VIRUS CLASSIFICATION

Introduction

- **More than 4000 different viruses and 30,000 different strains and subtypes infect animals, plants, invertebrates, protozoa, fungi and bacteria.**

- **Virologists have developed a single system of classification and nomenclature that covers all viruses**

(*International Committee on Taxonomy of Viruses*) (ICTV).

CLASSIFICATION METHODS

- **The earliest method based on:**

1. Common clinical and pathogenic properties.
2. Common organ tropism.
3. Common ecological and transmission characteristics.

Ex. Viruses that cause hepatitis (Canine hepatitis virus "adenovirus", Rift Valley fever virus "bunyavirus" and hepatitis B virus "hepadnavirus" "Bacteriophage").

CLASSIFICATION METHODS

- **Subsequent taxonomic systems have focused on the viruses themselves and based on determination of:**

1. Virion size by ultracentrifugation and electron microscopy.

2. Virion morphology by electron microscopy.

3. Virion stability by varying pH and temperature, exposure to lipid solvents and detergents, etc.

4. Virus reactivity in serological methods.

CLASSIFICATION METHODS

- **Primary criteria for classifying the viruses are:**

1. **The structure of the virion and the type and character of the viral genome (Hierarchical virus classification system).**

2. **The strategy of viral replication and mRNA synthesis (Baltimore classification system).**

Sequencing or partial sequencing of the viral genome (Phylogenetic analysis or genotyping).

Hierarchical virus classification system

- **The criteria of this system:**
1. **The virus nucleic acid (Virus genome) :**

    DNA or RNA – ds or ss – Positive or negative sense – segmented or non-segmented – linear or circular – Haploid or Diploid.

2. **The size and symmetry of the capsid: Helical or Icosahedral.**

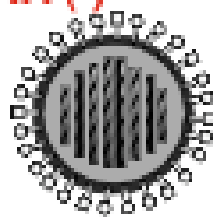3. **Presence or absence of a lipid bilayer envelope: enveloped or naked.**

RNA

dsRNA

Reoviridae
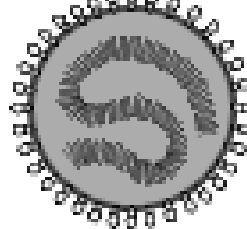Orthoreovirus
Orbivirus
Coltivirus
Rotavirus
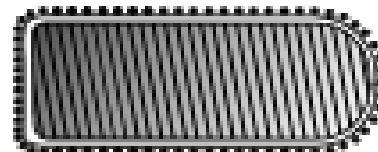Aquareovirus

Birnaviridae
Aquabirnavirus
Avibirnavirus
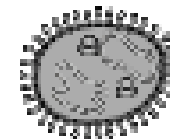
100 nm

ssRNA (-)

Orthomyxoviridae

Rhabdoviridae
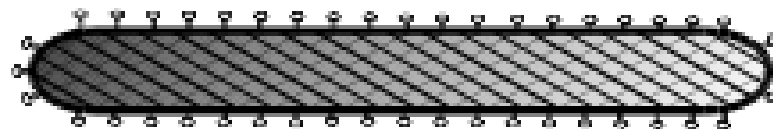Lyssavirus
Vesiculovirus
Ephemerovirus
Novirhabdovirus

Deltavirus

Paramyxoviridae   *Bornaviridae*   *Arenaviridae*   *Bunyaviridae*
Orthobunyavirus
Hantavirus
Nairovirus
Phlebovirus

Filoviridae

ssRNA (RT)

Retroviridae

ssRNA (+)

Caliciviridae   HEV-like   *Nodaviridae*   *Togaviridae*
Betanodavirus

Picornaviridae

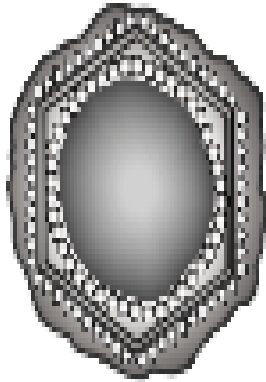*Astroviridae*   *Flaviviridae*   *Coronaviridae*   *Arteriviridae*
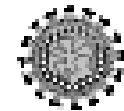
DNA

dsDNA

Asfarviridae
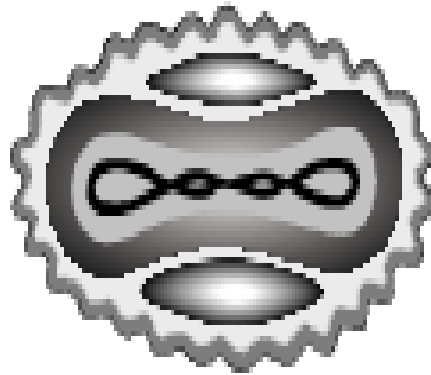
Poxviridae
Chordopoxvirinae
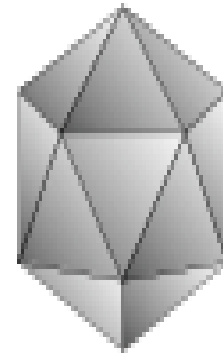
Iridoviridae
Ranavirus
Lymphocystivirus

dsDNA (RT)

Hepadnaviridae

Herpesviridae

Polyomaviridae
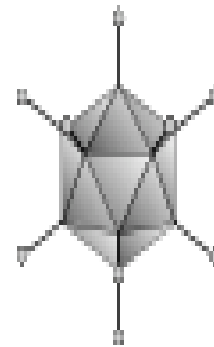
Papillomaviridae *Adenoviridae*

ssDNA

Circoviridae

Parvoviridae
Parvovirinae

Baltimore classification system
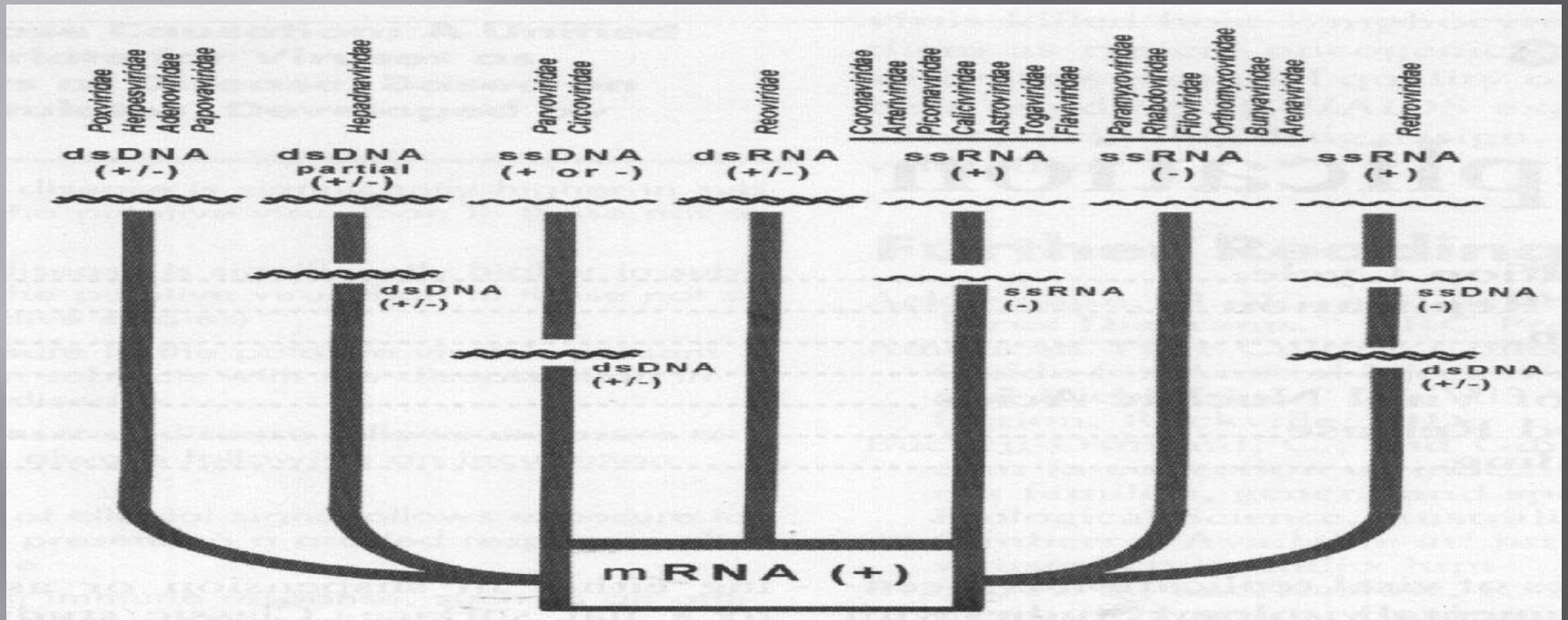
The phylogenetic analysis virus classification system (genotyping)

- Based on complete or partial sequencing of the viral genome.
- Comparison of the nucleotide sequence using computer software.
- Classify the viral strains into different lineages.
- http://www.ncbi.nlm.nih.gov).
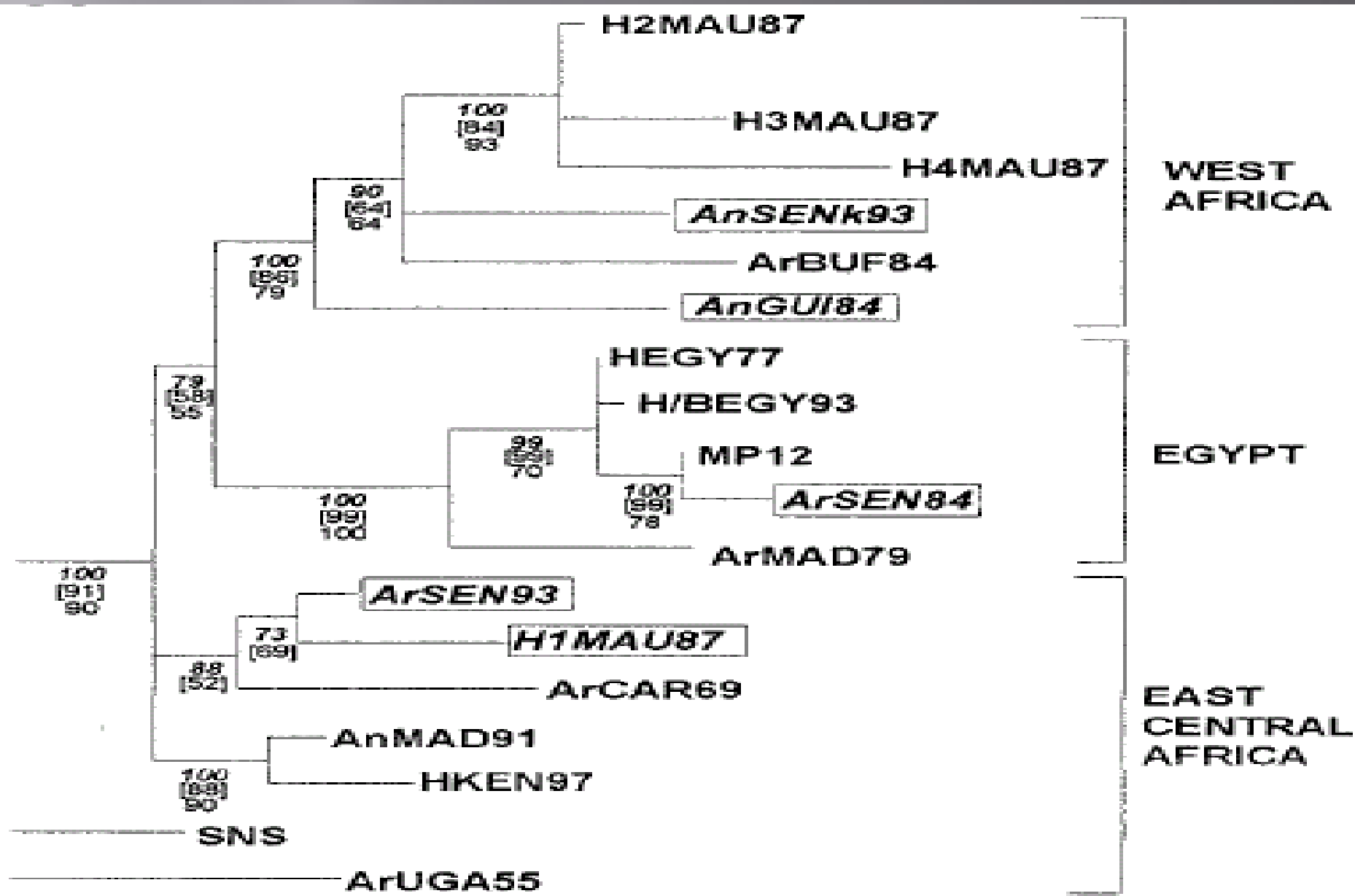
Phylogenetic tree of RVFV

The universal system for virus taxonomy (USVT)

- Established by the **international committee on the nomenclature of viruses (ICNV) (1966)** that modified into **international committee on the taxonomy of viruses (ICTV) (1973)** and based on:

1. Size of Virion.
2. Capsid symmetry.
3. presence or absence of virus envelope.
4. Type and characteristics of the viral genome .
5. The strategy of virus replication.

- Classified the viruses into Order, Families, Subfamilies, Genera and Species.

USVT

- **The <u>order</u> named with the suffix (Virales)**
  O. Mononegavirales (Paramyxoviridae, Rhabdoviridae, Bornaviridae and Filoviridae)
  O. Nidovirales (Coronaviridae, Arteriviridae, Roniviridae)

- **The <u>family</u> named with the suffix (Viridae)**
  Family: Poxviridae

- **The subfamily named with suffix (Virinae)**
  Subfamily: Chordopoxvirinae.
  Only Familes Pox, Herpes, Paramyxo, and Retro contains subfamilies.

- **The genera named with suffix (Virus)**
  Genus: Capripoxvirus

Classification criteria

	RNA														DNA						
Symmetry of capsid	Icosahedral				Helical										Icosahedral					Helical	Complex
Naked or enveloped	Naked		Enveloped					Enveloped							Naked		Enveloped		Naked/Env. (cytoplasmic)	Enveloped	Enveloped (cytoplasmic)
Genome architecture	ds 10–18 seg.	ds 2 seg.	(+) ss cont.	(+) ss cont.	(+) ss cont.	(+) ss cont.	(+) ss 2 copies	(+) ss cont.	(–) ss cont.	(–) ss cont.	(–) ss 3 seg.	(–) ss 8 seg.	(–) ss cont.	(–) ss 2 seg	ss linear (+) or (–)	ds circular	ds linear	ds circle gapped	ds linear	ds linear	ds circular	ds linear (x linked)
Baltimore class	III	III	IV	IV	IV	IV	VI	IV	V	V	V	V	V	V	II	I	I	I	I	I	I	I

Properties

Family name	Virion polymerase	Virion diameter (nm)	Genome size (total in kb)
Reo	(+)	60–80	22–27
Birna	(+)	60	7
Calici	(–)	35–40	8
Picorna	(–)	28–30	7.2–8.4
Flavi	(–)	40–50	10
Toga	(–)	60–70	12
Retro	(+)	80–130	3.5–9
Corona	(–)	80–160	16–21
Filo	(+)	80 X 790–14,000	12.7
Rhabdo	(+)	70–85 X 130–380	13–16
Bunya	(+)	90–120	13.5–21
Ortho-myxo	(+)	90–120	13.6
Para-myxo	(+)	150–300	16–20
Arena	(+)	50–300	10–14
Parvo	(–)	18–26	5
Papova	(–)	45–55	5–8
Adeno	(–)	70–90	36–38
Hepadna	(+)	42	3.2
Herpes	(–)	150–200	120–200
Irido	(–)	125–300	150–350
Baculo	(–)	60 X 300	100
Pox	(+)	170–200 X 300–450	130–280

Other terms related to virus classification

- **Pathotypes**: Variation in the virulence of the virus strains.

  NDV (Lentogenic, Mesogenic and Velogenic).

- **Biotypes**: Variation of the cytopathogenisity of the virus strains.

  BVD (Cytopathogenic and non-cytopathogenic biotypes).