Time line:

1892-1898: Russian and Dutch Investigators

The earliest indications of the biological nature of viruses came from studies in 1892 by the Russian scientist [Dmitry I. Ivanovsky](https://www.britannica.com/biography/Dmitry-Ivanovsky) and in 1898 by the Dutch scientist [Martinus W. Beijerinck](https://www.britannica.com/biography/Martinus-W-Beijerinck).

Beijerinck first surmised that the virus under study was a new kind of [infectious](https://www.britannica.com/science/infection) agent, which he designated contagium vivum fluidum, meaning that it was a live, reproducing organism that differed from other organisms.

Both of these investigators found that a [disease](https://www.britannica.com/science/disease) of [tobacco](https://www.britannica.com/plant/common-tobacco) plants could be transmitted by an agent, later called [tobacco mosaic virus](https://www.britannica.com/science/tobacco-mosaic-virus), passing through a minute filter that would not allow the passage of bacteria.

1915-1917: British investigators

This virus and those subsequently isolated would not grow on an artificial medium and were not visible under the light microscope. In independent studies in 1915 by the British investigator [Frederick W. Twort](https://www.britannica.com/biography/Frederick-William-Twort) and in 1917 by the French Canadian scientist [Félix H. d’Hérelle](https://www.britannica.com/biography/Felix-d-Herelle), lesions in [cultures](https://www.merriam-webster.com/dictionary/cultures) of bacteria were discovered and attributed to an agent called [bacteriophage](https://www.britannica.com/science/bacteriophage) (“eater of bacteria”), now known to be viruses that specifically infect bacteria.

1933: British investigators

The unique nature of these agents meant that new methods and [alternative](https://www.merriam-webster.com/dictionary/alternative) models had to be developed to study and classify them. The study of viruses confined exclusively or largely to [humans](https://www.britannica.com/topic/human-being), however, posed the [formidable](https://www.merriam-webster.com/dictionary/formidable) problem of finding a susceptible animal [host](https://www.britannica.com/science/parasitism). In 1933 the British investigators Wilson Smith, Christopher H. Andrewes, and Patrick P. Laidlaw were able to transmit [influenza](https://www.britannica.com/science/influenza) to ferrets, and the influenza virus was subsequently adapted to mice.

1941: American investigators

In 1941 the American scientist [George K. Hirst](https://www.britannica.com/biography/George-K-Hirst) found that influenza virus grown in tissues of the chicken embryo could be detected by its capacity to agglutinate (draw together) red blood cells.

1949: American Investigators

A significant advance was made by the American scientists [John Enders](https://www.britannica.com/biography/John-Franklin-Enders), [Thomas Weller](https://www.britannica.com/biography/Thomas-H-Weller), and [Frederick Robbins](https://www.britannica.com/biography/Frederick-Chapman-Robbins), who in 1949 developed the technique of [culturing](https://www.britannica.com/science/cell-culture) [cells](https://www.britannica.com/science/cell-biology) on glass surfaces; cells could then be infected with the viruses that cause [polio](https://www.britannica.com/science/polio) ([poliovirus](https://www.britannica.com/science/poliovirus)) and other diseases. (Until this time, the poliovirus could be grown only in the brains of chimpanzees or the spinal cords of monkeys.) [Culturing](https://www.merriam-webster.com/dictionary/Culturing) cells on glass surfaces opened the way for diseases caused by viruses to be identified by their effects on cells ([cytopathogenic effect](https://www.britannica.com/science/cytopathic-effect)) and by the presence of [antibodies](https://www.britannica.com/science/antibody) to them in the blood. Cell [culture](https://www.merriam-webster.com/dictionary/culture) then led to the development and production of [vaccines](https://www.britannica.com/science/vaccine) (preparations used to elicit immunity against a disease) such as the poliovirus [vaccine](https://www.britannica.com/science/vaccine).

1952: American investigators

Scientists were soon able to detect the number of bacterial viruses in a culture vessel by measuring their ability to break apart (lyse) adjoining bacteria in an area of bacteria (lawn) overlaid with an inert gelatinous substance called [agar](https://www.britannica.com/topic/agar-seaweed-product)—viral action that resulted in a clearing, or “[plaque](https://www.britannica.com/science/plaque-microbiology).” The American scientist [Renato Dulbecco](https://www.britannica.com/biography/Renato-Dulbecco) in 1952 applied this technique to measuring the number of animal viruses that could produce plaques in layers of adjoining animal cells overlaid with agar.

In the 1940s the development of the [electron microscope](https://www.britannica.com/technology/electron-microscope) permitted individual virus particles to be seen for the first time, leading to the classification of viruses and giving insight into their structure.

1960 onwards: Modern technology

Advancements that have been made in chemistry, physics, and [molecular biology](https://www.britannica.com/science/molecular-biology) since the 1960s have revolutionized the study of viruses. For example, [electrophoresis](https://www.britannica.com/science/electrophoresis) on gel substrates gave a deeper understanding of the [protein](https://www.britannica.com/science/protein) and [nucleic acid](https://www.britannica.com/science/nucleic-acid) composition of viruses. More-sophisticated immunologic procedures, including the use of monoclonal antibodies directed to specific antigenic sites on proteins, gave a better insight into the structure and function of viral proteins. The progress made in the physics of crystals that could be studied by [X-ray diffraction](https://www.britannica.com/science/X-ray-diffraction) provided the high resolution required to discover the basic structure of minute viruses. Applications of new knowledge about [cell biology](https://www.britannica.com/science/cytology) and biochemistry helped to determine how viruses use their host cells for synthesizing viral nucleic acids and proteins.