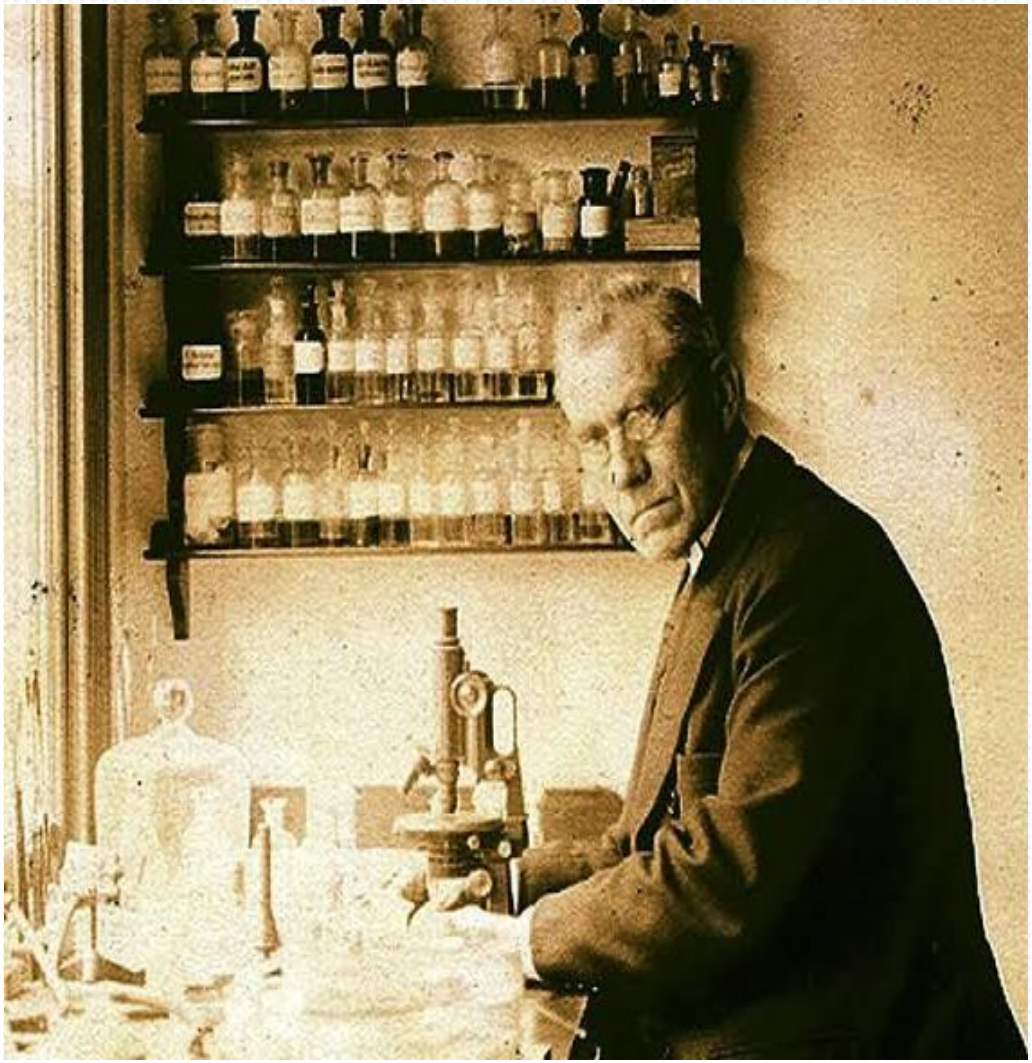
FTech 1200A – Food Microbiology Lecture I

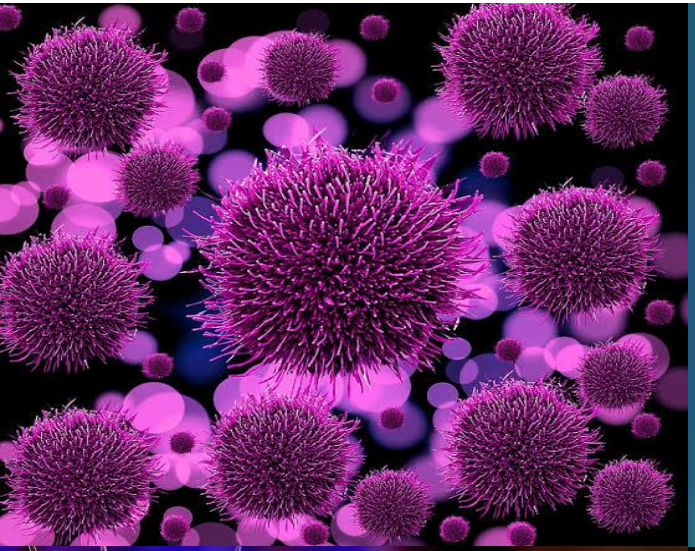
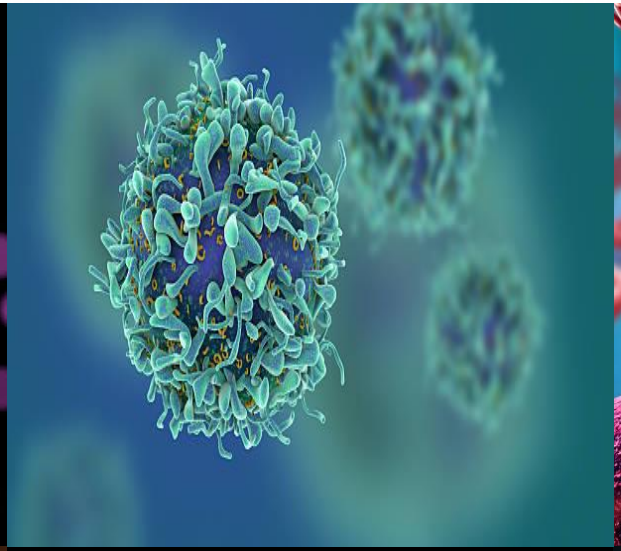
Janice C. Laforteza. MSc.

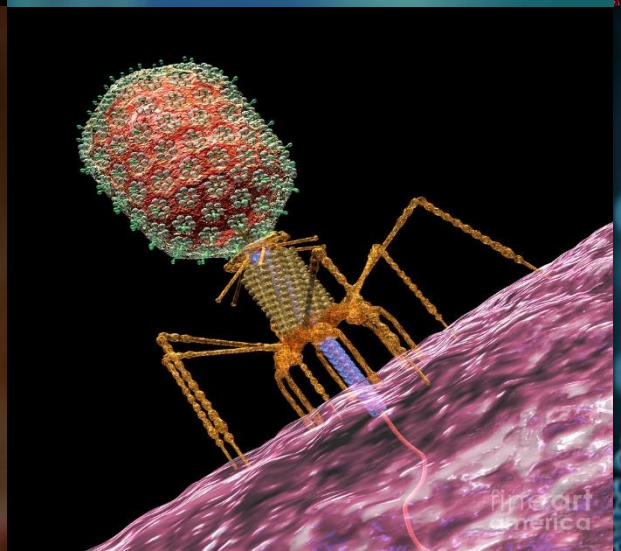
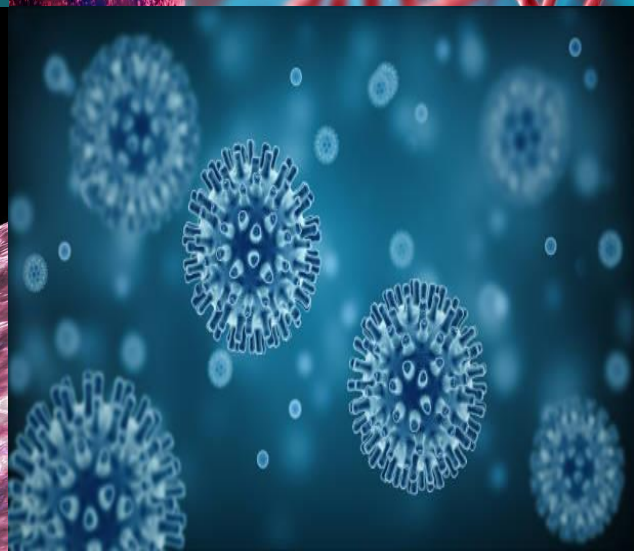
Viruses Discovery

- in 1892, Dmitri Ivanousky described a non-bacterial pathogen infecting tobacco plants



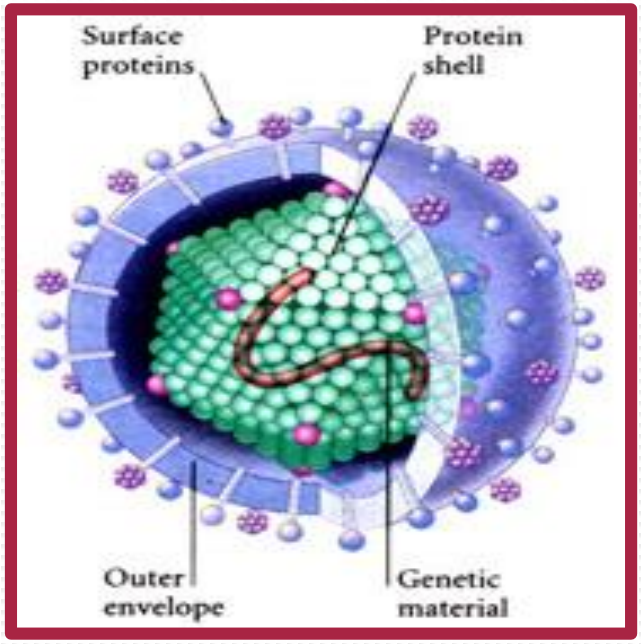
VIRUSES

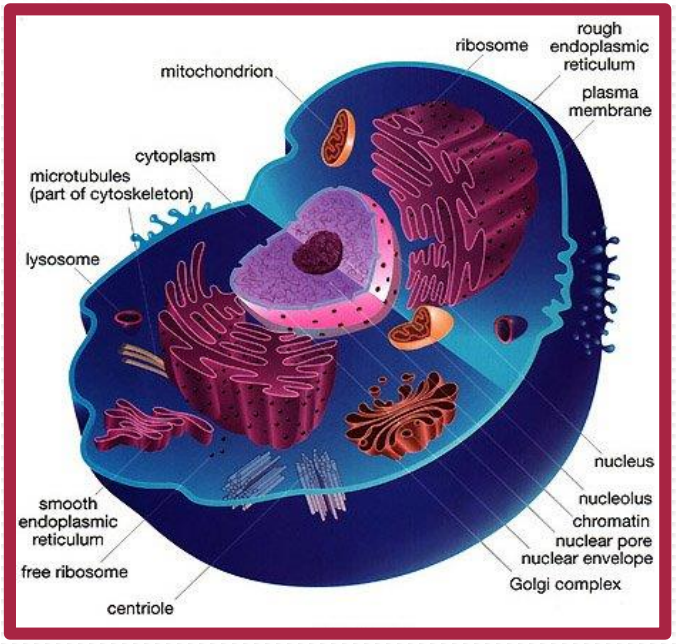




VIRUS

- is an infectious agent made up of nucleic acid (DNA or RNA) wrapped in a protein coat called a capsid
- non-cellular
- after the Latin word "poison"



VS



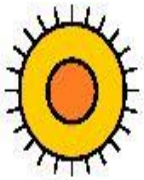
VIRUSES

- have either DNA or RNA but NOT both
- organism that depends entirely upon another living organism (a host) for its existence in such a way that it harms that organism

- is the study of viruses
- a sub-speciality of microbiology

Bacteria Vs. Viruses

Bacterium



Virus

Cocci means sphere

Spirillum means spiral

Bacillus means cylinder-shaped

80-750 microns ← **Size** → 0.01-0.3 microns

Coccus
Spirillum
Bacillus
← **Shapes** →
Helical
Polygonal
Spherical
Phage

Helix

Polygonal

Spherical

Phage

Food Source ← **Replication Requirements** → Specific tissue on a host cell

Some are, others are harmful ← **Beneficial?** → **NO!!**

YES!! ← **Cause disease?** → **YES!!**

Prescription Medications

Keeping areas clean

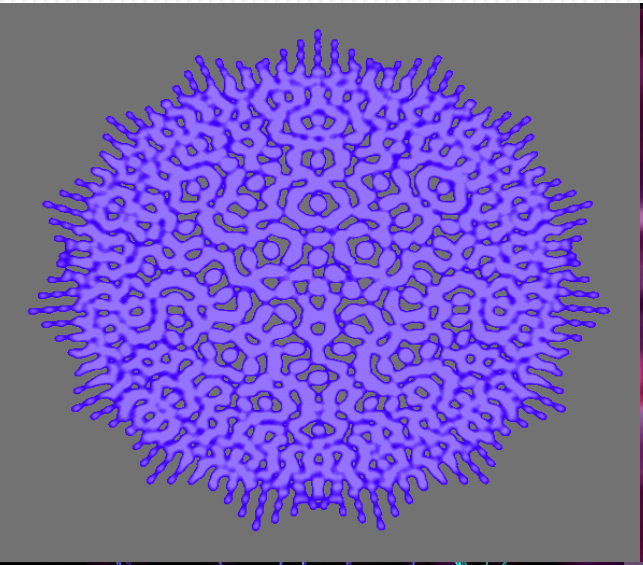
Sterilize
Disinfect
Antibiotics
← **Elimination Techniques** →
Sterilize
Disinfect
Antiviral Agents

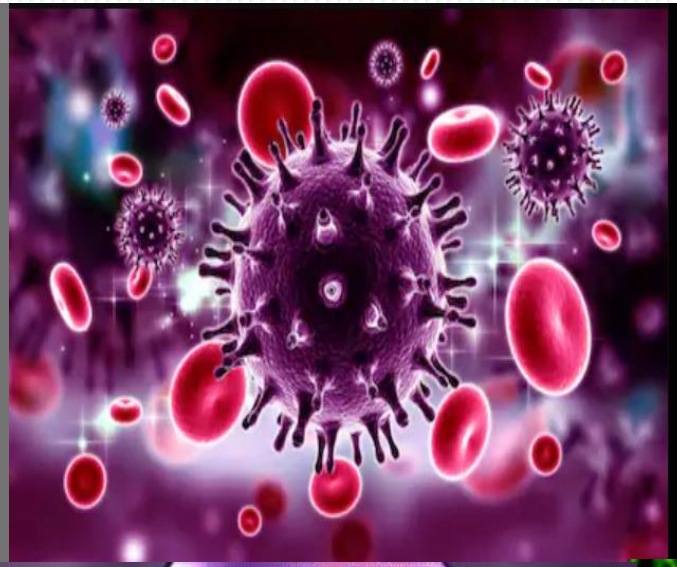
Detergents

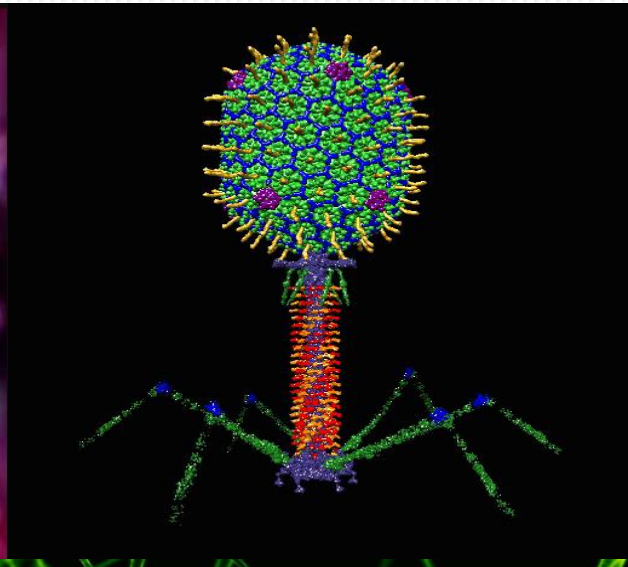
Alcohol

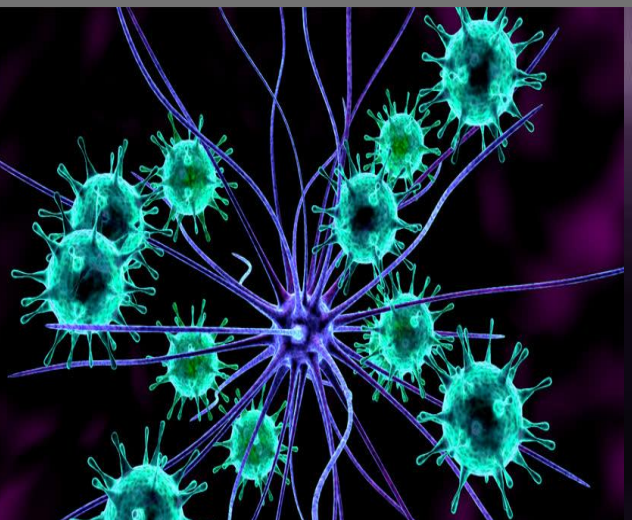
Chemicals

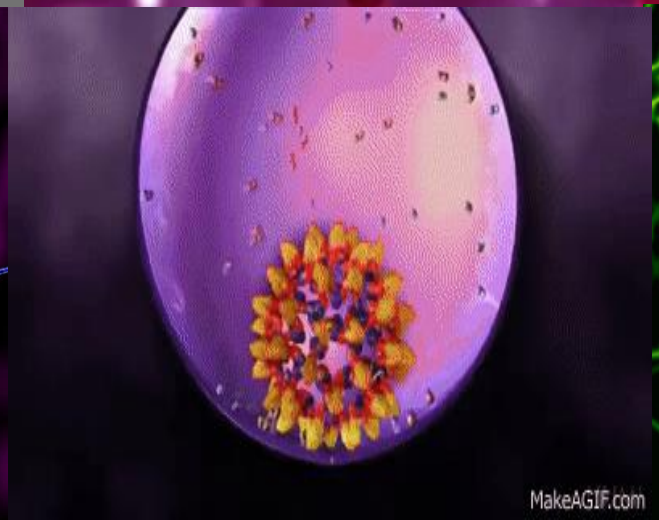
Viruses Morphology

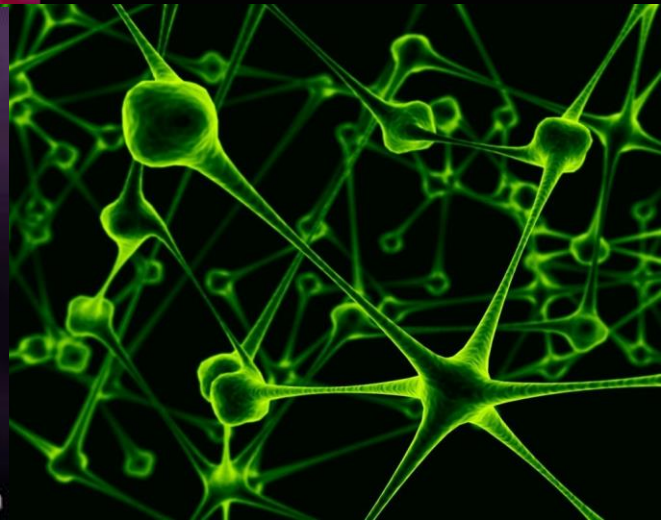






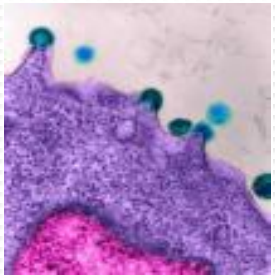


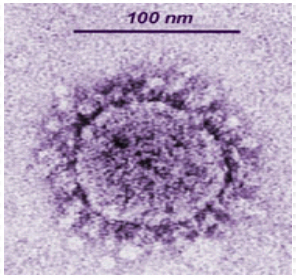


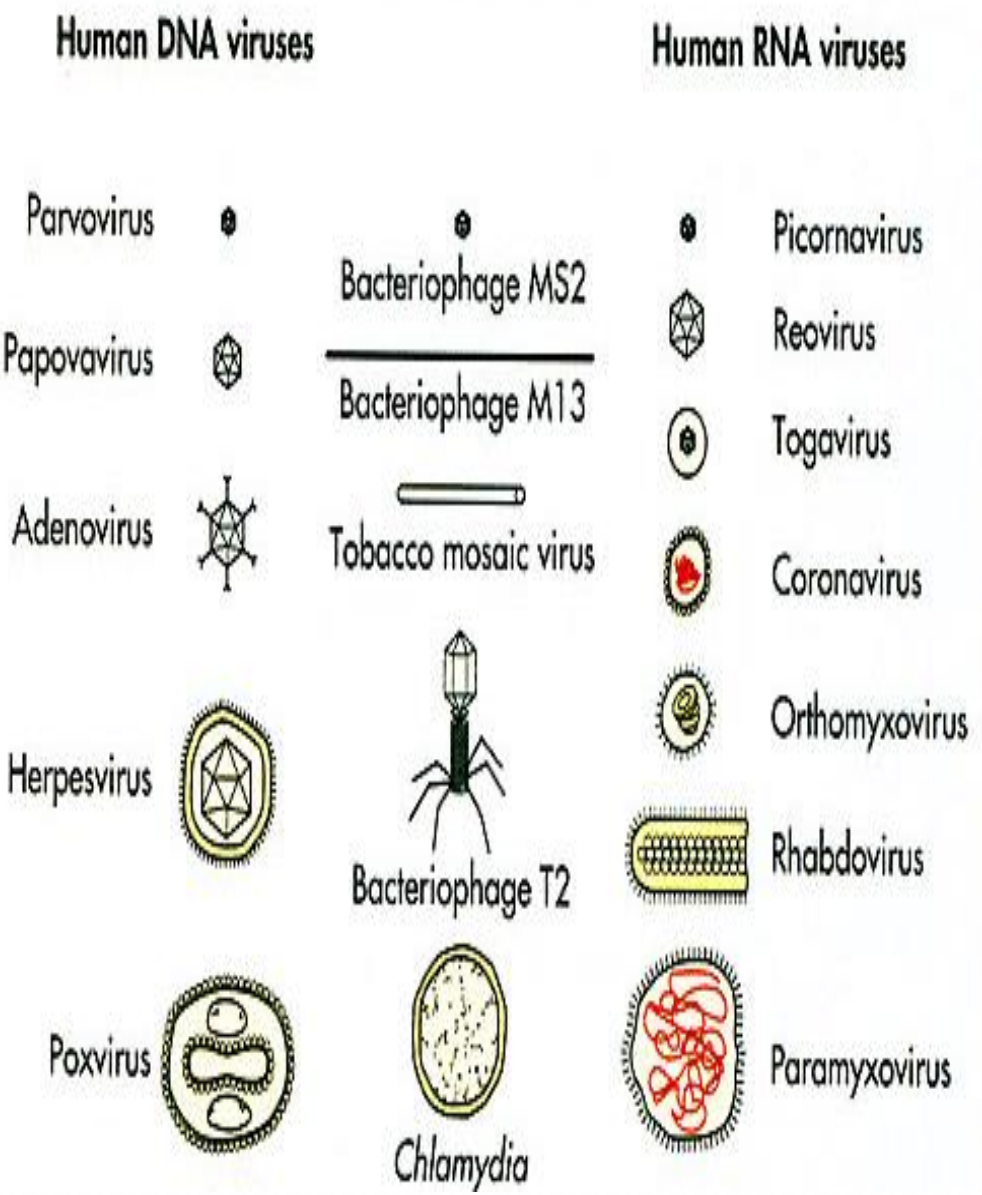


Viruses Sizes

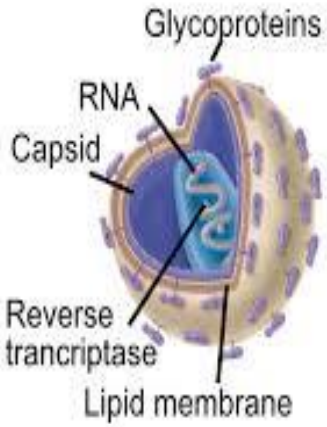
- much smaller than bacteria (<0.3 μ)
- "Filterable agents" – can pass through filters that can hold back bacteria
- vary widely in size:
  - Largest – poxvirus (300 nm)
  - Smallest – parvovirus (20 nm)
- Virion – extracellular infectious virus particle

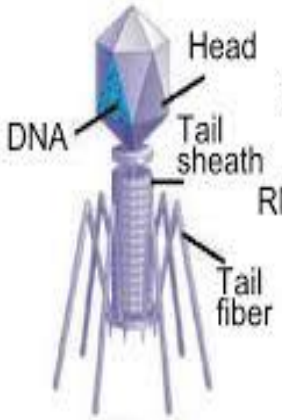


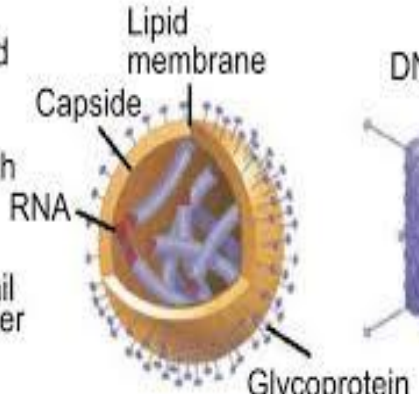


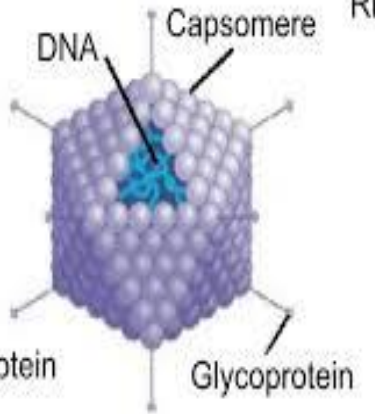


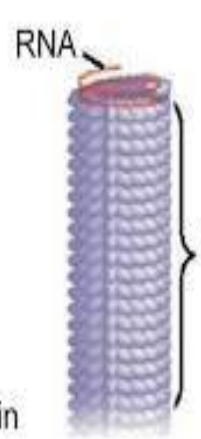
Viruses Shapes

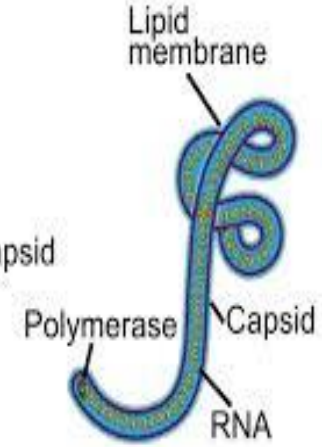


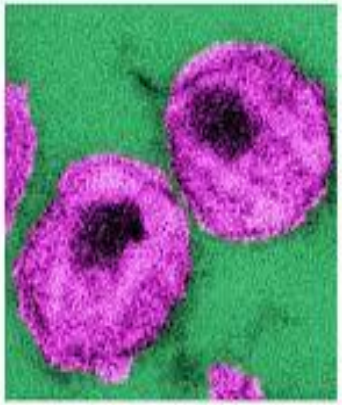










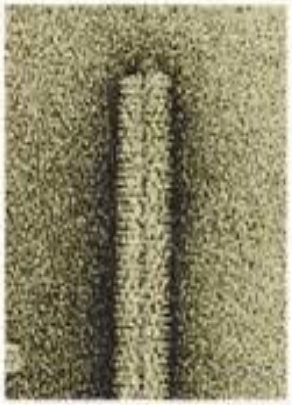


Human immudeficiency virus

Bacteriophage

Influenza virus

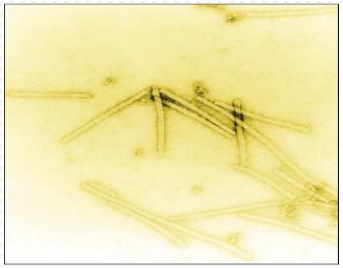
Adenovirus



Tobacco mosaic virus

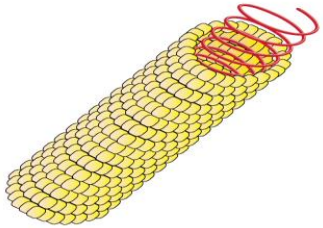
Ebola virus

Viruses Shapes



Tobacco mosaic virus

Helical



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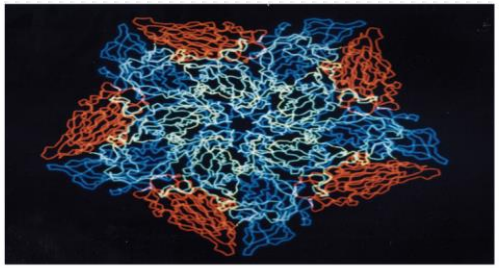
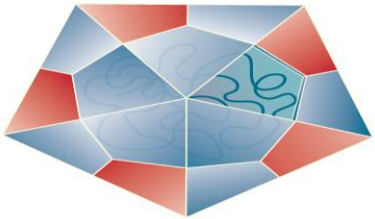


Human rhinovirus HRV14

Icosahedral



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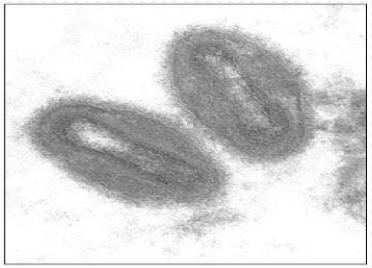
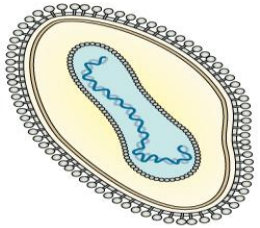


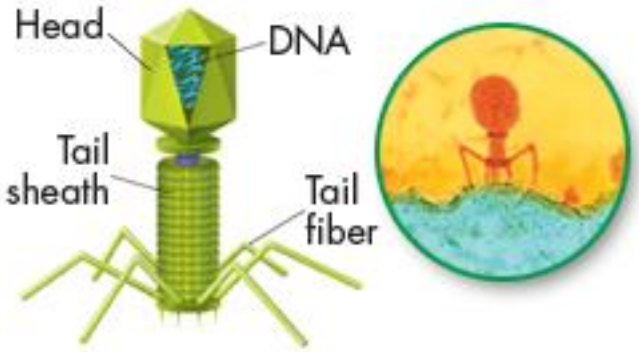
Variola virus

Complex

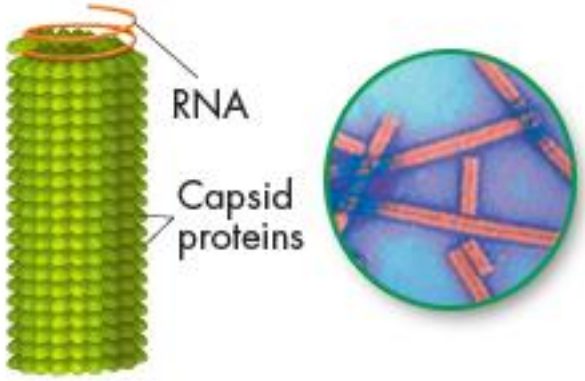


(c)

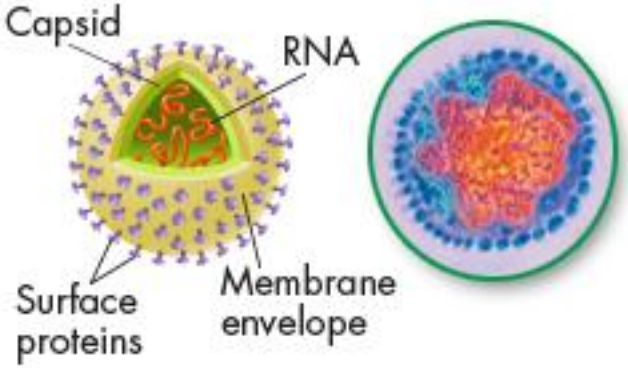
T4 Bacteriophage



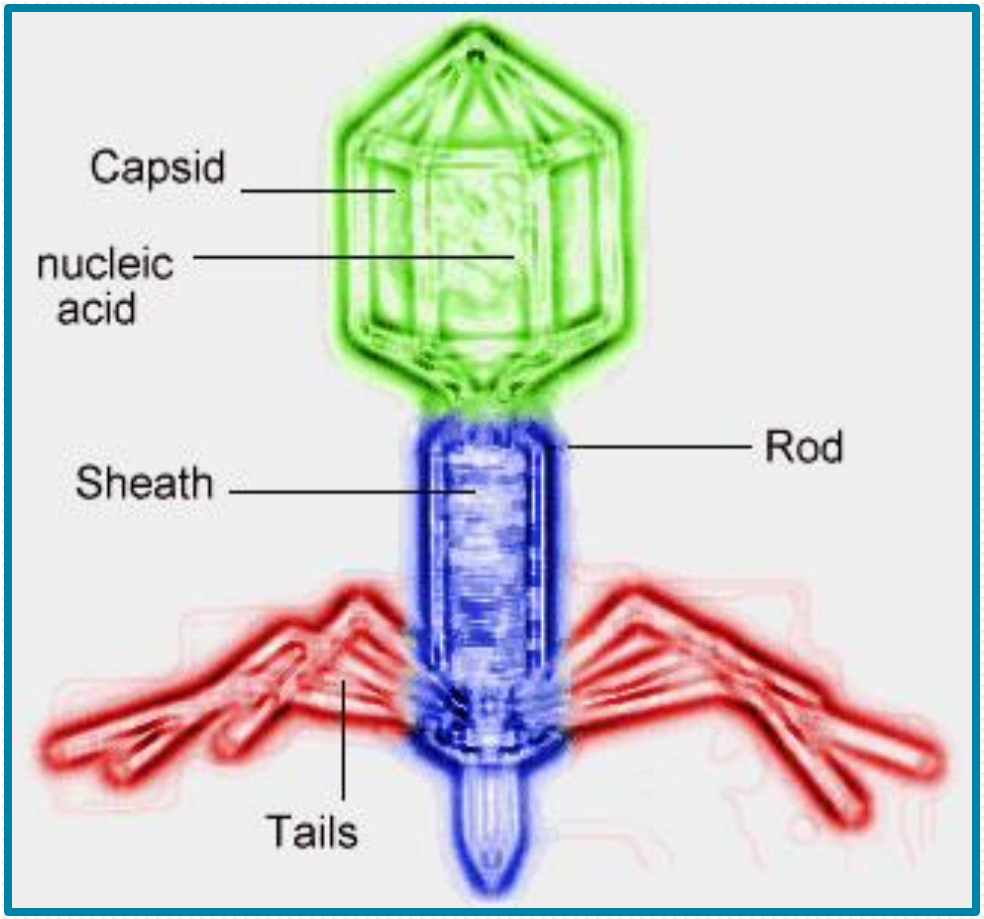
Tobacco Mosaic Virus

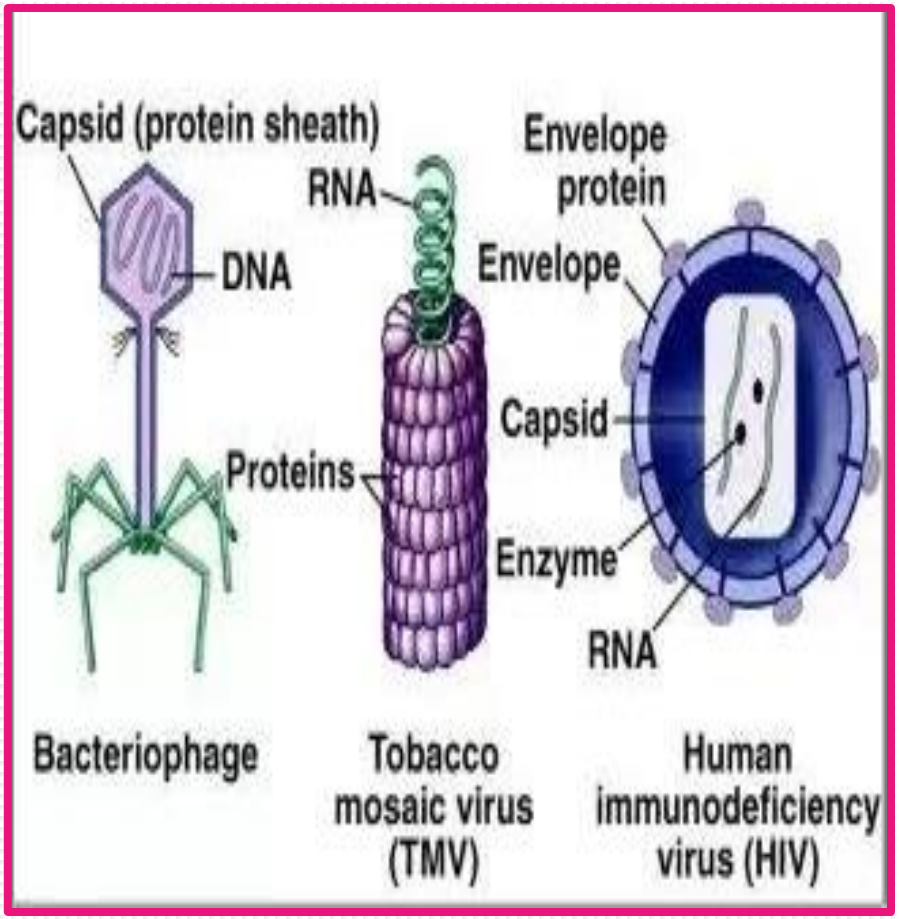


Influenza Virus

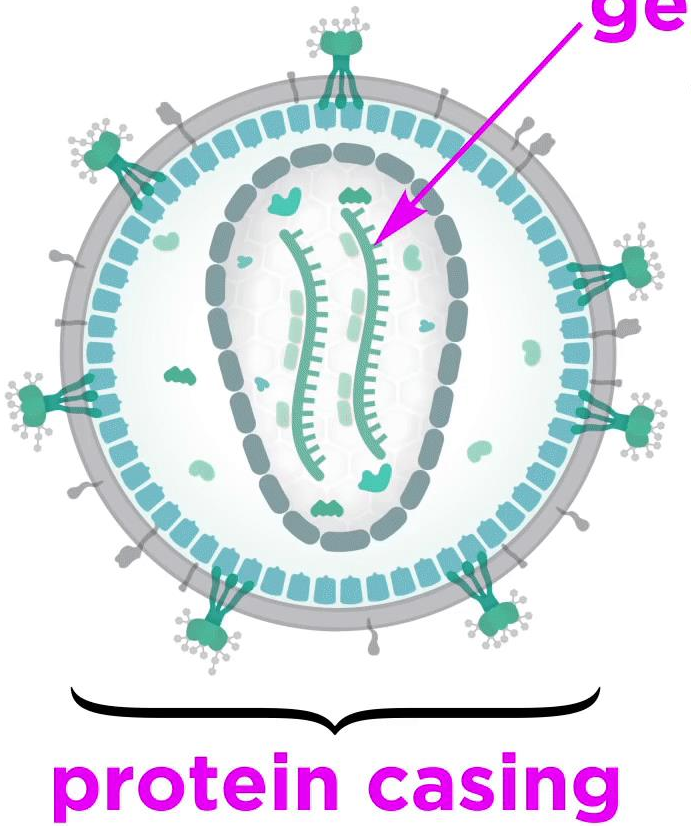


Viruses Structure



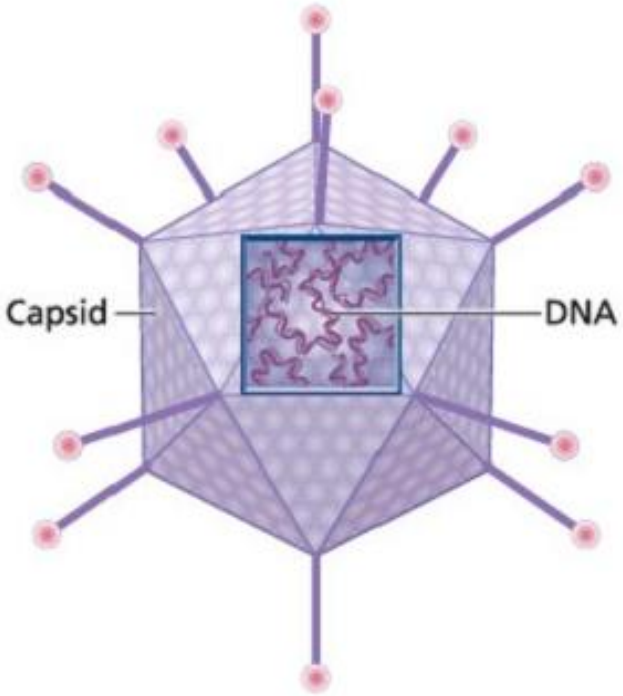


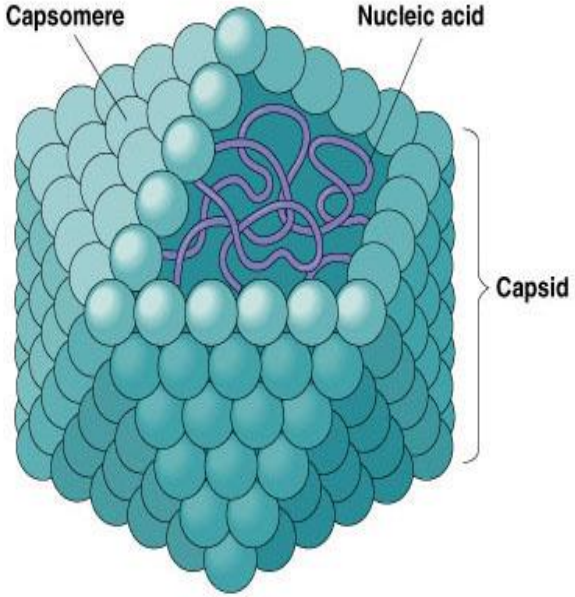
Virus Structure



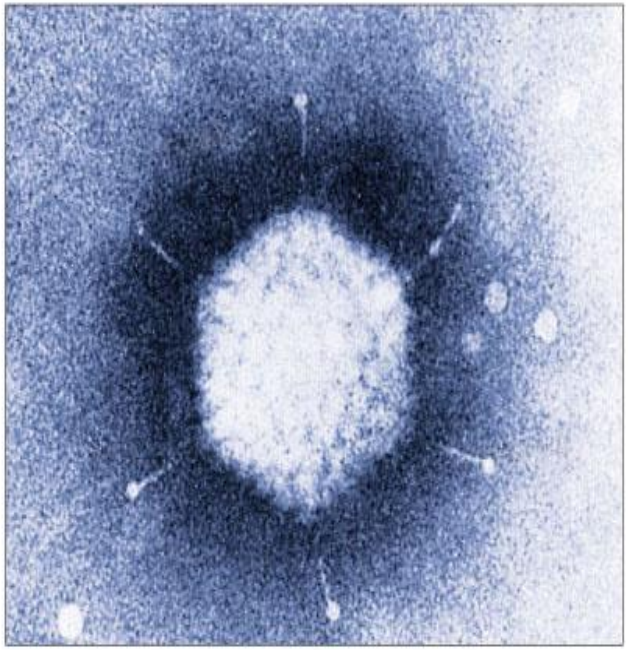
Capsid

- protein coat or outer shell surrounding the nucleic acid core
- protects nucleic acid (DNA/RNA) from inactivation
- helps to introduce viral genome into host cell





(a) A polyhedral virus



(b) A *Mastadenovirus*

Enveloped Helical Virus

- are membranous coverings derived from the membrane of the host cell

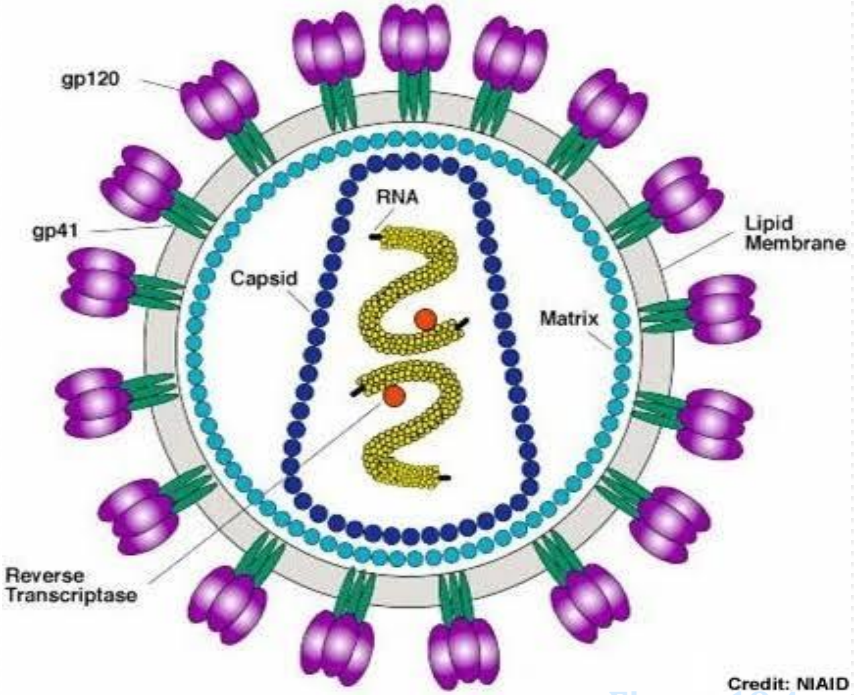
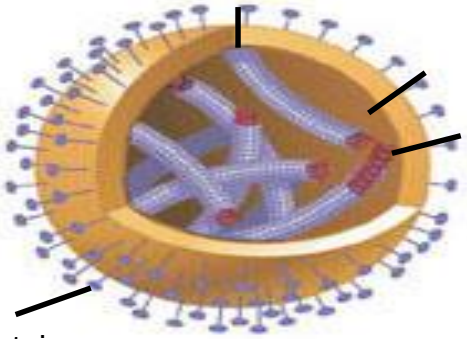
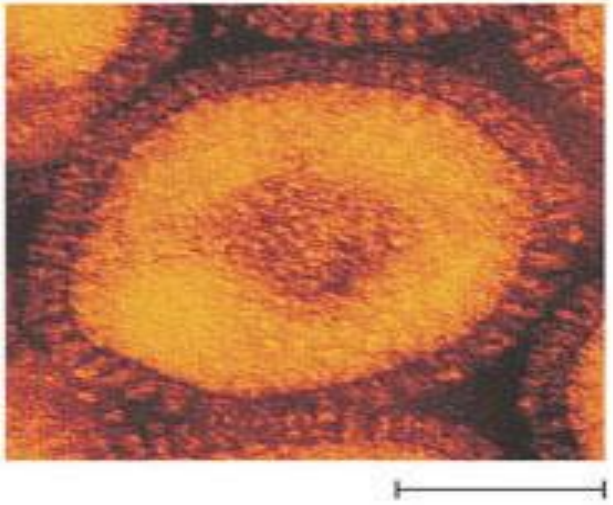


Figure 18.4c

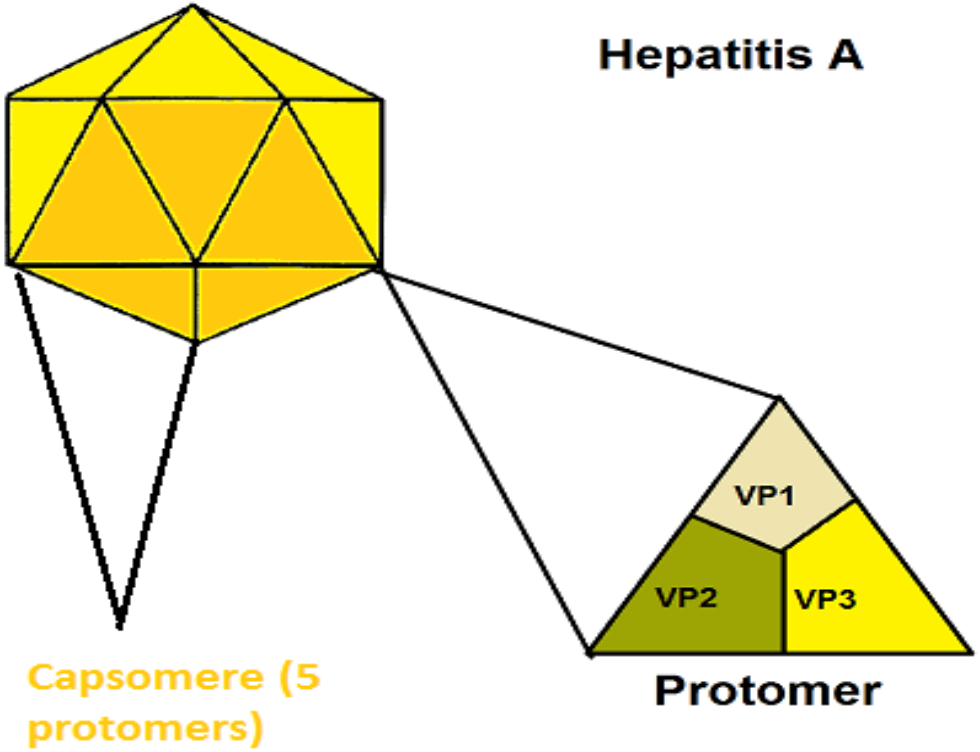


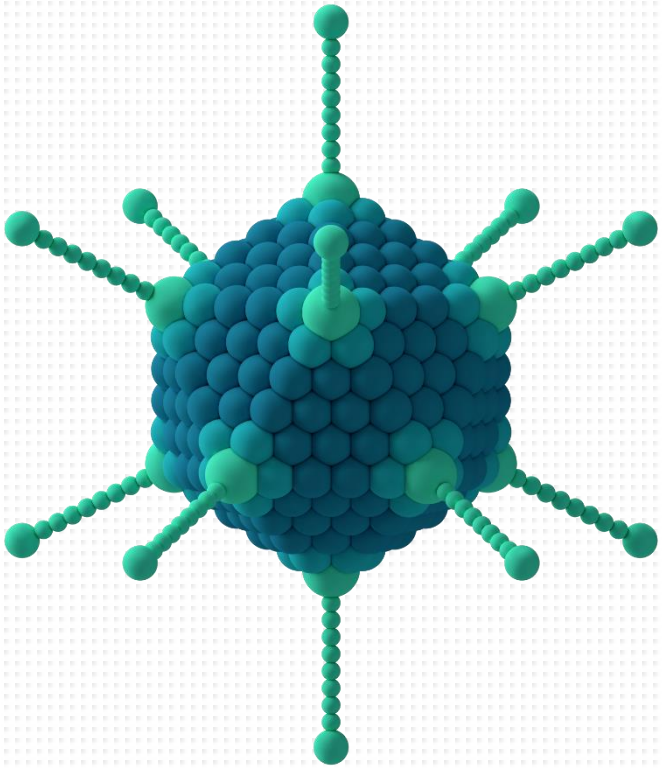
80–200 nm (diameter)



(c) Influenza viruses

Protomer & Capsomers





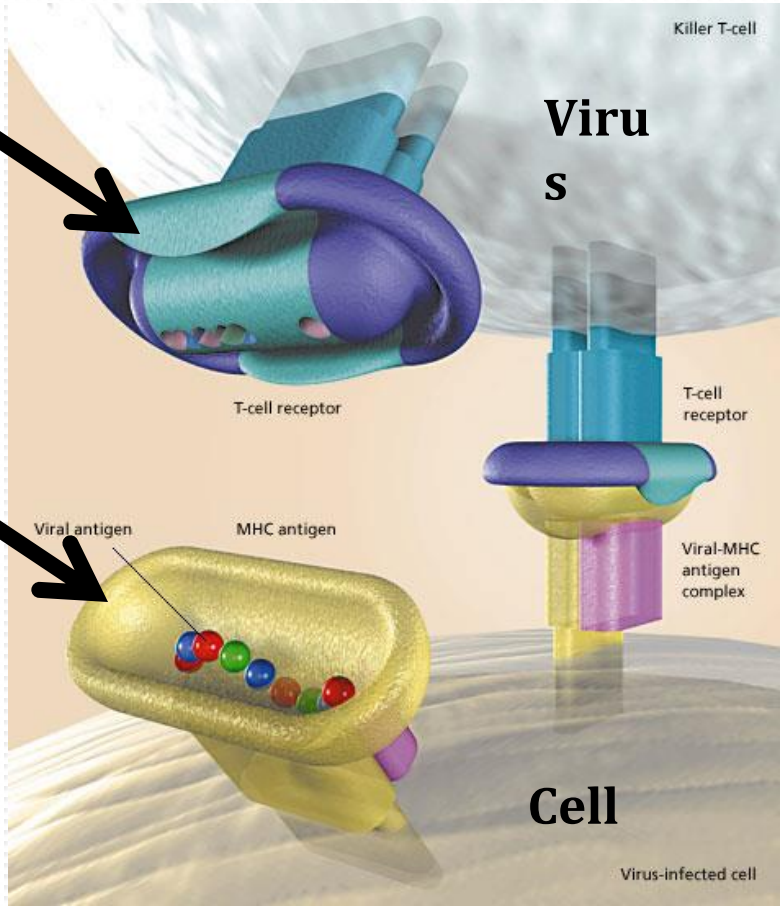
Certain viruses can only attack certain cell types. They are said to be specific.

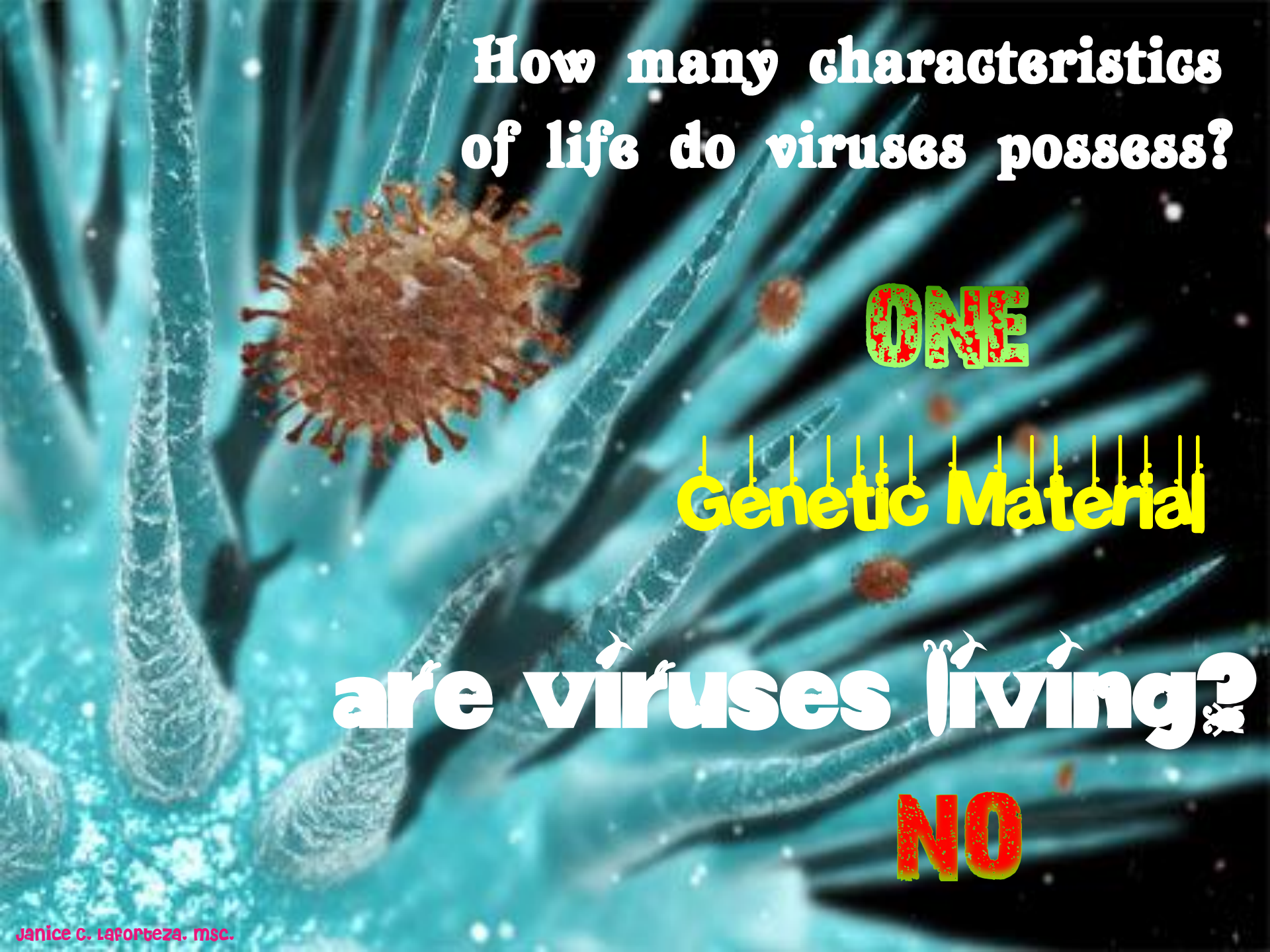
Example: The rabies virus only attacks brain or nervous cells.

Surface Markers

Receptor Sites

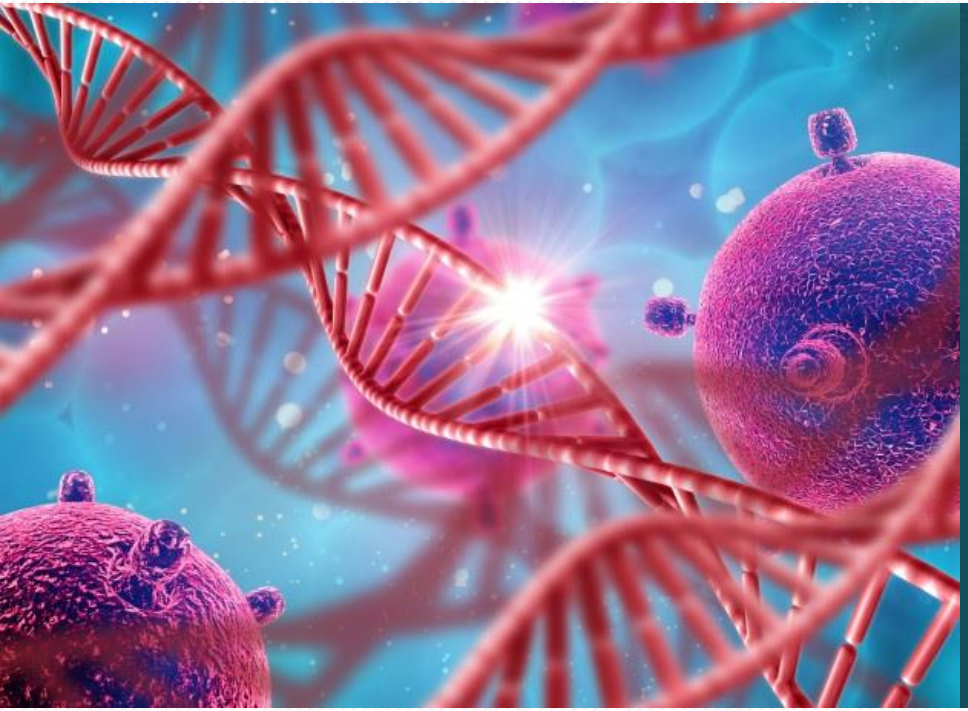
It's like the pieces of a puzzle. The ends have to match up so only certain pieces fit.




How many characteristics of life do viruses possess?
ONE
Genetic Material
are viruses living?
NO
Janice C. Laforteza. MSc.

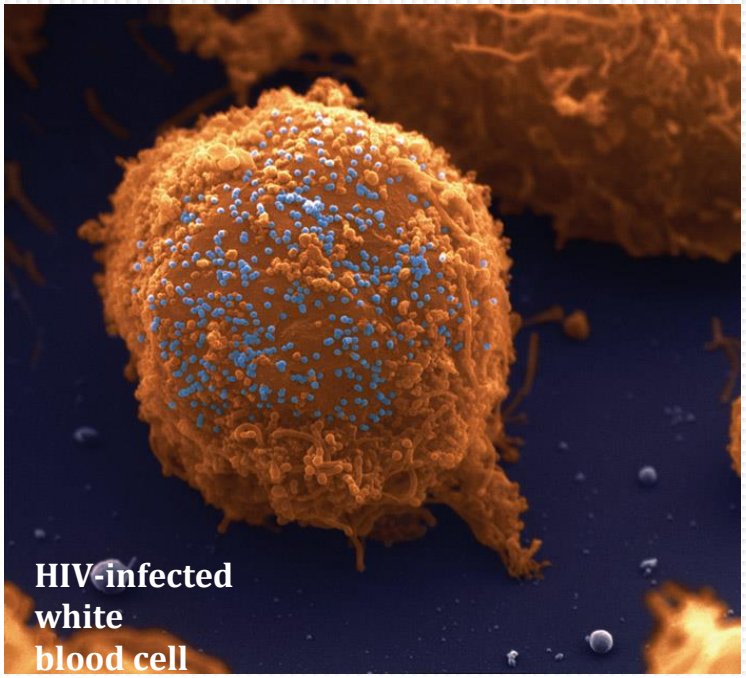
Virus Genetics

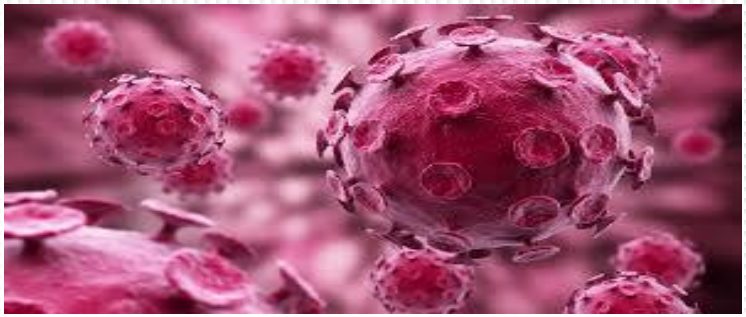
- this is the direction to make more virus
- DNA, RNA, single or double-stranded
- Types of viruses: DNA virus or RNA virus



Vectors

- transmitters of genetic information through the plasmids from one bacteria to another
- Retrovirus - RNA virus that infects host cells by reverse-transcribing DNA from RNA
  - HIV (human immunodeficiency virus): disguises itself by changing the surface markers when the immune system starts targeting it





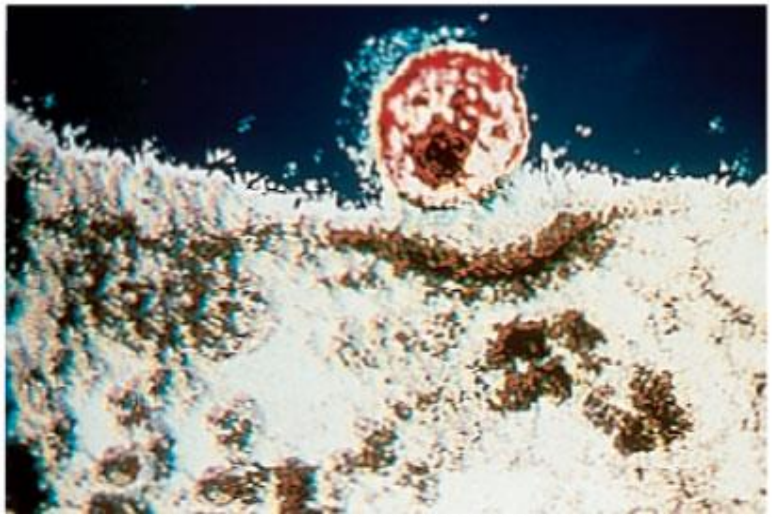


TABLE 13.2 **Families of Viruses That Affect Humans**

Characteristics/ Dimensions	Viral Family	Important Genera	Clinical or Special Features
Single-stranded DNA nonenveloped 18–25 nm	Parvoviridae 	Human parvovirus B19	Fifth disease; anemia in immunocompromised patients. Refer to Chapter 21.
Double-stranded DNA nonenveloped 70–90 nm	Adenoviridae 	*Mastadenovirus*	Medium-sized viruses that cause various respiratory infections in humans; some cause tumors in animals.
40–57 nm	Papovaviridae 	*Papillomavirus* (human wart virus) *Polyomavirus*	Small viruses that induce tumors; the human wart virus (papilloma) and certain viruses that produce cancer in animals (polyoma and simian) belong to this family. Refer to Chapters 21 and 26.
Double-stranded DNA enveloped 200–350 nm	Poxviridae 	*Orthopoxvirus* (vaccinia and smallpox viruses) *Molluscipoxvirus*	Very large, complex, brick-shaped viruses that cause diseases such as smallpox (variola), molluscum contagiosum (wartlike skin lesion), and cowpox. Refer to Chapter 21.
150–200 nm	Herpesviridae 	*Simplexvirus* (HHV-1 and 2) *Varicellovirus* (HHV-3) *Lymphocryptovirus* (HHV-4) *Cytomegalovirus* (HHV-5) *Roseolovirus* (HHV-6) HHV-7 Kaposi's sarcoma (HHV-8)	Medium-sized viruses that cause various human diseases, such as fever blisters, chickenpox, shingles, and infectious mononucleosis; implicated in a type of human cancer called Burkitt's lymphoma. Refer to Chapters 21, 23, and 26.
42 nm	Hepadnaviridae 	*Hepadnavirus* (hepatitis B virus)	After protein synthesis, hepatitis B virus uses reverse transcriptase to produce its DNA from mRNA; causes hepatitis B and liver tumors. Refer to Chapter 25.

TABLE 13.2 **Families of Viruses That Affect Humans**

Characteristics/ Dimensions	Viral Family	Important Genera	Clinical or Special Features
Single-stranded RNA, + strand nonenveloped 28–30 nm	Picornaviridae 	*Enterovirus* *Rhinovirus* (common cold virus) Hepatitis A virus	At least 70 human enteroviruses are known, including the polio-, coxsackie-, and echoviruses; more than 100 rhinoviruses exist and are the most common cause of colds. Refer to Chapters 22, 23, 24, and 25.
35–40 nm	Caliciviridae 	Hepatitis E virus Norwalk agent	Includes causes of gastroenteritis and one cause of human hepatitis. Refer to Chapter 25.
Single-stranded RNA, + strand enveloped 60–70 nm	Togaviridae 	*Alphavirus* *Rubivirus* (rubella virus)	Included are many viruses transmitted by arthropods (*Alphavirus*); diseases include eastern equine encephalitis (EEE) and western equine encephalitis (WEE). Rubella virus is transmitted by the respiratory route. Refer to Chapters 21, 22, and 23.
40–50 nm	Flaviviridae 	*Flavivirus* *Pestivirus* Hepatitis C virus	Can replicate in arthropods that transmit them; diseases include yellow fever, dengue, St. Louis encephalitis, and West Nile virus. Refer to Chapters 22 and 23.
Nidovirales 80–160 nm	Coronaviridae 	*Coronavirus*	Associated with upper respiratory tract infections and the common cold. Refer to Chapter 24.

TABLE 13.2 (continued)

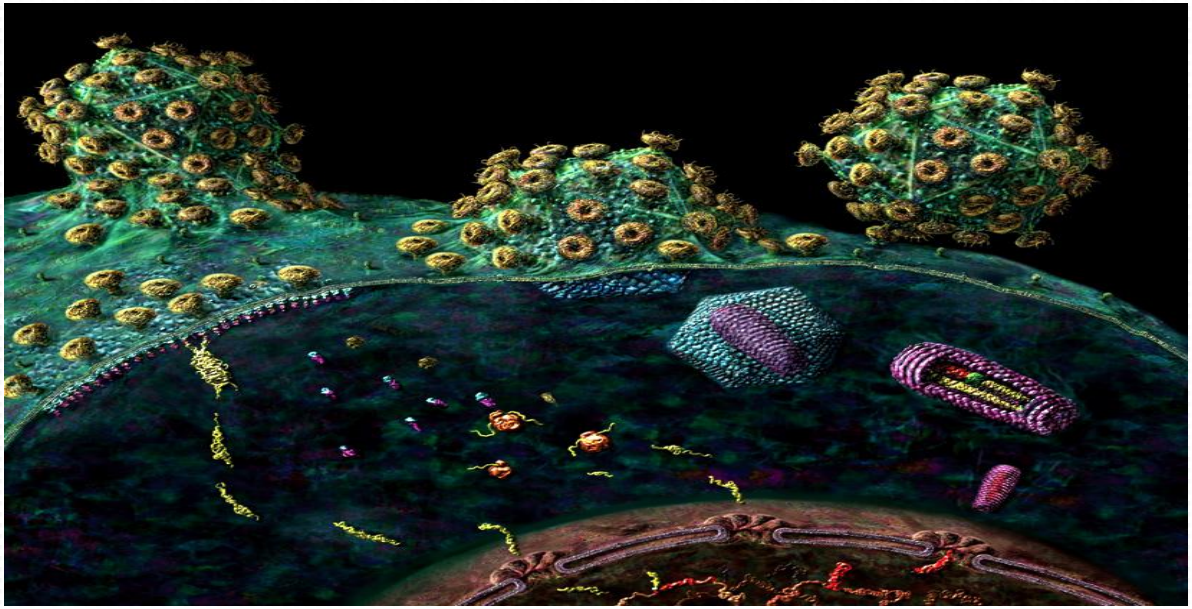
Characteristics/ Dimensions	Viral Family	Important Genera	Clinical or Special Features
Mononegavirales – strand, one strand of RNA 70–180 nm	Rhabdoviridae 	*Vesiculovirus* (vesicular stomatatis virus) *Lyssavirus* (rabiesvirus)	Bullet-shaped viruses with a spiked envelope; cause rabies and numerous animal diseases. Refer to Chapter 22.
80–14,000 nm	Filoviridae 	*Filovirus*	Enveloped, helical viruses; Ebola and Marburg viruses are filoviruses. Refer to Chapter 23.
150–300 nm	Paramyxoviridae 	*Paramyxovirus* *Morbillivirus* (measleslike virus)	Paramyxoviruses cause parainfluenza, mumps, and Newcastle disease in chickens. Refer to Chapters 21, 24, and 25.
–strand, one strand of RNA 32 nm	Deltaviridae 	Hepatitis D	Depend on coinfection with hepadnavirus. Refer to Chapter 25.
–strand, multiple strands of RNA 80–200 nm	Orthomyxoviridae 	*Influenzavirus* (influenza viruses A and B) Influenza C virus	Envelope spikes can agglutinate red blood cells. Refer to Chapter 24.

TABLE 13.2 (continued)

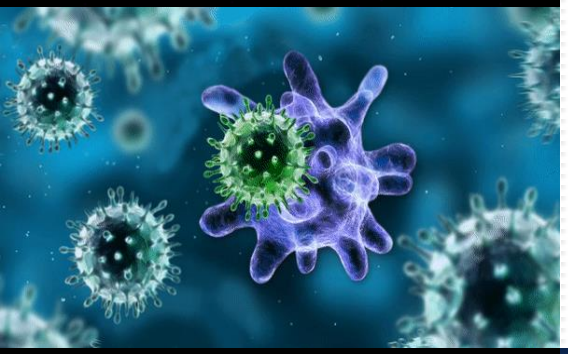
Characteristics/ Dimensions	Viral Family	Important Genera	Clinical or Special Features
90–120 nm	Bunyaviridae 	*Bunyavirus* (California encephalitis virus) *Hantavirus*	Hantaviruses cause hemorrhagic fevers such as Korean hemorrhagic fever and *Hantavirus* pulmonary syndrome; associated with rodents. Refer to Chapter 23.
110–130 nm	Arenaviridae 	*Arenavirus*	Helical capsids contain RNA-containing granules; cause lymphocytic choriomeningitis, and Venezuelan hemorrhagic fever, and Lassa fever. Refer to Chapter 23.
Produce DNA 100–120 nm	Retroviridae 	Oncoviruses *Lentivirus* (HIV)	Includes all RNA tumor viruses and double-stranded RNA viruses. Oncoviruses cause leukemia and tumors in animals; the *Lentivirus* HIV causes AIDS. Refer to Chapter 19.
Double-stranded RNA nonenveloped 60–80 nm	Reoviridae 	*Reovirus* Colorado tick fever virus	Involved in mild respiratory infections and infantile gastroenteritis; an unclassified species causes Colorado tick fever.

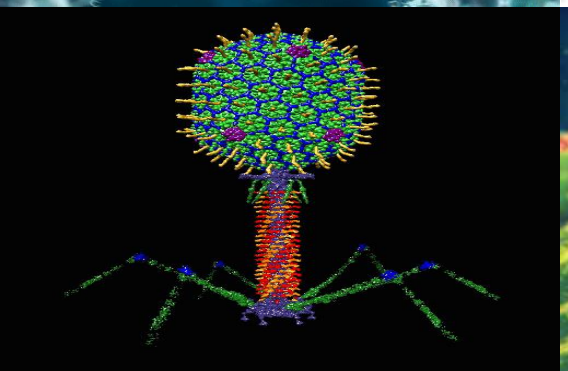
Transmission of Viral Disease

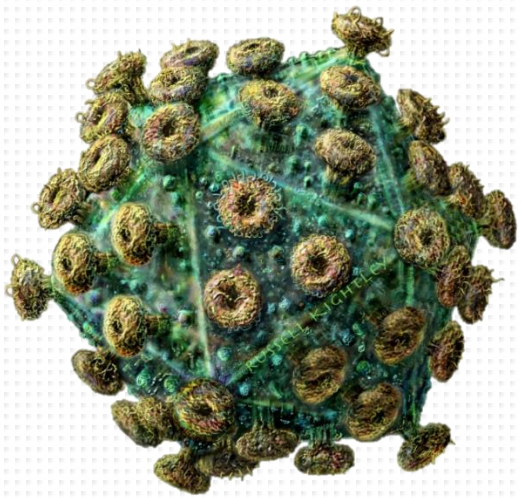
- Viruses are pathogenic
  - cannot reproduce unless they attack another cell
- Viruses are carcinogenic
  - once in the cell they can have a tendency to cause irreparable genetic damage that can lead to cancer
    - Cervical cancer
    - Hepatitis B & C
    - Liver cancer
    - T Lymphotropic
    - Leukemia



Transmission of Viral Disease



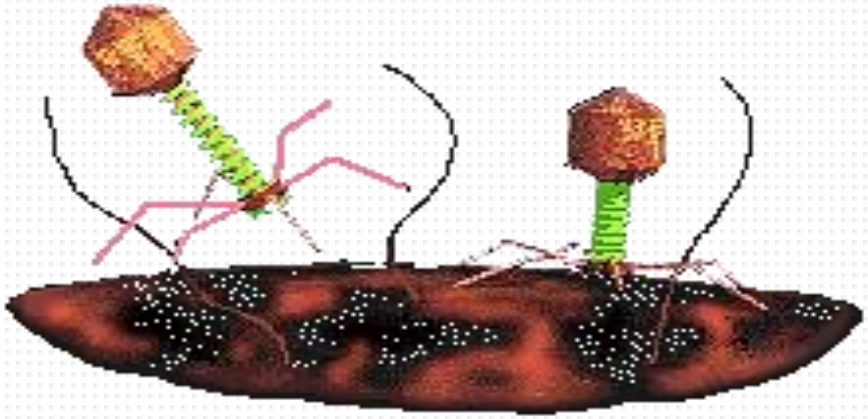




- Possible ways to become infected:
  - bites (animals,insects)
  - physical contact
  - body fluid (blood,saliva)
  - mother to child
  - contact in the air (respiratory)
  - sexual contact
  - fecal/oral
  - environmental exposure

Viral Replication

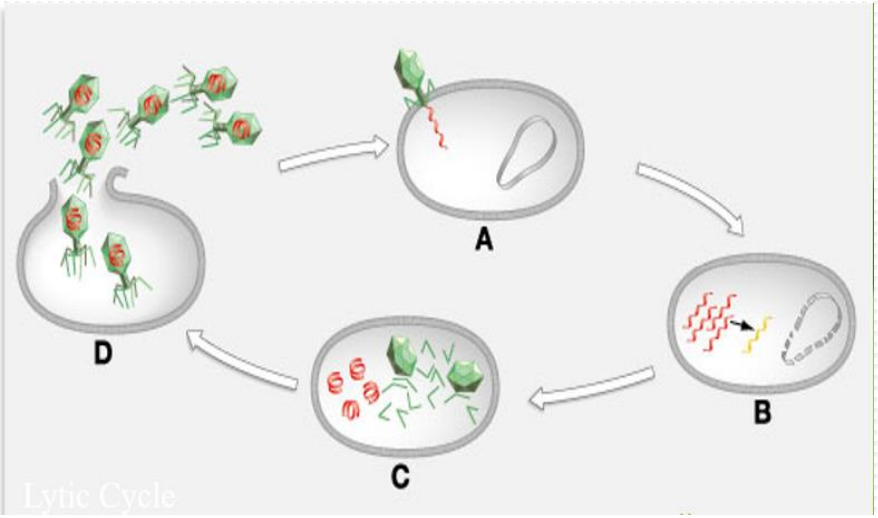
- Viruses must have a living host cell to reproduce
  - Bacteriophages – viruses that infect bacteria
    - Head – capsid and DNA
    - Tail – with fibers to attach to bacteria
    - T group
    - Most commonly studied are T group – T1, T2, T3, T4 etc…
    - T4 has a DNA core within a protein coat, and tail with tail fibers to attach to bacteria.

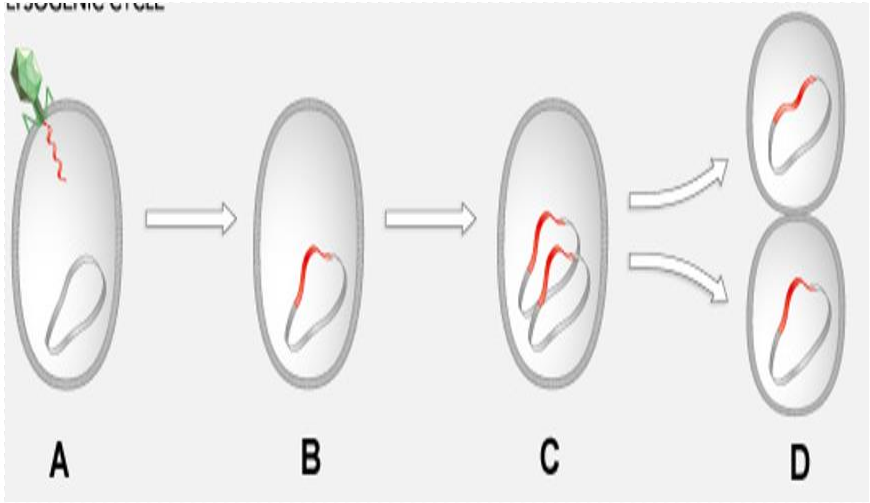


E. coli bacteria

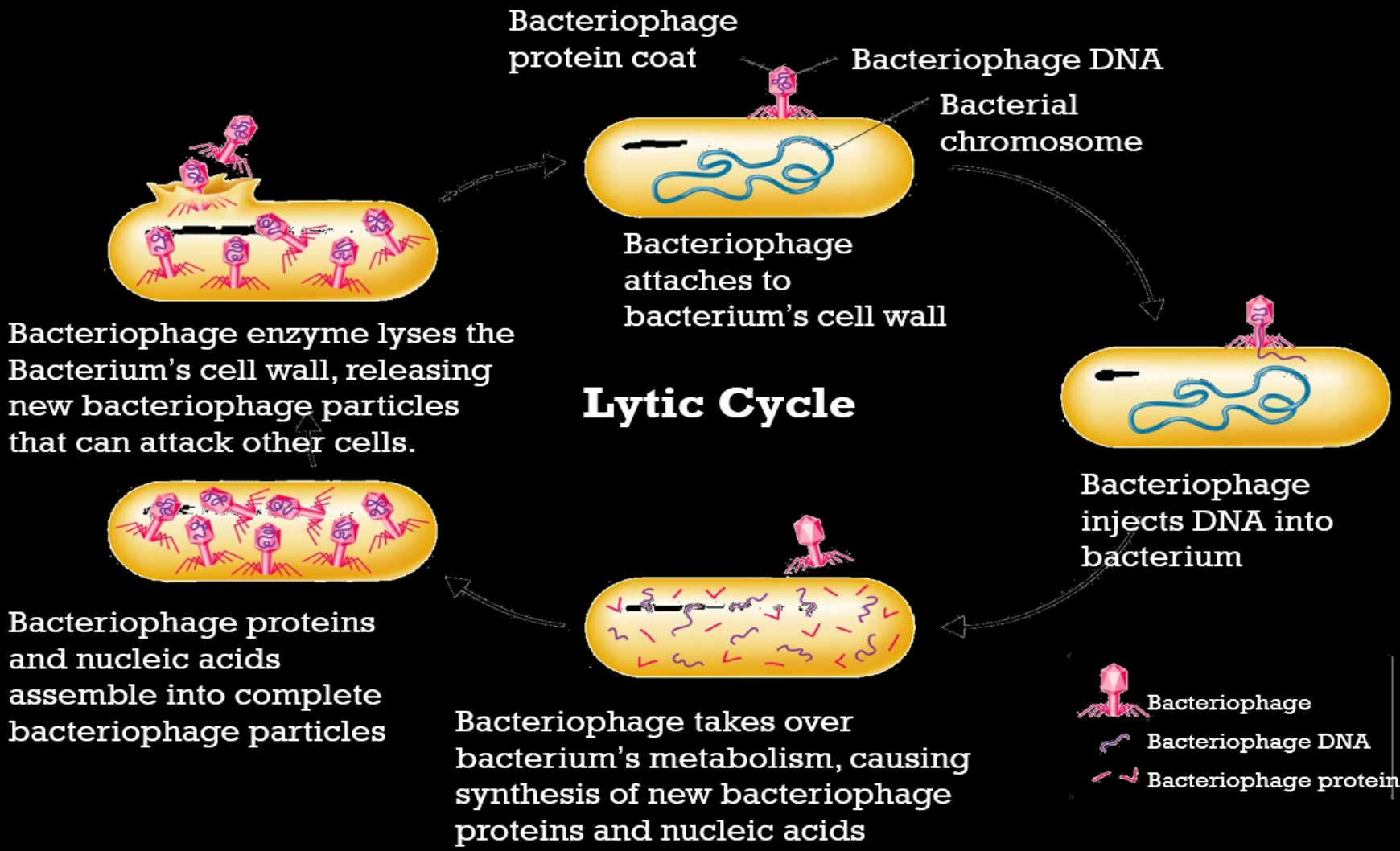
Viral Replication

- Viruses must have a living host cell to reproduce
  - Bacteriophages – viruses that infect bacteria
  - Herpes Simplex1 - infects lip cells
- Virus insert their genetic information inside the host cell and use the host cell to make more virus particles.
- This process is broken down into 2 pathways.
  - Lytic
  - Lysogenic Pathways of Viral Infections





Lytic Infection



Lysogenic Infection