

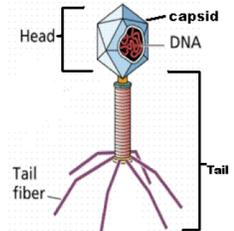
VIRUSES

Pathogen = anything that causes a disease.

Viruses are microscopic and non-cellular. Typical virus made up of outer protein capsid and inner nucleic acid core (DNA or RNA – never both)

Some viruses have an envelope = extra protective coat of protein and fat

Structure of a bacteriophage = a virus that infects only bacteria ex. T4 bacteriophage.



Viruses have living and non living characteristics

Living (organism) When inside the cell	Non living (chemical) When outside the cell
Has nucleic acid core DNA or RNA	Viruses have no metabolic needs (don't eat, breathe, sleep)
Able to invade a host cell and take over its reproductive machinery → not just kills host	They are not made up of cells (no membrane, organelles, or nucleus)
Can cause contagious disease	They are crystallizable – solutions of viruses when evaporated leave behind crystals = virus (like sea water → salt) <ul style="list-style-type: none"> - can await a new host in this form - length of time varies based on the type of the virus.
Can reproduce BUT only within a host cell	
Can mutate	

Because viruses have characteristics like living and non- living things, they are considered to be transitional between life and non- life.

VIRAL REPRODUCTION

Viruses evolve and reproduce, but they are obligate intracellular parasites.

There are 4 MAIN STEPS to viral reproduction:

- Virus attaches to cell and nucleic acid enters cell – either injects DNA/RNA or whole virus enters cell
- Replicate parts – nucleic acid, capsid, envelope...= Synthesis
- Assemble new viruses from parts
- Cell lysis or viral release from infected cell
- Viruses infect bacteria by the lytic cycle or lysogenic cycle

VIRAL LIFE CYCLES

Lytic Cycle: (Viral reproduction)

- ❑ Virus attacks cell, kills it and releases more viruses right away – follows the 4 steps of viral reproduction.
- ❑ Virulent = how quickly a virus reproduces and is spread – tend to follow lytic cycle
- ❑ CAUSES the disease **right away**

Lysogenic Cycle: (latent or hidden)

- ❑ Lysogenic cycle: sometimes a virus doesn't kill host cell right away or immediately cause the disease – it may coexist with the host for a period of time.
- ❑ Virus stays dormant (as a prophage) in the cell for several generations.
 - Prophage = host DNA & virus DNA
- ❑ Viral DNA gets copied at each replication of host cell and is passed on to offspring / daughter cells
- ❑ Later, the virus is activated or triggered and causes the disease by entering the lytic cycle. The trigger may be time, stress, other illness.....

Retroviruses

- Has RNA as the genetic material
- RNA is converted into DNA copy inside the host cell by an enzyme called **reverse transcriptase**
- Follows the lysogenic pathway
- Can mutate easily – hard to make vaccines for these ones
- Infects mainly animal cells
 - Ex. HIV, influenza

Viral Specificity

- A virus infects a specific host: only plants, only animals, only fungus or only bacteria.
- Some are very specific in that they infect a particular species such as only humans, only peach tree etc...
- As well, viruses may infect only specific cells of the body Ex. Influenza infects lung cells

Host Range: the number of different species a virus can infect

- **Narrow host range** = infects only 1-3 species.
 - Ex. Human cold virus
- **Broad host range** = infects many different species
 - Ex. Rabies – infects mammals & birds
- A virus identifies the host cell by a “lock & key” system.
 - Antigens on the outside of the virus fit into a specific receptor site on the host cell's surface.

Vaccines

= a weakened, diluted or dead form of the virus that is injected (because saliva & stomach enzymes would destroy it) into the body to produce immunity.

- The body reacts to the shape of the virus and produces antibodies – so immune system can fight off the disease (produce immunity).

- Vaccines can prevent outbreaks, infection and death. However, vaccines can also weaken the immune system – you cannot fight off other diseases because your immune system is busy.

Hard to make vaccines for retroviruses because they mutate so quickly.

Effects of viruses on human health

Harmful	Beneficial
<ul style="list-style-type: none">• Causes disease, cancer• Causes brain damage (ex. Measles)• Destroys organs (ex) hepatitis ⇒liver, heart• Can be fatal	<ul style="list-style-type: none">• Vector for gene splicing (to “replace” bad gene)• Biological control (control or eliminate other organisms)• Make vaccines

Avoiding Viruses:

- Vaccinations
- Good hygiene – wash hands, bedding, clothing..
- Abstinence
- Boil water where cleanliness is in question
- Eat healthy

3 Theories of Virus Evolution

1. At one time, viral ancestors were cellular organisms that were parasitic (*feed off living organisms*) on other cells. Since they were parasites, they lost their cellular components (they didn't need them anymore).
2. At one time, viral ancestors were free living organisms having a structure **before** the first cells were formed. Later on, they became parasitic on the cells that evolved.
3. Viruses were once just fragments of genetic material that came from cellular organisms (left over parts). This is why viruses are specific to certain cells (because they came from them).

↳ *This is the most widely accepted theory.*