Viral Infections Video Notes Guide

Purpose: To be able to compare the structure of viruses to cells, describe viral reproduction and describe the role of viruses in causing diseases such as human immunodeficiency virus (HIV) and influenza. To compare and contrast the lytic and lysogenic cycles of viral reproduction.

Why we should care: Viruses cause many diseases that range from mildly irritating to life-threatening. Some viruses will cause birth defects in unborn children. Viral diseases don't have a cure. We can treat the symptoms, but the immune system must fight the invaders on their own. Viruses can mutate and scientists must constantly try to stay ahead of that with effective vaccines. Scientists are working on genetically engineering viruses to be used for medical treatments.

Instructions: As you go through this reading color code your reading. Highlight or underline vocab and important information as follows:

- ✓ Highlight (or underline) the vocab and material you already know in green
- ✓ Highlight (or underline) the vocab and material you didn't already know in red

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<td>Questions and Thoughts
Use this area to write down any questions that occur to you as you go. You can also sketch anything that you think might be helpful from the video.</td>
<td>Video Notes
This is the script from the video to be used as your notes. You don't have to try to copy everything down as you go. Listen to what you hear and highlight and use the space to the side to add to the notes.</td>
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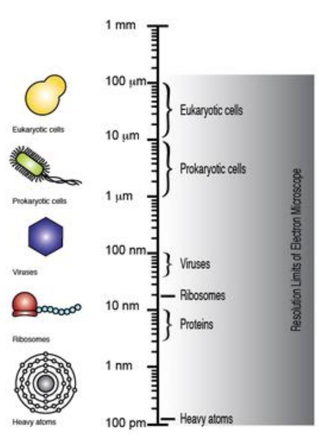
Introduction
Viruses are not truly considered to be living organisms. Unlike cells, viruses cannot reproduce on their own; the require a host cell to make more viruses. Viruses do not grow and develop, they do not carry out any cellular processes like photosynthesis or cellular respiration, and they do not have the ability to maintain homeostasis. However, viruses do contain genetic material, which means viruses can evolve. Viruses are incredibly small compared to the smallest prokaryotic cells and as a group, there is a lot of diversity. The symptoms and damage caused by viruses often depends on what type of cell the virus infects. Some viruses are specific about the type of cell they will infect; for example, HIV infects the helper T-cells of the immune system. This weakens the immune system and can lead to more infections and illnesses for the host.



Basic Viral Structure
While there are several differences between all the different viruses, they are all basically a genome surrounded by a capsid. The genome is either DNA or RNA and

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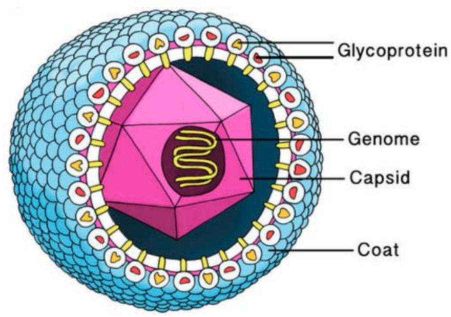
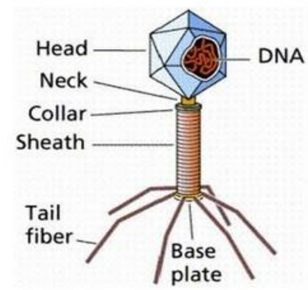
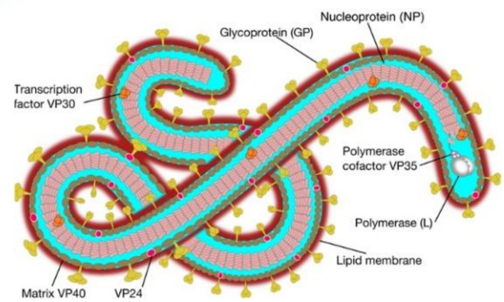
contain the instructions for making new viral capsids. The capsid is a protein coat protecting the genome. The DNA or RNA is used to infect host cells and the DNA is used by the cell's organelles to make new virus parts through protein synthesis. Some viruses will also contain an outer envelope that can serve as receptors to allow easier attachment to host cells.



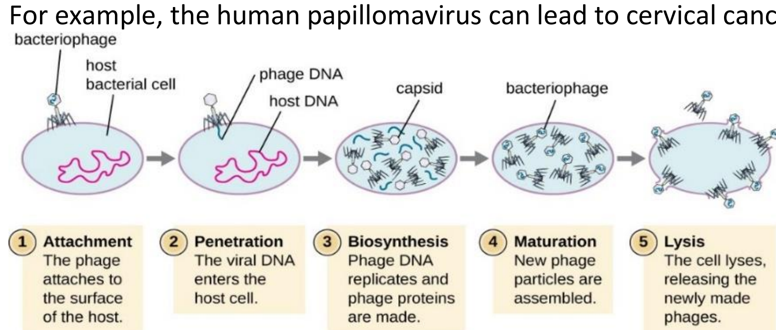




Basic Viral Reproduction

There are many types of viruses. Any type of cell can be infected by certain viruses. That means any type of living cell can be infected by a virus. Viral infections do not just infect animals, but don't worry, plant viruses don't make us sick. All viral infections work the same way. It starts when the virus attaches to the host cell using the envelope proteins on the outer surface (cell membrane or cell wall). The envelope proteins have a specific shape that matches receptors on the cell membrane of the host cell. The viral DNA (if it is an RNA virus, there is an extra step we are going to skip) enters the cells and goes to the nucleus. The cell does not recognize the DNA as an invader because DNA is universal; there aren't any major differences that would tip off the host.

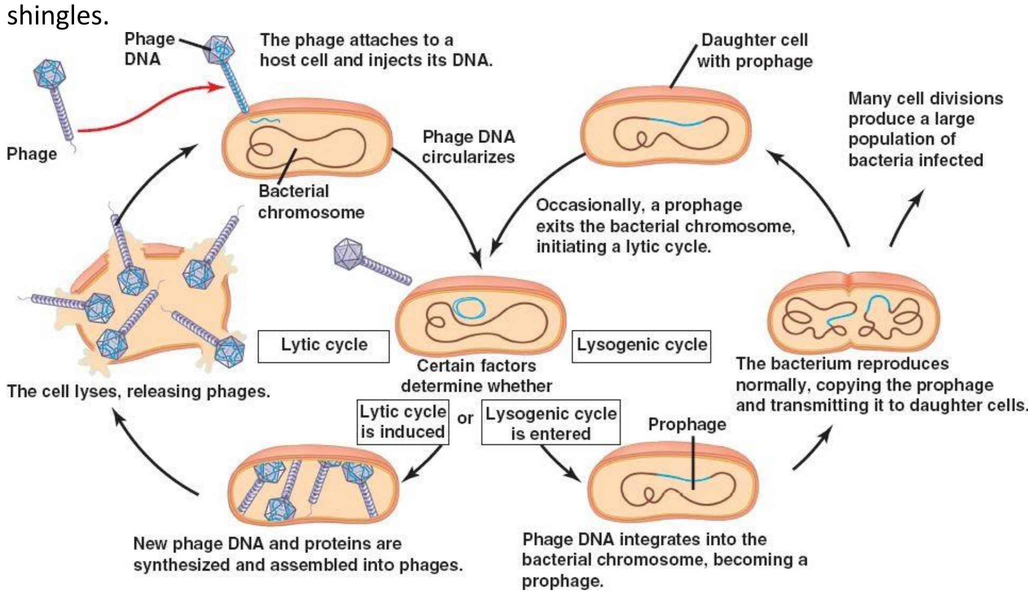
Once the DNA is in the nucleus, it will integrate with the host's DNA. From here, the DNA is replicated and used to create new capsids during protein synthesis on the cell's ribosomes. The new viruses are assembled and are released from the cell. This causes the cell to lyse or break open, killing the cell. The new viruses can infect nearby cells, and this can lead to tissue damage in the person. The disease or illness results from this damage. Not all viruses lyse cells; some disrupt homeostasis, some can cause the immune system to destroy the host cell and others can lead to cancer. For example, the human papillomavirus can lead to cervical cancer in females.



Viral Infections

The first type of infection to discuss if the lytic cycle. The lytic cycle is the shorter cycle and is a period of time when the virus is active. During the lytic cycle, the virus is actively replicating and making new copies. The viruses will lyse the host cells and cause a person to experience symptoms of the illness. The picture above shows what happens during the lytic cycle. Some viruses only go through the lytic cycle and when the host is infected, the viruses will continue to infect cells and cause damage until the immune system can contain the infection. Influenza is an example of a lytic virus.

The other type of infection is known as the lysogenic cycle. This is the longer cycle. During the lysogenic cycle the viral DNA is incorporated into the host cell's genome but is not active. This is known as a period of latency. The cell will continue to grow, replicate its DNA, and divide into new cells. The viral DNA is copied into the new cell's along with the host's DNA. The viral DNA can remain dormant for years before becoming active and scientists aren't really sure what causes the viruses to become active; although, the environment seems to play a role. When the DNA becomes active the virus enters the lytic cycle and begins destroying cells. Examples of lysogenic viruses include HIV, chicken pox, and herpes. Chicken pox can remain dormant in bundles of nerve cells for years and when it becomes active causes shingles.

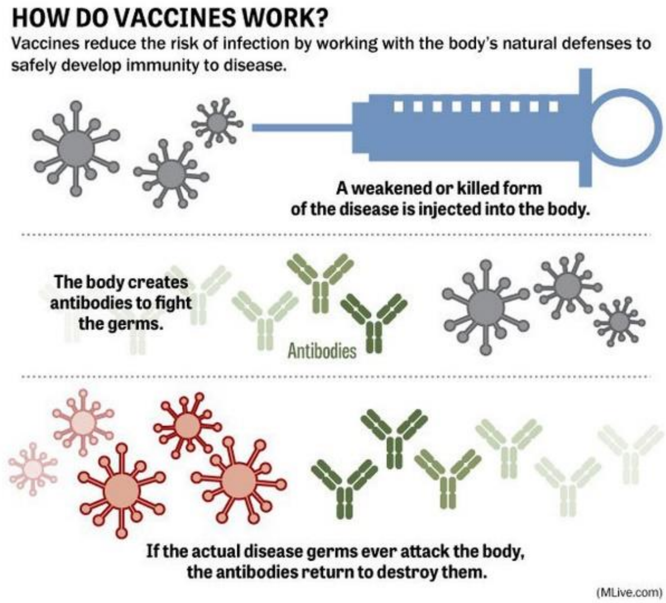


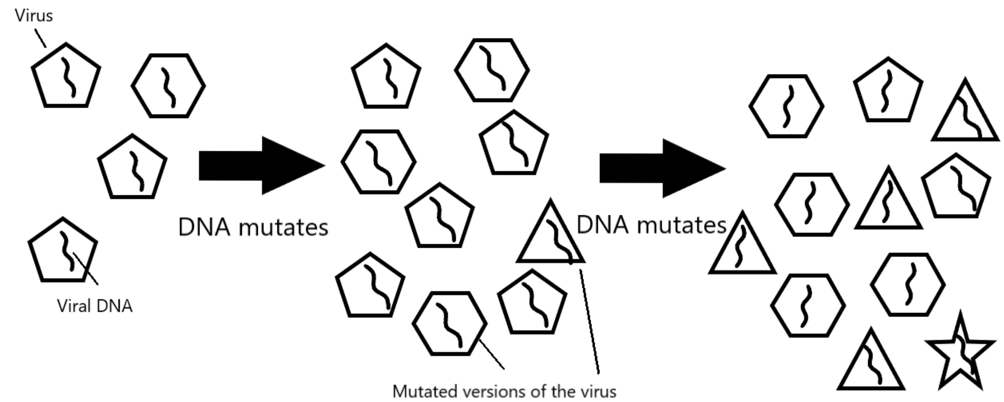
Treatments for Viruses

Since viruses are not living cells, antibiotics or drugs designed to kill cells will not work on a viral infection. However, we can protect ourselves from getting an infection by using common disinfecting cleaners on surfaces and practicing good hygiene by washing our hands. Household cleaners will break down the protein coat and cause the virus to become inactive. Some viruses will not survive drying out, so they cannot hang out on surfaces or in the air for very long. Scientists have successfully developed some antiviral drugs that are helping to combat the spread of HIV, herpes, hepatitis, and even influenza. However, there are no "cures" for most viruses and treatments focus on controlling the symptoms and keeping the person comfortable until the immune system can control the infection.

Vaccines

Vaccines are used to introduce small amounts of an inactive virus or parts of the virus, known as antigens, to create an immune response by the body. The first

	vaccine was developed by Edward Jenner to inoculate, which involves introducing small amounts of a virus into a healthy person's body, people against smallpox. The body produces antibodies in response to the antigens and this helps protect the body against future infections. If the virus is introduced into the body again, the immune system is ready to defend again the invader and most people do not get sick a second time. If they do, the symptoms are usually milder. Vaccines have been used to greatly reduce the number of illnesses or deaths due to viruses. Diseases that were just a way of life for older generations, such as polio, measles, mumps, and rubella are rare. People who didn't receive the chicken pox vaccine and had chicken pox must worry about getting shingles later in life, but children are usually vaccinated and are protected from both. Thanks to vaccines, smallpox has been eradicated from nature since 1979. Scientists hope they can do the same for other diseases.  **Viral Evolution** Like cells, when the DNA is replicated, mistakes happen. These mistakes, or mutations, are a source of genetic variation, which can lead to a changing population of viruses. This means that viruses can evolve or change over time. The diagram below shows the viruses as different shapes, which isn't really accurate; we are just using shapes to represent the potential change in the shape of the proteins when the DNA changes. In one host, the DNA of a "pentagon" virus may replicate incorrectly resulting in different "hexagon" DNA. When this happens, the "hexagon" DNA causes different outer proteins to be made. The result is a different "hexagon" virus that may not be recognized by the body as being the same as the "pentagon" invader. This can result in a wide range of strains or "shapes" that exist in a human population. Viruses may continue to mutate as they are replicated in different hosts, but not all viruses mutate at the same rate. The evolution of viruses can make it hard for scientists when trying to develop a vaccine against a virus because there are many different strains out there. A vaccine effective against one strain may not be effective against other strains. We see this in the influenza vaccines. Scientists make vaccines for 3 or 4 commons strains, but they may not be the only strains a person comes in contact with: resulting in the person getting the flu anyway. The different strains can also cause problems for our immune systems. You might get the flu and build up an immunity to that strain; however, if you contract a different strain that your immune system doesn't recognize, you can get sick again.



Viruses in Medicine

Since viruses carry the DNA straight to the nucleus of the cells they infect, scientists are working on treating gene defects in cells. The virus delivers a working gene to replace the faulty gene. This is new technology, but scientists are hopeful the treatments will be succesful. Scientists are working to make bacteriophages that can infect bacteria that are resistant to antibiotics as an alternative, but this does not work with some of the more common superbugs. Scientists are also hoping to use oncolytic viruses, which infect cancer cells, to treat cancer in the future.