Virus Life Cycle

Image: [Viral cycle of infection](http://www.nationalacademies.org), National Academy of Sciences

From the [Virtual Microbiology Classroom](http://www.scienceprofonline.com) on ScienceProfOnline.com
**Bacteriophages** (Phages) & **Animal Viruses**

The two categories of **viruses** that we are going to discuss in this class.
How Do Viruses Reproduce?

Four basic steps:

1. Recognize & attach to host cell.
2. Infect (get inside) host cell.
3. Force cell to manufacture viruses.
4. New viruses exit the host cell.

Image: Source unknown.

From the Virtual Microbiology Classroom on ScienceProfOnline.com
1. How does a virus recognize & attach to its host?

- Most viruses infect only a certain type of host.

- Specificity due to affinity of viral surface proteins to proteins on the surface of the host cell.
  - **bacteriophages** have proteins in their tail fibers (those extensions that look like legs) that are attracted to proteins on the surface of bacterial cells.
  - **animal viruses** have proteins or glycoprotein spikes that correspond to glycoproteins on the surface of animal cells.

- **Viruses** may also be so specific that they infect a particular cell type of the host organism. (HIV only attacks helper-T lymphocytes, a type of white blood cell, in humans.)
How Do Viruses Reproduce?

Four basic steps:

1. Recognize & attach to host cell.

2. Infect (get inside) host cell.

3. Force cell to manufacture viruses.

4. New viruses exit the host cell.
2. How does a virus infect its host?

Remember, a **virus** can exist outside of its host or inside its host. So we need some more terms:

**extracellular state**

- Called virion (vie-ree-on)
- **Protein** coat (capsid) surrounding nucleic acid
- Some have phospholipid envelope
- Outermost layer provides protection and recognition sites for host cells

**intracellular state**

- Capsid removed
- Virus exists as **nucleic acid** (genetic material)

From the [Virtual Microbiology Classroom](http://ScienceProfOnline.com) on ScienceProfOnline.com
2a. How does a **bacteriophage** infect its host?
2b. How does an animal virus infect its host?

Entry of Viruses into Animal Cells – 3 Methods:

1. Direct penetration of naked virus
   - Viral genome enters cell, while capsid remains on cell’s surface.
     Like how phages enter bacteria.

   Remember the endomembrane system of eukaryotes?

2. Endocytosis

3. Membrane fusion
   - With membrane fusion and endocytosis, the capsid is removed once inside the host cell.

Images: Virus Entry into Cell; Endocytosis & Exocytosis, NIGMS; Endocytosis & exocytosis, Nicolle Rager Fuller, NSF

From the Virtual Microbiology Classroom on ScienceProfOnline.com
2b. How does an animal virus infect its host?

Examples of Animal Virus Entry
How Do Viruses Reproduce?

Four basic steps:

1. Recognize & attach to host cell.
2. Infect (get inside) host cell.
3. Force cell to manufacture viruses.
4. New viruses exit the host cell.
3. How does the infecting **virus** trick the host into manufacturing more viruses?

- Host cell reads viral genetic instructions and manufactures raw materials needed to build copies of new viruses.
- The viral parts and pieces self-assemble.
- **Q**: What process is required for host to make more genetic material for new **DNA** viruses?
- **Q**: What processes are required for cell to produce viral **proteins** to function as capsids and envelope proteins for new viruses?

Image: Source unknown.

From the [Virtual Microbiology Classroom](https://ScienceProfOnline.com)
How Do Viruses Reproduce?

Four basic steps:

1. Recognize & attach to host cell.
2. Infect (get inside) host cell.
3. Force cell to manufacture viruses.
4. New viruses exit the host cell.

Image: Source unknown.

From the Virtual Microbiology Classroom on ScienceProfOnline.com
4a. How do new phages exit host bacterium?

- Most commonly released through cell lysis.

- **Enzyme** called endolysin, is coded for in the viral **nucleic acid** of lytic phages.

- Endolysin attacks and breaks down **bacteria's cell wall** peptidoglycan.

- Infected bacterium is destroyed as a result.
4b. How do new animal viruses exit host cell?

Depends whether or not they have an envelope.

- **Naked viruses**
  
  After construction of capsid, naked viruses may be released from animal cell through exocytosis or may cause lysis and death of cell.

- **Enveloped viruses**
  
  Often released through a process called budding.

  Virus exits cell with part of cell's plasma membrane.

Image: [Viral life cycle](https://www.nasonline.org), National Academy of Sciences; [Rubella virions budding](https://phil.cdc.gov), PHIL # 10220

From the [Virtual Microbiology Classroom](https://scienceprofonline.com) on ScienceProfOnline.com
Take a look at:
“How A Virus Invades Your Body” an animated video from NPR.

Image: Viral life cycle, National Academy of Sciences

From the Virtual Microbiology Classroom on ScienceProfOnline.com
More about

Bacteriophages

Image: Bacteriophages attached to a bacterial cell, Graham Colm

From the Virtual Microbiology Classroom on ScienceProfOnline.com
Phage Replication

The Lytic Cycle of Bacteriophages

REVIEW!

Steps in Replication of T4 Phage
an animated video and quiz from McGraw-Hill.

Image: Bacteriophage Lytic Replication, Suly12

From the Virtual Microbiology Classroom on ScienceProfOnline.com
Phage Replication

The Lysogenic Cycle of Bacteriophages

REVIEW!

Animated lesson and quiz on Phage Replication Cycles

Image: Bacteriophage Lysogenic Replication, Suly12

From the Virtual Microbiology Classroom on ScienceProfOnline.com
Q: What topic introduced bacteriophages earlier in the semester? —It’s how we discovered that DNA is the material coding for proteins.

- Transfer of DNA from one cell to another via a replicating virus (bacteriophage).

- Can occur between prokaryotic cells or between eukaryotic cells. (The following is an example of transduction in bacterial cells by bacteriophage virus).