DEFINITION

A virus is a ultramicrosopic, acellular (non-cellular) parasite of cells. Its genome, which is composed of either DNA or RNA, is enclosed in a protein coat (capsid).

REASONS FOR STUDYING VIRUSES

- Ubiquitous Presence
- Human Diseases Causation
- Infect all Living things
- Potential Cross-species Transmission
- Can be Beneficial
- Unique Tools for Biology

DISCOVERY

1886	Adolph Mayer	Described light and dark green patterns on tobacco leaves infected with mosaic virus.
1892	Dmitri Ivanovsky	Tobacco mosaic disease (ssRNA Plant Virus) transmitted through porcelain Pasteur-Chamberland filters, excluding bacteria.
1898	Martinus Beijerinck	Replicates Dmitri Ivanovsky's filtration experiments and identified a "virus" responsible for tobacco mosaic disease. a “virus” (Latin for Poison), which he describes as a “contagium vivum fluidum” or “contagious living fluid”. Beijerinck and Ivanovsky are considered to be founders of virology.

DISCOVERY (cont)

1935	Wendell Stanley	Produces the first crystals of tobacco mosaic virus and shows that the virus remains active after crystalli-zation. Crystallization of the virus was the first step toward proving that the virus is particulate.

VIRUSES: LIVING OR NON-LIVING?

The debate on viruses' living or nonliving status depends on definition of life.

Living characteristics..

Possess genetic material.

Ability to replicate.

Undergo evolution.

Adapt to hosts.

Engage in biotic interactions.

Occupy ecological niches.

Non-living characteristics..

Lack of metabolism

Requires host cell to replicate.

Exists in an inactive state (Outside of the host cell)

Inability to divide.

Absence of cell organelles

DEFINITIVE FEATURES OF VIRUSES

Smaller than Bacteria

Non-Cellular Infectious Entities

Obligate Intracellular Parasites

Single type of nucleic acid genomes (DNA /or RNA)

Nucleic Acid Genomes Shielded by Protein coat called "Capsids"

VIRUS STRUCTURE

All particles have

✔ Genome (Nucleic acids either DNA or RNA)

✔ Protein Coat (Capsid)

✔ Enzymes

Some particles have

✔ Envelope (Lipid bilayer)

✔ Envelope proteins

COMPONENTS OF VIRUS

1. Nucleic Acid Core	✔ DNA or RNA (not both!) ✔ RNA viruses are either positive (+) sense or negative (-) sense. Positive sense RNA can function directly as mRNA ✔Single stranded vs. double stranded ✔Linear vs. circular ✔Continuous vs. segmented	☐ **Functions:** Contains hereditary information Codes for ✔ synthesis of structural proteins (capsid) ✔non-struc-tural proteins (enzymes necessary for the replication of the genome) ✔ Genome replicates itself within a living system to pass on genetic information to the viral progeny.

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COMPONENTS OF VIRUS (cont)

2. Capsid /Shell	✔ Consists of protein subunits, **capsomeres**	☐ **Functions:** Contains hereditary information Codes for ✔ synthesis of structural proteins (capsid) ✔ non-structural proteins (enzymes necessary for the replication of the genome) ✔ Genome replicates itself within a living system to pass on genetic information to the viral progeny.

COMPONENTS OF VIRUS (cont)

3. Envelopes / Membranes	✔ Enveloped vs. naked viruses . ✔ Lipid bilayer Acquired from host cell when budding through plasma membrane (paramyxoviruses), golgi apparatus and endoplasmic reticulum (hepatitis B) or nuclear membrane (herpes simplex virus) ✔ Damaged by detergents, alcohols, etc.	
4. Spikes/Envelope Proteins	✔ Situated in the envelope of enveloped viruses	☐ **Functions:** ✔ attachment to host-cell receptor for viral entry ✔ Major antigenic determinant(s) of virion. ✔ Host immune responses directed towards these 'spikes'.

COMPONENTS OF VIRUS (cont)

5. Enzymes	✔ Many Viruses package their own enzymes needed for replication

SHAPES OF VIRUS

Helical	Capsid consists of a ribbonlike protein that forms a spiral around the nucleic acid.	*Tobacco Mosaic Virus*
Polyhedral	Polyhedral (many-sided) capsid shapes is the icosahedron; icosahedral viruses have 20 triangular faces.	*Adenovirus*
Complex	A combination of helical and icosahedral shapes,	*Bacteriophages*

TYPES OF VIRUSES

☐ Based on Genetic material
✔ **RNA Virus**: Contain RNA (Tobacco mosaic virus)
✔ **DNA Virus**: Contain DNA (T-Phage)

IMPACTS OF VIRUSES

Negative	Viruses have caused extensive disease and suffering for Humans Domesticated plants and animals

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IMPACTS OF VIRUSES (cont)

Positive

✔ Viruses are so important in terms of recycling.

☐ **Phage Therapy**

✔ Prevention & treatment of Human infectious disease

✔ Prevention & tratment of animal infectious diseases

✔ Control of bacterial plant diseases

✔ Sanitizing & disinfection of Food

☐ **Oncolytic viruses**: are ones that selectively infect and destroy cancer cells, are also increasingly being explored as a less toxic and more efficient cancer treatment.

IMPORTANT TERMS

Capsid	The protein coat that encloses the nucleic acid of a virus.
Capsomere	Small, protein subunits that make up the protein coat (capsid).
Prion	A protein-based infectious particle that causes disease.
Virion	A complete virus, with all the components needed for host cell infection.
Envelope	A lipid bilayer and associated protein forming the outer component of an enveloped virion.
Naked Virus	A virus that does not have an envelope.
Nucleo-capsid	The virus genome enclosed in a protein capsid.

IMPORTANT TERMS (cont)

Bacter-iophage (phage)	A type of virus that infects bacteria.
Endemic	A disease that is constantly present or commonly present in a geographical area.
Epidemic	A rapid increase in the number of cases of a disease that spreads over a larger geographical area.
Pandemic	A disease outbreak throughout the world.

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