Introduction to **Virology**

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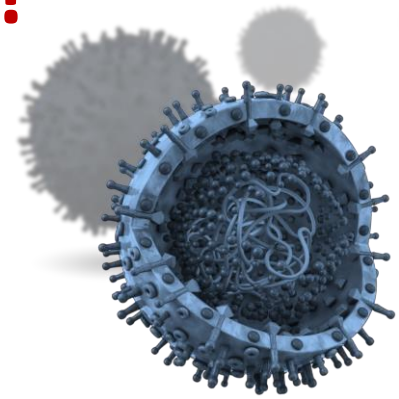
What is a virus?



- **Viruses** are very different from the other microbial groups. They are so small (filterable)that most can be seen only with an **electron microscope**, and they are **acellular** (not cellular).

- Viruses can reproduce only by using the cellular machinery of other organisms **(obligatory intracellular parasites)**

Virus Host Range

The **host range** of a virus is the cells the virus can infect. → spectrum of host

Viruses are able to infect specific types of cells of **only** **one host species.** **(host-specific)**

In rare cases, viruses cross the host-species barrier, thus **expanding** their host range.

Viruses infect:

- **Humans**

Smallpox [1]

- **Other vertebrates**

Foot and mouth disease [2]

- **Invertebrates**

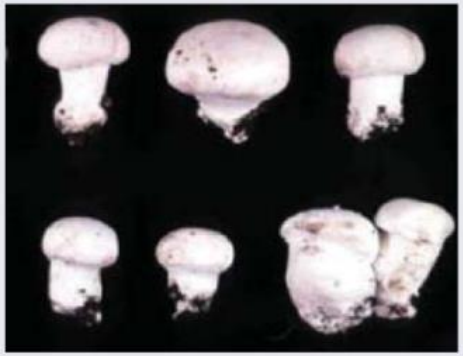
Leatherjackets infected with *Tipula* iridescent virus

- **Plants**

Delayed emergence of potato caused by tobacco rattle virus infection [3]

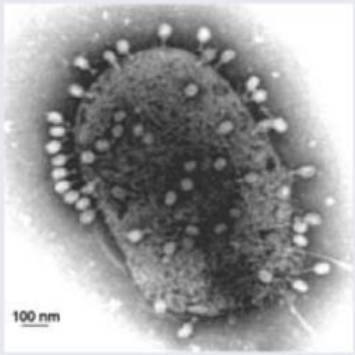
Damaged potato (spraing) caused by tobacco rattle virus infection [3]

- **Fungi**



Mushroom virus X [4]

- **Bacteria**



Escherichia coli cell with phage T4 attached [5]

(Virology Principles & Applications Book, p1)

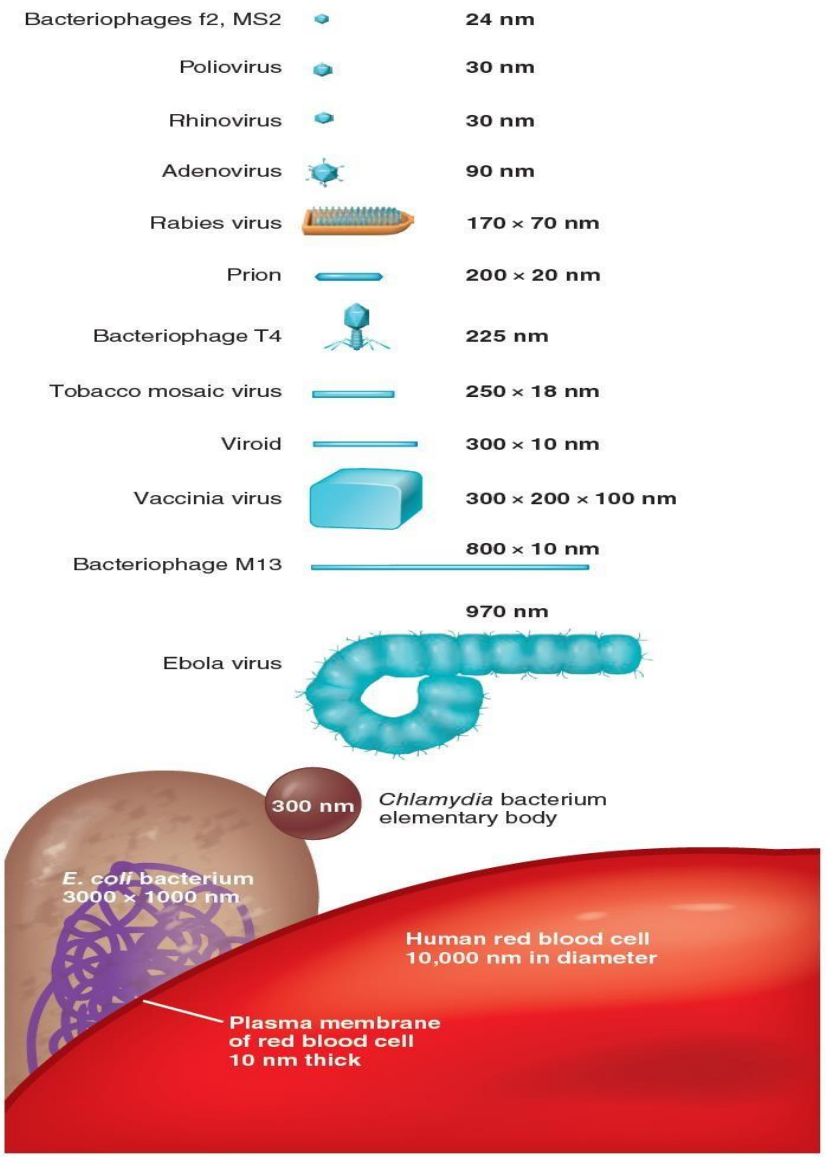
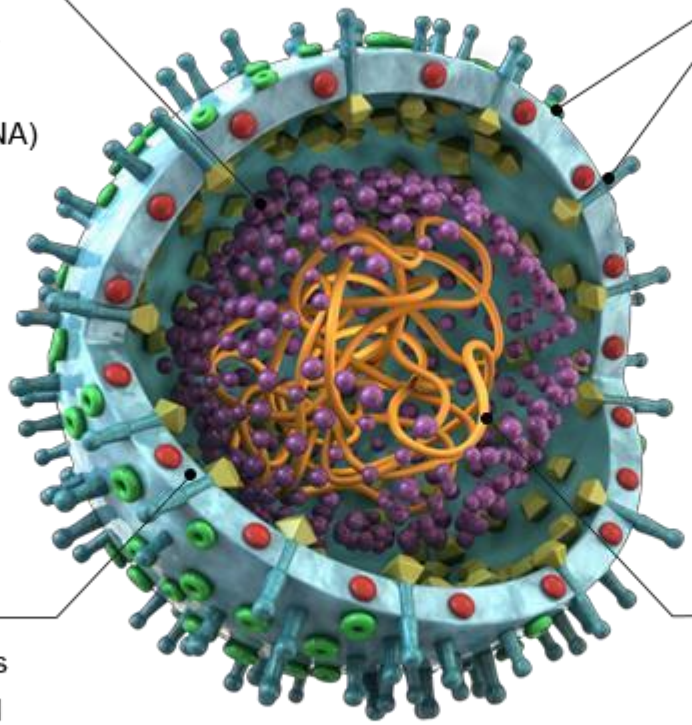


Figure 3 **Virus sizes.** The sizes of several viruses (teal blue) and bacteria (brown) are compared with a human red blood cell, shown below the microbes. Dimensions are given in nanometers (nm) and are either diameters or length by width.

Structure of Virus



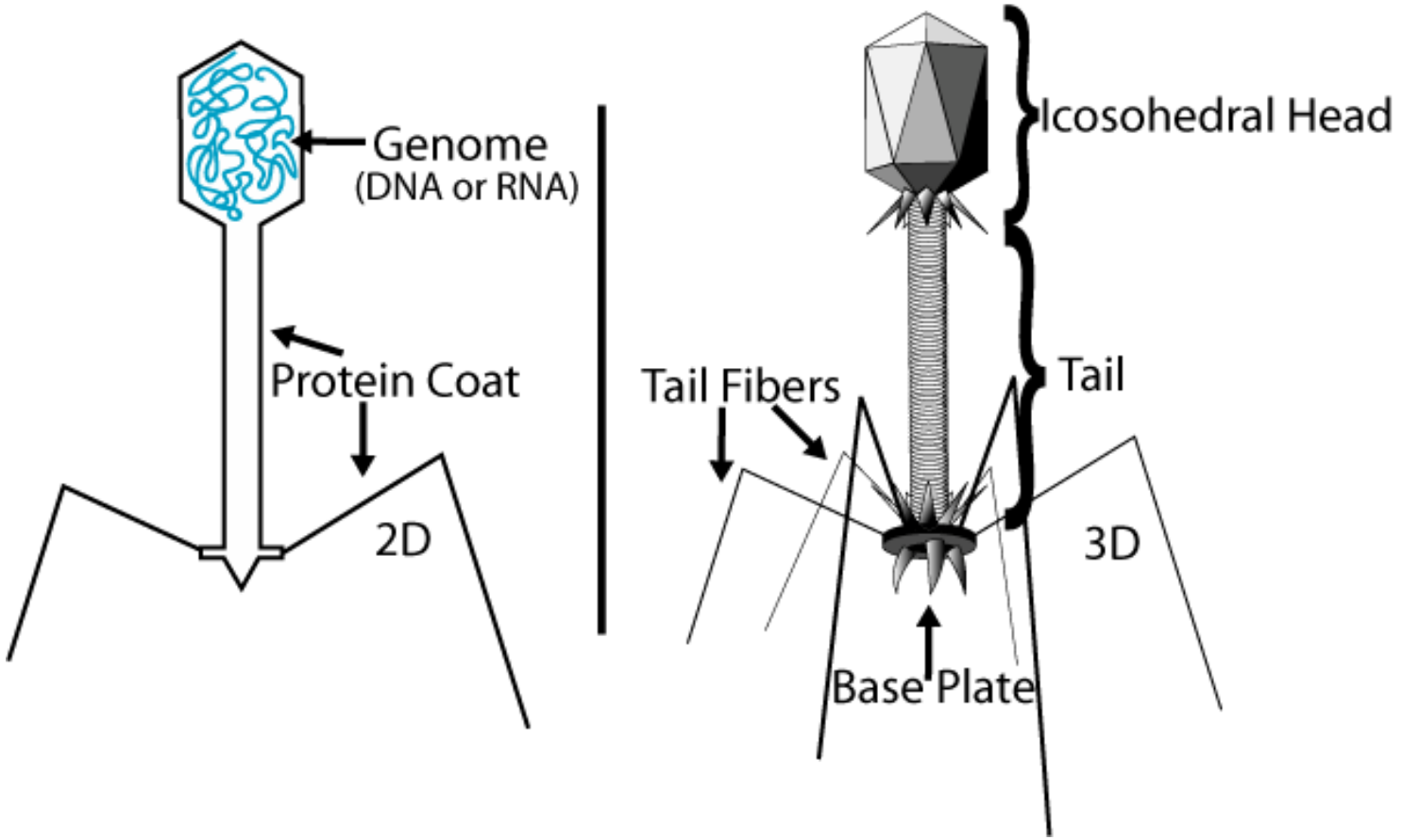
Capsid
The capsid contains the vius'genetic material (DNA or RNA)

Surface proteins
These help the virus recognise and bind to cells in the host organism

Viral envelope
The viral envelope is made from fatty lipid molecules taken from cells in the host

Virus genetic material
(DNA or RNA) material contains the instructions for making new copies of the virus

Bacteriophage Structure



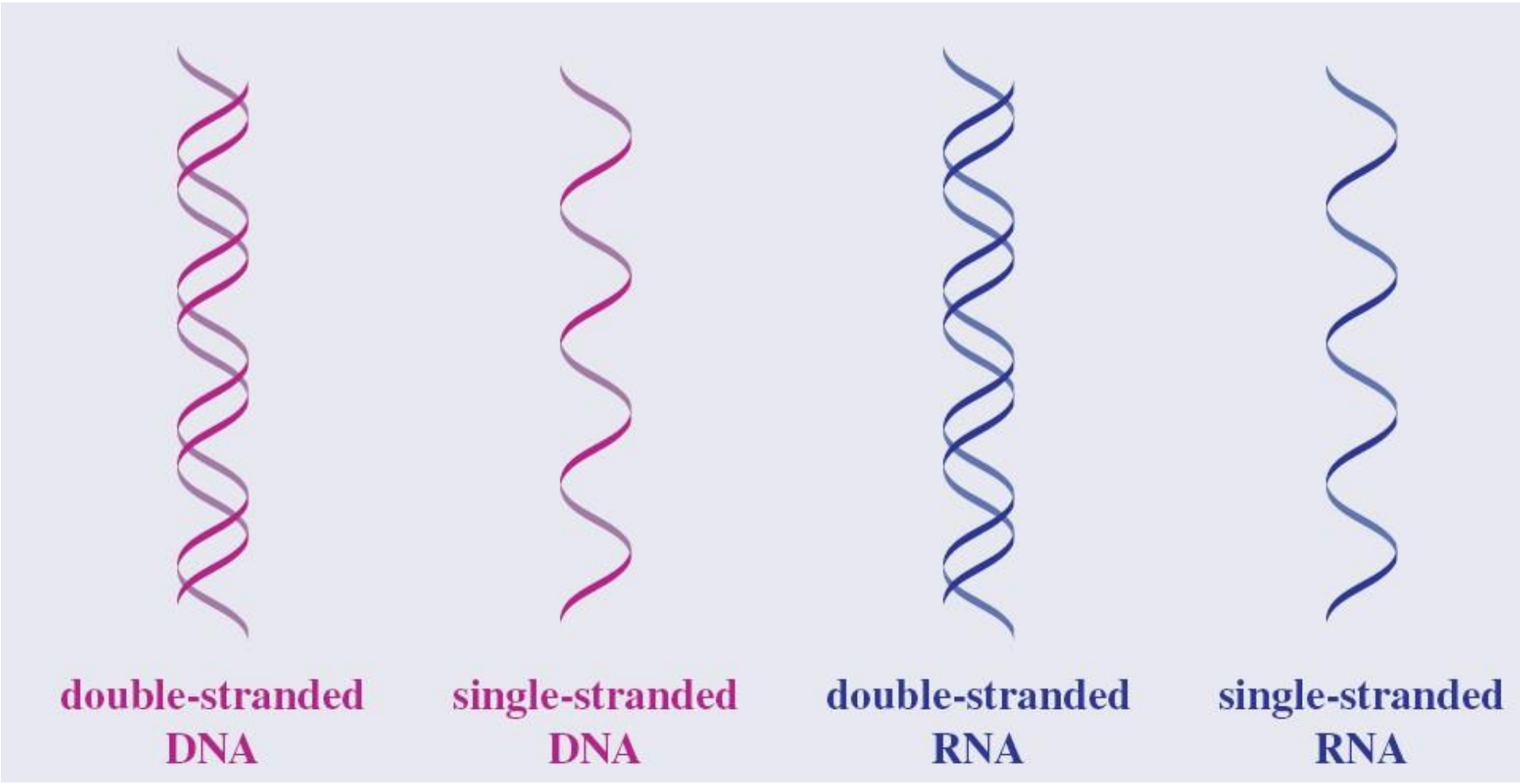
Virus Genomes

In contrast to prokaryotic and eukaryotic cells, in which DNA is always the primary genetic material (and RNA plays an auxiliary role), a virus can have either **DNA** or **RNA** but never both.

The nucleic acid of a virus can be

- single-stranded
- double-stranded.

Virus Nucleic acid

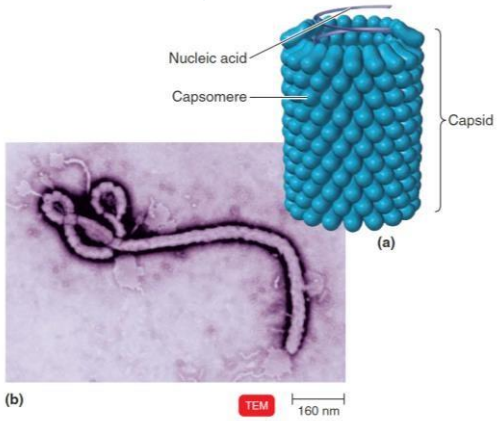


General Morphology

(basis of their capsid architecture.)

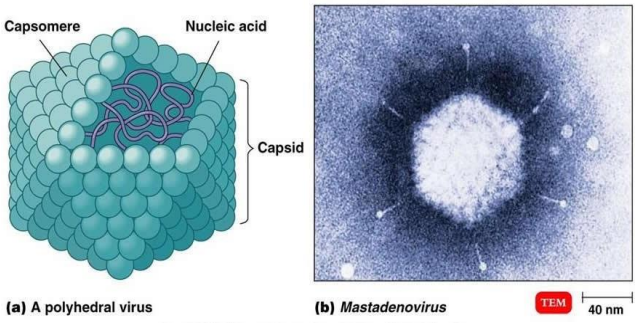
▷ Helical Viruses:

▷ Example: **Ebola** viruses



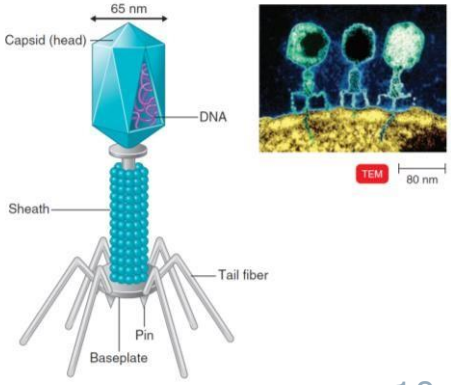
▷ Polyhedral Viruses:

▷ Example: **poliovirus.**



▷ Complex Viruses:

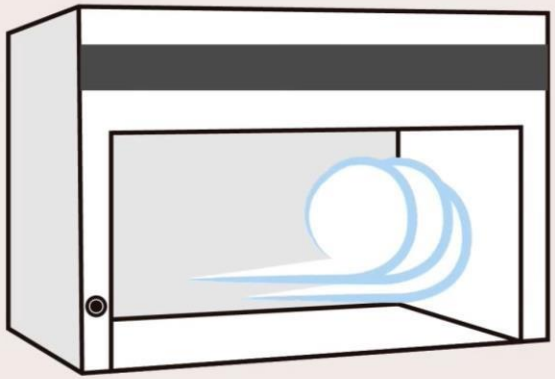
example :**bacteriophage.**



How do we Detect and Measure Viruses?

(Isolation, Cultivation, and Identification of Viruses)

Laminar Flow Hood



They can **not** be cultivated on artificial culture media.

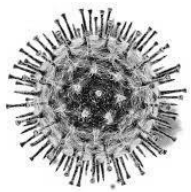
Methods for growing viruses in the laboratory

(1) Growing Bacteriophages

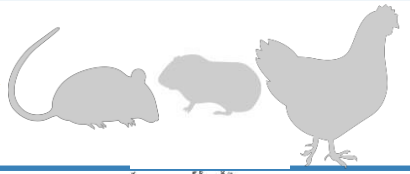
solid media → *plaque method* *)detect and count viruses(*

liquid media

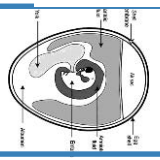
(2) Growing Animal Viruses



Living Animals →

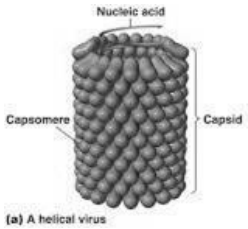


Embryonated Eggs →



Cell Cultures →

(3) Growing plant Viruses



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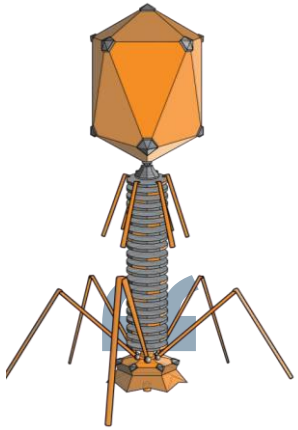
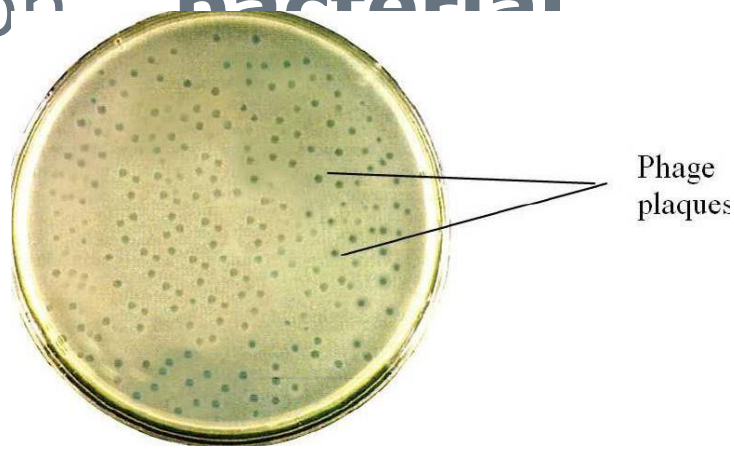


- However, viruses that use bacterial cells as a host (**bacteriophages**) are rather **easily** grown on **bacterial cultures.**



(1) Growing Bacteriophages in the Laboratory

The Number of Plaques

=

Plaque-forming Units (PFU).

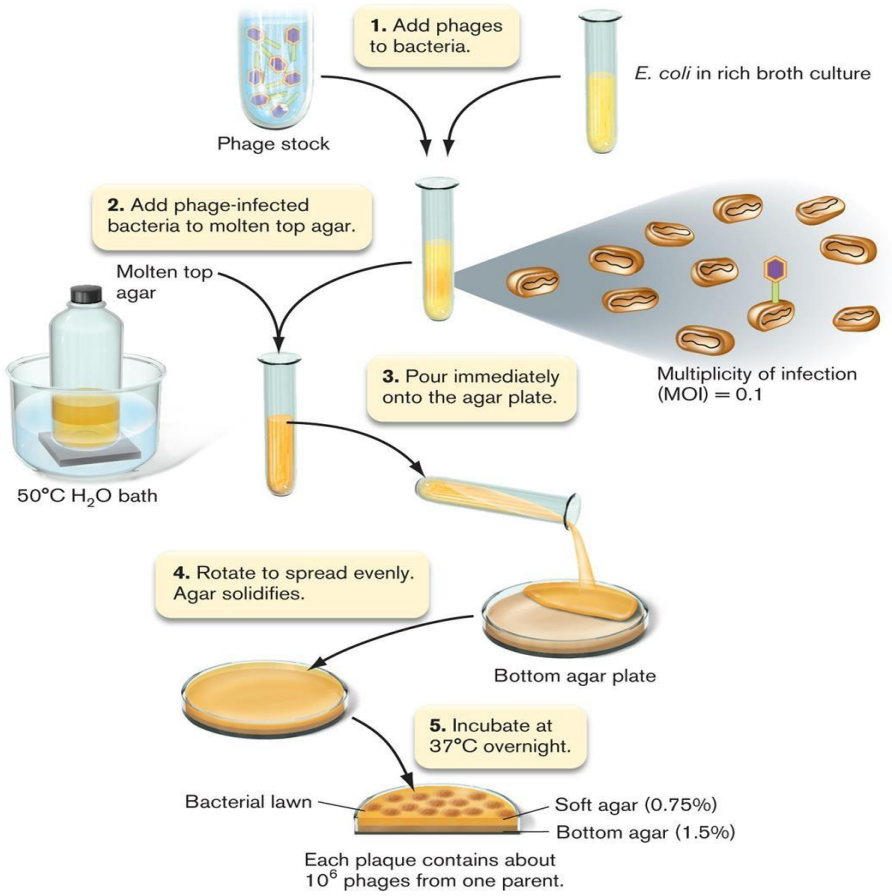


Figure 4. *plaque method.*

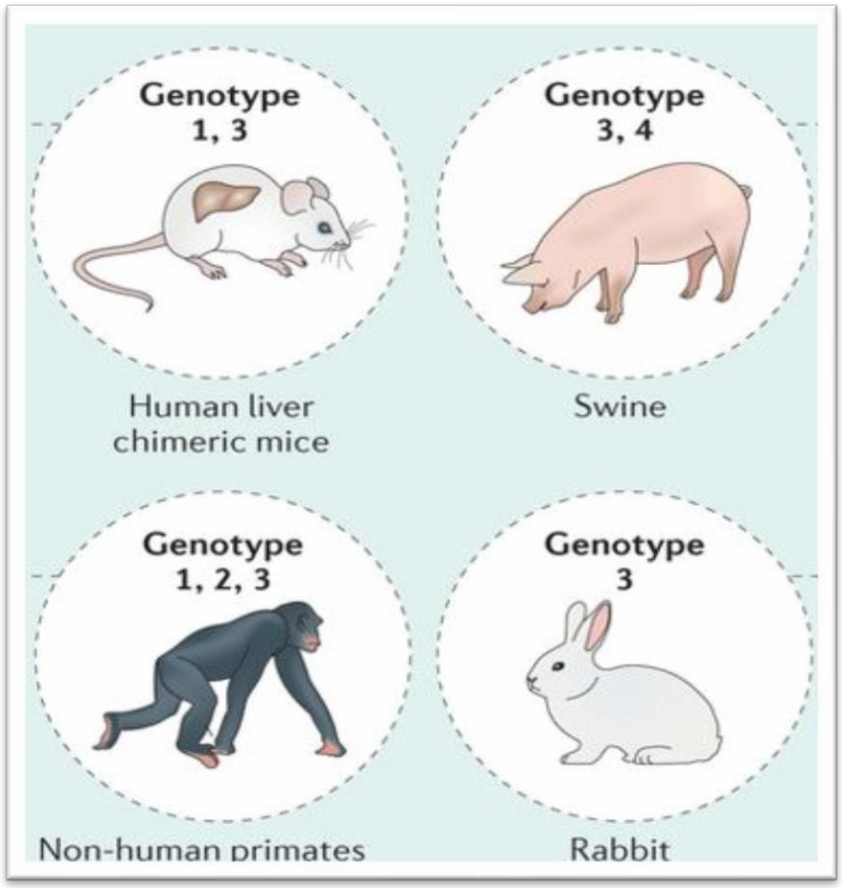
(2)Growing Animal Viruses

A- In Living Animals

▷ Some animal viruses can be cultured **only** in living animals, such as mice, rabbits, and guinea pigs.

▷ Most experiments to study the **immune system's response** to viral infections .

▷ Animal inoculation may be used as a diagnostic procedure for **identifying** and **isolating** a virus from a clinical specimen.



(2)Growing Animal Viruses

B- In Embryonated Eggs:

The different sites of viral inoculation in embryonated eggs are:

1. Chorioallantoic membrane(CAM)
2. Amniotic Cavity
3. Allantoic Cavity
4. Yolk sac

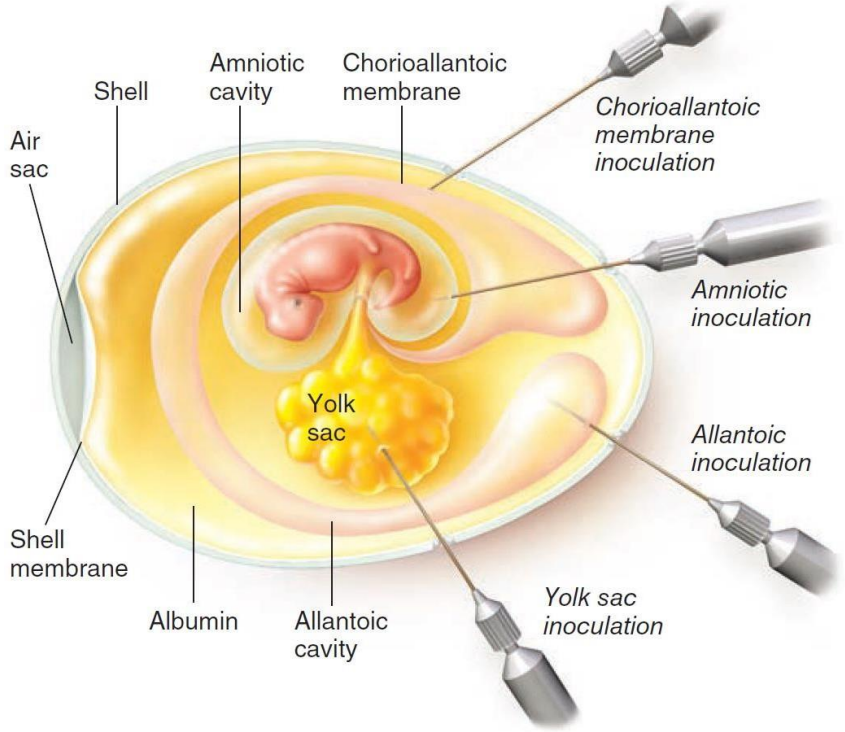


Figure 5. Inoculation of an embryonated egg. The viruses will grow on the membrane at the inoculation site.

(2)Growing Animal Viruses

B- **In Embryonated Eggs**:

Viral growth is signalled by:

1. the death of the embryo.
2. embryo cell damage.
3. by the formation of typical pocks or lesions on the egg membranes.

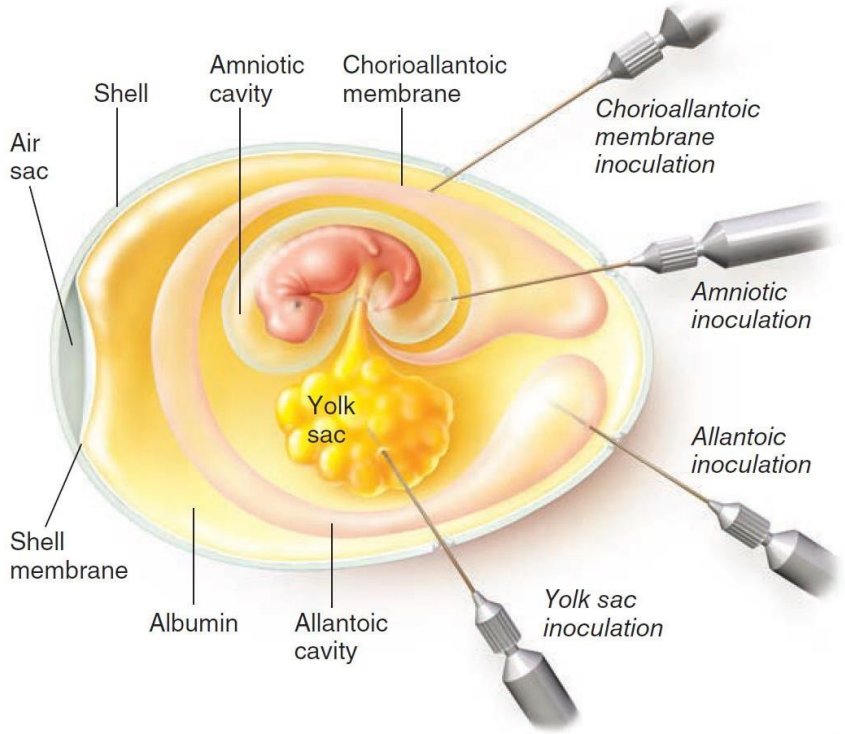


Figure 5. Inoculation of an embryonated egg. The viruses will grow on the membrane at the inoculation site.

(2)Growing Animal Viruses

C - In Cell Cultures:

Cell cultures have replaced **embryonated eggs** as the preferred type of growth medium for many viruses. **Cell cultures consist of cells grown in culture media in the laboratory.**

(2)Growing Animal Viruses

C- In Cell Cultures:

Cell culture lines are started by treating a slice of animal tissue with enzymes that separate the individual cells (**Figure5**). These cells are suspended in a solution that provides the osmotic pressure, nutrients, and growth factors needed for the cells to grow.

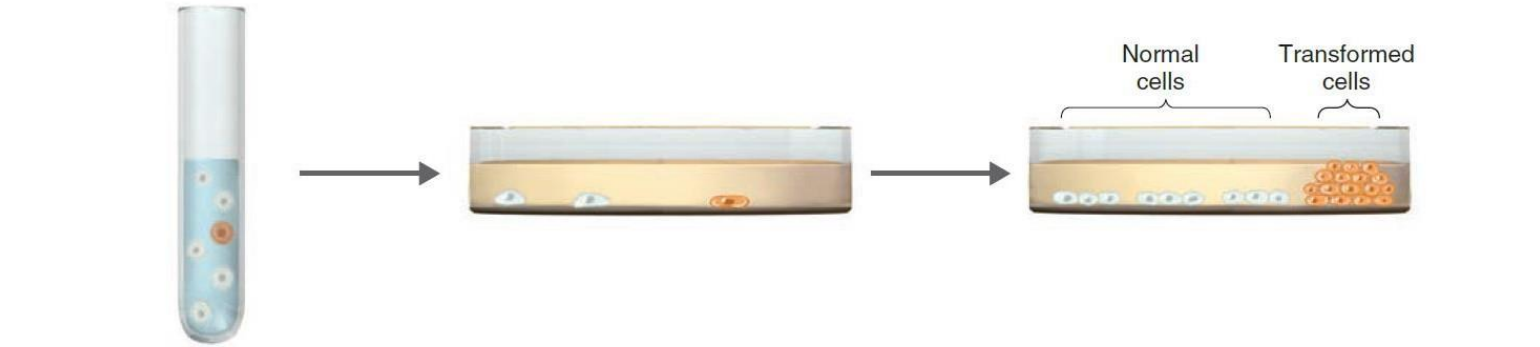


Figure **Cell cultures.** Transformed cells can be grown indefinitely in laboratory culture.

Examples of Cultureware

Flasks

Plates

Roller Bottles

Commonly Used Commercial Media

1. Dulbecco's Modified Eagle Medium (DMEM)
2. Roswell Park Memorial Institute-1640 (RPMI)
3. Ham's F12 Nutrient Mixture (F12)

(٣) Growing plant Viruses in the Laboratory

Plant viruses = similar in morphology and nucleic acid types to animal viruses

Common crop viruses:

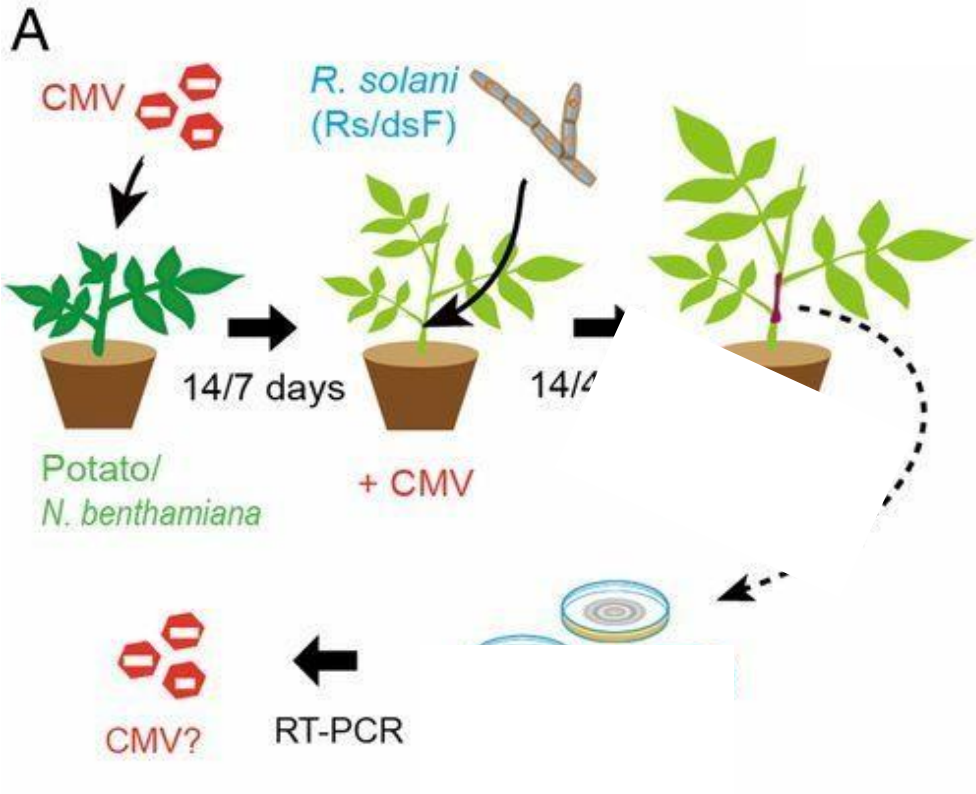
- Bean mosaic virus
- Wound tumor virus
  - corn and sugarcane
- Potato yellow dwarf virus

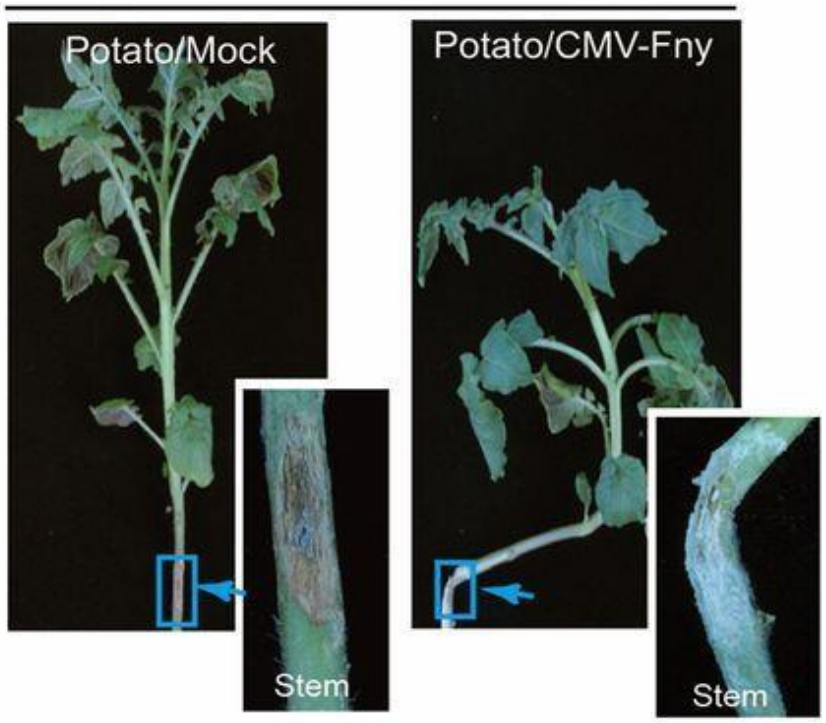
Must penetrate cell wall by:

- Wounds
- Parasites
  - Ex) aphids that eat sap

Result = color change, deformed/stunted growth, wilting

(٣) Growing plant Viruses in the Laboratory





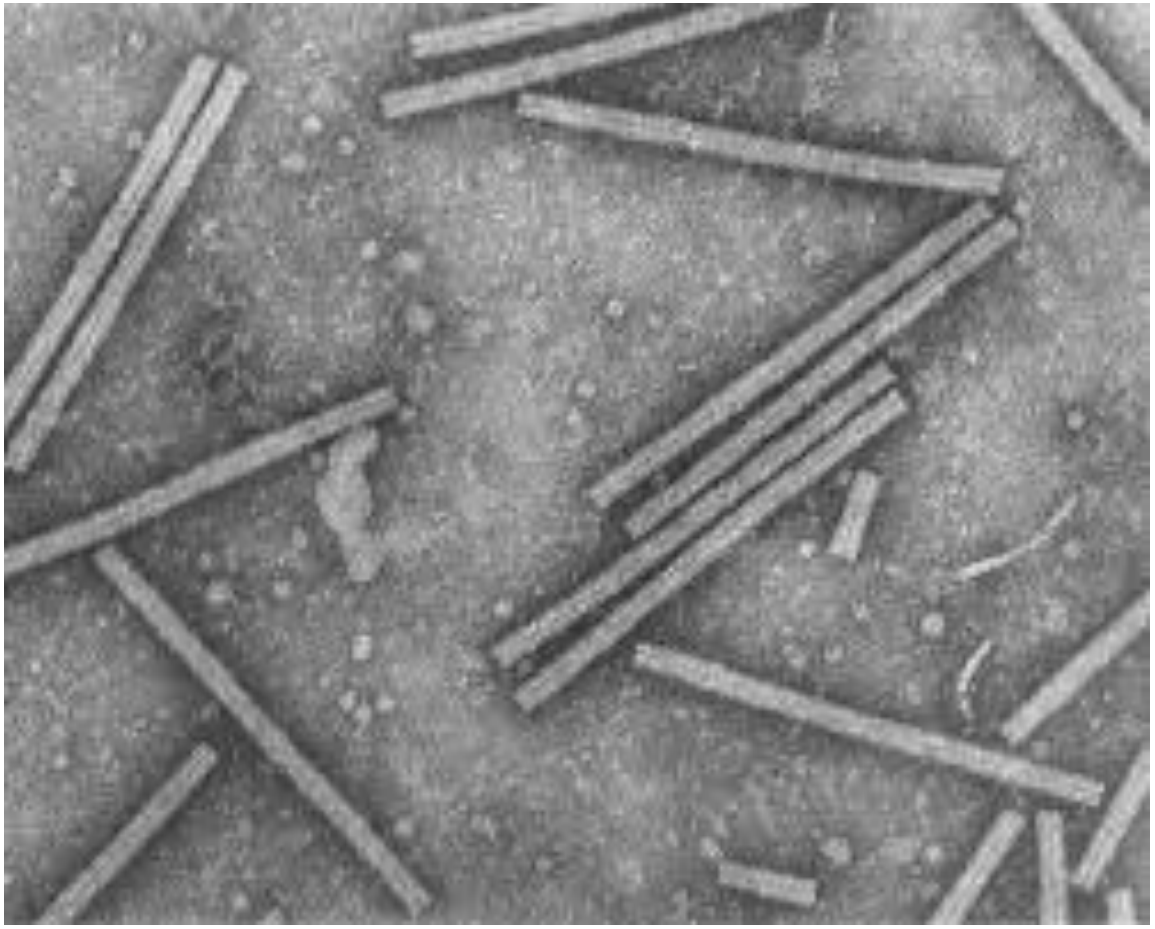


Figure 2. Tobacco mosaic virus (TMV)