Classification of viruses

Classification of Viruses

Viruses are classified by the following characteristics:

1. Type of genetic material (DNA or RNA).
2. Shape of capsid.
3. Number of capsomeres.
4. Size of capsid.
5. Presence or absence of an envelope.
6. Type of host that it infects.
7. Type of disease that it produces.
8. Target cells.
9. Immunologic or antigenic properties.

Authority: International Committee on Taxonomy of Viruses

http://www.ncbi.nlm.nih.gov/ICTVdb/index.htm

Taxonomic groups: Order

Family

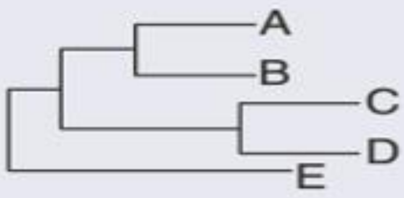
Subfamily

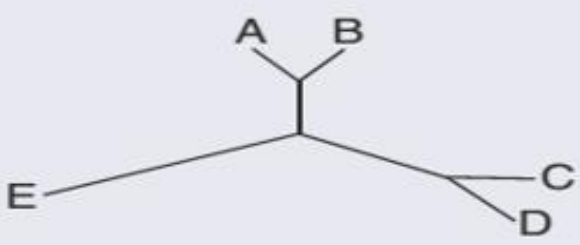
Genus

Species

Phylogenetic trees - based on genome sequences

- indicate relationships between viruses:





Baltimore Classification: - seven classes of viruses

- based on genome type and transcription.

10.2.2 Nomenclature of viruses and taxonomic groups

The naming of individual viruses has been a rather haphazard business, with somewhat different approaches taken for viruses of different host types. Bacterial viruses were simply allotted codes, such as T1, T2 and φX174. Viruses of humans and other vertebrates were commonly named after the diseases that they cause, e.g. measles virus, smallpox virus, foot and mouth disease virus, though some were named after the city, town or river where the disease was first reported, e.g. Newcastle disease virus, Norwalk virus, Ebola virus. Some of these original names have been adopted as the formal names of the viruses.

Some of the place names where viruses were first found have become incorporated into the names of virus families and genera (Table 10.2).

Table 10.2 Names of virus families and genera derived from place names

Place name	Family/genus name
Bunyamwera (Uganda)	Family *Bunyaviridae*
Ebola (river in Zaire)	Genus *Ebolavirus*
Hantaan (river in South Korea)	Genus *Hantavirus*
Hendra (Australia) and Nipah (Malaysia)	Genus *Henipavirus*
Norwalk (United States)	Genus *Norovirus*

Many insect viruses were named after the insect, with an indication of the effect of infection on the host. A virus was isolated from *Tipula paludosa* larvae that were iridescent as a result of the large quantities of virions in their tissues (see photograph in Chapter 1, at a glance). Another virus was isolated from *Autographa californica* larvae that had large polyhedral structures in the nuclei of infected cells. These viruses were named *Tipula* iridescent virus and *Autographa californica* nuclear polyhedrosis virus.

Most plant viruses were given names with two components: the host and signs of disease, e.g. potato yellow dwarf virus, tobacco rattle virus. Some of these names have been used as the bases for family and genus names (Table 10.3).

As in other areas of biology, many names of virus taxonomic groups are based on Latin words, while some have Greek origins; a sample is given in Table 10.4.

The student of virology thus gains some grounding in the classical languages! We can note that both Latin and Greek translations of ‘thread’ have been used to name the filoviruses and the closteroviruses, respectively. Both of these families have thread-shaped virions. Similarly, Latin and Greek translations of ‘small’ have been used to name the parvoviruses (animal viruses) and the microviruses (phages). The word for ‘small’ from a third language was used when devising a name for small RNA viruses; the Spanish ‘*pico*’ was linked to ‘RNA’ to form ‘picornaviruses’.

Table 10.4 Names of virus families and genera based on Latin and Greek words. Note that there are two Latin words meaning yellow. One was used to name the flaviviruses (animal viruses) and the other was used to name the luteoviruses (plant viruses)

		Translation	Reason for name	Family/genus name
Latin	*Arena*	Sand	Ribosomes in virions resemble sand grains in thin section	Family *Arenaviridae*
	Baculum	Stick	Capsid shape	Family *Baculoviridae*
	Filum	Thread	Virion shape	Family *Filoviridae*
	Flavus	Yellow	Yellow fever virus	Family *Flaviviridae*
	Luteus	Yellow	Barley yellow dwarf virus	Family *Luteoviridae*
	Parvus	Small	Virion size	Family *Parvoviridae*
	Tenuis	Thin, fine	Virion shape	Genus *Tenuivirus*
	Toga	Cloak	Virion is enveloped	Family *Togaviridae*
Greek	*Kloster*	Thread	Virion shape	Family *Closteroviridae*
	Kystis	Bladder, sack	Virion is enveloped	Family *Cystoviridae*
	Mikros	Small	Virion size	Family *Microviridae*
	Pous	Foot	Phages with short tails	Family *Podoviridae*

Baltimore Classification

- The most commonly and currently used system of virus classification was first developed by Nobel Prize-winning biologist David Baltimore in the early 1970s. In addition to the differences in morphology and genetics mentioned above, the Baltimore classification scheme groups viruses according to how the mRNA is produced during the replicative cycle of the virus.

- **Group I viruses** contain double-stranded DNA (dsDNA) as their genome. Their mRNA is produced by transcription in much the same way as with cellular DNA, using the enzymes of the host cell.

- **Group II viruses** have single-stranded DNA (ssDNA) as their genome. They convert their single-stranded genomes into a dsDNA intermediate before transcription to mRNA can occur.

Baltimore Classification

- **Group III viruses** use dsRNA as their genome. The strands separate, and one of them is used as a template for the generation of mRNA using the RNA-dependent RNA polymerase encoded by the virus.

- **Group IV viruses** have ssRNA as their genome with a *positive polarity*, which means that the genomic RNA can serve directly as mRNA. Intermediates of dsRNA, called *replicative intermediates*, are made in the process of copying the genomic RNA. Multiple, full-length RNA strands of *negative polarity* (complementary to the positive-stranded genomic RNA) are formed from these intermediates, which may then serve as templates for the production of RNA with positive polarity, including both full-length genomic RNA and shorter viral mRNAs.

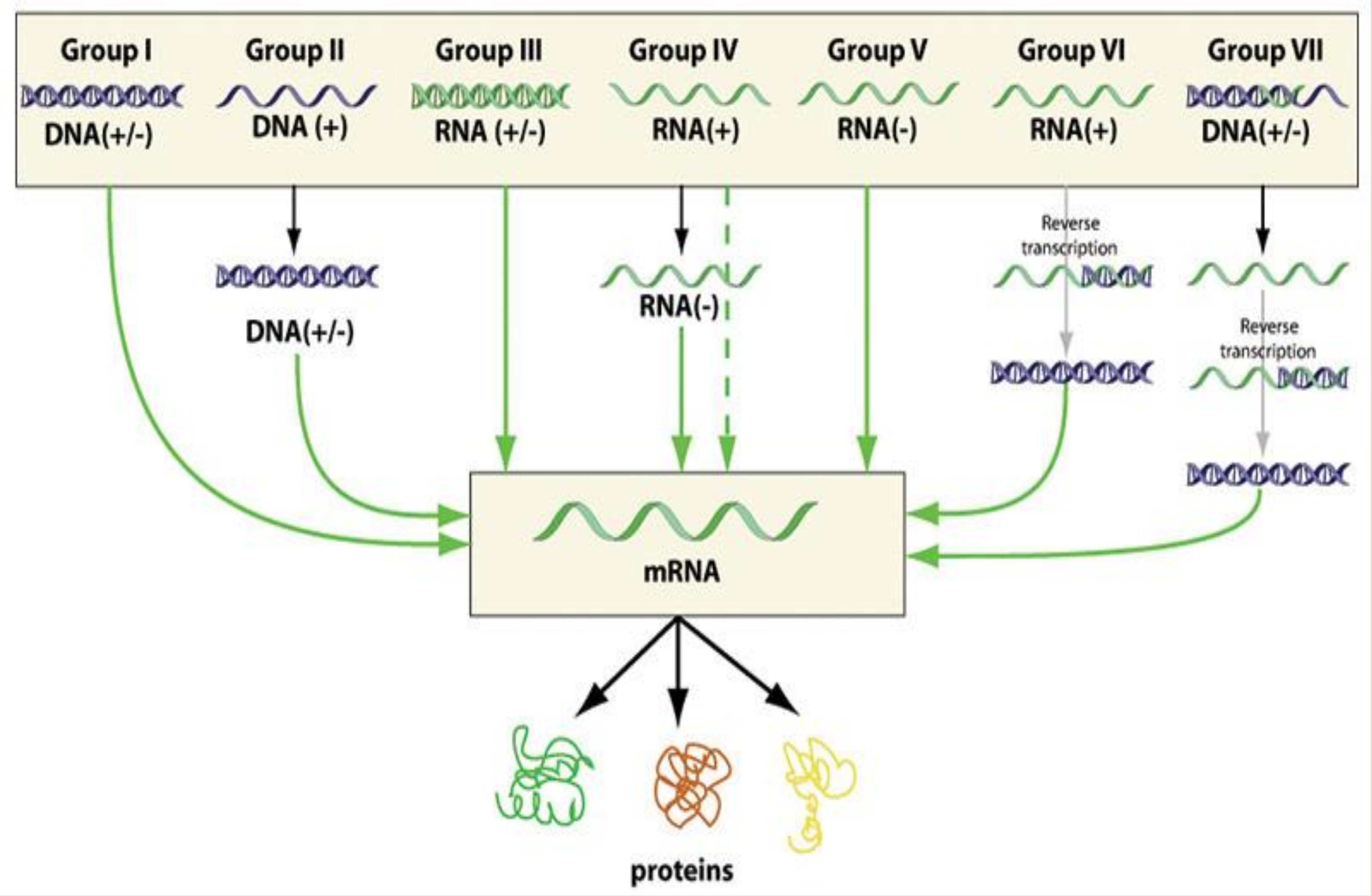
- **Group V viruses** contain ssRNA genomes with a negative polarity, meaning that their sequence is complementary to the mRNA. As with Group IV viruses, dsRNA intermediates are used to make copies of the genome and produce mRNA. In this case, the negative-stranded genome can be converted directly to mRNA. Additionally, full-length positive RNA strands are made to serve as templates for the production of the negative-stranded genome.

Baltimore Classification

- **Group VI** viruses have diploid (two copies) ssRNA genomes that must be converted, using the enzyme reverse transcriptase, to dsDNA; the dsDNA is then transported to the nucleus of the host cell and inserted into the host genome. Then, mRNA can be produced by transcription of the viral DNA that was integrated into the host genome.

- **Group VII** viruses have partial dsDNA genomes and make ssRNA intermediates that act as mRNA, but are also converted back into dsDNA genomes by reverse transcriptase, necessary for genome replication.

Baltimore classification



Baltimore Classification			
Group	Characteristics	Mode of mRNA Production	Example
I	Double-stranded DNA	mRNA is transcribed directly from the DNA template	Herpes simplex (herpesvirus)
II	Single-stranded DNA	DNA is converted to double-stranded form before RNA is transcribed	parvovirus (parvovirus)
III	Double-stranded RNA	mRNA is transcribed from the RNA genome	Childhood gastroenteritis (rotavirus)
IV	Single stranded RNA (+)	Genome functions as mRNA	Common cold (picornavirus)
V	Single stranded RNA (-)	mRNA is transcribed from the RNA genome	Rabies (rhabdovirus)
VI	Single stranded RNA viruses with reverse transcriptase	Reverse transcriptase makes DNA from the RNA genome; DNA is then incorporated in the host genome; mRNA is transcribed from the incorporated DNA	Human immunodeficiency virus (HIV)
VII	Double stranded DNA viruses with reverse transcriptase	The viral genome is double-stranded DNA, but viral DNA is replicated through an RNA intermediate; the RNA may serve directly as mRNA or as a template to make mRNA	Hepatitis B virus (hepadnavirus)

Thank you for listening