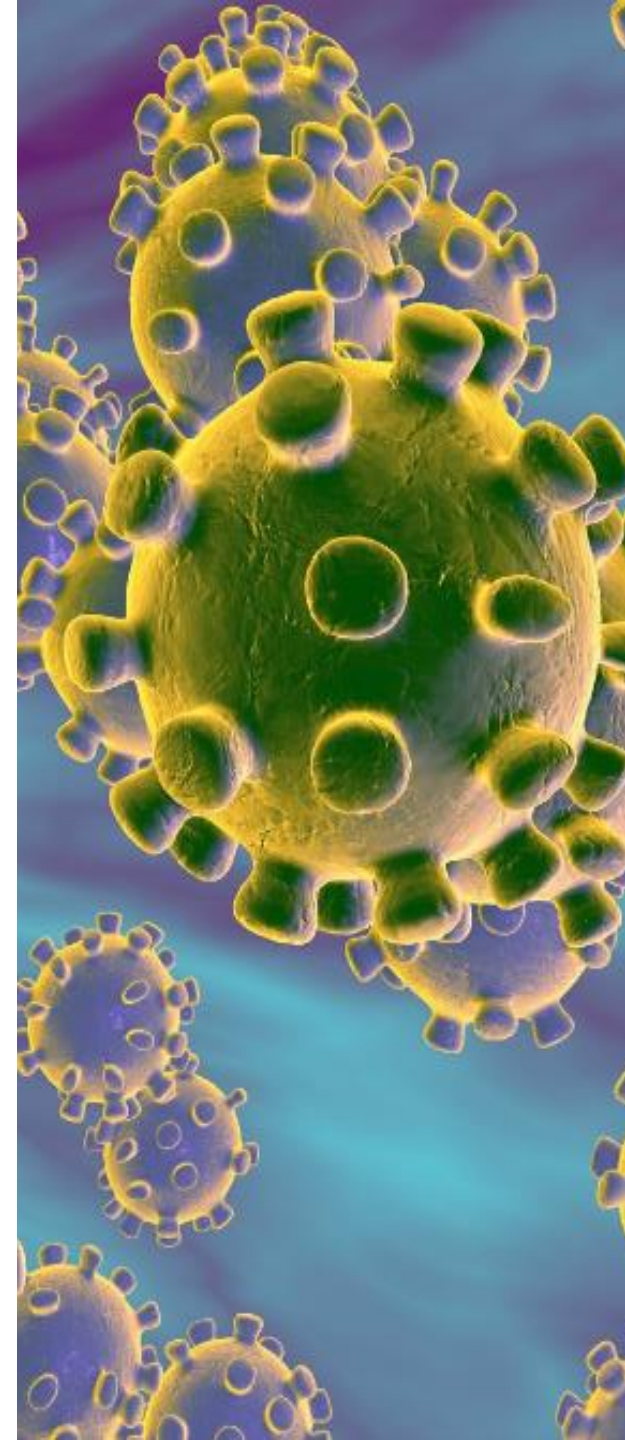


# **A221 Microbiology Problem 11**

## **The Mysterious**

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**Approved by: Serene Choo (Dr)**  
**Module Chair: Foo Toon Tien**



## In today's problem...

- Virus can mutate and spread easily, causing outbreak.
- Living organisms including bacteria, plant cells and animals cells have some similarities in their cellular structure.
- A virus lacks cellular components such as cell membrane, organelles and cytoplasm.
- There is uncertainty whether a virus is considered a living organism.

# A Possible Approach

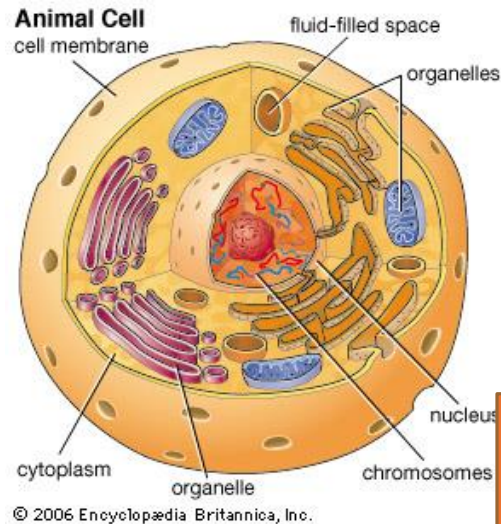
- What are some characteristics that define living organisms?
- How do viruses compare to other forms of life in terms of structure?
- What are viruses?
- How do viruses reproduce?
- Are viruses considered living organisms?

# Some characteristics of living organisms

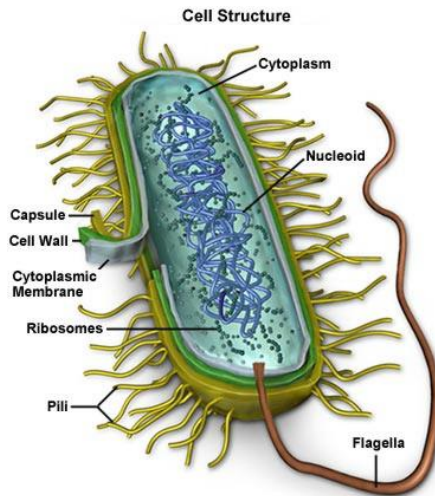
Living things share several common characteristics:

- Reproduction
- Metabolism
- Growth
- Response to stimuli

# How do viruses compare to other forms of living organisms in terms of structure?

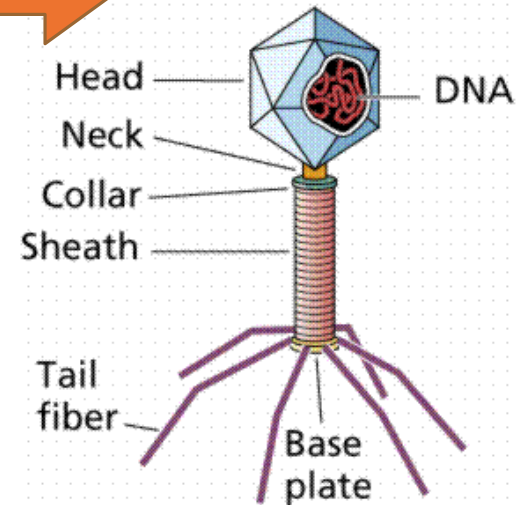
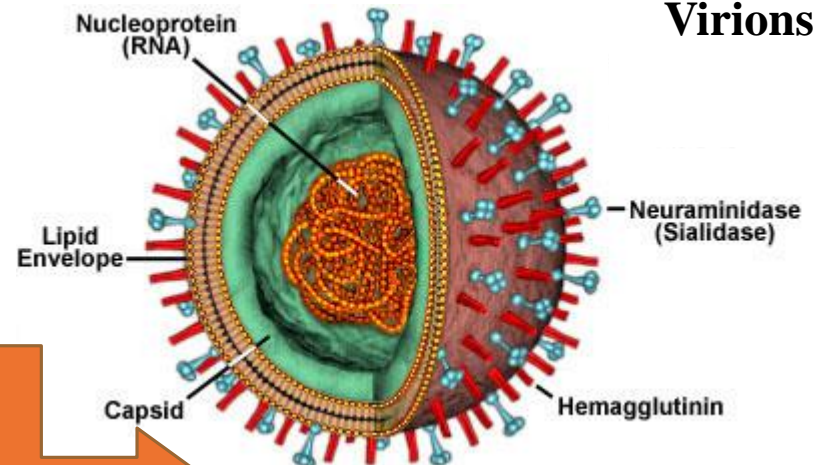


## Bacterial Cell



Lacks  
organelles

## Virions

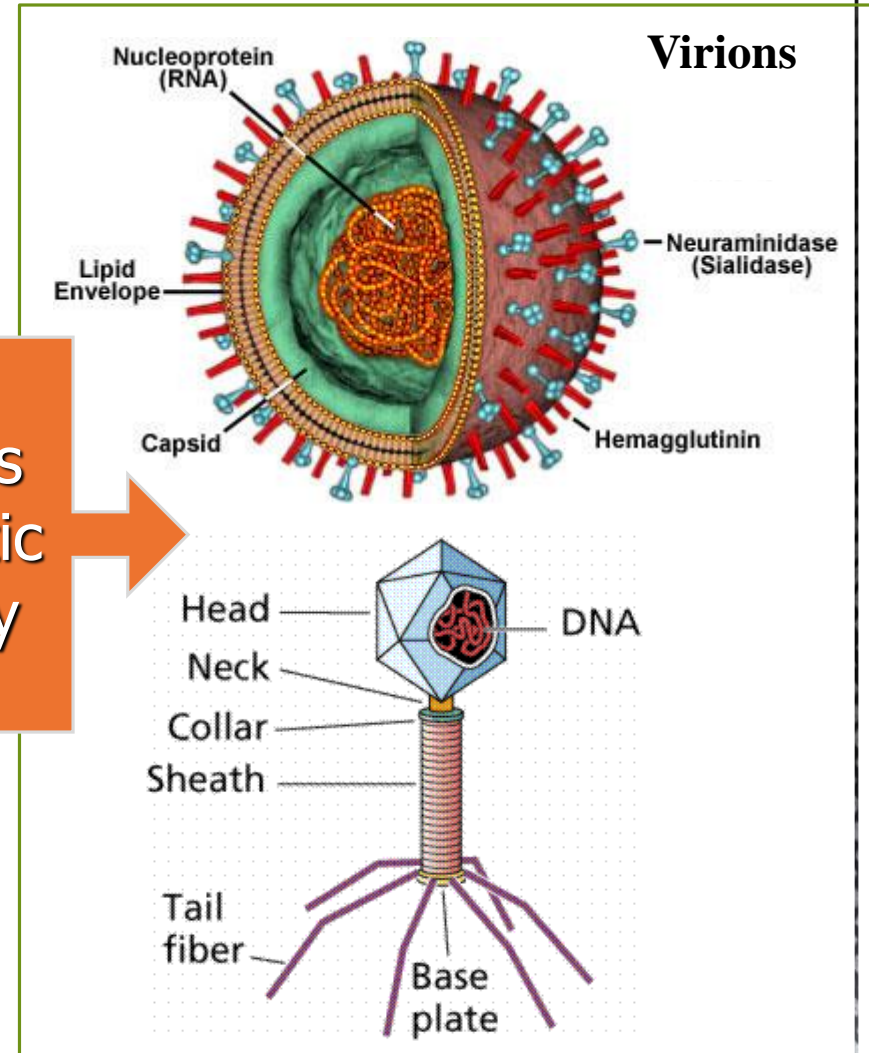




# How do viruses compare to other forms of living organisms in terms of structure?

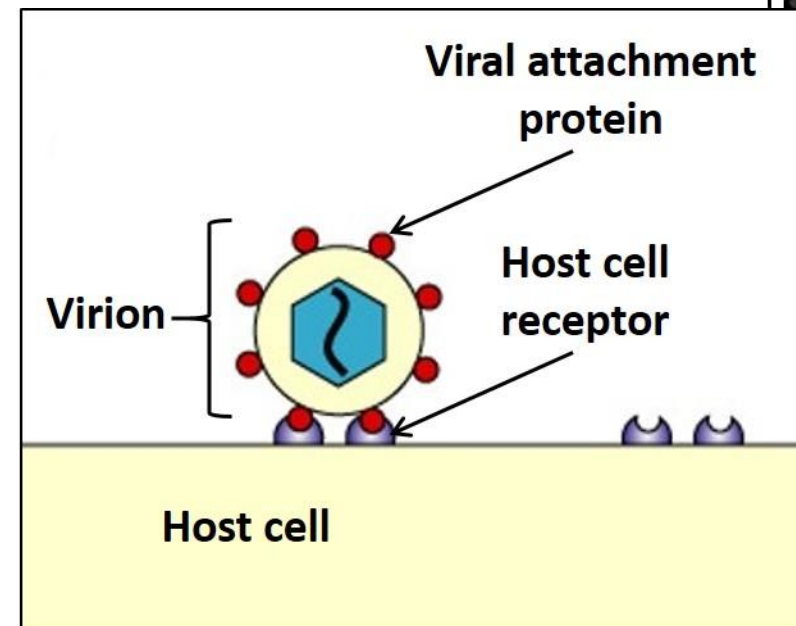
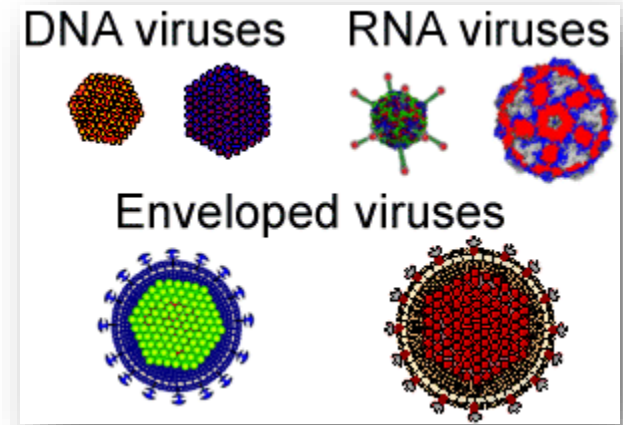
- Reproduce
- Metabolize
- Growth
- Response to stimuli

Virus lacks  
biosynthetic  
machinery



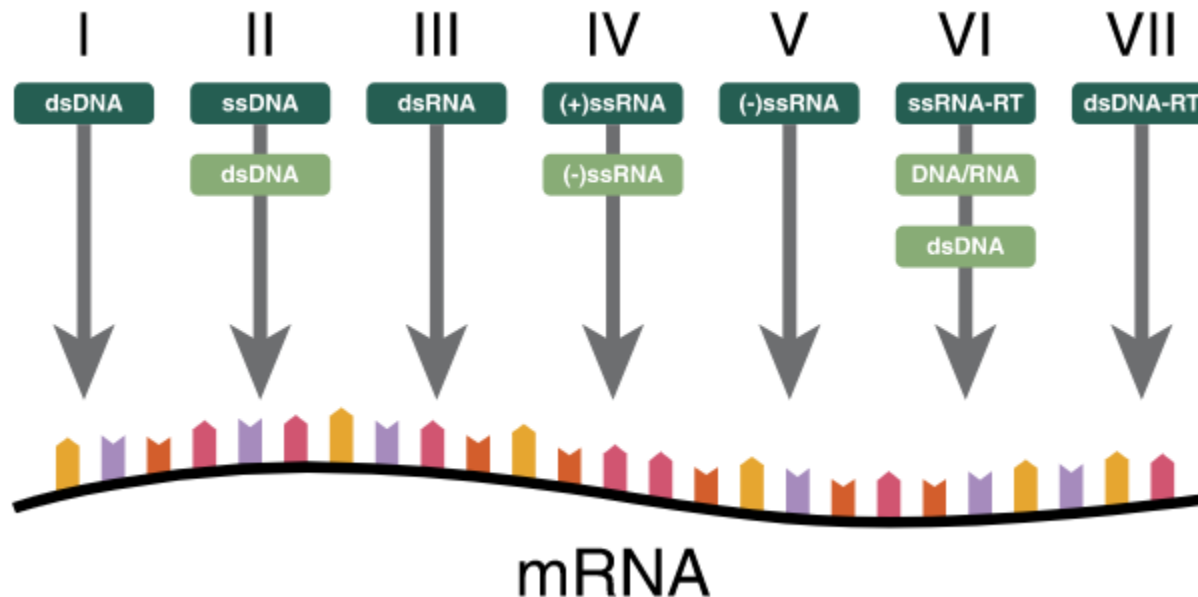
# What are viruses?

- **Obligate intracellular parasites**
  - Lack nucleic acid replication and protein synthesis machineries
- Very small in size (around 20nm to 200nm)
  - Can only be viewed using **electron microscope**
- Basic components of a virion:
  - Contain a protein coat (i.e. **capsid**)
  - **Attachment protein**
  - **Either DNA or RNA** as genetic materials
  - May possess a **lipid envelope** – derived from host cell membrane
- Each virus only **infects specific hosts**:
  - Specificity of viral attachment proteins to receptors on host cell














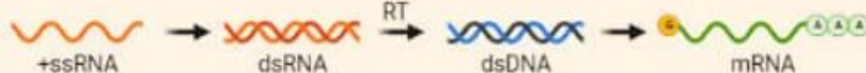


# Baltimore classification

- **Baltimore classification** is a system that places viruses into groups depending on a combination of:
  - Nucleic acid (DNA or RNA)
  - Strandedness (Single or Double)
  - Sense
  - Method of replication





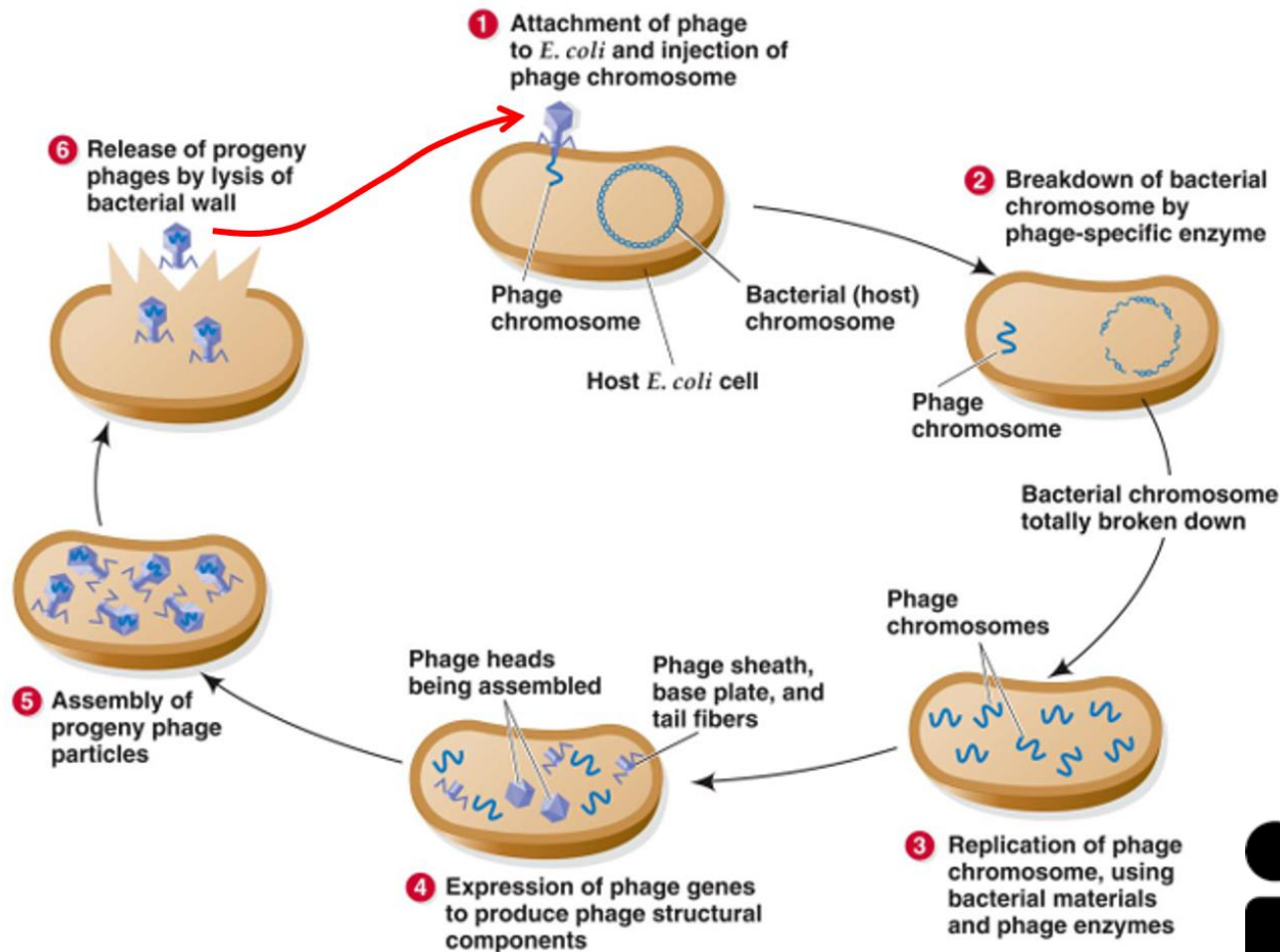
# Baltimore classification

Group	Example	Genetic Material Processing
Group 1 dsDNA	 Smallpox	
Group 2 +ssDNA	 HPV	
Group 3 dsRNA	 Rotaviruses	
Group 4 +ssRNA	 Coronaviruses	
Group 5 -ssRNA	 Measles	
Group 6 +ssRNA-RT	 HIV	
Group 7 dsDNA-RT	 Hepatitis B	

# How do Viruses Replicate?

- Viruses lack the biosynthetic machinery that is necessary for replication
- In order for a virus to replicate, it must first infect a suitable living host cell

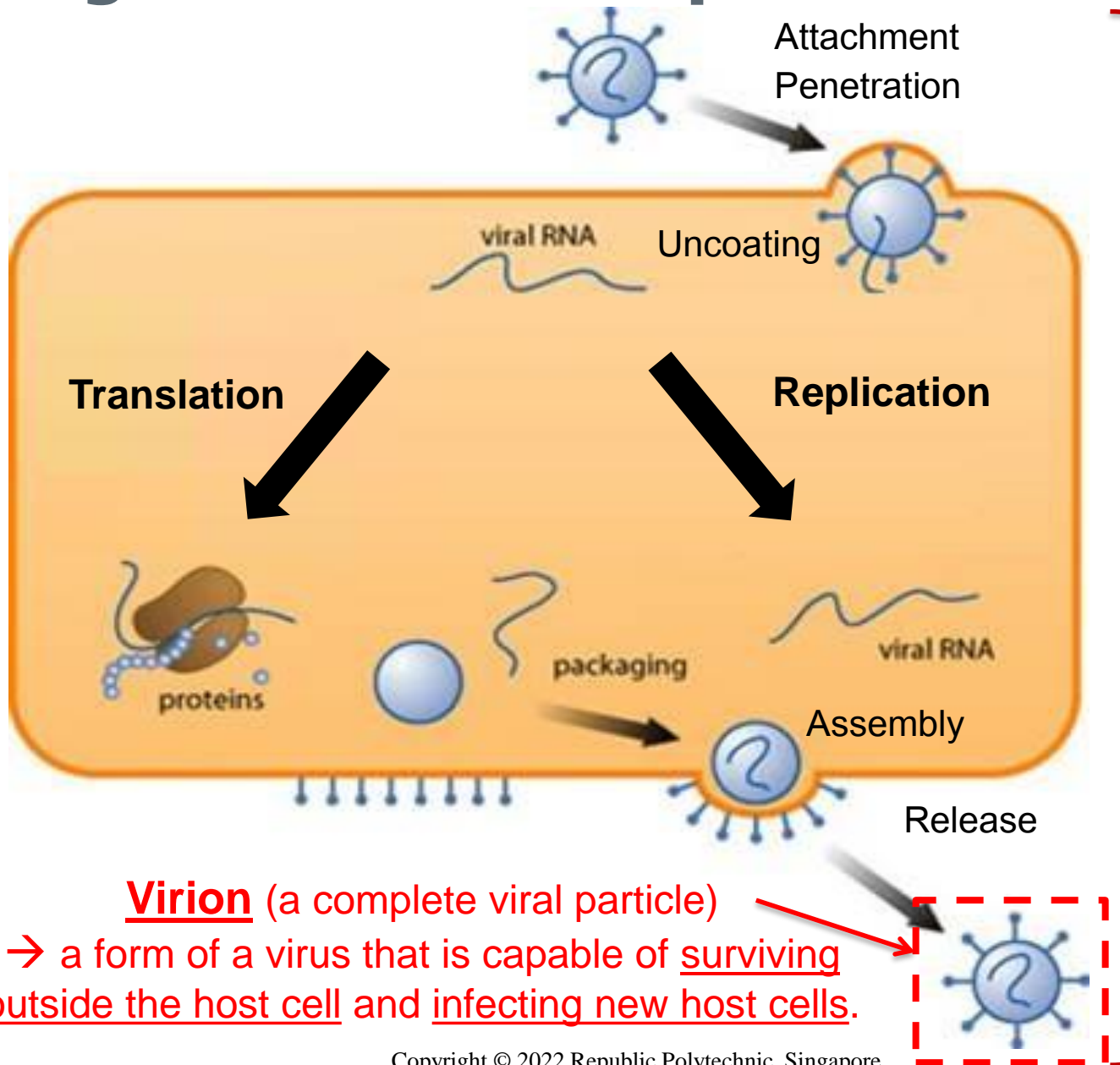
# Diagram of Bacteriophage Replication in Prokaryote



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# Diagram of Virus Replication in Eukaryote



## Virus

→ the infectious agent that requires a living host cell for it to multiply, in all its stages of replication cycle.



Click to view video

# Applications of viruses

## Viruses in biological studies

- Viruses have been used extensively in genetics research and understanding of the genes and DNA replication, transcription, RNA formation, translation, protein formation and basics of immunology.

## Viruses in bacteriophage therapy

- These are highly specific viruses that can target, infect, and (if correctly selected) destroy pathogenic bacteria.

## Viruses in agriculture

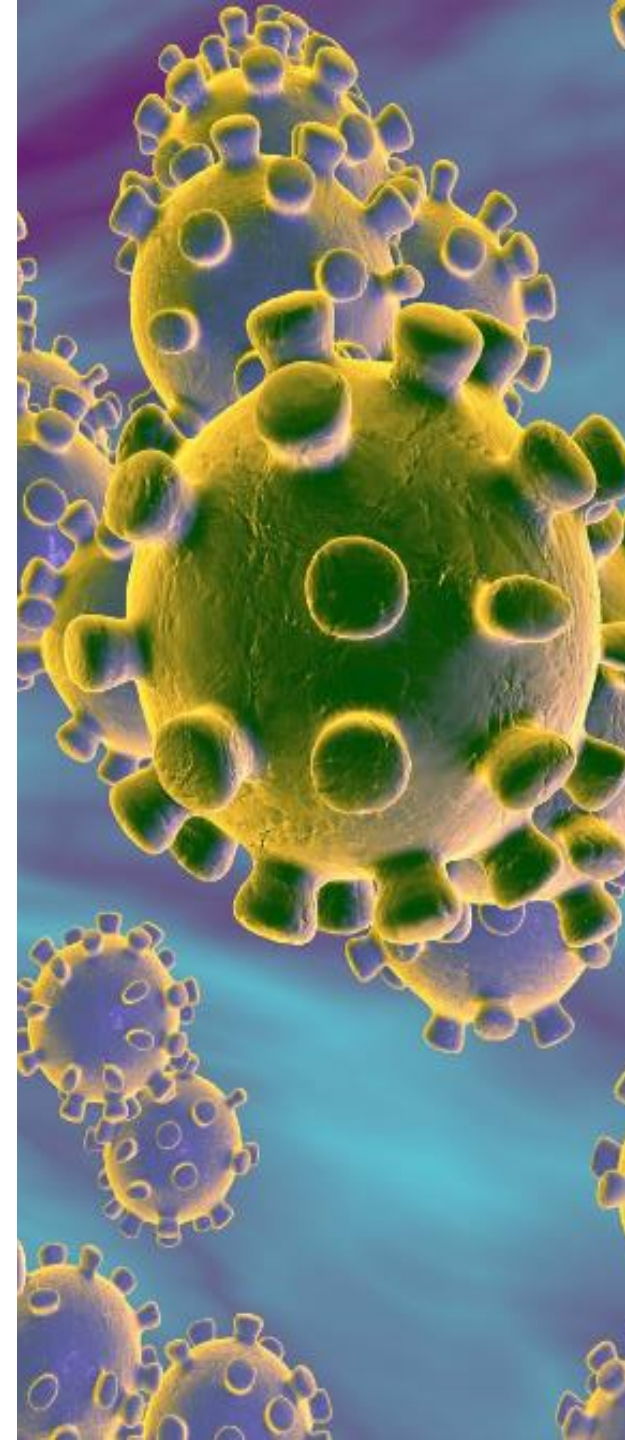
- Modification and genetic engineering methods can be used to make modified genomes that can be carried into plants and animals by viruses acting as vectors or vehicles. This method can lead to more productive transgenic animals and plants.

## Vaccines for cancer and disease prevention

- Vaccines for COVID-19, hepatitis B and those for human papillomavirus protect against COVID-19, liver and cervical cancer respectively. Both use selected proteins of the virus (subunit vaccines). Non infectious particles made with viruses can be used to deliver material into cells to stimulate a strong host immune response to protect against infectious diseases.



# Is a virus alive?





# What have you learnt (I)?

- Define characteristics of living organism as the ability to reproduce, metabolize, respond to environment and grow
- Relate that viruses are structurally simple and much smaller compared to the cells of bacteria, animals and plants.
  - Identify that viruses do not have organelles
  - Identify the different components that make up a virion
  - Identify that viruses can have either DNA or RNA as their genetic materials
  - Identify the type of microscope that viruses can be observed with
  - Classify viruses based on their size, shape, genetic materials or host they infect
  - Explain Baltimore classification of viruses
- Explain why viruses reproduce only with the help of living cells
  - Relate viruses as intracellular parasites due to their lack of biosynthetic machinery.
  - Explain why viruses can be cultured in laboratory using cell cultures.

# What have you learnt (II)?

- Describe viral replication cycle
  - List the steps of a viral replication cycle
  - Explain what happens during Attachment, Penetration, Uncoating, Replication, Assembly and Release
- Understand that viruses infect specific host cells.
  - Explain how viral surface attachment proteins bind to receptors on surfaces of host cells and play a role in viral specificity to host
  - Relate that viruses can infect eukaryotes and prokaryotes
  - Identify the use of viruses in research, agriculture and disease prevention