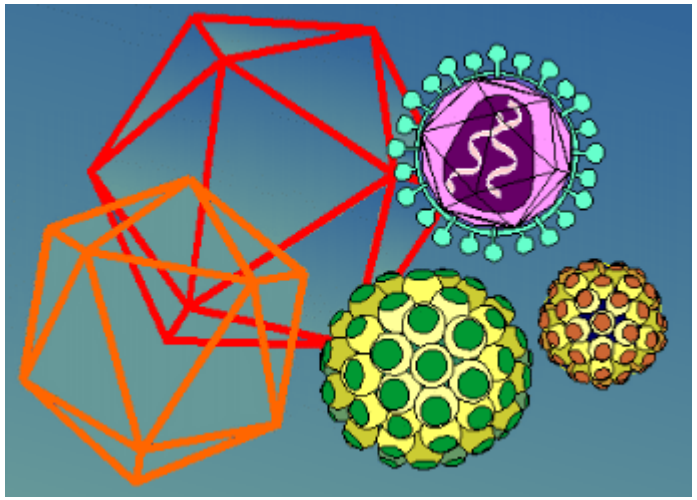
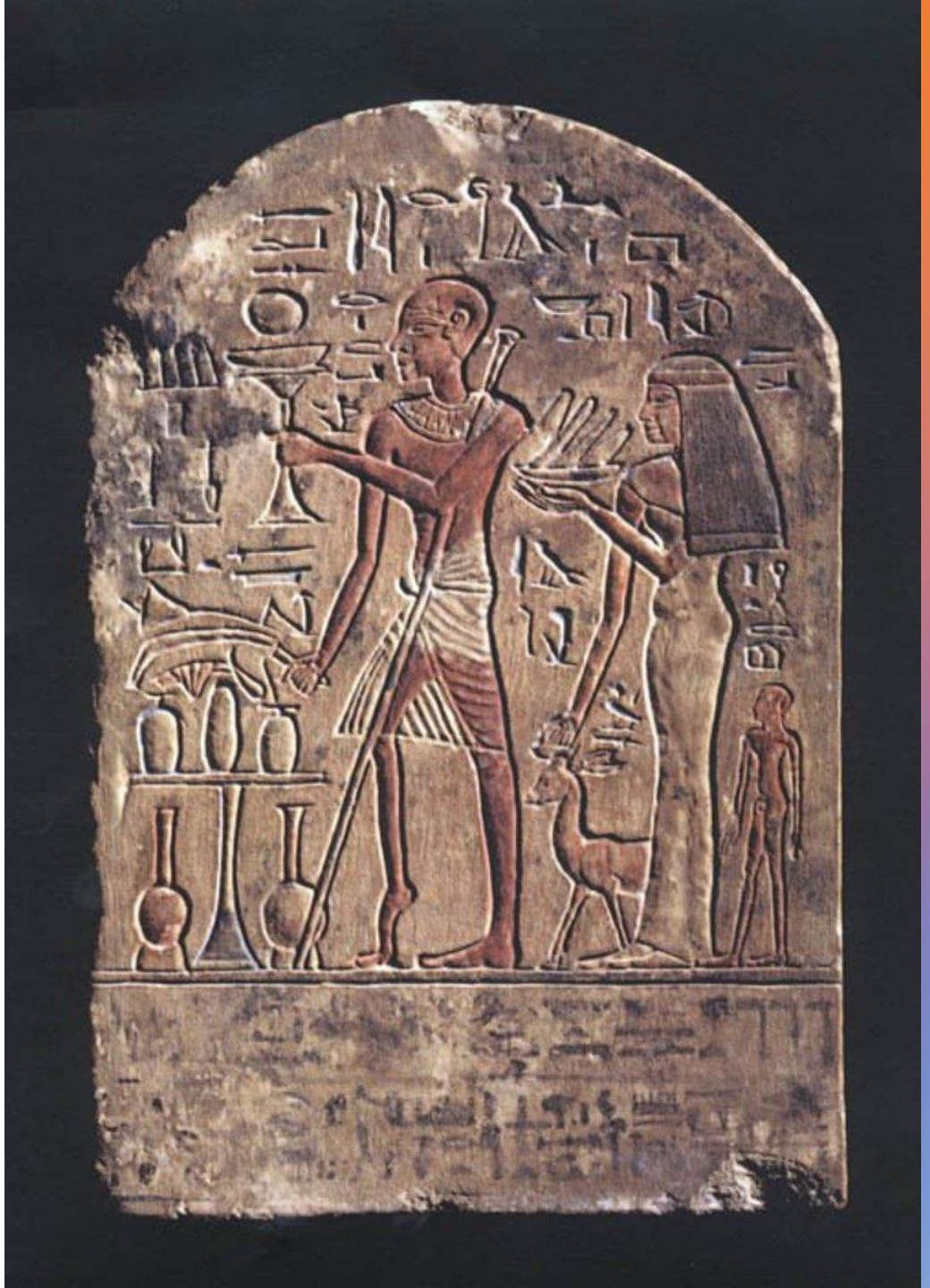


# VIROLOGY I

Assoc. Prof. İlke Karayel Hacioglu

- Tuesday 1 hour theory
- Thursday 2 hours practice
  - In the first 2 weeks, the whole class will have theoretical lessons during practice hours.
- 6 different applications will be performed;
  - Preparation of Primary cell culture
  - Preparation of inoculum from fecal samples
  - Embryonated chicken egg inoculations
  - Virus Titration
  - Neutralization test
  - Hemagglutination-Hemagglutination inhibition test

- The earliest known record of a viral infection comes from ancient Egyptian civilization. This is evidenced by photos on the walls of temples and a stone tablet dating back to the 18th dynasty (1580-1350 B.C.). The tablet depicts an Egyptian with polio, as evidenced by the withered leg and shape of the foot, which are typical symptoms of Poliomyelitis.



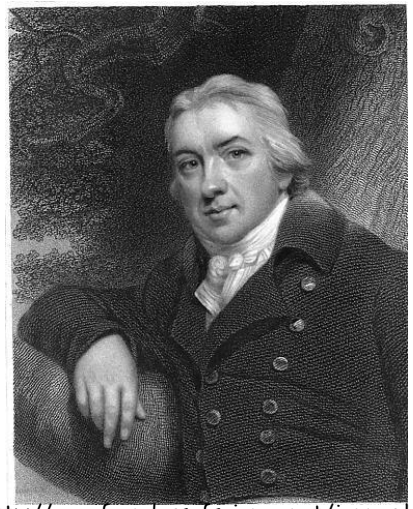
https://discover.hubpages.com/education/Polio-Virus-and-Its-Odd-History
https://vetmed.uodiyala.edu.iq/uploads/2019/dr-amer/Lecture%20%201%20Introduction%20to%20virology%20and%20Virus%20architecture.pdf

https://en.wikipedia.org/wiki/Ramesses_V#/media/File:Ramses_V_mummy_head.png

- Ramesses V died of smallpox at the age of 35 in 1145 BC, as evidenced by his preserved mummy.
- The pustular lesions on the mummy's face closely resemble those of modern smallpox patients.

- 1000 BC New smallpox epidemic and first vaccination (variolation) in China.
- The dried crusts of cowpox lesions were administered to healthy individuals by inhalation.

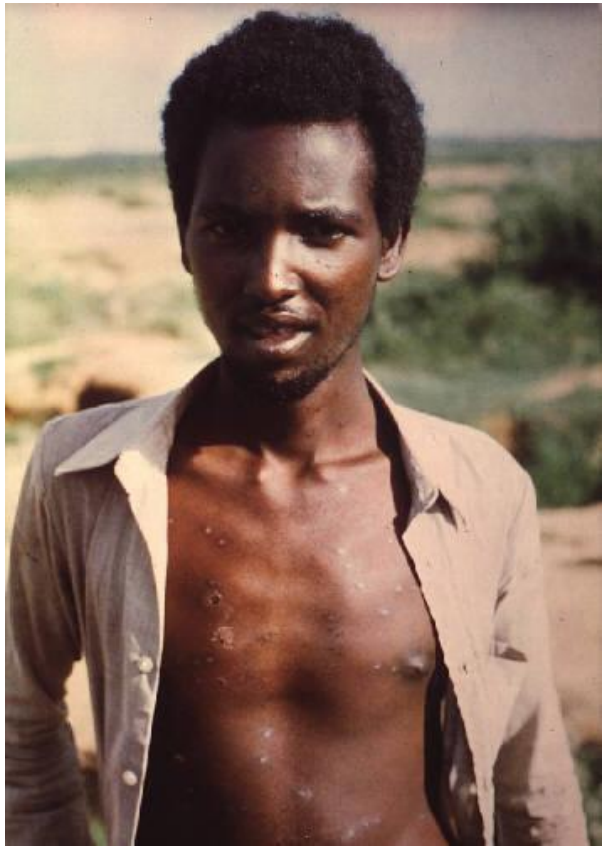
- Measles is an ancient disease. However, it was not identified until the 10th century by the Persian physician Muhammad ibn Zakariya al-Razi (865–925), also known as 'Rhazes'.
- The first scientific study was again focused on smallpox. Based on the observation that people in contact with cowpox-infected cattle were protected from human pox, Edward Jenner protected people against infection by administering cowpox vesicle fluids to humans in 1796.



http://www.foundersofscience.net/jenner.htm

Poster Edward Jenner performing the first vaccination against Smallpox in 1796, 1879-©Gaston Melingue,Bridgeman Images-Image No.417730

- The last known person in the world to have a natural case of smallpox. Variola minor in 23-year-old Ali Maow Maalin, Merka, Somalia CDC



Ali Maow Maalin said he avoided getting the smallpox vaccine as a young man because he was afraid of needles. He didn't want others to make the same mistake with polio.

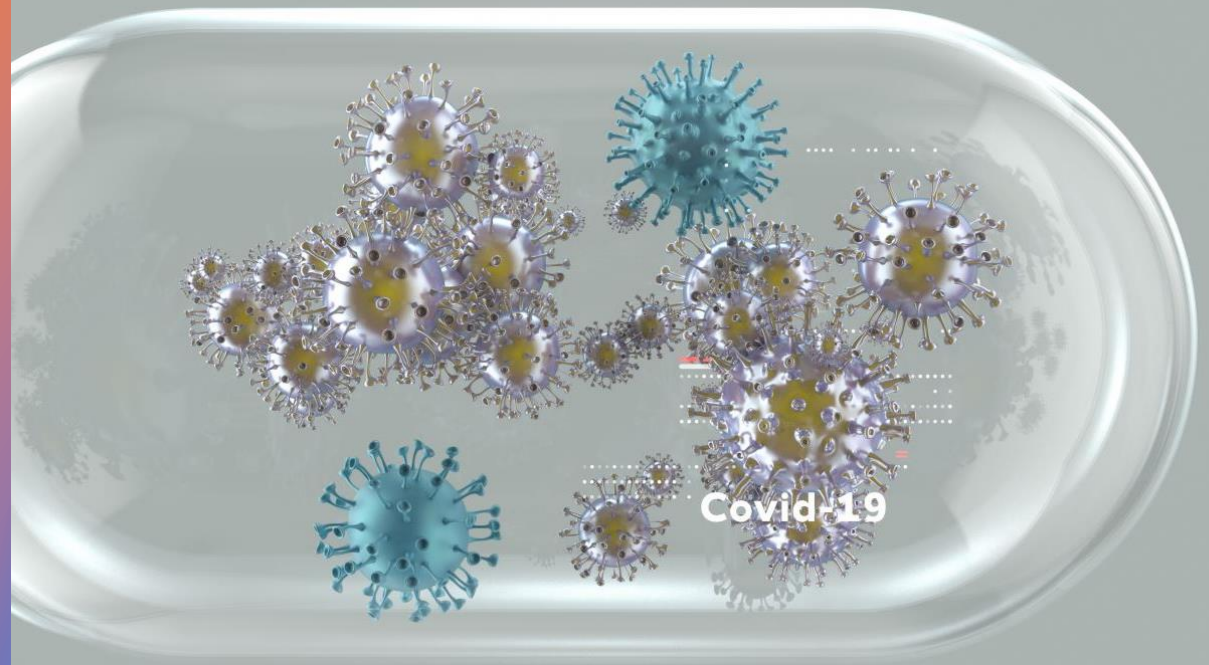
https://www.npr.org/sections/health-shots/2013/07/31/206947581/last-person-to-get-smallpox-dedicated-his-life-to-ending-polio

- Year 1886:
- Louis Pasteur tested the rabies vaccine.

It was based on experimental production of the vaccine by serial passage of the infectious virus in rabbit spinal cords.

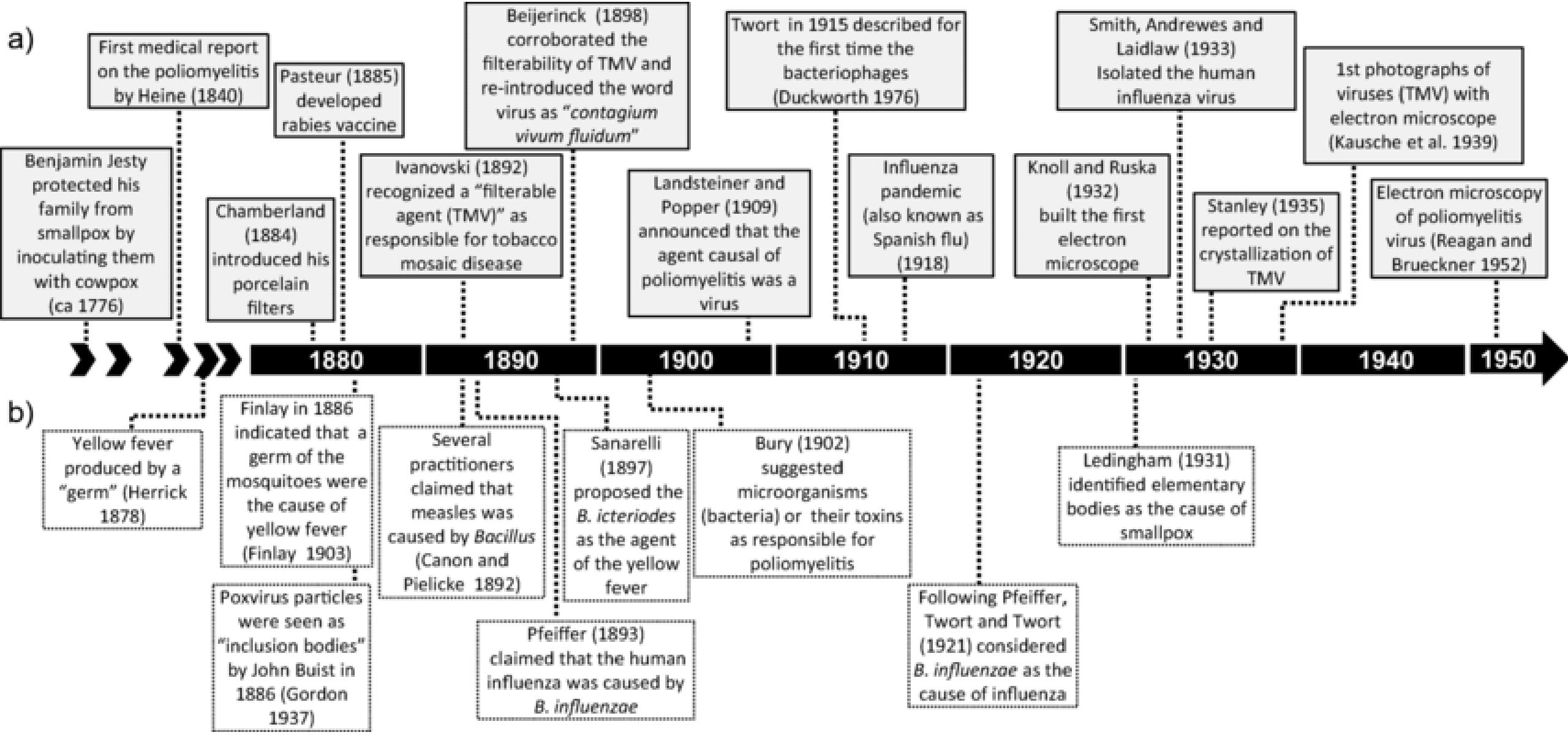
- The next vaccines for yellow fever and influenza did not appear until the 1930s.
- Louis Pasteur and Edward Jenner were the first to develop vaccines to protect against viral infections.

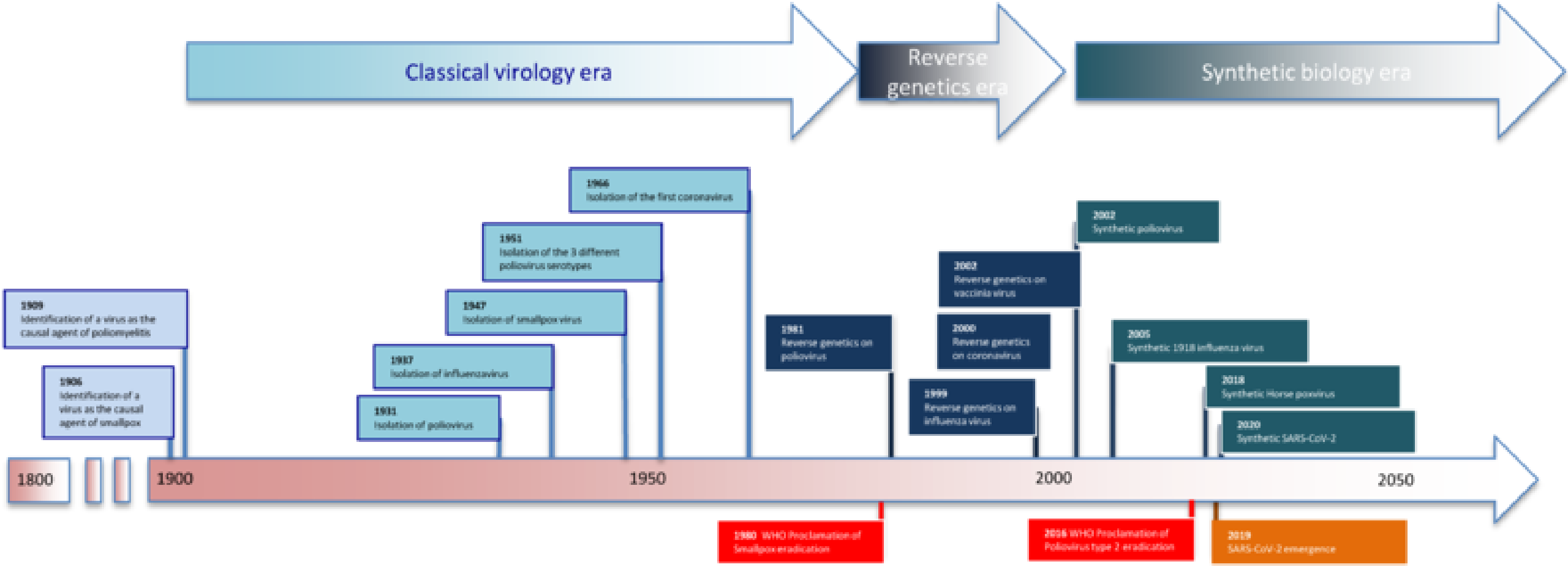
https://www.britannica.com/biography/Louis-Pasteur/Vaccine-development




VIRUS= POISON

- This term was used synonymously with the word "germ", which Pasteur used to describe infectious agents in the 19th century.




Classical virology era
Reverse genetics era
Synthetic biology era
1909
Identification of a virus as the causal agent of poliomyelitis
1906
Identification of a virus as the causal agent of smallpox
1966
Isolation of the first coronavirus
1951
Isolation of the 3 different poliovirus serotypes
1947
Isolation of smallpox virus
1937
Isolation of influenzavirus
1931
Isolation of poliovirus
1981
Reverse genetics on poliovirus
2002
Synthetic poliovirus
2002
Reverse genetics on vaccinia virus
2000
Reverse genetics on coronavirus
1999
Reverse genetics on influenza virus
2005
Synthetic 1918 influenza virus
2018
Synthetic Horse poxvirus
2020
Synthetic SARS-CoV-2
1800
1900
1950
2000
2050
1980 WHO Proclamation of Smallpox eradication
2016 WHO Proclamation of Poliovirus type 2 eradication
2019
SARS-CoV-2 emergence

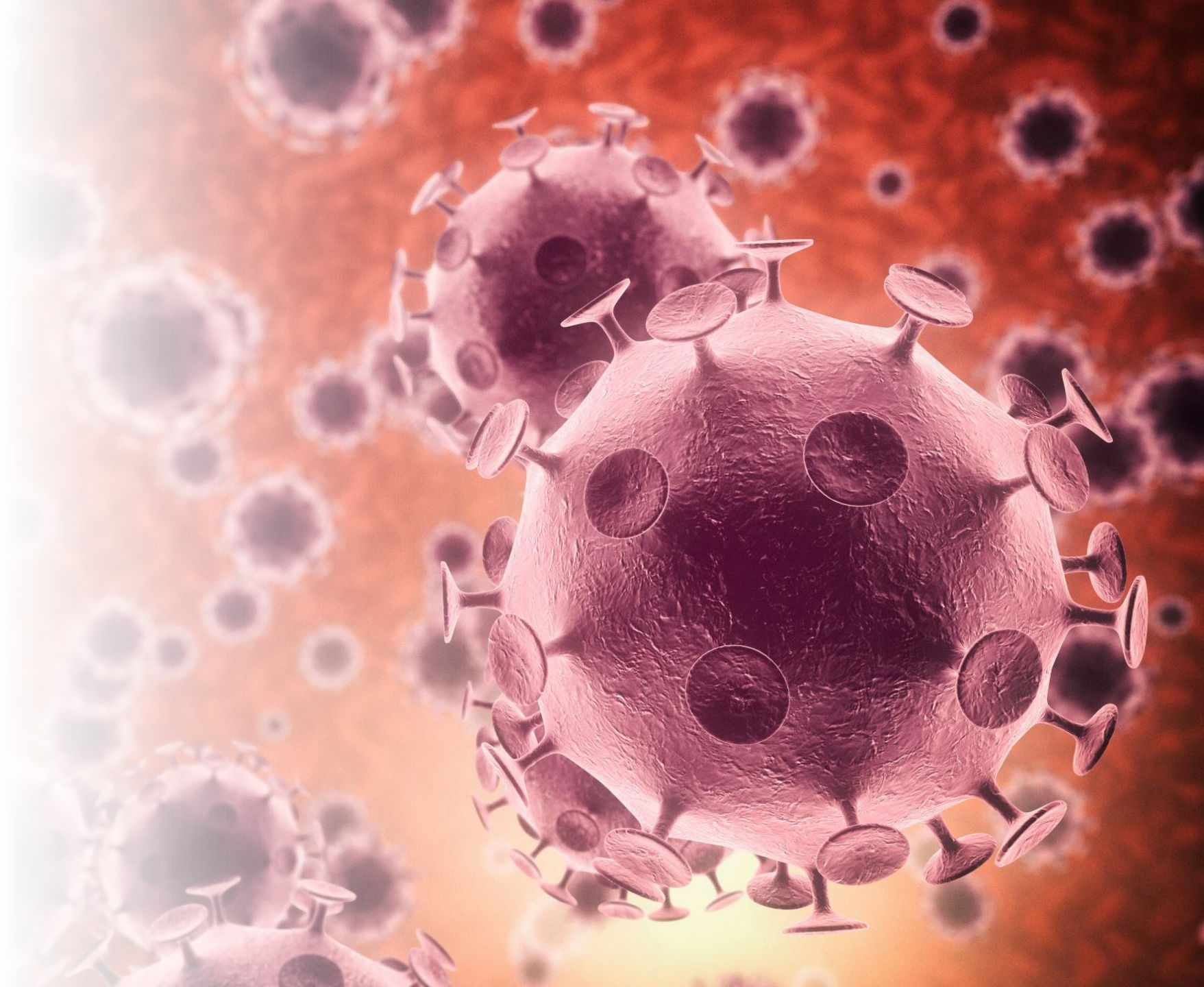
# Unicellular Microorganisms Prokaryotes

- Although these are small and simple, they are cells. They always carry DNA and have different types of RNA. They have unique mechanisms that can produce energy and macromolecules.
- Protozoon
- Yeast
- Bacteria
- Mycoplasma
- Ricketia
- Chlamidia

# Subviral Agents

- Viroid: Viroids consist only of a short strand of circular RNA capable of self-replication. Unlike viruses, viroids do not have a protein coat to protect their genetic information.
- Virusoid: Subviral particles they are non–selfreplicating ssRNAs. RNA replication of virusoids is similar to that of viroids but, unlike viroids, virusoids require that the cell also be infected with a specific “helper” virus. A virusoid genome does not code for any proteins, but instead serves only to replicate virusoid RNA
- Pirion: proteinaceous infectious particles. A prion is a misfolded rogue form of a normal protein (PrPc) found in the cell. BSE, Scrapie.

# Viruses Structure and Definition



# Origin of viruses

- Virus-First Hypothesis

Viruses formed before or together with their existing cellular hosts.

- Escape hypothesis

Viruses are composed of genetic elements that enable them to pass between cells. It has evolved and acquired a proliferation strategy that harms the cells from which it originated.

- Regressive hypothesis

Viruses thus could have evolved from more complex, possibly free-living organisms that lost genetic information over time as these became parasitic in their replication.

# WHAT IS VIRUS?

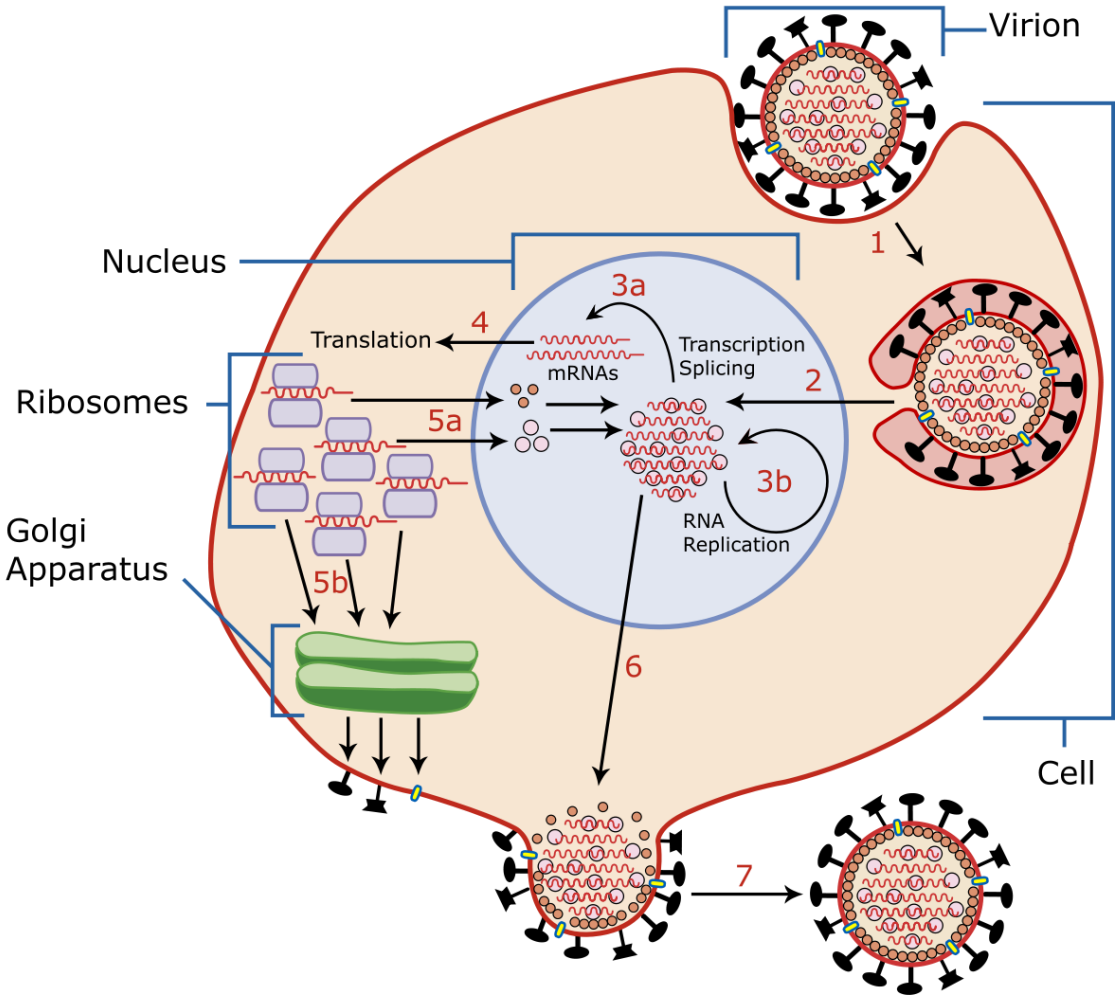
- Viruses are infectious agents that have their own replication strategy, have a single type of nucleic acid (DNA or RNA) surrounding by a protein coat and do not have mitochondria, ribosomes and other organelles, and are smaller and simpler than unicellular microorganisms.

They are submicroscopic, obligate intracellular parasites.

- Virus particles can never replicate on their own instead, it must infect cells and use components of the host cell to make copies of itself. Often, a virus ends up killing the host cell in the process, causing damage to the host organism.
- Binary fission seen in prokaryotes is not present in viruses.
- Viruses are formed by the combination of previously synthesized structural components.
- Viruses do not have energy production and protein synthesis apparatus.

# Viruses;

- are small parasite that cannot reproduce by itself.
- can direct the cell machinery to produce more viruses.
- have either RNA or DNA as their genetic material. The nucleic acid may be single- or double-stranded.



# Important Features

- Size, < 300 nm
- Reproduction in living environment, in vivo – in vitro
- Reproduction by cell division, ✗
- DNA + RNA only one of them

DNA or RNA which maybe double stranded (ds) or single stranded (ss), and linear or circular.

- Infectious nucleic acid, ✓
- Ribosome, ✗
- Metabolism, ✗
- Antibiotic sensitivity, ✗
- Interferon sensitivity, ✓

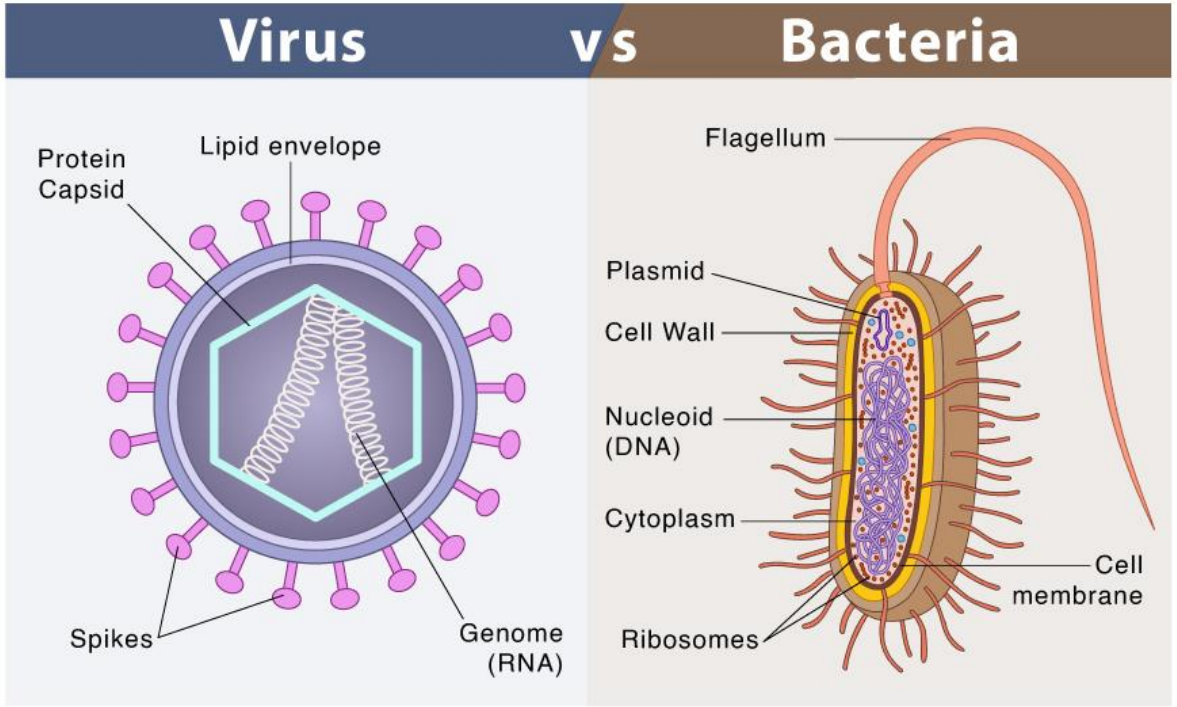
Comparison of Viruses and Cellular Organisms

| viruses | Cellular Organisms |
|---|---|
| Simple organization | Complex organization |
| Either DNA or RNA | Both DNA and RNA |
| Can not replicate outside the living cell | Cell division |
| Mandatory intracellular parasites | Some are obligatory intracellular parasites |

# Main differences between viruses and bacteria

1. Replication environment: Viruses can only replicate in intracellular (living) environments. Bacteria have the ability to reproduce in both living and non-living environments. In order to produce viruses under laboratory conditions, cell cultures, embryonic eggs or experimental animals are needed.

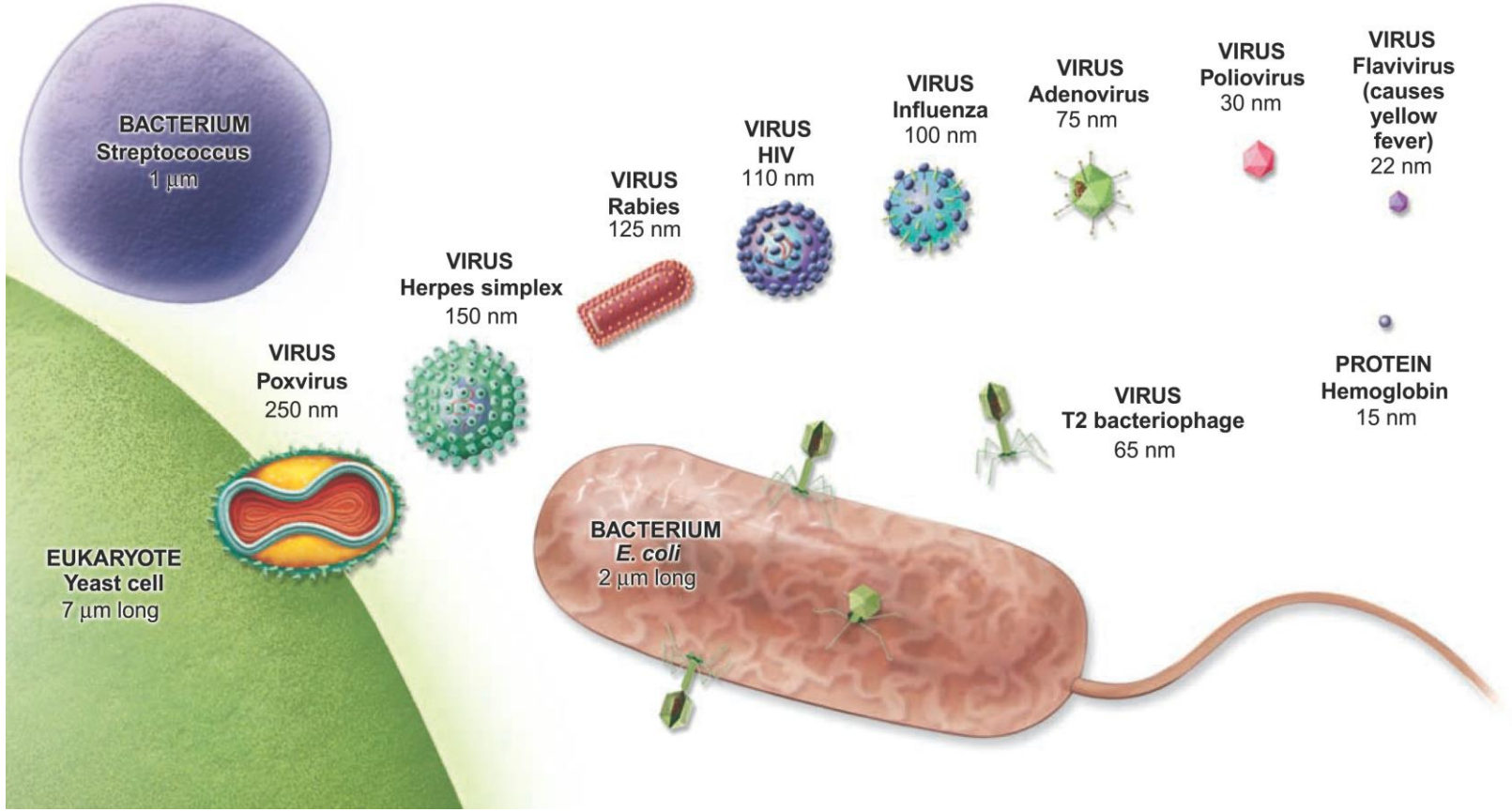
2. Structure and replication: The cell structure seen in bacteria is not found in viruses. Formations such as flagella, capsule and cell wall in the structure of bacteria are not included in the morphology of the virus. Additionally, viruses do not have intracellular organelles. While bacteria reproduce by splitting into two (Binary fission), the proliferation strategy in viruses is basically based on nucleic acid replication. During the replication of viruses, first the viral components are synthesized in the host cell and new virus particles are formed by assemblying them.



- 3. Nucleic acid: Both types of nucleic acids are present in bacteria. Viruses have a single type of nucleic acid, either DNA or RNA. ★ Therefore, viral RNA can also serve as a genetic code carrier.

- 4. Ability to pass through filters: Due to their size, the majority of viruses can pass through filter systems (Seitz, Chamberland, porcelain and membrane filters) that bacteria cannot pass through. While making this distinction, filters with 220 nm pore size are used.

5. Size & Microscopy: While bacteria can be seen under a light microscope, viruses other than smallpox virus can only be viewed under an electron microscope. Bacteria, which have sizes varying between approximately 0.5 - 5 µm, can be easily seen under a light microscope. Poxviruses (poxviruses), which are approximately 200x300 nm in size, can also be viewed with a light microscope. Most other animal viruses are smaller than 100 nm in size. In some non-enveloped viruses such as picornaviruses, caliciviruses, astroviruses and parvoviruses, the virion diameter varies between 17-25 nm. Therefore, imaging viruses and examining their structures can only be done with an electron microscope.



6. Sensitivity to antibiotics: The mechanism of action of antibiotics is to kill bacteria or slow down and stop their reproduction. The proliferation of viruses is generally not affected by antibiotics. Apart from antibiotics, some antiviral agents used against viruses are being developed. The mechanisms of action of these agents are quite different from antibacterials.

7. Sensitivity to interferon: Interferon is a biological product in protein structure secreted by cells infected with viruses. Using interferon, the proliferation of viruses can be stopped in vivo or in vitro, but not bacteria.

Use of viruses for different purposes

- Use of viruses as vectors
- Use as a biological control tool
- Use as vector in gene transfer and gene therapy
- Use of viruses (phages) in typing bacteria
- Obtaining enzymes used in molecular biology
- Use of viruses in cancer treatment