Basrah University
Al-Qurna Education college
Biology department : postgraduate

2nd Course -Lecture # 6: Virology

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Objectives

*To define the Viruses

*To explain Viral properties, Structure, Transmission, Replication and Classification

Viruses

- They are called **obligate intracellular parasites**
- Virus is an tiny, infectious particle that can reproduce only by infecting a host cell. Viruses "commandeer" the host cell and use its resources to make more viruses, basically reprogramming it to become a virus factory.

  They have no cell nucleus, organelles, or cytoplasm.
- virus particles contain **only one kind of nucleic acid**—either DNA or RNA but never both
- Because they can't reproduce by themselves (without a host), viruses are **not considered living organisms.**

Viral Properties

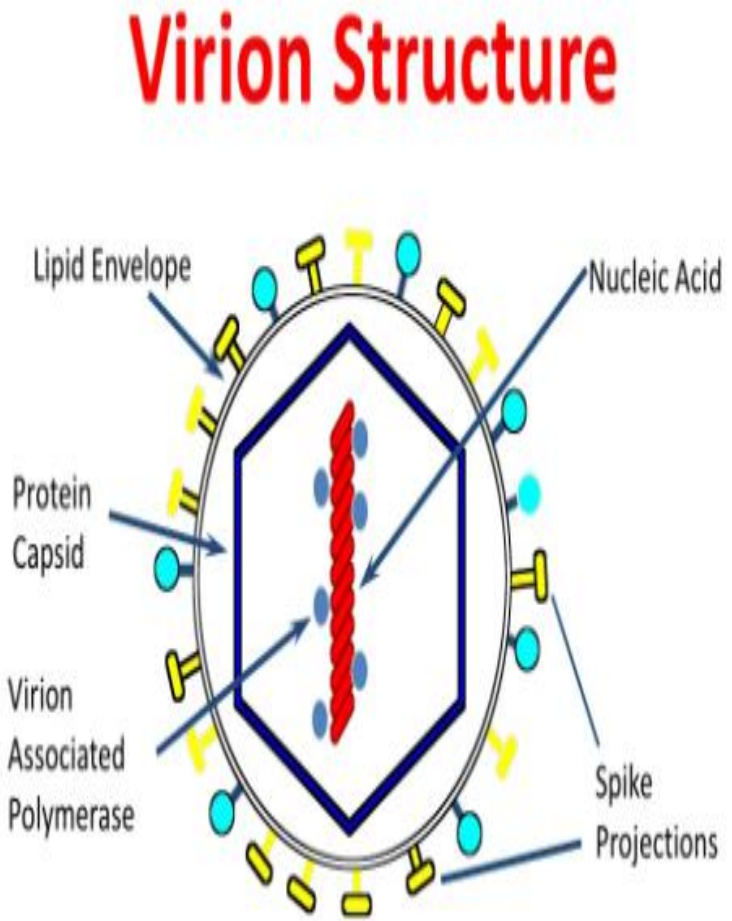
- Viruses are inert (nucleoprotein) filterable Agents
- Viruses are obligate intracellular parasites
- Viruses cannot make energy or proteins independent of a host cell
- Viral genome are RNA or DNA but not both.
- Viruses have a naked capsid or envelope with attached proteins
- Viruses do not have the genetic capability to multiply by division.
- Viruses are non-living entities

VIRAL STRUCTURE – SOME TERMINOLOGY

- virus particle = virion
- protein which coats the genome = capsid
- capsid usually symmetrical
- capsid + genome = nucleocapsid
- may have an envelope

The structure of a virus

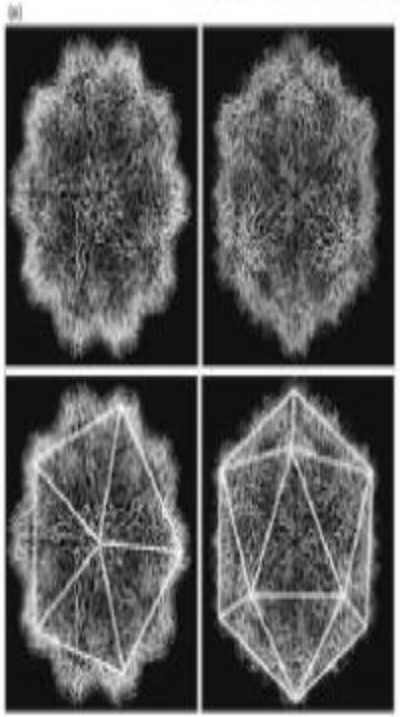
- Viruses vary in their sizes, shapes, and life cycles.
- Viruses consist of :
- A protective protein shell, or capsid
- A nucleic acid genome made of DNA or RNA, located inside of the capsid
- A layer of membrane called the envelope (some but not all viruses)



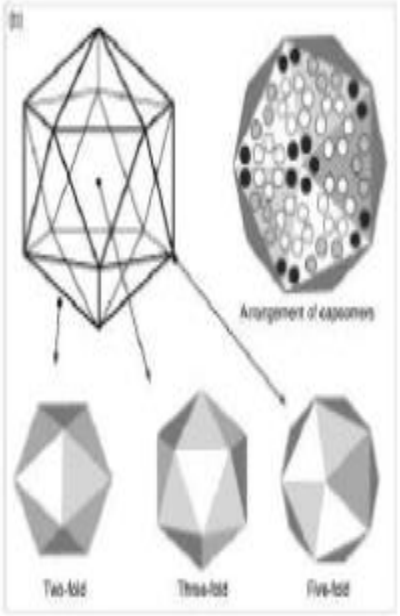
Viral Structure

- Varies in size, shape and symmetry
- VIP for classification
- 3 types of capsid symmetry:
  - Cubic (icosahedral)
    - Has 20 faces, each an equilateral triangle. Eg. adenovirus
  - Helical
    - Protein binds around DNA/RNA in a helical fashion eg. Coronavirus
  - Complex
    - Is neither cubic nor helical eg. poxvirus

Icosahedral capsids

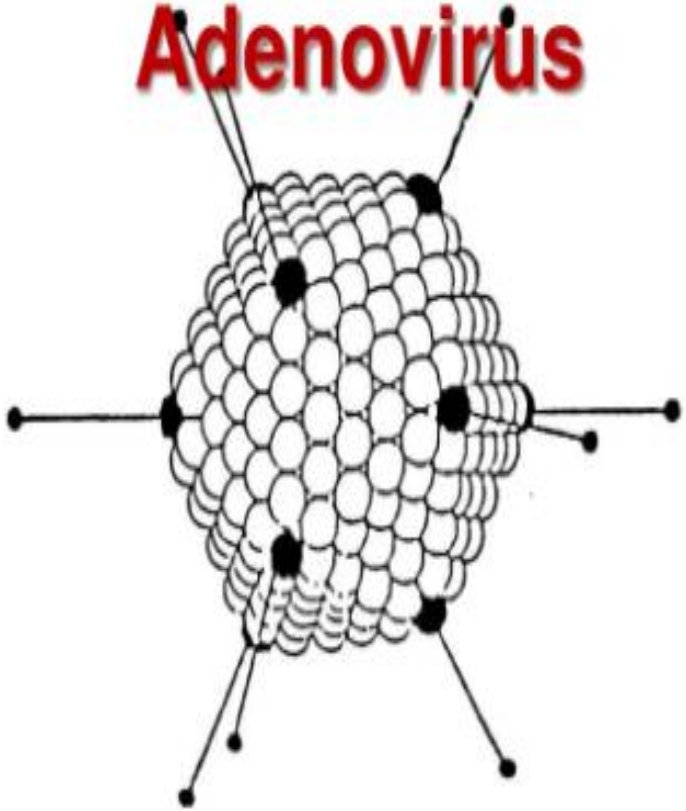


a) Crystallographic structure of a simple icosahedral virus.



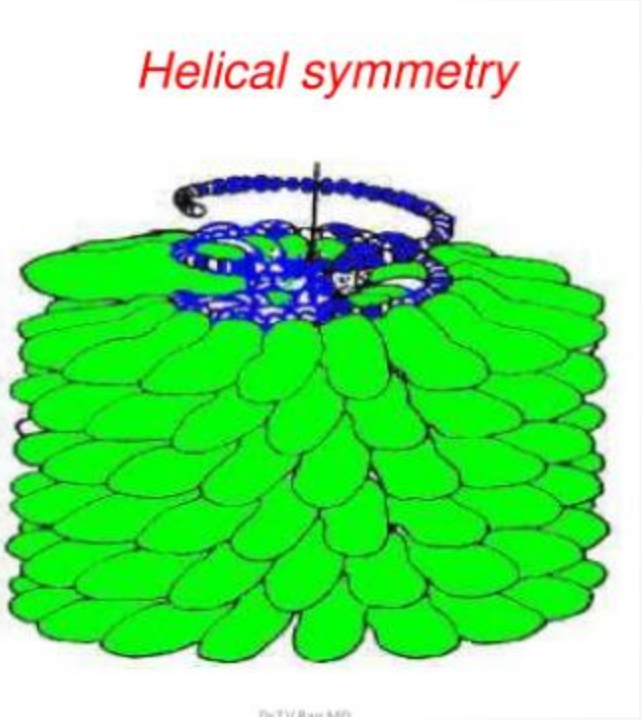
b) The axes of symmetry

Adenovirus

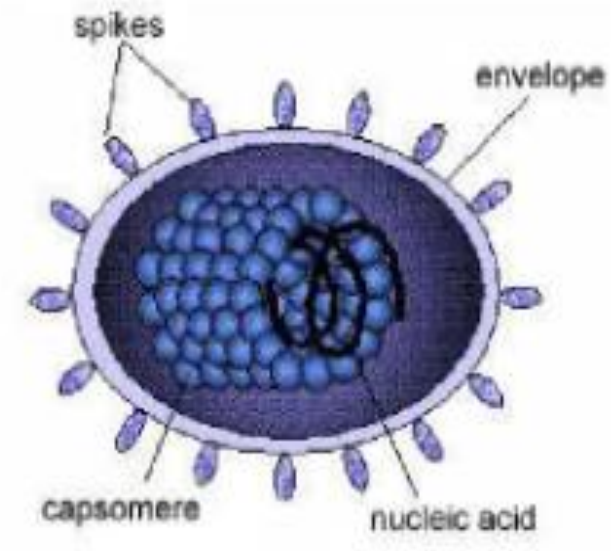


Helical

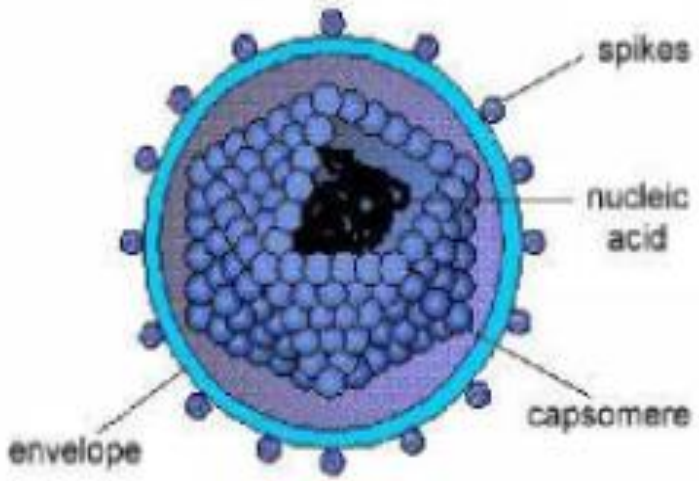
- California Encephalitis Virus
  Coronavirus
  Hantavirus
  Influenza Virus (Flu Virus)
  Measles Virus (Rubeola)
  Mumps Virus
  Para influenza Virus
  Rabies Virus
  Respiratory Syncytial Virus(RSV)



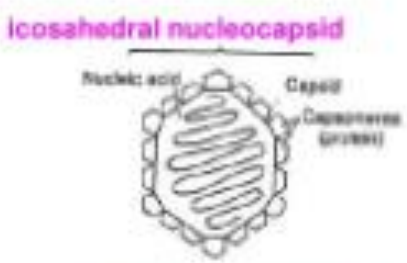
Enveloped helical virus



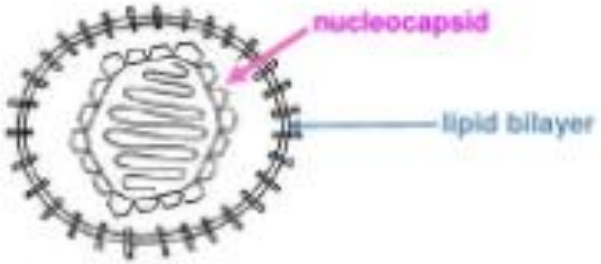
Enveloped icosahedral virus



5 BASIC TYPES OF VIRAL STRUCTURE

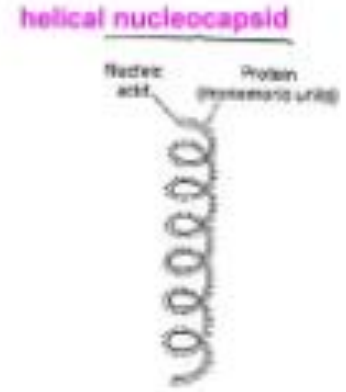


ICOSAHEDRAL

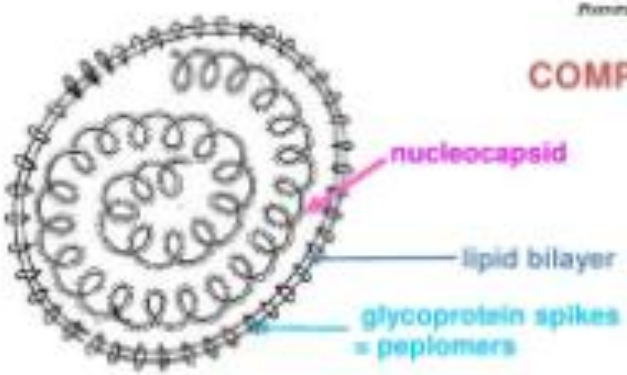


ENVELOPED ICOSAHEDRAL

COMPLEX



HELICAL



ENVELOPED HELICAL

Viral capsids

- The capsid, or protein shell, of a virus is made up of many protein molecules, These molecules join to make units called capsomers , which together make up the capsid . Capsid proteins are always encoded by the viral genome.

Capsids come in many forms

- **1.Icosahedral**: Icosahedral capsids have twenty faces.

- **2.Filamentous**: Filamentous capsids are linear, thin, thread like appearance. They may also be called rod shaped or helical.

- **3**. **Head tail :** These capsids are kind of a hybrid between the filamentous and icosahedral shapes. They basically consist of an icosahedral head attached to a filamentous tail.

Transmission of Viruses

- Respiratory transmission
  - Influenza A virus
- Faecal-oral transmission
  - Enterovirus
- Blood-borne transmission
  - Hepatitis B virus
- Sexual Transmission
  - HIV
- Animal or insect vectors
  - Rabies virus

The Baltimore classification system

Based on genetic contents and replication strategies of viruses. According to the Baltimore classification, viruses are divided into the following seven classes:

1. dsDNA viruses
2. ssDNA viruses
3. dsRNA viruses
4. (+) sense ssRNA viruses (codes directly for protein)
5. (-) sense ssRNA viruses
6. RNA reverse transcribing viruses
7. DNA reverse transcribing viruses

where "ds" represents "double strand" and "ss" denotes "single strand".

CLASSIFICATION

NUCLEIC ACID

- RNA or DNA
- segmented or non-segmented
- linear or circular
- single-stranded or double-stranded
- if single-stranded RNA
  - is genome mRNA (+) sense or complementary to mRNA (-) sense

Genome

- The genome of a virus can be either DNA or RNA

- DNA-double stranded (ds): linear or circular
  Single stranded (ss) : linear or circular
- RNA- ss:segmented or non-segmented
  ss:polarity+(sense) or polarity –(non-sense)
  ds: linear (only reovirus family)

Viral Replication

- **1.Attachment**

  The virus recognizes and binds to a host cell via a receptor molecule on the cell surface

- **2.Pentration and un coating**

  The virus or its genetic material enters the cell

- **3.Genome replication and gene expression**

  The viral genome is copied and its genes are expressed to make viral proteins

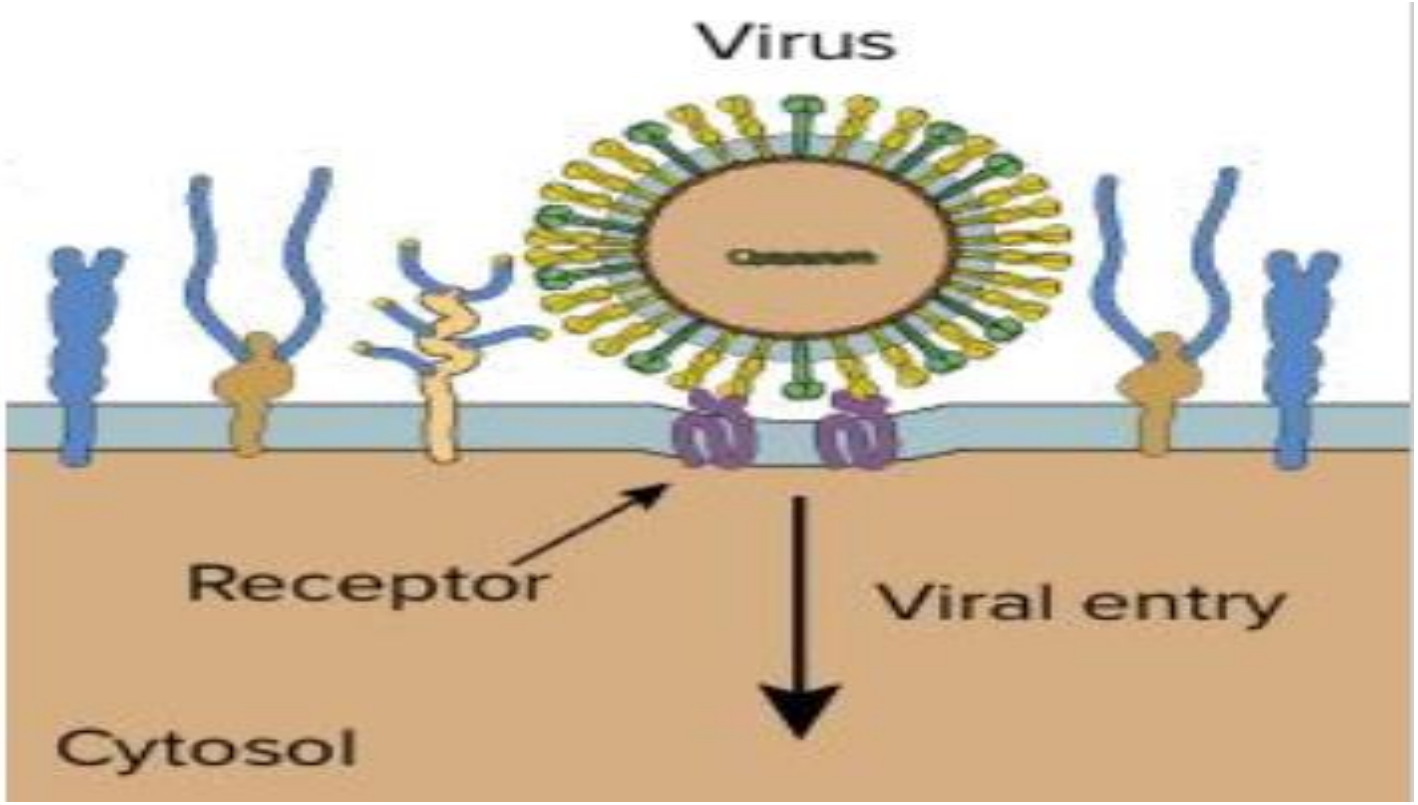
- **4.Assembly**

  New viral particles are assembled from the genome copies and viral proteins

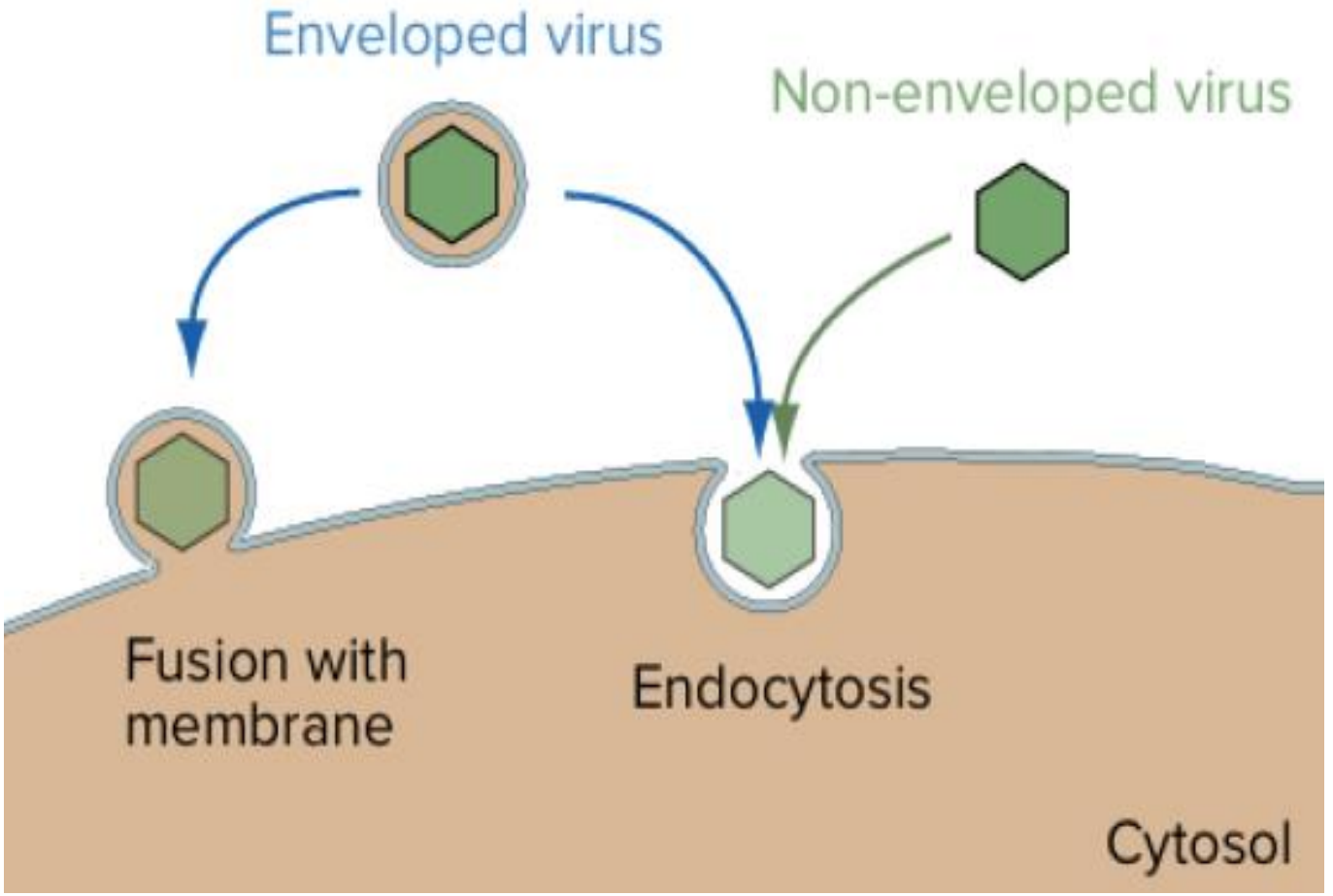
- **5.Release**

  Completed viral particles exit the cell and can infect other cells

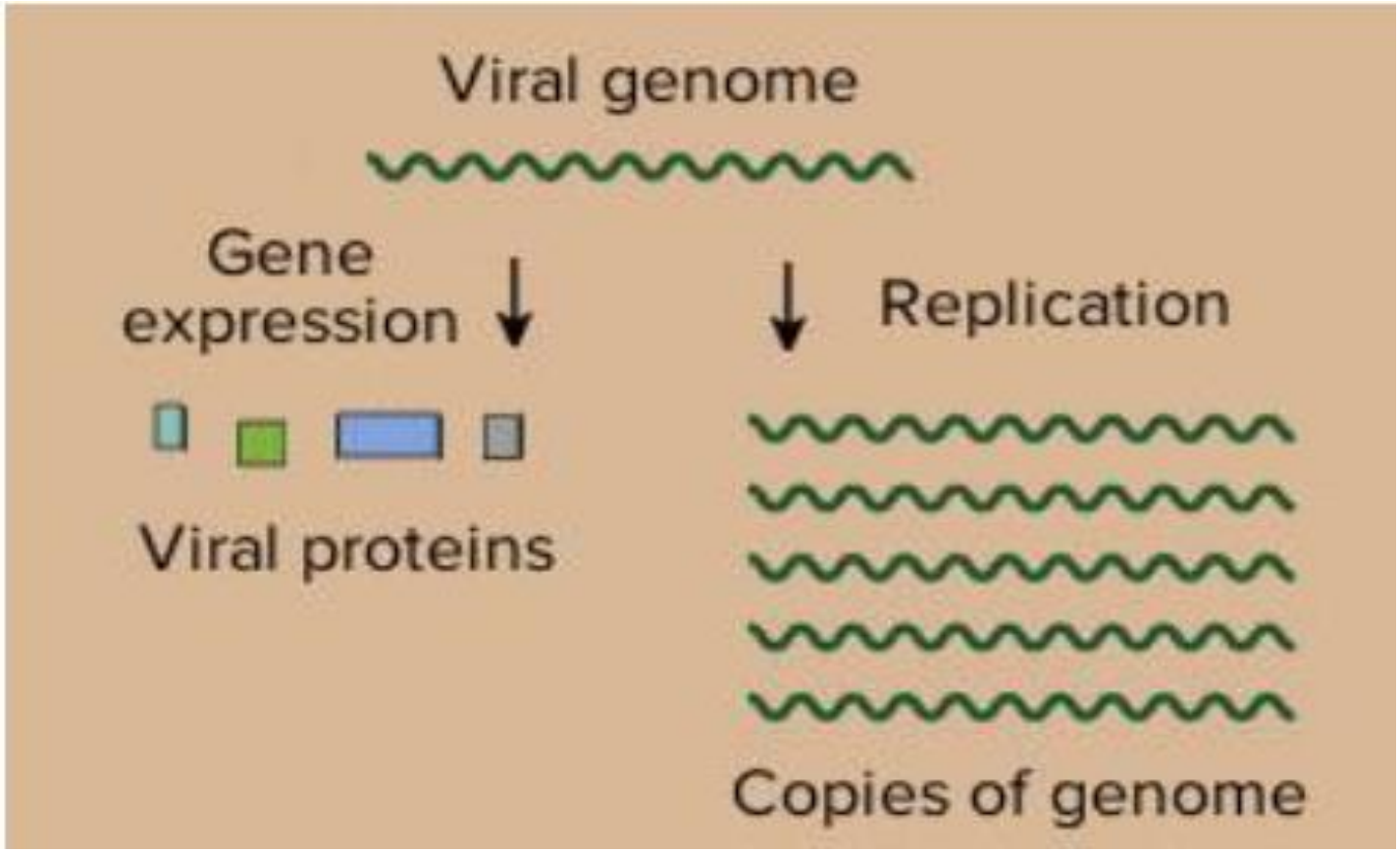
1. Attachment



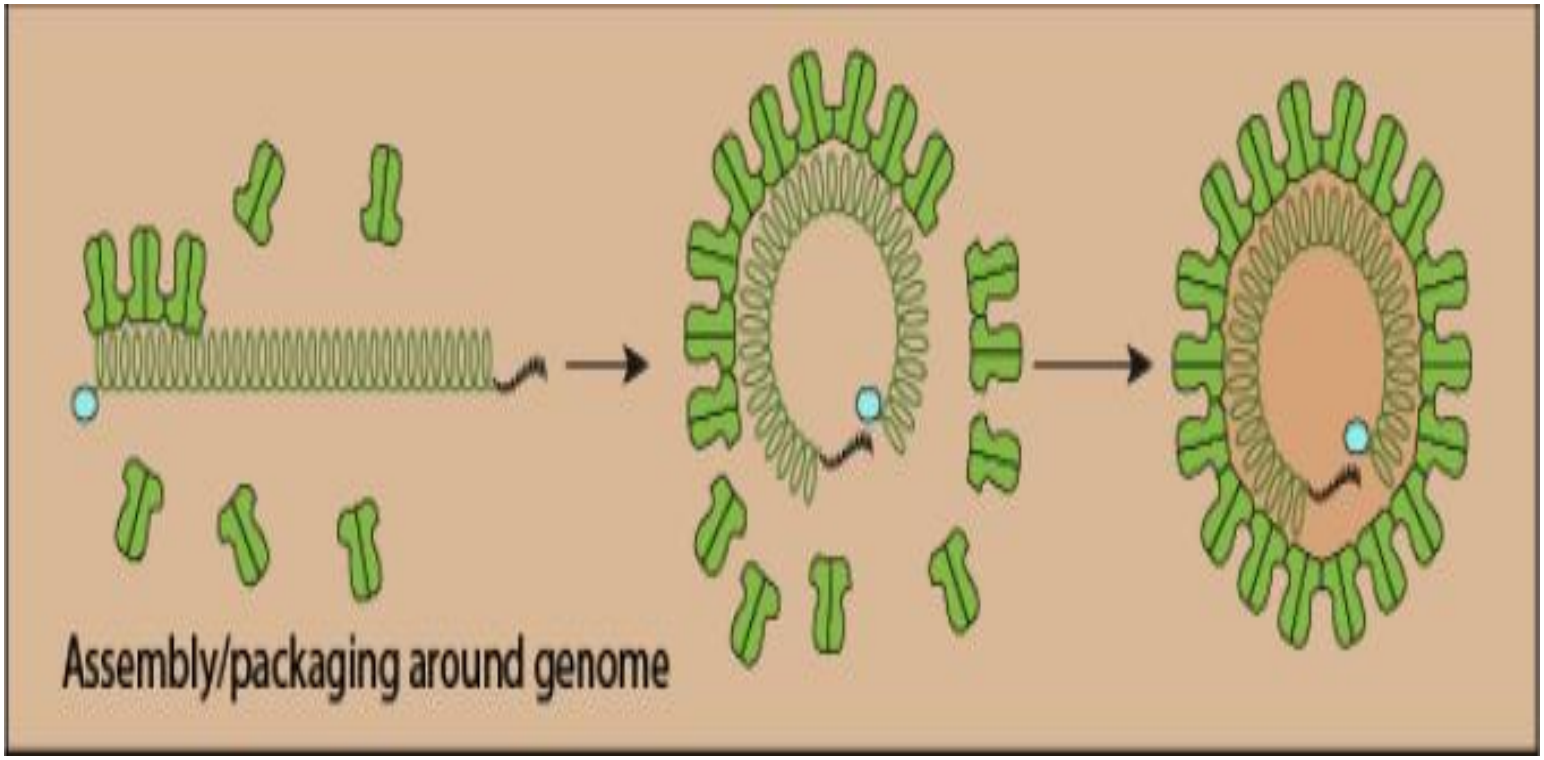
2. Entry


Enveloped virus
Non-enveloped virus
Fusion with membrane
Endocytosis
Cytosol

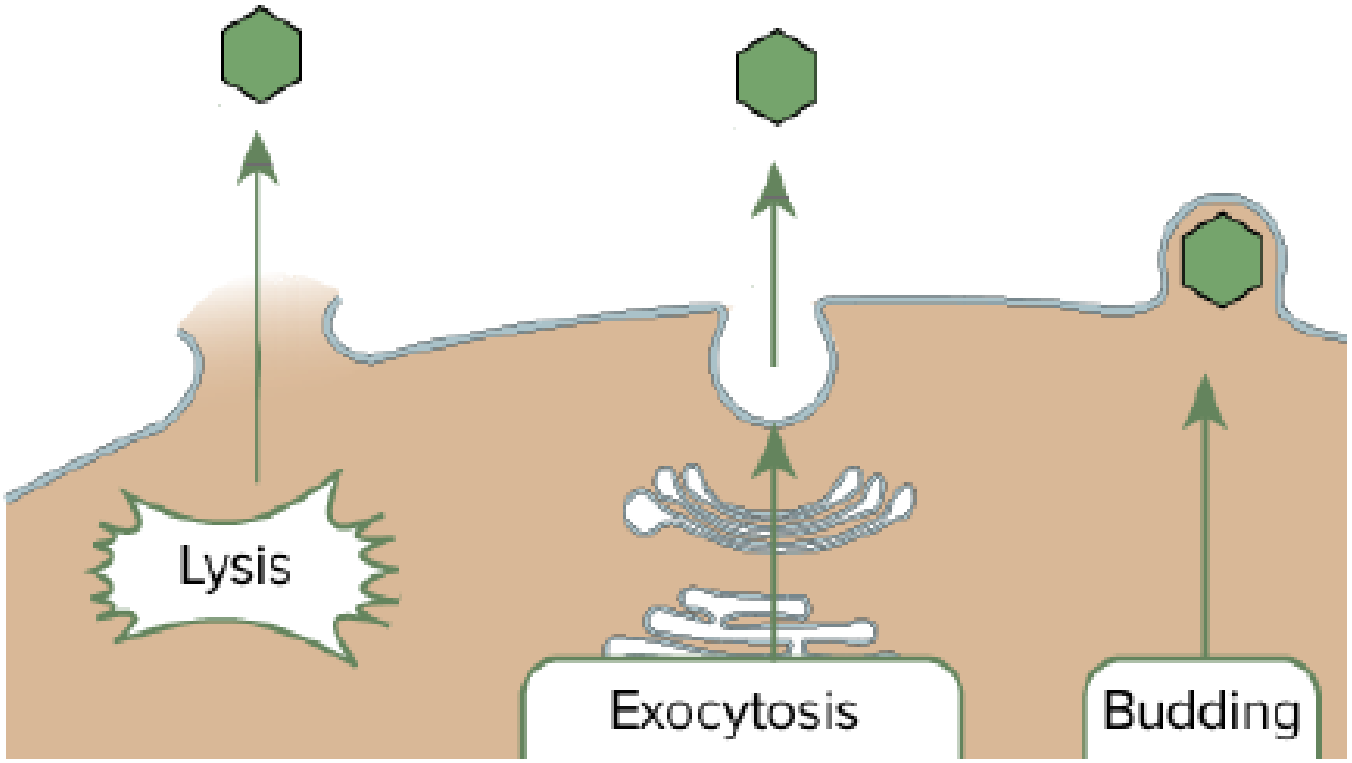
3. Genome replication and gene expression



4. Assembly



5. Release



Viroids & Prions

- **Viroids**
  - ss RNA genome and the smallest known pathogens.
  - Affects plants

- **Prions**
  - Infectious particles that are entirely protein.
  - No nucleic acid
  - Highly heat resistant
  - Animal disease that affects nervous tissue
  - Affects nervous tissue and results in
    - Bovine spongiform encepahltits (BSE) "mad cow disease",
    - scrapie in sheep
    - kuru & Creutzfeld-Jakob Disease (CJD) in humans