

Virus

Did you know that viruses cause the following threats to public health?

- [Herpes](#)
- [Chickenpox](#)
- [Influenza](#)
- [HIV](#)
- [SARS](#)

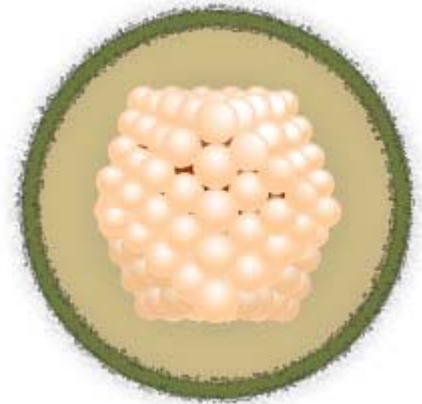
Objectives of This Lesson

After completing this lesson, you will be able to:

- Describe the general characteristics of a basic virus
- Describe how a virus takes over cell machinery
- List five ways of classifying viruses
- Describe and identify the infectious or disease-causing characteristics of viruses
- State at least one pathogenic disease associated with viruses

Virus: The Basics

Viruses are small, obligate, intracellular parasites, meaning that they require a host cell for their growth and replication. They take over, or invade, their host's cell machinery to produce copies of their genetic material or produce their progeny. They can also survive outside a host, but cannot grow or replicate without one. They are generally species specific, infecting bacteria, plants or animals.

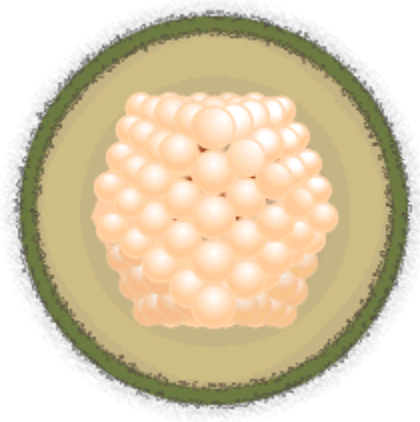


Viruses have these unique characteristics:

- Unlike prokaryotic and eukaryotic cells, they are energy-less. They float around until they come in contact with an appropriate cell
- They are basic life forms composed of a protein coat, called a **capsid**, that surrounds and protects the genetic material.
- Viruses do not have organelles or ribosomes.
- Some viruses are further enclosed by an external lipid bilayer membrane, or envelope, that surrounds the capsid and may contain glycoproteins. Some viruses also carry some structural proteins and enzymes inside their capsid.
- The genetic material is either DNA or RNA – never both. The nucleic acid may be single- or double-stranded. The genetic material contains instructions to make millions of clones of the original virus.
- Replication of the genetic material occurs when the virus takes control of the host cell's synthetic machinery to produce their progeny. Viruses contain all of the genetic information, but not the enzymes, needed to build millions of the original virus.

Capsids

The virus capsid is the term for the protein coat. Capsomers consist of one or more polypeptide chains that are organized into a protein subunit. Capsids are composed of capsomers held together by noncovalent bonds, surrounding the nucleic acid molecule. Capsids range in size from 18 μ m to several hundred nanometers. This outer coat protects and shields the viral nucleic acid and harbors specific receptor sites for host attachment.



Classifying Virus

Viruses can be classified according to:

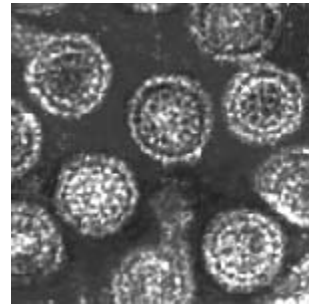
- Type of nucleic acid
- Capsid symmetry
- Site of capsid assembly
- Envelope
- Size and number of capsomers

Classifying Virus by Type of Nucleic Acid

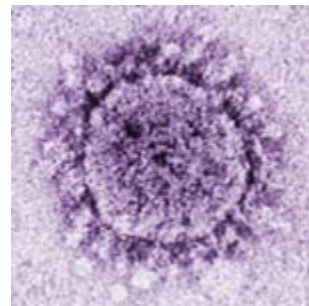
Viruses are classified by the type of nucleic acid. They are either:

- DNA virus
- RNA virus

The nucleic acid strands can be single-stranded, double-stranded, linear, or looped, in separate segments or one continuous strand. The nucleic acid sequences can encode a simple message or encode hundreds of enzymes and structural proteins.



Example of a DNA virus
(Hepadnaviridae)

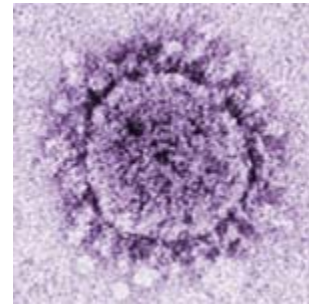


Example of an RNA virus
(Coronaviridae)

Classification by Nucleic Acid: RNA Viruses

There are three types of RNA:

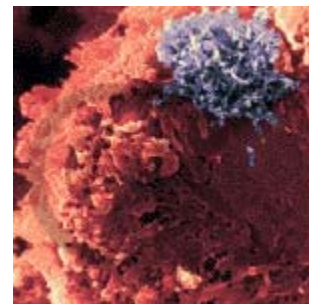
- **Positive-stranded**
 - When a positive-stranded RNA virus enters a host cell, its RNA can immediately be translated by the host's ribosomes into protein.
- **Negative-stranded**
 - When a negative-stranded RNA virus enters a host cell, it is not able to begin translation immediately. It must first be transcribed into a positive strand of RNA. To do this, a negative-stranded RNA virus must carry, in its capsid, an enzyme called **RNA-dependent RNA polymerase**, which will carry out the transcription of the negative strand into positive. Human cells do not have an **RNA-dependent RNA polymerase**, so a negative stranded virus must carry its own.
- **RNA of retroviruses**
 - The RNA of retroviruses is transcribed in a reverse fashion into DNA. To do this, these viruses carry a unique enzyme called **reverse transcriptase**. The HIV virus carries a retrovirus RNA.



Coronaviridae - positive-stranded RNA virus



Paramyxoviridae - negative-stranded RNA virus

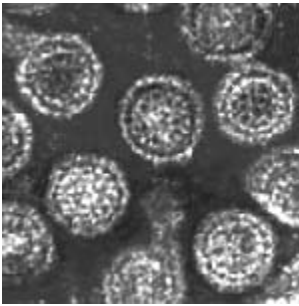


Retroviridae - RNA virus that carry unique enzymes called reverse transcriptase

Classification by Nucleic Acid: DNA Viruses

Unlike RNA, DNA cannot be translated directly into proteins. It must first be transcribed into mRNA, with subsequent translation of the mRNA into structural proteins and enzymes.

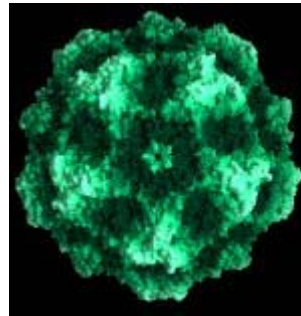
- Every DNA virus has both a negative and a positive strand. However, only the positive is read; the negative is ignored.
- Some carry enzymes for DNA repair.



Hepadnaviridae



Herpesviridae



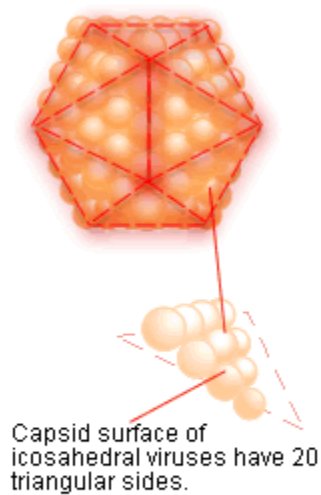
Parvoviridae

Classifying Virus by Capsid Symmetry

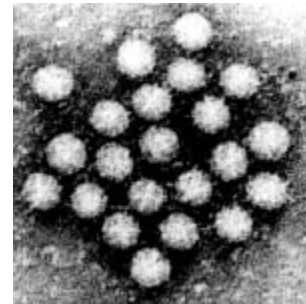
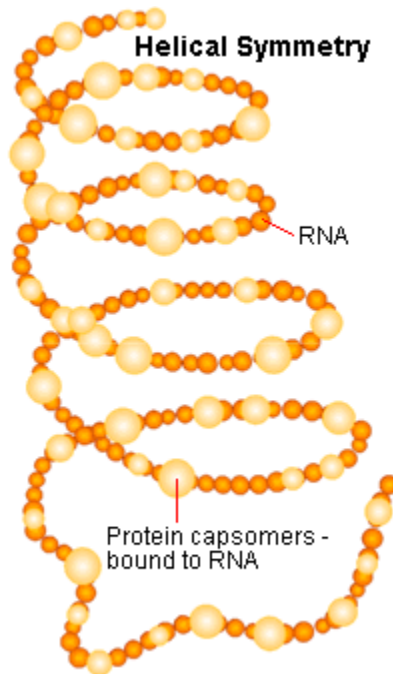
Viruses can be classified according to capsid symmetry:

- **Helical Viruses**
 - Resemble a spiral, or helix, with an overall cylindrical shape.
 - The protein capsomers are bound to RNA and coiled into a helical nucleoprotein capsid.
- **Icosahedral Viruses**
 - Have 20 triangular sides but appear spherical when viewed with an electron microscope.

Icosahedral Symmetry



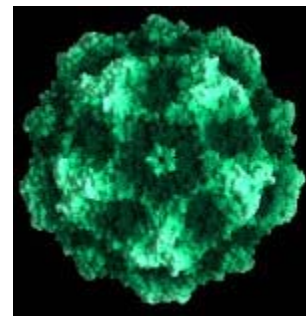
Helical Symmetry



Caliciviridae - icosahedral, RNA virus



Paramyxoviridae - helical, RNA virus



Parvoviridae - icosahedral, DNA virus. Most DNA viruses have an icosahedral symmetry.

Classifying Virus by Site of Capsid Assembly

Viruses are obligate intracellular parasites whose genomes use the enzymes, ribosomes, and small molecules of host cells to synthesize multiple copies of itself and the viral capsid. Viruses can be classified according to where in the host the virus replicates:

- **Nucleus**
 - In general, all DNA-containing viruses replicate in the host cell nucleus. The exceptions to the rule are the poxviruses.

- **Cytoplasm**
 - In general, all RNA-containing viruses replicate in the host cell cytoplasm. The exceptions to the rule are the retroviruses and the orthomyxoviruses.

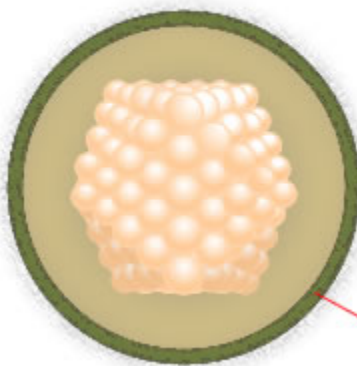
Classifying Virus by Envelope

Viruses can further be classified by the presence of an outermost coat of a lipid bilayer membrane. Quite simply, the classification by envelope is either:

- **Naked** – no lipid bilayer membrane
- **Enveloped** – lipid bilayer membrane present

Viruses acquire this membrane by budding through the host cell nuclear or cytoplasmic membrane and tearing off a piece of the membrane as they leave. There may be various glycoproteins embedded in their cell membranes.

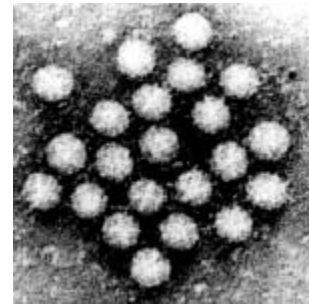
Enveloped



Naked



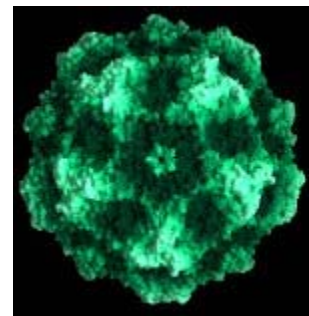
Lipid bilayer membrane



Caliciviridae -naked, icosahedral, RNA virus



Paramyxoviridae -enveloped, helical, RNA virus



Parvoviridae -naked, icosahedral, DNA virus



Herpesviridae - enveloped, icosahedral, DNA virus

Classifying Virus by Size and Number of Capsomers

Viruses can be further classified by the size and number of capsomers:

- The diameter of the helical capsid viruses
- The number of capsomers in icosahedral capsids

Question 1 of 5

Viruses have been classified according to:

- A. Size of capsomers
- B. Site of capsid assembly
- C. RNA or DNA
- D. all of the above
- E. none of the above

Submit Answer

Question 2 of 5

Viruses are called the "ultimate parasite" because

- A. They have no organelles
 - B. They can survive outside the host
 - C. They take control of the host cell machinery to produce the next generation of viruses.
 - D. They have no native nucleic acids
-

Submit Answer

Question 3 of 5

Viruses do not contain pre-made enzymes.

- A. True
- B. False

Submit Answer

Question 4 of 5

All known types of animal viruses replicate in the cell cytoplasm.

- A. True
- B. False

Submit Answer

Question 5 of 5

Humans, animals, fungi, and protozoa all can become infected with their own unique viruses.

- A. True
- B. False

Submit Answer

In The News

Bacteria

- [Anthrax \(*Bacillus anthracis*\)](#)
- [Syphilis \(*Treponema pallidum*\)](#)
- [Strep throat \(*Streptococcus*\)](#)
- [Botulism \(*Clostridium botulinum*\)](#)
- [Skin boils \(*Staphylococcus*\)](#)

Fungi

- [Aspergillosis \(*Aspergillus fumigatus*\)](#)
- [Meningoencephalitis \(*Cryptococcus neoformans*\)](#)
- [Oral Thrush \(*Candida albicans*\)](#)
- [Mold \(*Stachybotrys*\)](#)

Protozoa

- [Cryptosporidiosis \(*Cryptosporidium*\)](#)
- [Giardiasis \(*Giardia lamblia*\)](#)
- [Encephalitis](#)

Helminths

- [Trichinosis \(*Trichinella spiralis*\)](#)
- [Pinworms \(*Enterobius vermicularis*\)](#)
- [Ascaris \(*Ascaris lumbricoides*\)](#)

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