BIOLOGY
Topic Summary

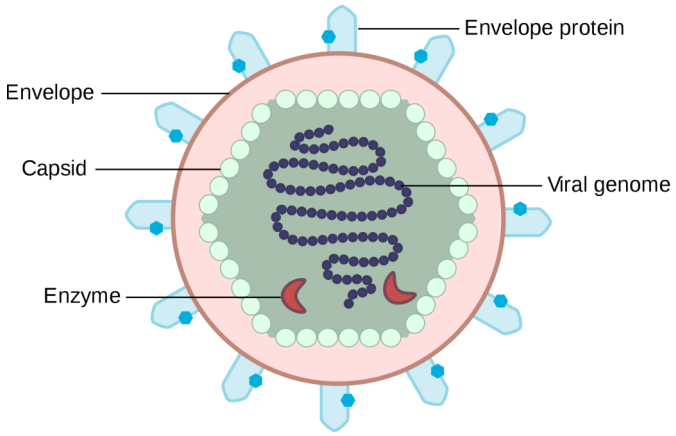
LT14 - VIRUS STRUCTURE

Viruses are small, acellular particles that can only reproduce inside host cells. They are generally considered non-living because they lack many characteristics of living organisms.

Acellular - Not made of or divided into cells

General structure:

Viruses are very small, ranging in size from around 20-300nm and they are unable to reproduce on their own. Consequently, their structure is adapted to allow them to enter a host cell and use its machinery to make copies of itself.



From Wikipedia at: https://en.wikipedia.org/wiki/Introduction_to_viruses#/media/File:Basic_Scheme_of_Virus_en.svg

▲ *Diagram showing the general structure of a virus particle. Some viruses may not have an envelope and their envelope proteins are on the capsid surface instead.*

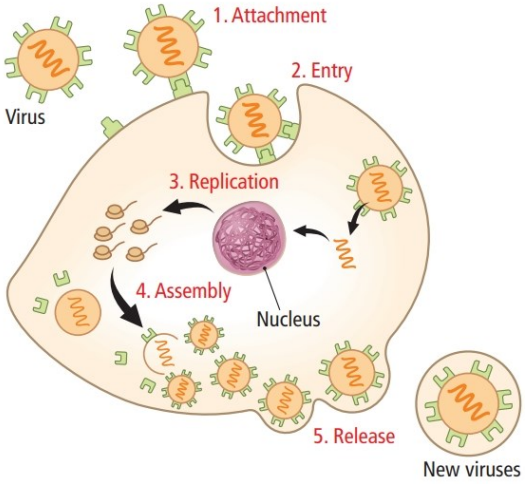
Generally, virus particles have their genome (can be RNA or DNA) packaged inside of a protein shell called a capsid. In some viruses there may also be some enzymes inside the capsid as well which help the virus replicate. A lot of viruses also have a lipid envelope surrounding the capsid with specialised attachment proteins on its surface which help the viruses infiltrate host cells. In viruses that do not have a lipid envelope, their attachment proteins are located on the outer surface of the capsid.

Virus replication:

The first step for a virus to replicate is to insert its genetic material into a host cell. It can do this by injecting the genetic material directly, or entering the cell and breaking down the capsid. This genetic material then forces the host cell to start producing proteins that the virus needs to replicate. Once all the necessary proteins have been constructed they are assembled into a new virus particle and it leaves the cell. In viruses that have a lipid envelope the particles 'steal' part of the host cell's surface membrane when leaving.

Different types of virus have different methods of forcing the cell to produce their proteins, however there are four main methods that viruses use to achieve this:

Positive-sense RNA viruses use their genetic material as if it were a strand of mRNA, proteins are able to be synthesised directly from it.



From Leaving Cert Biology at: https://leavingcertbiology.net/chapter-23-viruses/

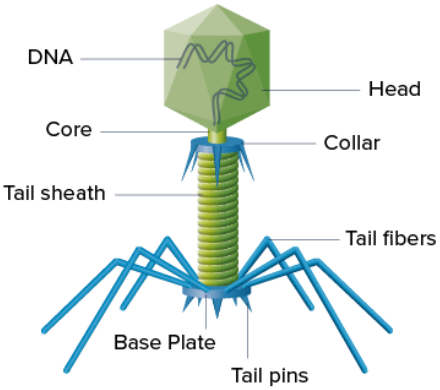
▲ *The replication cycle of a virus*

Negative-sense RNA viruses have a complementary RNA strand, which is used in the host cell to produce many copies of mRNA (using their own or the cells enzymes) that proteins can then be synthesised from.

Some viruses' genetic material is made of DNA. In this case the DNA is inserted into the host cells nucleus and the cells own enzymes will produce complementary mRNA, which can go on to synthesise viral proteins.

Finally, in retroviruses two enzymes called reverse transcriptase and integrase are used to insert the viral RNA into the hosts DNA, where it stays and is used to produce complementary mRNA like normal in the cell. Reverse transcriptase is used to turn the viral RNA into a DNA strand and integrase inserts it into the host cell's genome.

Structure of a bacteriophage:

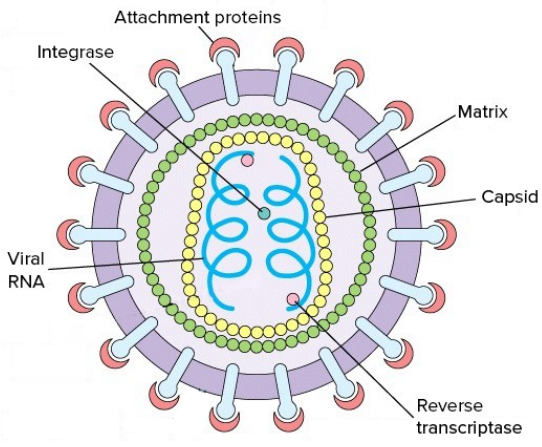


One example of a virus is the bacteriophage, a virus that only infects bacteria. It has a complex structure with a capsid 'head' containing its genetic material attached, by a 'collar', to a tail structure. The tail fibers and pins help the virus attach to the side of a bacterial cell while the tail sheath allows the genetic material to be injected into the host cell.

◀ *Diagram showing the structure of a bacteriophage particle.*

From Pherecydes Pharma at: https://www.pherecydes-pharma.com/natural-phages.html

Structure of HIV:



HIV (Human Immunodeficiency Virus) is a virus that causes AIDS in humans. It has 2 identical strands of RNA inside a protein capsid, which is further surrounded by a lipid envelope with attachment proteins that help it enter human T-cells. There is also a protein matrix that helps the lipid envelope attach to the internal parts of the virus. HIV is a type of retrovirus which means it has reverse transcriptase and integrase enzymes in its capsid that help it insert its viral genome into the host cell's genome.

◀ *Diagram showing the structure of a HIV particle.*

From MCDB at: https://biosci.mcdb.ucsb.edu/immunology/Immunodeficiencies/HIV-structure.htm