Biology
Infectious agents 9.2

"But fearful and unbelieving, the abominable and whoremongers, sorcerers and idolaters, and all liers shall have their part in the lake which burneth with fire and brimstone, which is the second death." Revelation 21:27

General information

1. Viruses are extremely small. One billionth of a meter. A thousand times smaller than a bacteria.
2. Viruses infect animals, plants, fungi, protista, and monera.
3. Viruses that infect bacteria are called bacteriophages.
4. Viruses that infect other viruses are called virophage. First discovered in 2009. A giant Mamavirus viral family named (*Acanthamoeba polyphaga* mimivirus, 1,023 protein-coding genes) was found infected by a virus named Sputnik (21 protein coding genes).
5. They can replicate only inside of a living cell. Sputnik replicates with Mamavirus in cells.
6. They are composed of nucleic acid protected by a coat of proteins and sometimes a lipid envelope.
7. Some have single or double stranded DNA, and others have single or double stranded RNA.
8. Viruses come in many shapes including helical and cylindrical shapes.
9. Because they lack a cell membrane, they are not considered alive. They are said to be viable.
10. Very specific affinity to specific organisms and cells: e.g. skin cells, liver, respiratory, brain, etc.
11. Viruses replicate much faster than cells.
12. All viruses are infectious and cause disease except for Anelloviruses which infect organisms but cause no known disease.
13. Interferon fights viruses by slowing the spread of virions.
14. Blood transport can complicate and spread disease.

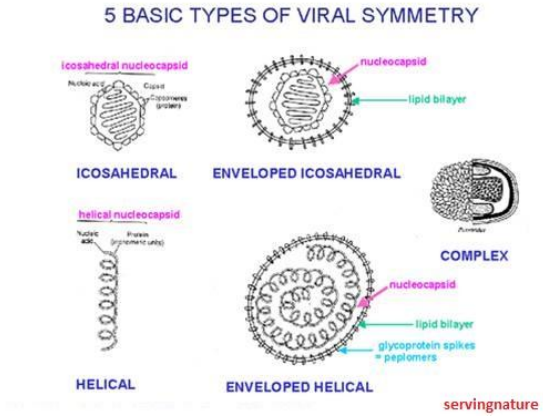
Infectious agent discovered

1. Dimitri Iwanowski noticed while studying tobacco mosaic disease which stunts leaf growth, that it was not a bacteria, and concluded that it must be bacterial poison.
2. *Virus* = poison
3. Dr. Wendell Stanley concentrated juice from a ton of mosaic leaves and isolated crystals that even though the infectious agent showed no metabolism and stored for long time, it could spread like an infection. Therefore, it was more than a chemical.

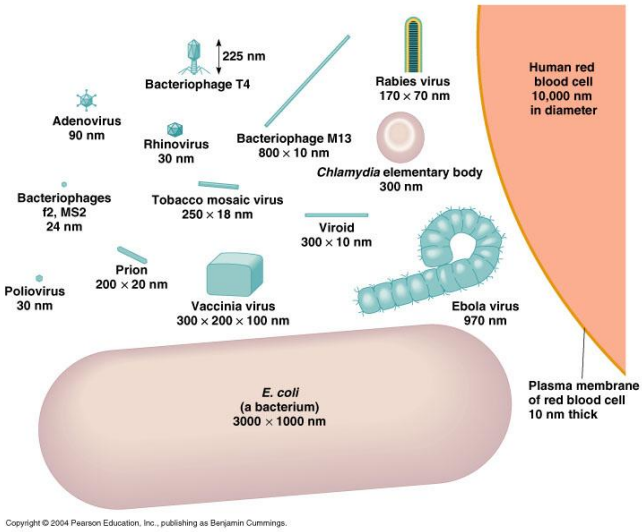
Taxonomy of viruses

1. Virus classification begins at the order rank. They are not included in a kingdom.
2. International Committee on Taxonomy of Viruses (ICTV) is trying to standardize the taxonomy of viruses.
3. Taxonomy ranking begins at Order. (Order, Family, Subfamily, Genus, Species)
4. Names of orders and families are also italicized and capitalized.
5. There are seven orders, over 2,600 species, and millions of 'types'.
6. They are classified by morphology, nucleic acid type, single or double nucleic acid strand, mode of replication, host organisms, and the type of disease.
    a. http://viralzone.expasy.org/all_by_protein/519.html
    b. http://www.uq.edu.au/vdu/VDUTaxonomy.htm

Morphology of viruses



Size comparisons



The viral cycle

1. Lytic cycle
    a. Virulent virus virions (particles) hijacks cell metabolism to produce more virus particles until the cell dies.
    b. Steps of the viral cycle: 1. attach, 2. inject nucleic acid, 3. transcribe and replicate, 4. produce viral parts, 5. Assembly, 6. cell breaks
2. Lysogenic cycle
    a. Latent viruses lie dormant in cells.
    a. Temperate phage: becomes a part of the bacterial chromosome
    b. Can become virulent due to changes caused by stress, UV, chemicals, etc.

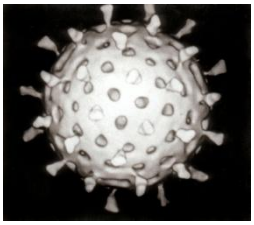
Viral groups and human diseases

Herpes viruses

1. Linear double-stranded DNA, icosahedral protein capsid, and envelope.
2. HSV causes cold sores, lesions (blisters), and cancers.
3. Latent-lytic cycles (Dormant-active). Latent location in nerve cells.
4. Spread by direct contact.

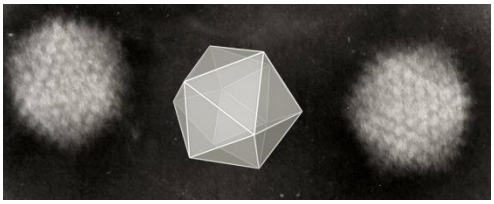
5. Long term infections. No cure.

Anelloviruses



1. Circular, single-stranded DNA (~3500 nucleotides), non-enveloped capsid, which is round with isometric, icosahedral symmetry.
2. Vertebrate viruses.
3. Abundant infections but no known diseases.

Adenoviruses

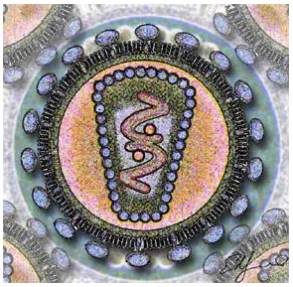


1. Circular double-stranded DNA (90-100nm) in non-enveloped capsid.
2. Cause respiratory disease and also cause gastroenteritis, conjuctivitis, and skin rashes.

Papillomaviruses

1. Circular double-stranded DNA, non-enveloped capsid.
2. Cause warts and cancer.
3. Long term infections.

Retroviruses



1. Single-stranded RNA, enveloped capsid
2. Requires reverse transcription to convert vRNA to vDNA
3. Long term infections.

Rhinoviruses

1. Single-stranded RNA enclosed in a capsid without an envelope.
2. The most prevalent viral pathogen in humans.

Norovirus

1. Single-stranded RNA virus, nonenveloped capsid.
2. Causes diarrhea and vomiting in humans.
3. Highly contagious.
4. The most prevalent viral pathogen identified in laboratory animal facilities.

Influenzavirus A, B, and C

1. Multiple strands of single RNA strands in enveloped capsid.
2. Infects respiratory tract. Causes the flu disease.

Human Immunodeficiency Virus (HIV)

1. Single-stranded RNA, enveloped capsids.
2. HIV causes Acquired Immune Deficiency Syndrome (AIDS).
3. Infection occurs by direct contact; most transmissions as STD, some by contaminated drug needles, a few by blood transfusion.

West Nile virus (WNV)

1. Single-stranded RNA (~11,500 nucleotides)
2. Mosquito vector.
3. Fever, headache, fatigue, muscle pain, nausea, rash, etc.
4. Can cause encephalitis.

Small pox

1. The story of **small pox**: Deadly for most. Survivors became immune. Edward Jenner noticed that milk maids and farmers were also immune. There appeared to be a link between cowpox and smallpox.
2. Jenner innoculated James Phipps with cowpox and then with small pox. He was immune.
3. Vaccination theory: (vacca latin = cow).
    a. Controlled exposure now or uncontrolled exposure later.
    b. Expose to weaker or dead viruses that cannot hurt you for immunity

Satellite viruses

1. Require a co-infection with a helper virus to multiply.
2. This requires a dual infection for their multiplication.

Prions

1. Infectious, misfolded proteinaceous particles.
2. They do not have nucleic acid, but can copy and spread like virions.
3. Cause untreatable, fatal disease of the brain or other neural tissues.
4. "Proteins within prion particles are arranged into a dense, highly organized lattice. Every protein subunit takes on the exact configuration of those it flanks. The subunits at the ends of the fiber are exposed. Each of those exposed surfaces acts as a sticky template that recruits the next subunit, locking it down and contorting it into the same configuration. That new subunit now acquires the property of the original, and the process repeats ad infinitum."