

Common diseases caused by protozoa

- Many types of protozoa are beneficial to the environment.
- They improve quality of water by eating bacteria and other particles.
- There are a few pathogenic protozoa.
 - A protozoan infection causes many of the most common and severe human diseases.

- The Sarcomastigophora and the Apicomplexa phyla contain the most important species causing human disease.
- Malaria, African trypanosomiasis, giardiasis, chagas disease (American trypanosomiasis), amoebiasis, leishmaniasis, toxoplasmosis, and cryptosporidiosis are some of the protozoal diseases.

Amoebiasis

Causative agent:	<i>Entamoeba histolytica</i>
Organs affected:	Intestine, liver
Transmission:	Ingestion of fecally contaminated food or water
Clinical features:	Amebic abscesses, intestinal cramps, and bloody diarrhea

Giardiasis

Causative agent:	<i>Giardia lamblia</i>
Organs affected:	Intestine
Transmission:	Ingestion of fecally contaminated food or water; personal contact
Clinical features:	Severe diarrhoea (greasy and foul-smelling) with poor absorption of nutrients

Trichomoniasis

Causative agent:	<i>Trichomonas vaginalis</i>
Organs affected:	Urogenital organs
Transmission:	Sexual contact
Clinical features:	pain, burning or itching in the penis, urethra, or vagina; vulvar erythema and edema; a yellow-green, itchy, frothy, foul-smelling vaginal discharge

African trypanosomiasis/sleeping sickness

Causative agent:	<i>Trypanosoma brucei</i>
Organs affected:	Blood, brain
Transmission:	The bite of an infected tsetse fly (Glossina)
Clinical features:	The initial hemolymphatic stage (fever, headaches, joint pains & itching) followed by the neurological stage (sleep disruption, confusion, lethargy, and convulsions).

Leishmaniasis (kala-azar)

Causative agent:	<i>Leishmania donovani</i>
Organs affected:	White blood cells, skin, intestine
Transmission:	The bite of sandfly of the genus <i>Phlebotomus</i>
Clinical features:	Skin ulcers, mucocutaneous complications and visceral diseases (hepatosplenomegaly)

Malaria

Causative agent:	<i>Plasmodium</i> spp.
Organs affected:	Liver, red blood cells
Transmission:	The bite of an infected female <i>Anopheles</i> mosquito.
Clinical features:	Fever, shivering, respiratory distress, muscle or joint pain, fatigue, headache, watery diarrhea, vomiting, convulsions, jaundice and severe anemia

Toxoplasmosis

Causative agent:	<i>Toxoplasma gondii</i>
Organs affected:	Blood, eye
Transmission:	eating undercooked meat, contact with cat feces
Clinical features:	Blindness and mental retardation (congenital toxoplasmosis); splenomegaly, polymyositis, dermatomyositis, chorioretinitis, myocarditis, pneumonitis, hepatitis, encephalitis, and multisystem organ failure in people with weakened immune systems

Viruses

- Viruses are submicroscopic obligate intracellular particles.
- Electron microscopy is the only technique that allows direct visualisation of viruses.
 - They are generally too small for a direct inspection by light microscopy.
- They are biological entities that do not have a cellular structure.

- They do not have a cellular machinery.
 - Viruses lack cell membrane, mitochondria, cell wall, chloroplasts, Golgi body, ER, ribosomes etc.
 - Viruses are unable to generate energy.
 - They multiply inside their host cell by using host's cellular machinery.
 - All viruses are obligate pathogens as they are dependent on the cellular machinery of their host.

Characteristics of Viruses

- They contain either an RNA or DNA genome surrounded by a protein coat.
- They cannot be grown in synthetic culture media.
 - Viral cultivation requires the presence of some form of host cell.
- They do not occur free in nature.

- Antibiotics do not work on viruses.
- They are metabolically inert and are nucleoprotein filterable agents.
- They are much smaller than bacteria, generally ranging in size from 20 to 450 nm.
- Viruses recognise and bind to target cells by the interaction of molecules on their surface with those on the target cell.

Structure of Viruses

- All viruses contain nucleic acid, either DNA or RNA (but not both), and a protein coat.
 - All viruses have a core that contains a DNA- or RNA-based genome.
 - The core is surrounded by a protective coat of proteins called the capsid.
 - In some viruses, the protein coat is covered by an envelope made of glycoprotein and phospholipid bilayer.

- The basic structural components of a virus are:

a. Core

- It is the genomic material (DNA or RNA).
- DNA or RNA may be single-stranded or double-stranded.

b. Capsid

- It is a protective coat of protein surrounding the core.

c. Nucleocapsid

- The combined structure formed by the core and capsid.

d. Envelope

- It is a lipoprotein layer around the capsid in some viruses (Enveloped viruses).
 - Influenza virus and HIV are enveloped viruses.
- It is derived from the cell surface membrane of the host cell.

e. Capsomers

- The capsomere is a subunit of the capsid or capsomeres self-assemble to form the capsid.

f. Enzymes

- Viruses encode a varying number of enzymes that are fundamental to their unique replication cycles.
- Viral enzymes play diverse roles including:
 - polynucleotide synthesis (transcription and replication),

- mRNA maturation and polypeptide processing,
 - cell wall/membrane breakdown, and
 - protein modifications to aid host immune evasion.
- Some bacteriophages make small hole in the bacterial cell using lysozyme.
- Some viruses use nucleic acid polymerases to transcribe the viral genome into an mRNA.
- All retroviruses contain reverse transcriptase to convert their RNA genome into dsDNA.

Viral Symmetry

- Symmetry refers to the way in which capsomere units are arranged in viral capsid.
- Most viruses have helical or icosahedral capsid structure, although a few have complex virion architecture.

1. Helical symmetry

- It results from a single type of capsomere stacked around a central axis to form a helical structure.

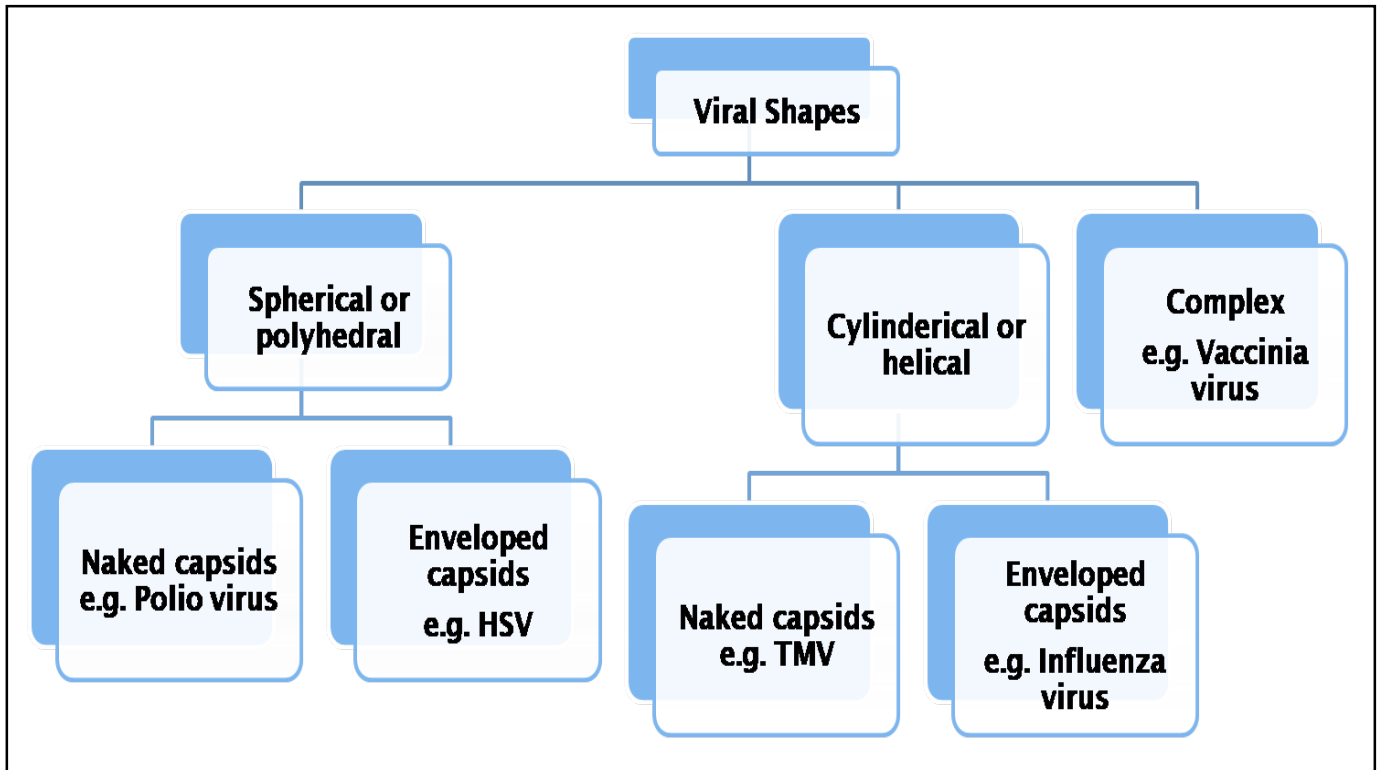
- Helical arrangement results in rod-shaped or filamentous virions.
- Virions with helical symmetry can be anything from short and very rigid, to long and very flexible.
- The well-studied tobacco mosaic virus (TMV) is an example of a helical virus.

2. Icosahedral symmetry

- An icosahedron is a polyhedron having 20 equilateral triangular faces and 12 vertices.
- It is by far more prevalent than the helical symmetry.
 - The capsids of nearly all spherical viruses adopt icosahedral symmetry.
- Papovavirus, Picornavirus, Adenovirus, Toga virus, etc. are examples.

3. Complex symmetry

- It is a capsid which is neither purely helical, nor purely icosahedral.
- The poxviruses are large, complex viruses that have an unusual morphology.



Classification of viruses

- There are currently over 2800 different viral species with very different properties!
- Viruses can be classified by nucleic acid type, mode of replication, and host organisms.

I. Based on the type and character of their genome

- a. DNA virus
- b. RNA virus
- c. Retrovirus

DNA viruses

1. Their genetic material is DNA.
2. They are mostly double-stranded.
3. Lower rate of mutation than RNA viruses.
4. They replicate in the nucleus.

RNA viruses

1. Their genetic material is RNA.
2. They are mostly single-stranded.
3. Higher rate of mutation than DNA viruses.
4. They replicate in the cytoplasm.

- Retroviruses are viruses that convert their genetic information from RNA into DNA after they have infected their host.

II. Based on the strategy of replication

- There are two strategies used by viruses to replicate: the **lytic cycle** and **lysogenic cycle**.
- Some viruses (e.g. Bacteriophages) reproduce using both strategies.

III. Based on their host type

- Viruses can be classified into three types:
 - a. **Animal viruses**
 - Viruses that infect animals.
 - b. **Plant viruses**
 - Viruses that infect plants.
 - c. **Bacteriophages**
 - Viruses that infect prokaryotes.

Viral Replication

- In general, viruses go through the following five steps in their reproduction cycle:
 1. **Adsorption:** The attachment of viruses to host cells.
 2. **Penetration:** The entry of virions or their genome into host cells.
 3. **Synthesis:** The formation of nucleic acids, proteins and other viral components.

- 4. Maturation:** The assembly of newly synthesized viral components into complete virions.
- 5. Release:** The departure of new virions from host cells. It may kill host cells.

Replication in bacteriophages

- The life cycle of bacteriophages tends to be either a lytic cycle or a lysogenic cycle.

A. The lytic life cycle of bacteriophages

- i. Adsorption:** The attachment sites on the bacteriophage adsorb to receptor sites on the host bacterium.
- ii. Penetration:** The bacteriophage injects its genome by drilling the bacterial wall

- iii. Replication:** The bacteriophage replicates its genome and uses the bacterium's metabolic machinery.
- iv. Maturation:** The phage parts assemble around the genomes.
- v. Release:** A bacteriophage lysozyme breaks down the bacterial peptidoglycan causing osmotic lysis and release of the intact bacteriophages.
- vi. Reinfection:** Upto 200 bacteriophages may be produced per infected bacterium.

B. The lysogenic life cycle of bacteriophages

- i. Adsorption:** Bacteriophage adsorbs to the host bacterium or lysogen and injects its genome.
- ii. Integration:** The bacteriophage inserts its DNA into the host bacterium's DNA.
 - At this stage, the virus is called a **prophage** and the phage DNA replicates as a part of the bacterium's DNA.

iii. Synthesis of proteins and nucleic acid:

Virus's DNA is replicated using the host cell's DNA.

iv. Virion assembly: Viral components (nucleic acid, capsid, viral enzymes, etc.) assemble to make new virions.

v. Release of virions: Phages displaying a lysogenic cycle do not kill the host and instead become long-term residents as prophages.

Lytic cycle

- The DNA of the virus doesn't integrate into the host DNA
- Host DNA hydrolyzed
- Absence of prophage stage
- DNA replication of the virus takes place independently from the host DNA replication

Lysogenic cycle

- The DNA of the virus integrates into the host DNA
- Host DNA not hydrolyzed
- Presence of prophage stage
- DNA replication of the virus takes place along with the host DNA replication

Lytic cycle

- Occurs within a short period of time
- Symptoms of viral replication are evident
- Genetic recombination in the host bacterium not allowed
- The cellular mechanism of the host cell is totally undertaken by the viral genome

Lysogenic cycle

- Takes time
- Symptoms of viral replication not evident
- Genetic recombination in the host bacterium allowed
- The cellular mechanism of the host cell is somewhat disturbed by the viral genome

Common viral diseases in Ethiopia

- Viral diseases are infections caused by viruses.
- Different types of viruses cause different infections.
- Ethiopia is endemic for many viral diseases.
- Examples of viral diseases include common cold, mumps, measles, rabies, polio and chickenpox.

Mumps

Causative agent	Mumps virus
Signs & symptoms	Swollen and painful parotid glands; pain during chewing and swallowing
Transmission	Person to person in infected saliva
Prevention & control	Vaccine

Measles (rubeola)

Causative agent	Measles virus
Signs & symptoms	Cough, nasal discharge, eye redness, and high fever
Transmission	Droplet contact
Prevention & control	Vaccine

Rabies

Causative agent	Rabies virus
Signs & symptoms	Tingling, burning, coldness at bite site, fever, headache, increased muscle tension, paralysis and hydrophobia
Transmission	Bite from rabid animals
Prevention & control	Avoiding rabid animals; washing bitten area thoroughly; pre-exposure vaccination when needed

Polio

Causative agent	Polio virus
Signs & symptoms	Often no sign and symptoms
Transmission	Fecal-oral route
Prevention & control	Polio vaccine, good personal hygiene

Common cold (rhinitis)

Causative agent	Rhinoviruses, Adenoviruses and other viruses
Signs & symptoms	Sneezing, sore throat, runny and stuffy nose, hacking cough
Transmission	Respiratory droplets
Prevention & control	Practicing good hygiene

Chickenpox (Varicella)

Causative agent	Varicella-zoster virus (VZV)
Signs & symptoms	Fever, headache, malaise with red, itchy rash on face, scalp, chest, and back
Transmission	Droplet contact
Prevention & control	Chickenpox vaccine