Microbiology

2025-2024

Dr.Saja Ebdah

ARKAN
ACADEMY

Viral Morphology and Classification

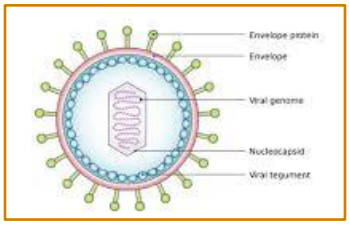
- **Introduction to virology history and definitions**
  - Viruses were too small to be seen with the first microscopes.The cause of viral infections has been unknown for years. *Important discoveries:*
    - ✓ *Louis Pasteur* first proposed the term virus
    - ✓ *Ivanovski and Beijerinck* showed that a disease in tobacco was caused by a virus
    - ✓ *Loeffler and Frosch* discovered an animal virus that causes foot –and-mouth disease in cattle
    - ✓ *Walter Reed* discovered the yellow fever virus
  - Many years of experimentation showed what we know today and by the 1950s virology had grown

- **Virus Properties**
  - A virus is defined as a ***nucleoprotein complex*** that infect cells and uses their metabolic processes to replicate
  - *Smallest* known infective agents ranging from 20-450 nm
  - Metabolically inert - *no metabolic activity outside host cell*; must enter host cell to replicate
  - Contain *only one type of nucleic acid*, either DNA or RNA but never both
  - ***Lack enzymes*** for most metabolic processes and lack machinery for protein synthesis
  - The nucleic acid is encased in a protein shell, which may be surrounded by a lipid-containing membrane
  - The entire infectious unit is termed a (*virion*)

- **Importance**
  - Major cause of human illnesses
  - Quick *transmission*
  - *New strains*: SARS, Corona, birds flue, etc
  - *Epidemics*/*pandemics*: Ebola Virus, COVID-19
  - Availability of *treatment*

- **Diversity**
  - Viruses *vary* greatly in structure, genome organization and expression, and strategies of replication and transmission.
  - The virus infection may have *little* or *no effect* on the host cell or may result in *cell damage* or death.
  - The host range for a given virus may be *broad* or *extremely limited*.
  - Viruses *infect* unicellular organisms, such as mycoplasmas, bacteria, algae, and all higher plants, animals, and vertebrates.

- **Definitions**
  - *Virion:* the *complete* virus particle
    - ✓ Nucleic acid: Either DNA or RNA
    - ✓ Capsid: The protein coat that encloses the viral genome
    - ✓ Envelope: A lipid-containing membrane that surrounds some viruses
    - ✓ Glycoprotein spikes: Projections from the envelope



  - *Nucleocapsid* = Nucleic acid + capsid (The *protein-nucleic acid* complex)
  - *Capsomeres:* morphologic units are seen in the electron microscope on the *surface* of icosahedral viruses.
  - *Peplomers:* virus-*encoded* glycoproteins that are projected from the envelope

- *Defective virus:* a virus particle that is functionally *deficient* in some aspect of replication
- *Structural units:* the basic protein *building blocks* of the coat. They are usually a collection of more than one non-identical protein subunit "protomer".

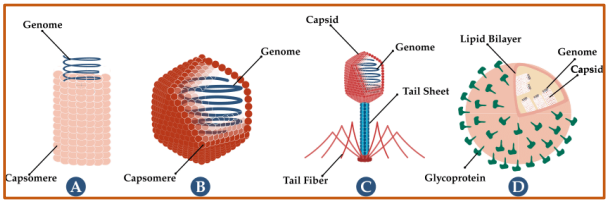
• Viruses structure:

➢ *Genome – Nucleic Acid*

- ✓ Genome- the *total of the genetic information* carried by an organism
- ✓ They only have the genes necessary to invade host cells and redirect their activity
- ✓ DNA or RNA
- ✓ single - or double –stranded
- ✓ linear or circular
- ✓ Segmented or intact
- ✓ RNA positive or negative sense

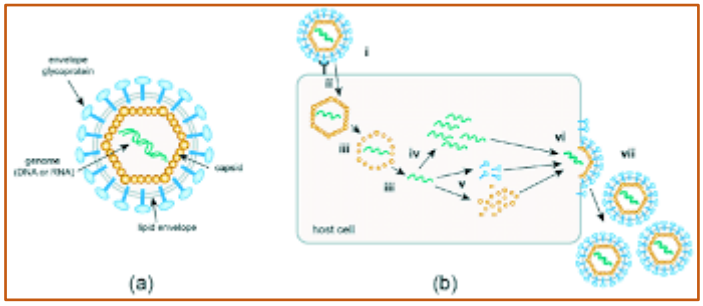
➢ *Capsid*

- ✓ Constructed from identical subunits called *capsomers*
- ✓ Made up of *protein* molecules
- ✓ *Three different types*
  - helical – tubular (A)
  - icosahedral - isometric or cubic (B)
  - complex - does not conform to either of above (C or D)



➢ *Envelope*

- ✓ Found in some viruses; *lipoprotein* envelope containing viral and host cell compounds
- ✓ Enveloped viruses *take a bit* of the host cell membrane in the form of an envelope
- ✓ Some proteins form a binding layer between the envelope and the capsid
- ✓ Glycoproteins remain exposed as spikes (*peplomers*)- essential for **<u>attachment</u>**



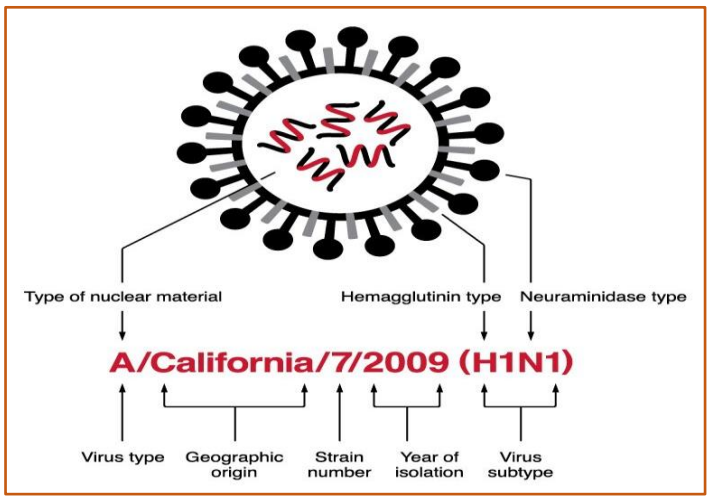
➢ *Functions of the Viral Capsid/Envelope*

- ✓ *Protects* nucleic acids
- ✓ *Help* introduce the viral DNA or RNA into a suitable host cell
- ✓ *Stimulate* the immune system to produce antibodies that can protect the host cells against future infections

- **Characteristics of Infectious Microorganisms**

Microorganisms Property	Bacteria	Viruses	Fungi	Protozoa
Size (nm)	100 -10,000	30 - 300	4,000 - 40,000	4,000 - 40,000
Nuclear structure	Prokaryotes	----	Eukaryotes	Eukaryotes
Obligate Intracellular	No	Yes	No	No
Nucleic acids	DNA/RNA Haploid	DNA or RNA	DNA /RNA	DNA /RNA
Culture on Artificial media	Yes	No	Yes	Yes

- **Virus Naming**
  - Viruses with *similar* structural, genomic & replication properties are grouped into **families** (suffix: viridae) e.g. Herpesviridae
  - Families *subdivided* into **genera** (suffix: virus) e.g. Herpes simplex virus, Cytomegalovirus, Varicella zoster virus
  - **Subtypes** based on *nucleotide sequence* and *antigenic reactivities* e.g. Herpes simplex virus type 1, Herpes simplex virus type 2



ARKAN

ACADEMY

علم في كل مكان

Arkan academy

Arkanacademy

www.arkan-academy.com

+962 790408805