Classification of Subcellular Infectious Agents

Classifying subcellular infectious agents is more complex than it may appear at first sight, and it is appropriate to start with a few definitions:

- *Systematics* is the science of organizing the history of the evolutionary relationships of organisms.
- *Classification* is determining the evolutionary relationships between organisms.
- *Identification* is recognizing the place of an organism in an existing classification scheme, often using dichotomous keys to identify the organism.
- *Taxonomy* (nomenclature) is assigning scientific names according to agreed international scientific rules. The official taxonomic groups (from the largest to the smallest) are:
    - *Kingdom* (e.g., animals, plants, bacteria; does not apply to viruses)
    - *Phylum* (e.g., vertebrates; does not apply to viruses)
    - *Class* (group of related orders; does not apply to viruses)
    - *Order* (group of related families)
    - *Family* (group of related genera)
    - *Genus* (group of related species)
    - *Species* (the smallest taxon)

The importance of virus identification has been discussed in Chapter 4. Subcellular agents present a particular problem for taxonomists. They are too small to be seen without electron microscopes, but very small changes in molecular structure may give rise to agents with radically different properties. The vast majority of viruses that are known have been studied because they have pathogenic potential for humans, animals, or plants. Therefore, the disease symptoms caused by infection are one criterion used to aid classification. The physical structure of a virus particle can be determined directly (by electron microscopy) or indirectly (by biochemical or serological investigation) and is also used in classification. However, the structure and sequence of the virus

genome have increased in importance as molecular biological analysis provides a rapid and sensitive way to detect and differentiate many diverse viruses.

In 1966, the International Committee on Nomenclature of Viruses was established and produced the first unified scheme for virus classification. In 1973, this committee expanded its objectives and renamed itself the International Committee on Taxonomy of Viruses (ICTV). Rules for virus taxonomy have been established, some of which include:

- Latin binomial names (e.g., *Rhabdovirus carpio*) are not used. No person's name should be used in nomenclature. Names should have international meaning.
- A virus name should be meaningful and should consist of as few words as possible. Serial numbers or letters are not acceptable as names.
- A virus species is a polythetic class (i.e., a group whose members always have several properties in common, although no single common attribute is present in all of its members) of viruses that constitute a replicating lineage and occupy a particular ecological niche.
- A genus is a group of virus species sharing common characters. Approval of a new genus is linked to the acceptance of a type species (i.e., a species that displays the typical characteristics on which the genus is based).
- A family is a group of genera with common characters. Approval of a new family is linked to the acceptance of a type genus.

In general terms, groups of related viruses are divided into families whose names end in the suffix *viridae* (e.g., *Poxviridae*). In most cases, a higher level of classification than the family has not been established, although six orders (groups of related families) have now been recognized (see Chapter 3). In a few cases, very large families have been subdivided into subfamilies and end in the suffix *virinae*. Subspecies, strains, isolates, variants, mutants, and artificially created laboratory recombinants are not officially recognized by the ICTV (see Van Regenmortel, M.H.V. (1999). How to write the names of virus species. *Archives of Virology*, 144(5): 1041−1042).

- The names of virus orders, families, subfamilies, genera, and species should be written in italics with the first letter capitalized.
- Other words are not capitalized unless they are proper nouns (e.g., Tobacco mosaic virus, Poliovirus, Murray River encephalitis virus).
- This format should only be used when official taxonomic entities are referred to—it is not possible to centrifuge the species *Poliovirus*, for example, but it is possible to centrifuge poliovirus.
- Italics and capitalization are not used for vernacular usage (e.g., rhinoviruses; cf. the genus *Rhinovirus*), for acronyms (e.g., HIV-1), nor for adjectival forms (e.g., poliovirus replicase).

In 2010 the ICTV formally recognized six orders, 87 families, 19 subfamilies, 348 genera, and 2285 species of viruses.

This formal taxonomy is constantly changing, so we advise you to perform a Google search for "International Committee on Taxonomy of Viruses," where you will be able to find the latest information for yourself. However, as a convenience, the structure of the major taxonomic groups of viruses as recognized at the time of publication is as follows.

Major Taxonomic Groups of Viruses	
Order	**Family**
Caudovirales	*Myoviridae*
	Podoviridae
	Siphoviridae
Herpesvirales	*Alloherpesviridae*
	Herpesviridae
	Malacoherpesviridae
Mononegavirales	*Bornaviridae*
	Filoviridae
	Paramyxoviridae
	Rhabdoviridae
Nidovirales	*Arteriviridae*
	Coronaviridae
	Roniviridae
Picornavirales	*Dicistroviridae*
	Iflaviridae
	Marnaviridae
	Picornaviridae
	Secoviridae
Tymovirales	*Alphaflexiviridae*
	Betaflexiviridae
	Gammaflexiviridae
	Tymoviridae
Unassigned	*Adenoviridae*
	Ampullaviridae
	Anelloviridae
	Arenaviridae

(*Continued*)

Major Taxonomic Groups of Viruses *Continued*	
Order	**Family**
	Ascoviridae
	Asfarviridae
	Astroviridae
	Avsunviroidae
	Baculoviridae
	Barnaviridae
	Bicaudaviridae
	Birnaviridae
	Bromoviridae
	Bunyaviridae
	Caliciviridae
	Caulimoviridae
	Chrysoviridae
	Circoviridae
	Closteroviridae
	Corticoviridae
	Cystoviridae
	Endornaviridae
	Flaviviridae
	Fuselloviridae
	Geminiviridae
	Globuloviridae
	Guttaviridae
	Hepadnaviridae
	Hepeviridae
	Hypoviridae
	Inoviridae
	Iridoviridae
	Leviviridae
	Lipothrixviridae
	Luteoviridae
	Metaviridae
	Microviridae
	Mimiviridae

Major Taxonomic Groups of Viruses *Continued*	
Order	**Family**
	Nanoviridae
	Narnaviridae
	Nimaviridae
	Nodaviridae
	Ophioviridae
	Orthomyxoviridae
	Papillomaviridae
	Partitiviridae
	Parvoviridae
	Phycodnaviridae
	Picobirnaviridae
	Plasmaviridae
	Polydnaviridae
	Polyomaviridae
	Pospiviroidae
	Potyviridae
	Poxviridae
	Pseudoviridae
	Reoviridae
	Retroviridae
	Rudiviridae
	Tectiviridae
	Tetraviridae
	Togaviridae
	Tombusviridae
	Totiviridae
	Virgaviridae