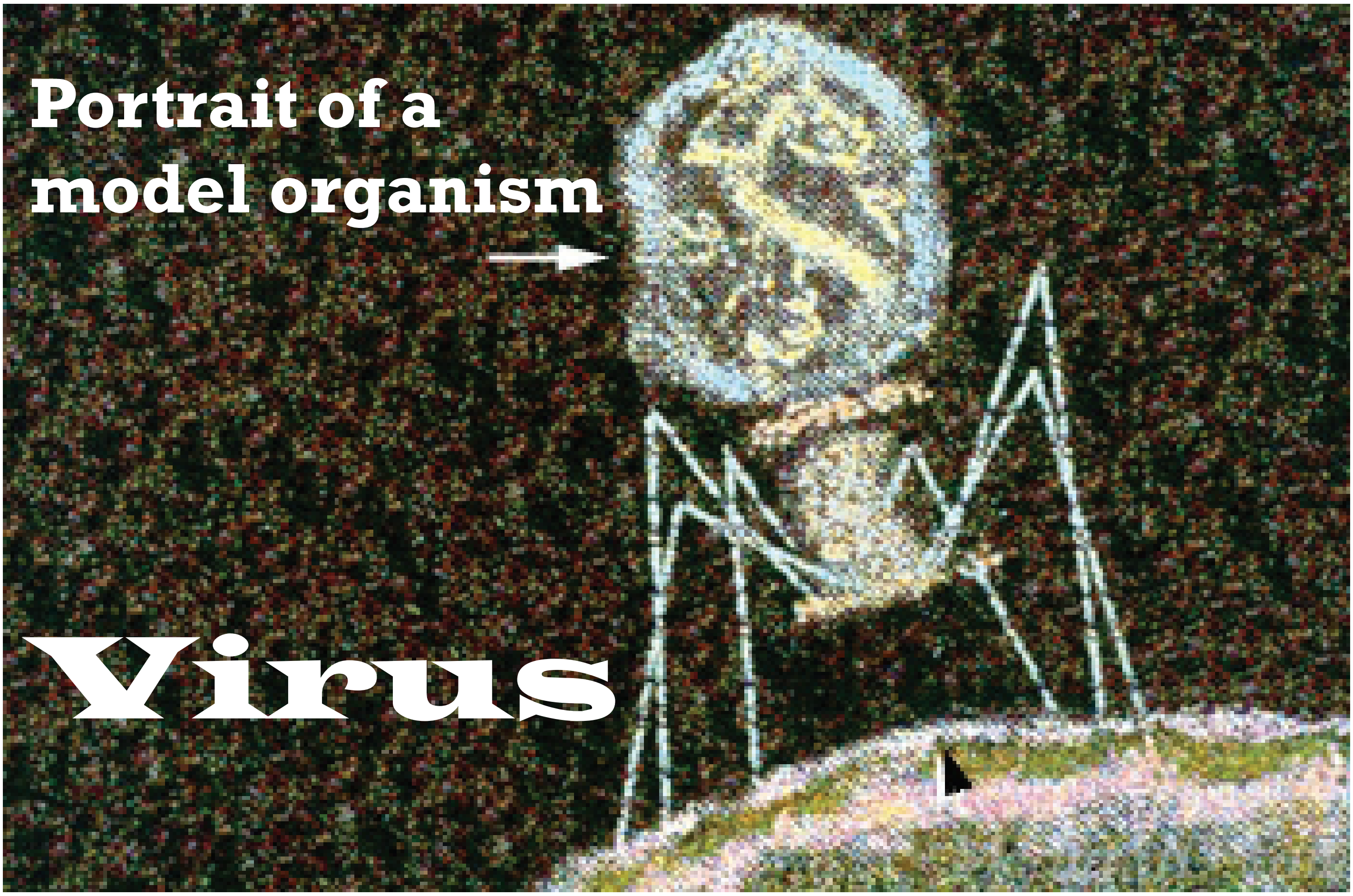


Portrait of a model organism

Virus

Virus, is an obligate intracellular parasite with a noncellular structure composed mainly of nucleic acid within a protein coat. Most viruses are too small to be seen with the light microscope and thus must be studied by electron microscopes. In one stage of their life cycle, in which they are free and infectious, virus particles do not carry out the functions of living cells, such as respiration and growth; in the other stage, however, viruses enter living plant, animal, or bacterial cells and make use of the host cell's chemical energy and its protein- and nucleic acid–synthesizing ability to replicate themselves. They lie somewhere in the grey area between living and non-living states.

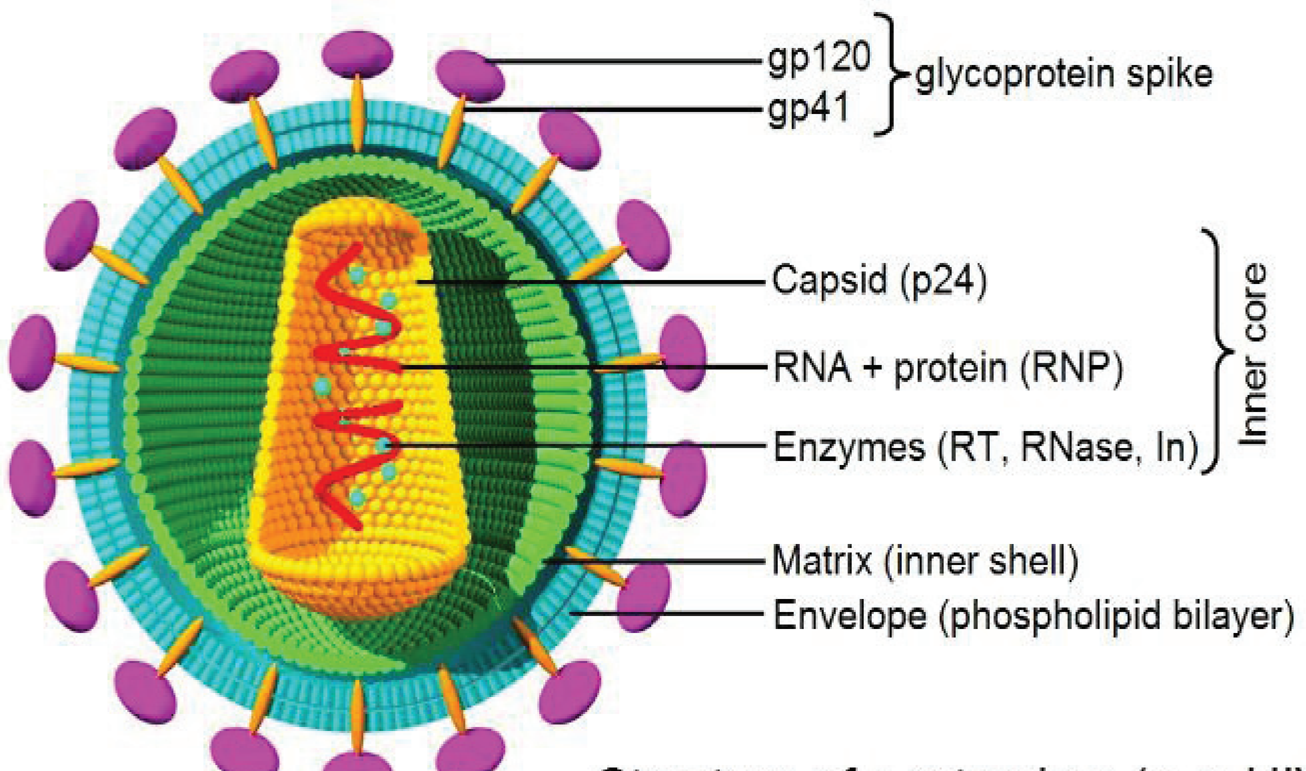
Discovery

The existence of submicroscopic infectious agents was suspected by the end of the 19th cent.; in 1892 the Russian botanist Dimitri Iwanowski showed that the sap from tobacco plants infected with mosaic disease, even after being passed through a porcelain filter known to retain all bacteria, contained an agent that could infect other tobacco plants. In 1900 a similarly filterable agent was reported for foot-and-mouth disease of cattle.

In 1935 the American virologist W. M. Stanley crystallized tobacco mosaic virus; for that work Stanley shared the 1946 Nobel Prize in Chemistry with J. H. Northrup and J. B. Summer. Later studies of virus crystals established that the crystals were composed of individual virus particles, or virions. By the early 21st cent. the understanding of viruses had grown to the point where scientists synthesized (2002) a strain of poliovirus using their knowledge of that virus's genetic code and chemical components required.

Virus structure

Viruses are among the smallest infectious agents, and most of them can only be seen by electron microscopy. Most viruses cannot be seen by light microscopy (in other words, they are sub-microscopic); their sizes range from 20 to 300 nm. A virus particle, also known as a virion, consists of genes made from DNA or RNA which are surrounded by a protective coat of protein called a capsid. Typically the protein coat, or capsid, of an individual virus particle, or virion, is composed of multiple copies of one or several types of protein subunits called capsomeres. The arrangement of the capsomers can either be icosahedral (20-sided), helical or more complex. There is an inner shell around the DNA or RNA called the nucleocapsid, which is formed by proteins. Some viruses are surrounded by a bubble of lipid (fat) called an envelope.



Structure of a retrovirus (e.g. HIV)

Viral genome

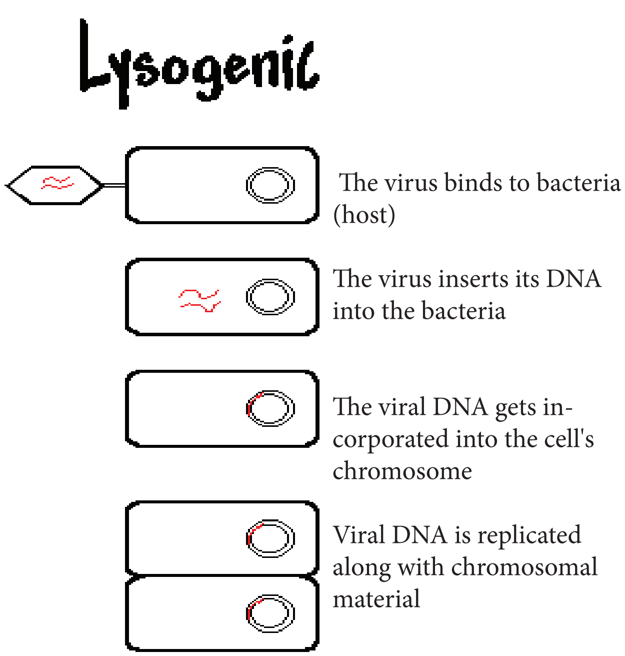
Genes are made from DNA (deoxyribonucleic acid) and, in many viruses, RNA (ribonucleic acid). Most organisms use DNA, but many viruses have RNA as their genetic material. The DNA or RNA of viruses consists of either a single strand or a double helix. Viruses have only a few genes compared to humans who have 20,000–25,000. For example, influenza virus has only eight genes and rotavirus has eleven. These genes encode structural proteins that form the virus particle, or non-structural proteins that are only found in cells infected by the virus. All cells, and many viruses, produce proteins that are enzymes called DNA polymerase and RNA polymerase which make new copies of DNA and RNA. A virus's polymerase enzymes are often much more efficient at making DNA and RNA than the host cell's. However, RNA polymerase enzymes often make mistakes, and this is one of the reasons why RNA viruses often mutate to form new strains. In some species of RNA virus, the genes are not on a continuous molecule of RNA, but are separated. The influenza virus, for example, has eight separate genes made of RNA called segmented genes.

Life-cycle of a virus

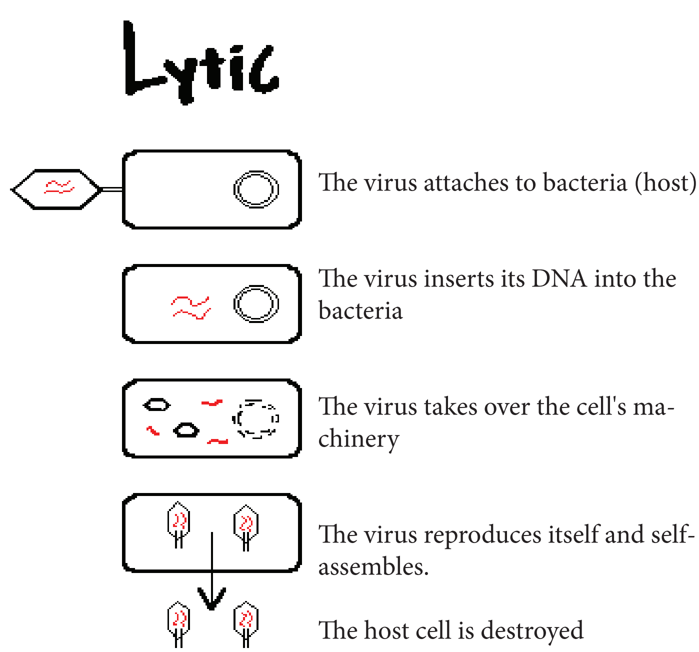
When a virus infects a cell, the virus forces it to make thousands more viruses. It does this by making the cell copy the virus's DNA or RNA, making viral proteins, which all assemble to form new virus particles.
There are six basic, overlapping stages in the life cycle of viruses in living cell.

- Attachment is the binding of the virus to specific molecules on the surface of the cell. This specificity restricts the virus to a very limited type of cell. For example, the human immunodeficiency virus (HIV) infects only human T cells, because its surface protein, gp120, can only react with CD4 and other molecules on the T cell's surface. Plant viruses can only attach to plant cells and cannot infect animals. This mechanism has evolved to favour those viruses that only infect cells in which they are capable of reproducing.
- Penetration follows attachment; viruses penetrate the host cell by endocytosis or by fusion with the cell.
- Uncoating happens inside the cell when the viral capsid is removed and destroyed by viral enzymes or host enzymes, thereby exposing the viral nucleic acid.
- Replication of virus particles is the stage where a cell uses viral messenger RNA in its protein synthesis systems to produce viral proteins. The RNA or DNA synthesis abilities of the cell produce the virus's DNA or RNA.
- Assembly takes place in the cell when the newly created viral proteins and nucleic acid combine to form hundreds of new virus particles.
- Release occurs when the new viruses escape or are released from the cell. Most viruses achieve this by making the cells burst, a process called lysis. Other viruses such as HIV are released more gently by a process called budding.

When it comes into contact with a host cell, a virus can insert its genetic material into its host, literally taking over the host's functions. An infected cell produces more viral protein and genetic material instead of its usual products. Some viruses may remain dormant inside host cells for long periods, causing no obvious change in their host cells (a stage known as the lysogenic phase). But when a dormant virus is stimulated, it enters the lytic phase: new viruses are formed, self-assemble, and burst out of the host cell, killing the cell and going on to infect other cells.



The virus is a prophage at this stage.



A virus is found in this phase when conditions are favorable

Virological online Resources

Classification and Nomenclature of Viruses

The Index Virum presents lists of virus taxa that reflect the currently approved classification of the International Committee on Taxonomy of Viruses (ICTV). The ICTV Web Page is up and running at the National Center for Biotechnology.

Virus Evolution

Noble Foundation Virus Evolution Page - This site is dedicated to the study of virus evolution. It includes a list of current references, web links, meeting lists and abstracts from the 1999 Virus Evolution Workshop.

Genomic Sequence Data of Viruses

From the Animal Virus Information System Site, several utilities in this area are available. These include FASTA for viral sequences - This utility allows the user to carry out the FASTA analysis with a variety of protein sequence libraries. These libraries include, the standard PIR databases, NRL-3D database and several libraries created for individual virus families. The results also lists the virus families to which the sequences belong. Also Available:

o BLAST for viral sequences - This utility allows to carry out the BLAST analysis with a variety of protein sequence libraries.

o MATCH a peptide among viral sequences - This utility allows to match a peptide with a variety of protein sequence libraries.

o SCAN a peptide among viral sequences - This utility allows to scan a peptide with a variety of protein sequence libraries.

- Geminivirus Sequences
- Herpesvirus sequence database at University College London : The site provides a clikable list of all completely sequence herpesvirus genomes. The user can also fetch herpesvirus protein sequences in Fasta format using keywords or GenBank GI code. There are also links to various sites for analysis of proteins.
- Los Alamos HPV Database
- Los Alamos HIV Database

o Picornavirus Sequence Database

o Ann Palmenberg's Picornavirus Sequence Alignments

Some well known animal viruses and their disesae

Virus	Disesae
Epstein-Barr Virus	-Burkitt Lymphoma
Hepatitis Virus	-Hepatitis
Herpes Simplex Virus, Type 1	-Hsv-1 Infection
Herpes Simplex Virus, Type 2	-Aseptic Meningitis
Cytomegalovirus	-Cytomegalic Inclusion Disease
HIV	-AIDS
Influenza Virus	-Influenza
Measles Virus	-Measles
Mumps Virus	-Mumps
Human Papillomavirus	-Hyperplastic Epithelial Lesions
Parainfluenza Virus	-Croup Pneumonia, Bronchiolitis, -Common Cold
Poliovirus	-Poliomyelitis
Rabies Virus	-Rabies
Rubella Virus	-Congenital Rubella
Varicella-Zoster Virus	-Varicella, Herpes Zoster

Top 10 plant virus list for Molecular Plant Pathology.

The Top 10 list includes, in rank order,
(1) Tobacco mosaic virus,
(2) Tomato spotted wilt virus, (3) Tomato yellow leaf curl virus, (4) Cucumber mosaic virus,
(5) Potato virus Y,
(6) Cauliflower mosaic virus,
(7) African cassava mosaic virus,
(8) Plum pox virus,
(9) Brome mosaic virus and
(10) Potato virus X

Mol Plant Pathol. 2011 Dec;12(9):938-54. doi: 10.1111/j.1364-3703.2011.00752.x. Epub 2011 Oct 21.