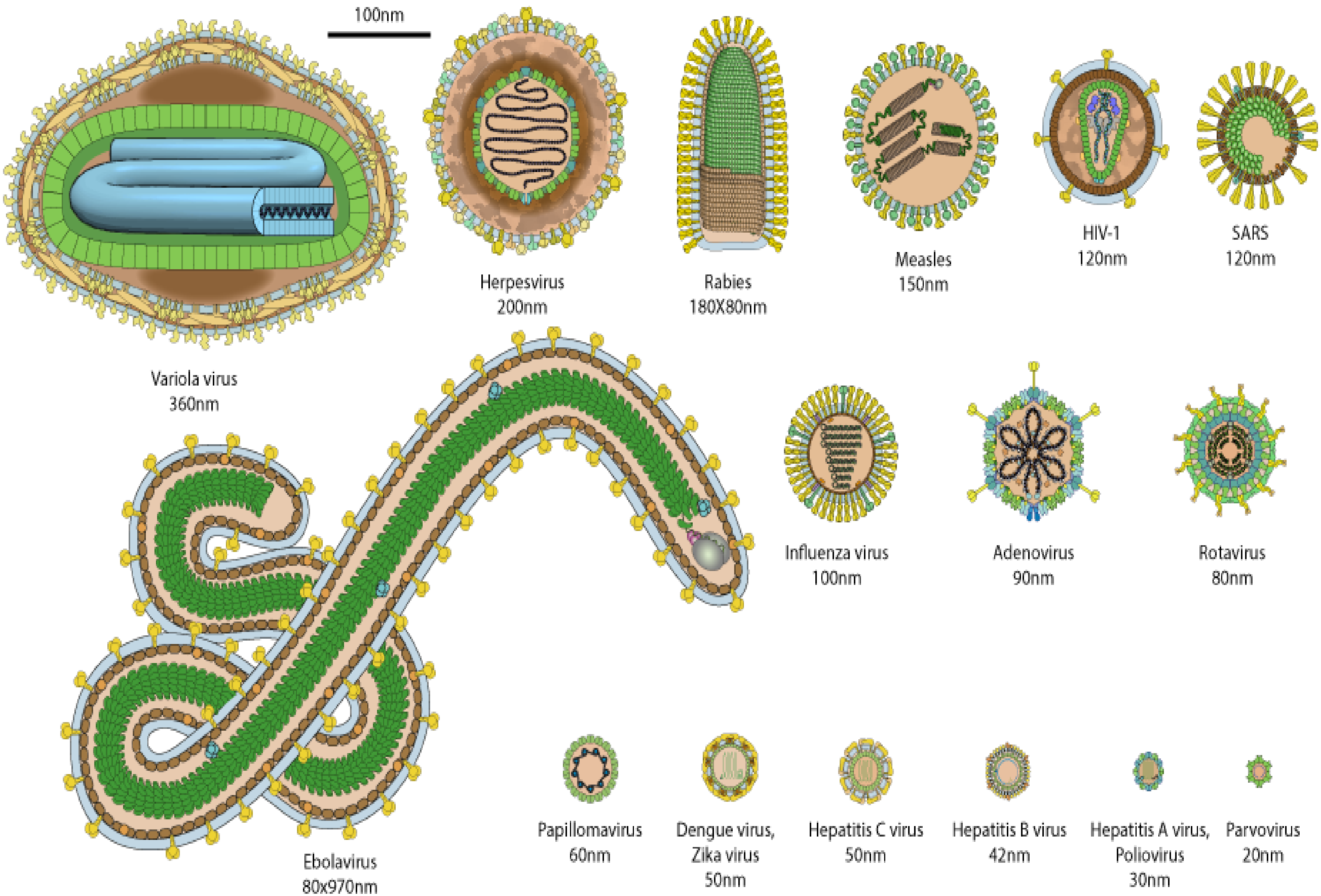
Human, animal and plant viruses

Human viruses

- Examples of common human diseases caused by viruses include the **common cold, influenza, and chickenpox.**
- Many serious diseases such as **Ebola virus** disease, AIDS, **avian influenza**, and **SARS** are caused by viruses.
- The relative ability of viruses to cause disease is described in terms of **virulence**.



100nm
Variola virus
360nm
Herpesvirus
200nm
Rabies
180X80nm
Measles
150nm
HIV-1
120nm
SARS
120nm
Ebolavirus
80x970nm
Influenza virus
100nm
Adenovirus
90nm
Rotavirus
80nm
Papillomavirus
60nm
Dengue virus,
Zika virus
50nm
Hepatitis C virus
50nm
Hepatitis B virus
42nm
Hepatitis A virus,
Poliovirus
30nm
Parvovirus
20nm

- Viruses have **different mechanisms** by which they produce disease in an organism, which depends largely on the **viral species.**

- Mechanisms at the **cellular level** primarily include **cell lysis;** the breaking open and subsequent death of the cell.

- In multicellular organisms, if **enough cells die**, the **whole organism** will start to suffer the effects.

- Viruses may exist **relatively harmlessly** within an organism.

- **Herpes simplex virus**, which causes cold sores, may remain in a **dormant state** within the human body.

- This is called **latency** and is a characteristic of the herpes viruses.

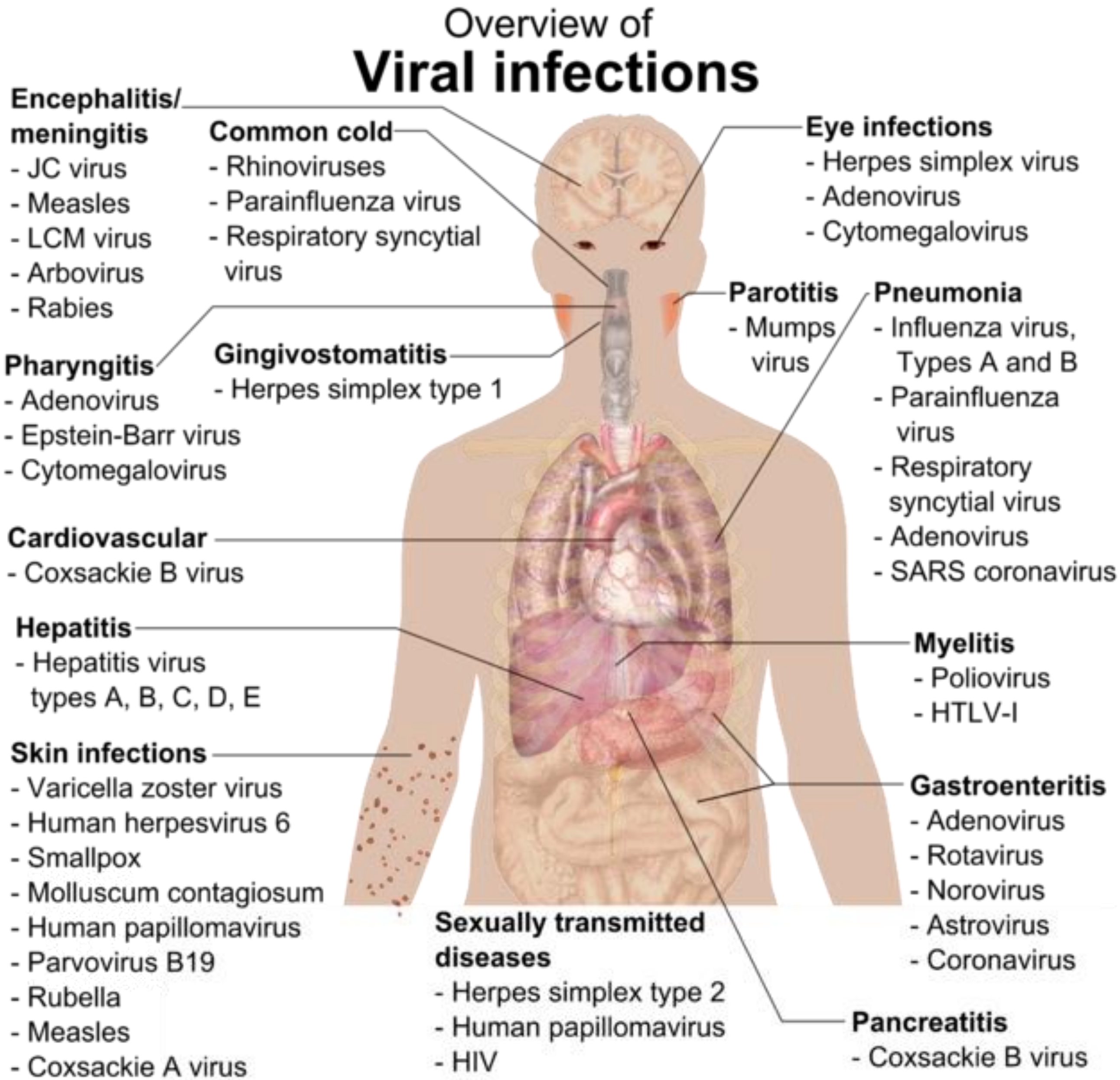
- Most people have been infected with **at least one type** of herpes virus in their life time.

- Some viruses can cause **lifelong or chronic infections**, where the viruses may continue to replicate in the body despite the host's defence mechanisms or stay dormant.

- This is common in **hepatitis B virus** and **hepatitis C virus** infections.

- People chronically infected are known as **carriers**, as they serve as reservoirs of infectious virus.

- In populations with a high proportion of carriers, the disease is said to be **endemic**.

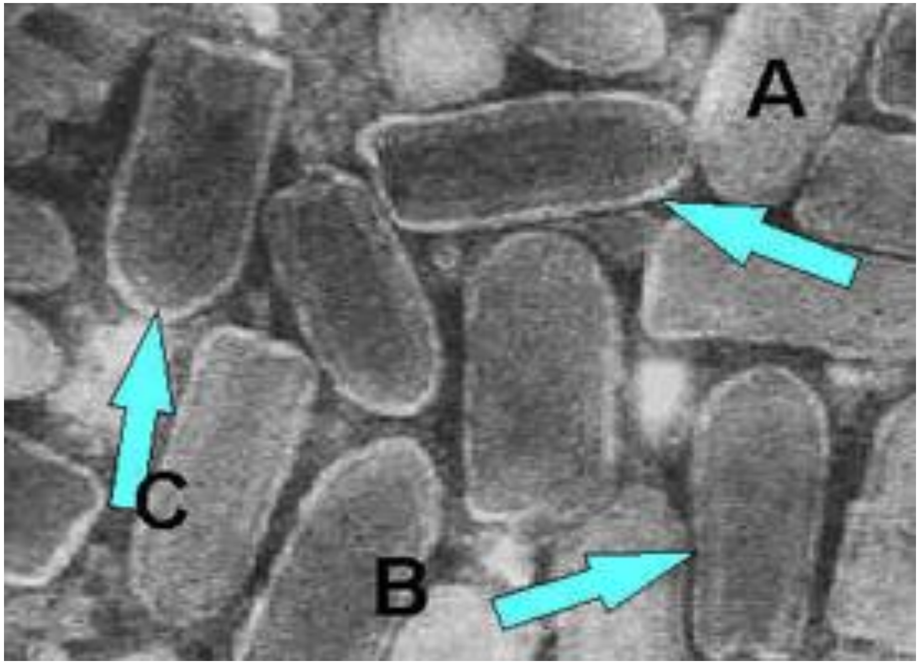


Overview of
Viral infections
Encephalitis/
meningitis
- JC virus
- Measles
- LCM virus
- Arbovirus
- Rabies
Common cold
- Rhinoviruses
- Parainfluenza virus
- Respiratory syncytial
virus
Eye infections
- Herpes simplex virus
- Adenovirus
- Cytomegalovirus
Pharyngitis
- Adenovirus
- Epstein-Barr virus
- Cytomegalovirus
Gingivostomatitis
- Herpes simplex type 1
Parotitis
- Mumps
virus
Pneumonia
- Influenza virus,
Types A and B
- Parainfluenza
virus
- Respiratory
syncytial virus
- Adenovirus
- SARS coronavirus
Cardiovascular
- Coxsackie B virus
Hepatitis
- Hepatitis virus
types A, B, C, D, E
Myelitis
- Poliovirus
- HTLV-I
Skin infections
- Varicella zoster virus
- Human herpesvirus 6
- Smallpox
- Molluscum contagiosum
- Human papillomavirus
- Parvovirus B19
- Rubella
- Measles
- Coxsackie A virus
Gastroenteritis
- Adenovirus
- Rotavirus
- Norovirus
- Astrovirus
- Coronavirus
Sexually transmitted
diseases
- Herpes simplex type 2
- Human papillomavirus
- HIV
Pancreatitis
- Coxsackie B virus

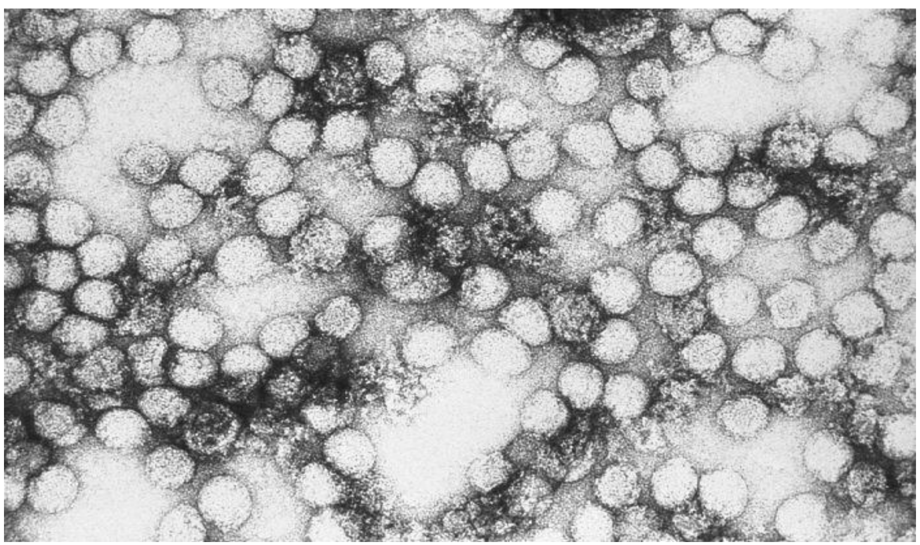
Animal viruses

Vertebrates

- Humans cannot be infected by plant or insect viruses, but they are **susceptible to infections with viruses from other vertebrates**.
- These are called viral **zoonoses** or **zoonotic infections**.
- Examples include, **rabies** and **yellow fever**.



Rabies virus (Bullet shaped)



Yellow fever virus

- The viruses that infect other vertebrates are **related to those of humans** and most families of viruses that cause human diseases are represented.

- These are **important pathogens of livestock** and cause diseases such as **foot-and-mouth disease** and **bluetongue**.

- **Myxomatosis** is a fatal pox virus infection of **rabbits**: once infected they die within twelve days.

- **Canine distemper** virus is closely related to measles virus and is the most important viral disease of **dogs**.

- Many other viruses, including **caliciviruses**, **herpesviruses**, **adenoviruses** and **parvoviruses**, circulate in **marine** mammal populations.

- **Fish** too have their viruses. They are particularly prone to infections with **rhabdoviruses**, which are distinct from, but related to rabies virus.

Invertebrates

- Invertebrates **do not produce antibodies** by the lymphocyte-based adaptive immune system that is central to vertebrate immunity, but they are **capable of effective immune responses**.

- **Phagocytosis** was first observed in invertebrates, and this and other **innate immune responses** are important in immunity to viruses and other pathogens.

- The **hemolymph** of invertebrates contains many soluble defence molecules, such as **hemocyanins, lectins,** and other **proteins,** which protect these animals against invaders.

- The health of the **honey bee** has been important to human societies for centuries.

- Honey bee (*Apis mellifera*) is susceptible to many viral infections, and their numbers have **dramatically declined** around the world.

- Bees are **crucial** to the survival of humans.

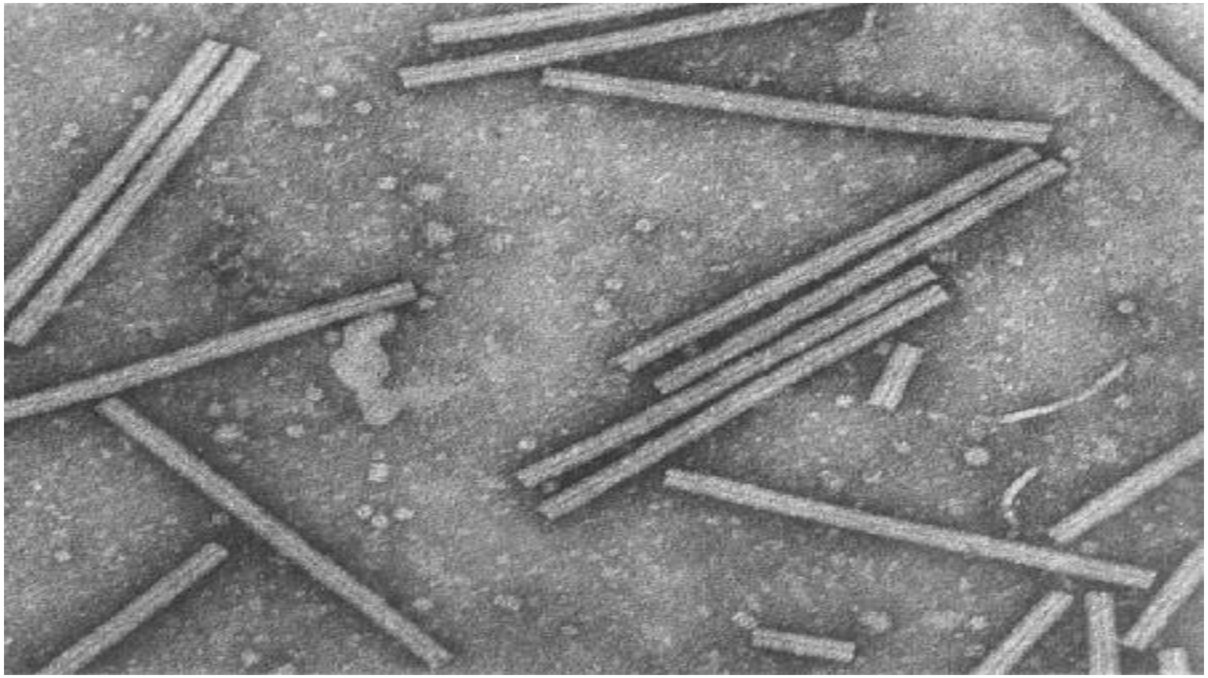
- Along with producing honey, they **pollinate** plants that contribute up to **one third of the food** we eat, and their dramatic decline is a grave concern.

- **Baculoviruses** are among the best studied of the invertebrate viruses.
- They infect and kill several species of **agricultural pests**.
- As **natural insecticides**, they have been used to control insect populations.
- Viruses are an **attractive** alternative to chemical pesticides because they are **safe to other wildlife** and **leave no residues**.

Plant viruses

- The first plant virus to be discovered was **Tobacco mosaic virus (TMV).**

- This and other viruses cause an estimated **US$60 billion loss** in crop yields worldwide each year.



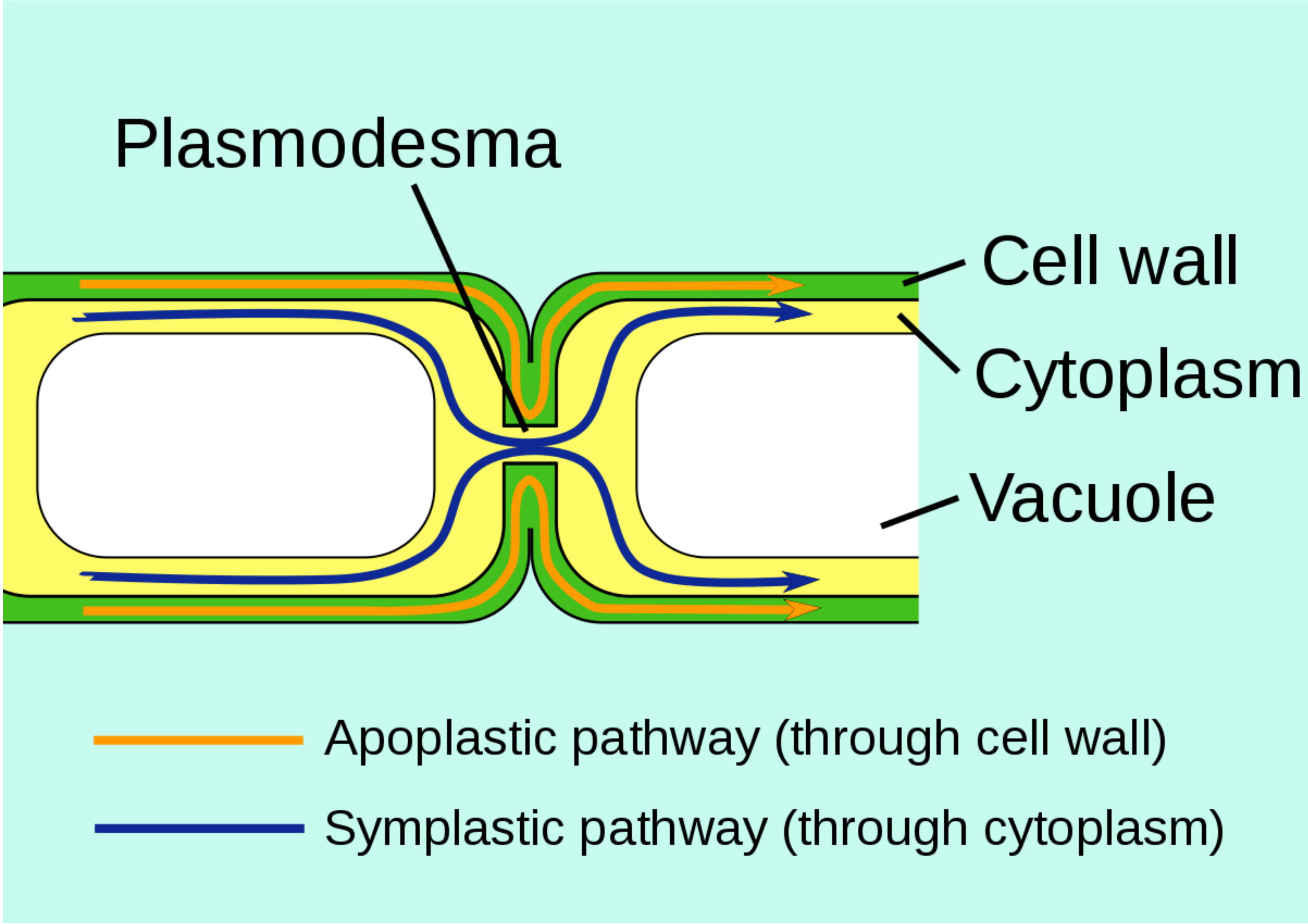
- Plant viruses are grouped into **73 genera** and **49 families**.
- However, these figures relate only to **cultivated plants** that represent only a **tiny fraction** of the total number of plant species.

- Plants **do not move**, and so plant-to-plant transmission usually involves **vectors (such as insects).**

- Due to **solid cell walls**, transport through **plasmodesmata** is the preferred path for virions to move between plant cells.

- Plants have specialized mechanisms for transporting **mRNAs** through plasmodesmata.

- These mechanisms are thought to be used by **RNA viruses** to spread from one cell to another.


Plasmodesma
Cell wall
Cytoplasm
Vacuole
Apoplastic pathway (through cell wall)
Symplastic pathway (through cytoplasm)

- Plant defenses against viral infection include, among other measures, the use of **siRNA (small interfering RNA)** in response to **dsRNA**.

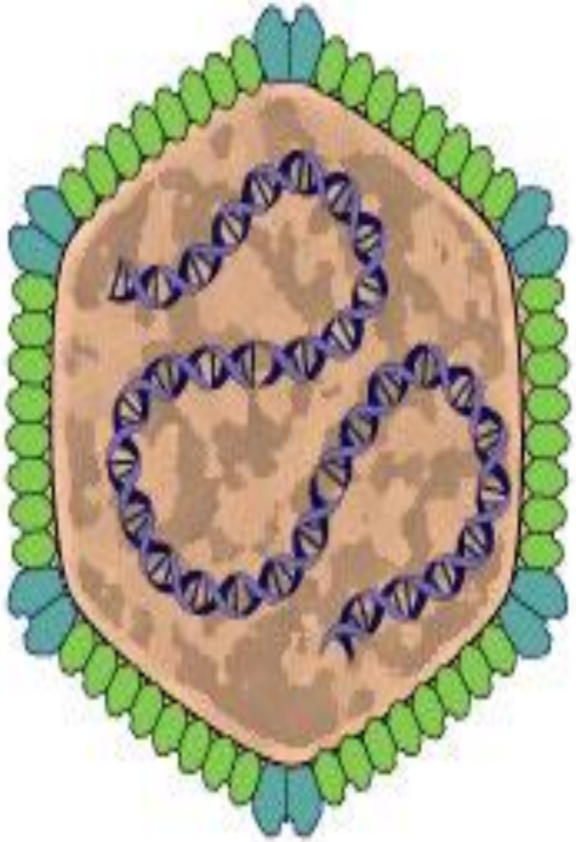
- Most plant viruses **encode a protein** to suppress this response.

- Plants also **reduce transport** through plasmodesmata in response to injury.

* siRNA is 20-24 base pair double stranded RNA which is responsible for RNA interference to reduce protein expression.

Structure

- Over 50% of known plant viruses are **rod-shaped** (flexuous or rigid).
- The length of the particle is normally dependent on the genome but it is usually between **300–500 nm** with a diameter of **15–20 nm.**
- The second most common structure amongst plant viruses are **isometric** particles.
- They are **25–50 nm** in diameter.
- A very small number of plant viruses have, in addition to their coat proteins, a **lipid envelope**.



T=?

Transmission of plant viruses

Through sap

- Viruses can be spread by **direct transfer** of sap by contact of a wounded plant with a healthy one.

- Such contact may occur during **agricultural practices**, as by damage caused by tools or hands, or naturally, as by an **animal feeding** on the plant.

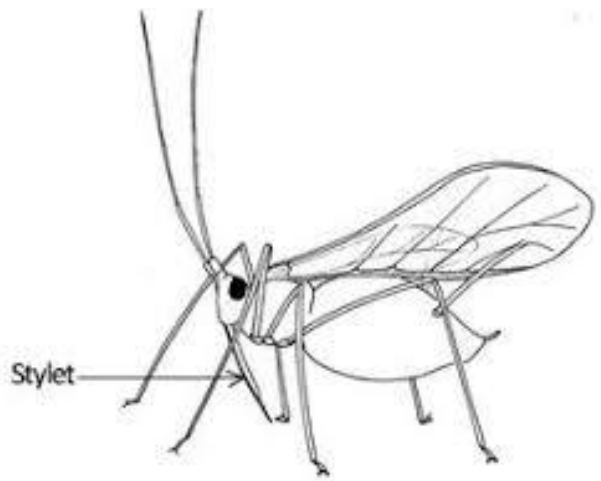
- Generally **TMV, potato viruses** and **cucumber mosaic viruses** are transmitted via sap.

Insects

- Plant viruses need to be transmitted by a vector, most often insects such as **leafhoppers**.
- One class of viruses, the **Rhabdoviridae**, has been proposed to actually be insect viruses that have evolved to replicate in plants.
- The chosen insect vector of a plant virus will often be the determining factor in that **virus's host range**: it can only infect plants that the insect vector feeds upon.

Nemataodes

- **Soil-borne** nematodes also have been shown to transmit viruses.
- They acquire and transmit them by feeding on **infected roots**.
- The virions attach to the **stylet** (feeding organ) or to the gut when they feed on an infected plant and can then detach during later feeding to infect other plants.



Protozoa

- A number of virus genera are transmitted by soil borne **protozoa**.
- These protozoa are plant **parasites**.
- Transmission of the virus takes place when they become associated with the **plant roots**.

Seed and pollen borne viruses

- Plant virus transmission from generation to generation occurs in about **20%** of plant viruses.

- When viruses are transmitted by seeds, the **seed is infected** in the generative cells and the virus is maintained in the **germ cells** and sometimes, but less often, in the **seed coat**.

- When the growth and development of plants is **delayed** because of situations like unfavourable weather, there is an **increase** in the amount of virus infections in seeds.


Thank You!