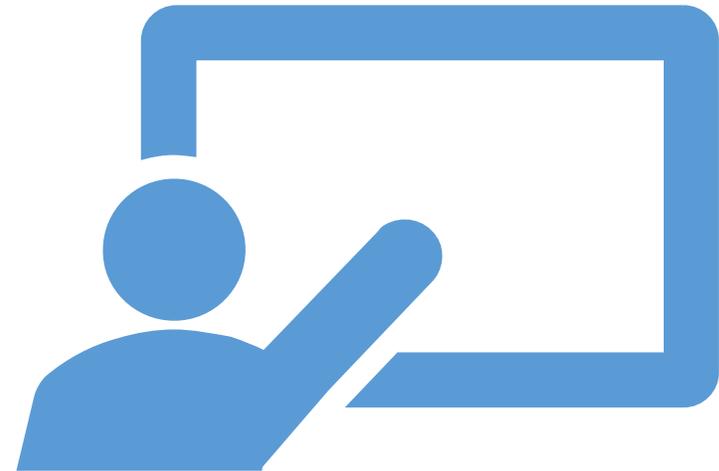


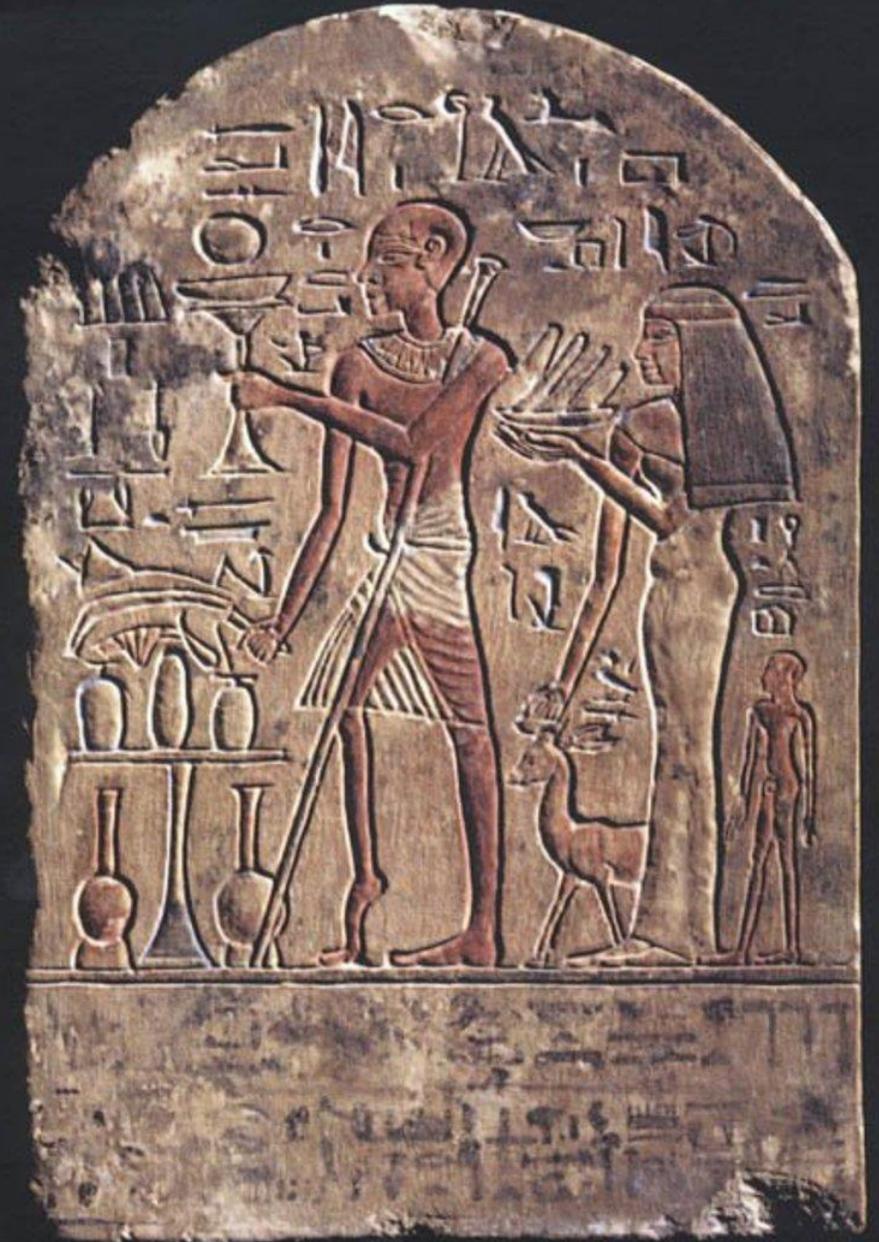
VIROLOGY I

Assoc. Prof. İlke Karayel Hacıoğlu

- 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. Evidence comes from wall reliefs in temples and a stone tablet from the 18th Dynasty (1580–1350 B.C.). This tablet shows an individual with characteristic signs of poliomyelitis, including a withered leg and foot deformity, which are typical clinical manifestations of the disease.



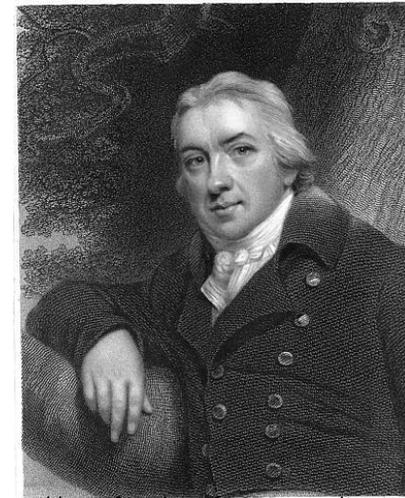


- **Ramesses V** is believed to have died of smallpox in 1145 B.C. at approximately 35 years of age.
- His well-preserved mummy revealed cutaneous lesions consistent with smallpox, providing some of the earliest physical evidence of this viral disease in human history.
- Measles is an ancient disease. However, it was not identified until the 10th century (by the Persian physician Muhammad ibn Zakariya al-Razi (865–925), also known as 'Rhazes'.)



- Records show that variolation was first practised by the Chinese as early as the 15th century. It was carried out by means of nasal insufflation, the process of sucking up material up the nose. This material was typically powdered smallpox scabs.
- In some practices, dried cowpox crusts were similarly inhaled to induce protective immunity.

- The first scientific study was 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://wwwFOUNDERSOFSCIENCE.NET/jenner.htm>



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



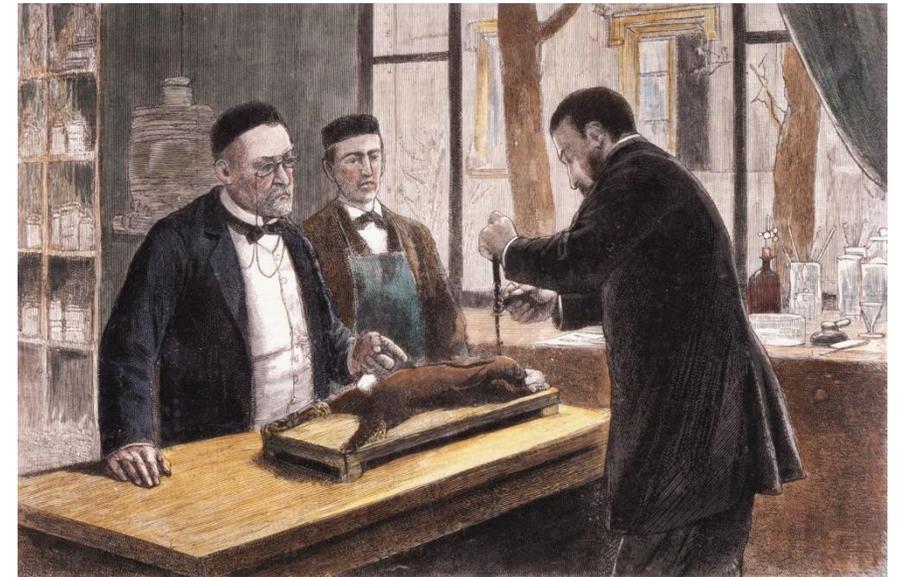
- The last known person in the world to have a natural case of smallpox.
- Variola minor in 23-year-old Ali Maow Maalin, Merka, Somalia CDC

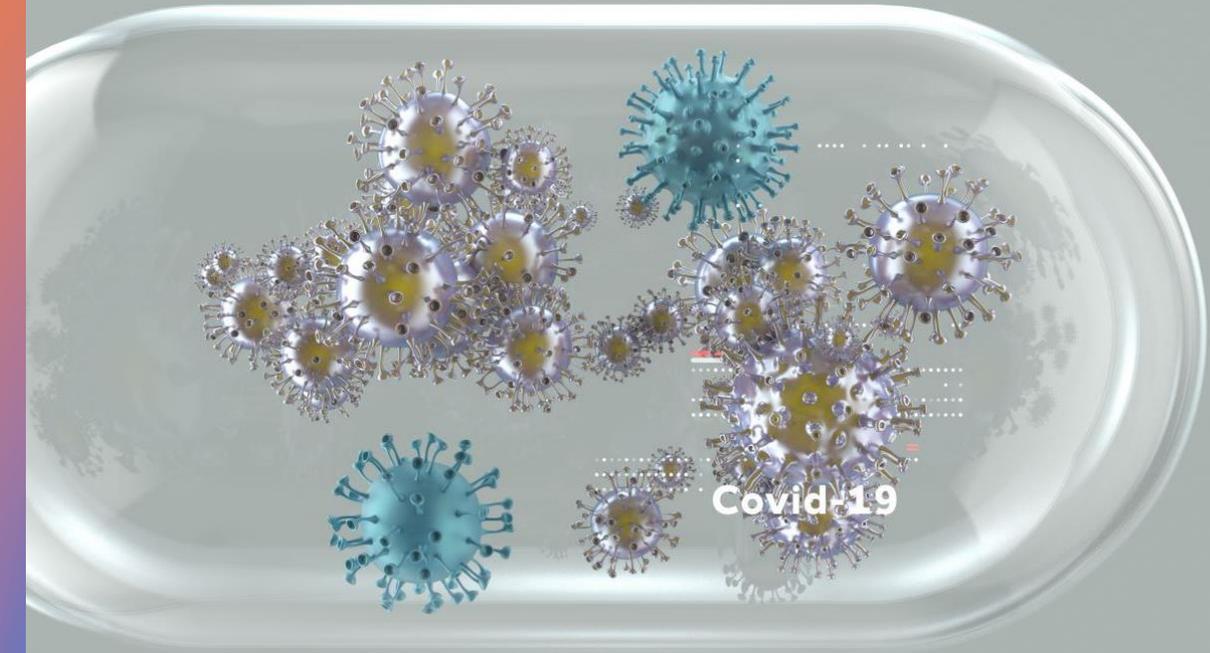
Ali Maow Maalin said he avoided getting the smallpox vaccine as a young man because he was afraid of needles. He didn't want others to make the same mistake with polio.

Year 1886:

Louis Pasteur developed and tested the rabies vaccine.

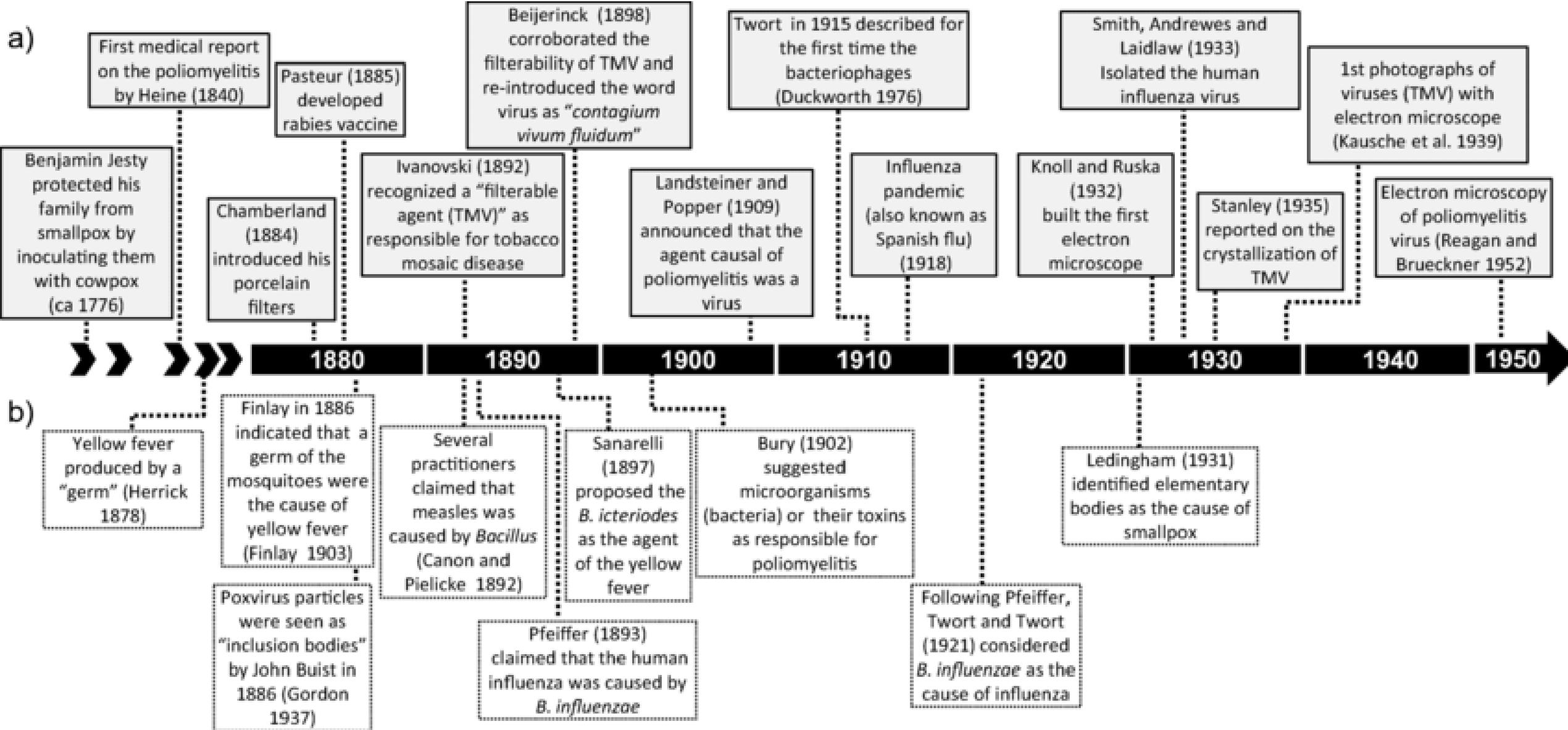
- The vaccine was produced through an experimental process involving the serial passage of the infectious virus in rabbit spinal cords.
- Subsequent vaccines against yellow fever and influenza were not developed until the 1930s.
- **Edward Jenner** and **Louis Pasteur** are regarded as pioneers in the development of vaccines for the prevention of viral infections.

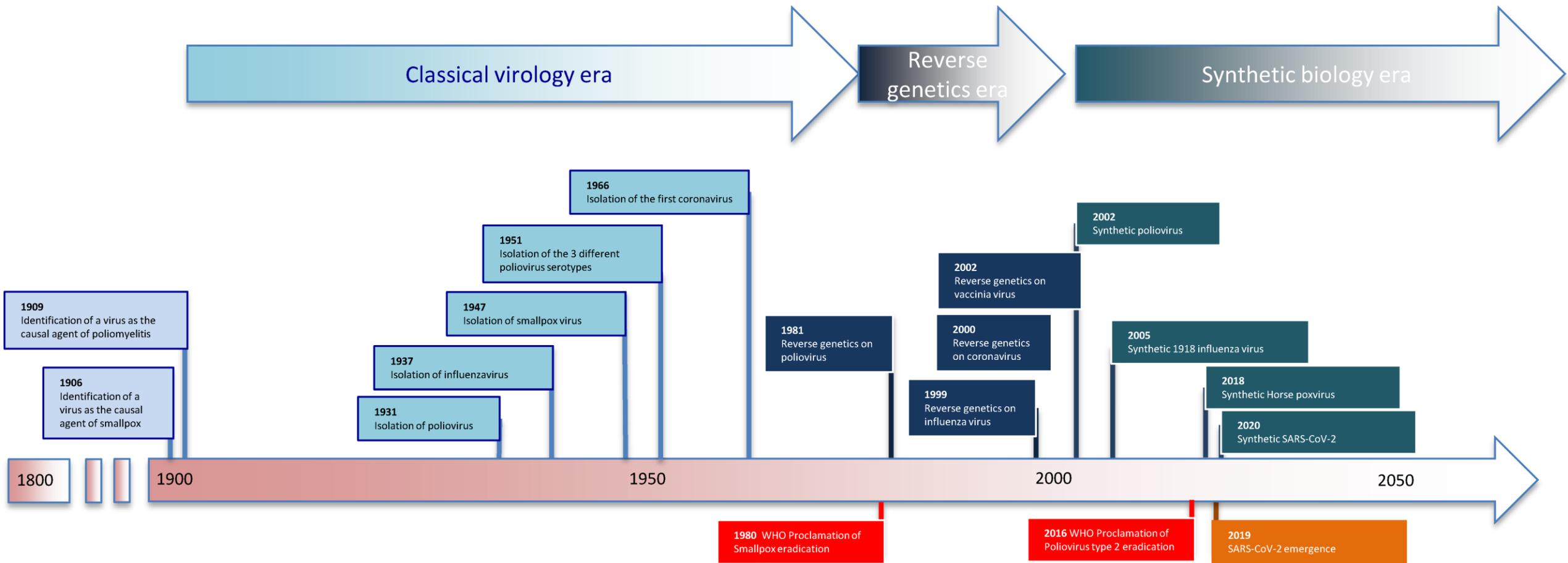




VIRUS= POISON

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





The light blue rectangles are virus discoveries, dark blue rectangles are for reverse genetics-based discoveries, and blue-green rectangles are for virus synthesis. The orange rectangle represents virus emergence, while red is for viral eradication as declared by the World Health Organization (WHO). Tournier, J.-N.; Kononchik, J. Virus Eradication and Synthetic Biology: Changes with SARS-CoV-2? *Viruses* **2021**, *13*, 569. <https://doi.org/10.3390/v13040569>

Unicellular Microorganisms Prokaryotes

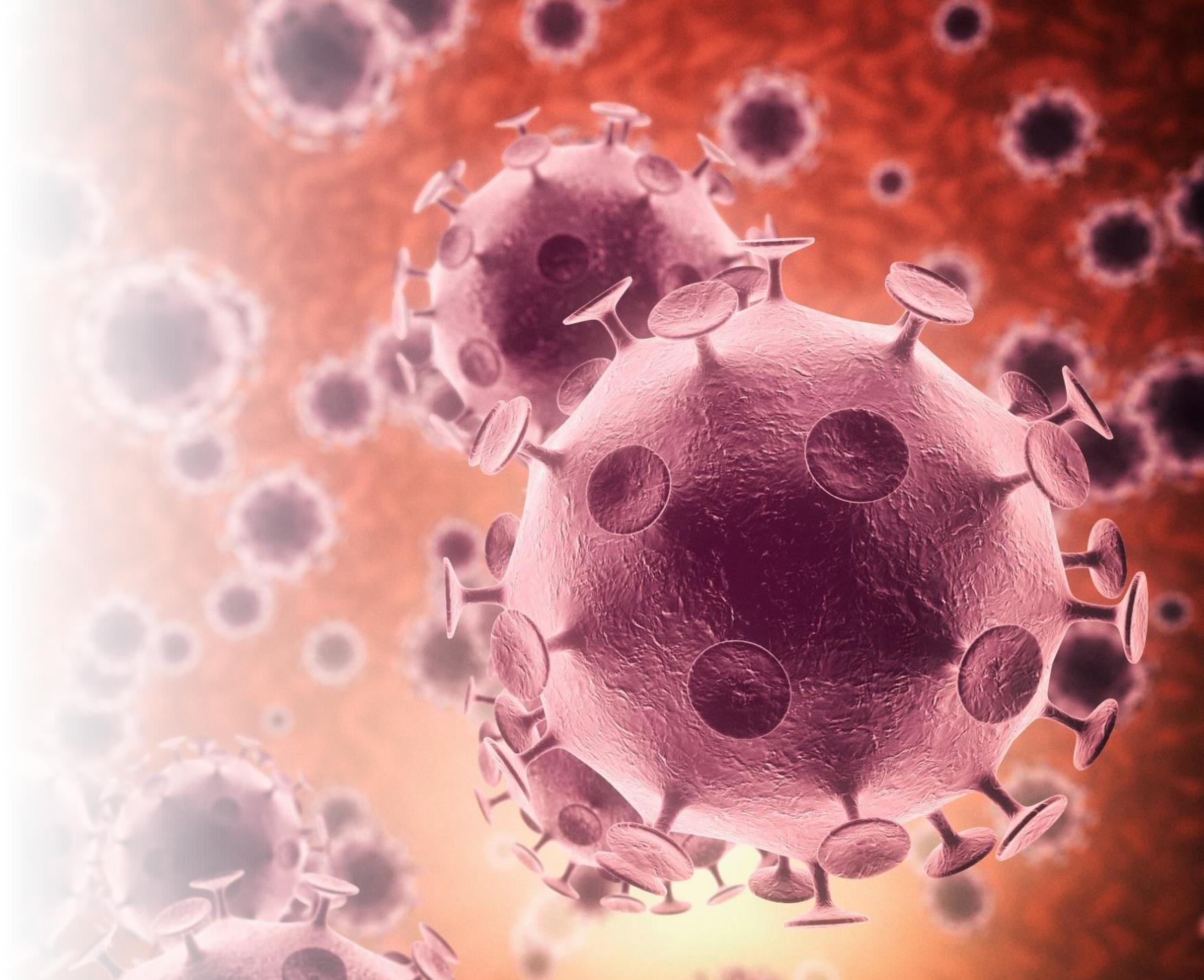
- Although these are small and simple, they are cells. They always carry DNA and have different types of RNA. They have unique mechanisms that can produce energy and macromolecules.
- Protozoon
- Yeast
- Bacteria
- Mycoplasma
- Ricketia
- Chlamidia

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.
- **Prion:** proteinaceous infectious particles. A prion is a misfolded rogue form of a normal protein (PrP^c) found in the cell. BSE, Scrapie.

Viruses

Structure and Definition



Origin of viruses

- **Virus-Early Hypothesis**

In this explanation, these pieces of RNA were around before the first cells. They slowly became more complex. Eventually, they gained the ability to make copies of themselves and infect other cells. This is how they became viruses.

- **Escape hypothesis**

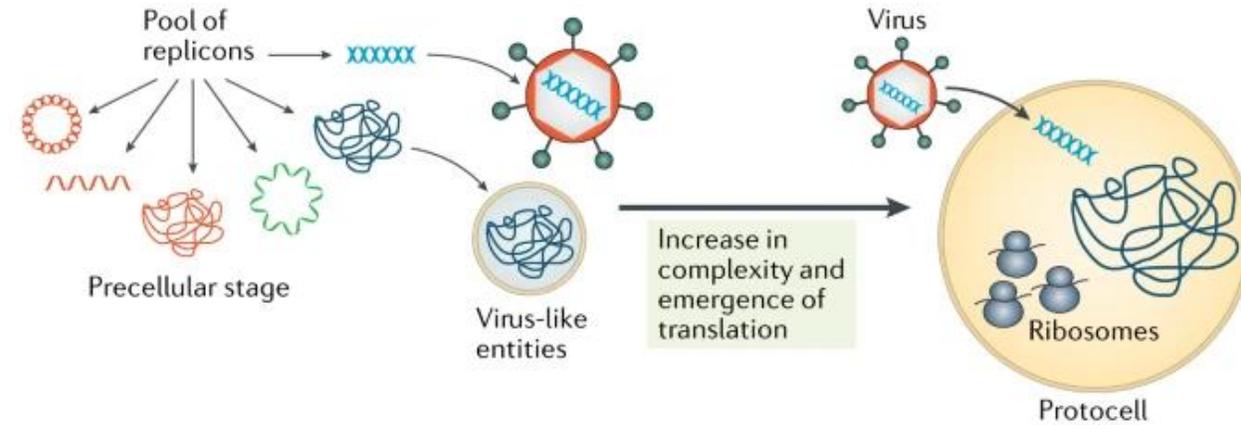
Viruses may have originated from small fragments of genetic material that escaped from their original host organisms. These genetic elements later gained the ability to infect other cells and eventually became viruses.

- **Regressive hypothesis**

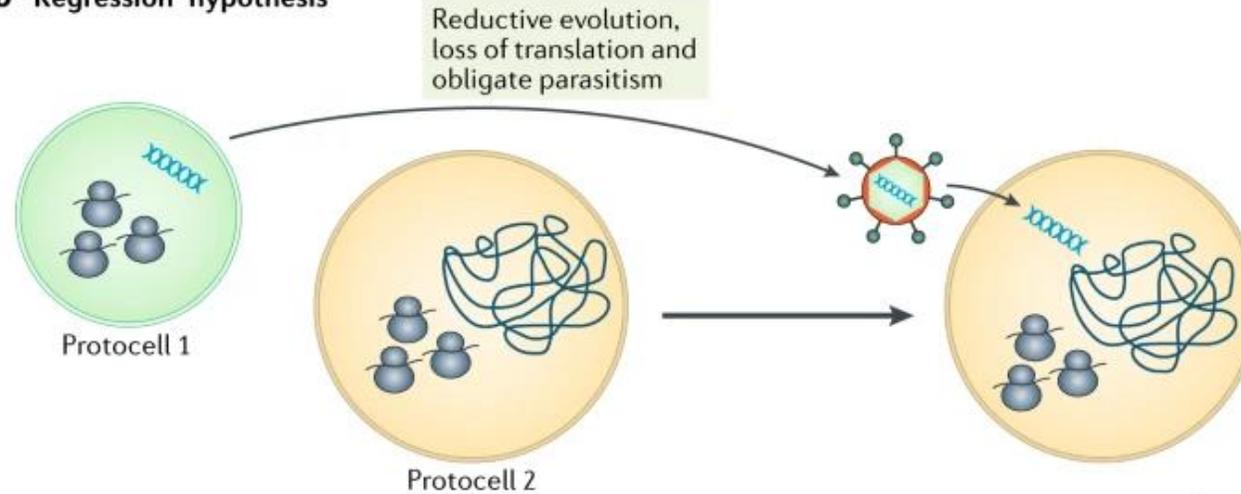
Viruses may have originated from more complex organisms that gradually became parasitic. During the evolution of a symbiotic relationship between two single-celled organisms, one organism increasingly depended on the other for survival.

As this dependence intensified, the smaller organism lost many cellular structures, including protein-synthesizing machinery, while retaining the ability to replicate. Over time, this simplified organism acquired the capacity to infect other cells and eventually became a virus.

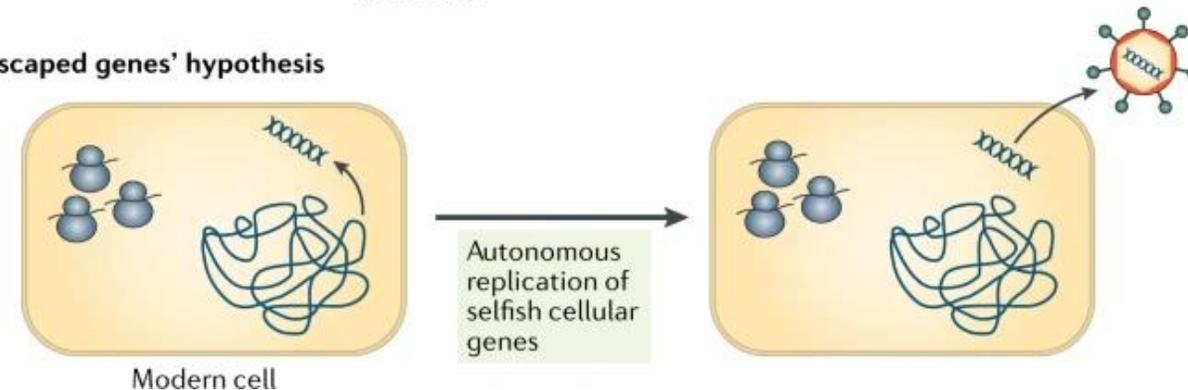
a 'Virus early' hypothesis



b 'Regression' hypothesis



c 'Escaped genes' hypothesis



WHAT IS VIRUS?

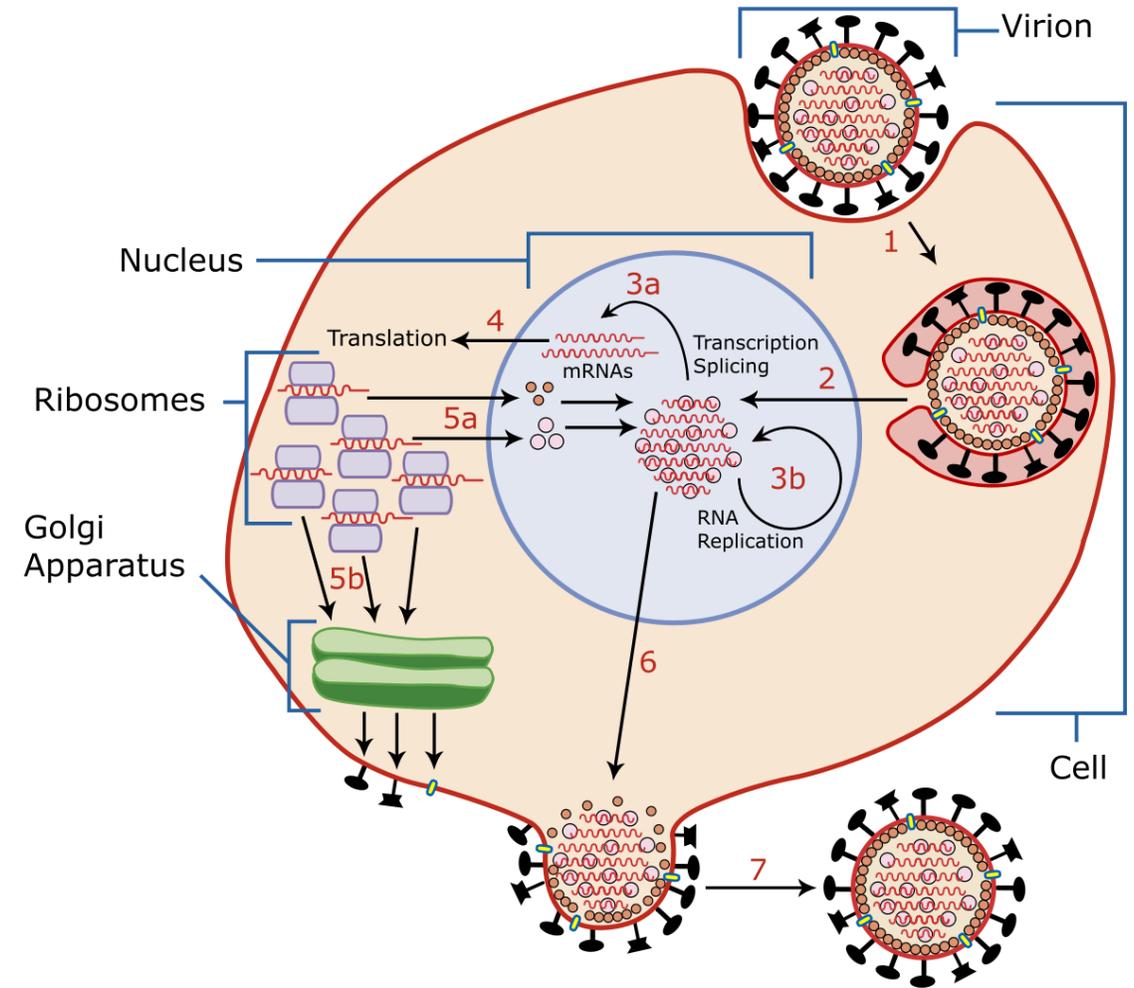
- Viruses are infectious agents that have their own replication strategy, have a single type of nucleic acid (DNA or RNA) surrounding by a protein coat and do not have mitochondria, ribosomes and other organelles, and are smaller and simpler than unicellular microorganisms.

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 produce new viral copies. In many cases, this replication process results in host cell death, leading to tissue damage and disease in the host organism.
- Viruses are formed by the combination of previously synthesized structural components.
- Binary fission seen in prokaryotes is not present in viruses.
- Viruses do not have energy production and protein synthesis apparatus.

Viruses;

- are small parasite that cannot reproduce independently.
- can direct the cell machinery to produce new 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
- No 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 (binary fission)
Mandatory intracellular parasites	Some are obligatory intracellular parasites

Main differences between viruses and bacteria

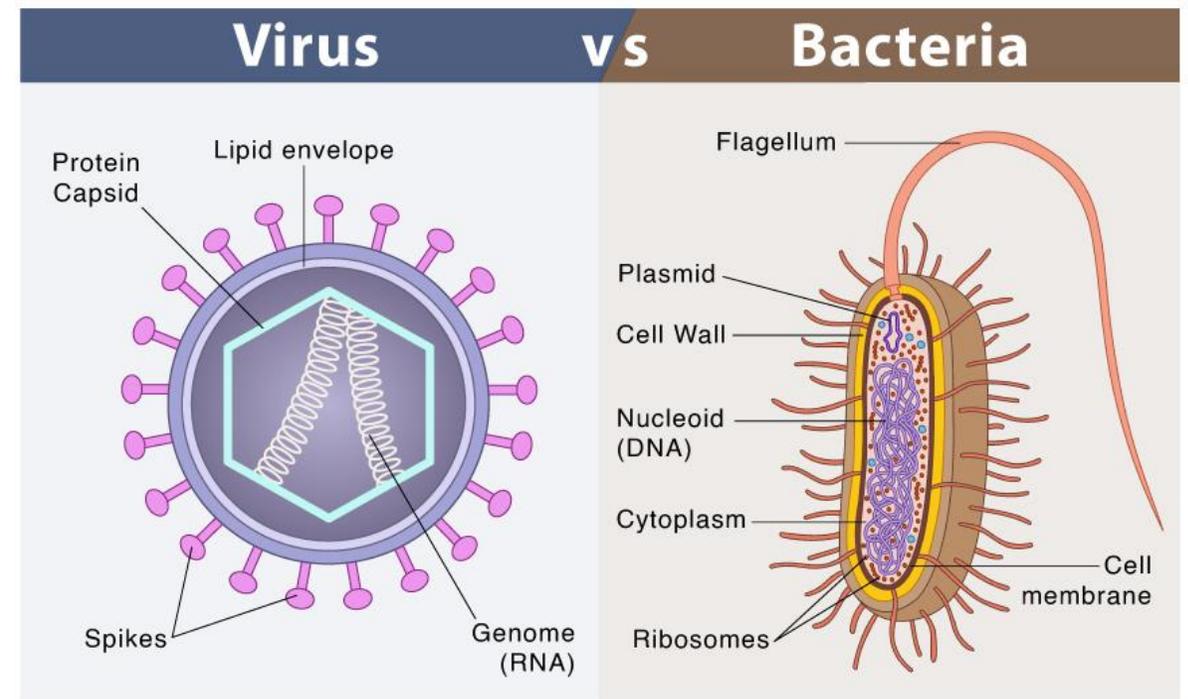
1. Replication environment: **Viruses can only replicate in intracellular (living) environments.** Bacteria have the ability to reproduce in both living and non-living environments. In order to produce viruses under laboratory conditions, cell cultures, embryonic eggs or experimental animals are needed.

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 assembling them.

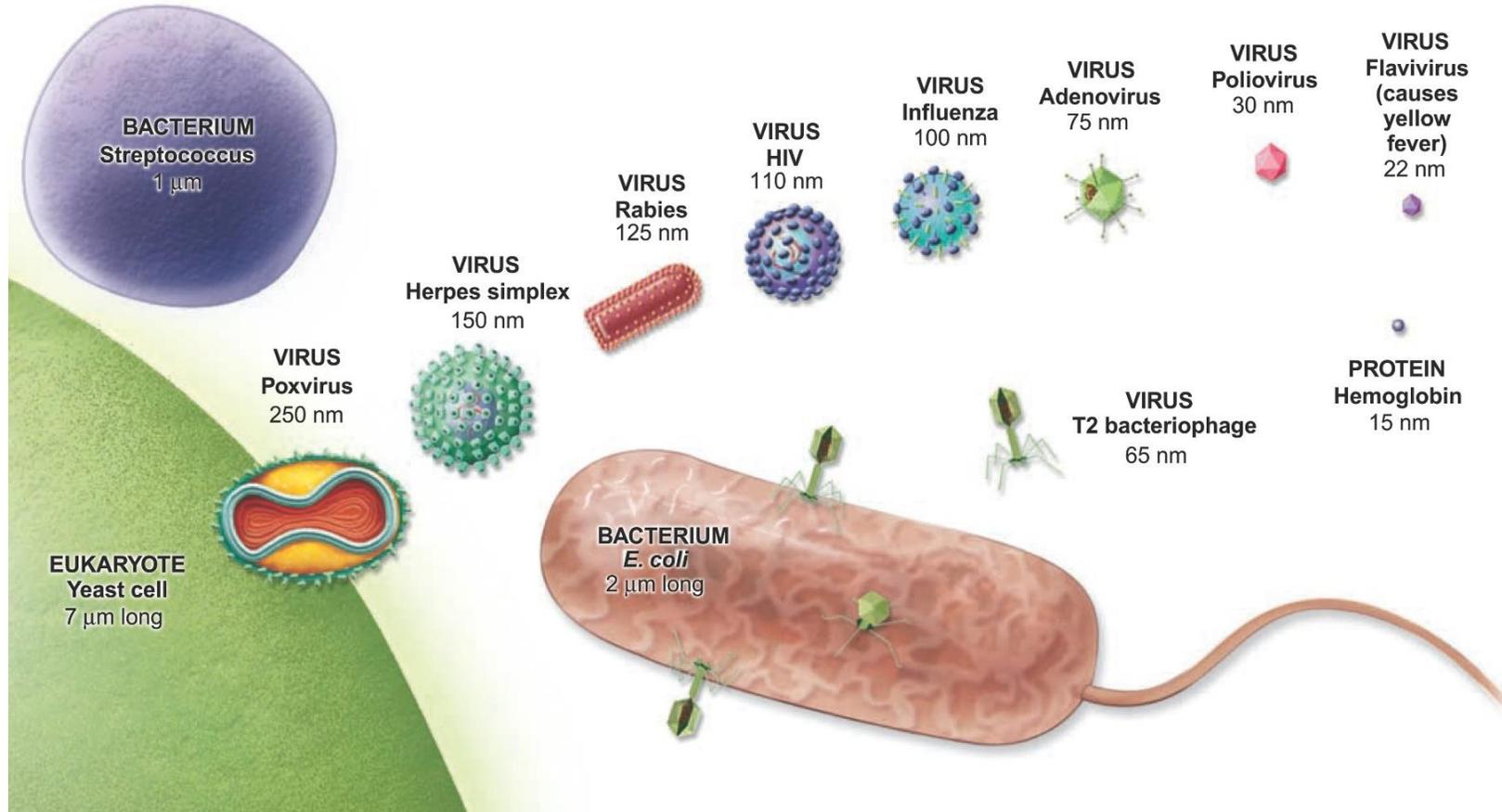


3. Nucleic acid: Both types of nucleic acids are present in bacteria. Viruses have a single type of nucleic acid, either DNA or RNA. ★
Therefore, viral RNA can also serve as a genetic code carrier.

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, except poxvirus, can only be seen under an electron microscope.

Bacteria, which have sizes varying between approximately 0.5 - 5 μm , can be easily seen under a light microscope. 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.

Antibiotics have no effect on viral replication.

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. **Interferons can inhibit viral replication in vivo and in vitro; however, they have no effect on bacteria.**

Use of viruses for different purposes

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

