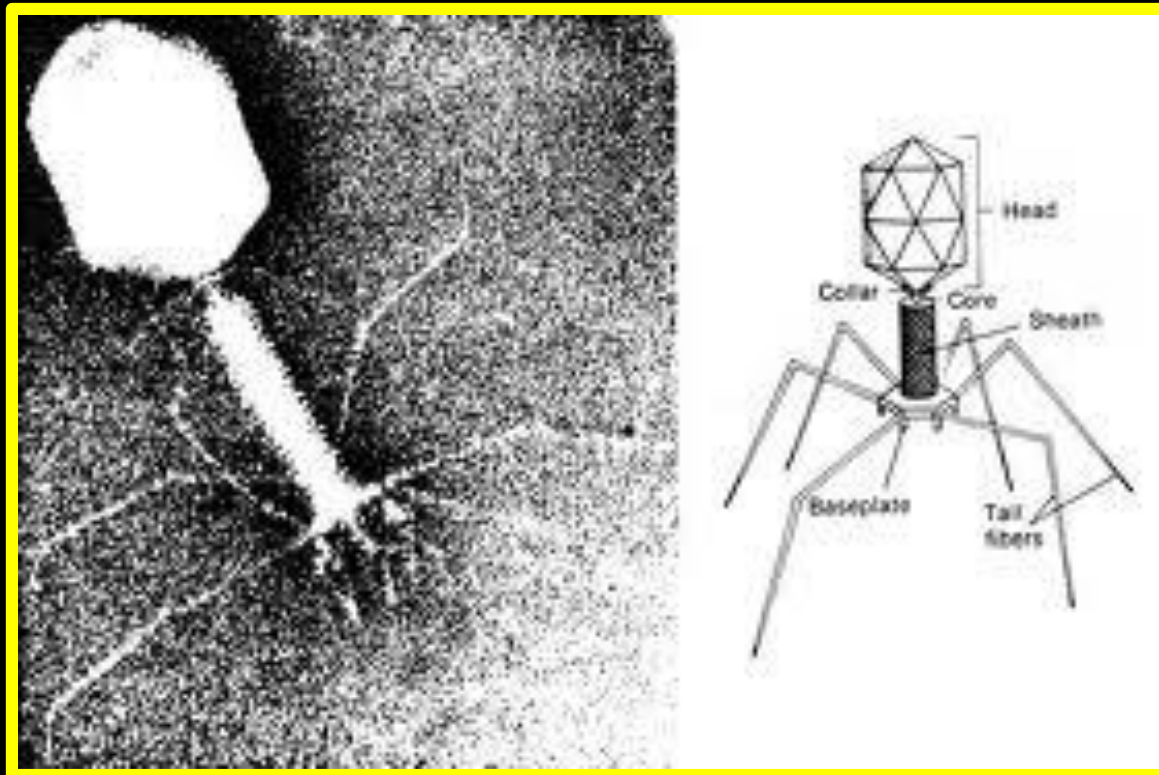


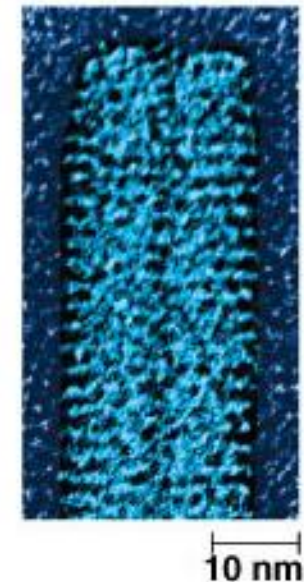
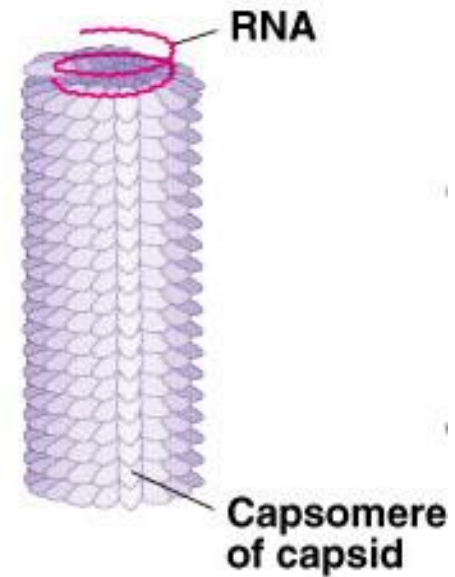
# Molecular Genetics of Viruses



# What is a virus?

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- parasitic infectious agent
  - host dependent
    - doesn't contain any ribosomes or enzymes for metabolism
    - receives all energy from the host
- used in DNA technology (transformation)
- first discovered via a tobacco mosaic virus (1898)



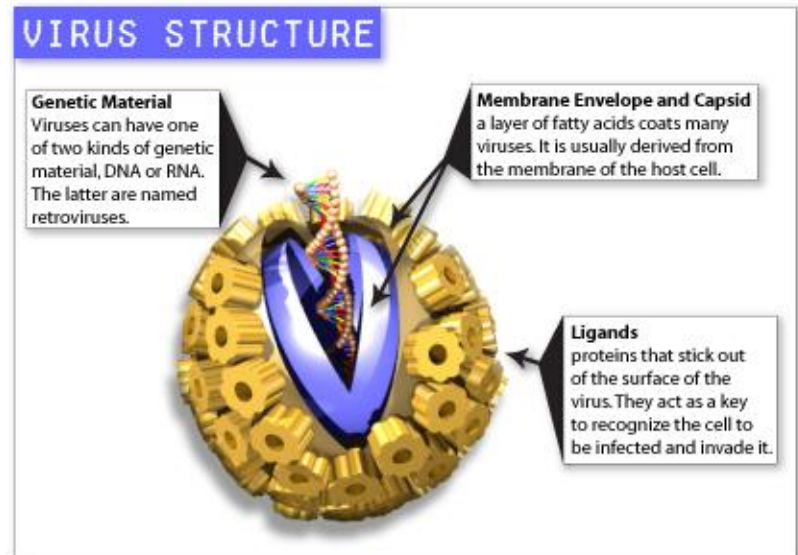
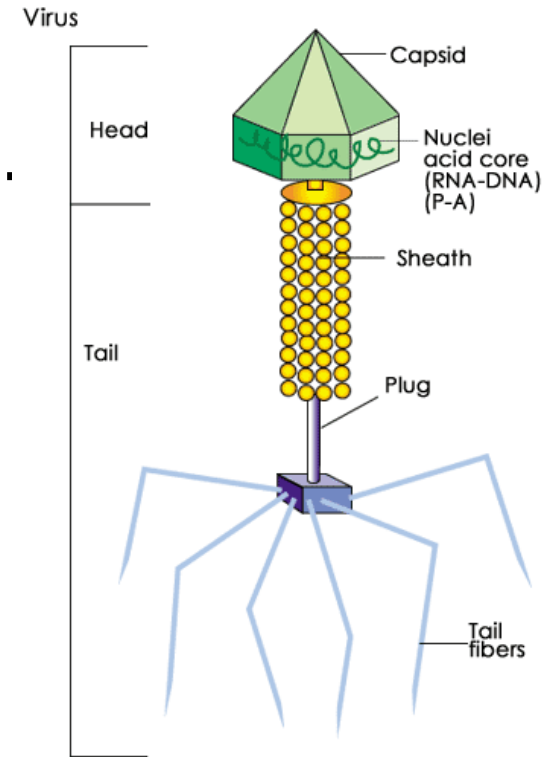
(a) Tobacco mosaic virus

# Anatomy of a Virus

## 3 Basic Parts:

1. **Capsid**- outer coat made up of protein subunits called capsomeres in varying shapes.
2. **Genetic material**- can either be RNA or DNA (ds or ss) (few genes 4-100).

- \* Very small 20nm and up
- \* Can have attachment fibers

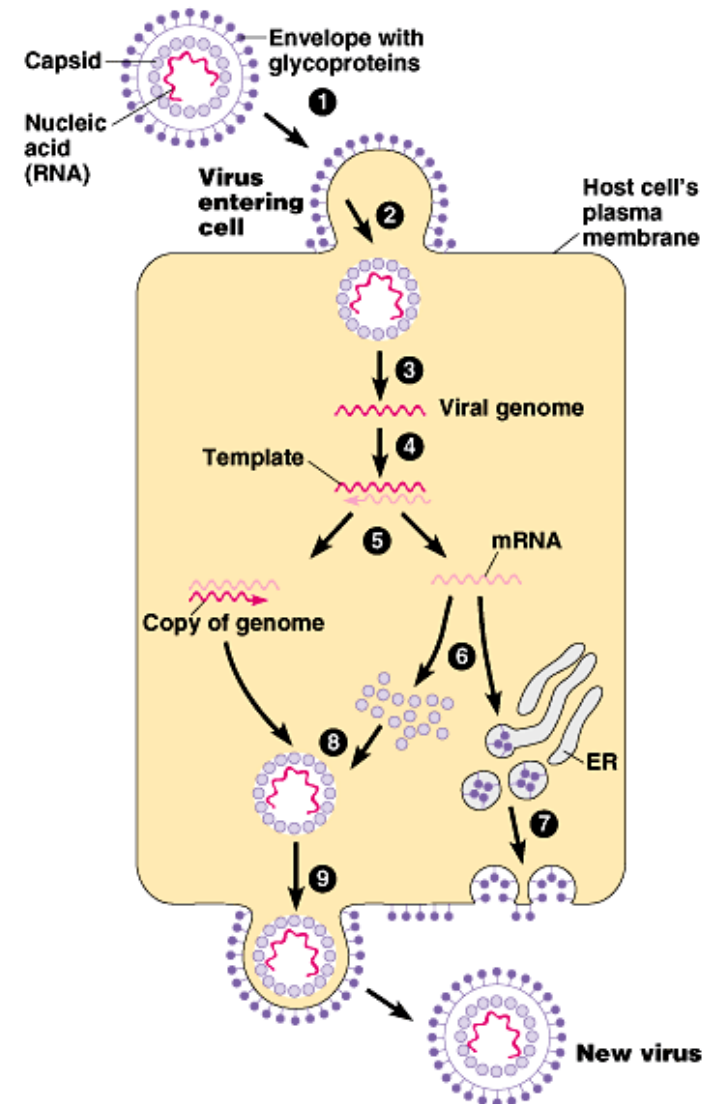


# Anatomy of a Virus

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- 3. Envelope** – made of glycoproteins (ligands)
- allows easier entrance/exit into a host cell
  - can fuse with the cell membrane

\*not all viruses have an envelope



# Classification of Viruses

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What type of genetic material?

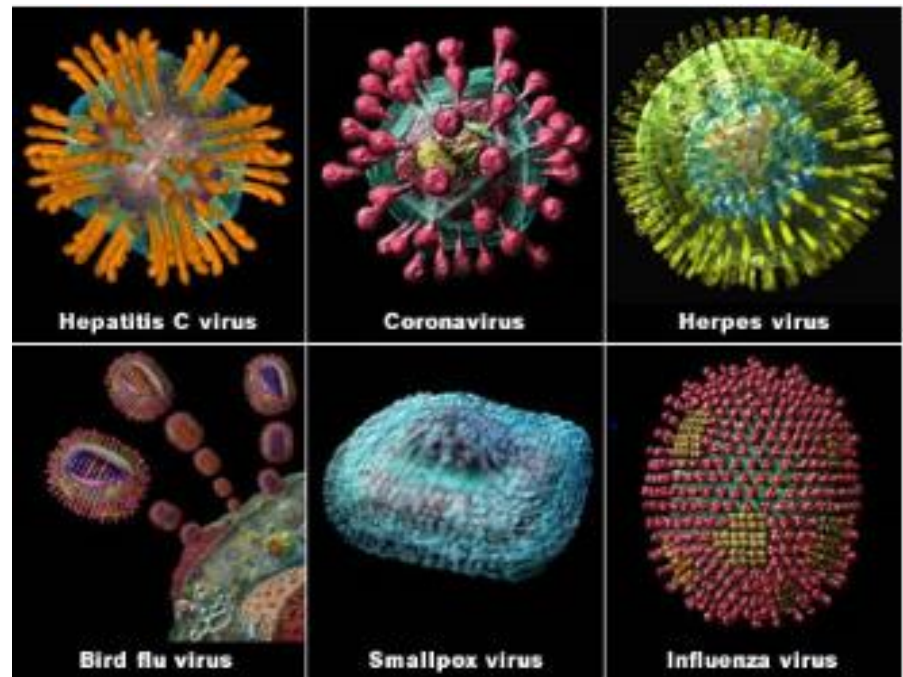
– DNA, RNA, proteins?

Type of capsid?

– What type of ligands?

Viral envelope present?

What type of host cells?

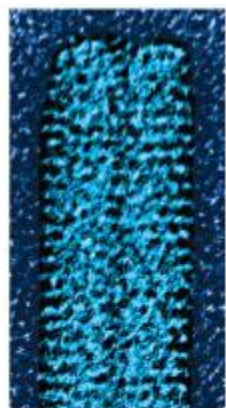
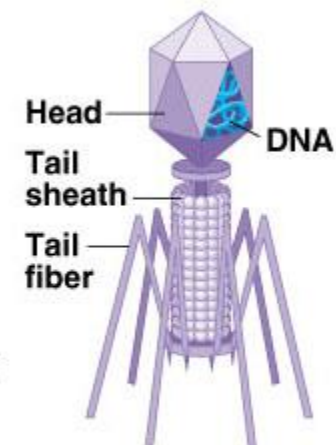
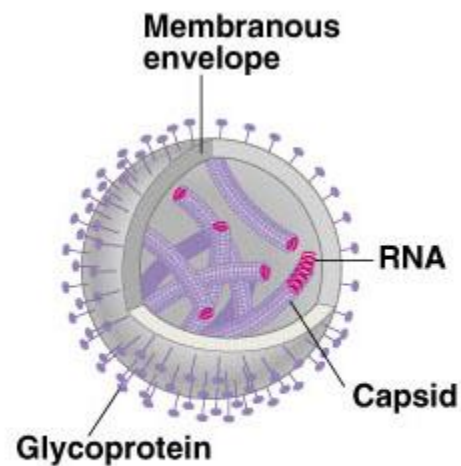
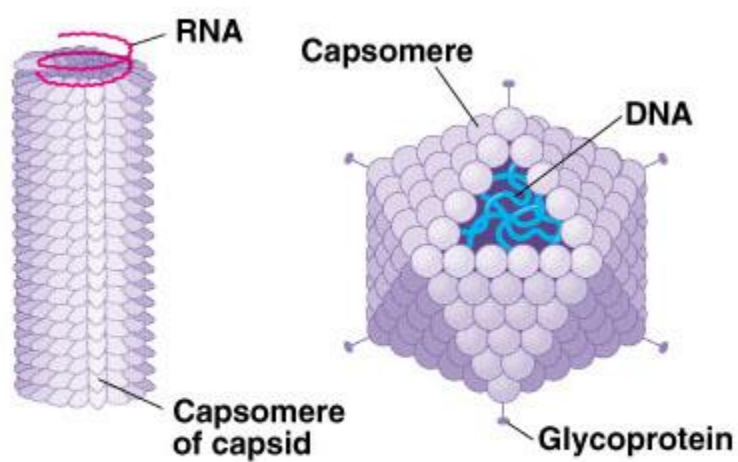


**Table 18.1 Classes of Animal Viruses, Grouped by Type of Nucleic Acid**

<b>Class*</b>	<b>Examples/Diseases</b>
<b>I. dsDNA**</b>	
Papovavirus	Papilloma (human warts, cervical cancer); polyoma (tumors in certain animals)
Adenovirus	Respiratory diseases; some cause tumors in certain animals
Herpesvirus	Herpes simplex I (cold sores), herpes simplex II (genital sores); varicella zoster (chicken pox, shingles); Epstein-Barr virus (mononucleosis, Burkitt's lymphoma)
Poxvirus	Smallpox; vaccinia, cowpox
<b>II. ssDNA</b>	
Parvovirus	Roseola; most parvoviruses depend on co-infection with adenoviruses for growth
<b>III. dsRNA</b>	
Reovirus	Diarrhea; mild respiratory diseases
<b>IV. ssRNA that can serve as mRNA</b>	
Picornavirus	Poliovirus; rhinovirus (common cold); enteric (intestinal) viruses
Togavirus	Rubella virus; yellow fever virus; encephalitis viruses
<b>V. ssRNA that is a template for mRNA</b>	
Rhabdovirus	Rabies
Paramyxovirus	Measles; mumps
Orthomyxovirus	Influenza viruses
<b>VI. ssRNA that is a template for DNA synthesis</b>	
Retrovirus	RNA tumor viruses (e.g., leukemia viruses); HIV (AIDS virus)

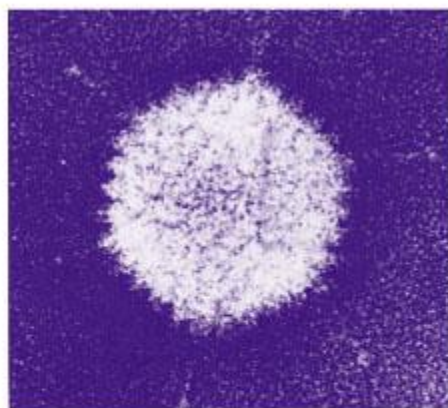
\*The classification is based on the type of nucleic acid and the mode of replication.





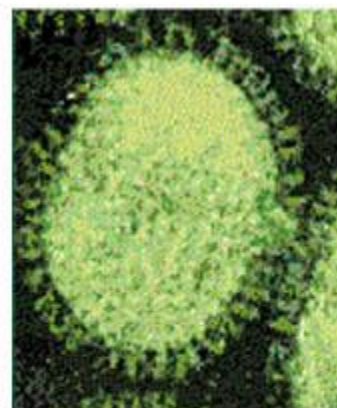
10 nm

(a) Tobacco mosaic virus



50 nm

(b) Adenoviruses



50 nm

(c) Influenza viruses

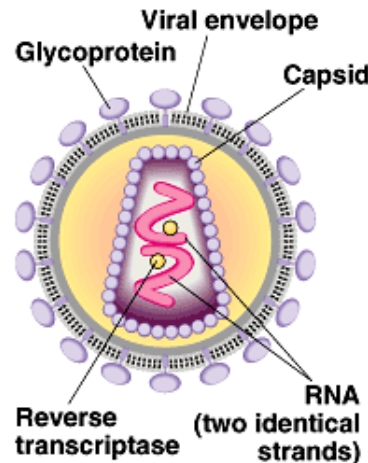


50 nm

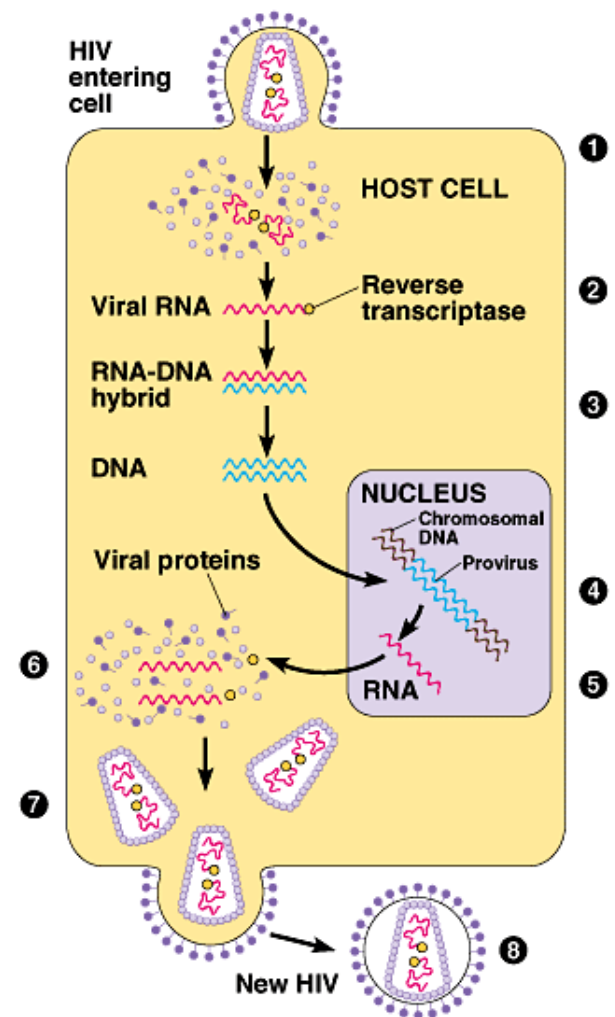
(d) Bacteriophage T4

# Notable Viruses - Retroviruses

- are special class that use RNA to make DNA with special enzyme called reverse transcriptase
- Ex: HIV



(a) The structure of HIV, the virus that causes AIDS



(b) The reproductive cycle of HIV



# Notable Viruses - Retroviruses

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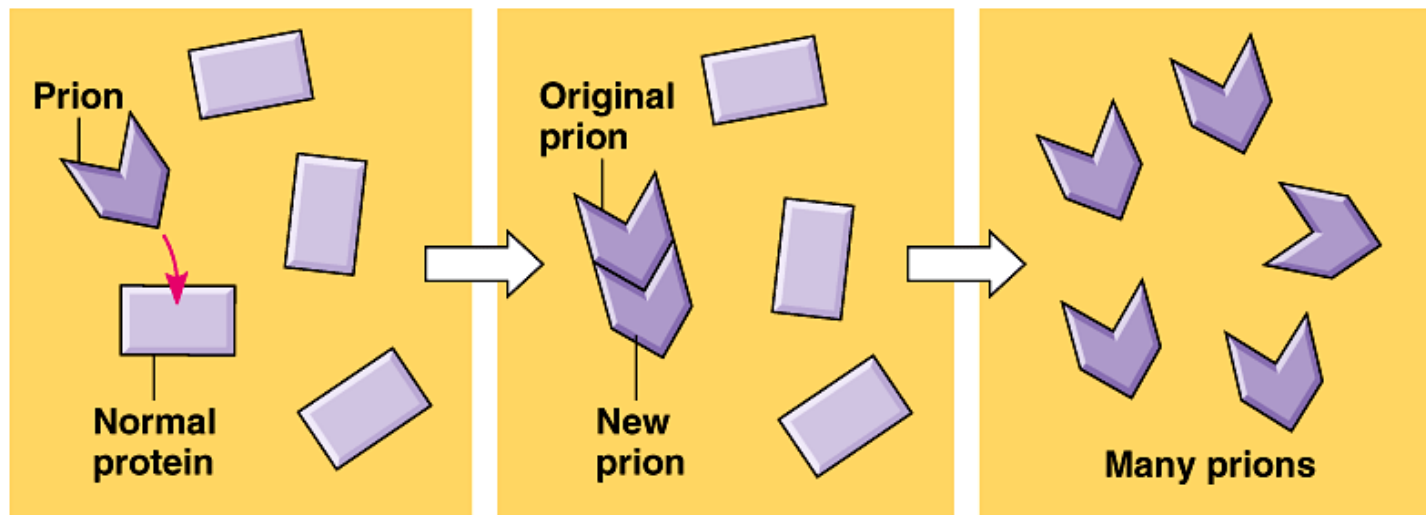
- once in the nucleus of the host cell, reverse transcriptase will change the viral RNA back to DNA
- DNA will enter the nucleus of the host cell
- when the cell undergoes transcription, it will transcribe the viral DNA into retrovirus offspring
- these offspring can leave the cell to infect others

# Notable Viruses - Prions

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- incorrectly folded form of a brain cell protein that makes other proteins fold incorrectly
- very little information is known about them
- Ex: mad cow

fatal familial insomnia



# Notable Viruses - Viroids

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- short RNA sequences (thought to be escaped introns) that don't code for proteins
- uses RNA polymerase II to make several circular copies
- can cause disease
- mostly in plants



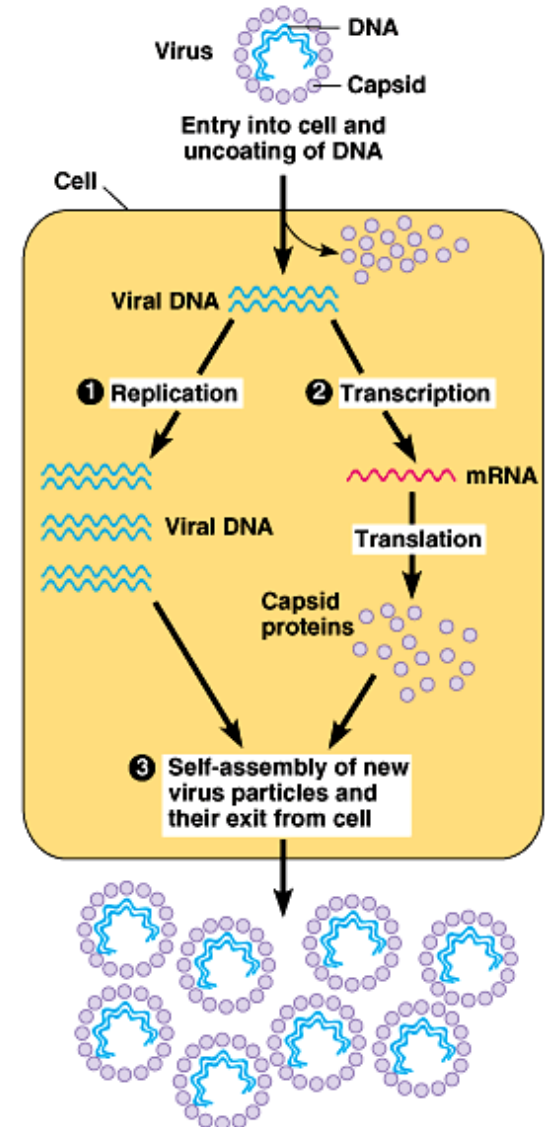
# Check for Understanding

1. What 3 parts do all viruses have?
  - What is important about the envelope?
2. What are the 4 types of genetic info that viruses may contain?
3. Do viruses metabolize?

# Life Cycle of a Virus - overview

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- inject DNA
- viral DNA takes over host metabolic machinery
- viral DNA is replicated and viral DNA is transcribed/translated
- parts are assembled and ready to infect new cells





# Life Cycle of a Virus -

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## 2 Major Life Cycle Pathways:

### 1. Lytic Cycle

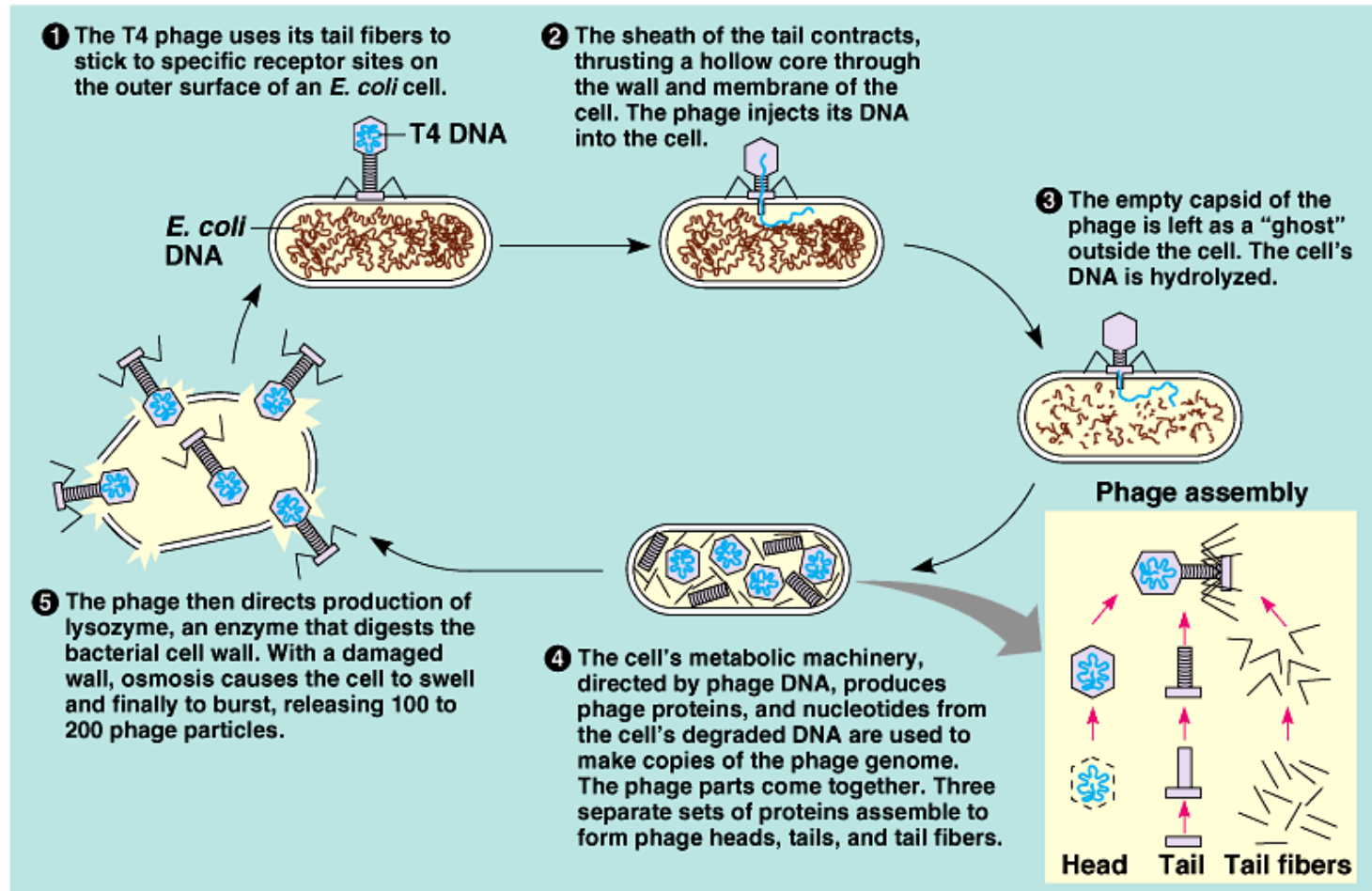
- active, virulent life cycle

### 2. Lysogenic Cycle

- virus become dormant
- incorporates its entire DNA into its host

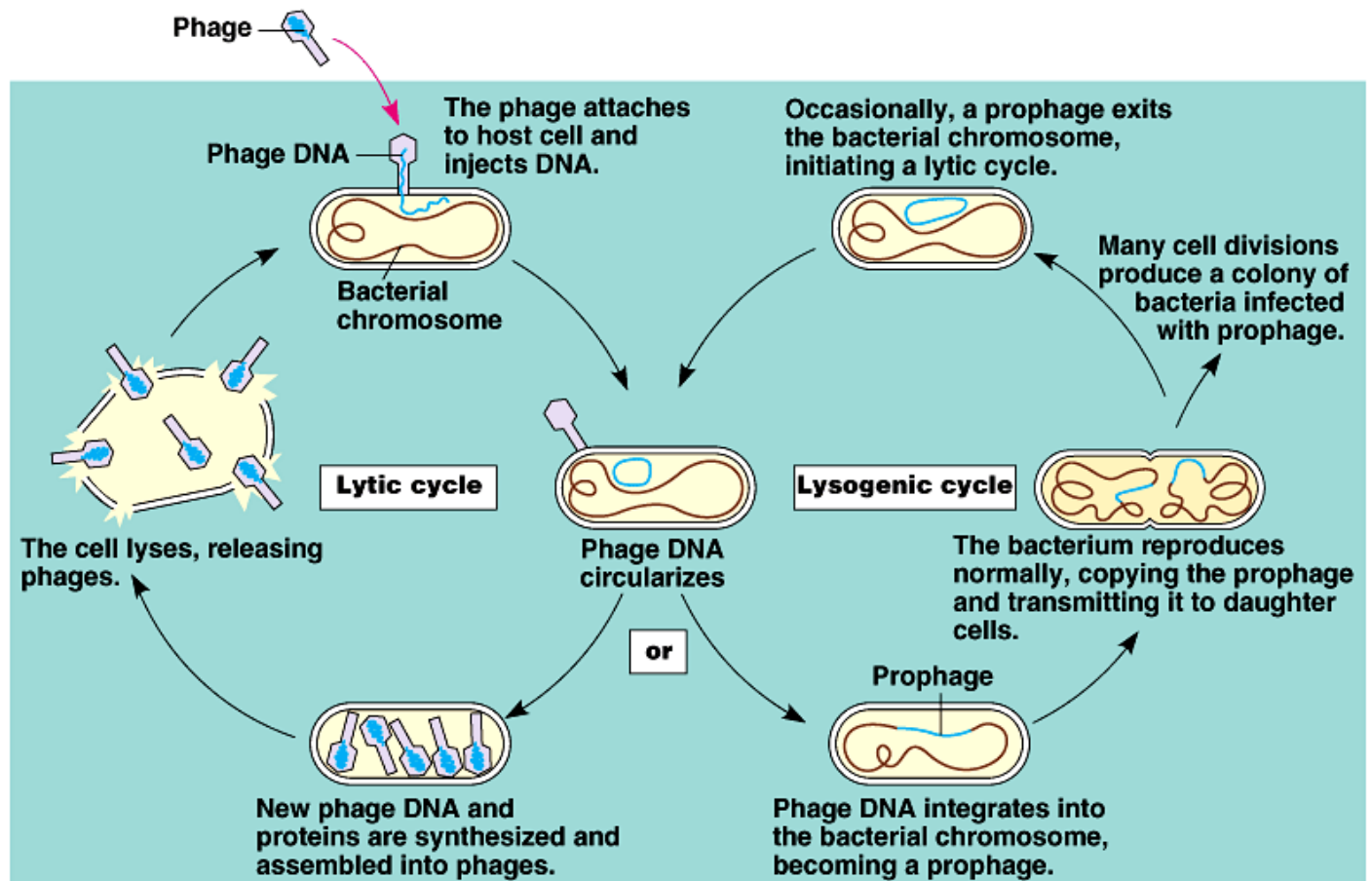
# Life Cycle of a Virus – Lytic Cycle

1) virus attachment, 2) injection, 3) replication, 4) lysis

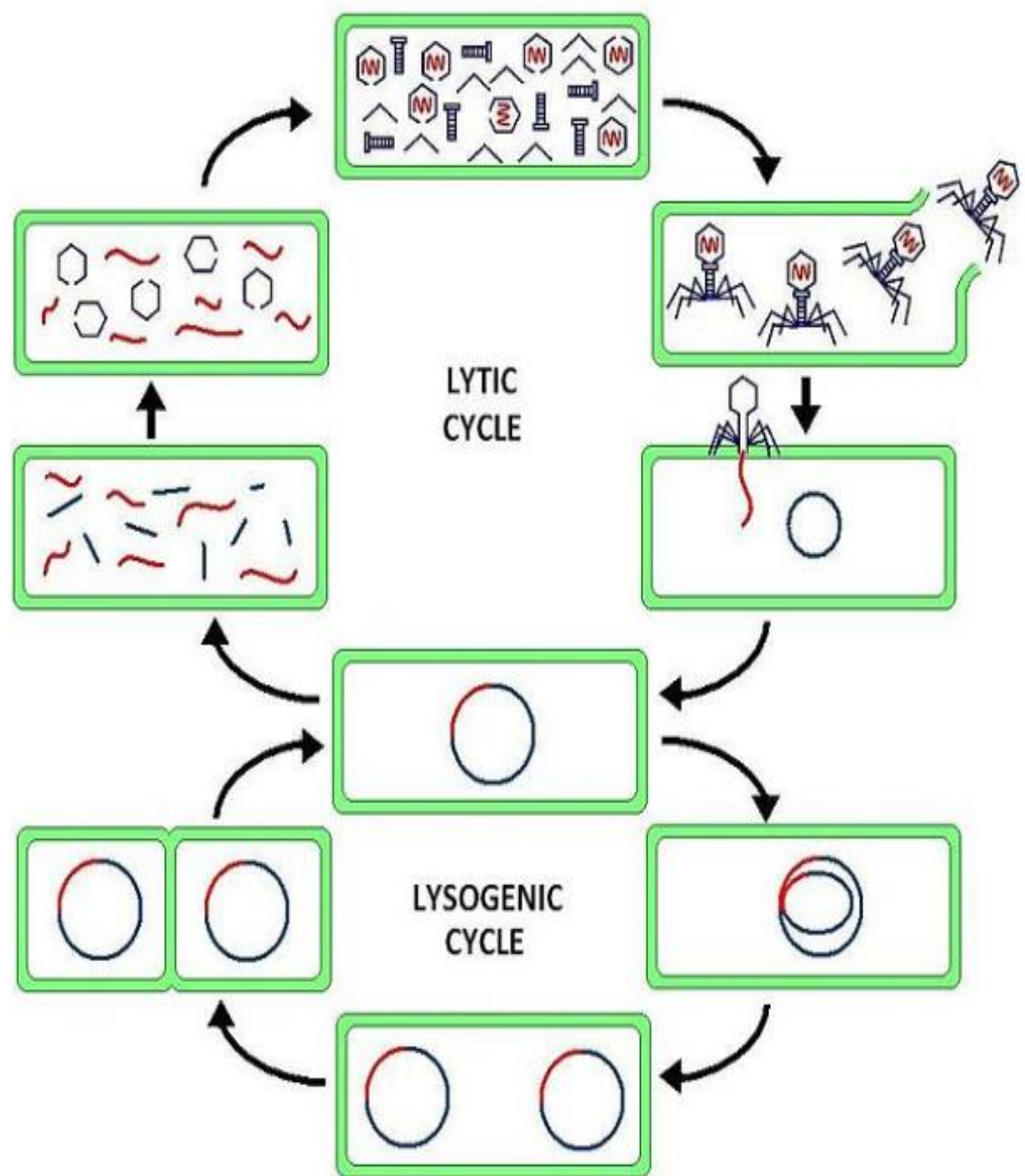


# Life Cycle of a Virus – Lysogenic Cycle

1) virus attachment, 2) injection, 3) replication, 4) prophage, 5) reproduction, 6) may finish lytic cycle



- chicken pox outbreak = lytic cycle
- chicken pox DNA stays embedded in cellular DNA, later becomes shingles = lysogenic cycle



## Misc.

- viruses can cause cancer
- viral disease can be from enzymes released from lysosomes or toxins on surface or tissue it invades lack of ability to regenerate (destroys tissue when breaks out)
- emerging viruses come from these sources: evolving viruses, species jump, or population changes