

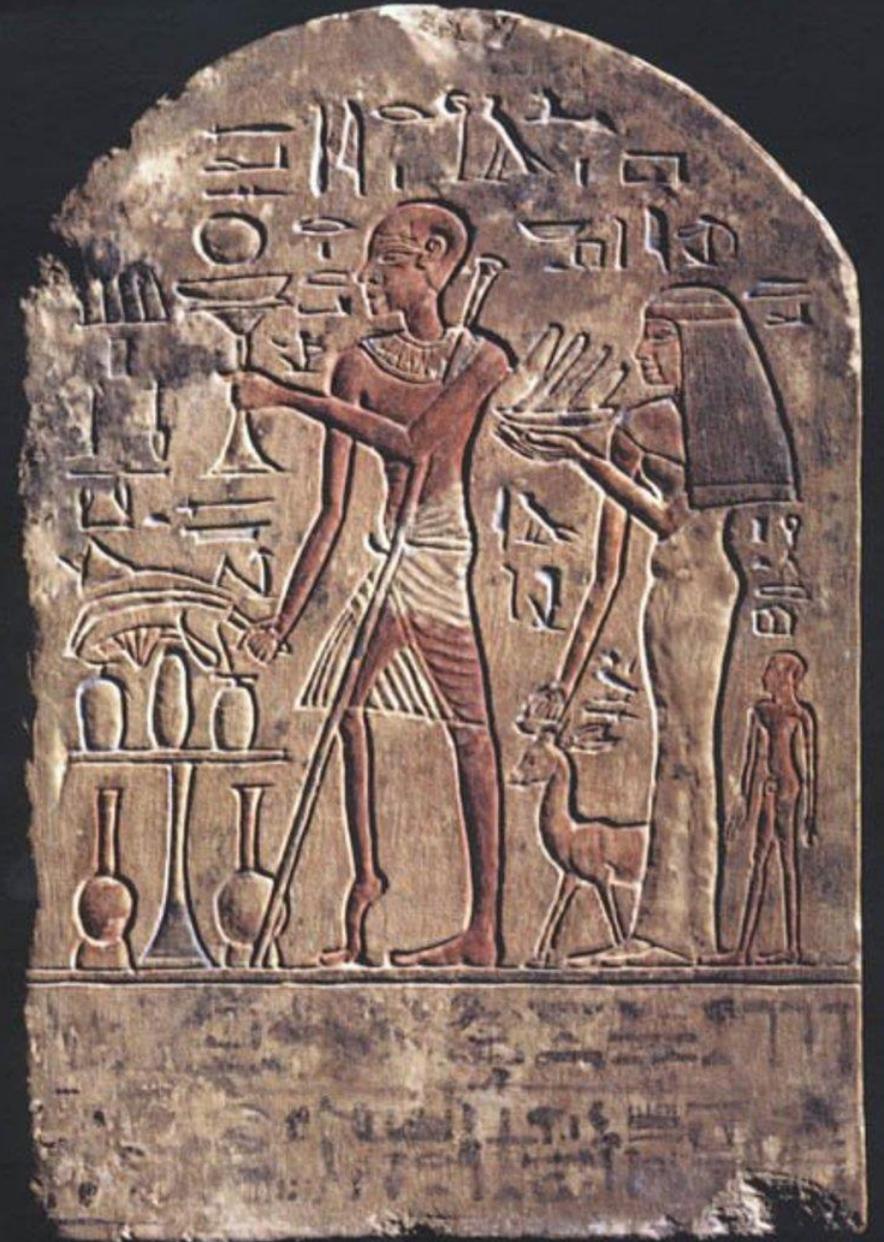
VIROLOGY I

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. 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 shows an Egyptian with polio, as evidenced by the withered leg and shape of the foot, which are typical symptoms of Poliomyelitis.



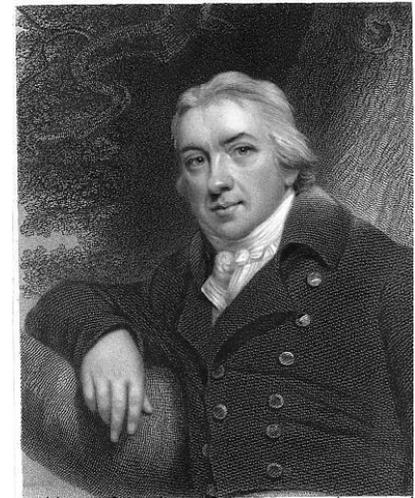


- Ramses V died of smallpox in 1145 BC at the age of 35. His preserved mummy is evidence of this.
- The pustular lesions on the mummy's face closely resemble those of modern smallpox patients.



- 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.
- 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://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

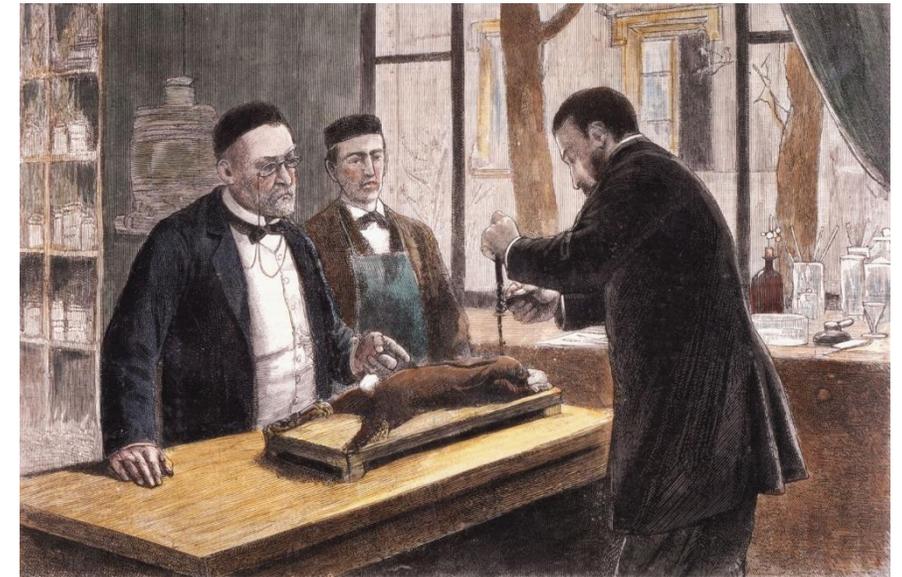
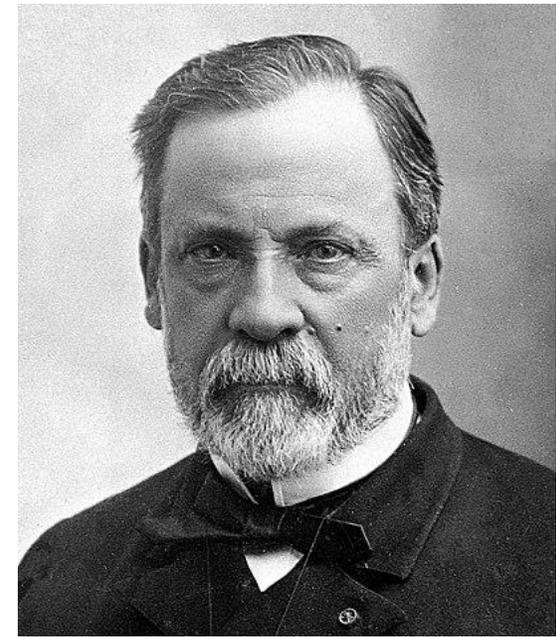
Ali Maow Maalin said he avoided getting the smallpox vaccine as a young man because he was afraid of needles. He didn't want others to make the same mistake with polio.

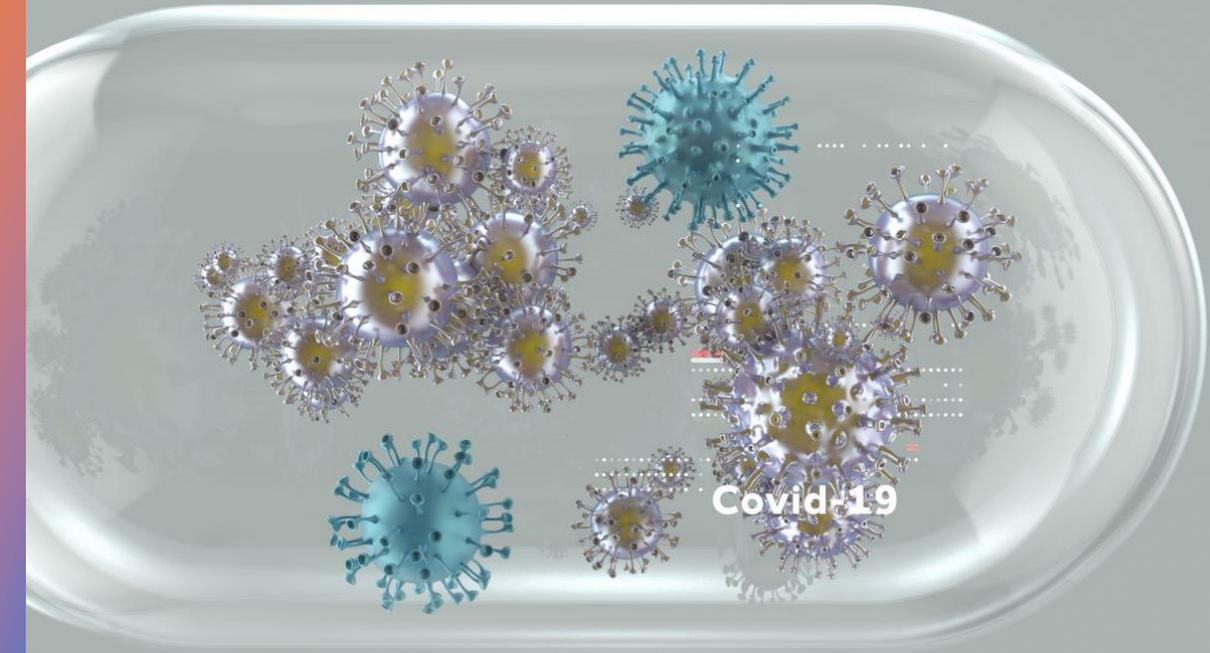
Year 1886:

- Louis Pasteur tested the rabies vaccine.

The vaccine was produced through an experimental process involving the serial passage of the infectious virus in rabbit spinal cords.

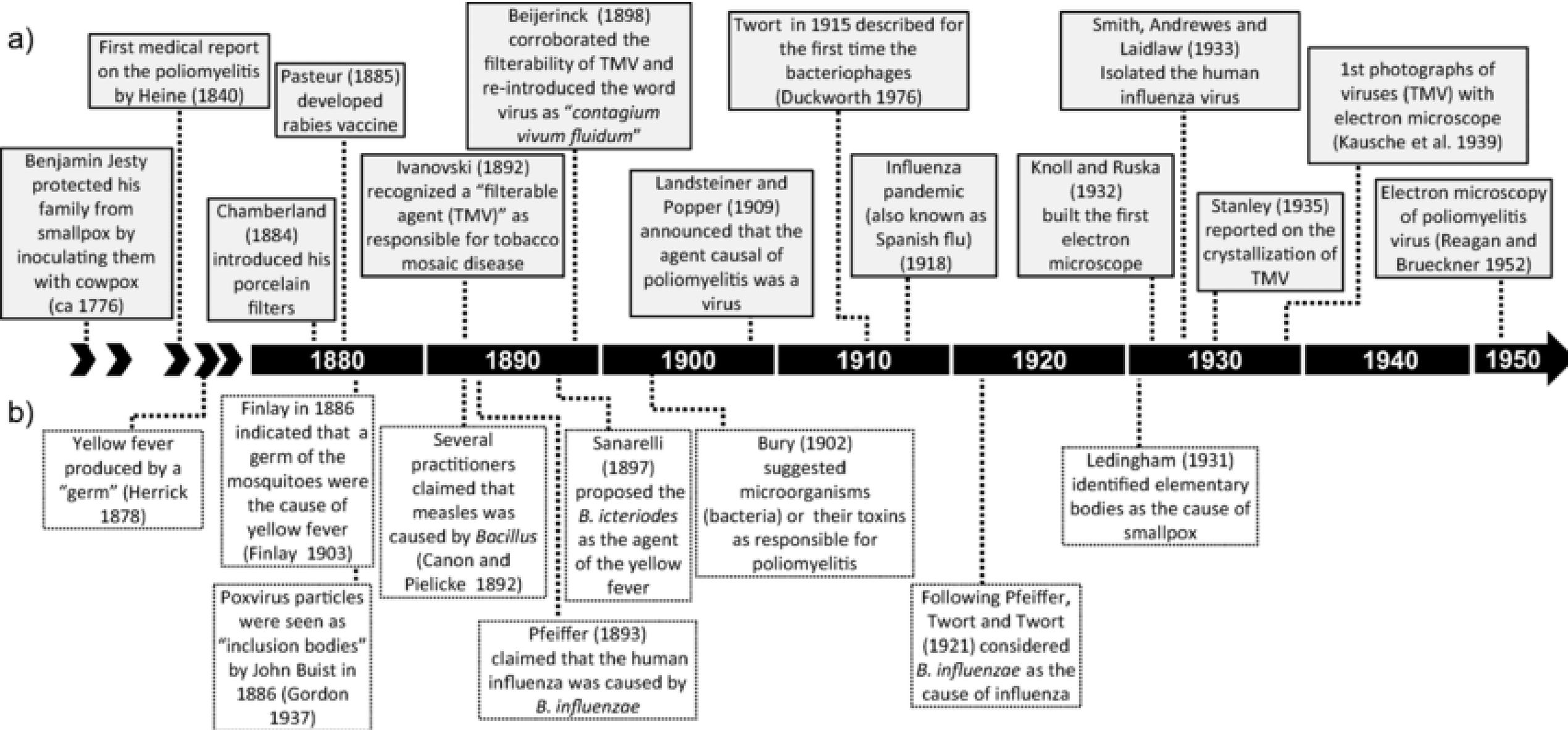
- The next vaccines for yellow fever and influenza did not appear until the 1930s.
- Louis Pasteur and Edward Jenner were the first to develop vaccines to protect against viral infections.

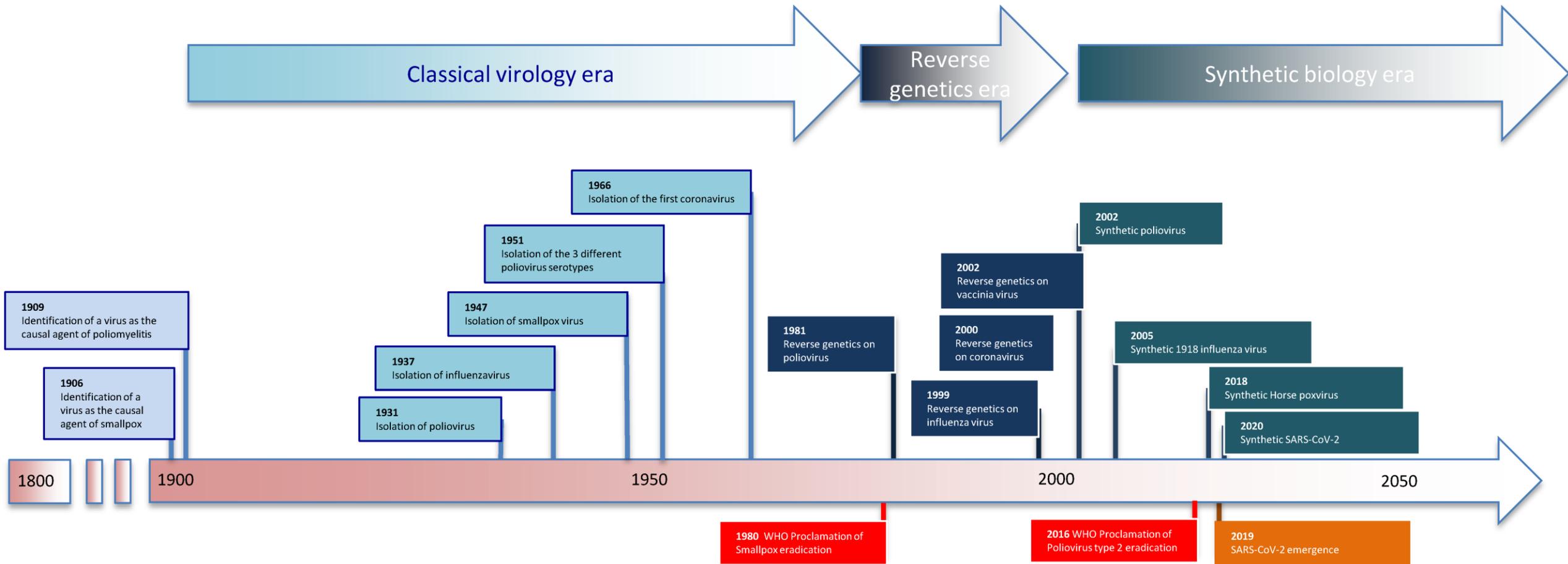




VIRUS= POISON

- 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

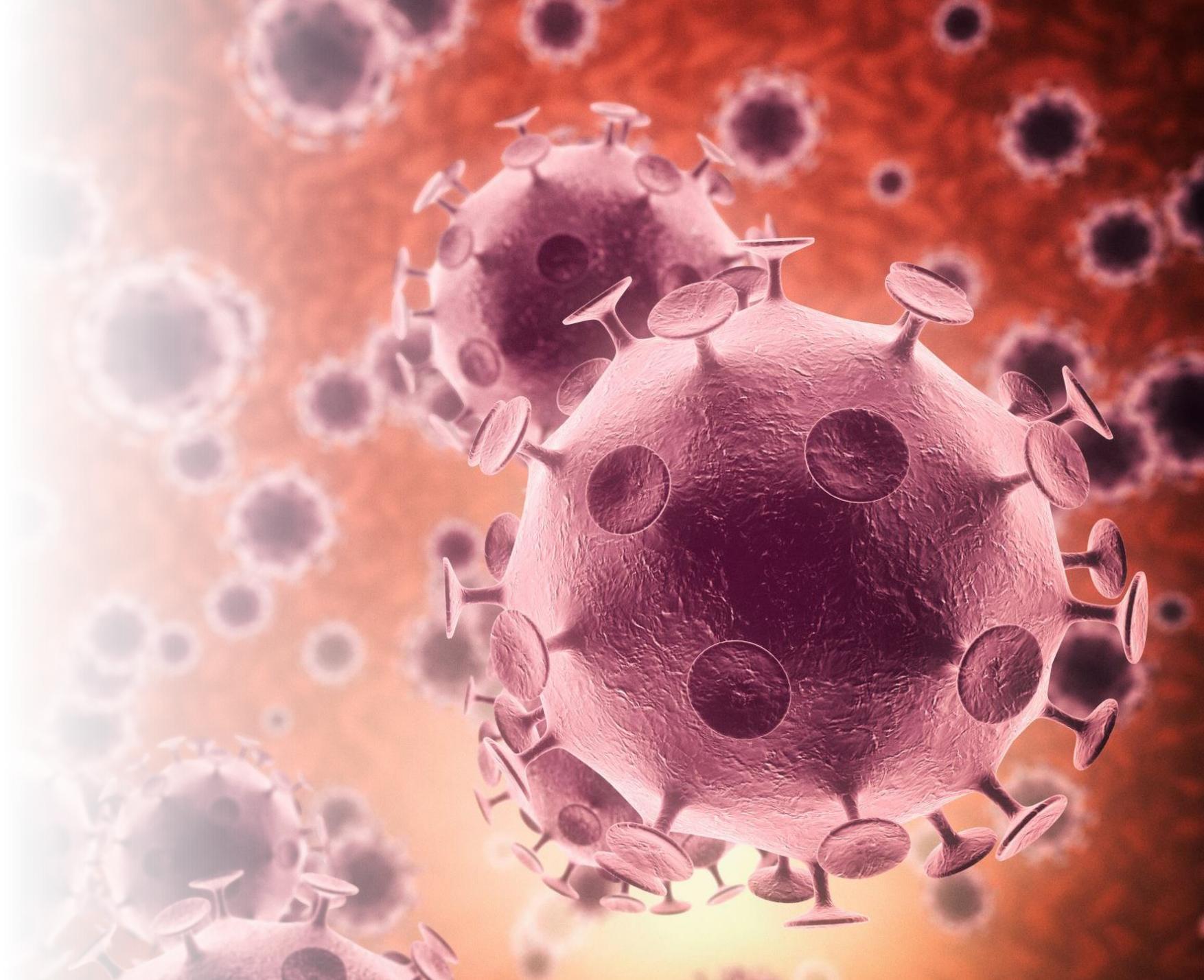
- Although these are small and simple, they are cells. They always carry DNA and have different types of RNA. They have unique mechanisms that can produce energy and macromolecules.
- Protozoon
- Yeast
- Bacteria
- Mycoplasma
- Ricketia
- Chlamidia

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-First 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 might have started out as small pieces of genetic material that got separated from their original organism. These pieces then managed to infect another cell. This is how they gradually changed over time and became what we now call viruses.

- **Regressive hypothesis**

Viruses might have come from more complex organisms. This could have happened when two single-celled organisms formed a relationship where they helped each other.

At some point, this relationship would have become parasitic. This happens when one organism starts to rely on the other organism to stay alive. As the smaller organism became more and more dependent on the larger organism, it lost its protein-building structures. However, it could still replicate itself. This new organism would be able to infect new organisms. And so the new organism became a virus.

WHAT IS VIRUS?

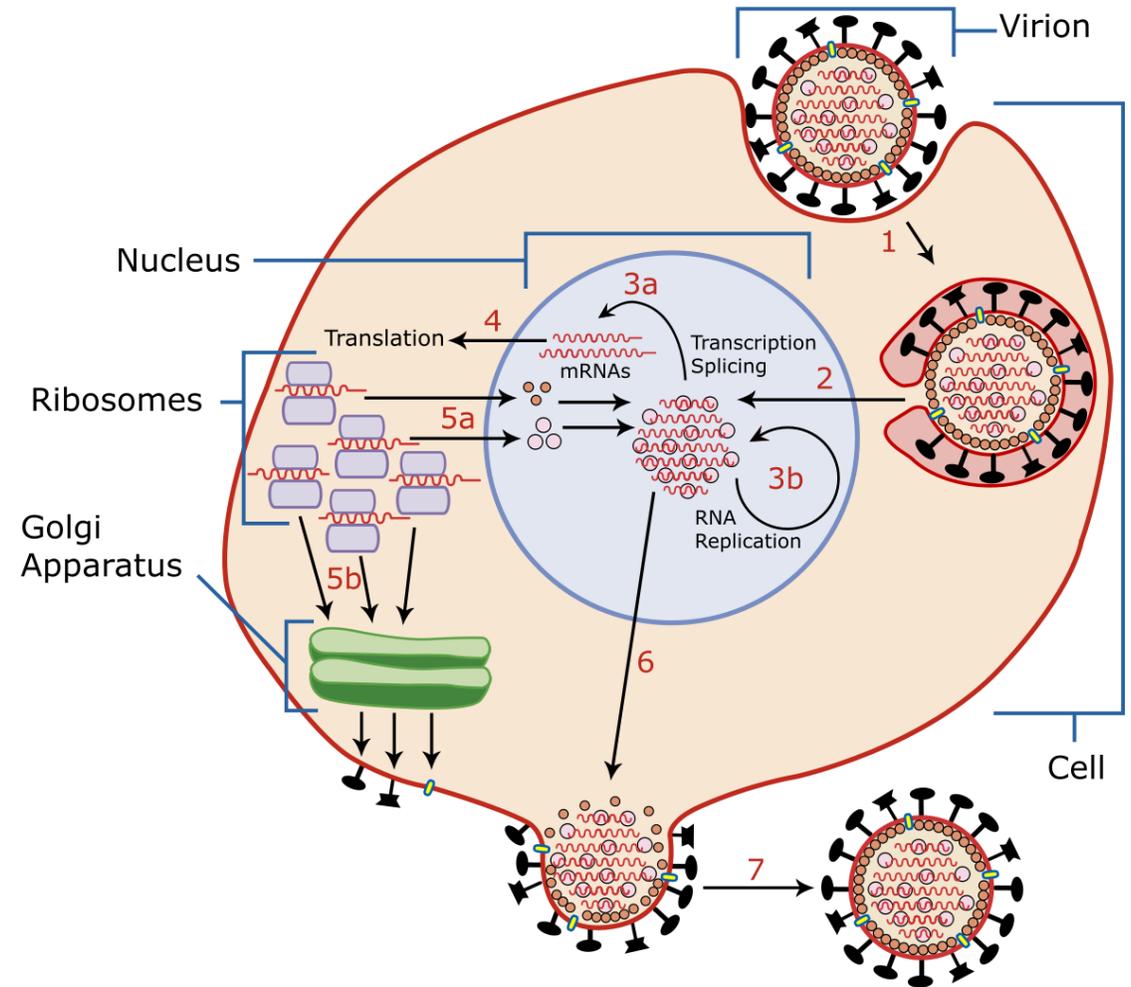
- Viruses are infectious agents that have their own replication strategy, have a single type of nucleic acid (DNA or RNA) surrounding by a protein coat and do not have mitochondria, ribosomes and other organelles, and are smaller and simpler than unicellular microorganisms.

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
- 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
Mandatory intracellular parasites	Some are obligatory intracellular parasites

Main differences between viruses and bacteria

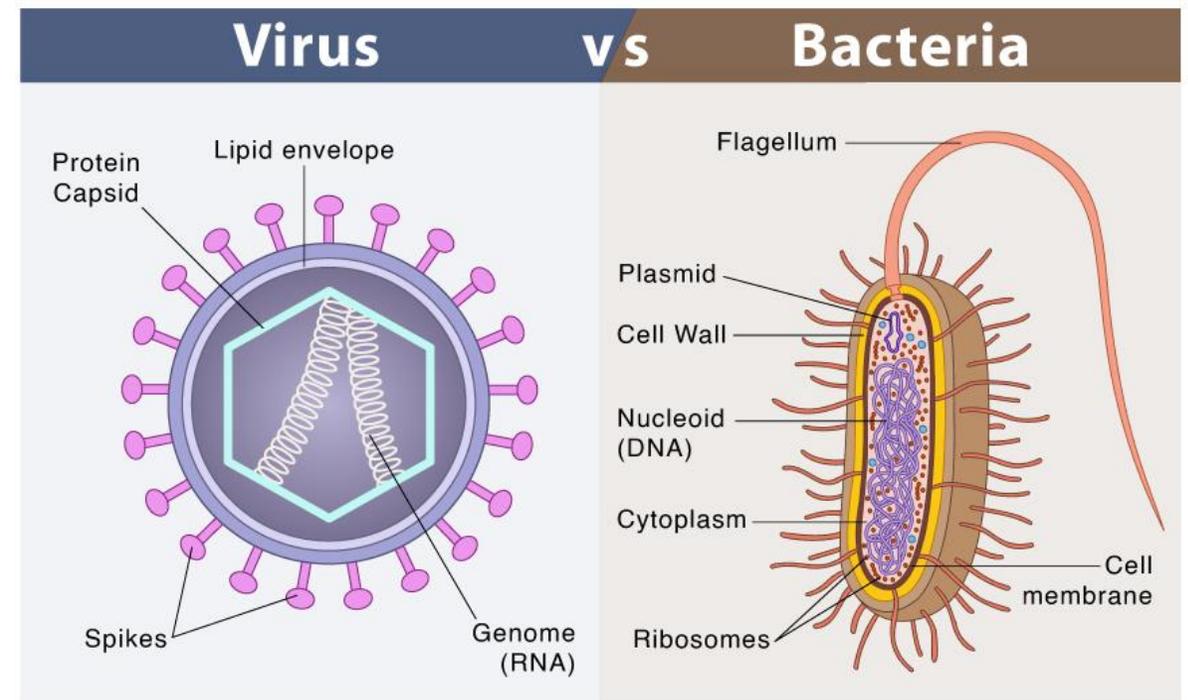
1. Replication environment: Viruses can only replicate in intracellular (living) environments. Bacteria have the ability to reproduce in both living and non-living environments. In order to produce viruses under laboratory conditions, cell cultures, embryonic eggs or experimental animals are needed.

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.

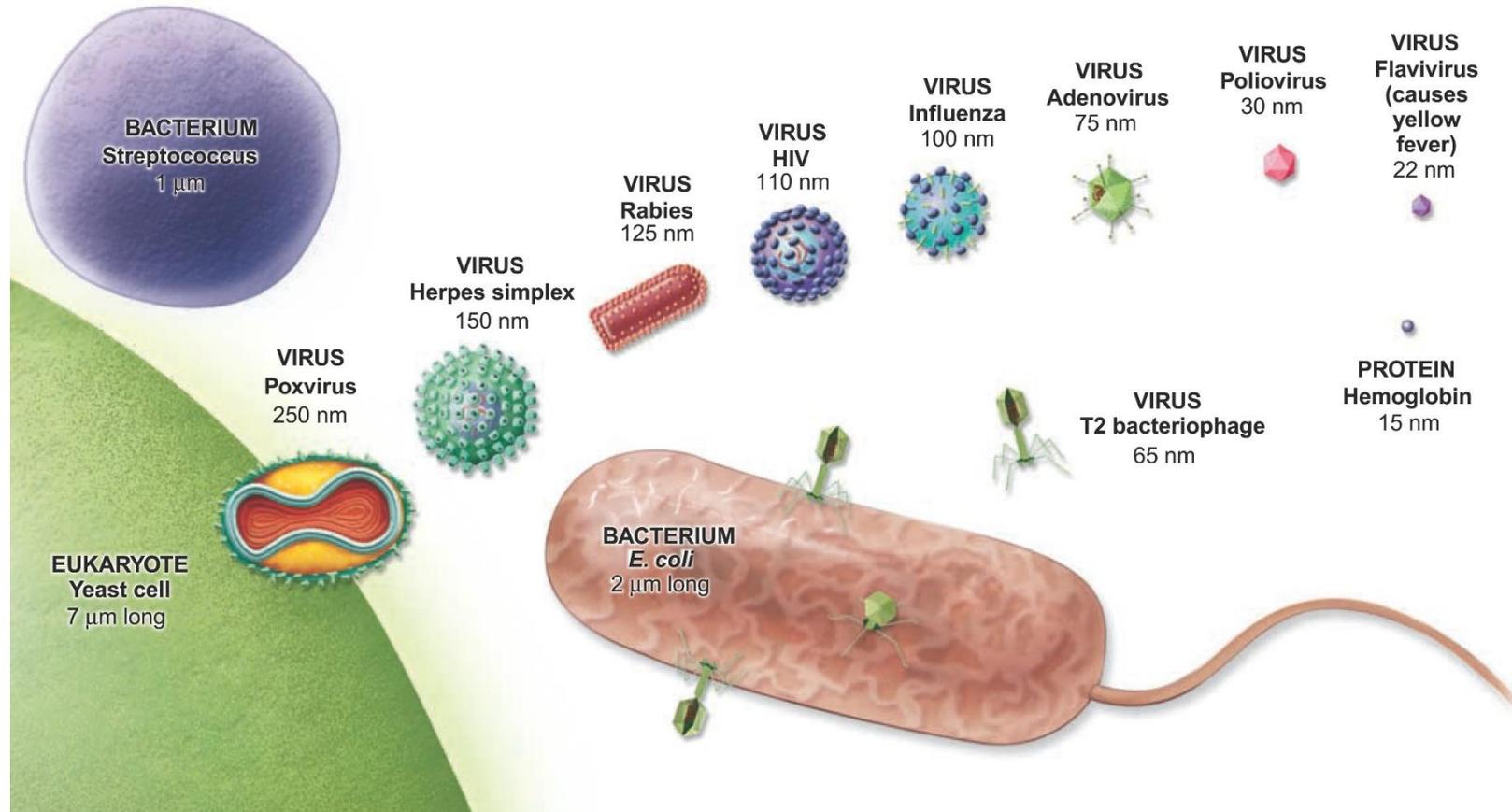
During the replication of viruses, first the viral components are synthesized in the host cell and new virus particles are formed by assembling them.



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 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 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

