VIRUSES

Small in size, Big in impact!

1. General Characteristics

- Acellular (non-cellular) infectious agents.
- Ultramicroscopic: visible only under electron microscope.
- Obligate intracellular parasites: can replicate only inside living cells.
- Host specific.
- Contain either DNA or RNA, never both.
- Lack cytoplasm, ribosomes and cell organelles.
- No independent metabolism.
- Inert outside the host cell.
- Can be crystallized.
- Show both living and non-living characters.

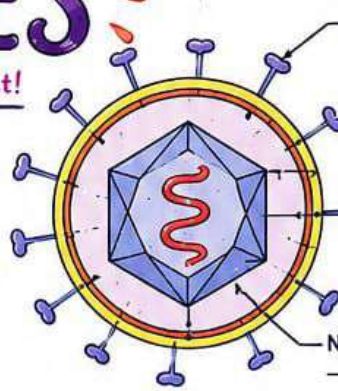
Living Characters

- ✓ Can replicate inside host cells.
- ✓ Can show mutation and variation.

Non-Living Characters

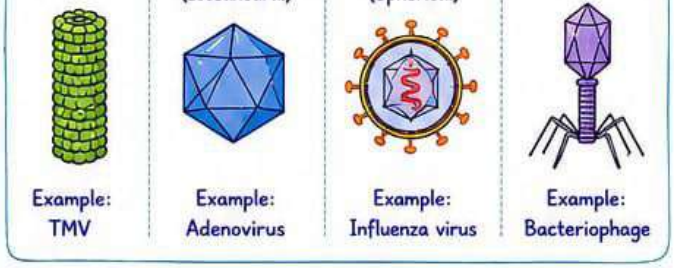
- × Inert outside host cell.
- × Can be crystallized.
- × No metabolism.
- × Do not grow.

2. Structure & Forms



Core components: Nucleic acid + Capsid
(Envelope & spikes may be present in some viruses)

Shapes of Viruses



3. Types of Viruses & Diseases Caused

A. Based on Host

1. Plant Viruses (Affect plants)

- Tobacco Mosaic Virus (TMV) → Tobacco mosaic disease
- Cucumber Mosaic Virus (CMV) → Mosaic disease in many plants
- Others: Citrus tristeza virus, Potato virus etc.

2. Animal Viruses (Affect animals)

- Foot and Mouth Disease Virus (FMD) → FMD in cattle, sheep, goat
- Rabies Virus → Rabies in dogs, other animals
- Avian Influenza Virus → Bird flu

3. Human Viruses (Affect humans)

- Influenza Virus → Flu
- HIV → AIDS
- Dengue Virus → Dengue fever
- Hepatitis Virus → Hepatitis
- Poliovirus → Polio
- Measles Virus → Measles
- Varicella Zoster Virus → Chickenpox
- SARS-CoV-2 → COVID-19

B. Based on Nucleic Acid

1. DNA Viruses

Double stranded or single stranded DNA.

Examples:
- Adenovirus
- Herpesvirus
- Poxvirus
- Papillomavirus

2. RNA Viruses

Single stranded RNA (+) sense or (−) sense.

Examples:
- TMV
- Influenza virus
- HIV
- Dengue virus
- Poliovirus
- Coronavirus

C. Based on Shape

- Helical (e.g., TMV)
- Polyhedral (Icosahedral) (e.g., Adenovirus)
- Enveloped (Spherical) (e.g., Influenza virus)
- Complex (e.g., Bacteriophage)

All viruses are obligate intracellular parasites. They use the host cell machinery to multiply.

Bacteriophages (Phages)

Viruses that infect bacteria.

Have a head, tail and tail fibres.

Used in research and phage therapy.

4. Economic Importance of Viruses

A. Beneficial Importance

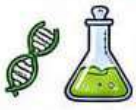
1. Vaccines

Many vaccines are prepared using weakened or inactivated viruses. (e.g., Polio, Measles, Hepatitis B, COVID-19 vaccines)

2. Phage therapy

Bacteriophages are used to treat bacterial infections.

3. Biotechnology



Viruses are used as vectors in genetic engineering, gene therapy, and cloning.

4. Biological control in agriculture

Some viruses control insect pests and weeds naturally.

5. Research

Viruses are used in scientific research, molecular biology and medicine.

B. Harmful Importance

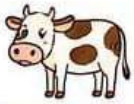
1. Human diseases

Cause many serious diseases like Influenza, AIDS, Dengue, Polio, Measles, COVID-19 etc.

2. Crop diseases

Cause heavy losses in crops, e.g., TMV in tobacco, mosaic in potato, CMV in vegetables.

3. Livestock losses



Diseases like FMD, Rabies, Avian influenza cause illness and death in animals.

4. Food spoilage & economic loss

Some viruses spoil fruits, vegetables and other food materials leading to economic loss.

Memory Trick

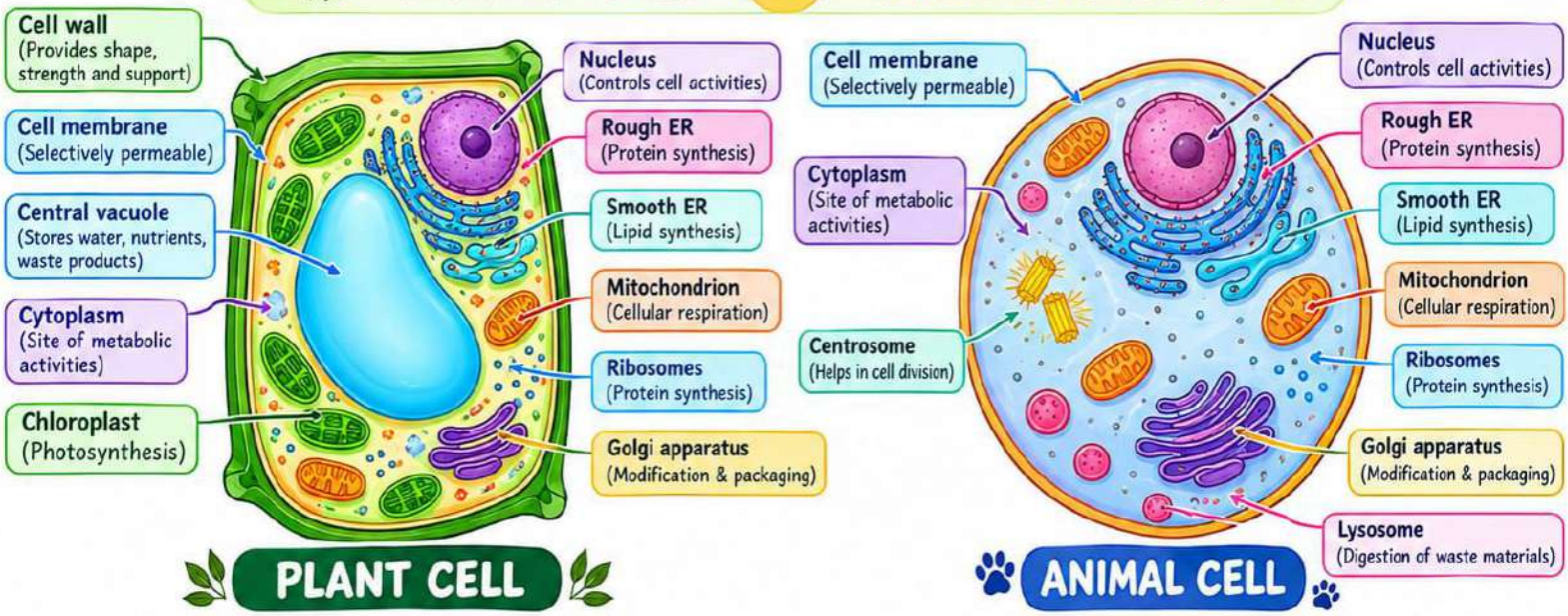
V I R U S

V	I	R	U	S
Very tiny	Intracellular parasite	Replicates only in host	Uses DNA or RNA	Surrounded by capsid

Key Fact Viruses are tiny but have a BIG impact on health, agriculture, industry and economy.

Written and developed by Prof. Maya

Plant Cell vs Animal Cell



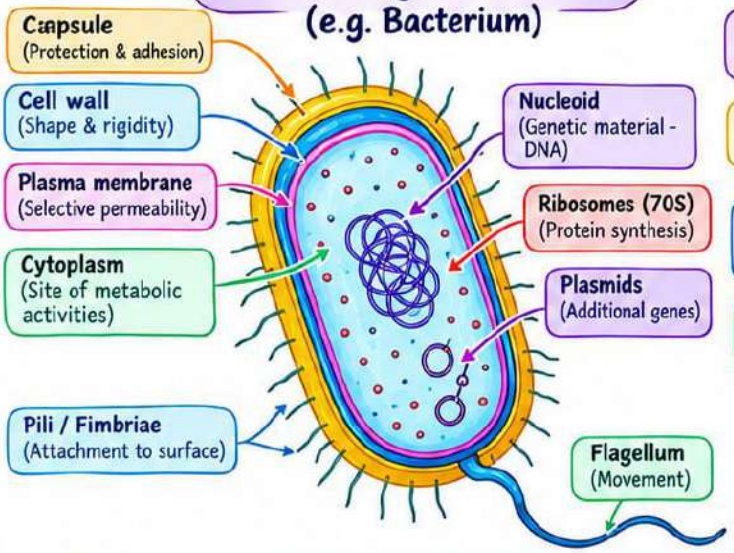
MAJOR DIFFERENCES BETWEEN PLANT CELL AND ANIMAL CELL

Feature	Plant Cell	Animal Cell
Cell wall	Present (cellulose)	Absent
Cell membrane	Present (inside cell wall)	Present (outer boundary)
Shape	Fixed, rectangular / angular	Variable, round / irregular
Central vacuole	One large central vacuole	Small and temporary (many)
Chloroplast	Present	Absent
Centrosome	Absent (in higher plants)	Present (with centrioles)
Lysosome	Rare (lytic vacuole performs similar function)	Present and numerous
Storage food	Starch	Glycogen
Mode of nutrition	Autotrophic (photosynthesis)	Heterotrophic
Ribosomes	Present (free and bound)	Present (free and bound)
Mitochondria	Present	Present
Golgi apparatus	Present (less prominent)	Present (well developed)

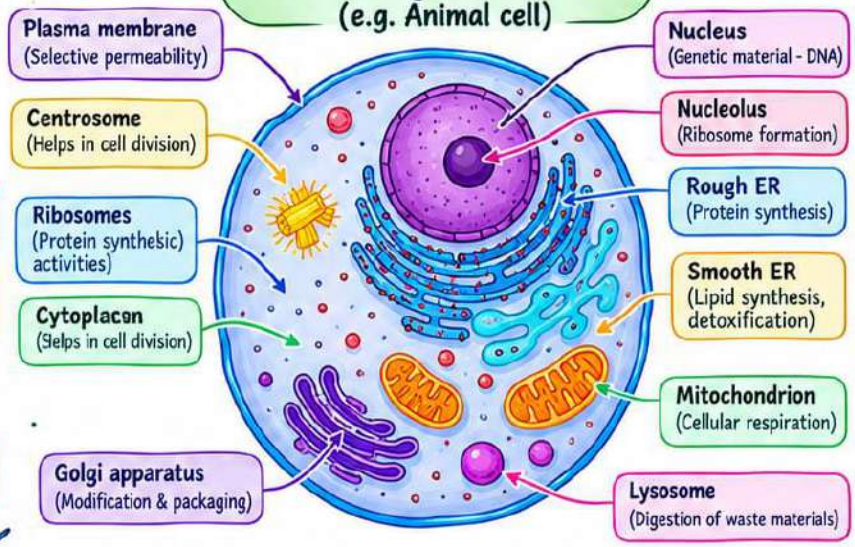
Developed by Prof. Maya

Prokaryotic vs Eukaryotic Cell

Prokaryotic Cell
(e.g. Bacterium)



Eukaryotic Cell
(e.g. Animal cell)



Major Differences Between Prokaryotic and Eukaryotic Cells

Feature	Prokaryotic Cell	Eukaryotic Cell
Size	Smaller (1–10 µm)	Larger (10–100 µm)
Nucleus	Absent (nucleoid region)	Present (well-defined nucleus)
Membrane-bound organelles	Absent	Present (mitochondria, ER, Golgi, lysosomes, etc.)
Genetic material	Single, circular DNA (nucleoid)	Multiple, linear chromosomes (in nucleus)
Ribosomes	70S (smaller)	80S (larger)
Cell wall	Present (peptidoglycan)	Absent in animals (present in plants – cellulose)
Plasma membrane	Present	Present
Cytoskeleton	Absent (rudimentary)	Present (well developed)
Mode of reproduction	Binary fission	Mitosis and meiosis
Examples	Bacteria, Archaea	Protists, Fungi, Plants, Animals

Developed by Prof. Maya

Evolution of Kingdom Classification

From Two Kingdoms to Six Kingdoms – A Journey of Understanding Life

2 Kingdoms
Carl Linnaeus (1735/1758)

- Based on external morphology and mode of nutrition.
- Considered plants and animals as the two main groups.

Plantae (Plants)

Animalia (Animals)

3 Kingdoms
Ernst Haeckel (1866)

- Introduced **Protista** for unicellular organisms (mainly algae and protozoa).
- Recognized greater diversity in living world.

Plantae

Animalia

Protista

4 Kingdoms
Herbert F. Copeland (1938)

- Separated Monera (prokaryotes) from Protista.
- Based on cell structure, level of organization and reproduction.

Monera

Protista

Plantae

Animalia

5 Kingdoms
Robert H. Whittaker (1969)

- Separated **Fungi** as a distinct kingdom.
- Based on cell type, body organization and mode of nutrition.

Monera

Protista

Fungi

Plantae

Animalia

6 Kingdoms
Carl Woese (1977)

- Based on rRNA and molecular evidence.
- Recognized **Archaebacteria** as a separate kingdom (extremophiles).

Archaebacteria

Eubacteria

Protista

Fungi

Plantae

Animalia

Comparison of the Kingdom Classification Systems

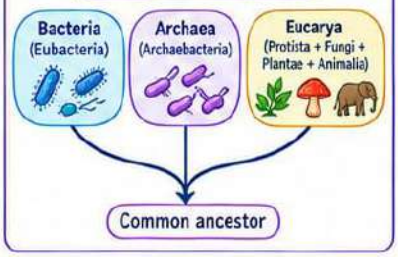
Criteria	2 Kingdoms (Linnaeus)	3 Kingdoms (Haeckel)	4 Kingdoms (Copeland)	5 Kingdoms (Whittaker)	6 Kingdoms (Woese)
No. of Kingdoms	2	3	4	5	6
Cell type	Eukaryotic (only)	Eukaryotic (only)	Prokaryotic + Eukaryotic	Prokaryotic + Eukaryotic	Prokaryotic + Eukaryotic (Archaea distinct)
Level of organization	Multicellular (Plants and Animals)	Mostly multicellular (Plants & Animals) + unicellular (Protista)	Both unicellular and multicellular	Both unicellular and multicellular	Both unicellular and multicellular (with molecular basis)
Mode of nutrition	Autotrophic (Plants), Heterotrophic (Animals)	Autotrophic, Heterotrophic (Protista included)	Autotrophic & Heterotrophic (Monera included)	Autotrophic & Heterotrophic (Fungi included)	Autotrophic & Heterotrophic (Archaea & Bacteria separately)
Major innovation	Basic grouping (plants vs animals)	Recognition of Protista (unicellular life)	Separation of Monera (prokaryotes)	Recognition of Fungi (as a separate kingdom)	Molecular evidence (rRNA) and inclusion of Archaebacteria

Important Note

Woese & Fox (1977) identified three primary evolutionary lineages:

- **Bacteria** (Eubacteria)
- **Archaea** (Archaebacteria)
- **Eucarya** (all eukaryotes – Protista, Fungi, Plantae, Animalia)

Three-domain system



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