**Viruses**

**General features of Virus:**

Viruses are infectious agents with both living and nonliving characteristics.

1. Living characteristics of viruses

a- They reproduce at a fantastic rate, but only in living host cells.

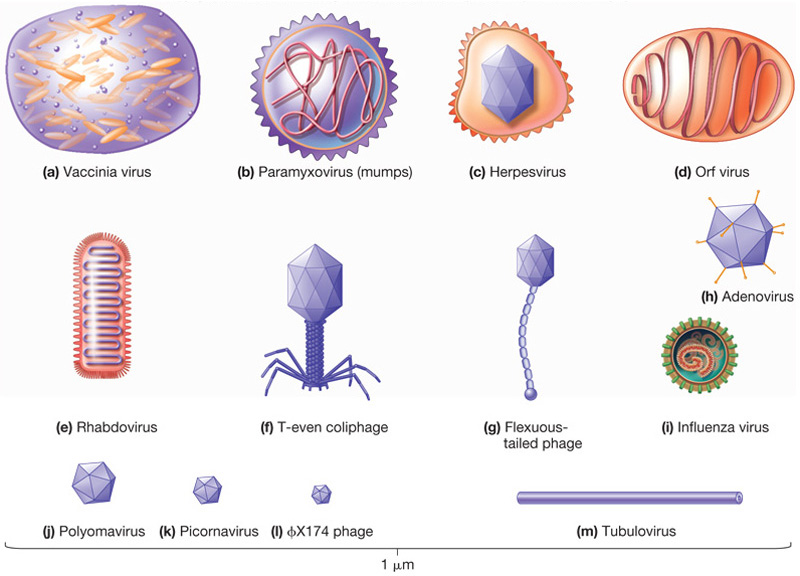
b- They can mutate.

2. Non living characteristics of viruses

-They are a cellular, that is, they contain no cytoplasm or cellular organelles.

- They carry out no metabolism on their own and must replicate using the host cell's metabolic machinery.

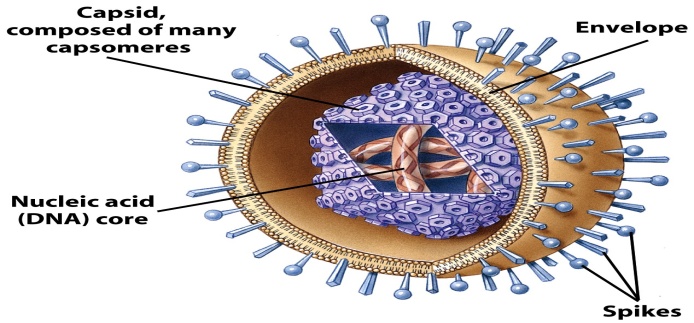
**The Size and Morphology of Selected Viruses**



**Generalized Structure of Viruses:**

Viral components

* + Nucleic acids-
  + Capsid-
  + -Envelope



**The Structure of Viruses:**

-Virion size range is ~10-400 nm

-All virions contain a nucleocapsid which is composed of nucleic acid (DNA or RNA) and a protein coat (capsid)

-Some viruses consist only of a nucleocapsid, others have additional components named Envelopes

* + virions having envelopes = enveloped viruses
  + virions lacking envelopes = naked viruses

**VIRAL ENVELOPES:**

-Many viruses that infect humans and other animals are enveloped.

-Envelopes form when viral glycoproteins and oligosaccharides associate with the plasma membrane of the host cell.

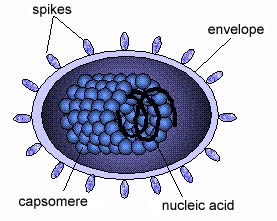
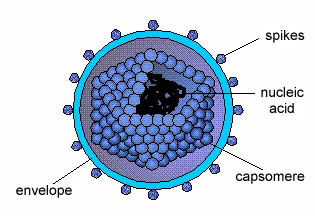
-All envelopes have a phospholipids bilayer.

**Capsid :**

-Capsid are large macromolecular structures which serve as protein coat of virus

-Protect viral genetic material and aid in its transfer between host cells

-Made of protein subunits called **protomers**



Enveloped helical virus Enveloped icosahedral virus

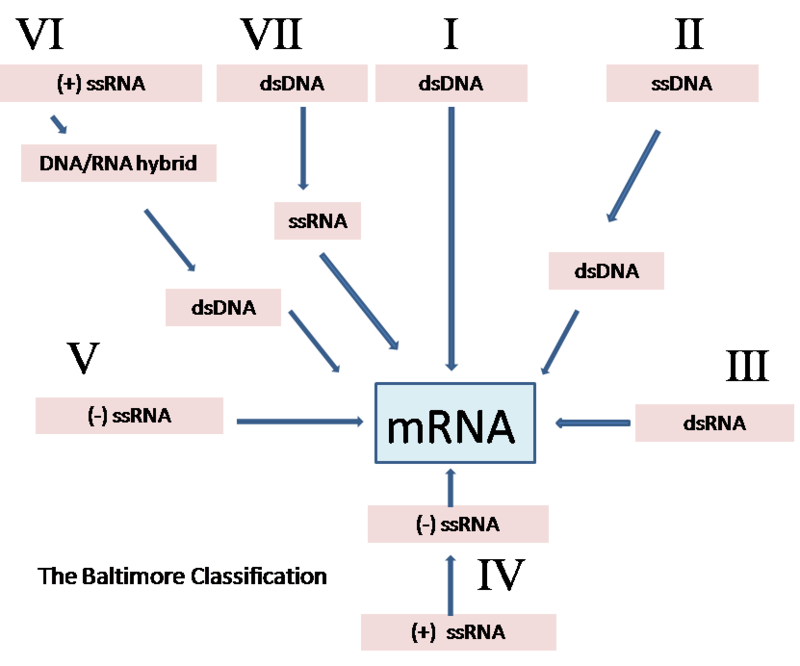
:**VIRUS CLASSIFICATION**

[International Committee on Taxonomy of Viruses](https://en.wikipedia.org/wiki/International_Committee_on_Taxonomy_of_Viruses) classified virus to [Order](https://en.wikipedia.org/wiki/Order_%28biology%29) (*-virales*) , [Family](https://en.wikipedia.org/wiki/Family_%28biology%29) (*-viridae*) Subfamily (*-virinae*) , [Genus](https://en.wikipedia.org/wiki/Genus) (*-virus*) ,[Species](https://en.wikipedia.org/wiki/Species) seven orders, [96 families, 22 subfamilies](https://en.wikipedia.org/wiki/List_of_virus_families_and_subfamilies), 420 genera, and 2,618 species of viruses have been defined by the ICTV .

**Baltimore classification**

classification system that places viruses into one of seven groups depending on a combination of their [nucleic acid](https://en.wikipedia.org/wiki/Nucleic_acid) ([DNA](https://en.wikipedia.org/wiki/DNA) or [RNA](https://en.wikipedia.org/wiki/RNA)), strandedness (single-stranded or double-stranded), [Sense](https://en.wikipedia.org/wiki/Sense_%28molecular_biology%29), and method of [replication](https://en.wikipedia.org/wiki/Viral_replication).

* I: [**dsDNA viruses**](https://en.wikipedia.org/wiki/DsDNA_virus) (e.g. [Adenoviruses](https://en.wikipedia.org/wiki/Adenovirus), [Herpesviruses](https://en.wikipedia.org/wiki/Herpesvirus), [Poxviruses](https://en.wikipedia.org/wiki/Poxvirus))
* II: [**ssDNA viruses**](https://en.wikipedia.org/wiki/SsDNA_virus) (+ strand or "sense") DNA (e.g. [Parvoviruses](https://en.wikipedia.org/wiki/Parvovirus))
* III: [**dsRNA viruses**](https://en.wikipedia.org/wiki/DsRNA_virus) (e.g. [Reoviruses](https://en.wikipedia.org/wiki/Reovirus))
* IV: [**(+)ssRNA viruses**](https://en.wikipedia.org/wiki/Positive-sense_ssRNA_virus) (+ strand or sense) RNA (e.g. [Picornaviruses](https://en.wikipedia.org/wiki/Picornavirus), [Togaviruses](https://en.wikipedia.org/wiki/Togavirus))
* V: [**(−)ssRNA viruses**](https://en.wikipedia.org/wiki/Negative-sense_ssRNA_virus) (− strand or antisense) RNA (e.g. [Orthomyxoviruses](https://en.wikipedia.org/wiki/Orthomyxovirus), [Rhabdoviruses](https://en.wikipedia.org/wiki/Rhabdovirus))
* VI: [**ssRNA-RT viruses**](https://en.wikipedia.org/wiki/SsRNA-RT_virus) (+ strand or sense) RNA with DNA intermediate in life-cycle (e.g. [Retroviruses](https://en.wikipedia.org/wiki/Retrovirus))
* VII: [**dsDNA-RT viruses**](https://en.wikipedia.org/wiki/DsDNA-RT_virus) (e.g. [Hepadnaviruses](https://en.wikipedia.org/wiki/Hepadnavirus))



**Replication cycle** :

The life cycle of viruses differs greatly between species but there are six basic stages in the life cycle of viruses:

**1- Attachment**: is a specific binding between viral capsid proteins and specific receptors on the host cellular surface. This specificity determines the host range of a virus. For example, HIV infects a limited range of human [leucocytes](http://en.wikipedia.org/wiki/Leucocytes). This is because its surface protein, [gp120](http://en.wikipedia.org/wiki/Gp120), specifically interacts with the [CD4](http://en.wikipedia.org/wiki/CD4) molecule – a [chemokine receptor](http://en.wikipedia.org/wiki/Chemokine_receptor) – which is most commonly found on the surface of [CD4+](http://en.wikipedia.org/wiki/CD4+) [T-Cells](http://en.wikipedia.org/wiki/T-Cells).

**2-** [**Penetration**](http://en.wikipedia.org/wiki/Viral_entry): Virions enter the host cell through receptor-mediated [endocytosis](http://en.wikipedia.org/wiki/Endocytosis) or [membrane fusion](http://en.wikipedia.org/wiki/Lipid_bilayer_fusion). This is often called [viral entry](http://en.wikipedia.org/wiki/Viral_entry).

**3- Uncoating**: is a process in which the viral capsid is removed: This may be by degradation by viral enzymes or host enzymes or by simple dissociation; the end-result is the releasing of the viral genomic nucleic acid.

[**4- Replication**](http://en.wikipedia.org/wiki/Viral_replication) of viruses involves primarily multiplication of the genome. Replication involves synthesis of viral messenger RNA (mRNA),viral [protein synthesis](http://en.wikipedia.org/wiki/Protein_biosynthesis), possible assembly of viral proteins, then viral genome replication mediated by early or regulatory protein expression.

**5- Assembly**: Following the structure-mediated self-assembly of the virus particles, some modification of the proteins often occurs. In viruses such as HIV, this modification (sometimes called maturation) occurs after the virus has been released from the host cell.

**6- Release** : Viruses can be [released](http://en.wikipedia.org/wiki/Viral_shedding) from the host cell by [lysis](http://en.wikipedia.org/wiki/Lysis), a process that kills the cell by bursting its membrane and cell wall if present: This is a feature of many bacterial and some animal viruses. Some viruses undergo a [lysogenicA cycle](http://en.wikipedia.org/wiki/Lysogenic_cycle) where the viral genome is incorporated by [genetic recombination](http://en.wikipedia.org/wiki/Genetic_recombination) into a specific place in the host's chromosome. Enveloped viruses (e.g., HIV) typically are released from the host cell by [budding](http://en.wikipedia.org/wiki/Viral_shedding). During this process the virus acquires its envelope, which is a modified piece of the host's plasma or other, internal membrane.

