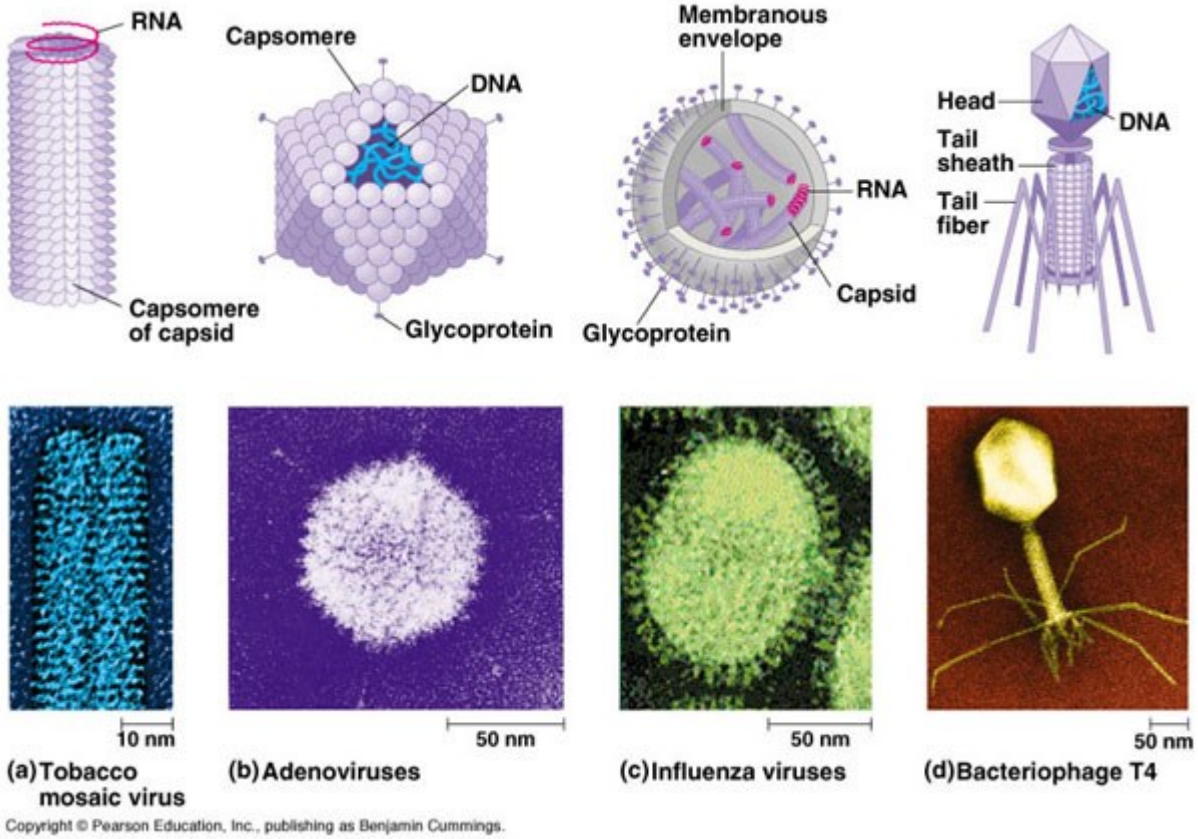
VIRUSES

Viruses Molecular Hijackers

- are not classified into a domain because they do not possess all of the traits of living things:
  - does not grow, respire, or respond to stimuli but it does **reproduce**
  = **non-living particles** which infect every form of life, in every kingdom
  - the word Virus comes from Latin meaning **poison**
  - are classified by the type of **nuclear material** they contain
  - are named after the **disease** they cause (ex: Rabies virus) or for the **organ or tissue** they infect (ex, Meningitis)
- **Structure And Shape**
  - are very small
  - all viruses are made of at least 2 parts:
    1. an inner core of **nuclear material** (DNA or RNA)
    2. enclosed in protein shell called a **capsid** (about 95% of the virus)
    3. some also contain a fatty **lipoprotein envelope**
  - viruses do not contain the **organelles** of a cell
  - the capsid of a virus gives it its **shape**

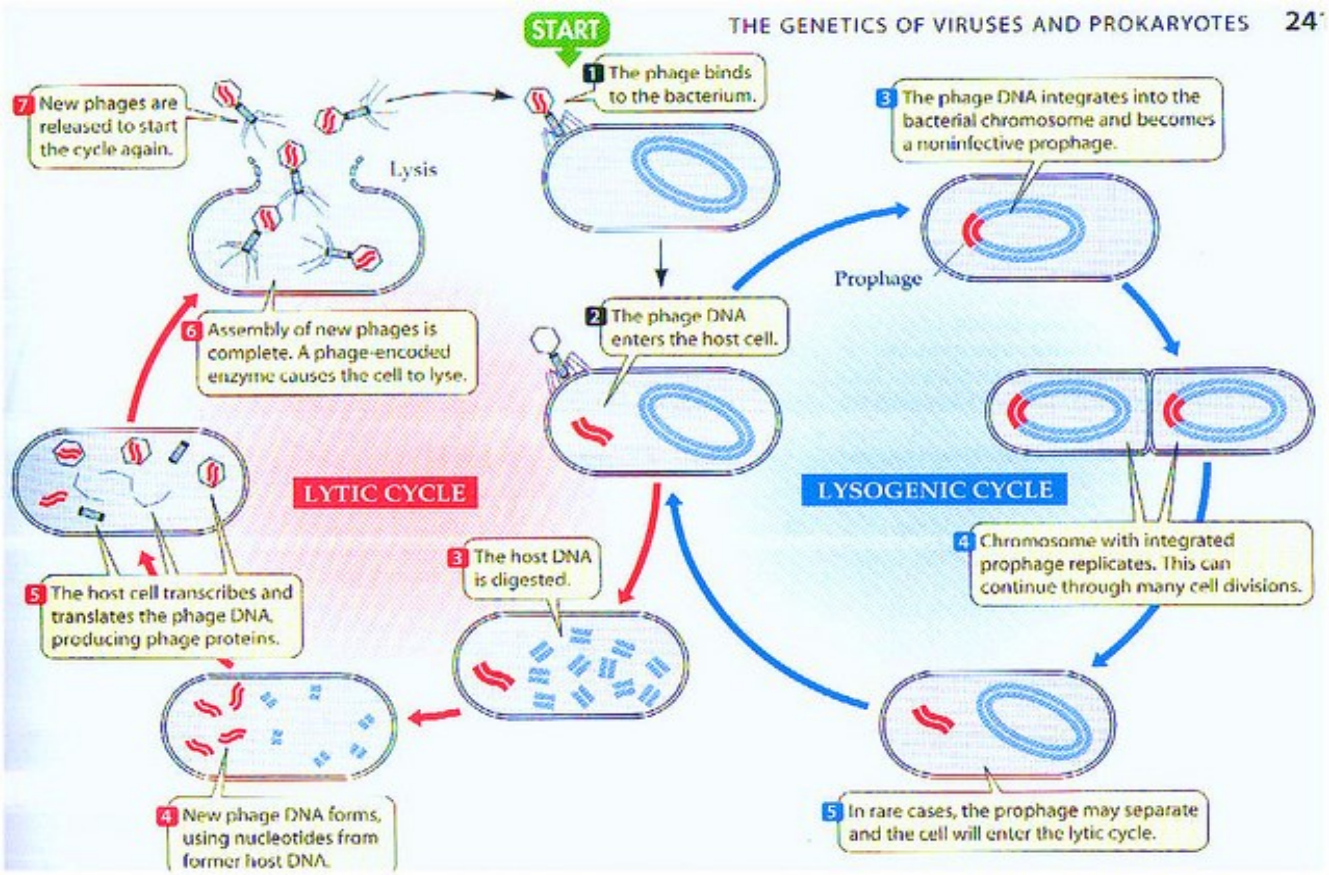


- **Function And Reproduction**
  - viruses are strict parasites and function only when inside a **host cell**
  - when outside a host cell, viruses can **crystalize** and remain **inert** for long periods of time
  - crystals become **infectious** when the viral particles they contain come in contact with and invade host cells
  - viruses are specific to the **species** and **cell-type** they infect
    example: polio infects only human intestinal and nerve cells
  - once it enters a host cell, the virus takes over the **cell's processes** to produce more viral material killing the original cell and infecting other cells

- two types of viruses:

a) **Virulent Virus**: reproduction starts **immediately** after entering the host cell
= **Lytic Cycle**
: example - cold, flu

b) **Latent Virus**: after entering the host cell, the virus may go through a **'resting stage'** before something triggers reproduction to begin
= **Lysogenic Cycle**
: example – AIDS, Shingles



- **Significance Of Viruses**
  - cause sickness and **disease**
  - cause some forms of **cancers**
  - can be used to better our lives
    a) further our understanding of **genes** and **DNA replication**
    b) transmit **a specific gene** to engineer cells for a specific purpose
    c) destroy **resistant bacteria** & control **insect pests**
    d) control pandemics through the creation **vaccines** and **antiviral drugs**
    e) treat **cancer**

- **Phylogeny of Viruses**
  - there is no fossil evidence as to the origin of viruses but many theories:
    a) ancestors of viruses were **parasitic** cells that lost their cellular components
    b) viruses came from detached fragments of **genetic material belonging to other cells

- **Treatment of Viruses**
  - As viruses are **nonliving** they cannot be killed using antibiotics so alternate methods must be used:
    a) Prevent primary infection **(vaccination)**
    b) Treat **symptoms**
    c) Localize the infection **(antivirals)**
    d) Immunoglobulin therapy- **synthetic antibodies** used to identify and neutralize viruses

Agent	*Constituents*	*Example*	*Disease*
Viruses	DNA plus protein	Parvovirus	Hepatitis A
		Herpes simplex I, II	Herpes
		Epstein-Barr	Mononucleosis, Burkitt's lymphoma
		Smallpox virus	Smallpox
	RNA plus protein	Paramyxovirus	Measles
		Togavirus	Rubella (German measles)
		Rhinoviruses	Common cold
		Myxovirus	Influenza
		Poliovirus	Poliomyelitis
		Paramyxovirus	Mumps
		Rhabdovirus	Rabies
		Togavirus, flavivirus	Yellow fever
		Retroviruses	Cancer (some forms)
			AIDS

RETROVIRUS

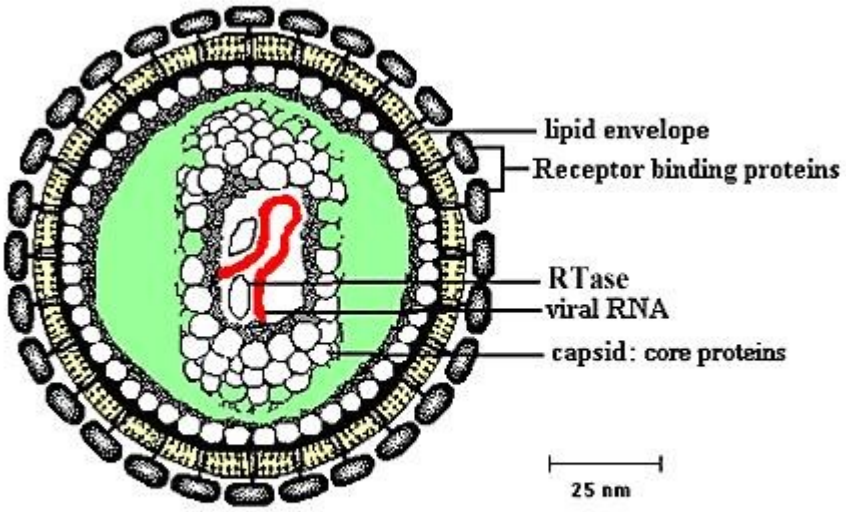


Diagram of a Retrovirus

Retroviruses are infectious particles consisting of an **RNA genome** packaged in a protein **capsid**, surrounded by a **lipid envelope**. This lipid envelope contains polypeptide chains including **receptor binding proteins** which link to the membrane receptors of the host cell, initiating the process of infection.

Retroviruses contain RNA as the hereditary material in place of the more common DNA. In addition to RNA, retrovirus particles also contain the enzyme reverse transcriptase (or **RTase**), which causes synthesis of a complementary DNA molecule (cDNA) using virus RNA as a template.

When a retrovirus infects a cell, it injects its RNA into the cytoplasm of that cell along with the reverse transcriptase enzyme. The cDNA produced from the RNA template contains the virally derived genetic instructions and allows infection of the host cell to proceed.

Both the CoVid-19 virus and HIV virus are retroviruses.

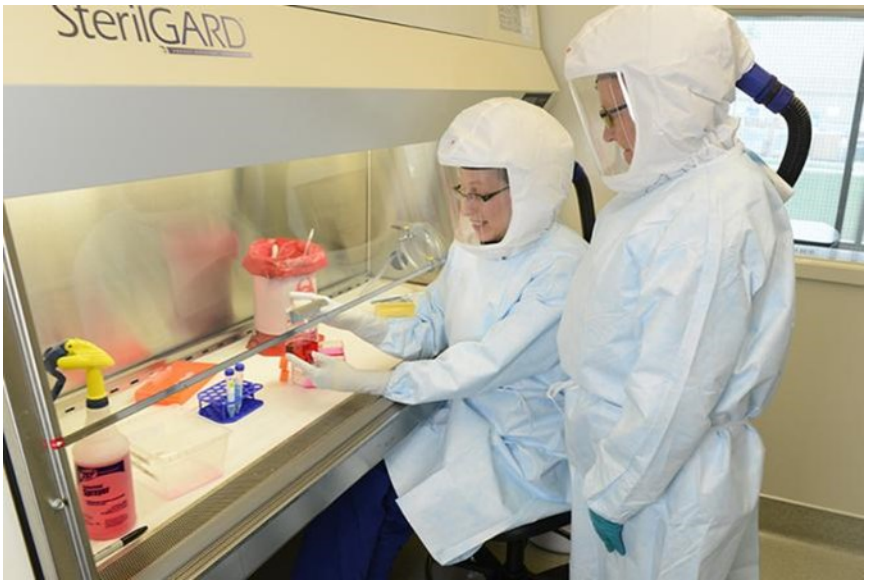
- **Other Noncellular Agents of Disease**
  - even viruses are not the smallest infectious particles around:

a) Viroids
- **RNA molecules** with no protein capsid or fatty envelope
- disease causing
- only infect plants
- ie. Potato spindle tuber

b) Prions
- naked pieces of **proteins molecules**; no nucleic acids involved
- normally exist in cells and are shaped like a coil
- when mutated prions are shaped like a piece of paper folded many times = cause disease
- ie. Mad Cow disease, Chronic Wasting Disease

Vaccine & Infectious Disease Organization-International Vaccine Centre (VIDO-InterVac) University of Saskatchewan, Saskatoon, Saskatchewan

Area(s) of Expertise



VIDO-InterVac is one of Canada's premier research institutes, with over 40 years of experience in infectious disease research and vaccine development for animals and humans. VIDO-InterVac has more than 150 personnel and some of the world's most advanced containment infrastructure, including containment level 2 and level 3 animal housing and laboratories, a select agent lab, an aerobiology challenge unit, and a 160-acre containment level 2 research station. The unique $140-million large animal containment level 3 laboratory (the International Vaccine Centre or InterVac) became operational in 2013. VIDO-InterVac can complete multiple stages of vaccine development including Vaccine development and testing, containment level 2 and 3 infectious disease research, large animal models of disease, preclinical trials, and regulatory trials for animals and humans.

Biosafety Level	BSL-1	BSL-2	BSL-3	BSL-4
Description	· No Containment · Defined organisms · Unlikely to cause disease	· Containment · Moderate Risk · Disease of varying severity	· High Containment · Aerosol Transmission · Serious/Potentially lethal disease	· Max Containment · "Exotic," High-Risk Agents · Life-threatening disease
Sample Organisms	E.Coli	Influenza, HIV, Lyme Disease	Tuberculosis	Ebola Virus
Pathogen Type	Agents that present minimal potential hazard to personnel & the environment.	Agents associated with human disease & pose moderate hazards to personnel & the environment.	Indigenous or exotic agents, agents that present a potential for aerosol transmission, & agents causing serious or potentially lethal disease.	Dangerous & exotic agents that pose a high risk of aerosol-transmitted laboratory infections & life-threatening disease.
Autoclave Requirements	None	None	Pass-thru autoclave with Bioseal required in laboratory room.	Pass-thru autoclave with Bioseal required in laboratory room.

Research Services

Pathogenomics, proteomics, metabolomics, kinomics, antigen identification, vaccine development, vaccine formulation and delivery, animal disease models (containment 2 and 3), preclinical vaccine testing (human), regulatory vaccine testing (animals)

Sectors of Application

•Agriculture, animal science and food
•Defense and security industries
•Fisheries and aquaculture
•Health care and social services