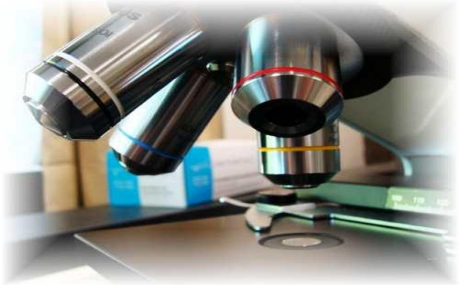

About Science Prof Online PowerPoint Resources

• Science Prof Online (SPO) is a free science education website that provides fully-developed Virtual Science Classrooms, science-related PowerPoints, articles and images. The site is designed to be a helpful resource for students, educators, and anyone interested in learning about science.

• The SPO Virtual Classrooms offer many educational resources, including practice test questions, review questions, lecture PowerPoints, video tutorials, sample assignments and course syllabi. New materials are continually being developed, so check back frequently, or follow us on Facebook (Science Prof Online) or Twitter (ScienceProfSPO) for updates.

• Many SPO PowerPoints are available in a variety of formats, such as fully editable PowerPoint files (.ppt), as well as uneditable versions in smaller file sizes, such as PowerPoint Shows (.pps) and Portable Document Format (.pdf), for ease of printing. The font "Jokerman" is used frequently in titles. It has a microbiology feel to it. If you do not have this font, some titles may appear odd, oversized and off-center. Find free downloads of Jokerman by Googling "download jokerman font microsoft".

• Images used on this resource, and on the SPO website are, wherever possible, credited and linked to their source. Any words underlined and appearing in blue are links that can be clicked on for more information. PPT files must be viewed in *slide show mode* to use the hyperlinks directly.

• Several helpful links to fun and interactive learning tools are included throughout the PPT and on the Smart Links slide, near the end of each presentation. You must be in *slide show mode* to utilize hyperlinks and animations.

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Image: Compound microscope objectives, T. Port

Virus Life Cycle

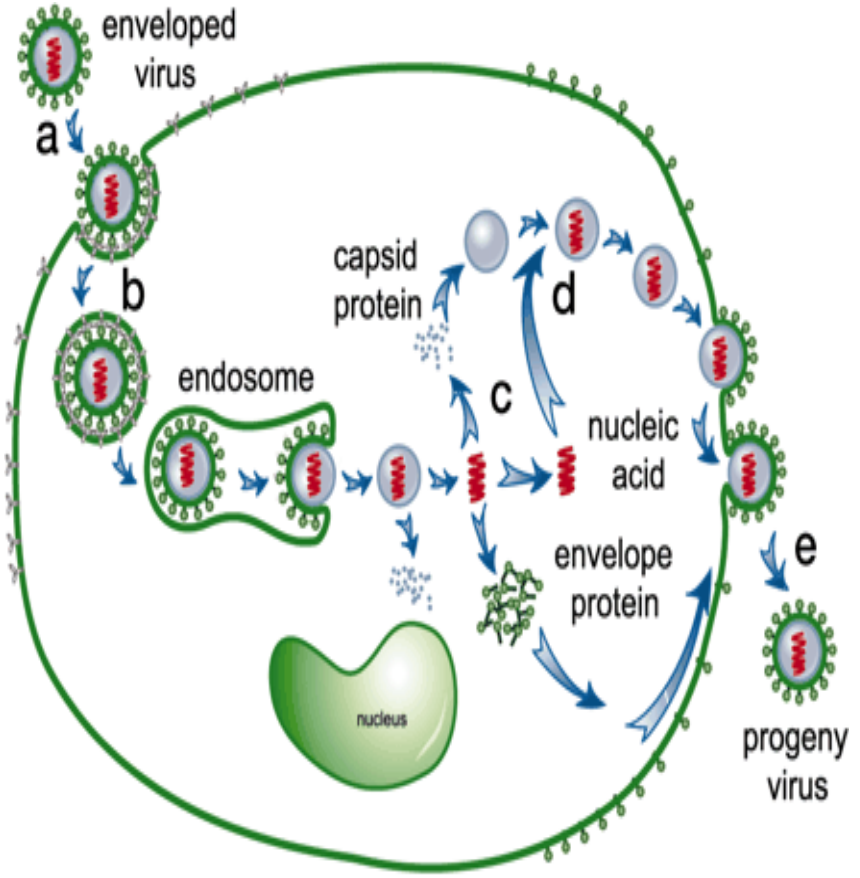


Image: Viral cycle of infection , National Academy of Sciences

From the Virtual Microbiology Classroom on ScienceProfOnline.com

Bacteriophages (Phages) & Animal Viruses

The two categories of **viruses** that we are going to discuss in this class.

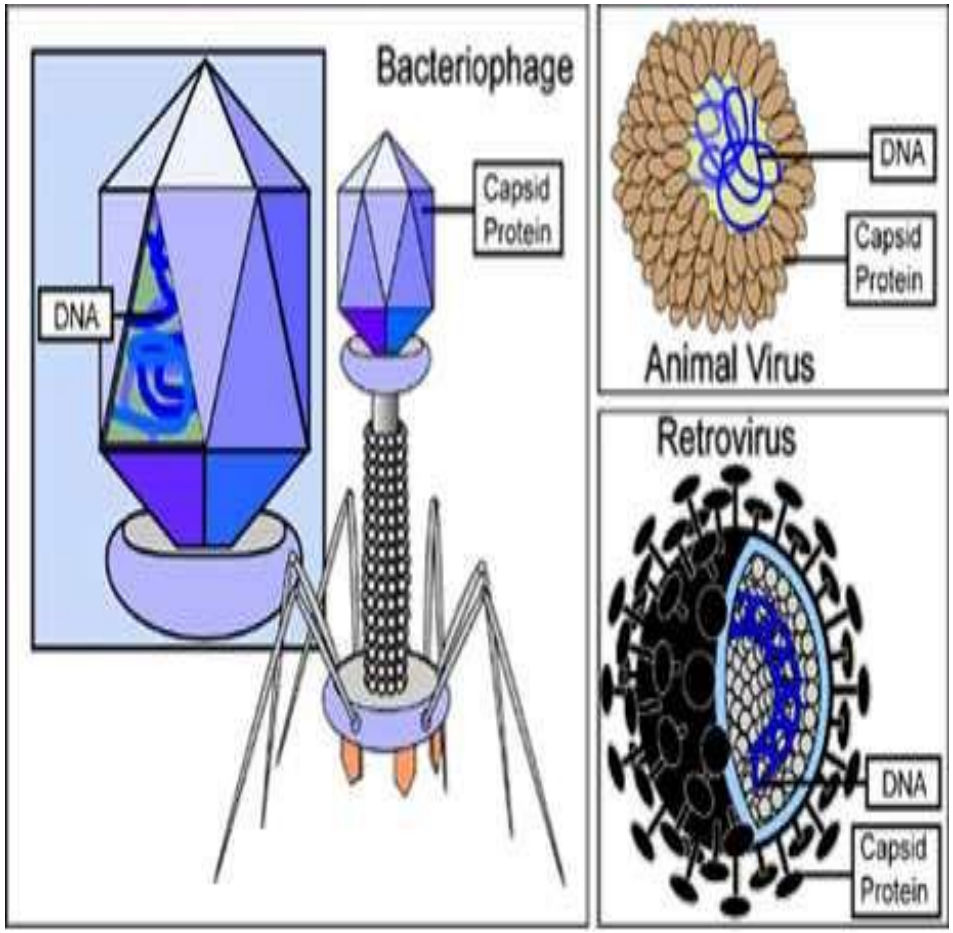
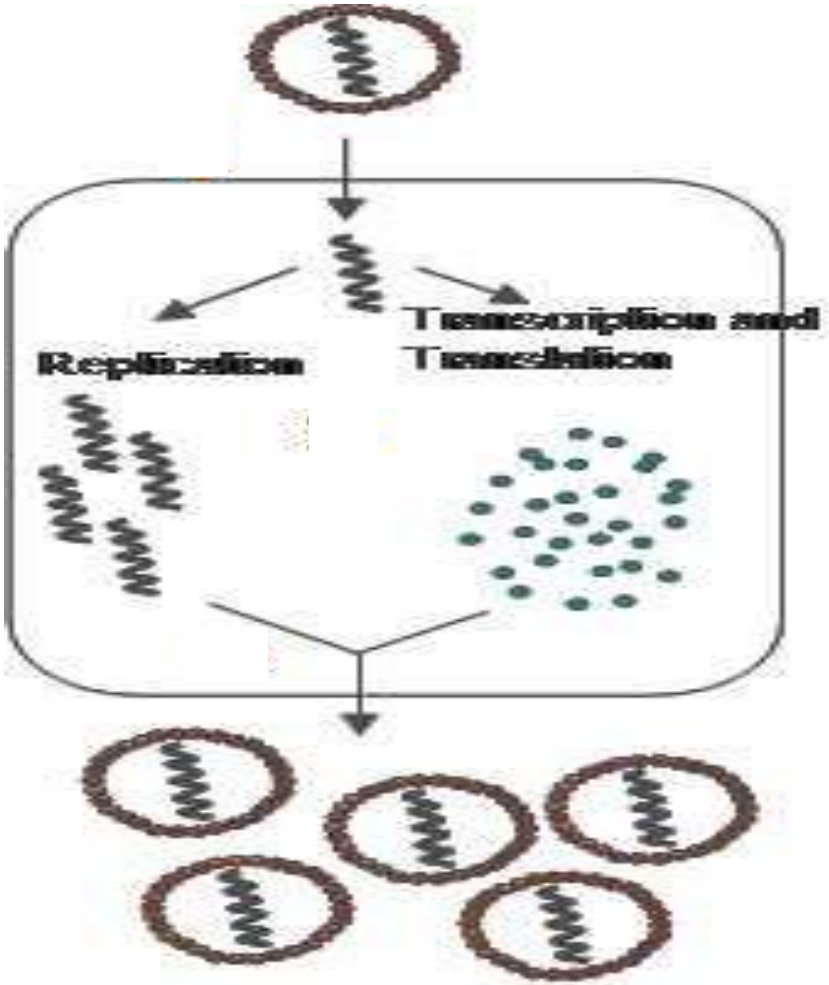


Image: Types of Viruses, National Institutes of Health

From the Virtual Microbiology Classroom on ScienceProfOnline.com

How Do Viruses Reproduce?



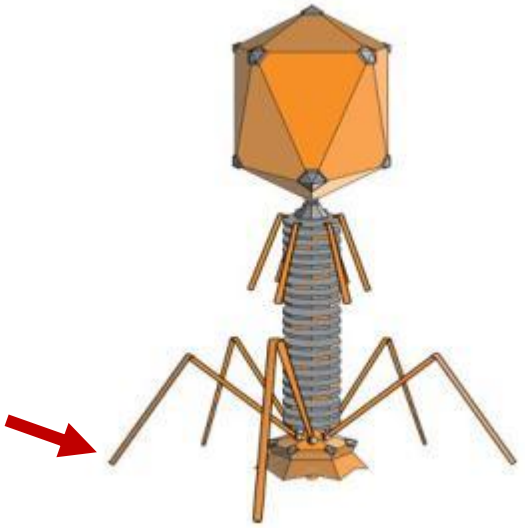
Four basic steps:

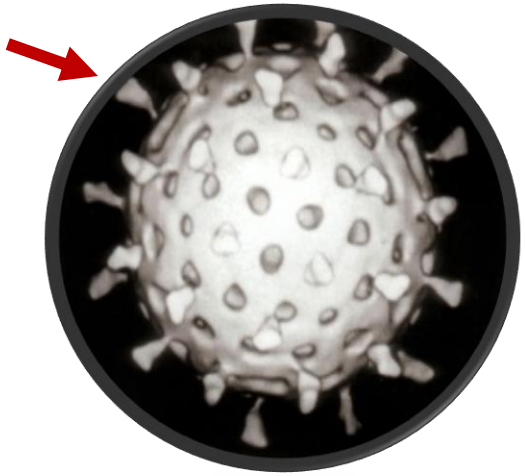
1. Recognize & attach to host cell.
2. Infect (get inside) host cell.
3. Force cell to manufacture viruses.
4. New viruses exit the host cell.

Image: Source unknown.

1. How does a virus recognize & attach to its host?

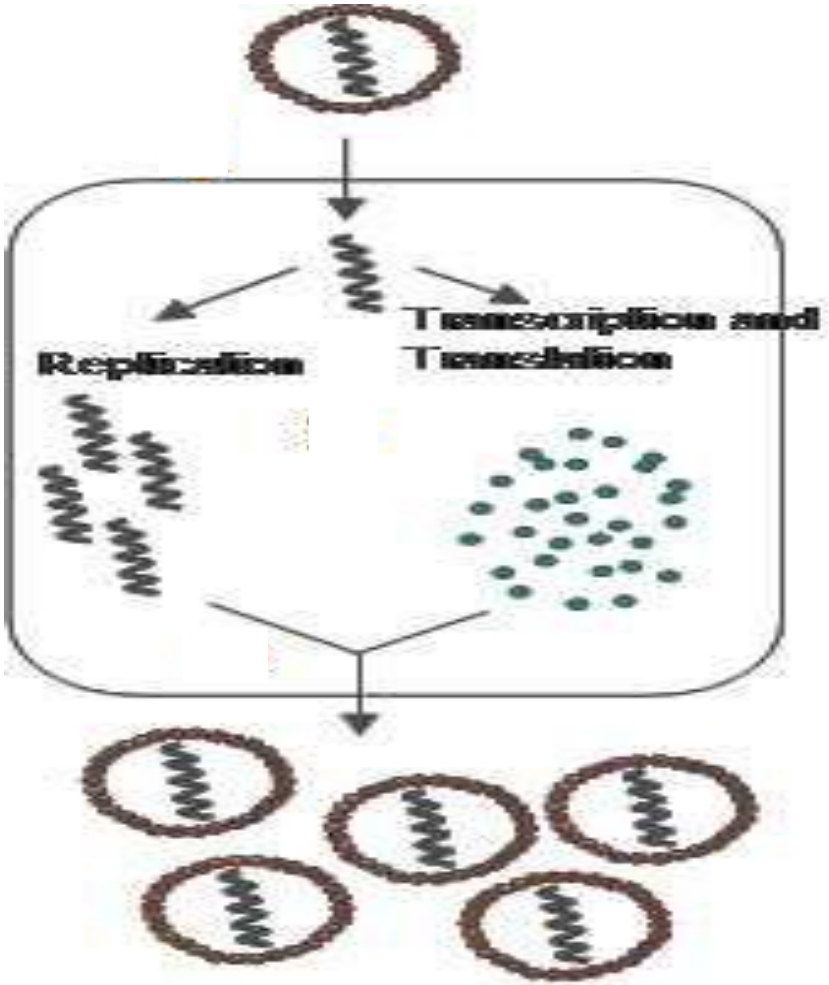
- Most viruses infect only a certain type of host.
- Specificity due to affinity of viral surface **proteins** to proteins on the surface of the host cell.
  - **bacteroiphages** have proteins in their tail fibers (those extensions that look like legs) that are attracted to proteins on the surface of 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.)





Images: Bacteriophage, Adenosine; Rotavirus, Animal Virus, Graham Colm;

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.

2. How does a virus infect its host?

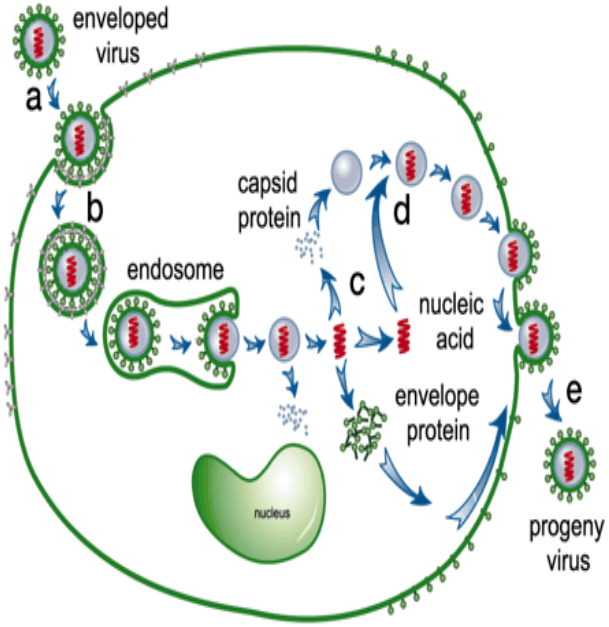
Remember, a **virus** can exist outside of its host or inside its host. So we need some more terms:

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)



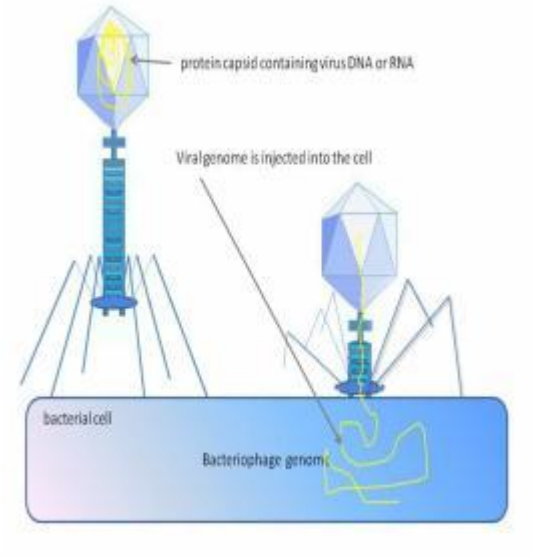


Image: Viral life cycle, National Academy of Sciences;
Bacteriophage injecting DNA into bacterial cell, Graham Colm.

2a. How does a bacteriophage infect its host?

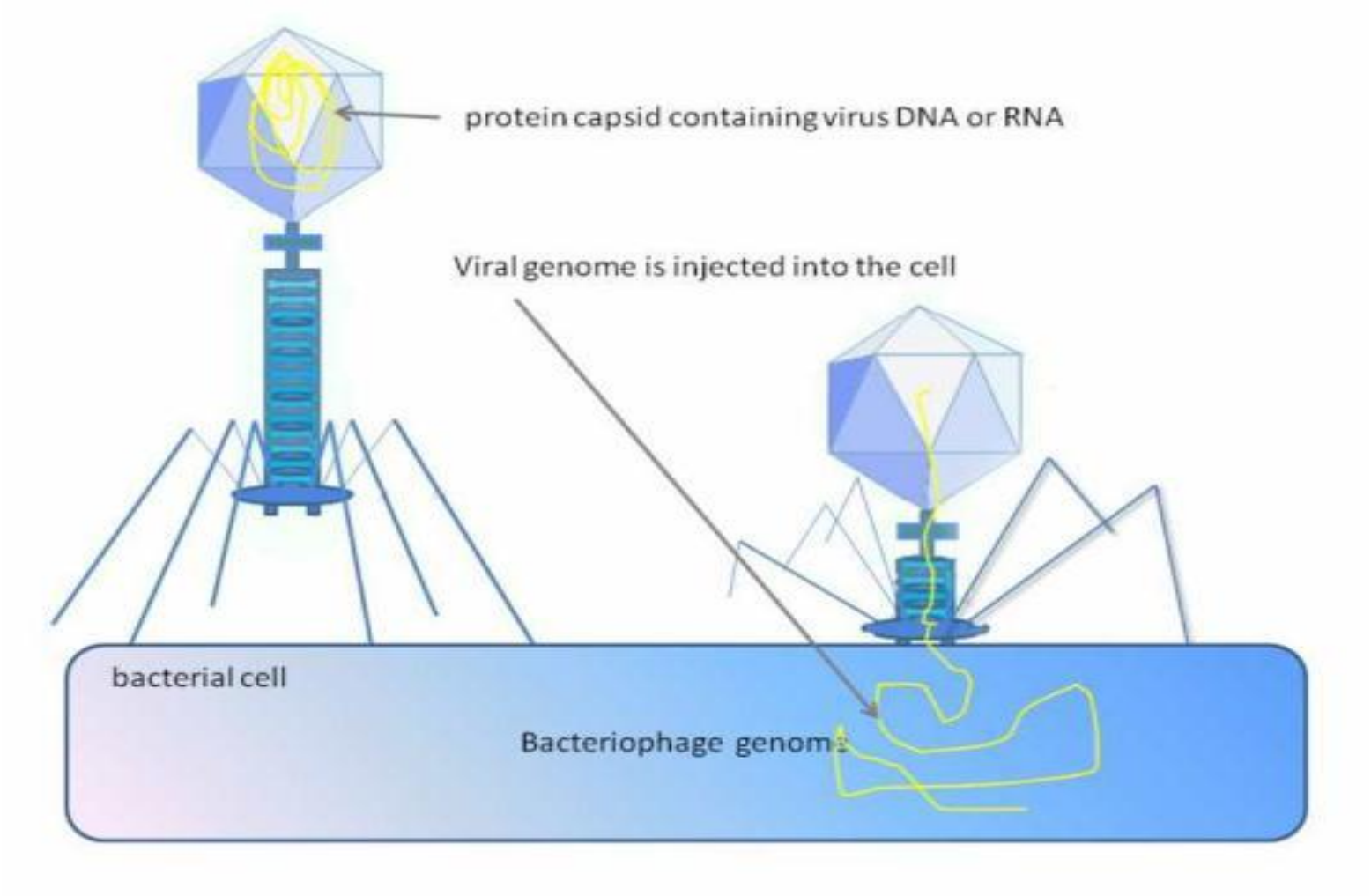


Image: Bacteriophage injecting DNA into bacterial cell, Graham Colm

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.

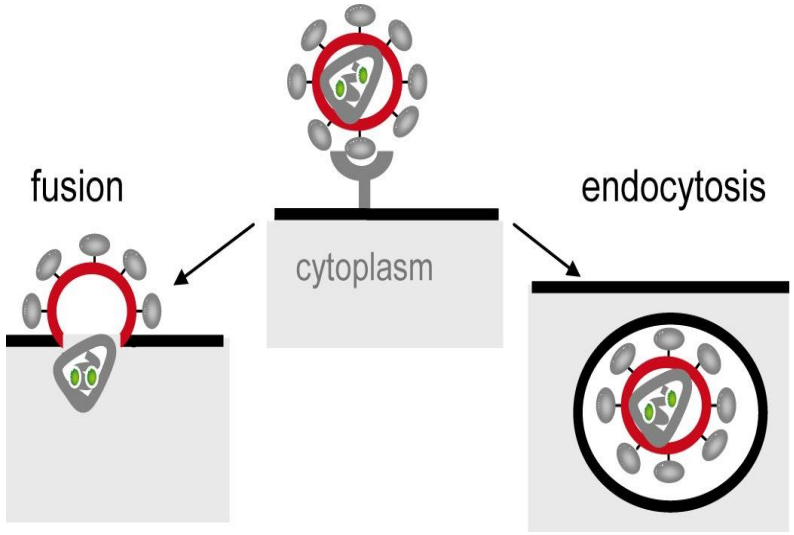
Remember the endomembrane system of eukaryotes?

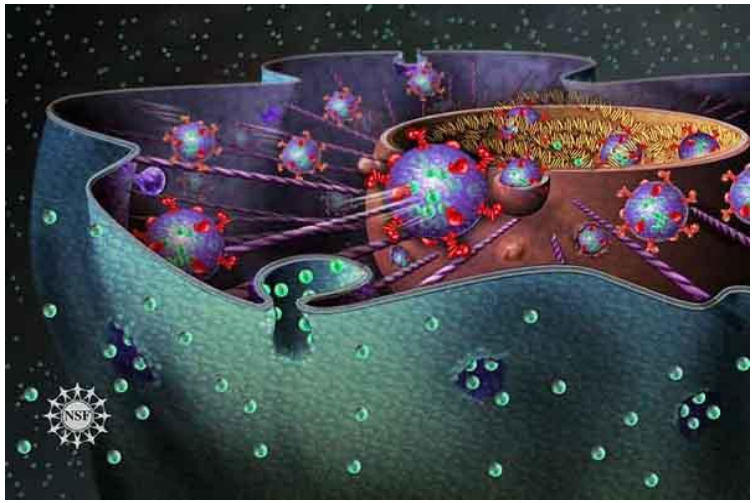
2. Endocytosis

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

REVIEW!

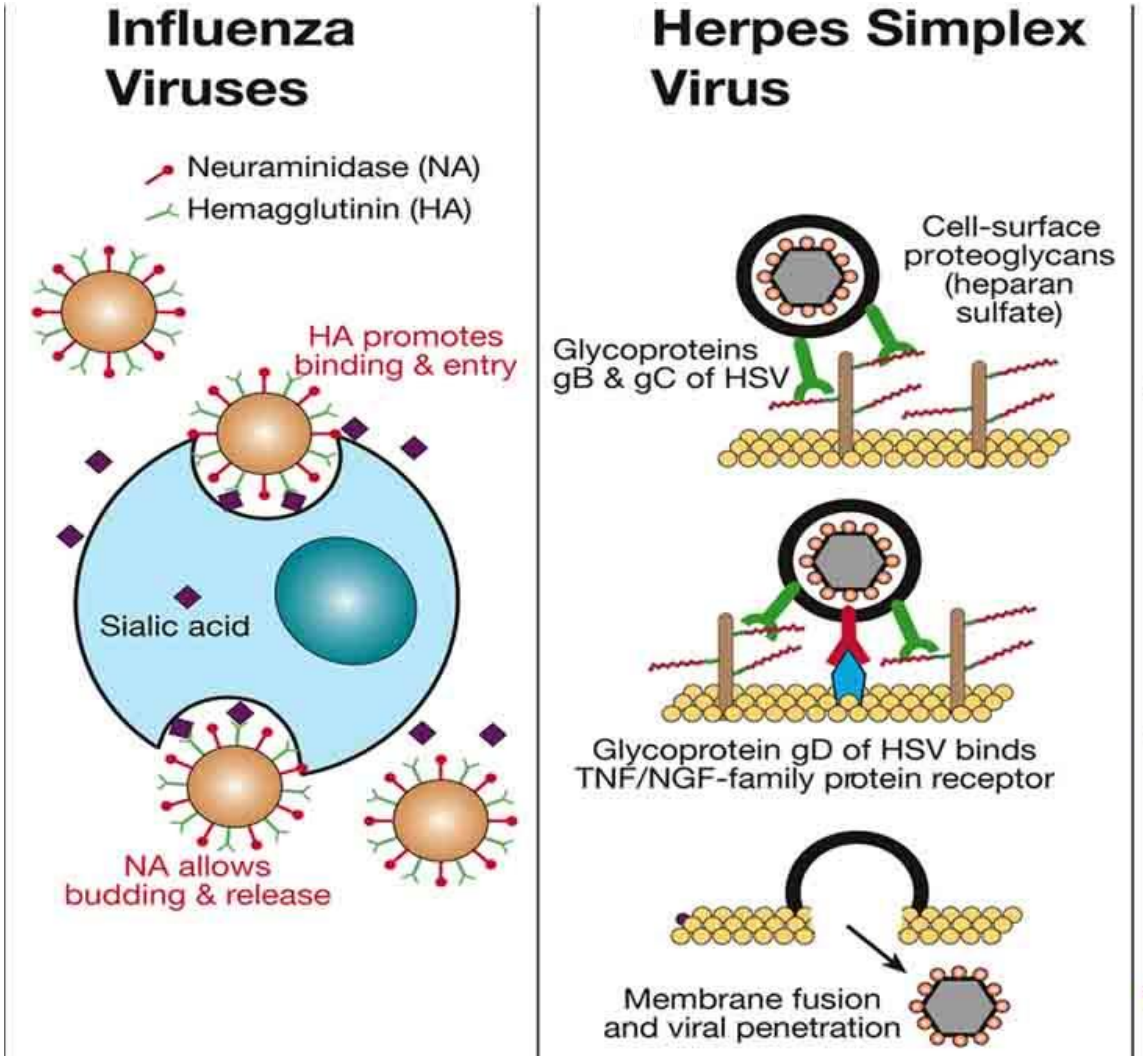
Animation on endocytosis & exocytosis





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

From the Virtual Microbiology Classroom on ScienceProfOnline.com

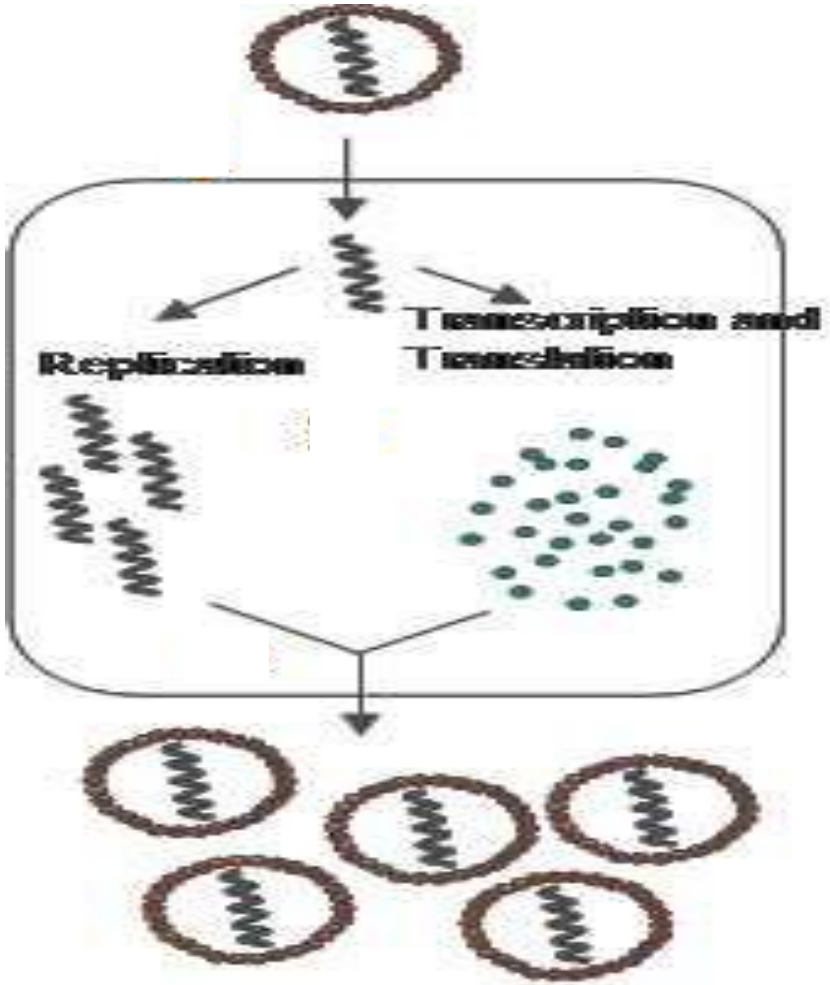


2b. How does an animal virus infect its host?

Examples of Animal Virus Entry

Image: Mechanisms of Viral entry into host cells, NCBI, US Gov.

How Do Viruses Reproduce?

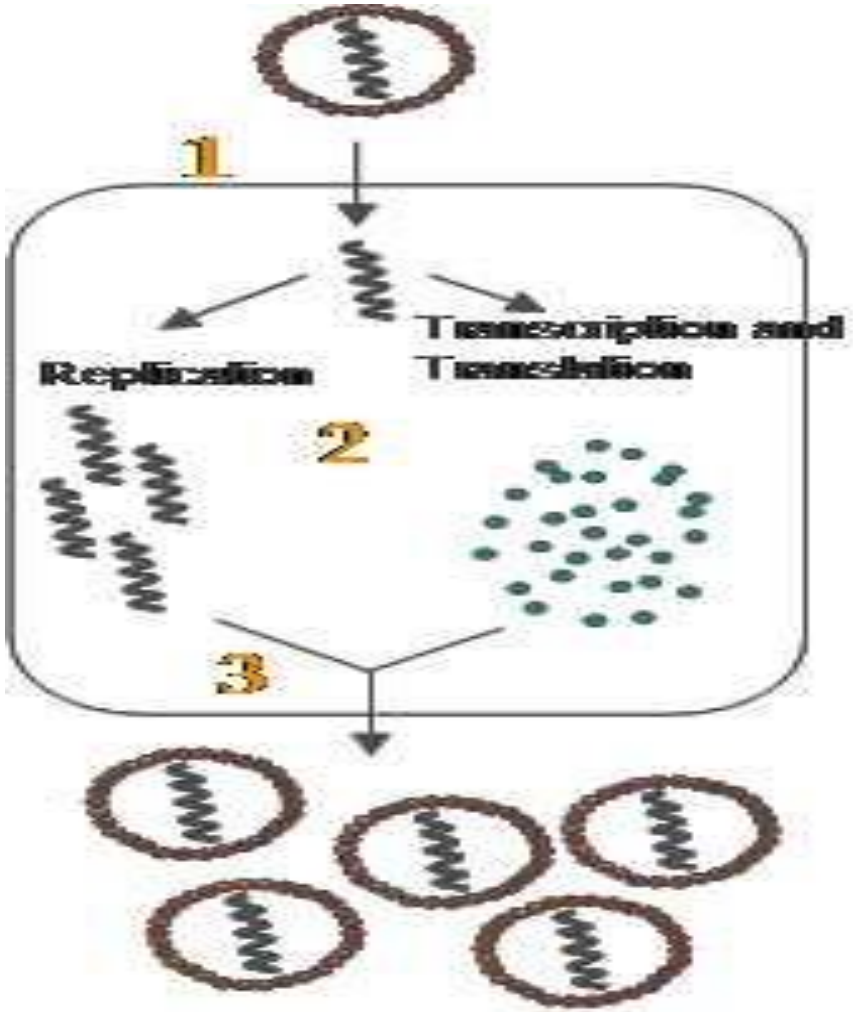


Four basic steps:

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.

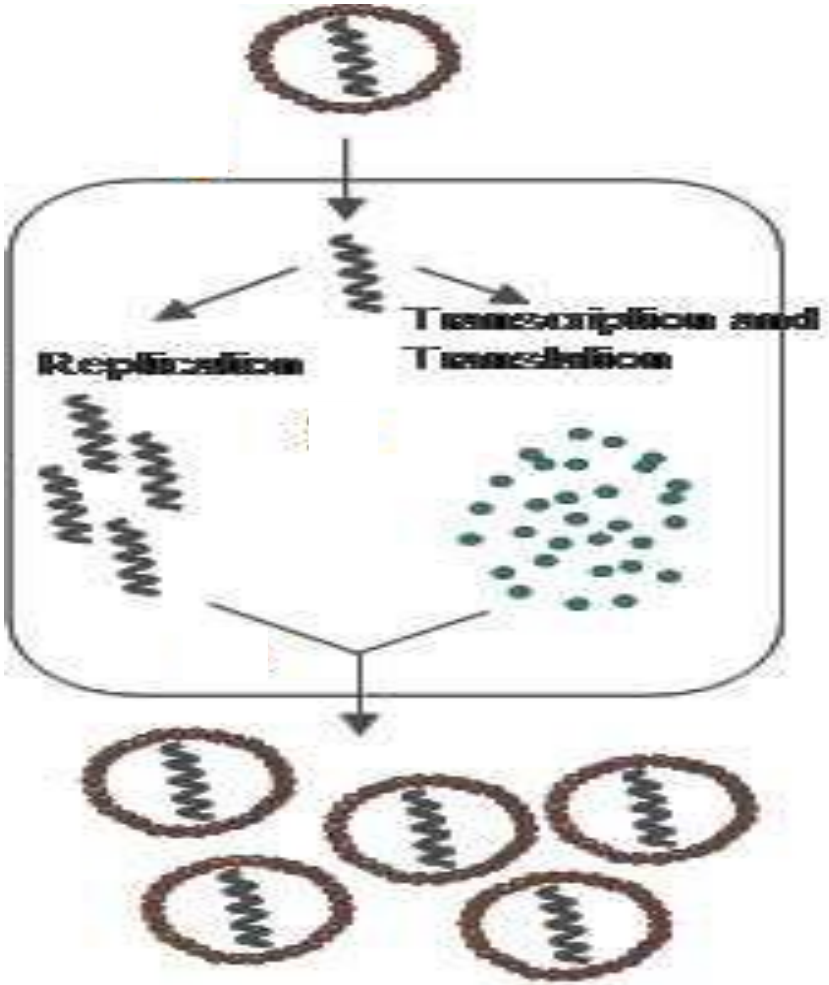
3. How does the infecting virus trick the host into manufacturing more viruses?



- 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.

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.

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.

Image: Bacteriophage Cell Lysis, Suly12

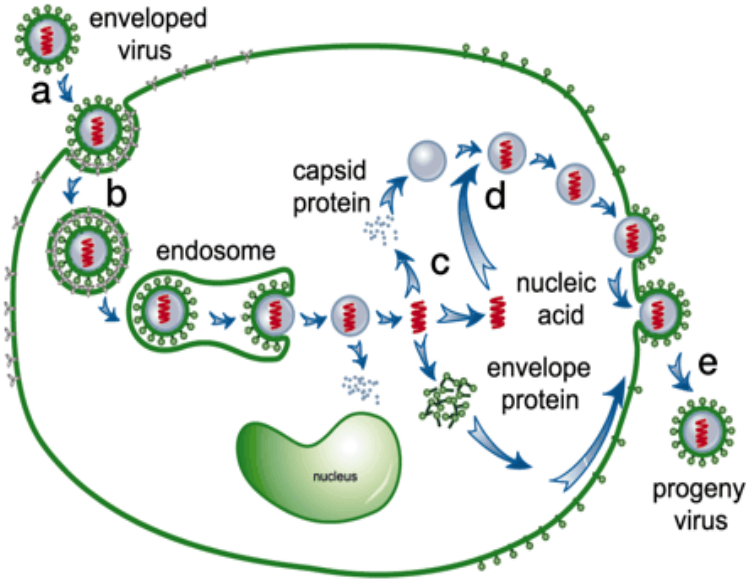
4b. How do new animal viruses exit host cell?

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.



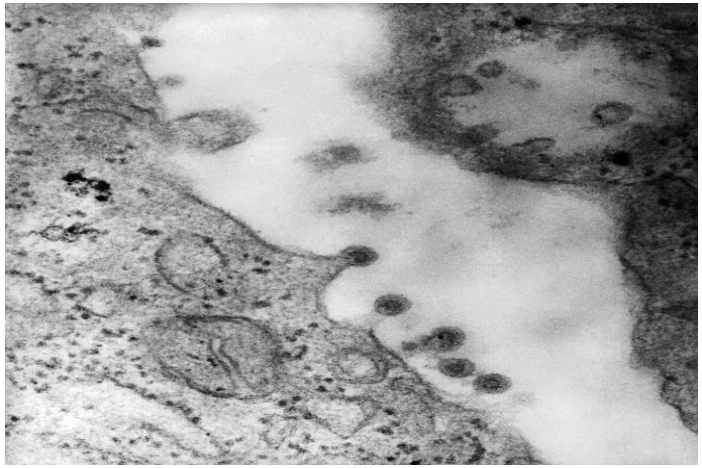
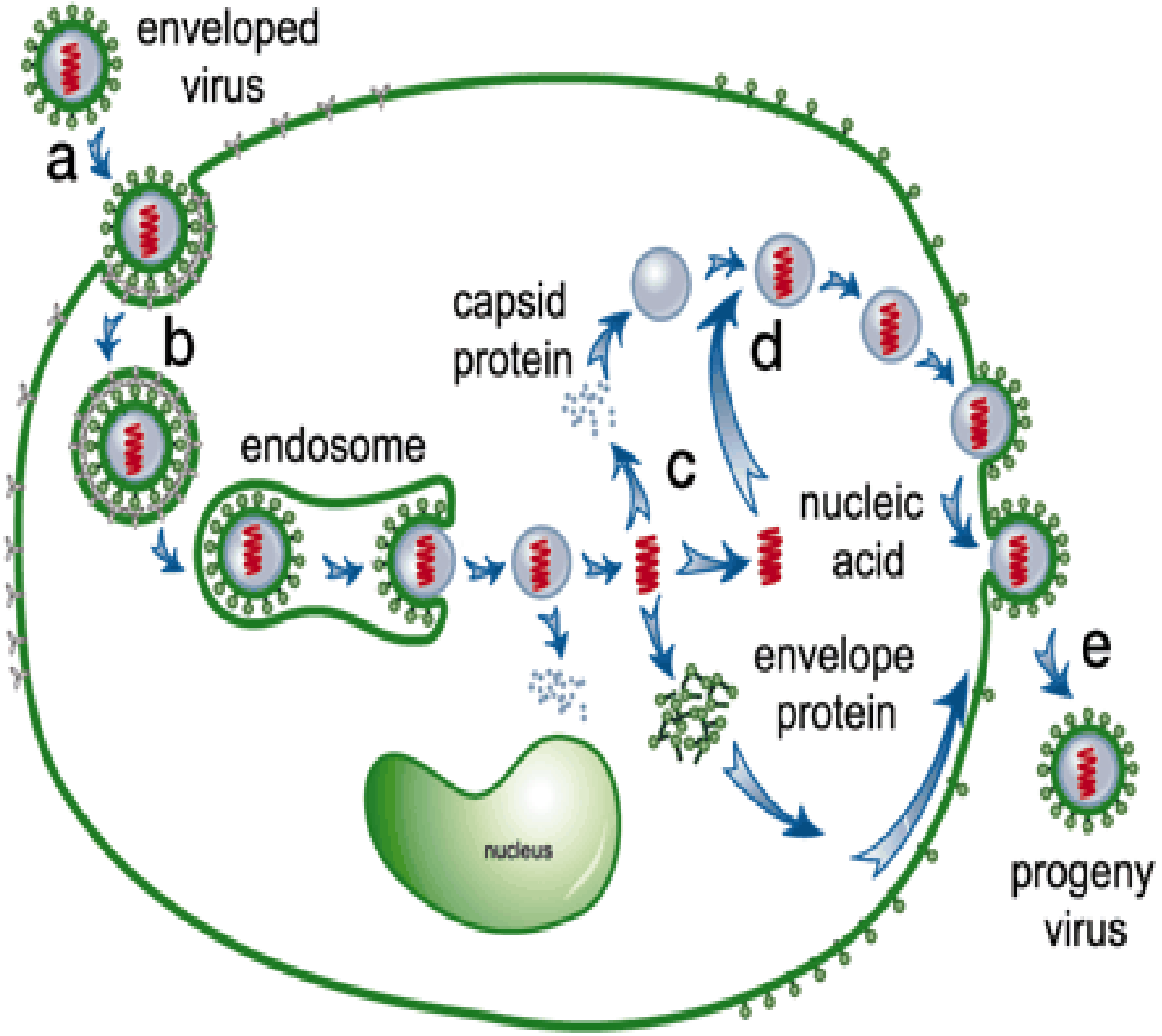


Image: Viral life cycle, National Academy of Sciences; Rubella virions budding, PHIL # 10220

From the Virtual Microbiology Classroom 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

More about

Bacteriophages

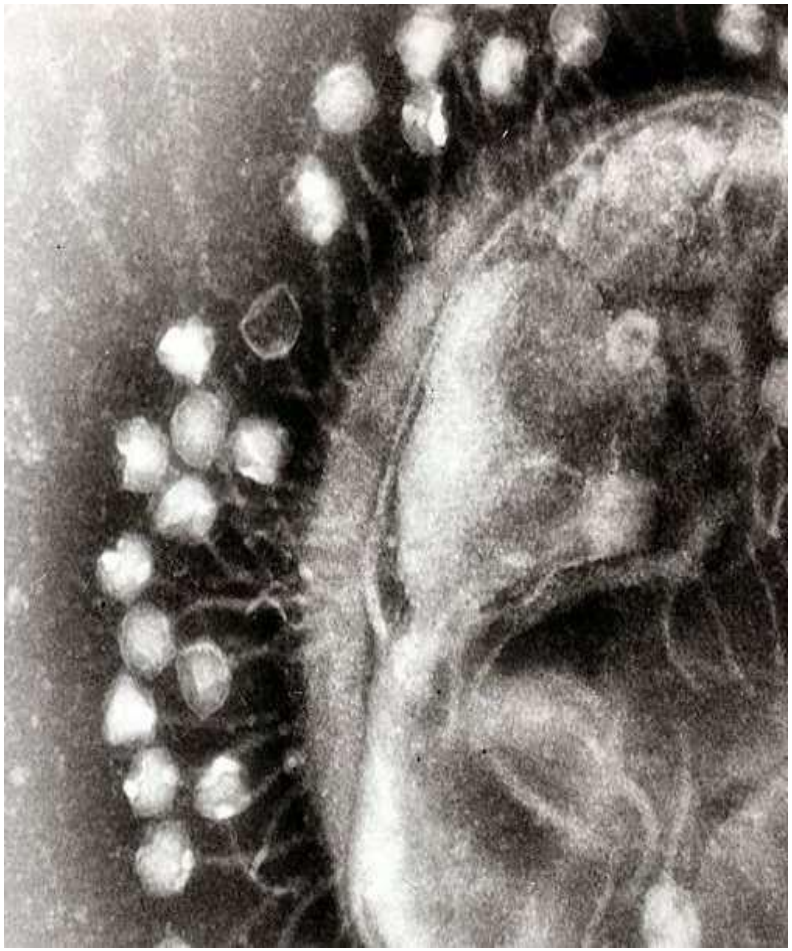
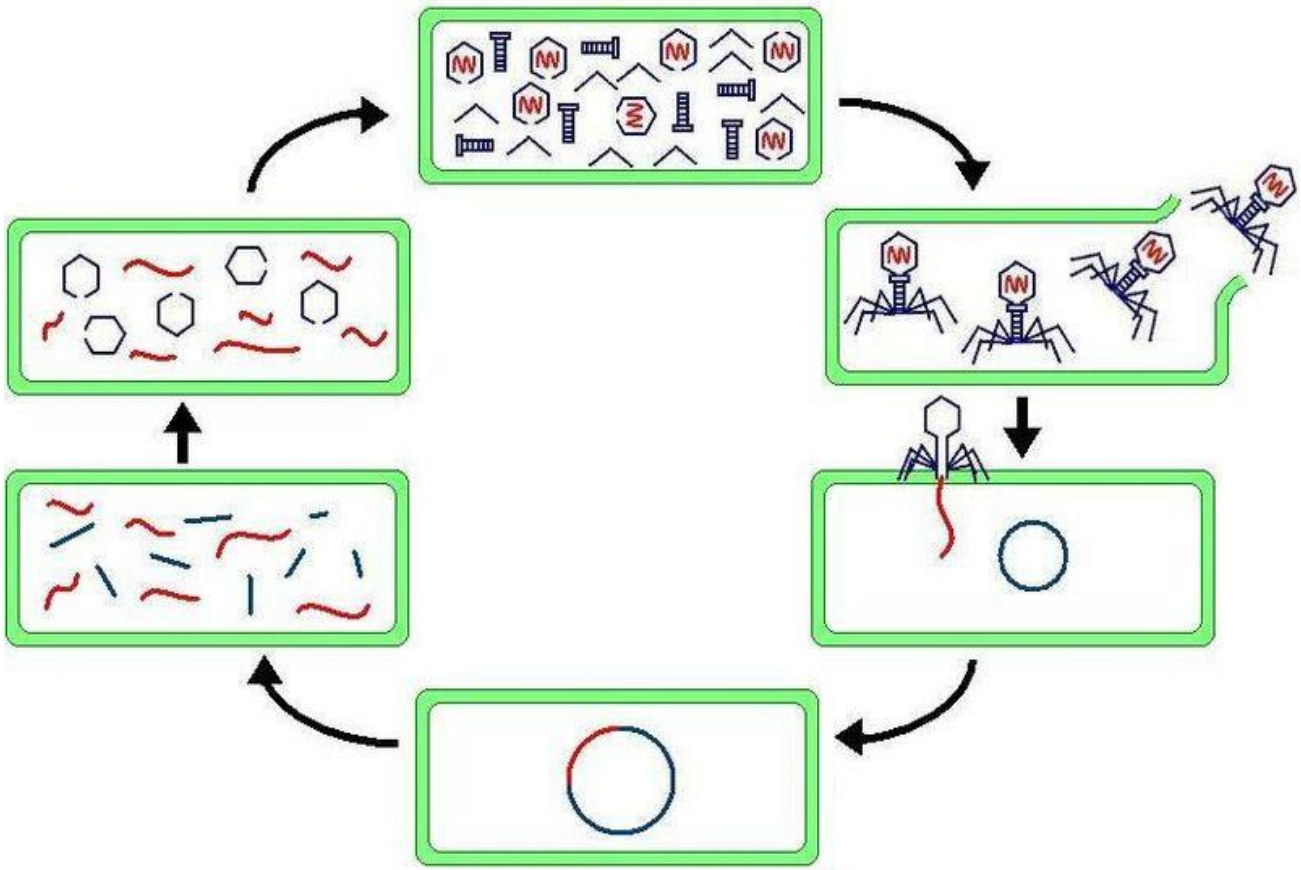


Image: Bacteriophages attached to a bacterial cell, Graham Colm

From the Virtual Microbiology Classroom on ScienceProfOnline.com

Phage Replication

The Lytic Cycle of Bacteriophages



REVIEW!

Steps in Replication of T4 Phage

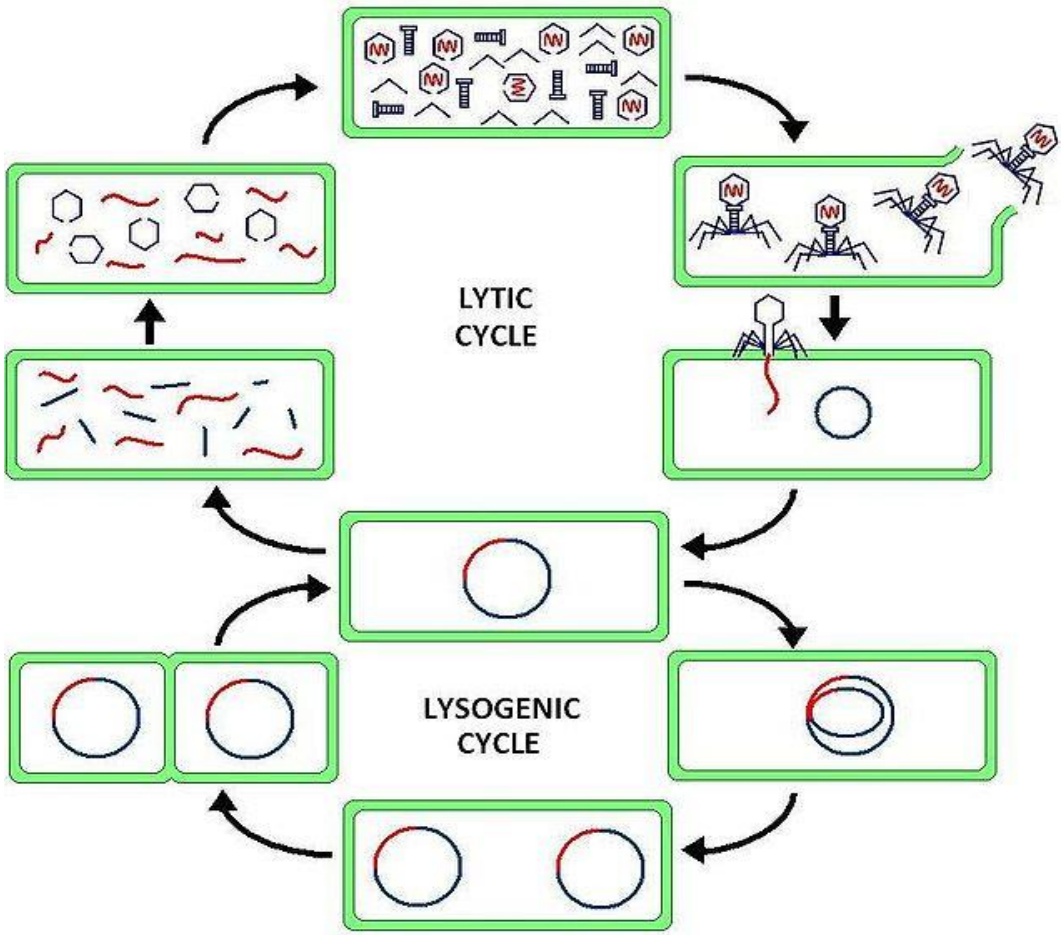
an animated video and quiz from McGraw-Hill.

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?

- 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).

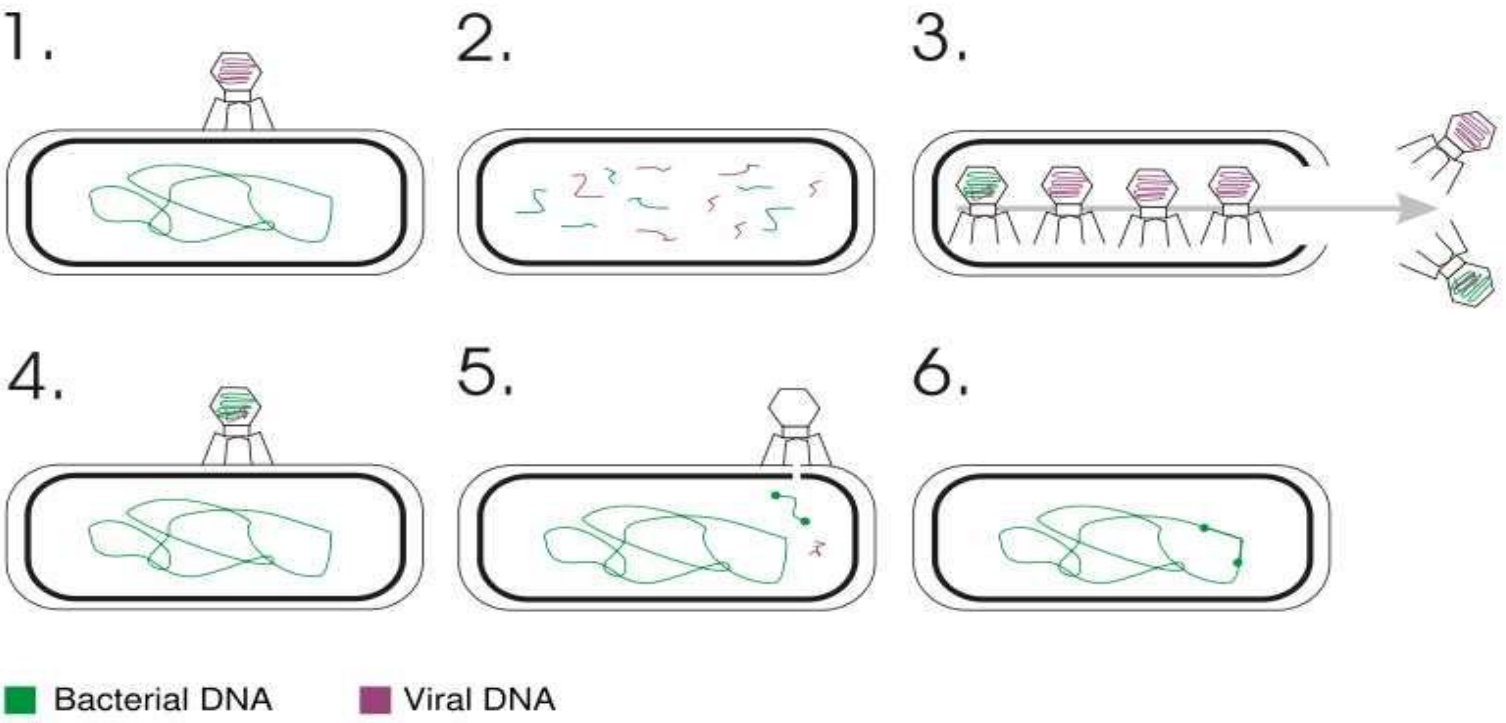


Image: Transduction, Geni

Confused?

Smart Links

Here are links to fun resources that further explain Microbiology:

- Virus Life Cycle Main Page on the Virtual Microbiology Classroom of Science Prof Online.
- How A Virus Invades Your Body animated video from NPR.
- Steps in Replication of T4 Phage in E. coli animated video and quiz from McGraw-Hill.
- Play Pandemic 2 a video game of strategy, where you try to become a successful pandemic microbe and infect the world. My 13-year old, pink-haired, daughter and I recommend this one to you.
- "Quarantine" a scary movie about a new infectious disease.
- Play Disease Defenders educational video game, Rice University.
- "Virus" a song by Björk's from Biophalia album with video of viruses infecting cell.
- Giant Microbes, a company that sells adorable stuffed microbes.

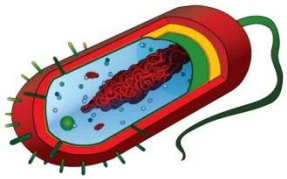
(You must be in PPT slideshow view to click on links.)

Are microbes intimidating you?

Do yourself a favor. Use the…

Virtual Microbiology Classroom *(VMC)* !

The VMC is full of resources to help you succeed, including:



- practice test questions
- review questions
- study guides and learning objectives

You can access the VMC by going to the Science Prof Online website
www.ScienceProfOnline.com

Images: Bacteriophage; Giant Microbes; Prokaryotic cell, Mariana Ruiz