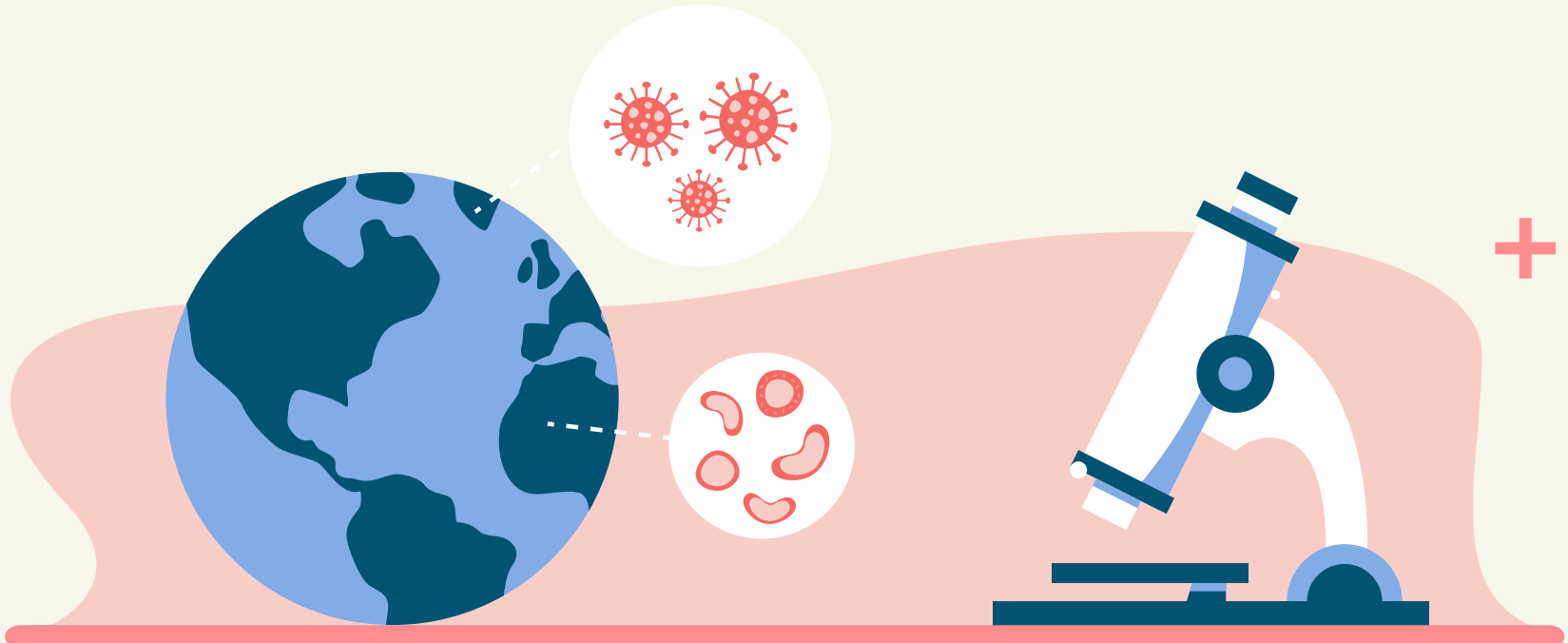


MICROBIOLOGY

Chapter 17





VIRUSES

Chapter 17

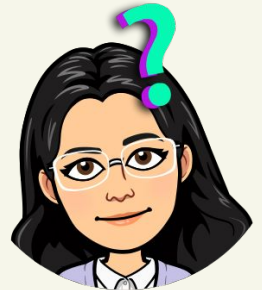
Virus Learning Objectives:

1. Describe the basic structure of a virus
2. Compare and contrast the lytic and lysogenic cycles
3. Evaluate the effects of viruses on human health
4. Evaluate the evidence used to classify viruses as living or nonliving

What is a Virus?

Discuss with your table neighbour: Be ready to share!

1. Can you think of reasons how you got sick and what caused your sicknesses?
2. How do you think a virus spreads?



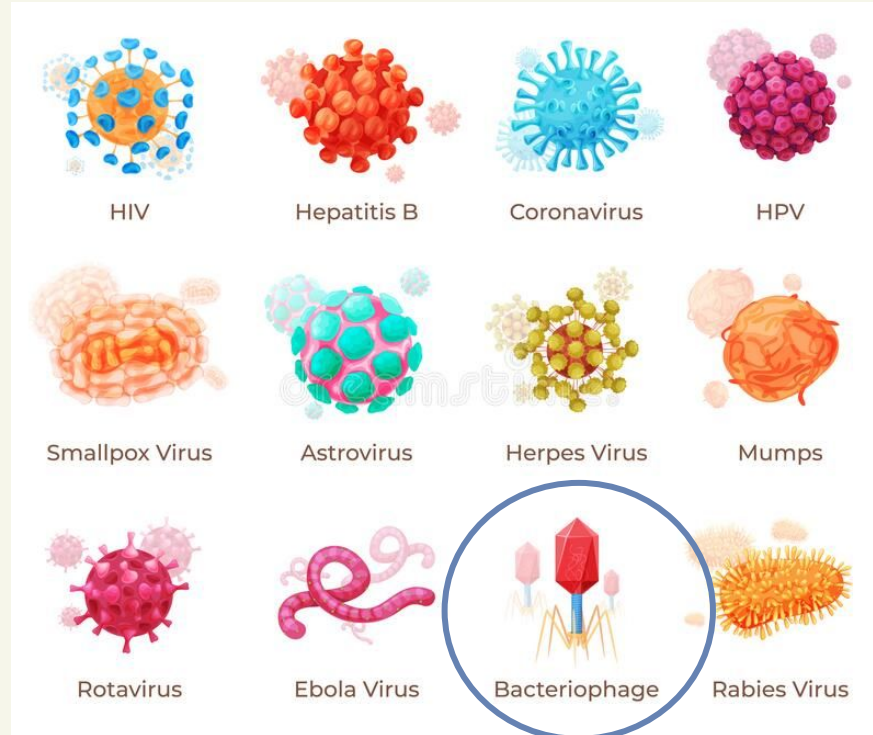
★ Video: What is a Virus?



https://www.youtube.com/watch?v=sgYSxr4tlZg&ab_channel=Flocabulary

What is a Virus?

The term *virus* comes from the Latin word *virus* meaning **toxin** or **poison**.

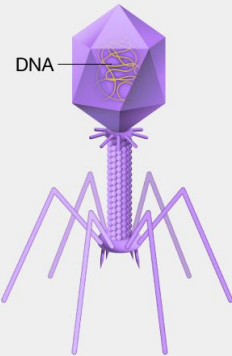


What is a Virus?

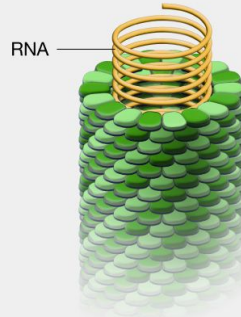
Virus: is a non-cellular particle made up of genetic material and protein that can invade living cells.

Examples of viruses

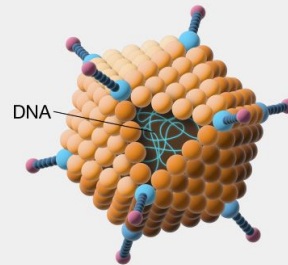
Bacteriophage



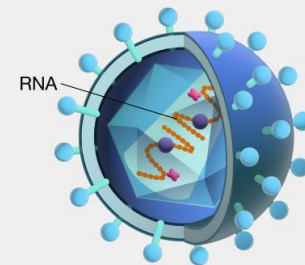
Tobacco mosaic virus



Adenovirus



Influenza virus

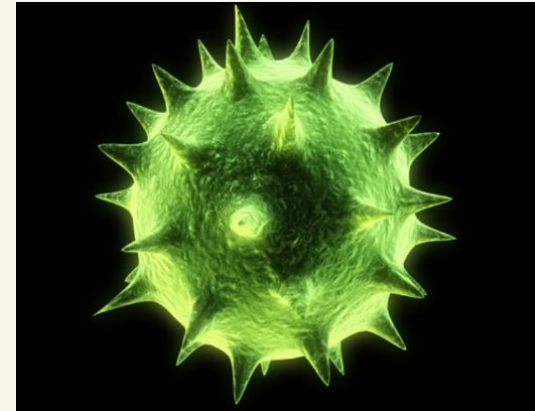


Virus

The name “virus” comes from the Latin word meaning poison.



A virus is a lifeless chemical, and seems to carry out no life function of its own. However, once it invades a living cell, the virus displays an important trait that it shares with all living things.... It reproduces!



* Tobacco Mosaic Virus

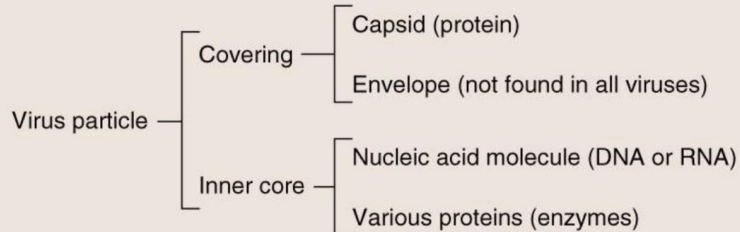
At the end of the 19th century, the first virus discovered was called the tobacco mosaic virus.



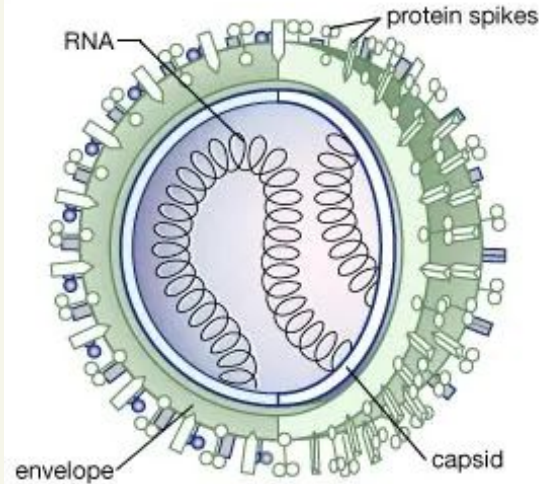
Virus Structure

Consist of two parts:

- A. Outer **protein capsid**
- B. Inner **nucleic acid core (DNA or RNA)**

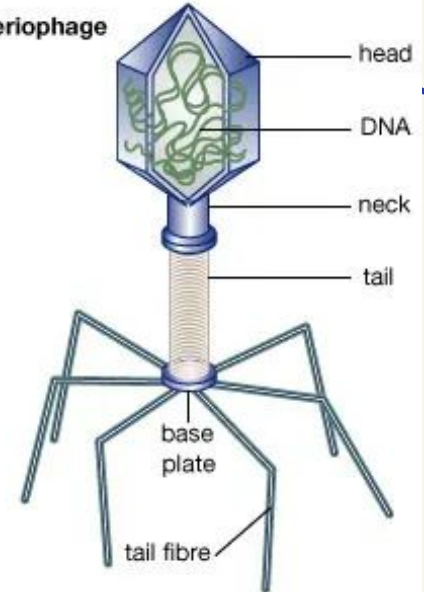


influenza virus

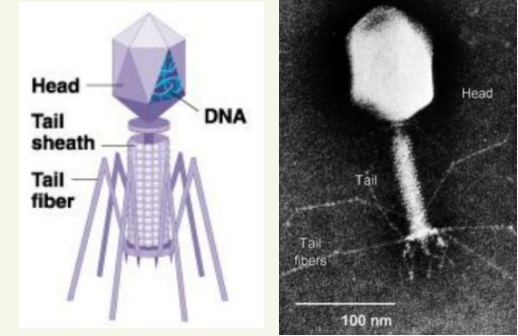
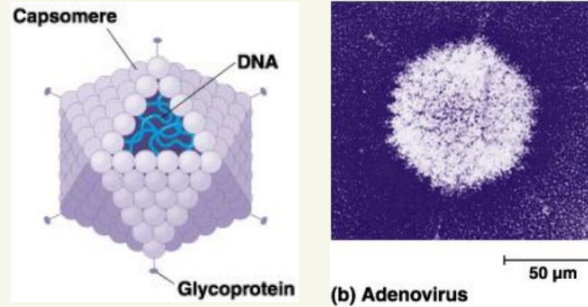
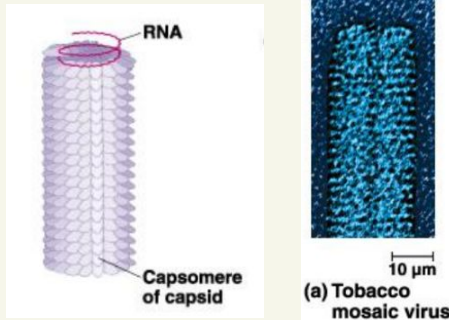


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bacteriophage



Viruses have various shapes:



Rod-shaped

- DNA/RNA is found coiled within the hollow tube of the rod
- *ex. Tobacco mosaic virus*

Spherical

- DNA/RNA is found coiled within the center
- *ex. Adenovirus and influenza*

Irregular or tadpole

- Attack only bacterial cells. DNA/RNA is found within the head
- *ex. T4 bacteriophage*

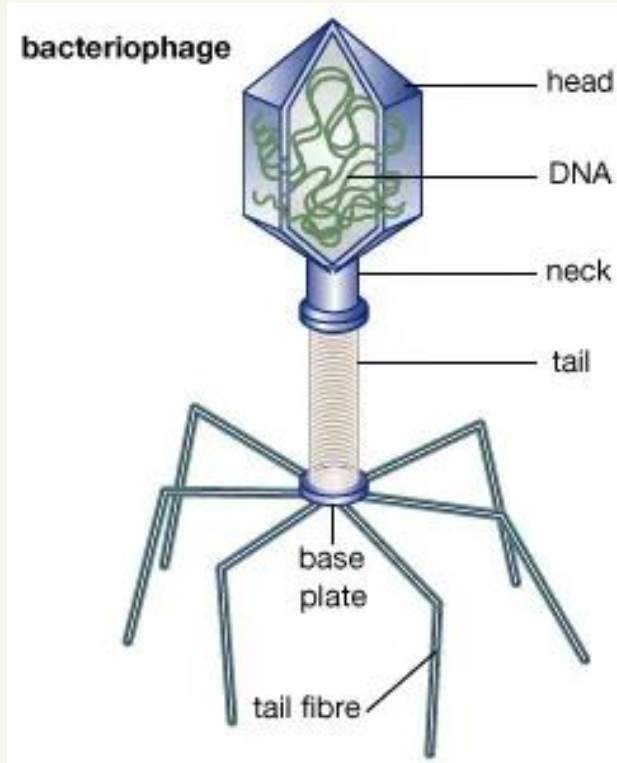


Beautifully Accurate Glass Sculptures of Deadly Viruses

<https://mymodernmet.com/luke-jerram-glass-microbiology>



Structure of a Bacteriophage



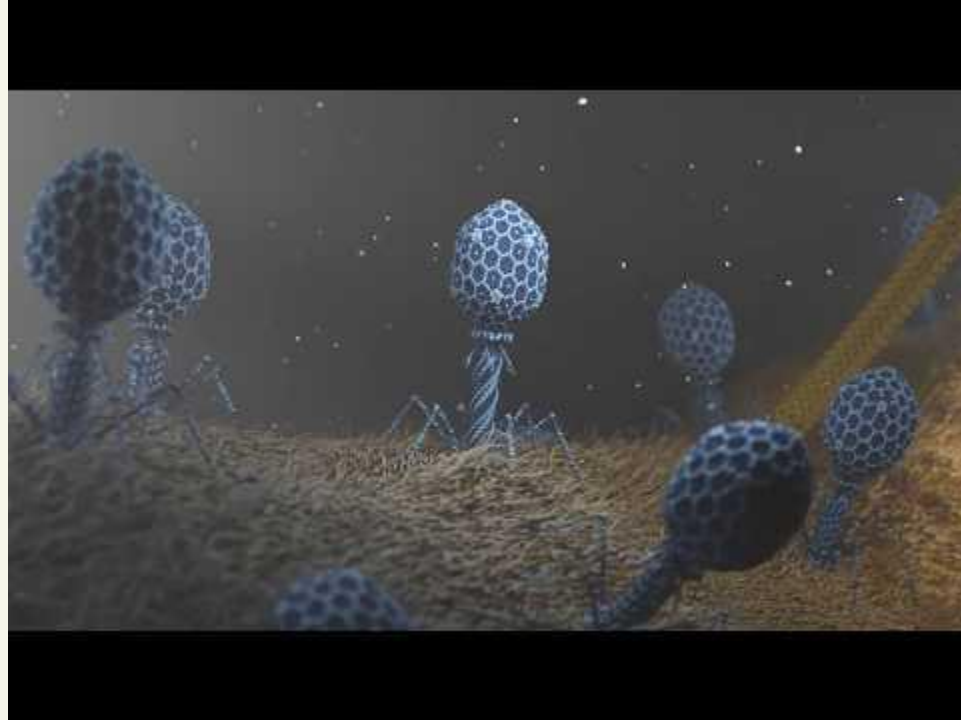
Bacteriophage:

A virus that only infects *bacteria*.

- Head
- DNA
- Neck (collar)
- Tail (sheath)

All viruses have a **capsid** or **head region** that contains either **DNA** or **RNA**

T4 Phage attacking E.coli

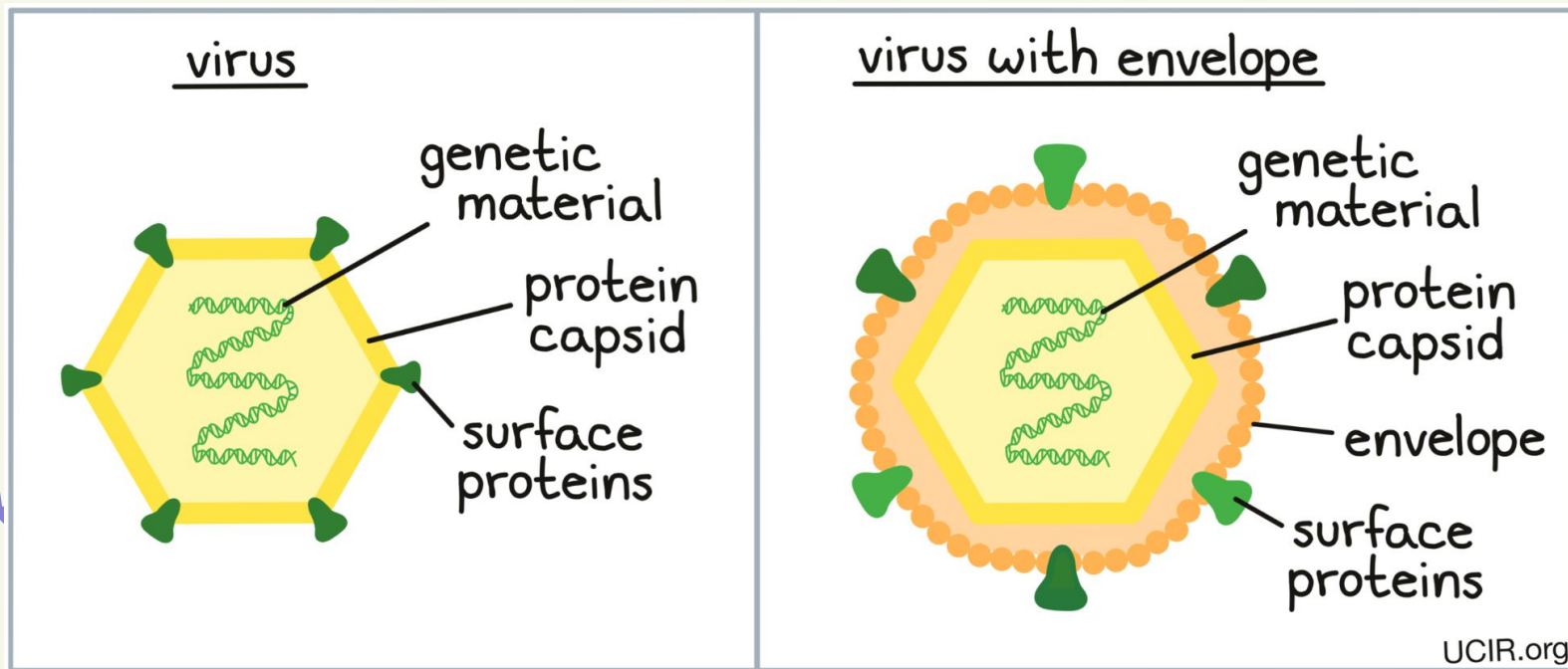


VIDEO



Enveloped vs Non-enveloped Virus

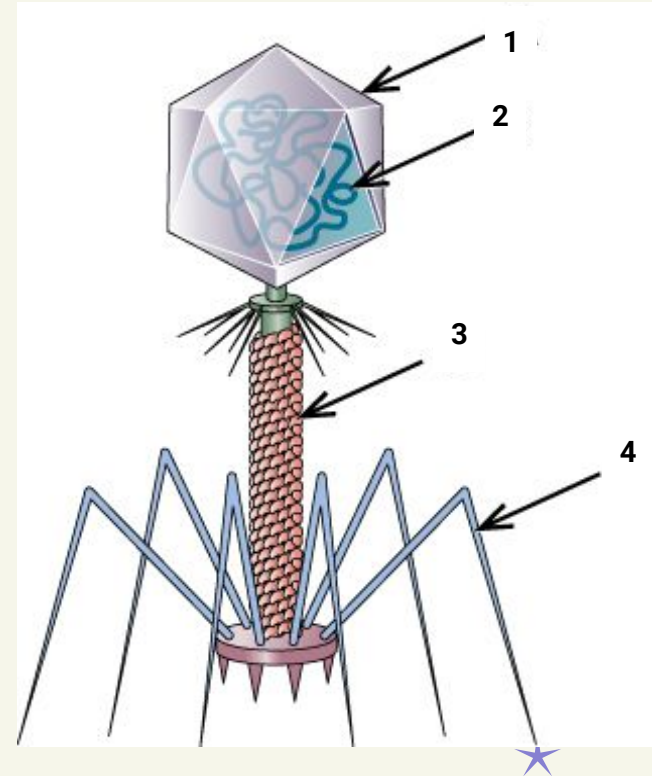
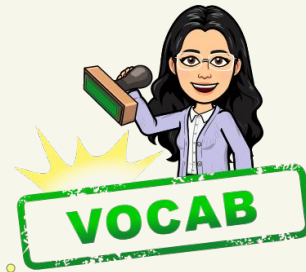
Some viruses have an envelope = extra protective coat of protein and fat!



★ Knowledge Check

Using your fingers, show me which number on the diagram represents:

- **Capsid:** the outer protein shell of a virus.
- **DNA or RNA**
- **Tail fibers**



★ Review: Virus Structure

Provide a Drawing of a virus using the following labels:

- Nucleic Acid (DNA or RNA)
- Capsid
- Envelope



Viral Replication

There are 4 main steps to viral reproduction:



1. Virus **attaches** to cell and nucleic acid enters cell – either injects DNA/RNA or whole virus enters cell
2. Replicate parts – nucleic acid, capsid, envelope...= **Synthesis**
3. **Assemble** new viruses from parts
4. Cell lysis or viral **release** from infected cell

Viruses infect bacteria by the **lytic cycle** or **lysogenic cycle**.



Video: Flu Attack! How A Virus Invades Your Body

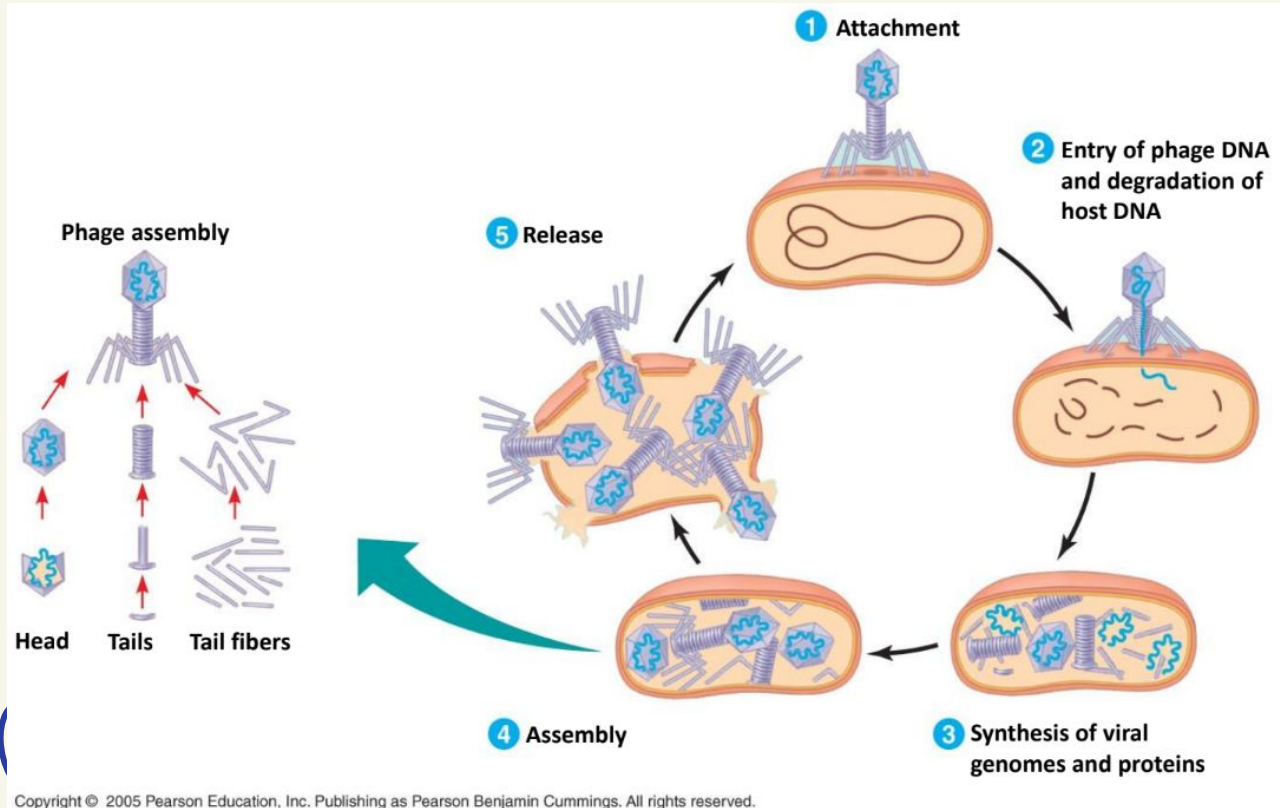
https://www.youtube.com/watch?v=Rpj0emEGShQ&ab_channel=NPR

Lytic Cycle (Viral Replication)

- **Lytic cycle:** Virus attacks cell, kills it and releases more viruses right away – follows 4 steps of viral reproduction
- CAUSES the disease right away



Lytic Cycle



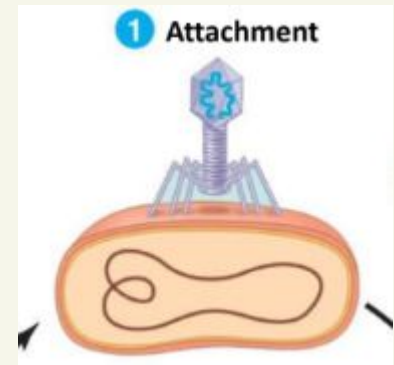
5 Phases of the Lytic Cycle:

1. Attachment
2. Entry
3. Synthesis
4. Assembly
5. Release

1. Attachment

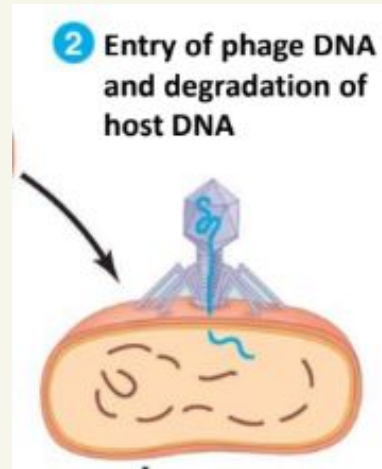
Virus attaches to host cell using tail fibres to attach to receptor sites on cell surface.

- Receptor sites: Areas on the cell which the virus can recognize and bind to.
- Receptor sites are important, because if a cell doesn't have them, viruses move to the next group of cells which do.
- This is how viruses gain **specificity** (eg. Hepatitis virus only infects liver cells)



2. Entry

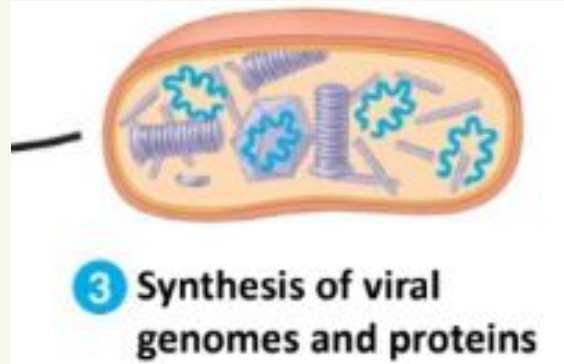
- Bacteriophage releases an enzyme which weakens the cell wall, allowing for nucleic acid to be inserted into the cell



3. Replication / Synthesis

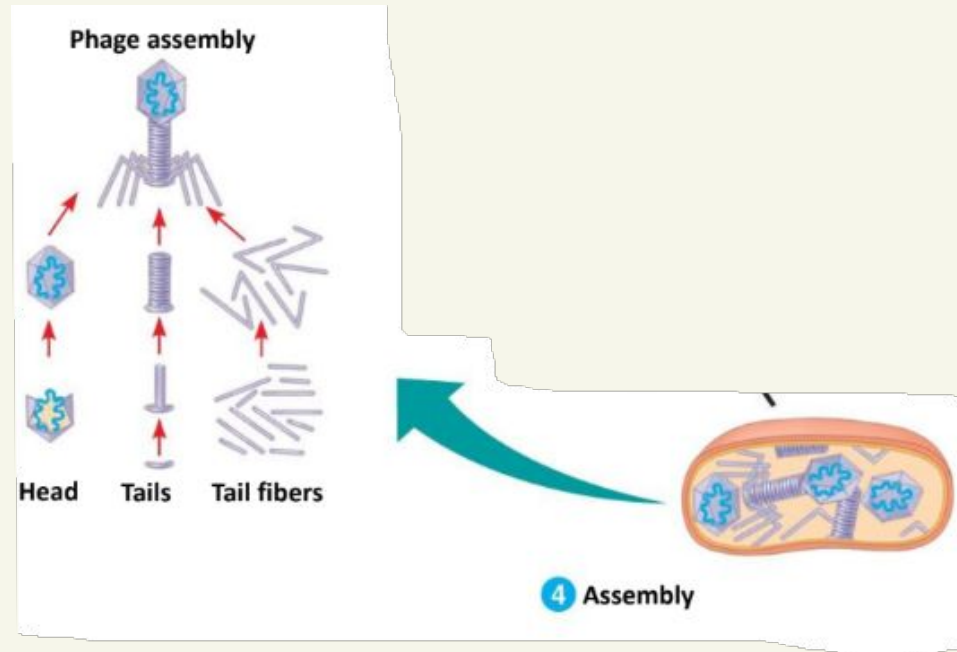
How the Viral DNA is replicated

- Using host cell's machinery:
 - Transcribe Viral DNA into Viral RNA, which is then translated into Viral proteins
 - Viral proteins form the capsid



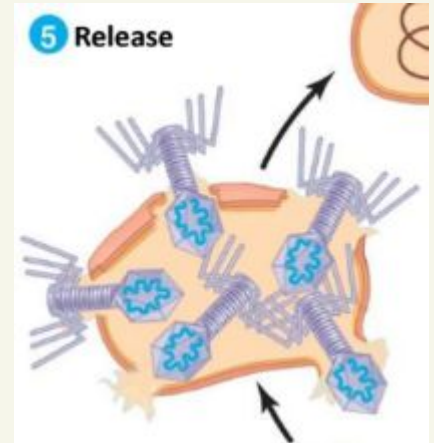
4. Assembly

Viral genes are enclosed in the newly created viral capsids



5. Release

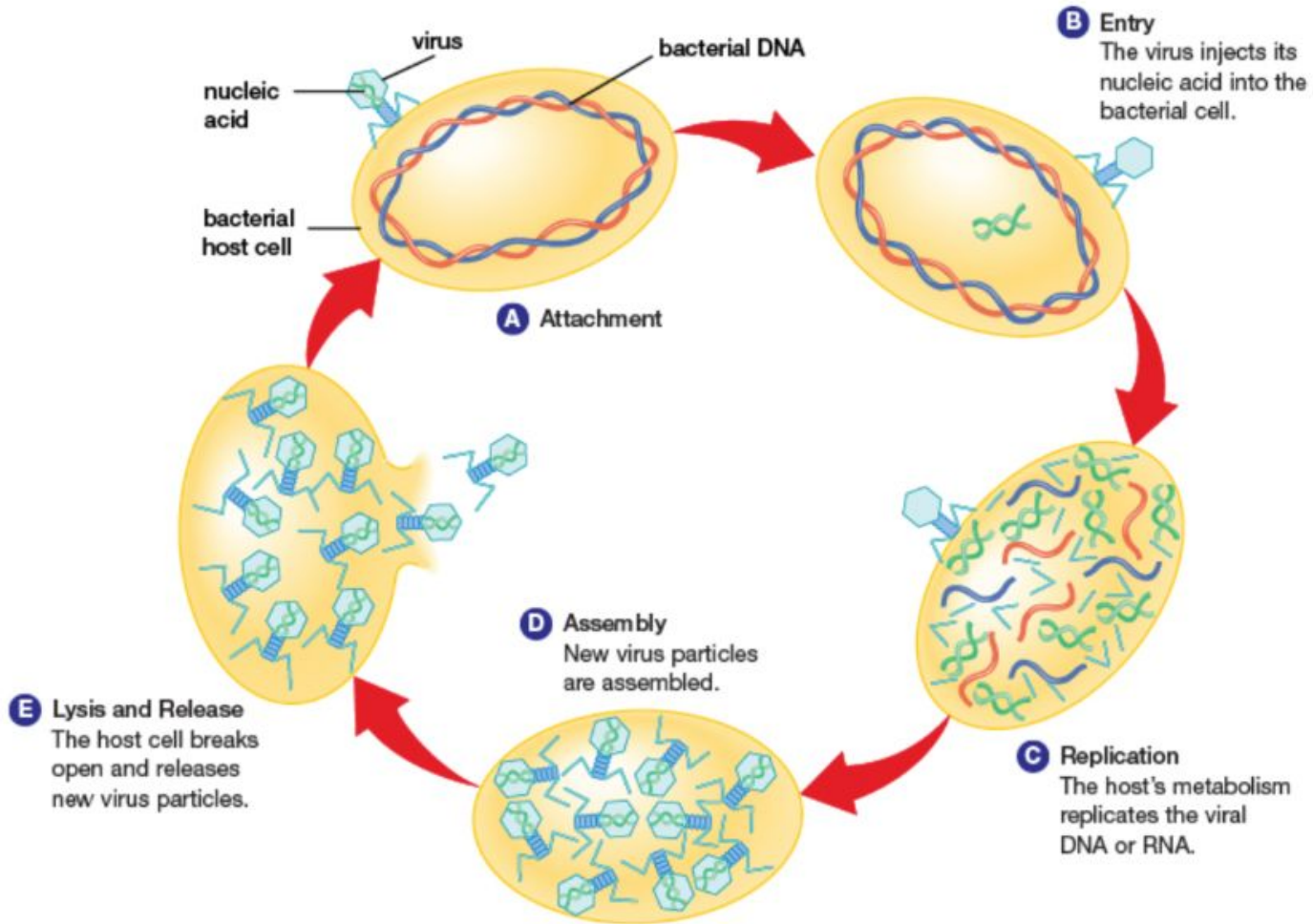
- Bacteriophage releases enzyme which disintegrates host cells
- Cell disintegration is known as **LYSIS**
- Viruses with envelopes force themselves through the cell and “borrow” a piece of the cell as th envelope



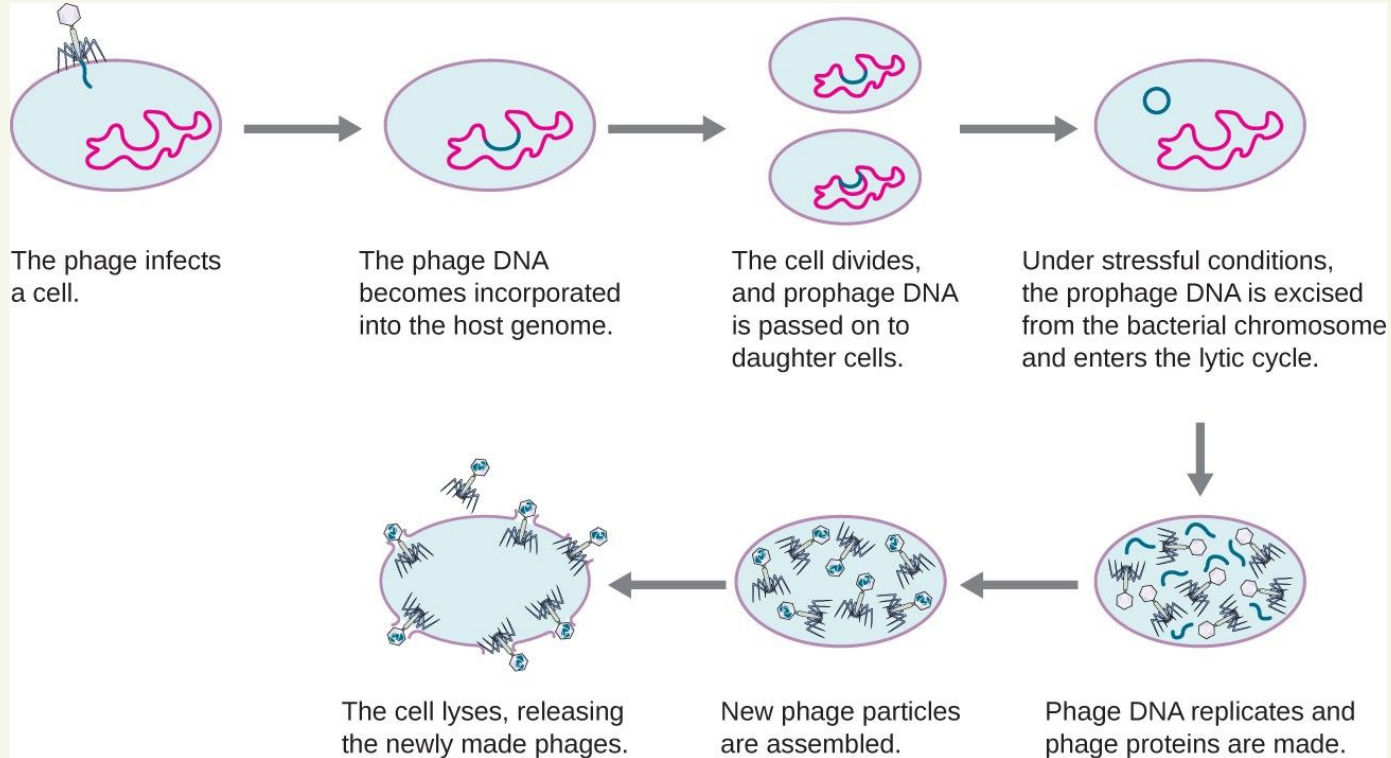
★ **Activity: Draw the Lytic Cycle**

On a sheet of paper, show the Lytic Cycle in action:

1. Draw each different stages of the lytic cycle.
2. Provide a brief description of each stage in your own words.



Lysogenic Cycle

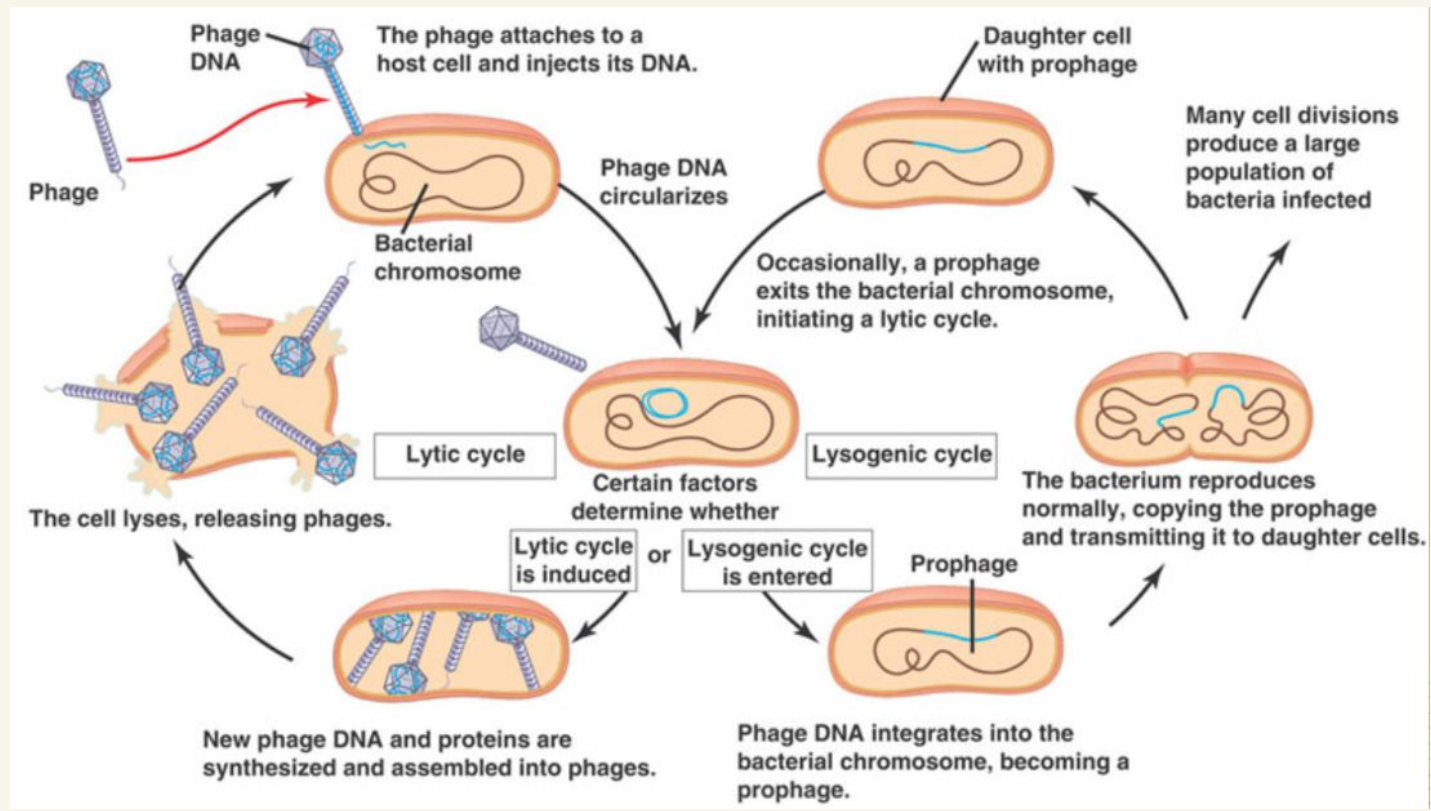


Lysogenic cycle (Latent or Hidden)

Lysogenic cycle: sometimes a virus doesn't *kill host cell right away* or *immediately cause disease* – coexist with host.

- 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 – passed to offspring
- Later, the virus is activated or triggered and causes the disease by entering the lytic cycle
 - Trigger may be time, stress, other illness...

Lysogenic vs Lytic Cycle



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, cancer-causing viruses**

