Notes: Virology

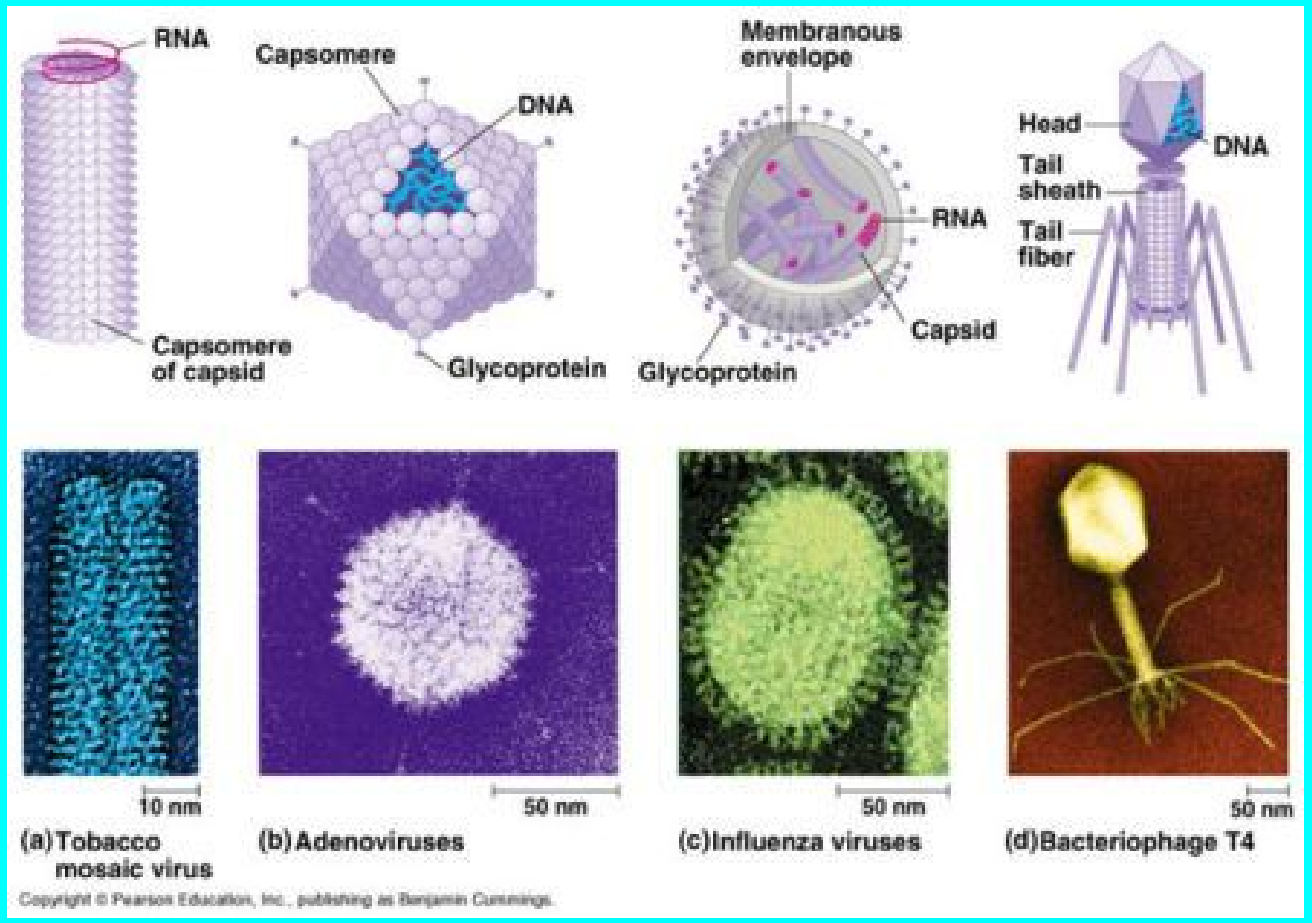
Read & Answer Questions from the following notes into your ISN to study

Virus Notes Review Questions

Glue in & Answer on paper. Get Teacher Stamp.

1. Identify 3 things found in cells that are not in viruses.
2. Identify the 2 parts of a virus.
3. Name the 3 general groups of viruses.
4. Name the first virus discovered and who discovered said virus.
5. How many different viral shapes are there?
6. Define virulence.
7. What is a bacteriophage?

Viruses



Dead or alive?

First virus discovered

Tobacco Mosaic Virus

by Martinus Beijerinck – 1898

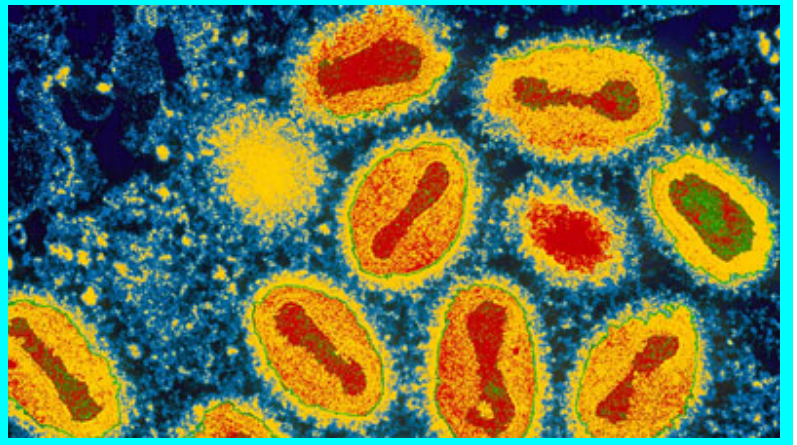
- Founder of Virology – even though he couldn't see them!
- Called them viruses after the Latin word – **virulentus** – poisonous or foul

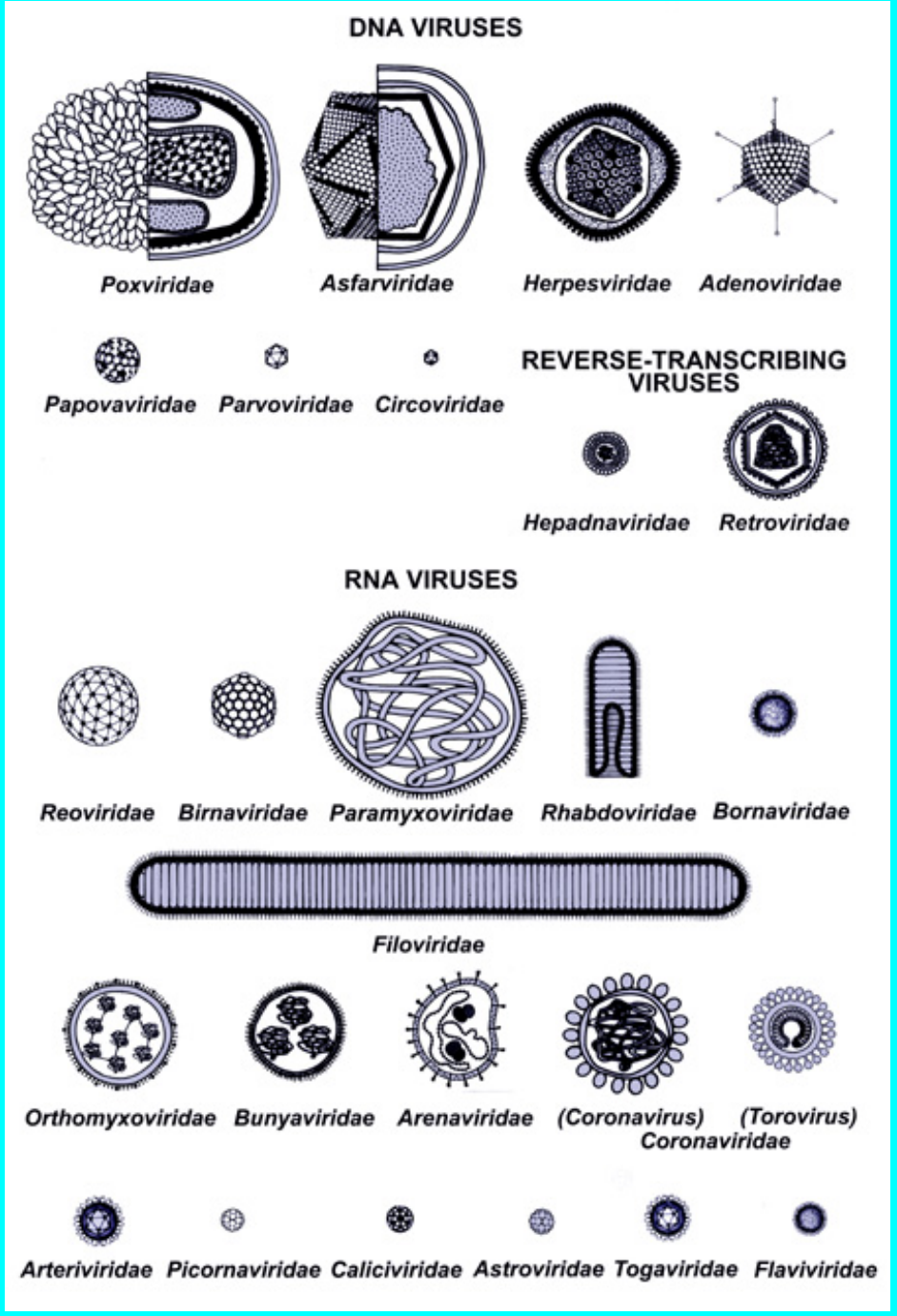
Viral structure

- Viruses are NOT cells.
- Basic Structure:
  - Protein coat
  - Nucleic acid core (RNA or DNA)
  - Lipoprotein coat
    - (second coat – only in enveloped viruses)

Virus Categories

- **DNA viruses** – stable, do not mutate rapidly
  - Single-stranded or double-stranded
  - Smallpox, Hepatitis B
- **RNA viruses** – mutate rapidly, unstable
  - Single-stranded or double-stranded
  - HIV, Rhinovirus




DNA VIRUSES
Poxviridae
Asfarviridae
Herpesviridae
Adenoviridae
Papovaviridae
Parvoviridae
Circoviridae
REVERSE-TRANSCRIBING VIRUSES
Hepadnaviridae
Retroviridae
RNA VIRUSES
Reoviridae
Birnaviridae
Paramyxoviridae
Rhabdoviridae
Bornaviridae
Filoviridae
Orthomyxoviridae
Bunyaviridae
Arenaviridae
(Coronavirus)
(Torovirus)
Coronaviridae
Arteriviridae
Picornaviridae
Caliciviridae
Astroviridae
Togaviridae
Flaviviridae

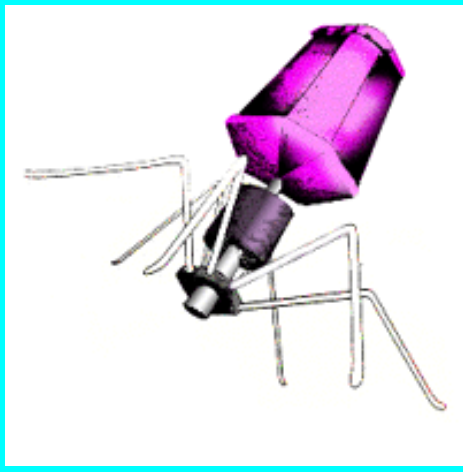
Viruses -The Boundary of Life

- At the boundary of life, between the **macromolecules** (which are not alive) and the **prokaryotic cells** (which are), lie the **viruses** and **bacteriophages** (phages).

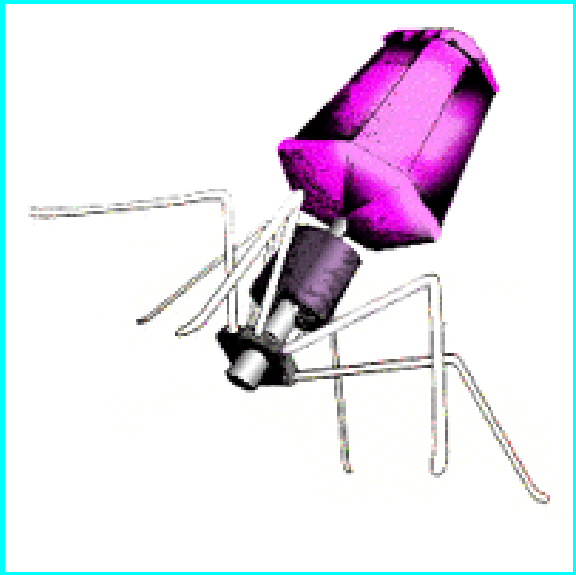
- These twilight creatures are **parasites** responsible for causing many diseases in living things (herpes and HIV in humans, for example).

- **Viruses are found everywhere.**

- Viruses consist of a **core of nucleic acid, either DNA or RNA, and a protective coat of protein molecules and sometimes lipids.**



- In isolation, viruses and bacteriophages show **none** of the expected signs of life. They **do not** respond to stimuli, grow, or do any of the things we normally associate with life.



- Strictly speaking, they should not be considered "living" organisms at all.
- They are more complex than a lifeless collection of macromolecules and they do show one of the most important signs of life: the ability to **reproduce at a fantastic rate but only in a host cell**.

- **Bacteriophages attack bacteria (prokaryotes)**

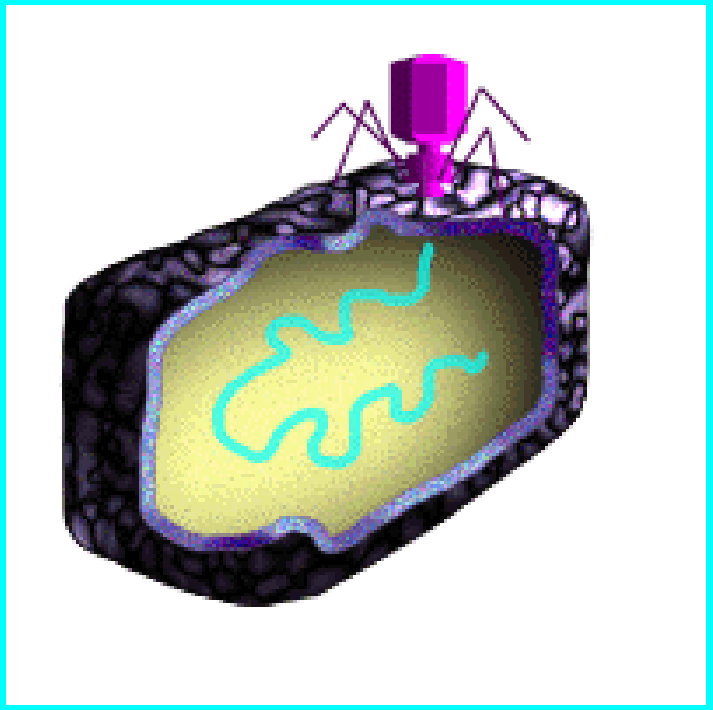
- **viruses attack eukaryotic cells.**

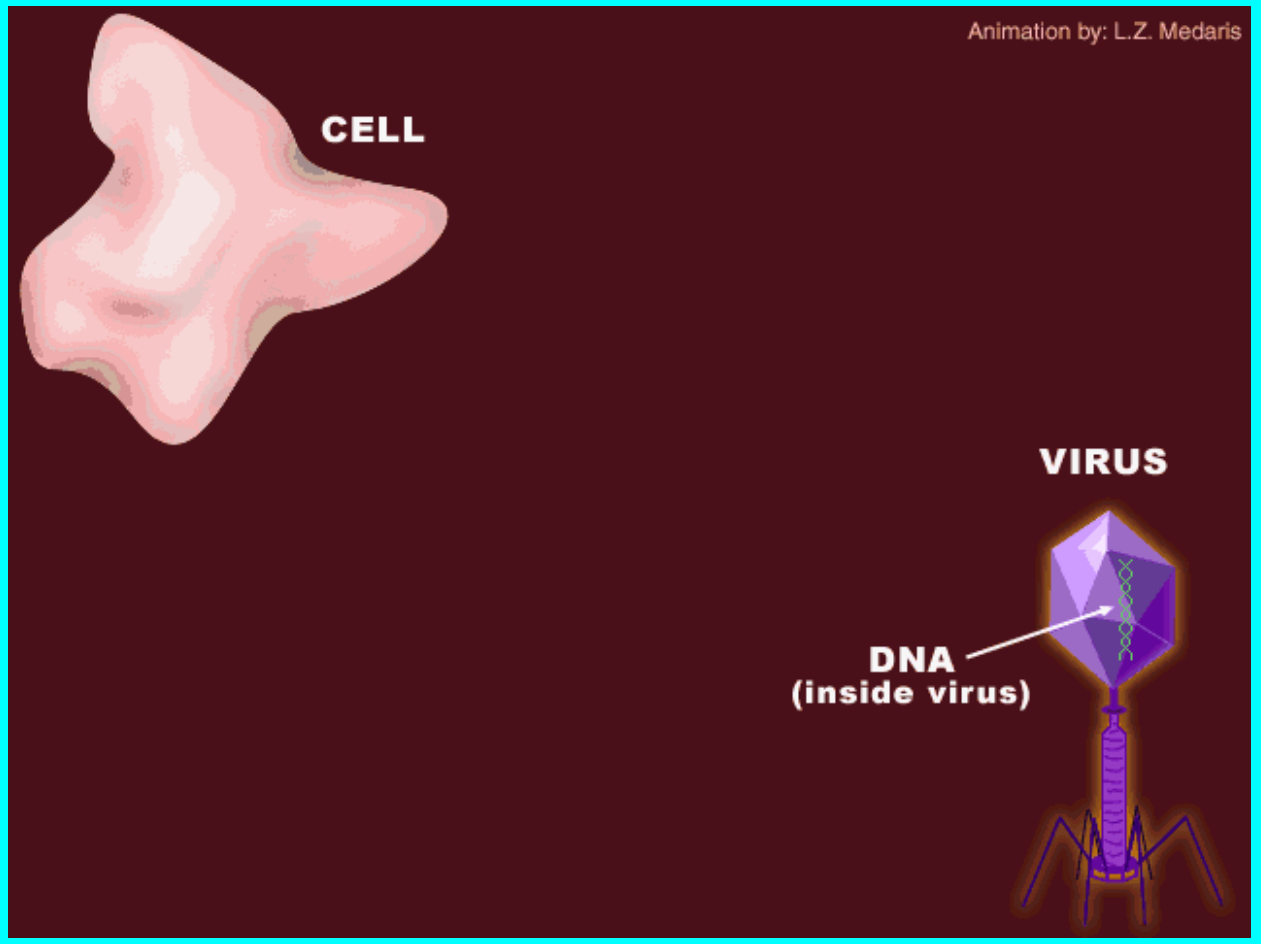
- Viruses and bacteriophages invade cells and use the host cell's machinery to synthesize more of their own macromolecules.

- Once inside the host the bacteriophage or virus will either go into a **Lytic Cycle - destroying the host cell during reproduction.**

OR

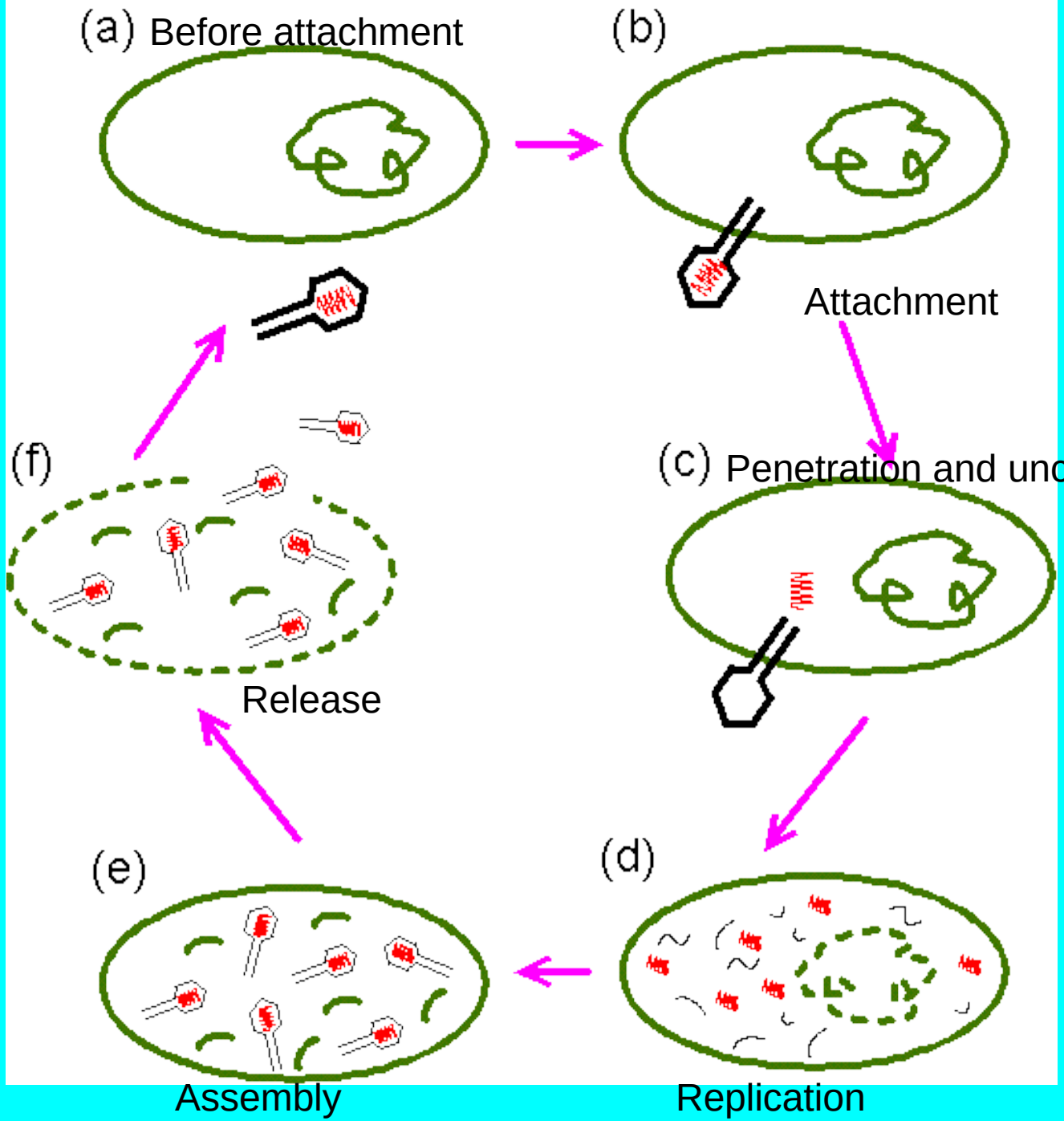
- It will go into a **Lysogenic Cycle - a parasitic type of partnership with the cell**

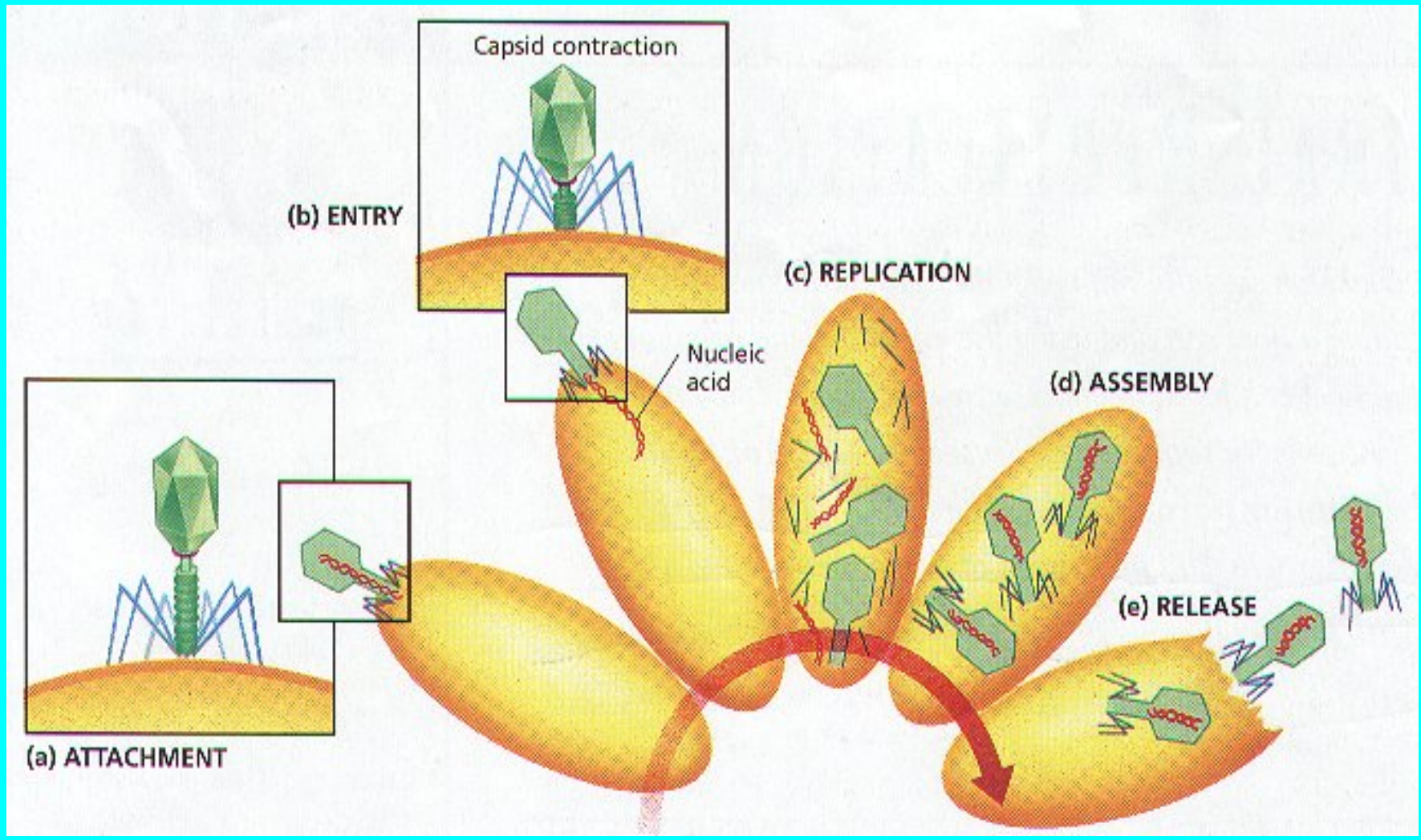



Animation by: L.Z. Medaris
CELL
VIRUS
DNA
(inside virus)

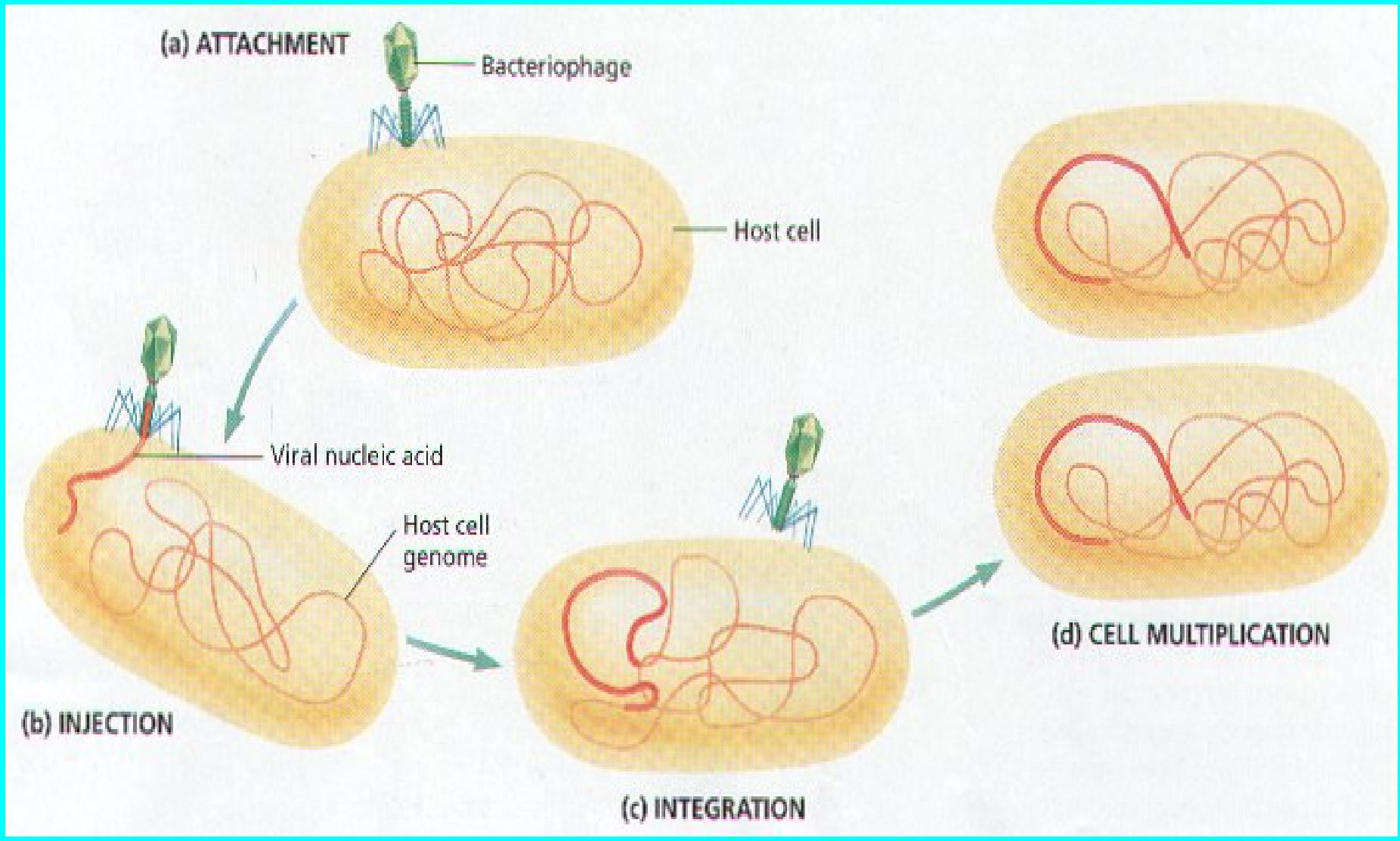
Lytic Cycle

- Virus attaches to host cell's membrane and injects its nucleic acid into the host cell.
- The viral nucleic acid takes over protein synthesis, creating new viruses.
- The host cell bursts, lyses, releasing the newly formed viruses.
- Host cell dies, hence the word lysis

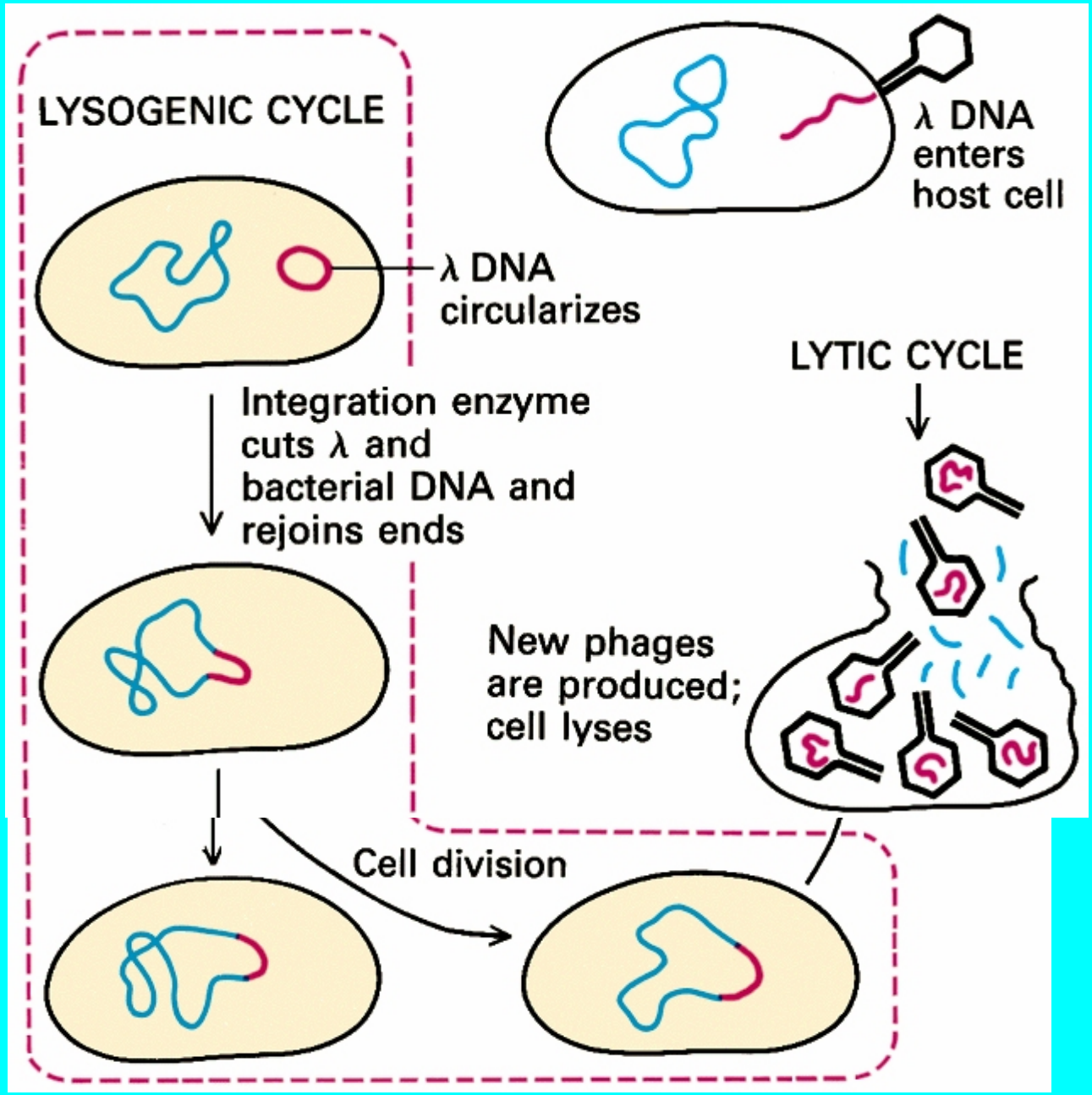

(a) Before attachment
(b)
Attachment
(c) Penetration and uncoating
(d)
Replication
(e)
Assembly
(f)
Release



The Lytic Cycle



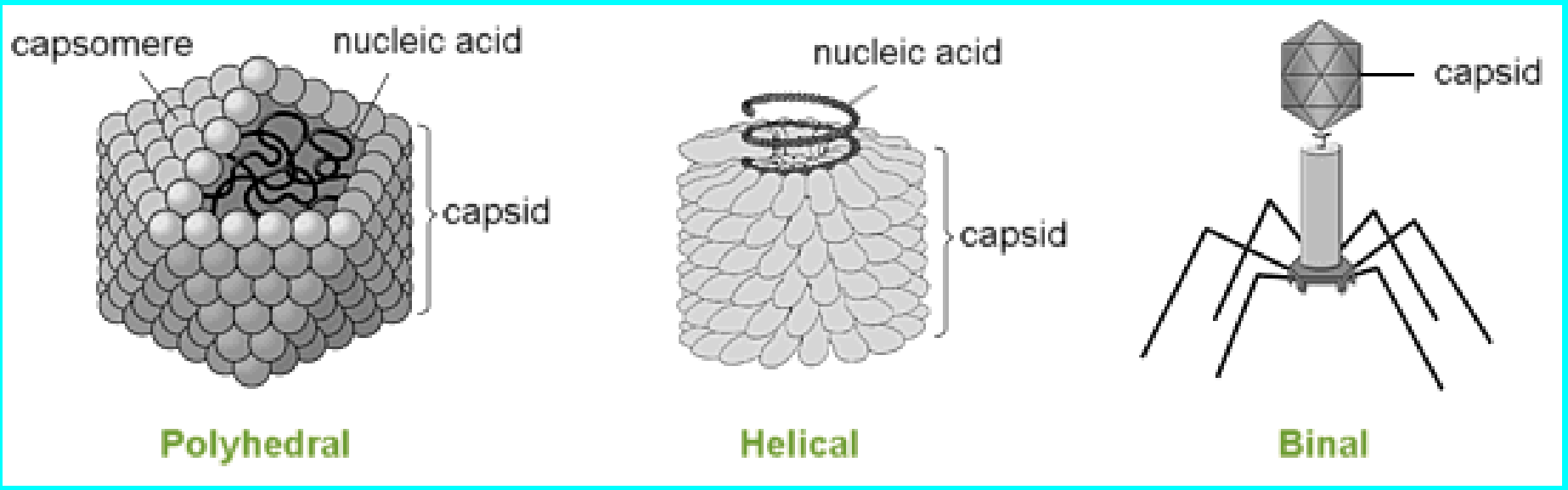
The Lysogenic Cycle

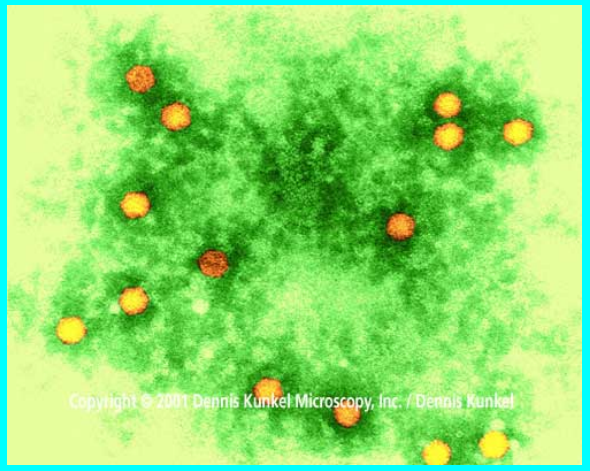

LYSOGENIC CYCLE
λ DNA enters host cell
λ DNA circularizes
LYTIC CYCLE
Integration enzyme cuts λ and bacterial DNA and rejoins ends
New phages are produced; cell lyses
Cell division

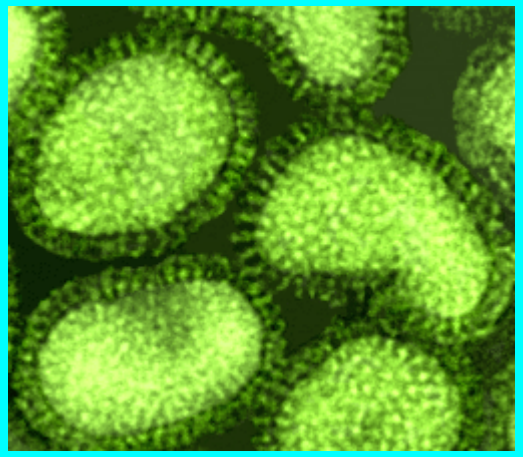
Examples of LYSOGENIC viruses:

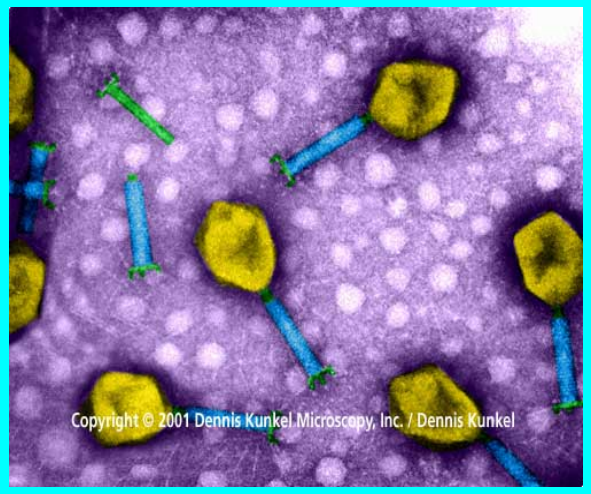
- **Varicella zoster AKA chicken pox** – first enters lytic stage after infecting a human– breakout of sores, then the lysogenic cycle before travelling to the nervous system, where it resides in the nerve fibers as an episomal element (element residing in chromosome without affecting the cell). After a long period of time(months to years) in a latent stage, the virus is often reactivated to the lytic stage during which it manifests itself as shingles.
- **Herpes** – after the lysogenic phase, the lytic stage can damage the nervous system in severe cases
- **Human Papilloma Virus – AKA warts**

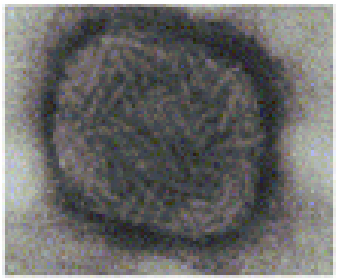
What triggers the lytic stage varies – stress, illness, immune supressant disorders, etc.


capsomere
nucleic acid
capsid
Polyhedral
nucleic acid
capsid
Helical
capsid
Binal

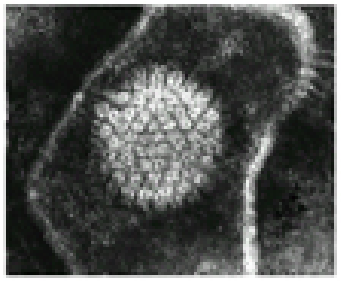

Copyright © 2001 Dennis Kunkel Microscopy, Inc. / Dennis Kunkel



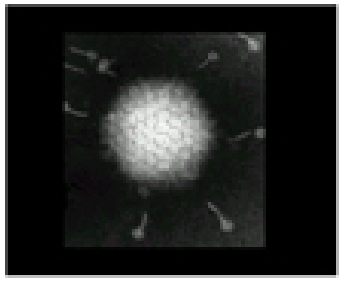

Copyright © 2001 Dennis Kunkel Microscopy, Inc. / Dennis Kunkel



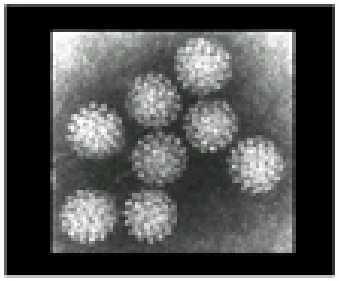
Poxviridae



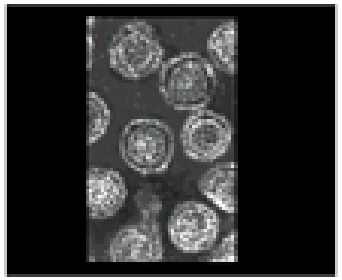
Herpesviridae



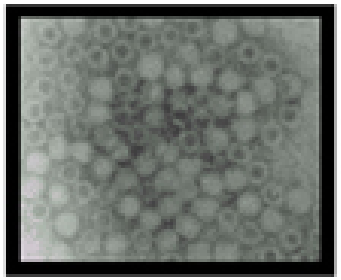
Adenoviridae



Papovaviridae
human papilloma



Hepadnaviridae

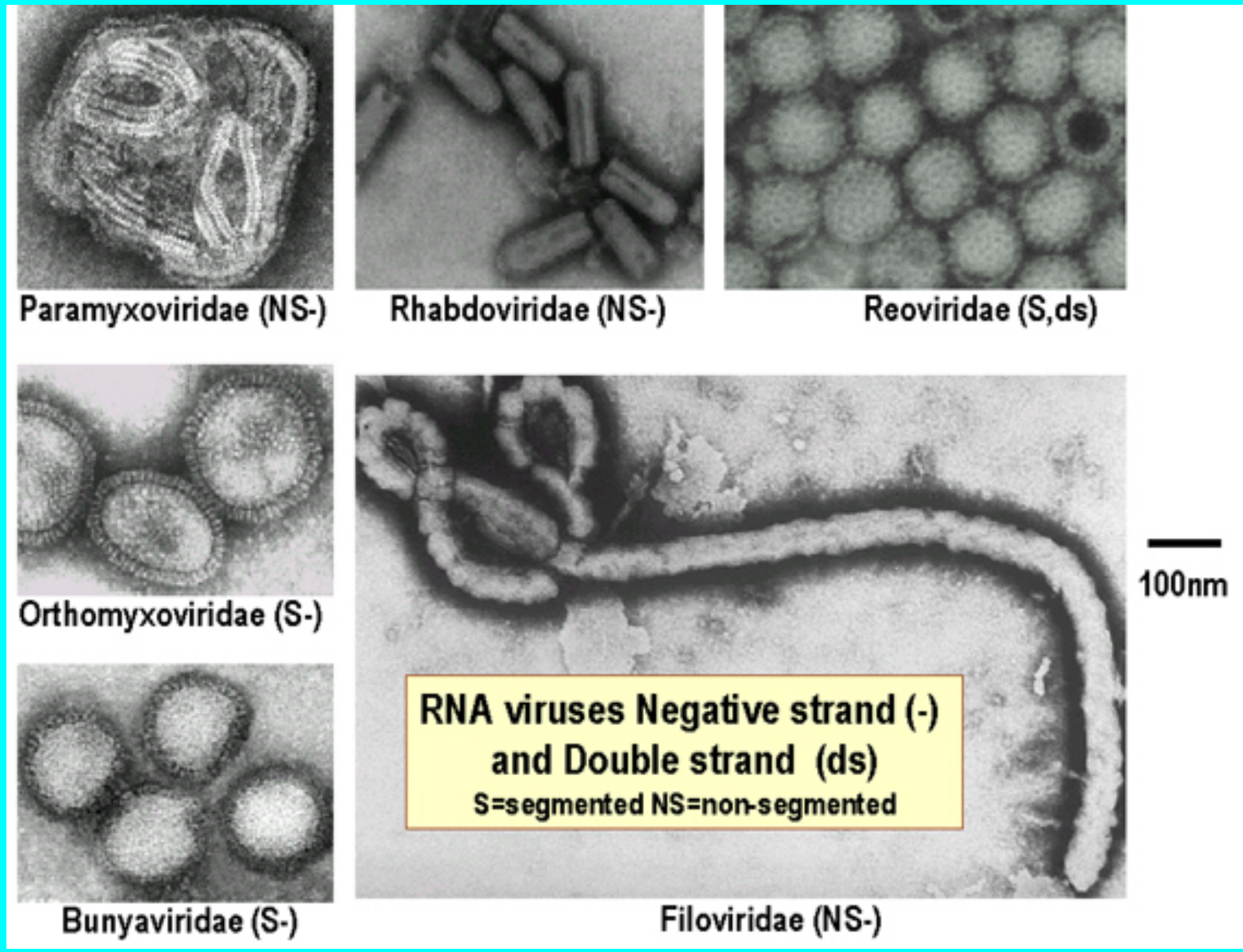


Parvoviridae

DNA Viruses

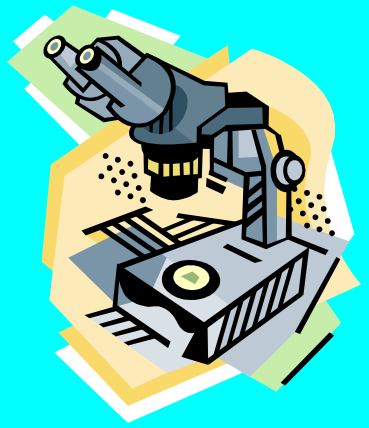
100 nanometers

A provirus is a DNA virus that has been inserted into a host cell chromosome.



A **retrovirus** injects the enzyme, reverse transcriptase into the cell to copy viral RNA into DNA.

- A virus is an obligate intracellular parasite containing genetic material surrounded by protein
- Virus particles can only be observed by an electron microscope



- The classification of viruses is based on the type of nucleic acid contained within
  - RNA viruses---also known as a retrovirus
  - DNA viruses

Please DO NOT COPY these classification FAMILIES…
COPY ONLY the GROUP INFO.

Group I - dsDNA viruses (double stranded DNA)

Order *Caudovirales* (tailed bacteriophages).

- Family *Myoviridae* - e.g. *Enterobacteria phage T4*
- Family *Podoviridae*
- Family *Siphoviridae* - e.g. *Enterobacteria phage λ*

Unassigned

- Family *Ascoviridae*
- Family *Adenoviridae*
- Family *Asfiviridae*
- Family *Baculoviridae*
- Family *Corticoviridae*
- Family *Fuselloviridae*
- Family *Guttaviridae*
- Family *Herpesviridae* - e.g. Human herpseviruses
- Family *Iridoviridae*
- Family *Lipothrixviridae*
- Family *Nimaviridae*
- Family *Papillomaviridae*

Please DO NOT COPY these classification FAMILIES…
COPY ONLY the GROUP INFO.

Group I - dsDNA viruses (double stranded DNA)

Unassigned (cont'd)

- Family *Phycodnaviridae*
- Family *Plasmaviridae*
- Family *Polyomaviridae* - e.g. *Simian virus 40*
- Family *Poxviridae* - e.g. *Cowpox virus*, *Variola virus* (smallpox)
- Family *Rudiviridae*
- Family *Tectiviridae*
- Unassigned genera
  - *Mimivirus*; type species: *Acanthamoeba polyphaga mimivirus*

Please DO NOT COPY these classification FAMILIES…
COPY ONLY the GROUP INFO.

Group II - ssDNA viruses (single stranded DNA)

Unassigned bacteriophages
- Family *Inoviridae*
- Family *Microviridae*

Unassigned viruses
- Family *Geminiviridae*
- Family *Circoviridae*
- Family *Nanoviridae*
- Family *Parvoviridae* - e.g. *Parvovirus B19*
  - (most depend on coinfection with adenoviruses for growth)
- Unassigned genera
  - *Anellovirus* ; type species: *Torque teno virus*

Please DO NOT COPY these classification FAMILIES…
COPY ONLY the GROUP INFO.

Group III - dsRNA viruses (double stranded RNA)

Family *Birnaviridae*
Family *Chrysoviridae*
Family *Cystoviridae*
Family *Hypoviridae*
Family *Partitiviridae*
Family *Reoviridae* - e.g *Rotavirus*
Family *Totiviridae*
Unassigned genera
Endornavirus ; type species: *Vicia faba endornavirus*

- Viral life cycle consists of **six stages** within the host cell
  1. Attachment
  2. Penetration
  3. Uncoating
  4. Multiplication
  5. Assembly
  6. Release

- Recognizing the **shape, size, and structure** of different viruses is critical to the study of disease
  - Viruses have an inner core of nucleic acid surrounded by protein coat known as an envelope
  - Most viruses range in sizes from 20 – 250 nanometers

Vaccines – named after Vaccinia – or Cow Pox

- Edward Jenner – 1796 -? – Small Pox
- Jonas Salk – 1952,1955 - ? - Polio
- Albert Sabin – 1962 – Oral polio vaccine

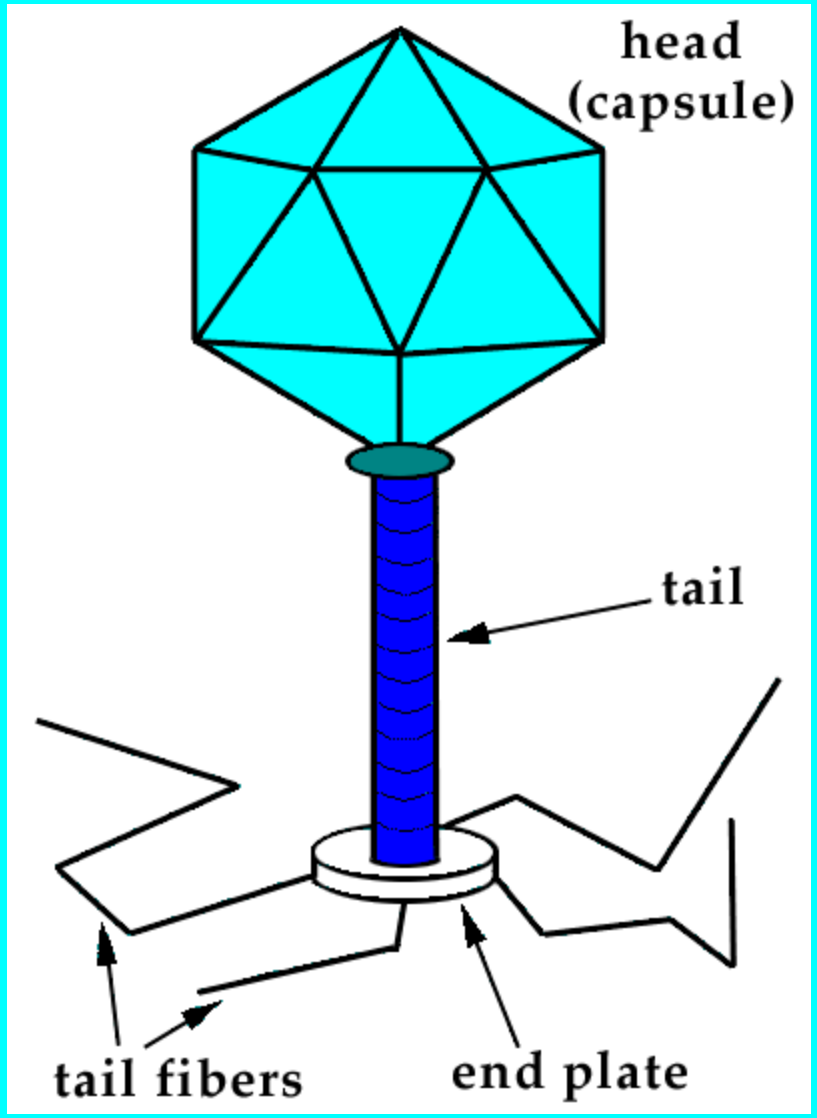
- Replication
  - Viruses replicate within a host cell while utilizing the host cell's nucleic acids.

- The cultivation of viruses is complex and includes three common methods
  - Chicken egg culture
  - Cell culture
  - Animal inoculation

http://cbm.msoe.edu/includes/swf/HAAnimation.swf

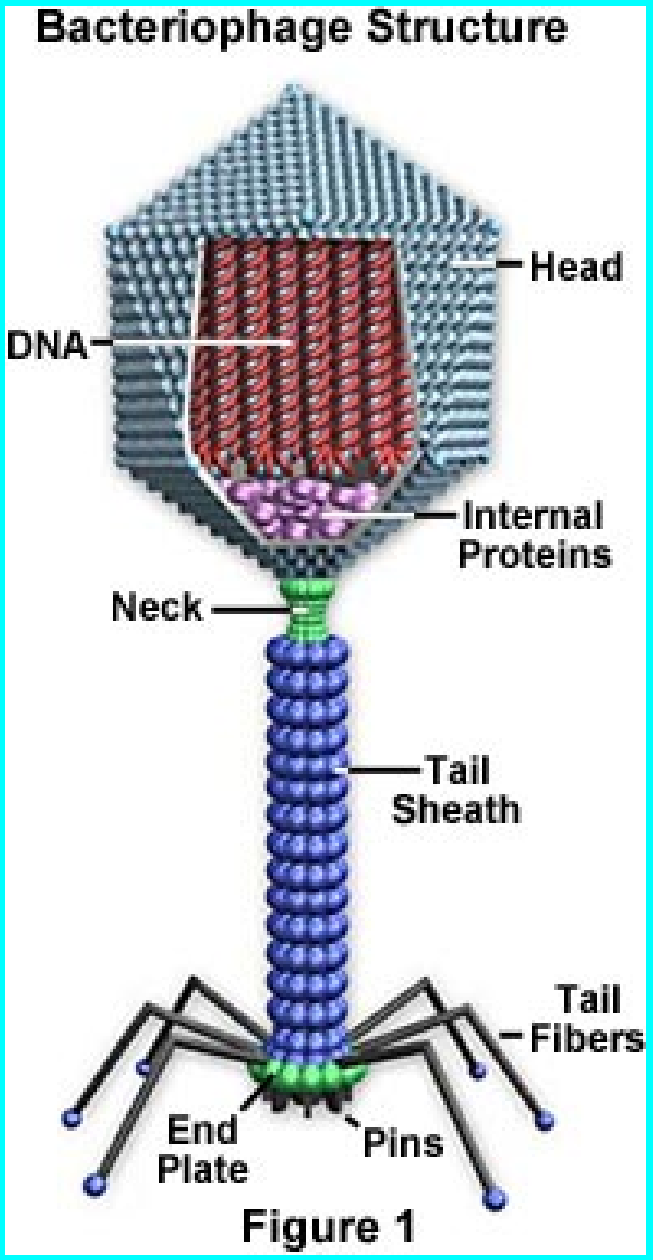
http://www.cellsalive.com/phage.htm

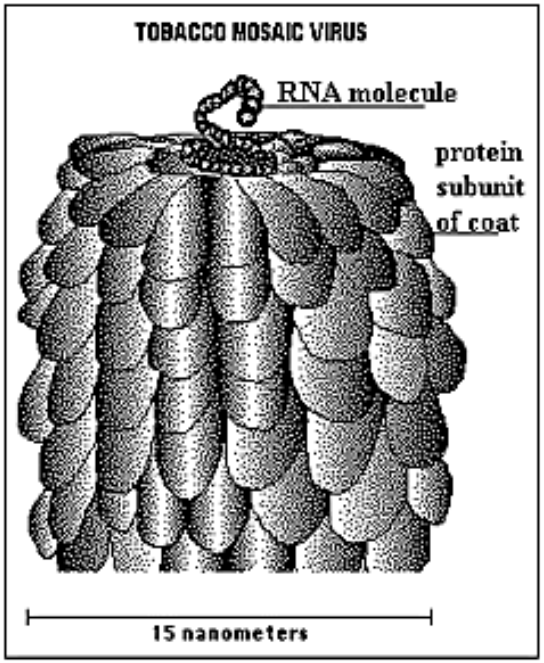
Bacteriophage

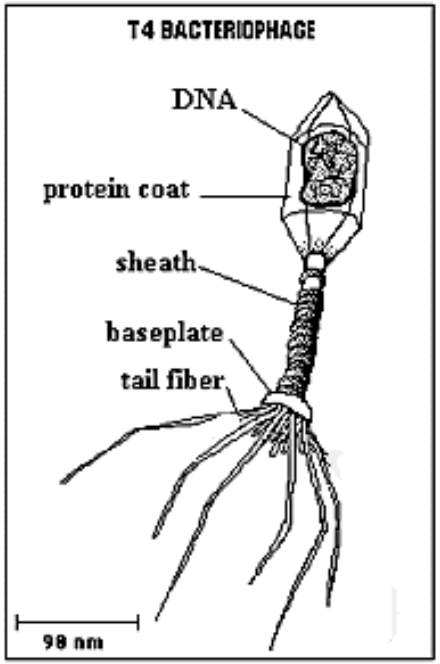


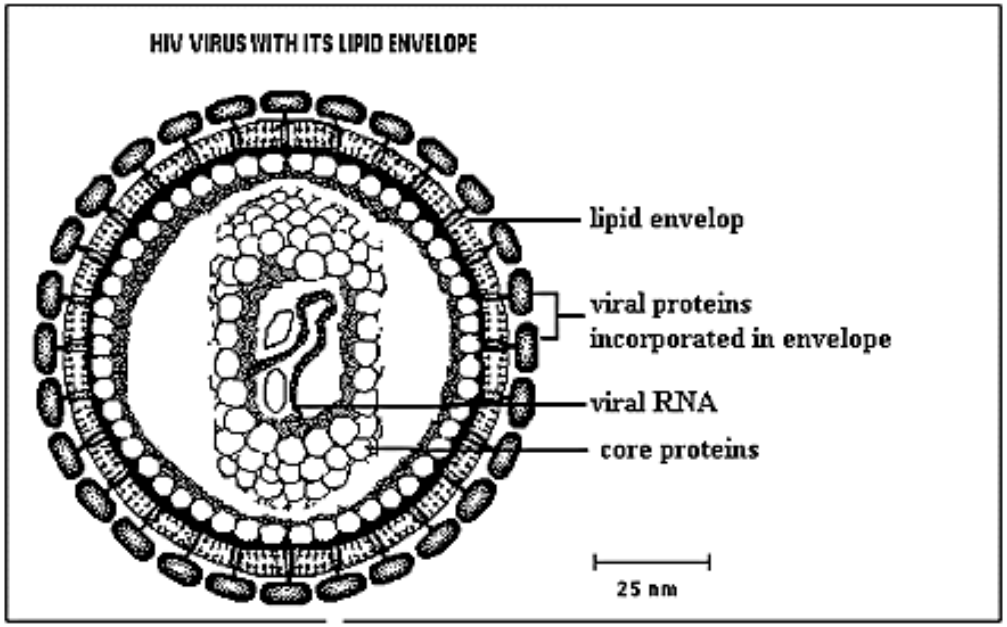
http://www.npr.org/templates/story/story.php?storyId=114075029

http://learn.genetics.utah.edu/content/begin/cells/scale/


Bacteriophage Structure
Head
DNA
Internal Proteins
Neck
Tail Sheath
Tail Fibers
End Plate
Pins
Figure 1







Examples of viruses

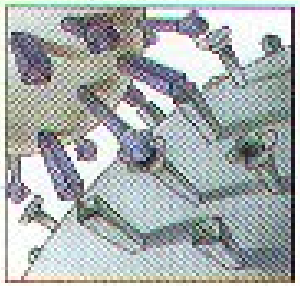
An Influenza Virus

Influenza viruses (red) attack a host cell (yellow) in a tissue culture.

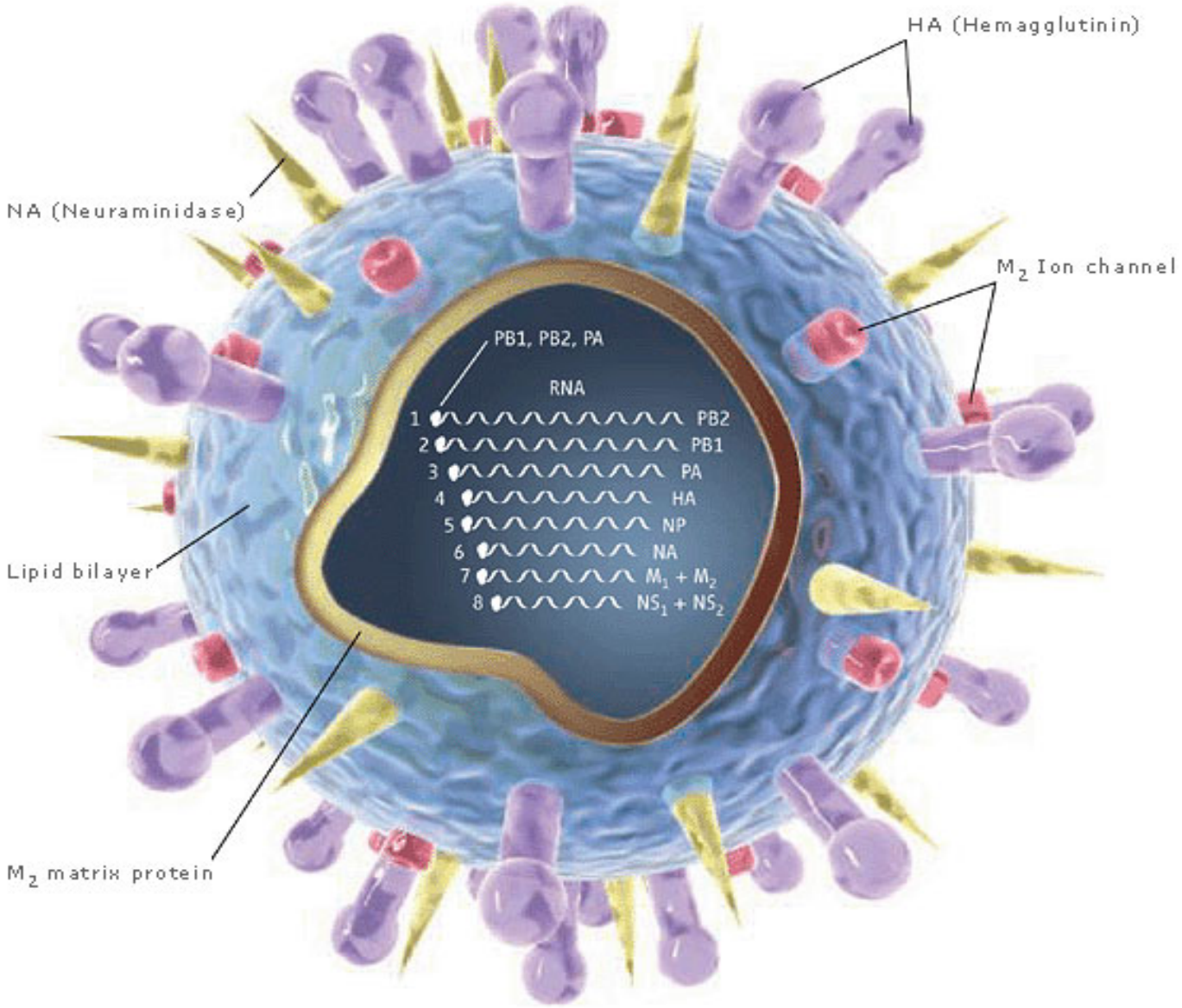
Envelope
An envelope is made of an outer lipid layer and an inner protein layer surrounding the capsid.

RNA
The influenza virus has a total of eight strands of RNA. Many viruses contain DNA rather than RNA.

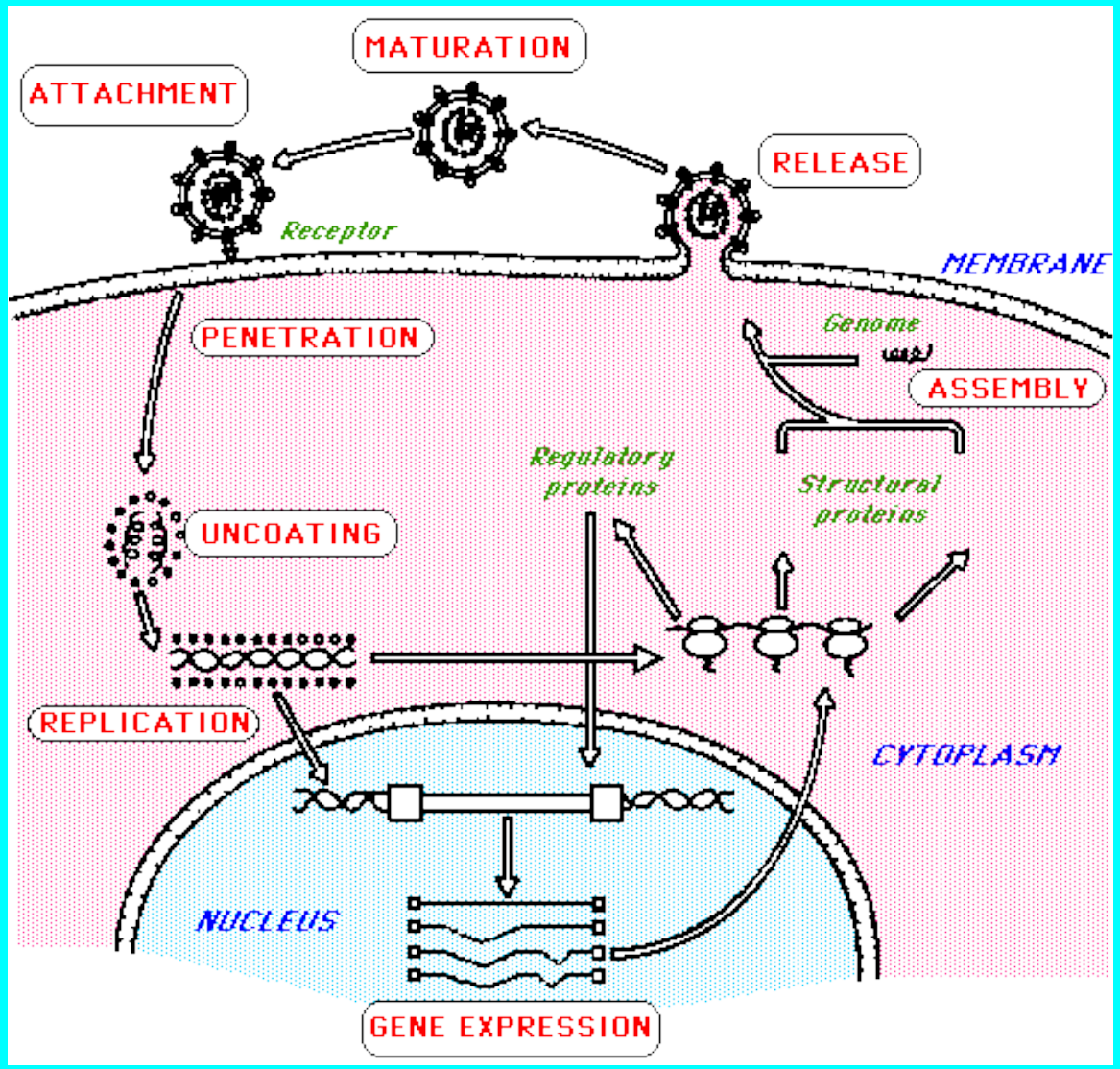
Capsid
The proteins in a capsid are determined by the genes in the virus.



Projections
The spikelike projections on the viral envelope help the virus recognize and attach to a host cell.



Viral Replication



http://www.youtube.com/watch?v=RO8MP3wMvqg

"OUT" Question– EXIT TICKET

Viruses

1. What was the most interesting virus you learned about today & Why?