Viruses

Definition

Virus is a Latin word meaning “Poison”

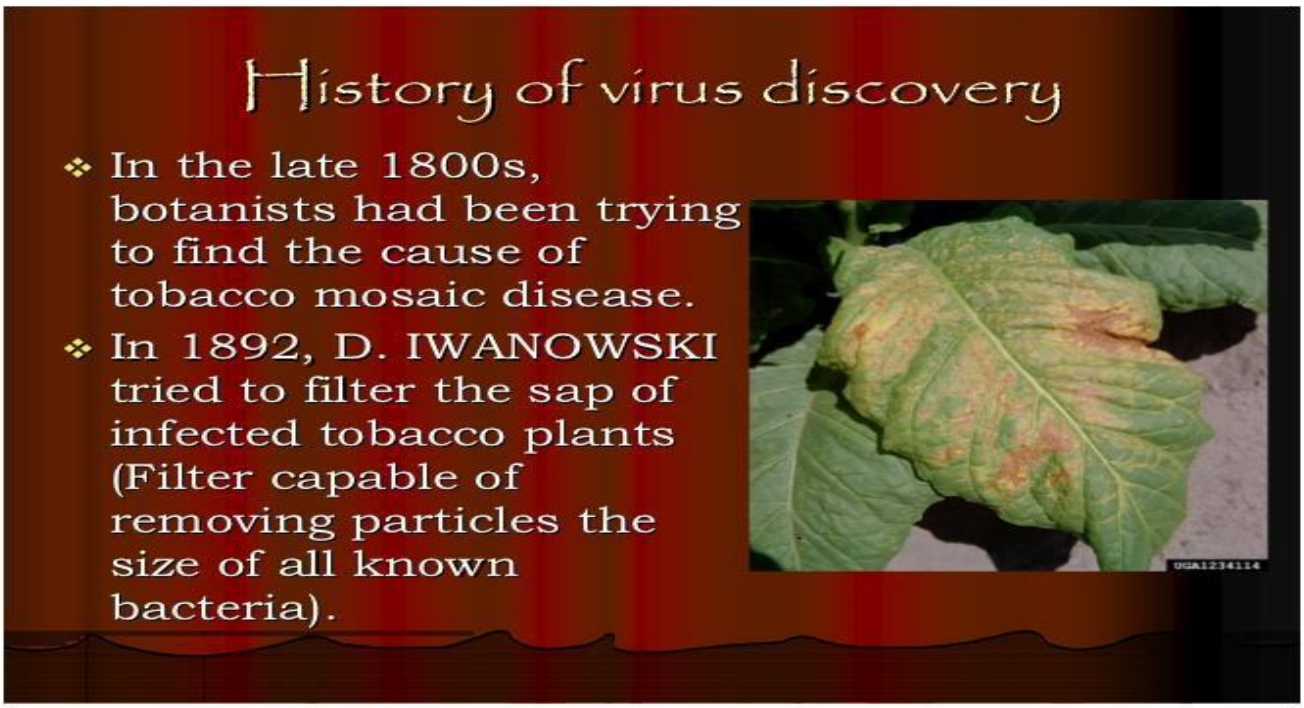
Viruses are obligate intracellular parasites which

mean that they replicate only inside a living host cell.

Or

Viruses are non cellular infectious agents consist of either DNA or RNA, reproduce only in living cells and use the biosynthetic machinery of the host cell to direct the synthesis of virion, containing viral genome and transfer them to the other cells

Cells and Viruses		
Characteristic	Cell	Virus
Structure	Cell membrane, cytoplasm; eukaryotes also contain nucleus and organelles	
Reproduction	Independent cell division either asexually or sexually	
Genetic Code	DNA	
Growth and Development	Yes; in multicellular organisms, cells increase in number and differentiate	
Obtain and Use Energy	yes	
Response to Environment	yes	
Change Over Time	yes	

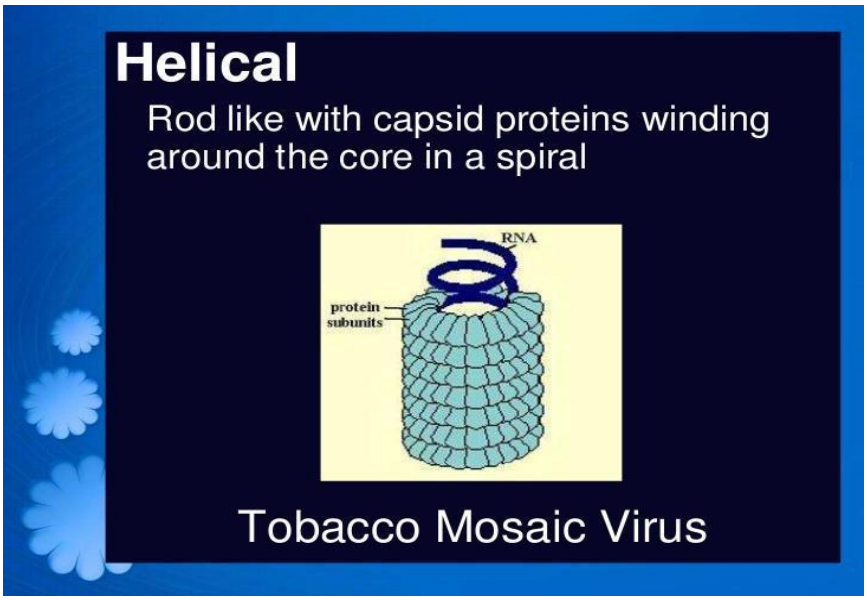


Shapes:

Viruses may appear in several shapes.

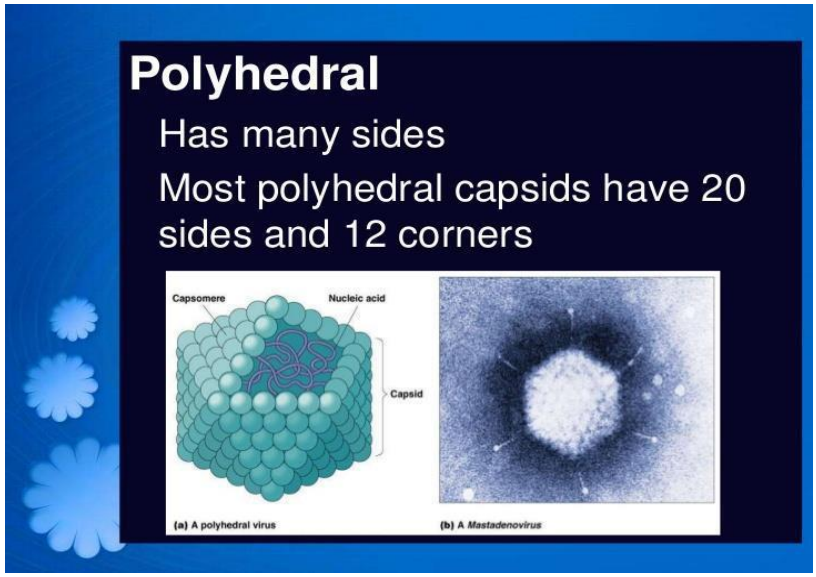
i-Helix:

The helix is a tightly wound coil resembling a corkscrew or spring. Viruses of rabies and tobacco mosaic viruses have helical symmetry.



ii- Icosahedron :

The **icosahedron** a polyhedron with20 triangular faces and 12 corners. Herpes simplex and polio viruses have icosahedral symmetry.



iii-Complex:

A combination of helical and icosahedral symmetry is described as **complex**. Some bacteriophages have complex symmetry. They have an icosahedral head and a collar and tail assembly in shape of a helical sheath.

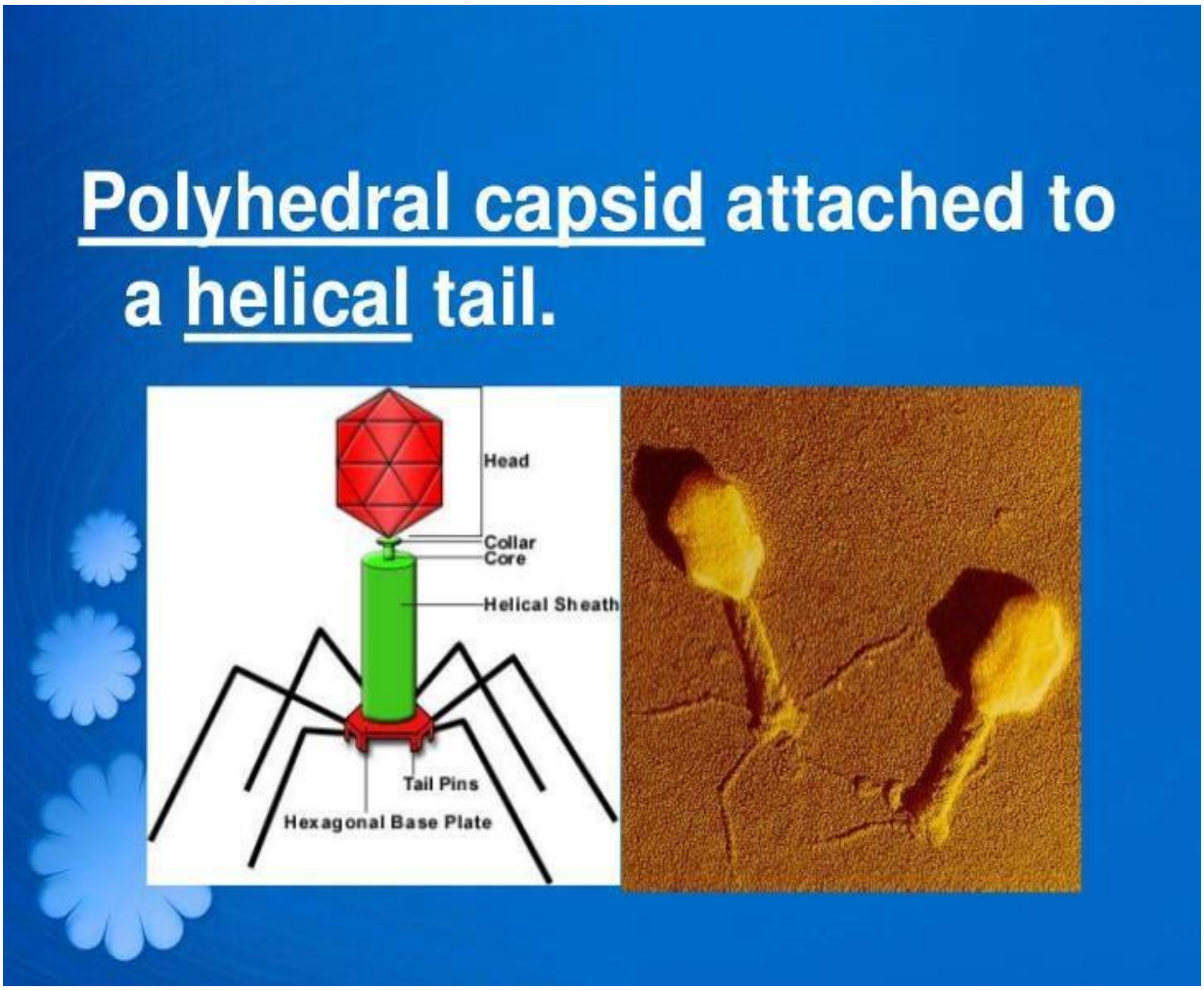


Figure 1 Enveloped viruses

Sturcutre of Virus:

All viruses consist of two basic components:

I a core of nucleic acid, the **genome**,

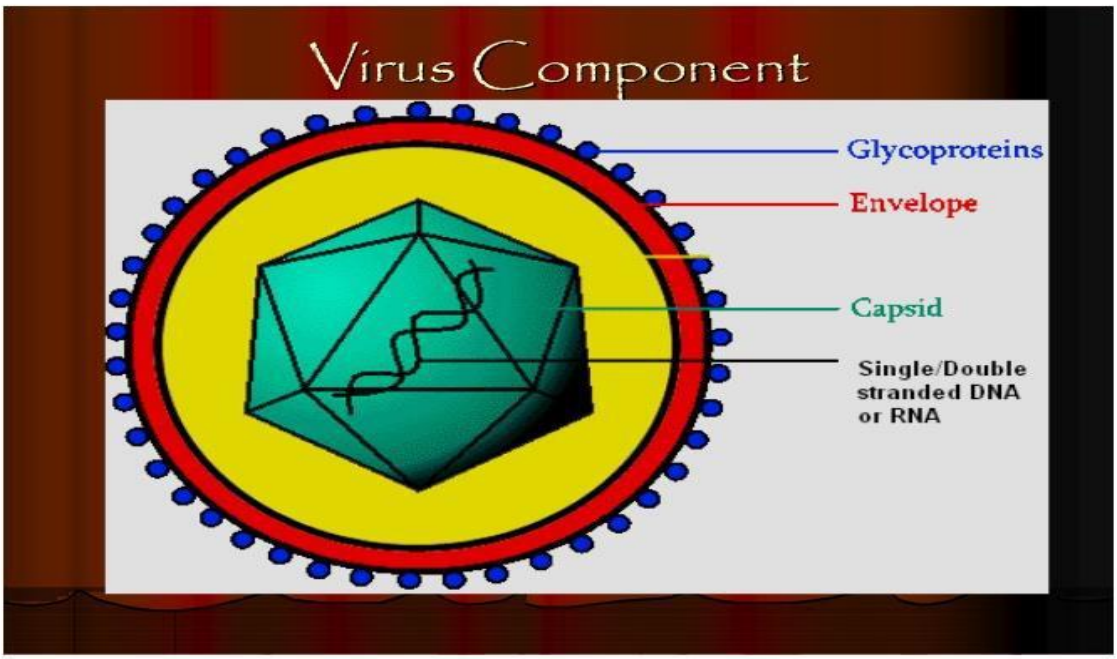
II coat of protein known as the **capsid**.

Genome:

The genome contains either DNA or RNA, but not both; and the nucleic acid occurs in double-stranded or single-stranded form. The genome may be folded, condensed, or coiled.

Capsid:

The capsid protects the genome. It also gives shape to the virus and is responsible for the helical, **icosahedral**, or complex symmetry.



Capsomers:

Generally, that capsid is subdivided into individual protein subunits called **capsomeres**

whose organization yields the symmetry. The number of capsomeres is characteristic for a particular virus.

For example,

Capsid of herpes viruses is made up of 162 capsomeres.

1-Capsid of adenoviruses which cause some common colds is made up of 252 capsomeres.

Envelope:

Many viruses are surrounded by a flexible membrane known as **envelope.**

i) It is composed of lipids and protein and is similar to the host cell membrane, except that it includes viral-specified components.

In some viruses as influenza and measles viruses, the envelope contains functional projections know as **spikes**. The spikes often contain enzymes to assist the attachment of viruses to host cells.

ii) Enveloped viruses may lose their infectivity when the envelope is destroyed.

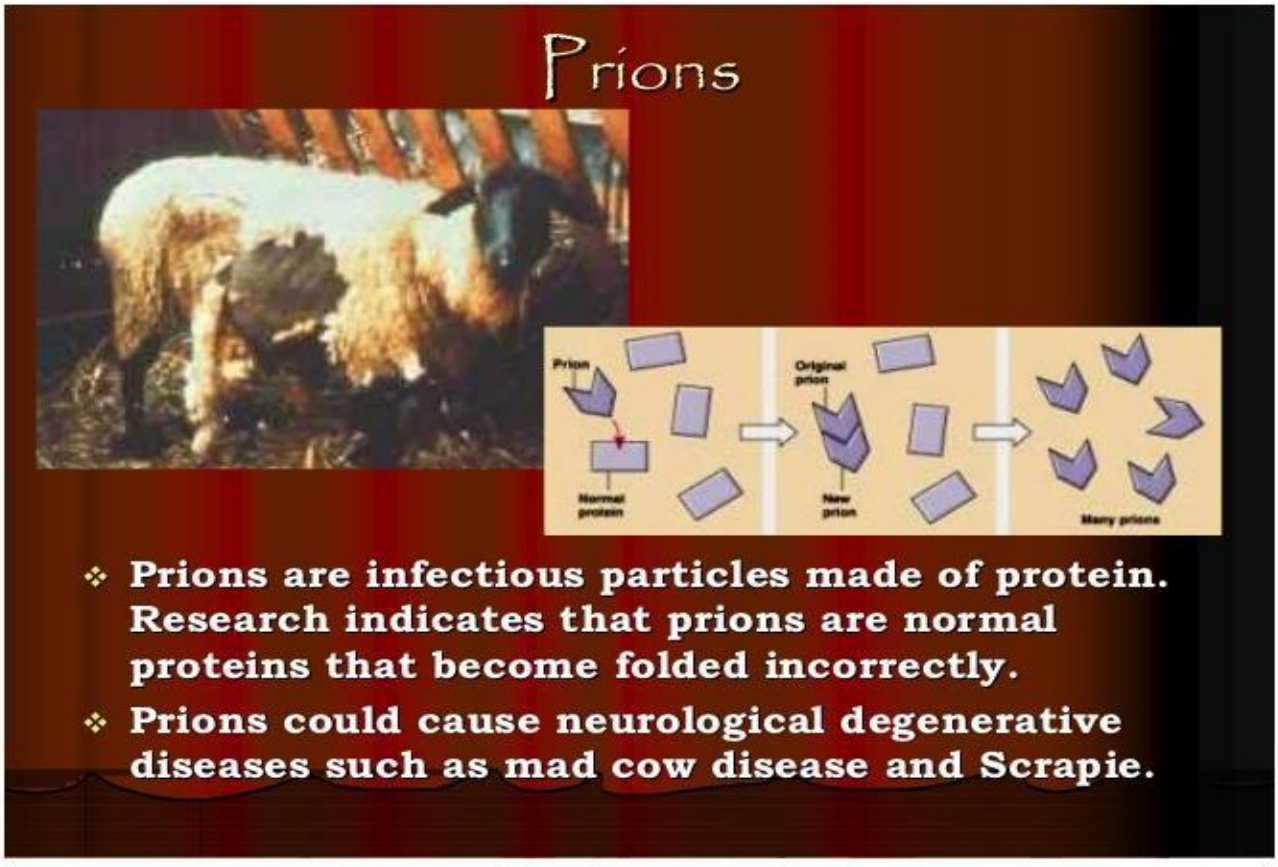
iii) Also, when the envelope is present, symmetry of the capsid may not be apparent since the envelope is generally loose-fitting structure

Virion:

A completely assembled virus outside its host cell is known as Virion. Virions lack the chemical machinery for generating energy and synthesizing large molecules. Therefore they must rely on the structures and chemical components of their host cells to replicate themselves. We shall examine how this takes place next.

Viroids

Viroids are tiny fragments of nucleic acid known to cause several diseases of plants and thought to be involved in human and animal diseases.



Viral Genome & Classification

DNA viruses

The genome replication of most DNA viruses takes place in the cell's nucleus. Most DNA viruses are entirely dependent on the host cell's DNA and RNA synthesizing machinery, and RNA processing machinery. The viral genome must cross the cell's nuclear membrane to access this machinery. The DNA may be double stranded or single stranded.

RNA viruses

These viruses are unique because their genetic information is encoded in RNA. Replication usually takes place in the cytoplasm. RNA may be single-stranded or double-stranded..

Sense:

Positive-sense viral RNA is identical to viral mRNA and thus can be immediately translated by the host cell.

Negative-sense viral RNA is complementary to mRNA and thus must be converted to positive-sense RNA by an RNA polymerase before translation.

DNA nomenclature is similar to RNA nomenclature, in that the ***coding strand*** for the viral mRNA is complementary to it (−), and the ***non-coding strand*** is a copy of it (+)

Reverse transcribing viruses

These replicate using reverse transcription, which is the formation of DNA from an RNA template. Reverse transcribing viruses containing RNA genomes use a DNA intermediate to replicate, whereas those containing DNA genomes use an RNA intermediate during genome

replication. Both types use the reverse transcriptase enzyme to carry out the nucleic acid conversion

Classification

Classification seeks to describe the diversity of viruses by naming and grouping them on the basis of similarities. In 1962, André Lwoff, Robert Horne, and Paul Tournier were the first to develop a means of virus classification, based on the Linnaean hierarchical system.[95]

This system bases classification on phylum, class, order, family, genus, and species. Viruses were grouped according to their shared properties (not those of their hosts) and the type of nucleic acid forming their genomes.[96] Later the International Committee on Taxonomy of Viruses was formed.

ICTV classification

The International Committee on Taxonomy of Viruses began to advise and implement rules for the naming and classification of viruses early in the 1990s, an effort that continues to the present day.

The system shares many features with the classification system of cellular organisms, such as taxon structure. Viral classification starts at the level of order and follows as thus, with the taxon suffixes given in italics:

Order	(*-virales*)
Family	(*-viridae*)
Subfamily	(*-virinae*)
Genus	(*-virus*)
Species	

So far, **six orders** have been established by the ICTV: Names of orders and families are italicized, species names generally take the form of [Disease] virus. The establishment of an order is based on the inference that the virus families contained within a single order have most likely evolved from a common ancestor.

1-Caudovirales:

They are tailed dsDNA (group I) bacteriophages,

2-Herpesviraleso :

It contains large eukaryotic dsDNA viruses,

3-Mononegavirales :

It includes non-segmented (-) strand ssRNA (Group V) plant and animal viruses,

4-Nidovirales :

It is composed of (+) strand ssRNA (Group IV) viruses with vertebrate hosts,

5-Picornavirales

It contains small (+) strand ssRNA viruses that infect a variety of plant, insect, and animal hosts, and

6- Tymovirales

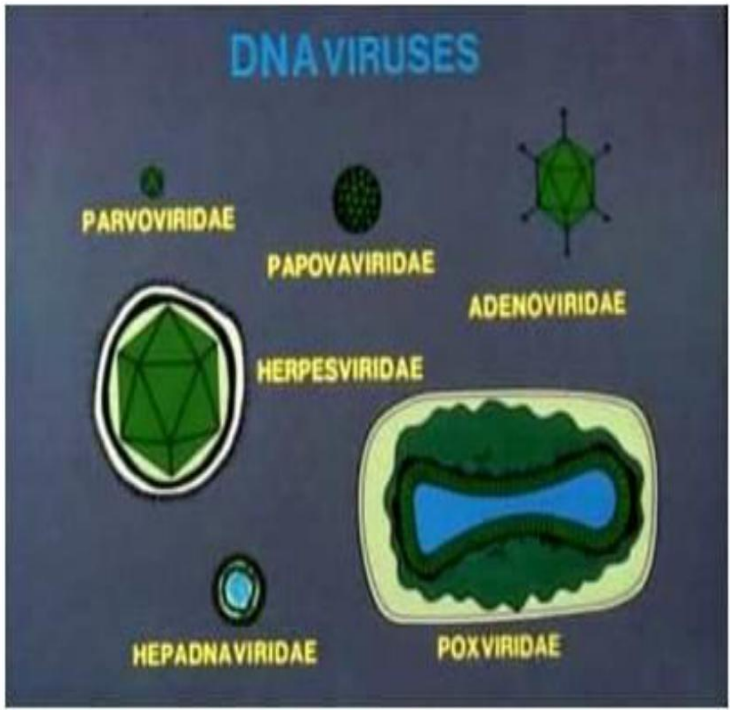
It ontains monopartite ssRNA viruses that infect plants.

Currently (2009) 6 orders, 87 families, 19 subfamilies, 348 genera, and 2,288 species of virus have been defined.

Baltimore classification

The Nobel Prize-winning biologist **David Baltimore** devised the Baltimore classification system. The ICTV classification system is used in conjunction with the Baltimore classification system in modern virus classification.

The Baltimore classification of viruse must generate mRNAs from their genomes to produce proteins and replicate s is based on the mechanism of mRNA production. Baltimore classification (first defined in 1971) is a classification system that places viruses into one of seven groups



- I: **dsDNA viruses** (e.g. Adenoviruses, Herpesviruses, Poxviruses)
- II: **ssDNA viruses** (+)sense DNA (e.g. Parvoviruses)
- III: **dsRNA viruses** (e.g. Reoviruses)
- IV: **(+)ssRNA viruses** (+)sense RNA (e.g. Picornaviruses, Togaviruses)
- V: **(−)ssRNA viruses** (−)sense RNA (e.g. Orthomyxoviruses, Rhabdoviruses)

VI:**ssRNA-RT viruses** (+)sense RNA with DNA intermediate in life-cycle (e.g.Retroviruses)

- VII: **dsDNA-RT viruses** (e.g. Hepadnaviruses
-

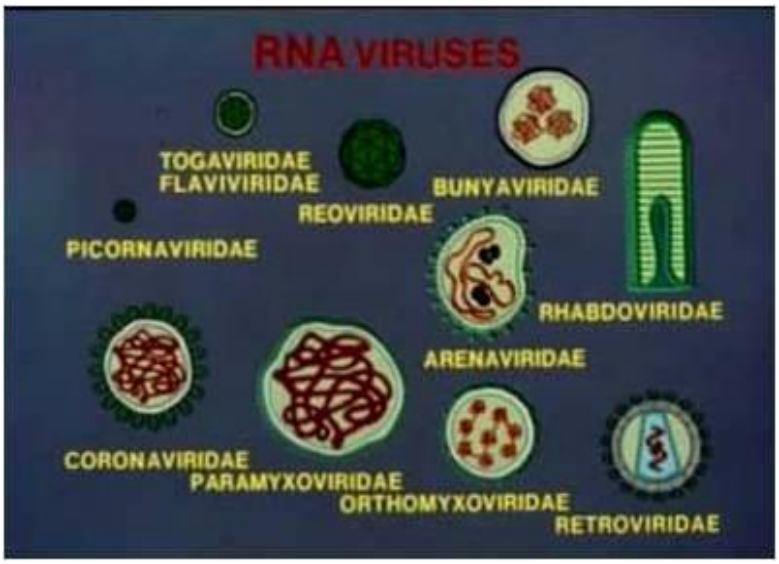
DNA viruses.

For more details on this topic, see DNA virus.

- **Group I**: viruses possess double-stranded DNA.
- **Group II**: viruses possess single-stranded DNA.

RNA viruses

For more details on this topic, see RNA virus.



- **Group III**: viruses possess double-stranded RNA genomes, e.g. rotavirus. These genomes are always segmented.

- **Group IV**: viruses possess positive-sense single-stranded RNA genomes. Many well known viruses are found in this group, including the picornaviruses (which is a family of viruses that includes well-known viruses like Hepatitis A virus, enteroviruses, rhinoviruses, poliovirus, and foot-and-mouth virus), SARS virus, hepatitis C virus, yellow fever virus, and rubella virus.
- **Group V**: viruses possess negative-sense single-stranded RNA genomes. The deadly Ebola and Marburg viruses are well known members of this group, along with influenza virus, measles, mumps and rabies.

Reverse transcribing viruses

For more details on this topic, see Reverse transcribing virus.

- **Group VI**: viruses possess single-stranded RNA genomes and replicate using reverse transcriptase. The retroviruses are included in this group, of which HIV is a member.

- **Group VII**: viruses possess double-stranded DNA genomes and replicate using reverse transcriptase. The hepatitis B virus can be found in this group.

Exampel: chicken pox virus, varicella zoster

(VZV), order Herpesvirales,

family *Herpesviridae*,

subfamily *Alphaherpesvirinae*,

genus *Varicellovirus*

VZV is in Group I of the Baltimore Classification because it is a dsDNA virus that does not use reverse transcriptase.

Reverse transcriptase, the key enzyme that retroviruses use to translate their RNA into DNA.