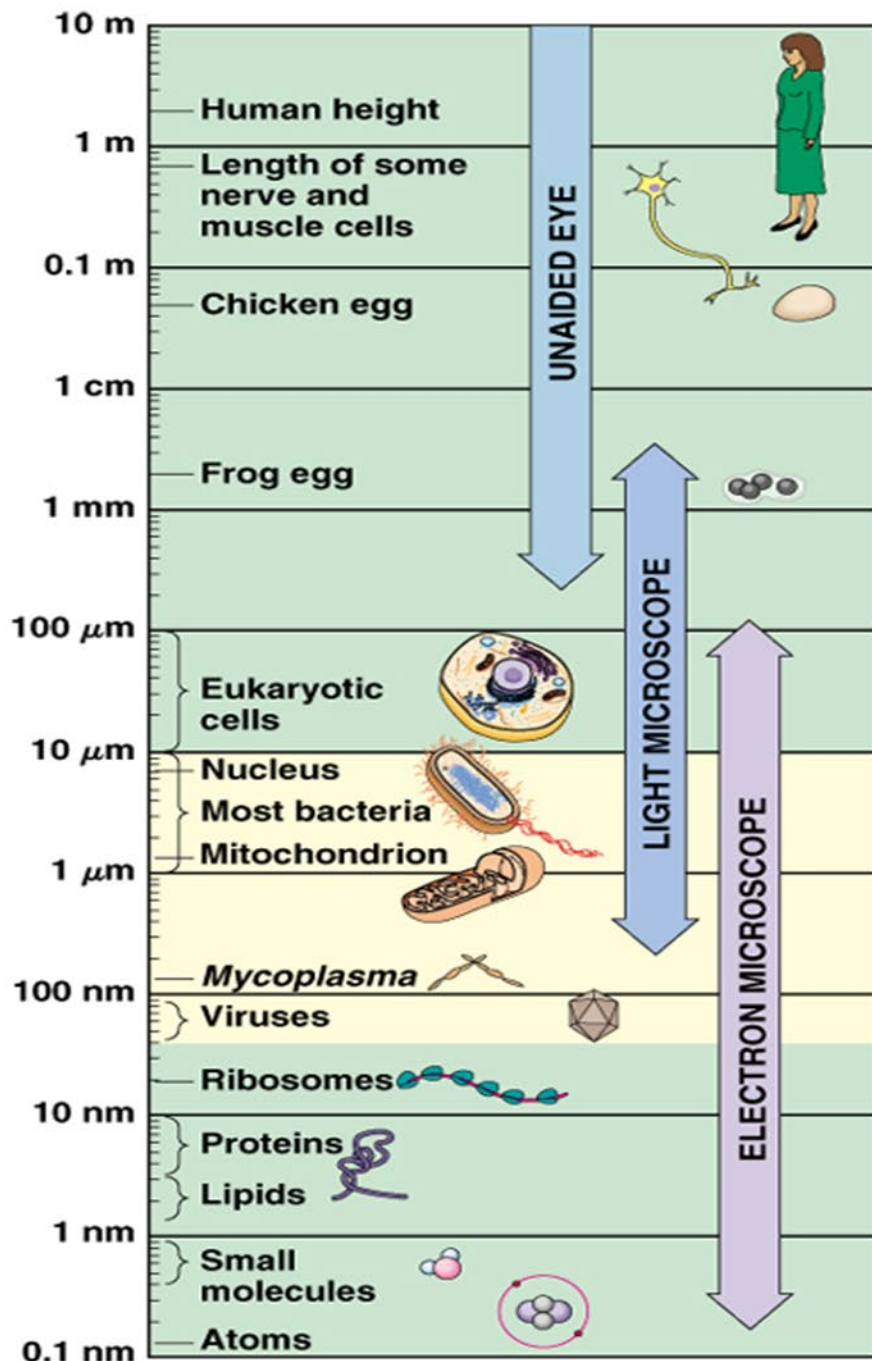


MSc III Sem – Life Sciences

Course – Virology

Introduction to Viruses and Basic Structure



UNITS OF MEASUREMENT

$$1\text{m} = 10^3 \text{ mm (millimetres)}$$

$$1\text{m} = 10^6 \mu\text{m (micrometres)}$$

$$1\text{m} = 10^9 \text{ nm (nanometres)}$$

Sometimes Angstroms (Å) are used **(the diameter of a hydrogen atom)**

$$1\text{m} = 10^{10} \text{ Å}$$

Dalton (Da): for proteins
molecular weight
kDa: kilodalton

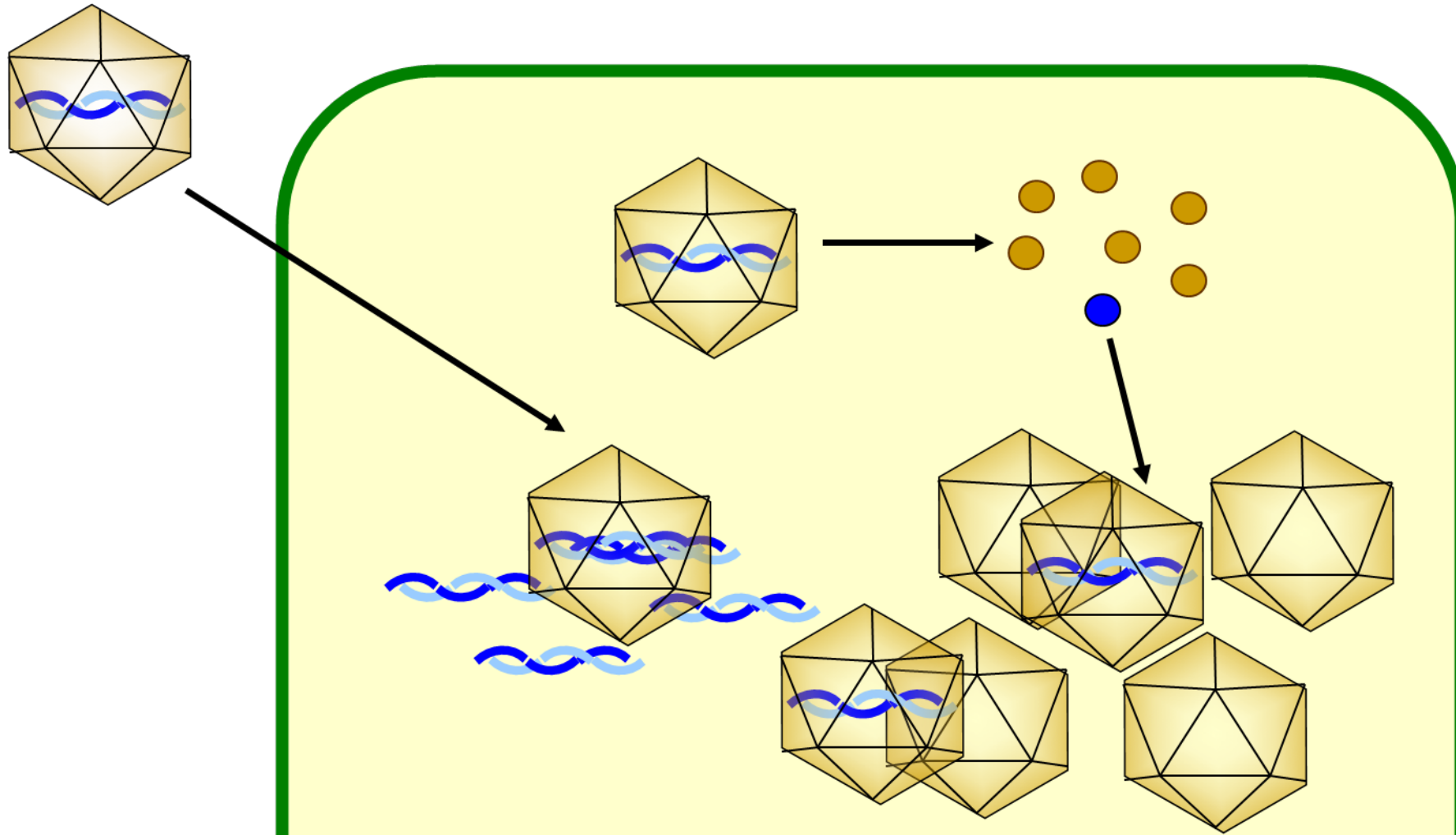
Viruses: basic

- Most virologists consider them non-living, as they do not meet all the criteria of the generally accepted definition of life.
- They are similar to obligate intracellular parasites as they lack the means for self-reproduction outside a host cell, but unlike parasites, viruses are generally not considered to be true living organisms.
- A definitive answer is still elusive because some organisms considered to be living exhibit characteristics of both living and non-living particles, as viruses do.
- For those who consider viruses living, viruses are an exception to the cell theory as viruses are not made up of cells.
- The word virus comes from the Latin, poison (syn. venenum).
- The study of viruses is known as virology, and those who study viruses are known as virologists.

Viruses: basic

- A virus is a microscopic “particle” that can infect the cells of a biological organism.
- Viruses can only replicate themselves by infecting a host cell and therefore cannot reproduce on their own.
- At the most basic level, viruses consist of genetic material contained within a protective protein coat called a capsid. They infect a wide variety of organisms: both eukaryotes and prokaryotes.
- A virus that infects bacteria is known as a bacteriophage, often shortened to phage.

Viruses: definition

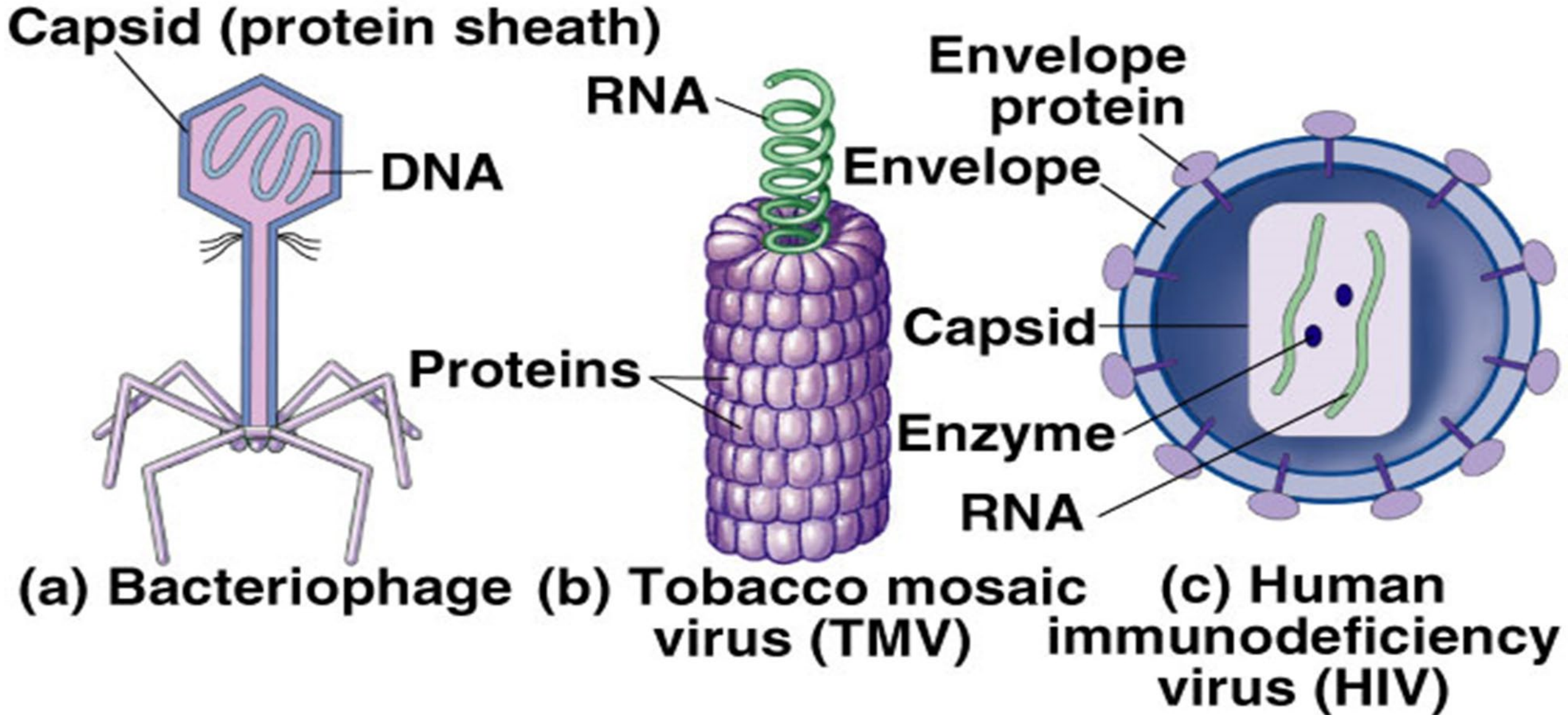


Obligate intracellular parasites

Viruses: nature and structure

- Viral structure - core of nucleic acid surrounded by protein
 - classified by nature of genomes
 - Either DNA or RNA
 - RNA-based viruses – retroviruses (more later)
 - Lack ribosomes and necessary enzymes for protein synthesis
 - nearly all form a protein sheath or capsid around their nucleic acid core
 - Many animal viruses form an envelope around the capsid.
- Host range - suitable cells for a virus

Viruses: basic structure



Viruses: basic structure

- helical - rodlike
- isometric - spiral
 - Icosahedron structure with 20 equilateral triangular facets
 - most efficient symmetrical arrangement that linear subunits can form a shell with maximum internal capacity
 - basic design of geodesic dome →



Viruses: types

- **DNA Viruses**

- [Adenoviruses](#)

- [Iridoviruses](#)

- [Herpesviruses](#)

- [Papovaviruses](#)

- [Parvoviruses](#)

- [Poxviruses](#)

- [Viral Hepatitis](#)

- ["Arboviruses"](#) Arenaviruses, Bunyaviruses, Flaviviruses, Togaviruses

- [Diarrhoea Viruses](#) Astroviruses, Caliciviruses, Reoviruses (inc. Rotaviruses)

- **RNA Viruses**

- [Coronaviruses](#)

- [Filoviruses](#)

- [Orthomyxoviruses](#)

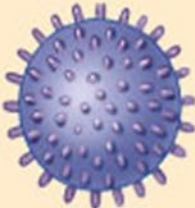

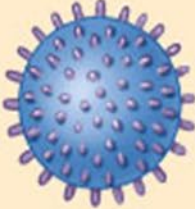
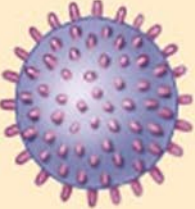
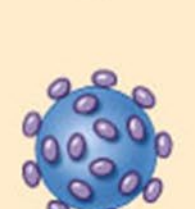

- [Paramyxoviruses](#)

- [Picornaviruses](#)





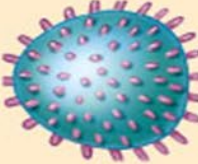
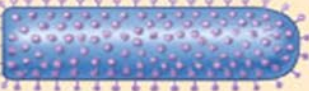
- [Retroviruses](#)

- [Rhabdoviruses](#)

Important Human Viral Diseases

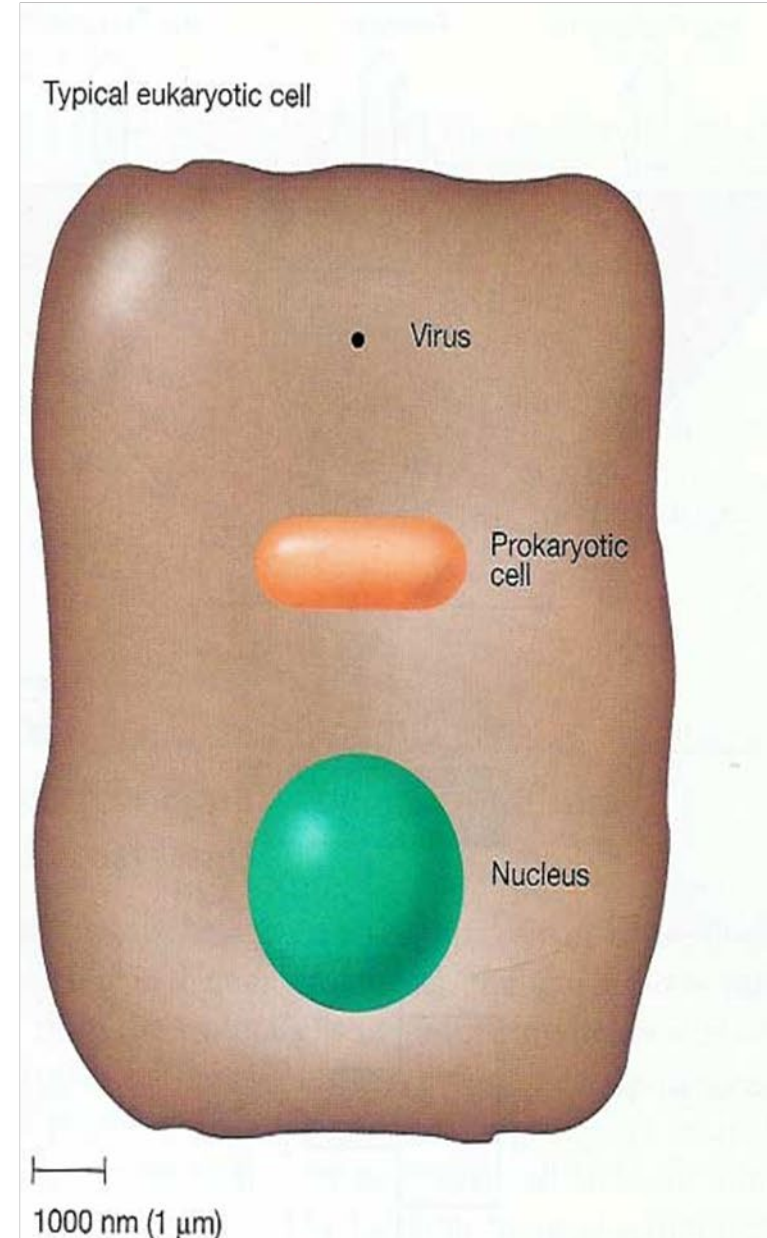
Disease	Pathogen		Genome	Vector/Epidemiology
Chicken pox	Varicella zoster		Double-stranded DNA	Spread through contact with infected individuals. No cure. Rarely fatal. Vaccine approved in U.S. in early 1995.
Hepatitis B (viral)	Hepadnavirus		Double-stranded DNA	Highly infectious through contact with infected body fluids. Approximately 1% of U.S. population infected. Vaccine available. No cure. Can be fatal.
Herpes	Herpes simplex virus		Double-stranded DNA	Fever blisters; spread primarily through contact with infected saliva. Very prevalent worldwide. No cure. Exhibits latency—the disease can be dormant for several years.
Mononucleosis	Epstein-Barr virus		Double-stranded DNA	Spread through contact with infected saliva. May last several weeks; common in young adults. No cure. Rarely fatal.
Smallpox	Variola virus		Double-stranded DNA	Historically a major killer; the last recorded case of smallpox was in 1977. A worldwide vaccination campaign wiped out the disease completely.
AIDS	HIV		(+) Single-stranded RNA (two segments)	Destroys immune defenses, resulting in death by infection or cancer. Over 42 million cases worldwide by 2002.

Important Human Viral Diseases

Disease	Pathogen	Genome	Vector/Epidemiology
Polio	Enterovirus 	(+) Single-stranded RNA	Acute viral infection of the CNS that can lead to paralysis and is often fatal. Prior to the development of Salk's vaccine in 1954, 60,000 people a year contracted the disease in the U.S. alone.
Yellow fever	Flavivirus 	(+) Single-stranded RNA	Spread from individual to individual by mosquito bites; a notable cause of death during the construction of the Panama Canal. If untreated, this disease has a peak mortality rate of 60%.
Ebola	Filoviruses 	(-) Single-stranded RNA	Acute hemorrhagic fever; virus attacks connective tissue, leading to massive hemorrhaging and death. Peak mortality is 50–90% if untreated. Outbreaks confined to local regions of central Africa.
Influenza	Influenza viruses 	(-) Single-stranded RNA	Historically a major killer (22 million died in 18 months in 1918–19); wild Asian ducks, chickens, and pigs are major reservoirs. The ducks are not affected by the flu virus, which shuffles its antigen genes while multiplying within them, leading to new flu strains.
Measles	Paramyxoviruses	(-) Single-stranded RNA	Extremely contagious through contact with infected individuals. Vaccine available. Usually contracted in childhood, when it is not serious; more dangerous to adults.
SARS	Coronavirus 	(-) Single-stranded RNA	Acute respiratory infection; an emerging disease, can be fatal, especially in the elderly.
Pneumonia	Influenza virus	(-) Single-stranded RNA	Acute infection of the lungs; often fatal without treatment.
Rabies	Rhabdovirus 	(-) Single-stranded RNA	An acute viral encephalomyelitis transmitted by the bite of an infected animal. Fatal if untreated.

Viruses: size and function comparison

- Outside a host cell, inert, no enzyme or other activity
- Inside a host cell – viral Nucleic Acid (DNA or RNA) takes over the cell and directs the cell to produce new virus particles (replication)
- ***Size of Virus in comparison to others →***



What is a virus?



'Infectious particle'

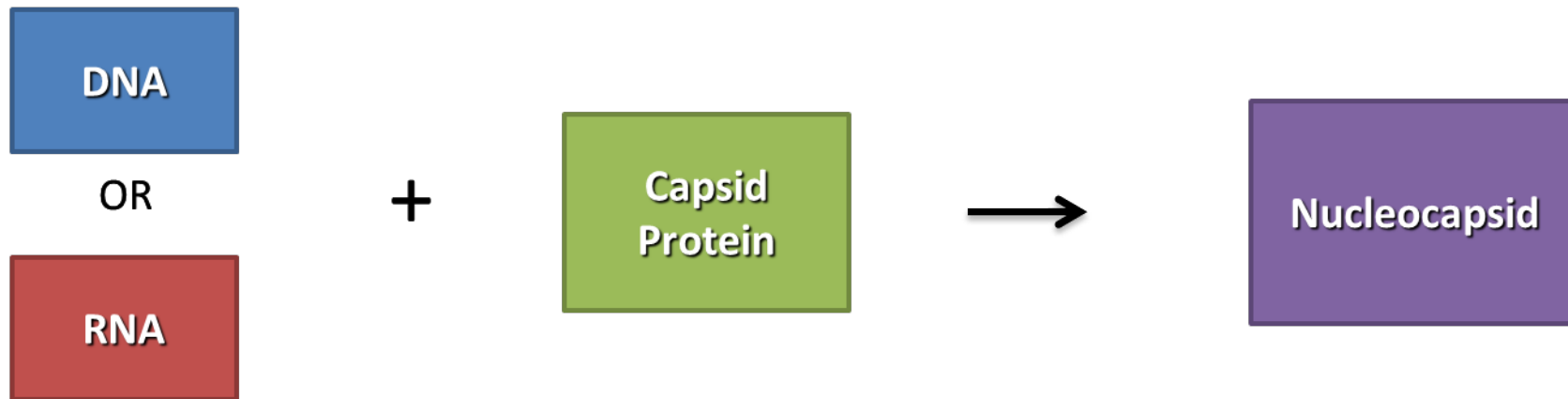
Genetic material

Protein coat

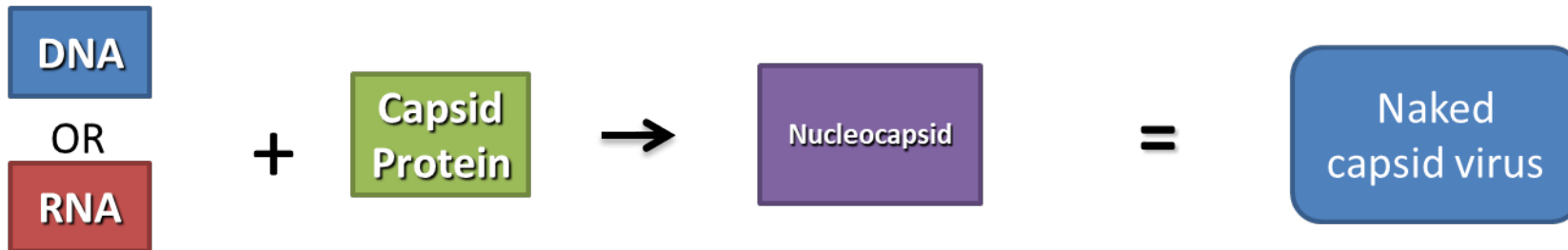
Properties of a virus

- A virus is a very small, infectious, obligate intracellular parasite
- Virus particles are **not** living
- Viruses are chemicals, and by themselves cannot reproduce
- A susceptible and permissive cellular host is needed for viruses to reproduce
- All viruses must make mRNA that can be translated by host ribosomes

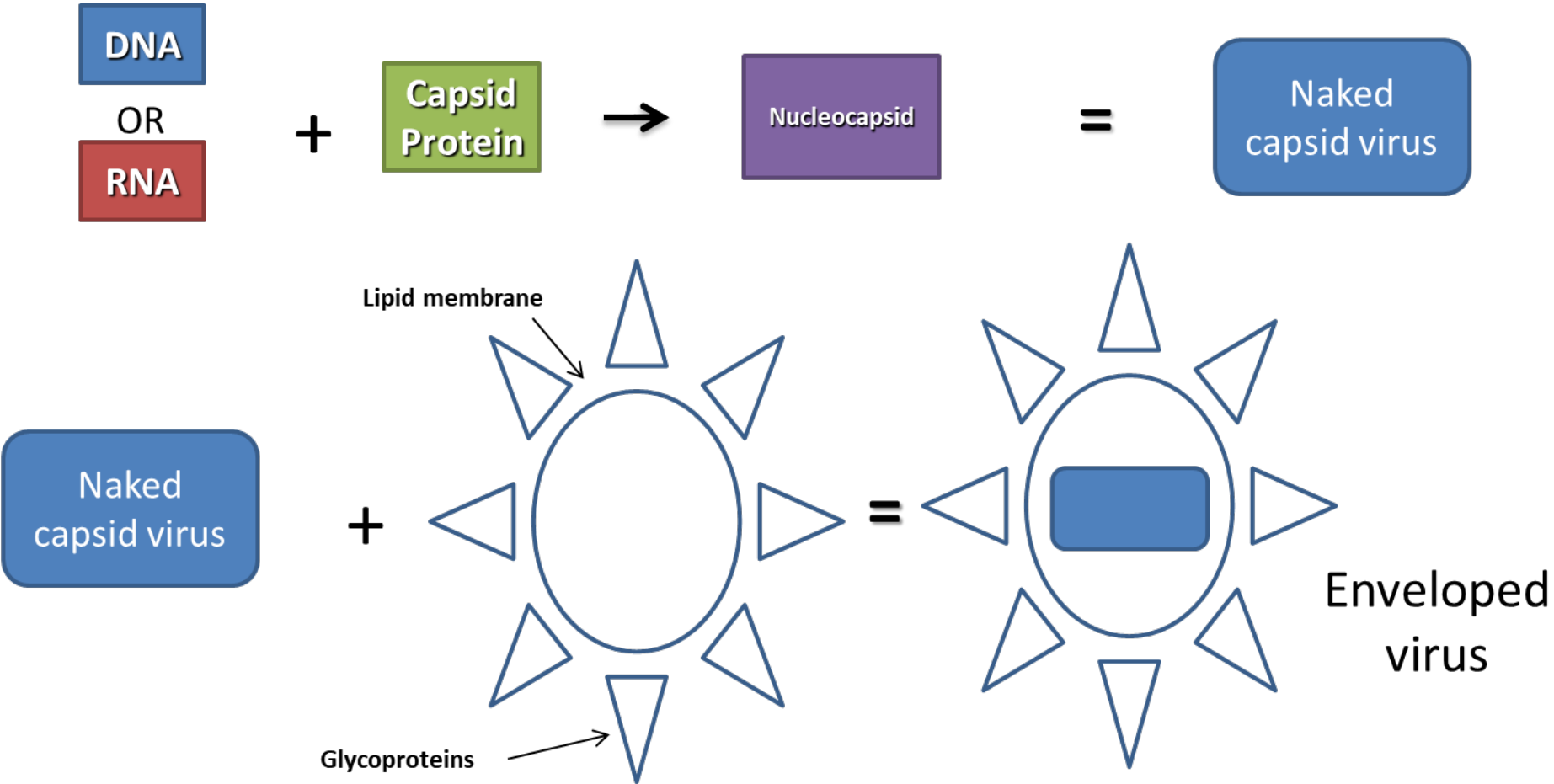
Basic virus structure



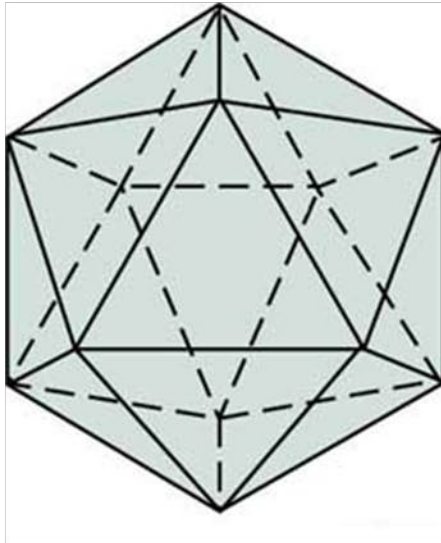
Basic virus structure



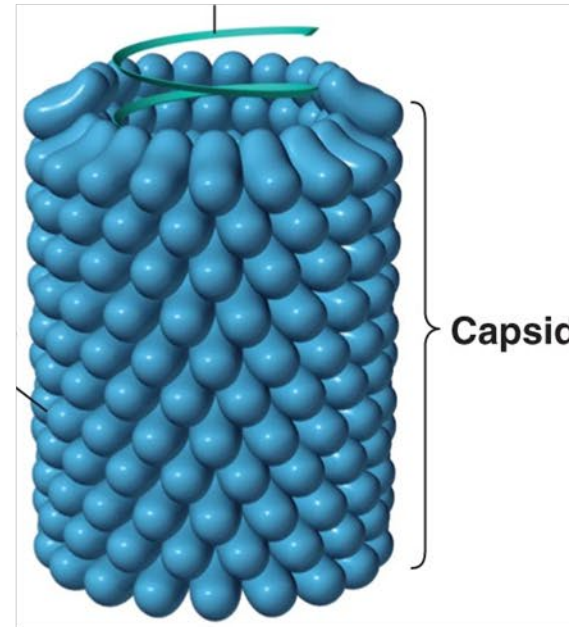
Basic virus structure



Capsid symmetry



Icosahedral



Helical

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