Viruses

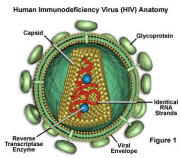
How Do Viruses Differ From Living Organisms?

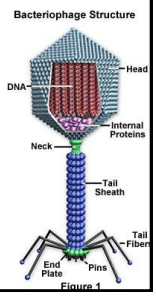
Viruses **are not living organisms** because they are incapable of carrying out all life processes.

Viruses
- **are not made of cells**
- **can not reproduce on their own**
- **do not grow or undergo division**
- **do not transform energy**
- **lack machinery for protein synthesis**

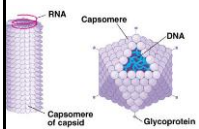
What Are Viruses Made Of?

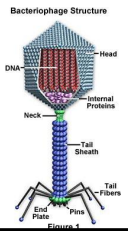
- **Nucleic Acid**
  - **DNA or RNA**
  - **But not both**
- **Capsid – a protein coat surrounding the nucleic acid.**
- **Envelope- membrane like structure outside the capsid in some viruses**
  - **Examples:**
    - **Influenza**
    - **Chickenpox**
    - **Herpes-simplex**
    - **HIV**





Viral Shapes





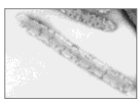
- **The shape of the virus is determined by either its capsid or its nucleic acid.**
- **Icosahedron has 20 triangular faces**
  - **ex: herpes simplex, chicken pox and polio**
- **Helix is a spiral shape (like DNA)**
  - **ex: rabies, measles and tobacco mosaic virus**
- **Complex is a combination of two other shapes**
  - **ex: bacteriophages**

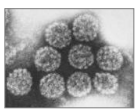
How Are Viruses Classified?

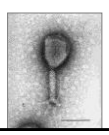
Genetic material
- DNA viruses contain DNA as their genetic material.
- RNA viruses contain RNA as their genetic material.

Capsid structure
- Helical (rod-shaped)
- Polyhedral
- Complex

Presence or absence of a membranous envelope surrounding the capsid







Two Types of Viruses

DNA

Replicated in one of two ways
- **Directly produce RNA that make new viral proteins**
- **Join with the host cell's DNA to produce new viral proteins**

RNA

- **Viral RNA is released into the host cell's cytoplasm and uses the ribosomes to produce new viral proteins**
- **Known as retroviruses containing an enzyme called reverse transcriptase.**
- **These use the RNA as a template to make DNA. This DNA is integrated into the host cell's DNA.**

What Organisms and Host Cells Do Viruses Infect?

Infection by viruses

- viruses infect bacteria, plants, animals and other living organisms in order to reproduce
- a given virus usually infects a limited number of species. within a host organism, usually only a limited number of cell types are susceptible to infection by a given virus

Host range

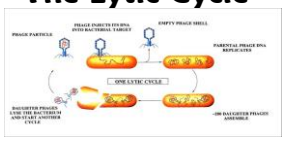
- array of host cells that a particular virus can infect
- determined by a "lock-and-key" fit between the virus and a receptor on the surface of a host cell

How Do Viruses Reproduce?

Viruses reproduce via three basic steps.

1. Viruses deliver their genomes into a host cell.
2. Viruses commandeer the host cell transcription and translation machineries and utilize host cell building blocks to copy viral genomes and synthesize viral proteins.
3. Viral genomes and proteins are self-assembled and exit host cells as new infectious particles.

The Lytic Cycle



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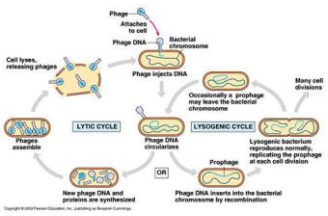
The basic steps of the cycle are:

1. The virus attaches to the cell and injects its DNA leaving its capsid on the outer surface of the cell.
2. Phage DNA is injected into the host cell where the ends attach and form a circle.
3. The phage DNA takes control of the host's protein synthesis and copies the viral genome, replicating the viral DNA
4. The head proteins bind to the newly made genomes, bind the tails, and assemble tail fibers.
5. Finally lysozyme (phage enzyme) digests the bacterial cell wall and release the newly formed viruses.

The Lysogenic Cycle

- While the lytic cycle directly bursts the host cell, the lysogenic cycle is a bit more sneaky.
- It will allow a virus to hide in its host cell for days, months, or years.
- Viruses that replicate by the lysogenic cycle are called **temperate viruses.**



animation

The basic steps of the lysogenic cycle are:

1. The virus enters the bacteria the same as in virulent phages.
2. The phage DNA incorporates itself into the host cell's chromosome and is called a prophage.
3. The propahge is replicated when the host bacterium replicates its own DNA, thereby infecting many cells. During lysogenic growth, the prophage does not harm the host cell.
4. The prophage then enters the lytic cycle, replicates, and its copies will be released when the host cell lyses.

Which Human Diseases Are Caused By Viruses?

DNA viruses

- Respiratory disease
- Smallpox
- Chicken pox
- Mononucleosis
- Cold sores

RNA viruses

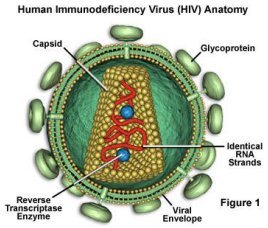
- AIDS
- Influenza (flu)
- Common cold
- Polio
- Measles

HIV, the AIDS Virus

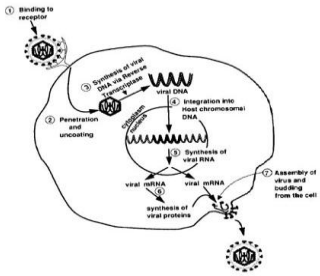
HIV is a retrovirus

Retrovirus- an RNA virus that reproduces by means of a DNA molecule

It copies its RNA into DNA using **reverse transcriptase**



How HIV reproduces inside a cell



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Emerging Viruses

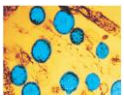
- **Many new viruses have emerged in recent years**

  HIV
  Ebola
  Hantavirus

EBOLA

- **How do new viruses arise?**
  Mutation of existing viruses

  Spread to new host species (Avian Flu and SARS)



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Viroids

- Smallest known particles able to replicate
- Short single strand of RNA
- No capsid
- Disrupts plant metabolism and may damage an entire crop

Prions

- **Abnormal forms of proteins that clump in cells**
- **Linked to diseases of the brain**
- **Consist of 250 amino acids and not associated with any nucleic acid**
- **Examples:**
  Scrapies in sheep
  Mad Cow Disease in cattle

animations

What is Mad Cow Disease

Mad cow disease, or **bovine spongiform encephalopathy** (BSE), is a fatal brain disorder that occurs in cattle and is caused by some unknown agent.

Brain cells die leaving the brain of the cow to look like a sponge.

It is believed to have come from a similar disease in sheep called **scrapie**.