VIRUSES

Viruses have a significant impact on humans. The common cold, influenza (the flu), **Severe Acute Respiratory Syndrome (SARS)** and diseases such as **Acquired Immunodeficiency Syndrome (AIDS)** are all products of viral infections. Scientists have worked tirelessly for centuries to understand how viruses work and to find better ways of fighting them.

Virus Structure

Viruses are very small - generally from 17 to 400 nanometres in diameter. This is approximately 1 000 times smaller than the diameter of a human hair - or 100 times smaller than the average bacteria. Due to the fact that viruses are so small, they have a much simpler cell structure than either animal or bacterial cells.

Viruses are made up of three basic parts (see Figure 1):

A. **Nucleic acid:** a set of genetic material, either **Deoxyribonucleic acid (DNA)** or **Ribonucleic acid (RNA)**, packaged in a protein shell.
B. **Capsid:** a protein coat that surrounds the DNA or RNA to protect it.
C. **Envelope:** a covering for the capsid that is made up of a mix of proteins, fats and carbohydrates (complex sugars). Not all viruses have envelopes – the ones that do not have envelopes are called naked or non-enveloped.

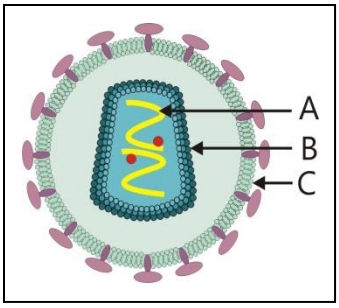

Figure 1: Structure of a virus (HIV). Image source: Let's Talk Science.

Viruses are diverse in shape and complexity and, like bacteria, can be classified based on their shape. Pictures of viruses resemble something out of science fiction. Some have heads shaped like polyhedrals (many-sided three-dimensional figures) connected to little jointed 'legs,' while others look like round popcorn (see Figure 2).

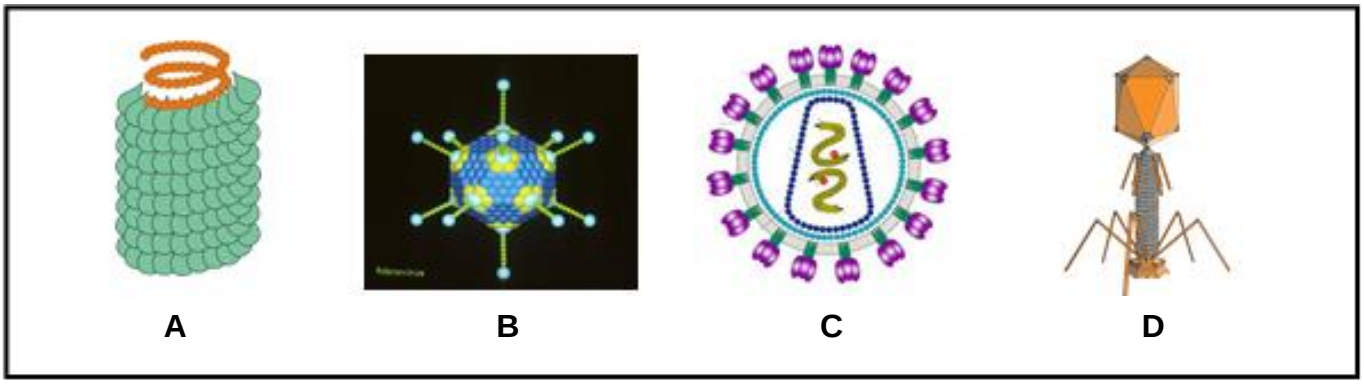

Figure 2: Types of viruses.
Image sources: **A:** Helical virus (influenza) Image source: Let's Talk Science. **B:** Adenovirus http://commons.wikimedia.org/wiki/File:Adenovirus.jpg Wikimedia Commons; **C:** HIV http://commons.wikimedia.org/wiki/File:Niaid-hiv-virion-mod.jpg Wikimedia Commons; **D:** Bacteriophage http://commons.wikimedia.org/wiki/File:PhageExterior.svg Wikimedia Commons.

Viruses can be placed in these four general categories (see Figure 2):

1. **Helical viruses**: resemble long rods that can be rigid or flexible. The example of a helical virus shown is the influenza virus.
2. **Polyhedral viruses:** are many-sided viruses, meaning that their capsids can have different numbers of sides. Most polyhedral viruses have 20 triangular sides and 12 vertices. The example of a polyhedral virus shown is the **adenovirus**, which causes respiratory illnesses.
3. **Enveloped viruses**: are basically spherical in shape because they have a protein, fat or carbohydrate coat over their capsid. The example of an enveloped virus shown is the **human immunodeficiency virus (HIV)**, which causes AIDS in humans.
4. **Complex viruses**: have complicated structures such as capsids attached to other structures such as 'legs.' The example of a complex virus shown is the **bacteriophage**, which is a virus that infects bacteria.

Viral Life Cycle

Despite appearances, viruses are not actually 'alive.' Viruses do not have a metabolism – the chemical reactions that happen in a living cell or organism that are needed for them to live – which is why we do not consider them to be alive. Viruses also lack the ability to **reproduce** (make more copies of themselves) on their own. A virus must have a host cell (i.e., a bacteria, plant or animal cell) in which to live and make more viruses. The steps a virus follows to reproduce are (see Figure 3):

1. **Attachment** (sometimes called absorption): the virus attaches to the host cell wall.
2. **Penetration**: the nucleic acid (genetic information) of the virus moves through the cell membrane into the host cell.
3. **Replication (Biosynthesis)**: once inside the host cell, the virus forces the host cell to produce the necessary components for its reproduction.
4. **Assembly (Maturation)**: the newly produced virus components are assembled into new viruses.
5. **Release**: the completed viruses are released from the cell and can now infect other cells and repeat the process.

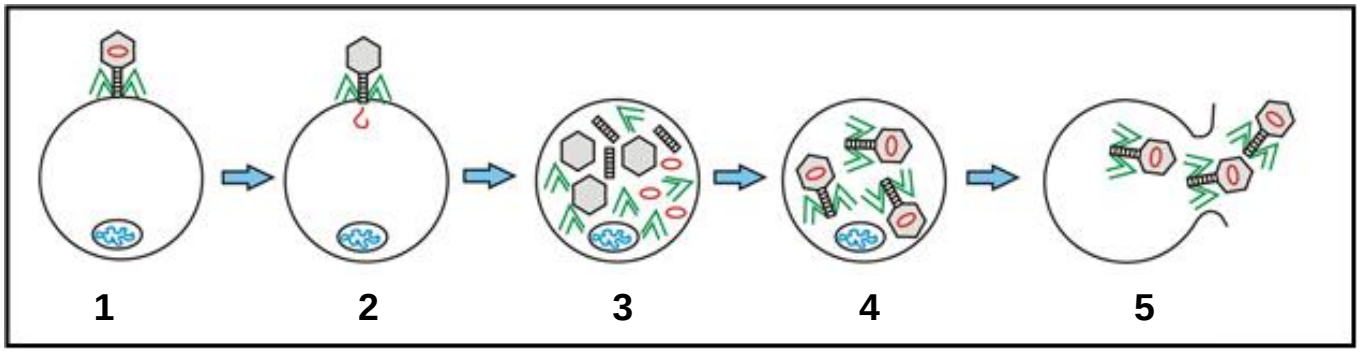

Figure 3: Viral life cycle.
Image source: Let's Talk Science.

Thank you to the Let's Talk Science Challenge volunteer writers who provided content in this backgrounder.