Virology: it is considered to be a subfield of microbiology. It is the study of viruses (submicroscopic parasitic particles of genetic materials contained in a protein coat). It focuses on many viruses aspects like: their structure, classification, evaluation, their way to infect host cells for reproduction, the disease they cause, the technique to isolate and therapy.

Some glossary in Virology……………

Virus: Latin word means "poisons fluid". A virus is a small infectious agent (ranging from 20-300 nm) that replicates only inside the living cells of other organisms. It can infect all types of life forms …human, animal, plants, fungus and bacteria.

Capsid: The protein coat that enclosed the genome (nucleic acid).

Nucleocapsid: The protein- nucleic acid complex representing the packaged form of the viral genome.

Envelope: A lipid- containing membrane that surrounded some virus particles, it is acquired during viral replication by a budding process through a cellular membrane.

Capsomere: Morphologic units on the surface of icosahedral virus particles.

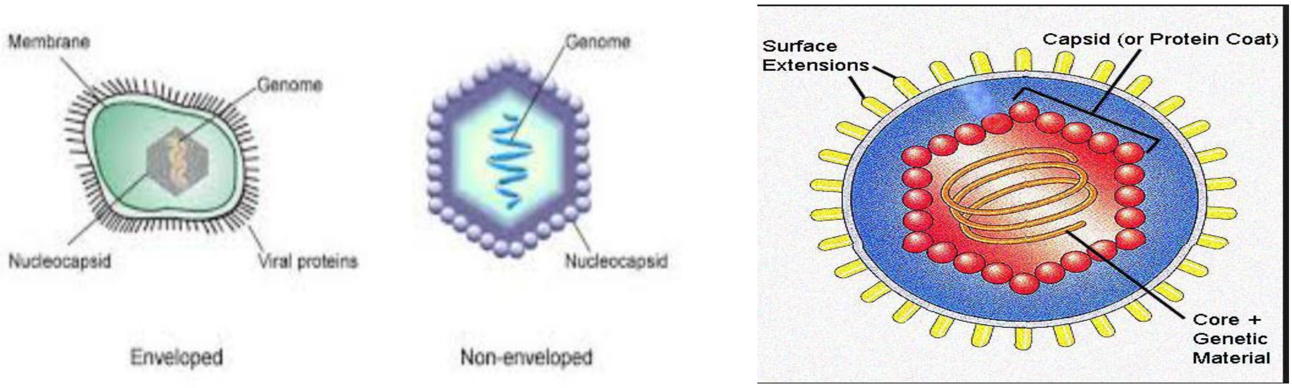
Defective viruses: A virus particle that is functionally deficient in some aspect of replication.

Structural units: The basic protein building blocks of the coat.

Virion: The complete virus particle.

Viriods: Small infectious agents that cause diseases of plants. They have nucleic acid without a protein coat.

Prions: Infectious particles composed solely of protein with no detectible N.A. Highly resistance to inactivation by heat, formaldehyde and UV light, cause Creutzfeld- Jacob disease in human. The prion protein is encoded by a single cellular gene.



"Schematic illustrating the components of virus particle"

Evolutionary origin of Viruses:

The origins of viruses in the evolutionary history of life are unclear, in evolution viruses are an important means of horizontal gene transfer which increases genetic diversity. However, some theories of viral origin can be summarized as follows:

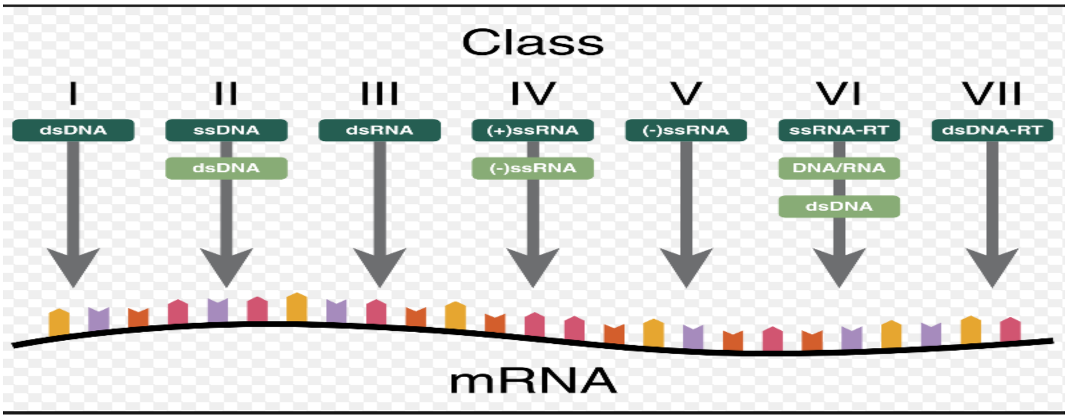
- Viruses may have evolved from plasmids (pieces of DNA) that can move between cells
- Viruses may be derived from DNA or RNA nucleic acid components of host cells that became able to replicate and evolve independently
- Viruses may be degenerate forms of intracellular parasites but there is no evidence that viruses evolve from bacteria.

Structure of Viruses:

The following properties have been used as basic components as well as for the classification of viruses:

1- Nucleic acid (the core):

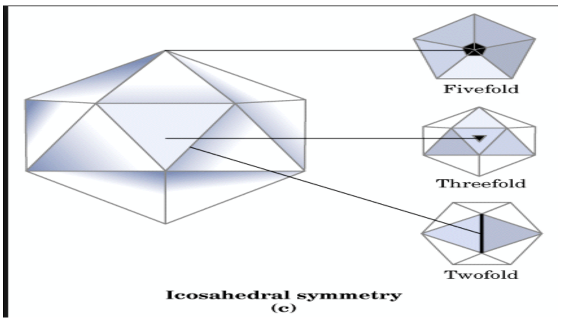
According to the nucleic acid, viruses either DNA or RNA. It can be classified:
I: ds DNA viruses
II: ss DNA viruses
III: ds RNA viruses
IV: + ss RNA viruses
V: - ss RNA viruses
VI: ss RNA RT viruses
VII: ds DNA RT viruses
*+ve sense: mean has the same sequence of mRNA so act as mRNA
*-ve sense: mean opposite of mRNA sequence so need to transcript to mRNA.
*DNA viruses…. circular, linear, ds or ss.
*RNA viruses…. segmented, non- segmented, ss, ds, +ve polarity or –ve polarity.



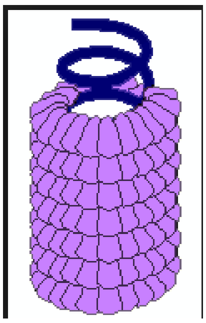
2- **Symmetry:**

Electron microscopy, cryoelectron microscopy and x- ray diffraction techniques have been made it possible to resolve fine differences in the basic morphology of viruses using heavy metal stain (e.g. potassium phosphotungstate) and viral architecture can be groups viruses into three types based on the arrangement of morphologic subunits:

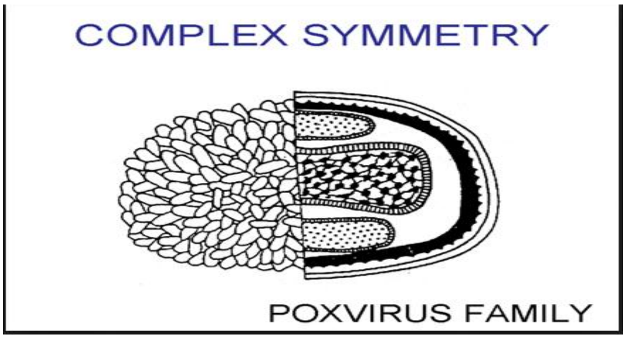
I. **Cubic symmetry:** or icosahedral pattern. The icosahedron has 20 faces, 12 vertices, and fivefold, threefold and twofold axes of rotational symmetry. Both DNA and RNA viruses exhibit cubic symmetry. ex. Adenoviruses.



II. **Helical symmetry:** in helical symmetry, protein subunits are bound to the viral nucleic acid winding it into a helix, the thus as is not the case of icosahedral structure. The filamentous viral nucleic acid- protein complex (nucleocapsid is then coiled inside a lipid-containing envelope. All RNA viruses has helical symmetry with the exception of rhabdoviruses.



III. Complex symmetry: are more complicated in structure, do not exhibit simple cubic or helical symmetry. ex: Pox viruses are brick- shaped.

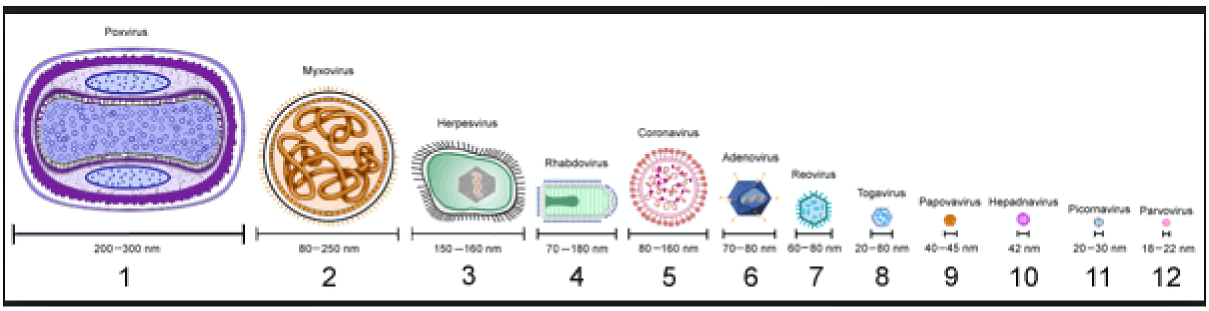


DNA viruses: **1-**complex…like pox virus
2- Icosahedral….Naked…ss ex. parvovirus
ds linear ex. Adenoviruses
ds circular ex. papilomavirus
Icosahedral….enveloped… ds linear ex. HSV
ds circular ex. HBV

RNA viruses: 1- Icosahedral…Naked…ds RNA ex. Reovirus
ss+ sense RNA ex. Picornaviruses
Icosahedral… Enveloped… ss+ sense RNA ex.Togaviruses
2- Helical…Enveloped… ss- sense segmented ex. Orthomyxoviruses
ss-sense non- segmented ex. Paramyxoviruses
3- Helical icosahedral…Enveloped…ss+v sense ex. Coronaviruses
4-Icosahedral helical…Enveloped… ss+sense ex. Flaviviridae
ss-sense segmented ex. Arenaviredae

3- Size:

Smallest infectious particles range from 10-300 nm.
The smallest DNA viruses is parvovirus (18- 26 nm)
The largest DNA viruses is Pox virus (230x400 nm)
The smallest RNA virus are picornavirus (28-30 nm)
The largest RNA virus are filovirus (80x 1000 nm)



4- **Physiochemical properties:**

<u>Heat:</u>

Viruses tend to be stable at 33-37^{o}C, losing little infectivity after several hours at 37^{o}C. Enveloped viruses are much more heat liable rapidly dropping in titer at 37^{o}C. Generally infectivity destroyed by heating at 50-60 ^{o}C for 30 minutes.

<u>Cold:</u>

Viruses can be preserved by storage at subfreezing temperature -90 ^{o}C. Enveloped viruses tend to lose infectivity after prolonged storage. Some viruses may withstand lypholization and can thus be preserved in the day state at 4 ^{o}C.

<u>Salts:</u>

Many viruses can be stabilized by salts in concentration of 1 mol/L. viruses are preferentially stabilized by certain salts $Mgcl_2$, $MgSo_4$ and $NaSo_4$. The stability of viruses is Important in the preparation of vaccines.

<u>pH:</u>

Viruses are usually stable at neutralized pH. Some enteroviruses are resistance to acidic conditions. All viruses are destroyed by alkaline conditions.

<u>Radiation:</u>

UV- light, X-ray and light energy particles inactivate viruses.

<u>Ether stability:</u>

Ether susceptibility test can be used to distinguished viruses that possess an envelope from those that do not.

<u>Formaldehyde:</u>

Formaldehyde destroys viral infectivity by reacting with nucleic acid. Viruses with single stranded genome are inactivated more radially than those with double-stranded genomes. It has minimal adverse effects on the antigenicity of proteins and therefor has been used frequently in the production of inactivated viral vaccines.

<u>Detergents:</u>

Both nonionic (like Triton) and anionic detergents (like sodium dodecyl sulfate) solubilized viral envelopes.

5- **Antibiotics:**

Have no effect on viruses.

6- **Properties of protein:**

There are naked and enveloped viruses, both of them have two group of proteins structural (matrix protein) and non- structural (polymerase responsible for viral nucleic acid replication). In addition to that some enveloped viruses has surface glycoprotein has spike shape. The structural proteins of viruses have several important functions:

- It facilitates transfer of the viral N.A from one host cell to another.
- Protect the viral genome against inactivation by nucleases enzymes.
- Participates in the attachment of the virus particle to the susceptible cell.
- Provide the structural symmetry of the virus particle.
- Determine the antigenic characteristics of the virus.

Virus VS. Bacteria:

	Bacteria	**Virus**
Ribosomes	present	absent
Cell wall	Peptidoglycan/lipopolysaccharides	No cell wall/protein coat
Nucleus	No	No
No. of cells	unicellular	No cell, not living
Nucleic acid	DNA and RNA	DNA or RNA
Enzymes	yes	yes in some
Virulence	yes	yes
Infection	Localized	Systemic
Reproduction	A sexual reproduction by fission	Invade host cell and replicate
Size	Larger (1000 nm)	Smaller (20-400 nm)
Treatment	Antibiotics	Vaccines