneous Generation

For example,

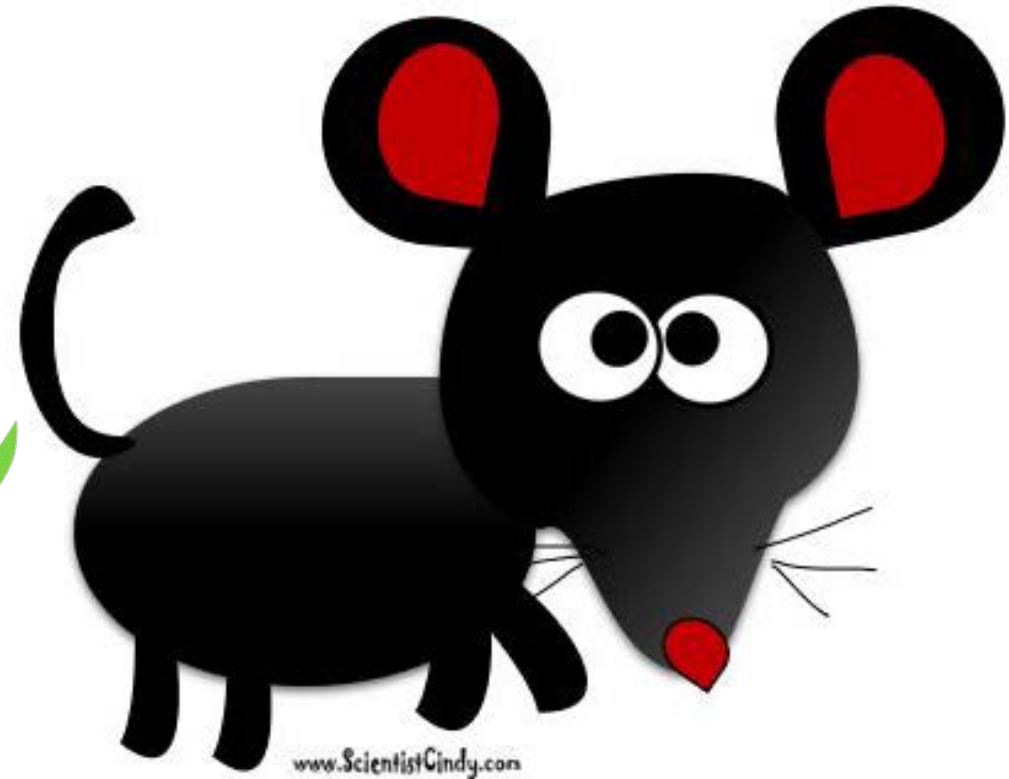
- Fleas would appear out of dust
- Maggots from rotting meat.
- Mice from corn grain.
- Flies from manure.



Observations that Supported the Idea of Spontaneous Generation

For example,

- Fleas would appear out of dust
- Maggots from rotting meat.
- Mice would come from a pile of corn husks.
- Flies from manure.



Observations that Supported the Idea of Spontaneous Generation



For example,

- Fleas would appear out of dust
- Maggots from rotting meat.
- Mice from corn grain.
- Flies would generate from manure.

Pneuma

- - *Pneuma was theorized as the "spiritual essence" or "vital heat" that non-living material could possess in order to undergo spontaneous generation!*

Challenges to the Theory of Spontaneous Generation

- *In the 1600s...*
- *2 scientists on opposite sides of the Theory of Spontaneous Generation (one believer and one non-believer) battle it out in the lab!*



**Antonie van Leeuwenhoek
(1632-1723)**



Francesco Redi

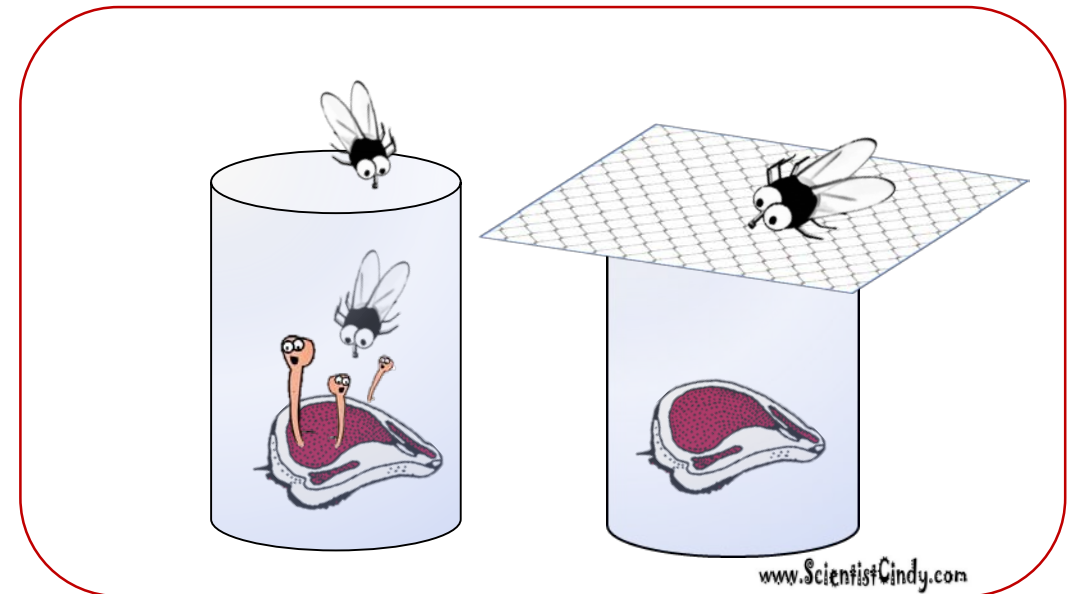
*Anton van Leeuwenhoek = believer
Francesco Redi = non-believer*

Francesco Redi (1626 - 1697)

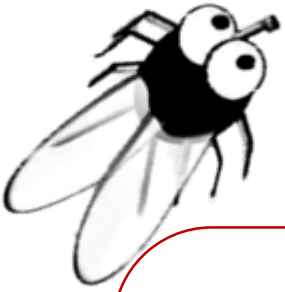
Francesco Redi's 1668 Experiment

- Redi performed an experiment using jars containing rotting meat. One jar was covered with gauze to prevent flies from coming into direct contact with the meat, while the other jar was left open, allowing flies to come into direct contact with the meat.

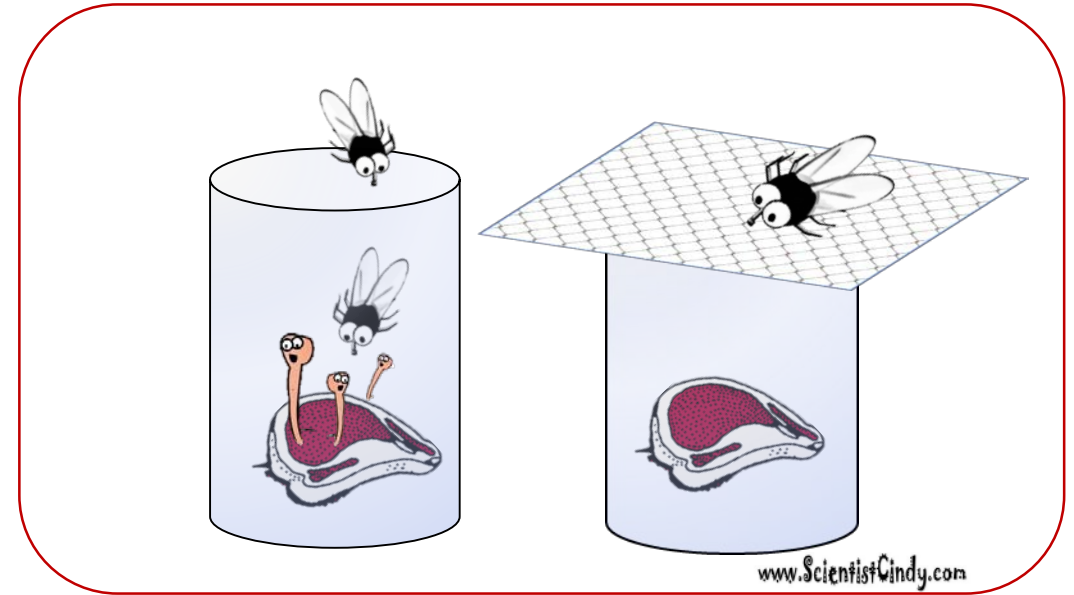
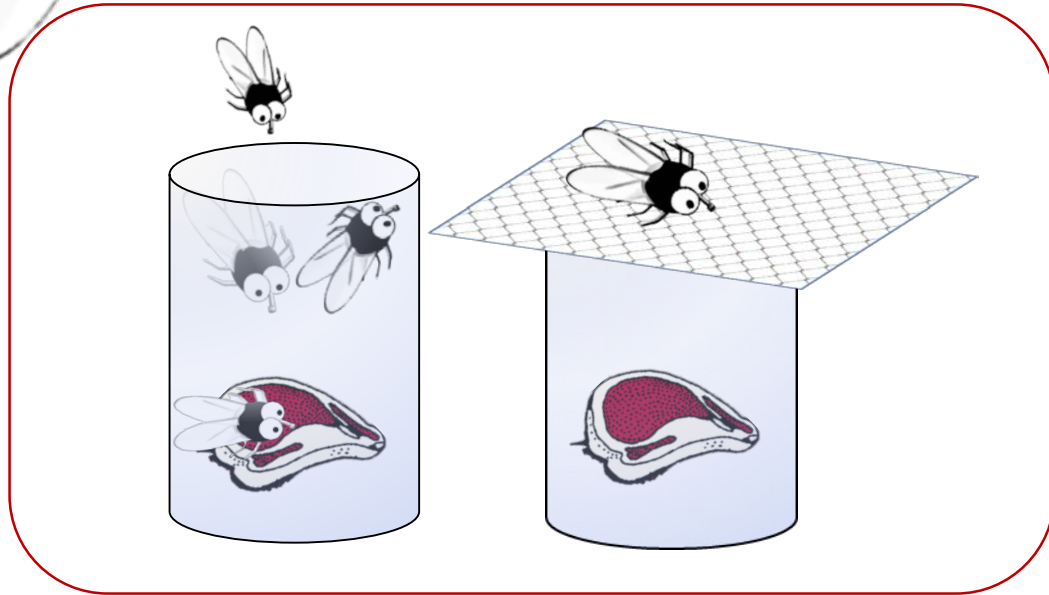
One of the ideas of spontaneous generation was "pneuma" or "vital force" which was believed to be the spiritual force that lead to spontaneous generation. The pneuma was believed to travel through the air. *This is why the jars were covered with gauze and not simply closed with their lids.*



Redi's Experiment

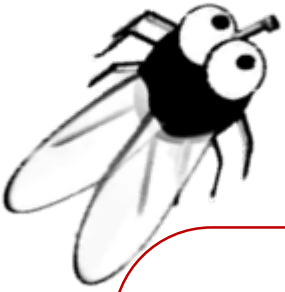


3 weeks later

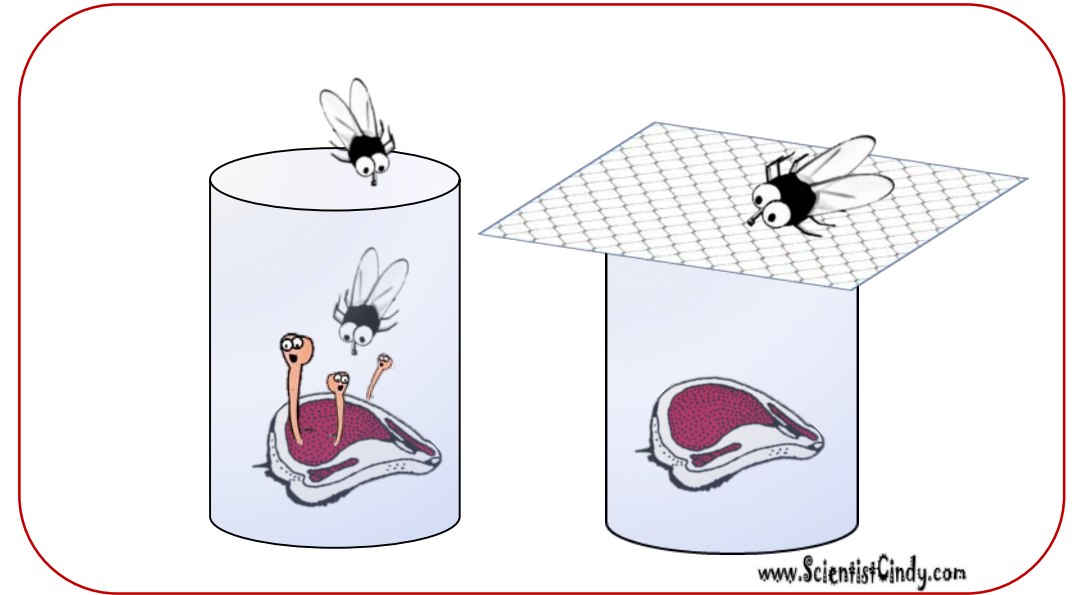
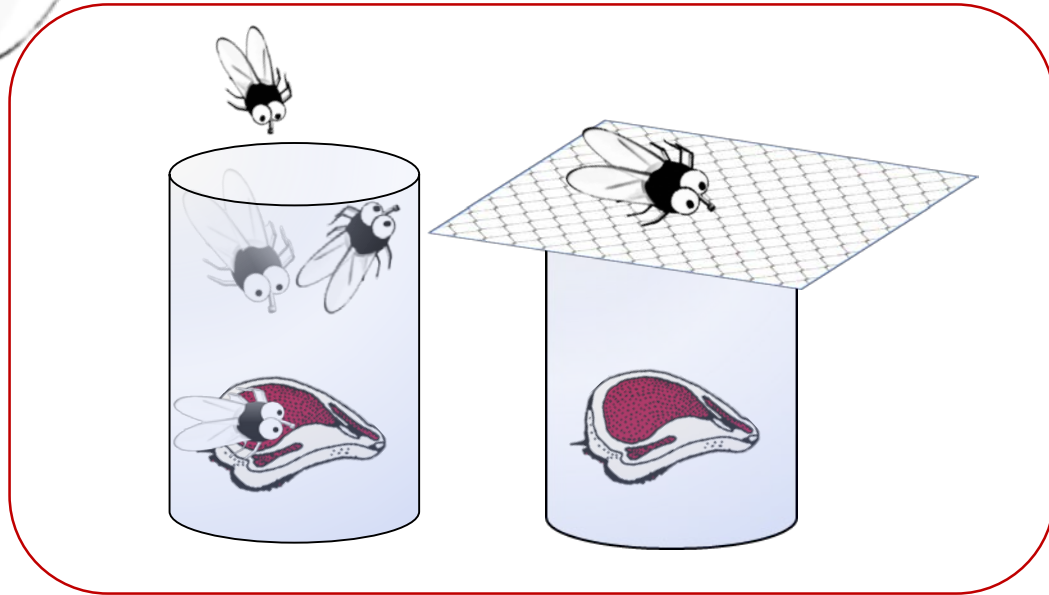


- Question – 1) Do Maggots form spontaneously in meat or 2) Do maggots come from flies coming into contact with meat.
- Set up experiment. Allowed meat to sit out unprotected from flies, and protected from flies.
- → If no maggots were observed in meat protected from flies, then #2 question is correct!

Redi's Experiment



3 weeks later



Possible outcomes: If spontaneous generation was correct, 1) both samples of meat should produce maggots, because they are exposed to the air.

If spontaneous generation was incorrect, 2) the meat inside the covered jar will not produce maggots.

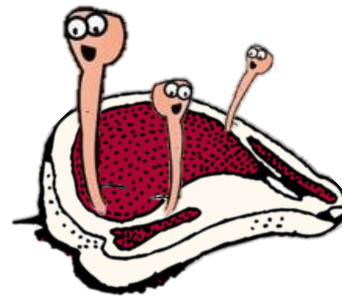
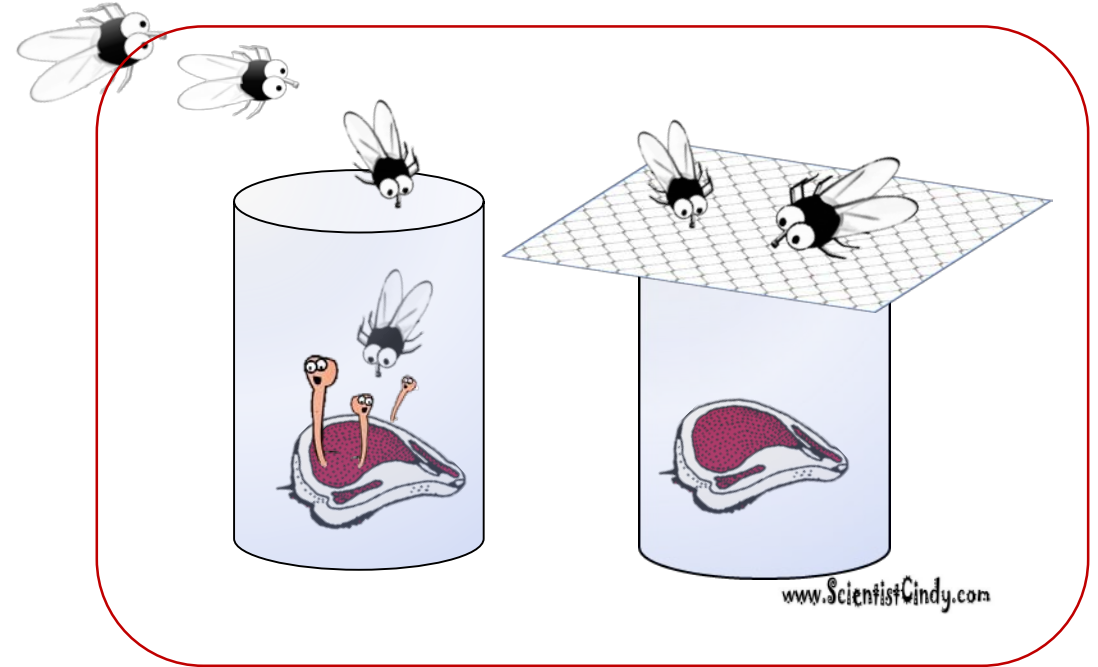
If flies produce maggots, 3) then maggots appear in meat only after there has been direct contact with flies, then the meat in the uncovered jar will produce maggots, and the meat in the covered jar will not produce maggots.



Redi's Experiment

- **OUTCOMES:** The meat inside of the uncovered jar that was exposed to direct contact with flies, produces maggots.
- The meat inside of the covered jar that was exposed to the air (or pneuma), but protected from flies, did not produce maggots.

3 weeks later





First Evidence Against Spontaneous Generation Francesco Redi – 1668

- Redi designed an experiment that disproved that maggots were able to spontaneously generate on rotting meat.
- His experiments also demonstrated that flies must have direct contact with the rotting meat in order for maggots to appear.

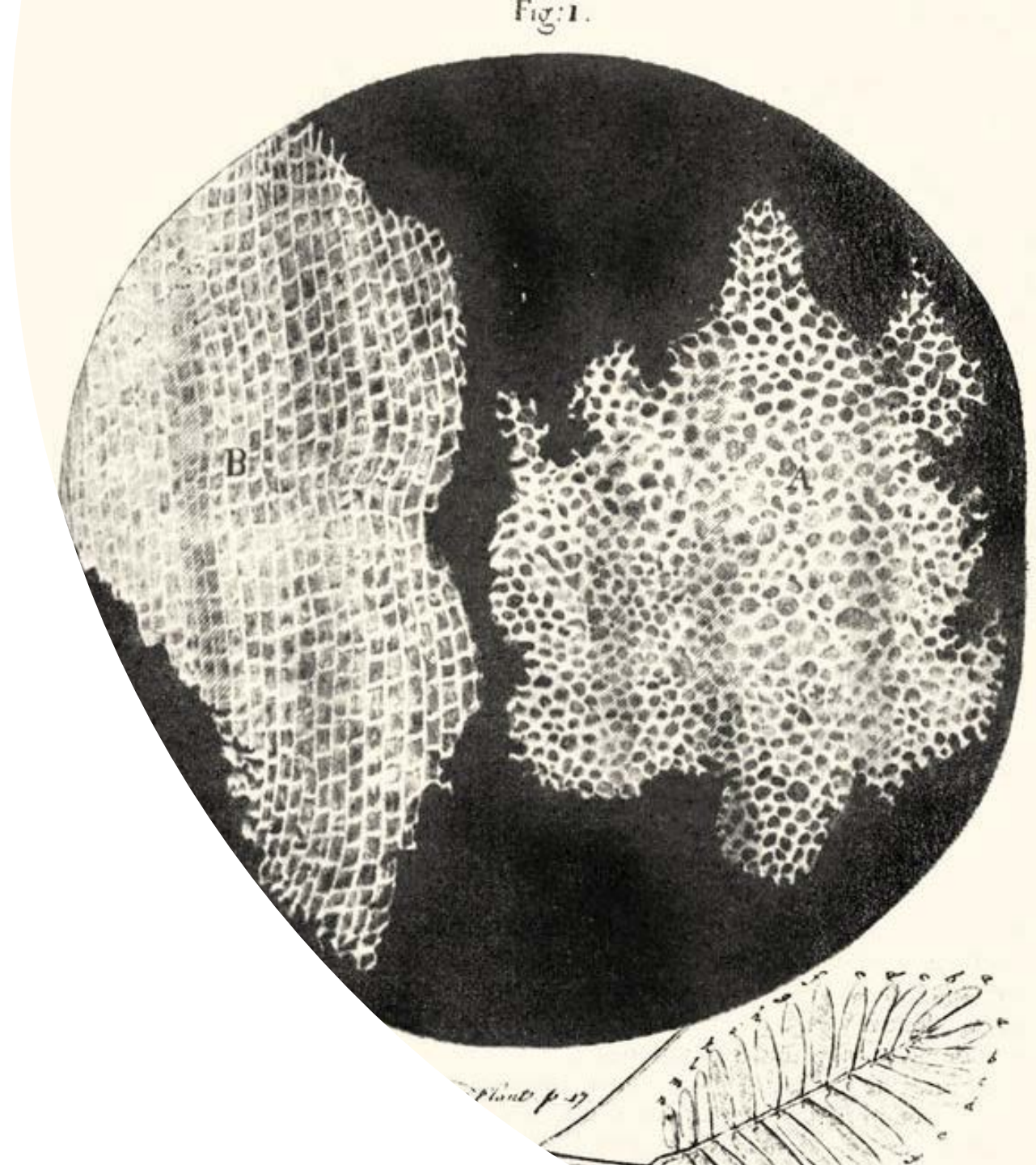
Microscopes

- The discovery of cells and the development of cell theory due to the invention of high-powered microscopes in the 17th century.



Robert Hooke

- Robert Hooke discovered cells in 1665 by looking at a piece of cork under a microscope.
- Cork is made of dead plant cells.
- He only recognized plants as having cells, not animals.
- Hooke named the structures he saw in cork "cells" after the Cells of a Honeycomb



Vaccines

In 1796, 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.



Vaccines - 1796

- **Edward Jenner observed** that milkmaids who had previously been infected with a similar disease called cowpox, were protected from smallpox.
- The principle behind vaccinations is that a disease can be prevented by exposing the subject to a milder form of the disease-causing agent.



Vaccine

- Interestingly, the term "vaccine" came from the term "*Variolae vaccinae*" which means "smallpox of the cow".

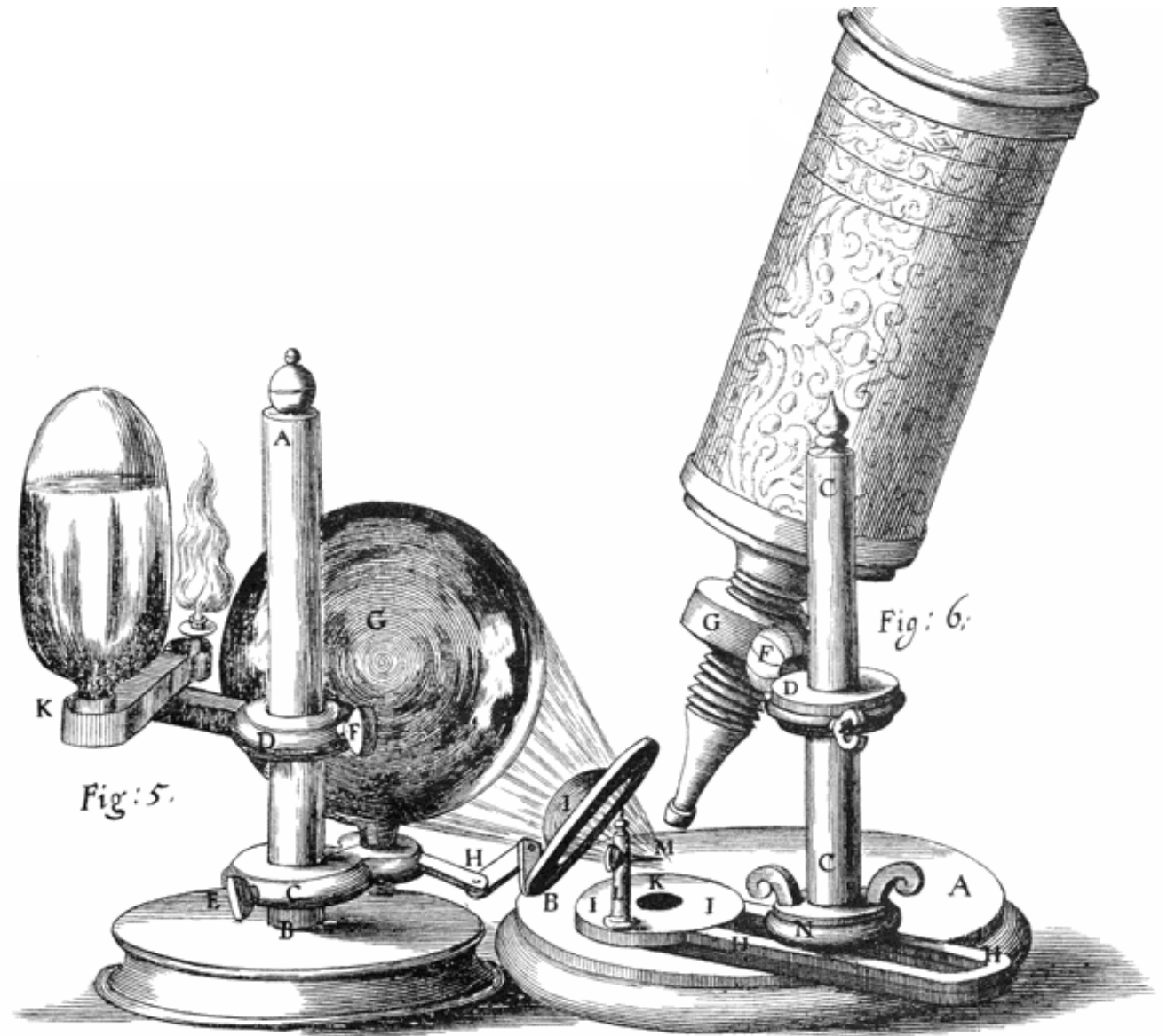


Discovery of Cells

Hooke described cells as structures resembling

- Honey Combs
- Small Boxes
- Bladders of Air
- Caverns
- Bubbles

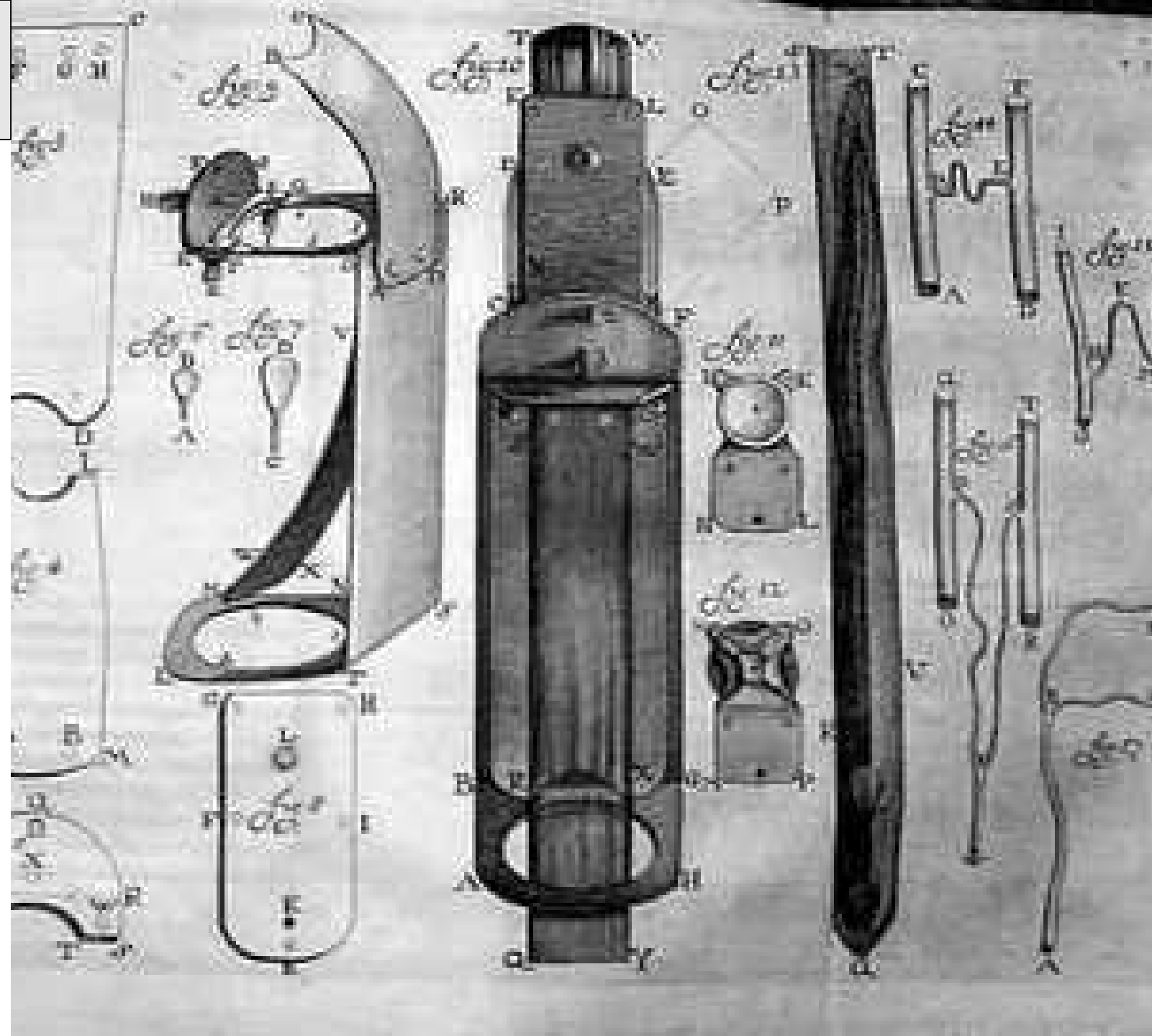
Robert Hooke published *Micrographia* in 1665.



Antonie van Leeuwenhoek Improved upon the design of the microscope which enabled the discovery of micro-organisms

Antonie van Leeuwenhoek

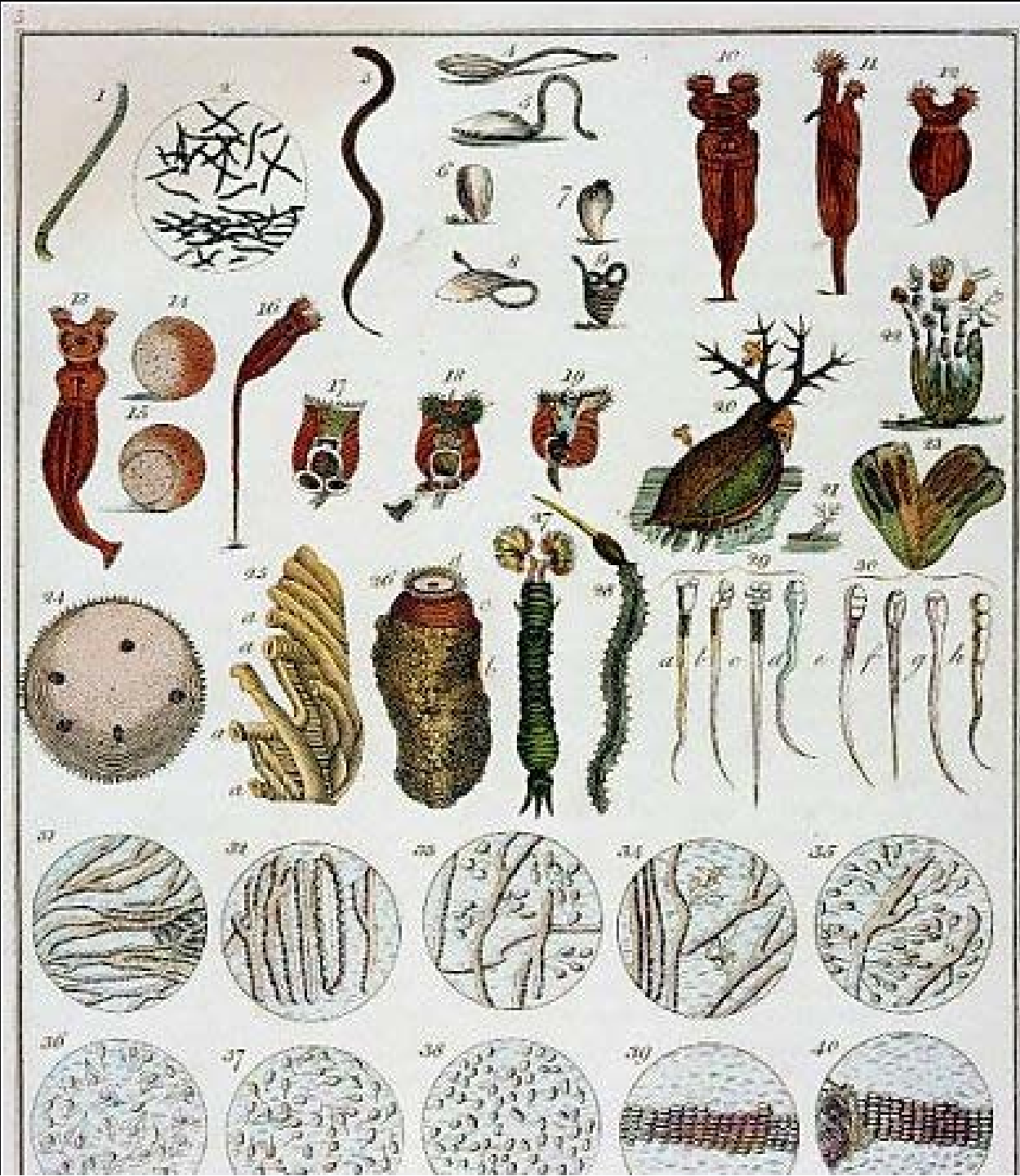
- Early microscopes did not have much magnifying power, until 1675 when a Dutch cloth merchant named Antonie van Leeuwenhoek developed the first microscope lenses powerful enough to view microbes.
- The improvements resulted in a magnification power of up to 300X.



Anton van Leeuwenhoek "The Father of Microbiology"

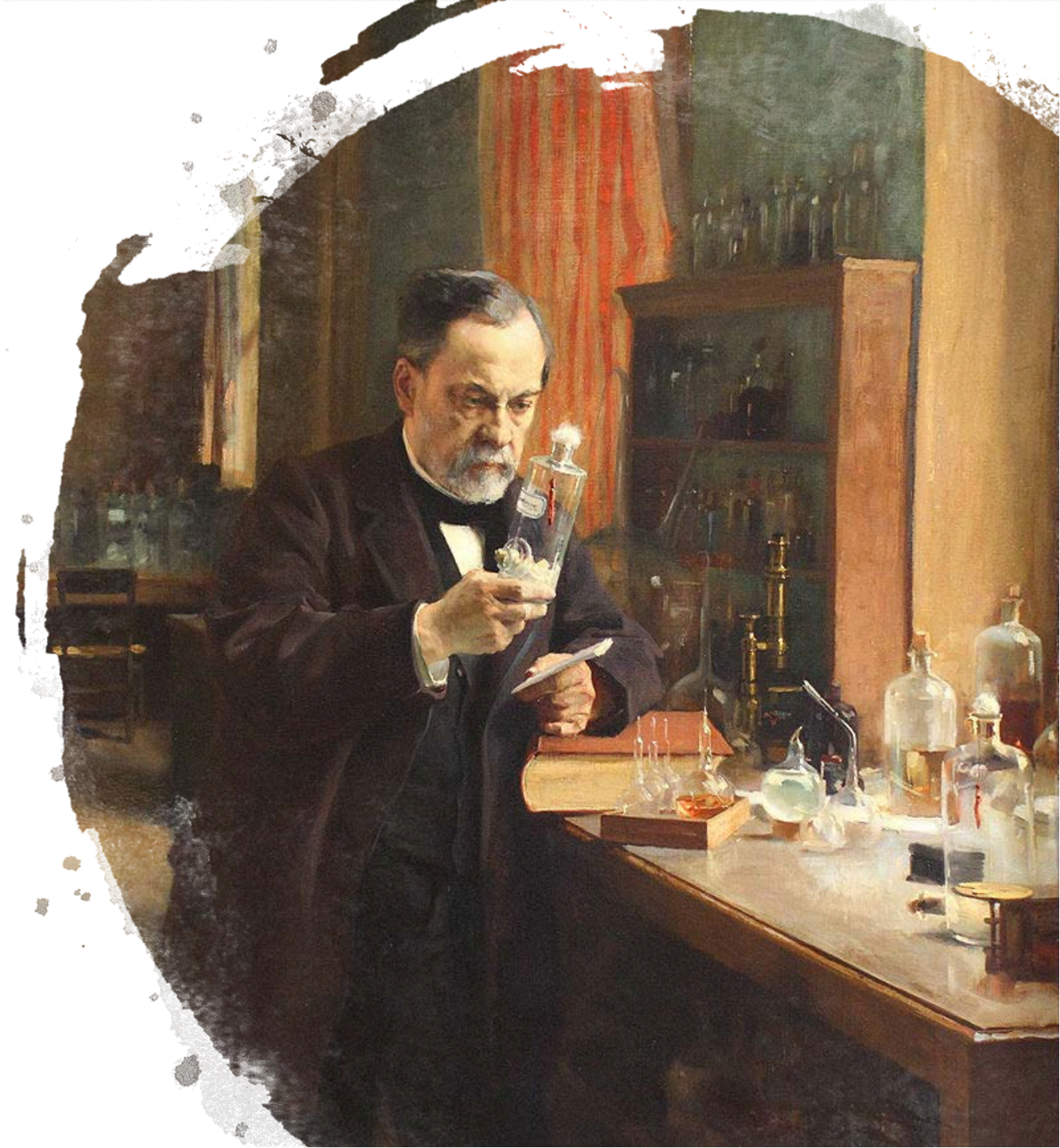
- Anton van Leeuwenhoek was coined "The Father of Microbiology".
- He observed the first motile microscopic lifeforms - he called them "animalcules" in a drop of water.

*By Anton van Leeuwenhoek [Public domain],
via Wikimedia Commons*



- Louis Pasteur performed a series of experiments that presented overwhelming evidence against the theory of spontaneous generation.

Louis Pasteur

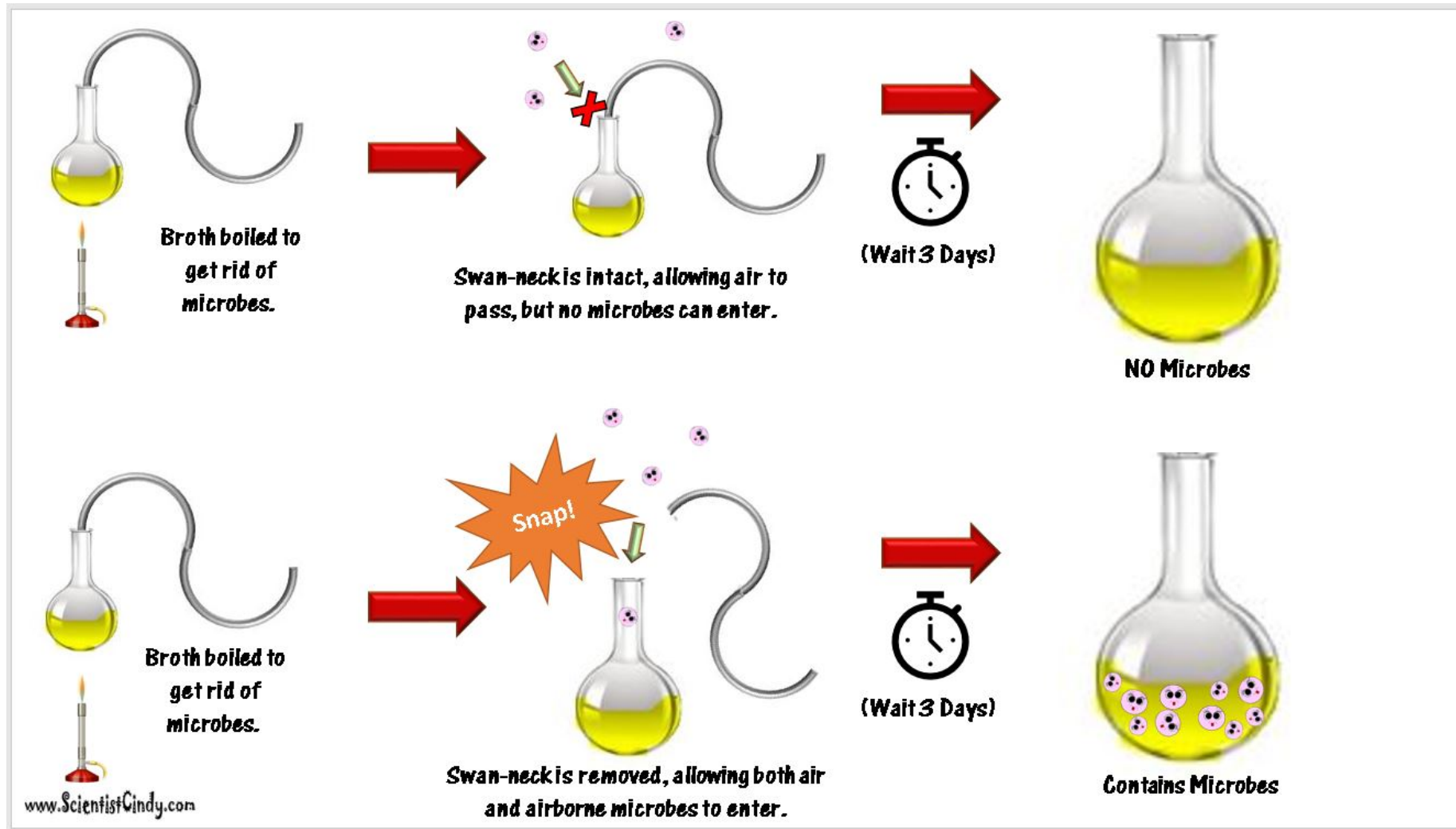




- **Pasteur designed special flasks containing swan neck tubes that protruded from the top. The design allowed for air to pass through to the broth, but prevented any microbes from passing through the air into the broth.**
- **His experiment demonstrated that exposure to air was not enough to grow microbes in broth. The broth had to have exposure to microbes in the air to grow microbes in the broth.**

Swan-Necked Flasks

Are Organisms Coming from Air or from Organisms in the Air?



Pasteur

- His experiment demonstrated that exposure to air was not enough to grow microbes in broth.
- The broth **MUST** have exposure to microbes in the air in order to grow microbes in the broth.



Pasteur → Fermentation and Pasteurization

Fermented Foods



Pickled Vegetables



Sauerkraut



Cheese



Yogurt

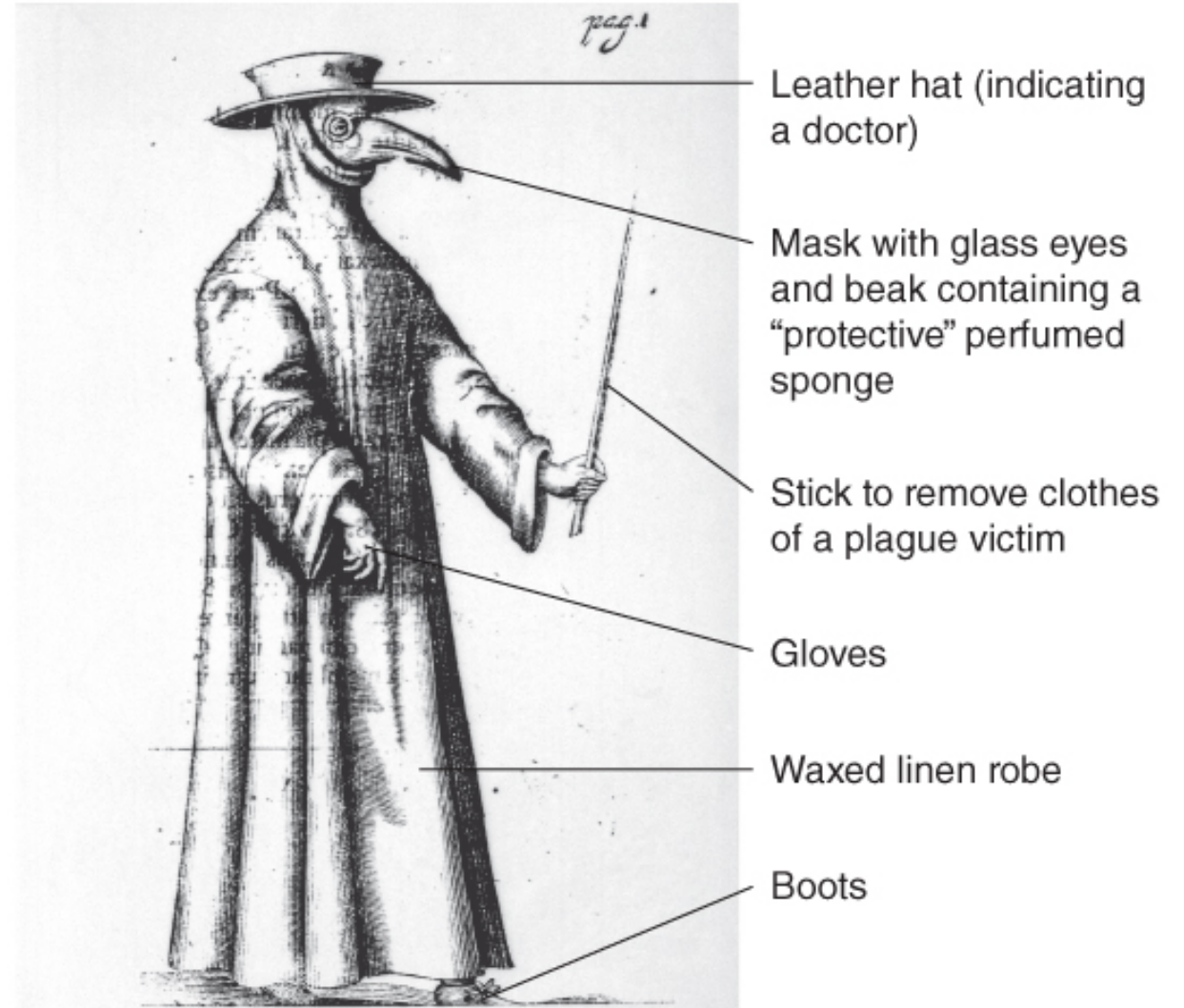


Pasteurization was his technique of heating to kill pathogens.

- He proved that yeasts are responsible for **fermentation**.

Disease Transmission

- In the 1700s: People thought diseases resulted from foul qualities or rotting particles, called miasma, in the environment or air.
- Late 1800s: Careful scientific inquiry into the nature of disease gave rise to the field of epidemiology.
 - Epidemiology is the study of the source, cause, and mode of transmission of disease.



The Father of Epidemiology

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

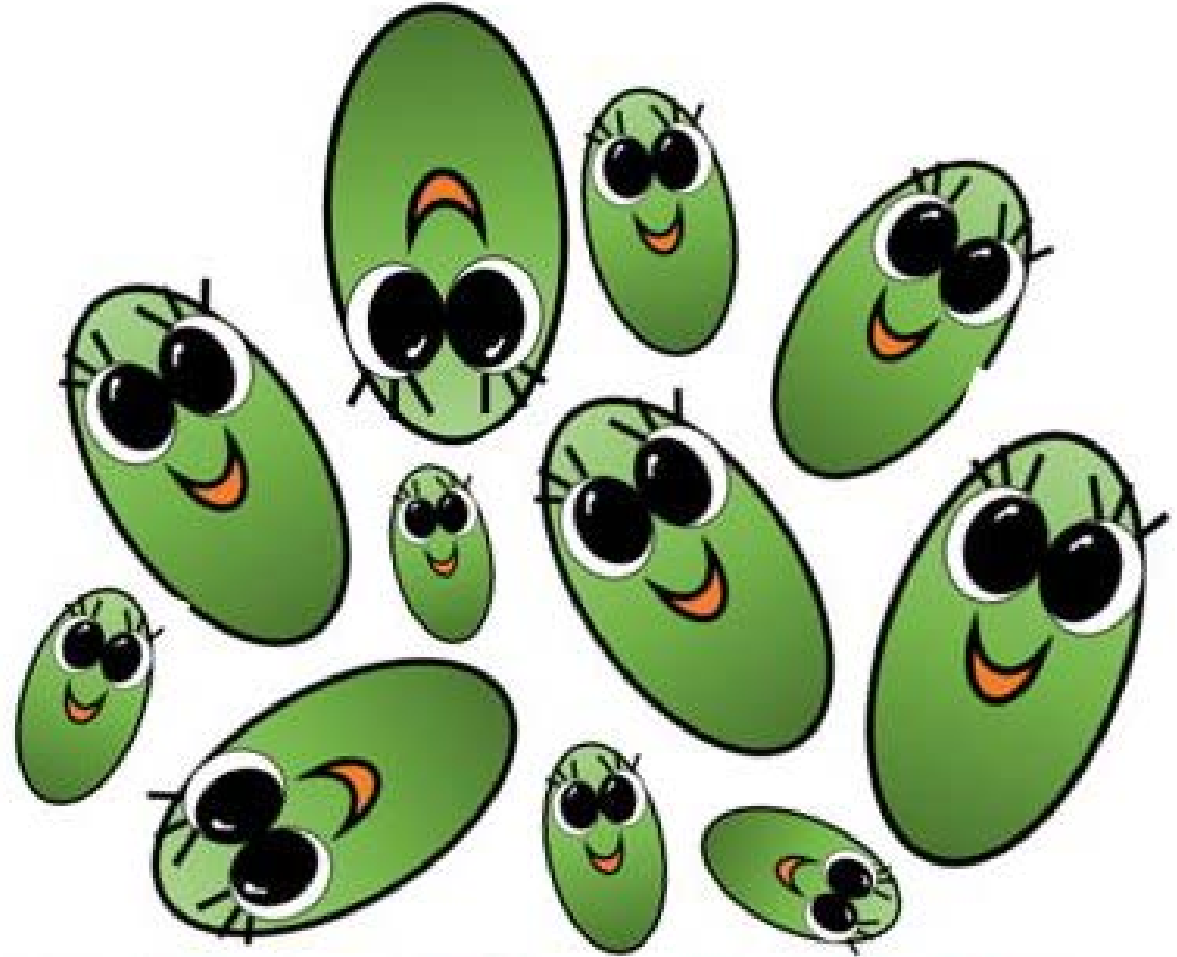
**This was the first
EPIDEMIOLOGICAL
STUDY~**

**John Snow is known as
“The Father of
Epidemiology”**



Germ Theory

- Louis Pasteur proposes that germs cause infectious disease.
 - He popularizes the germ theory in 1862.
 - The Germ Theory is the disease comes from GERMS not MIASMATIC ODORS.



“Golden Age of Microbiology” 1857 through 1914

- Ignaz Philipp Semmelweis was instrumental in the development of aseptic techniques as a defense against the germs that were the cause of disease, according to Germ Theory, which had not yet gained popularity at the time.





**“Golden Age of
Microbiology”
1857 through 1914**

- Semmelweis discovered that hand washing in obstetrical; clinics drastically reduced the incidence of "childhood fever", or puerperal fever.

“Golden Age of Microbiology” 1857 through 1914

- Semmelweis's discovery was tested and proved over and over again.
- However, the scientists of the day were reluctant to accept that hand washing reduced mortality rates, because the idea of Miasmatic Theory was prevalent and widely accepted within the medical and scientific communities.
- In fact, many medical practitioners refused to wash their hands and were insulted at the idea that their hands may be contaminated.



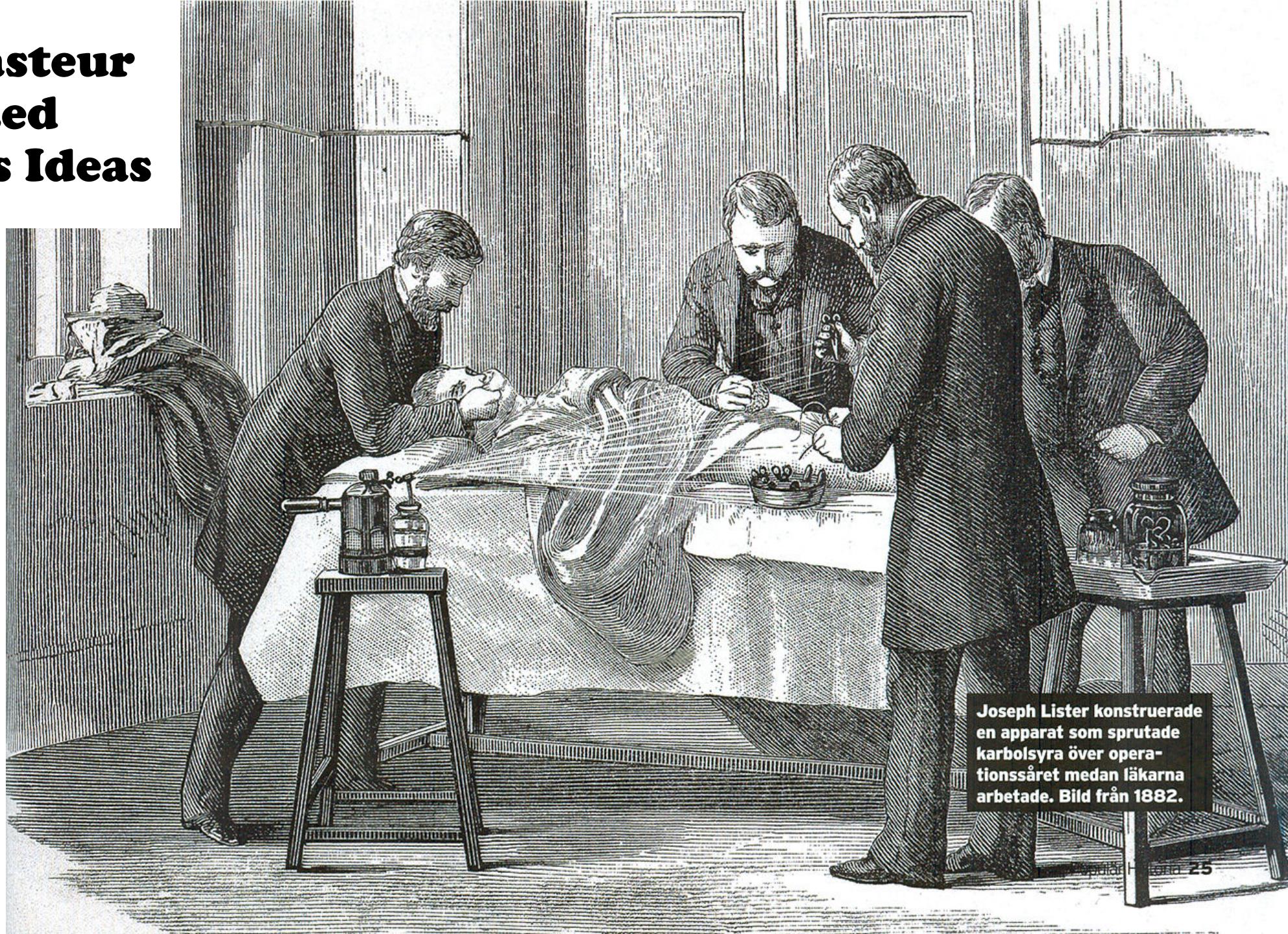
Semmelweis was coined "the Savior of Mothers".

- Semmelweis was coined "the Savior of Mothers". Puerperal fever was common in the 1850's and was often fatal. 50% of post-operative patients dies due to infection, before aseptic techniques were used.
- *Illustration - Ignaz Semmelweis washing his hands in chlorinated lime water before operating. Bettmann/Corbis National Public Radio*



Lister and Pasteur Popularized Semmelweis's Ideas

- Semmelweis concluded that these infections were due to unseen microbes that were able to travel through air or by a contaminated object coming into direct contact with the patients.
- Unfortunately, his ideas were not popularized until after his death, when Lister and Pasteur continued the work in antiseptis.



Joseph Lister konstruerade en apparat som sprutade karbolsyra över operationssåret medan läkarna arbetade. Bild från 1882.

Pasteur

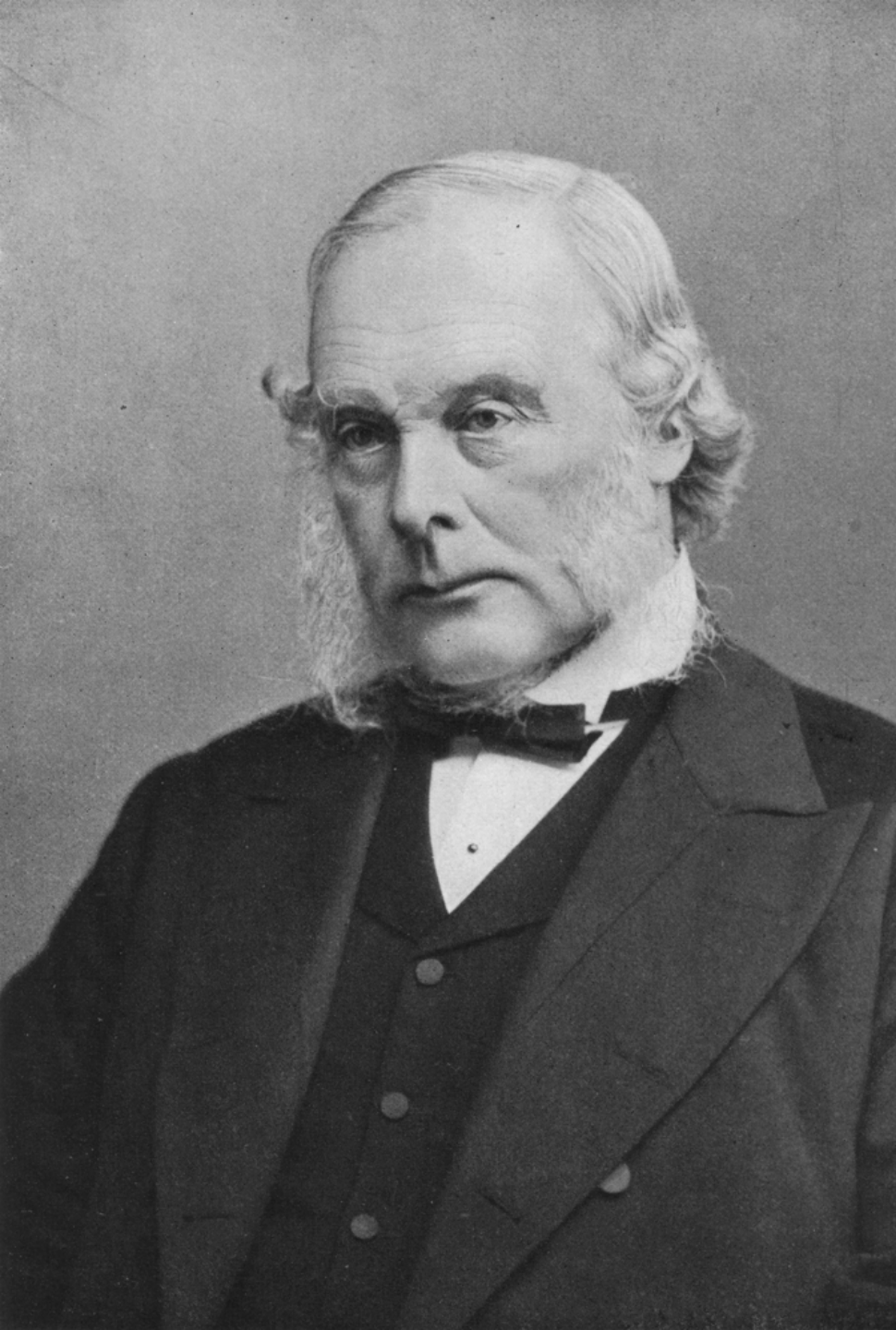
- Louis Pasteur invented a process that reduced the number of pathogens in certain food products, such as dairy products.
- This process was named "pasteurization" and is where we get products like "pasteurized" milk, etc.
- The process of pasteurization kills most of the bacteria that causes spoilage, thereby increasing food quality and protecting public health.



Pasteur

- Louis Pasteur also proved that the fermentation process was caused by the single-celled organisms called yeast.





John Lister - antiseptis

- John Lister also furthered the earlier work by Ignaz Semmelweis (1818–1865) who had developed the practice of sterile techniques and demonstrated the link between the non-sterile environment and disease.
- In 1865, Joseph Lister developed the practice of **antiseptis**, which is the chemical disinfection of external living surfaces.

Lister and Listerine?

- The medical field adopted many of the aseptic techniques set forth by Lister. These methods of sterility and decontamination became the new standard for patient care. A great many of the aseptic techniques developed by Joseph Lister are still used in the medical field today.

-

FUN FACT!

Listerine was developed in 1879 by Joseph Lawrence and was named after Joseph Lister, in honor of his contribution to antiseptic surgery.





Robert Koch (1843 - 1910) is known as *the founder of bacteriology*.

- Robert Koch performed an experiment that provided evidence that bacteria cause disease.
- Specifically, Koch identifying the pathogens that cause tuberculosis, cholera and anthrax.
- Koch experimentally identified 4 generalized principles linking pathogens to disease, now known as **KOCH'S POSTULATES**.

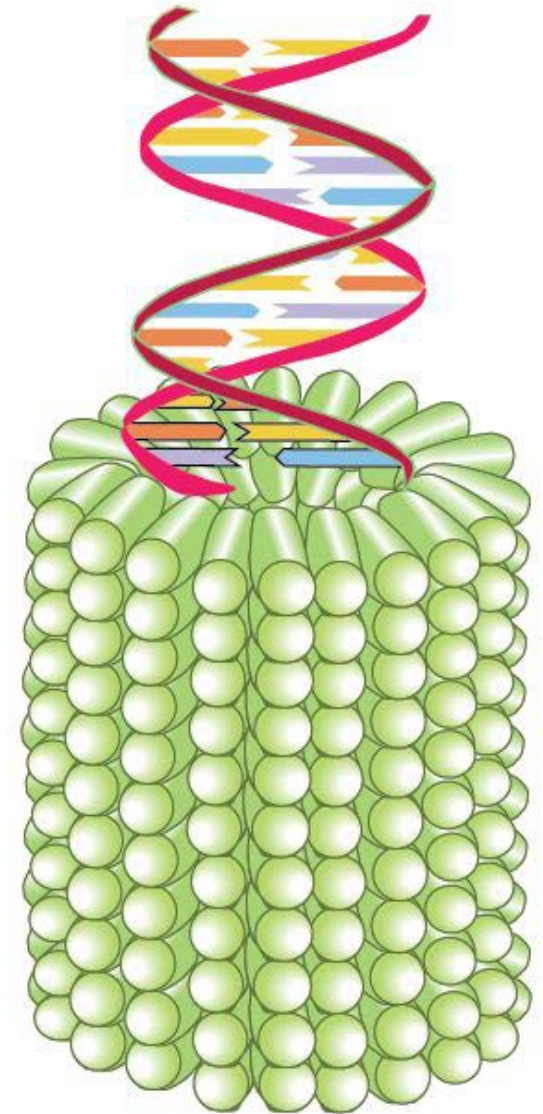
Koch's Postulates

- 1. The organism must always be present, in every case of the disease.**
- 2. The organism must be isolated from a host containing the disease and grown in pure culture.**
- 3. Samples of the organism taken from pure culture must cause the same disease when inoculated into a healthy, susceptible animal in the laboratory.**
- 4. The organism must be isolated from the inoculated animal and must be identified as the same original organism first isolated from the originally diseased host.**



Dmitry Ivanovsky and Martinus Beijerinck

- In 1892, Dmitry Ivanovsky filtered the sap from a diseased tobacco plant and discovered that the filtrate was able to infect a healthy tobacco plant with the disease.



tobacco mosaic

Dmitry Ivanovsky and Martinus Beijerinck

- Independently, Martinus Beijerinck, discovered the same virus while conducting similar experiments in 1899.
- Beijerinck described the filtrate as a “contagious, living liquid” that acted like a **poison or virus (virus = “poison”)**. This is how viruses got their name and the field of virology was born.

