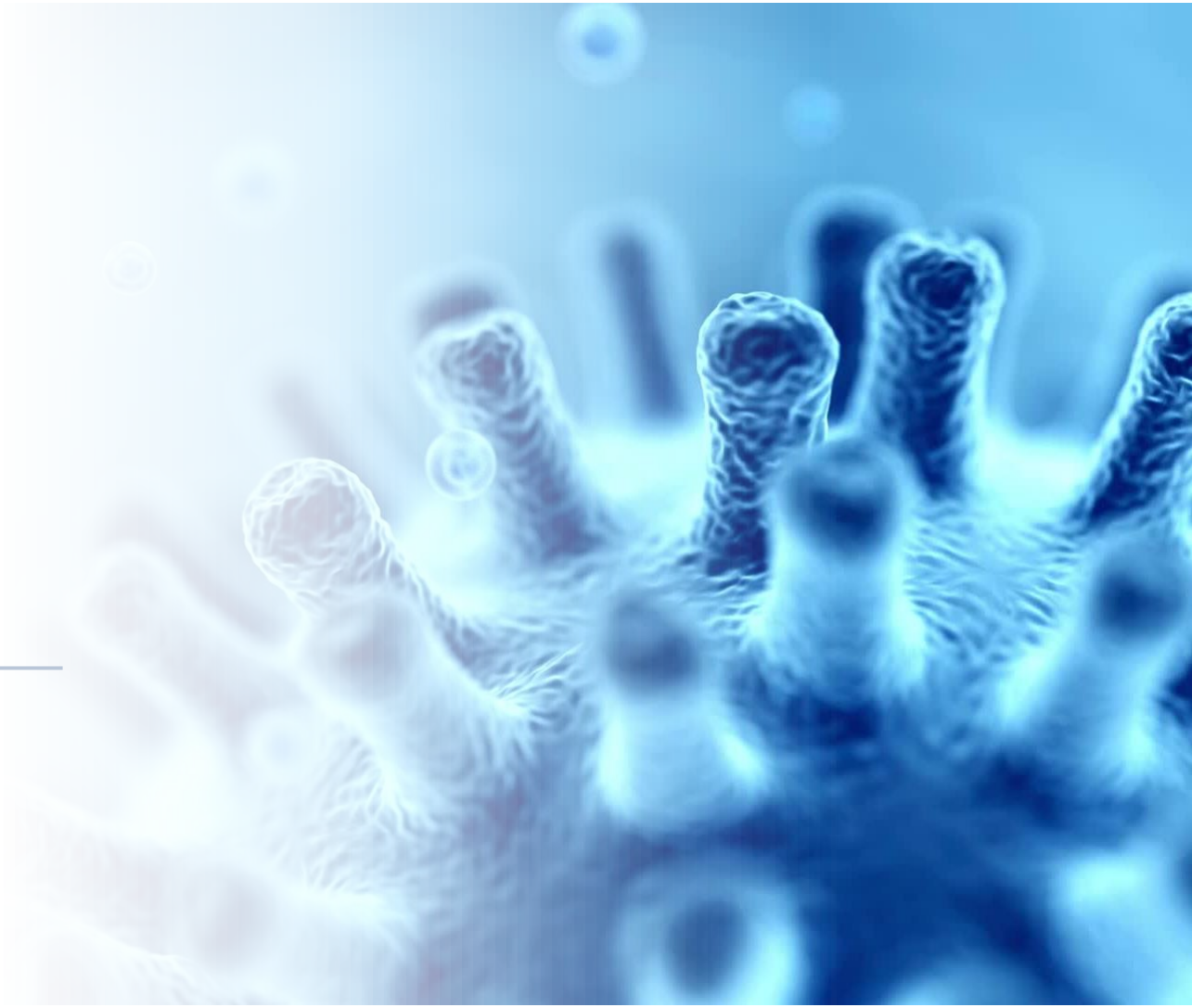
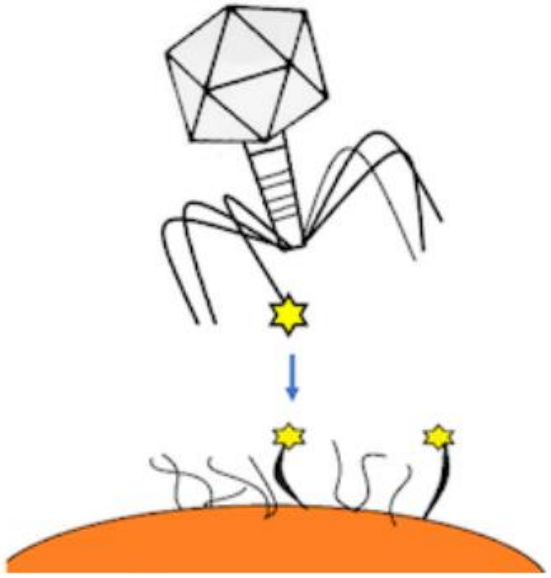
Virology



Wiwit Probowati, S.Si., M.Biotech.

Are viruses alive?



Viruses only become active when they come into contact with a host cell.

- Living things have cells → Viruses don't have cells.
- Living things reproduce → in general, cells reproduce by making a copy of their DNA. Unlike cells, virus don't have tools to make a copy of their DNA.
- Living things use energy → Outside of a host cell, viruses don't use any energy.
- Living things respond to their environment → whether or not viruses really respond to the environment is a subject of debate.

What's the final answer?

If viruses are not alive how can we destroy them?

1. Viruses with a lipid or fatty outer shell → coronavirus

2. Viruses with protein coatings → rhinoviruses and adenoviruses

General properties

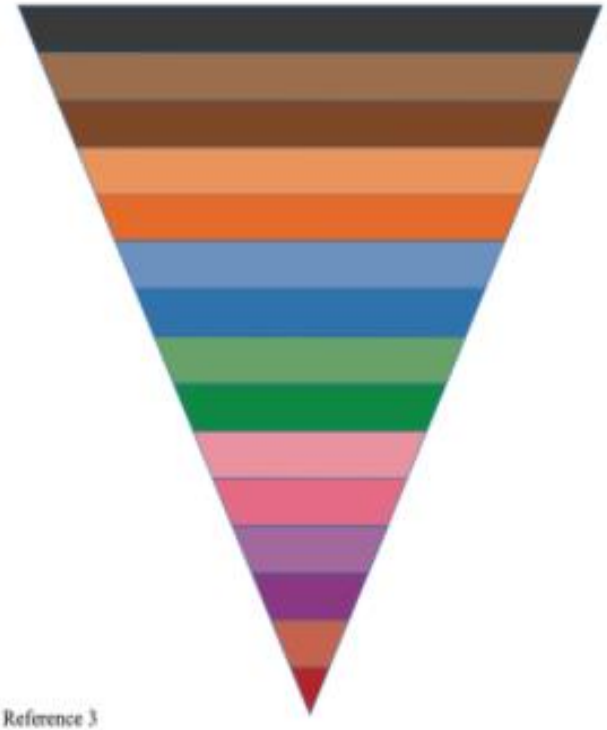
- The size ranges 20-300 nm. Most viruses are invisible under the light microscope.
- Viruses cannot multiply outside a living cell. They are obligate parasites.
- They can be crystallized.
- They are metabolically inactive. They lack enzyme systems and protein synthesis machinery.
- Viruses don’t have the power of growth and division. A fully formed virus can’t increase in size neither can it undergo division.
- Generally cell have both DNA and RNA. They have only one nucleic acid, either DNA or RNA.

Classification of Viruses

- Classified by phenotypic characteristics, such as morphology, nucleic acid type, mode of replication, host organisms, and type of disease they cause.
- Viruses are classified into group called taxa according to their similarities and dissimilarities.
- The lowest rank is the species.
- These are collected into genera, and so on up into families, orders, classes, phyla, kingdoms and realms.
- The is a hierarchical structure of 15 ranks.

How are viruses classified?

The structure of virus taxonomy



Fifteen-ranks	Ranks (...suffix)
	species (*irregular*)
	subgenus (*...virus*)
	genus (*...virus*)
	subfamily (*...virinae*)
	family (*...viridae*)
	suborder (*...virineae*)
	order (*...virales*)
	subclass (*...viricetidae*)
	class (*...viricetes*)
	subphylum (*...viricotina*)
	phylum (*...viricota*)
	subkingdom (*...virites*)
	kingdom (*...virae*)
	subrealm (*...vira*)
	realm (*...viria*)

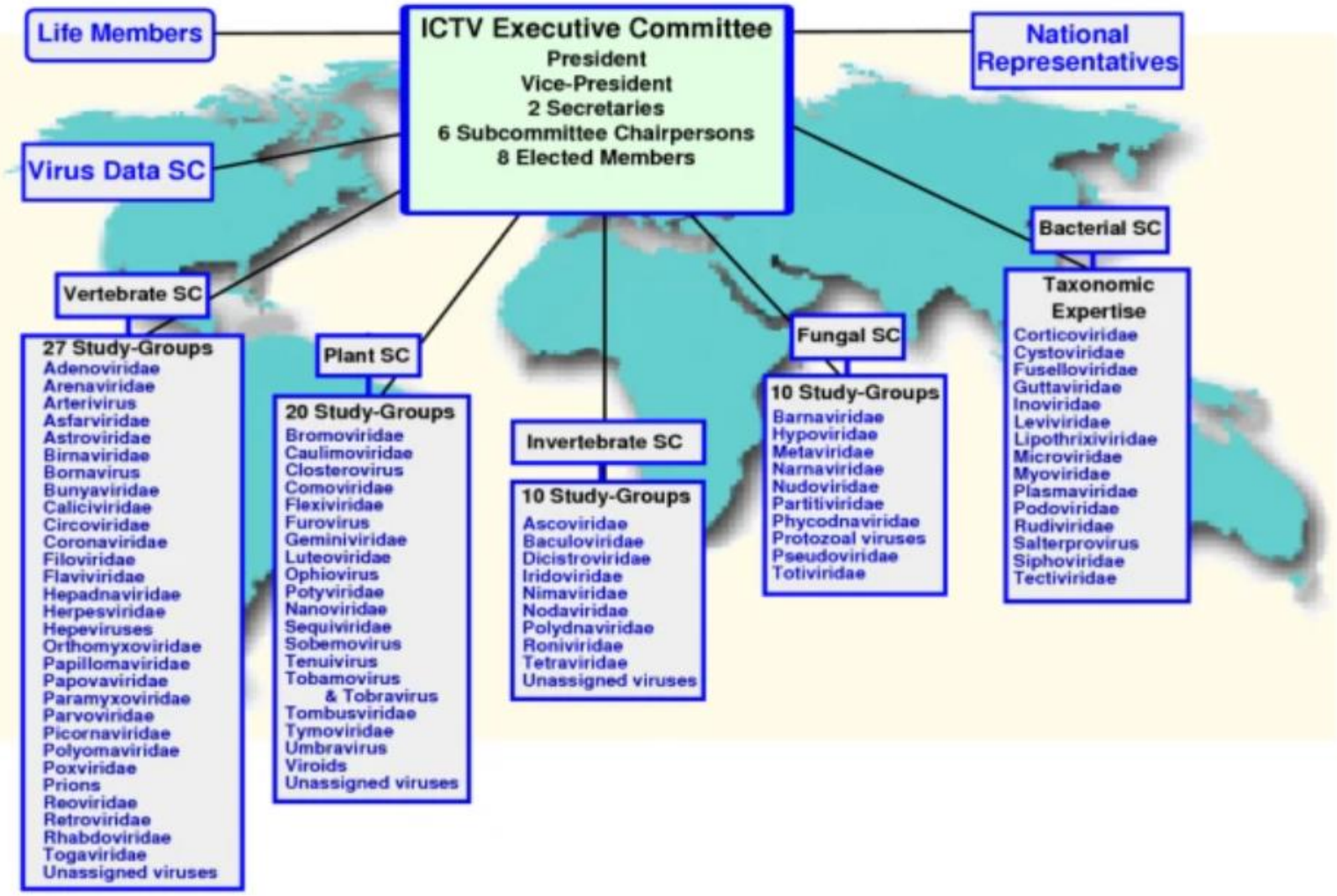
Reference 3

Examples of virus taxonomy

herpes simplex virus (a DNA virus)	poliovirus (an RNA virus)
Human alphaherpesvirus 1	*Enterovirus C*
Simplexvirus	*Enterovirus*
Herpesviridae	*Picornaviridae*
Herpesvirales	*Picornavirales*
Herviviricetes	*Pisoniviricetes*
Peploviricota	*Pisuviricota*
Heunggongvirae	*Orthornavirae*
Duplodnaviria	*Riboviria*

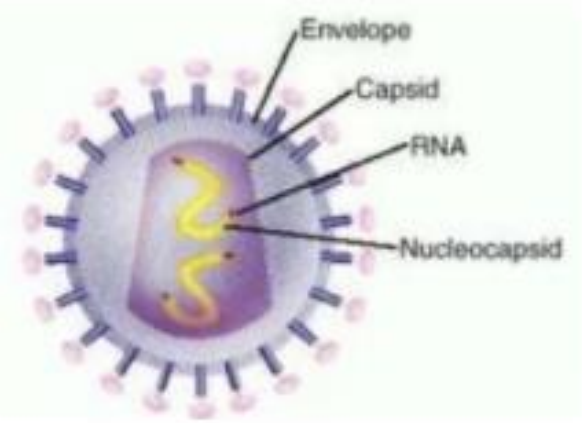
ICTV Organization

International Committee on Taxonomy of Viruses



Structure

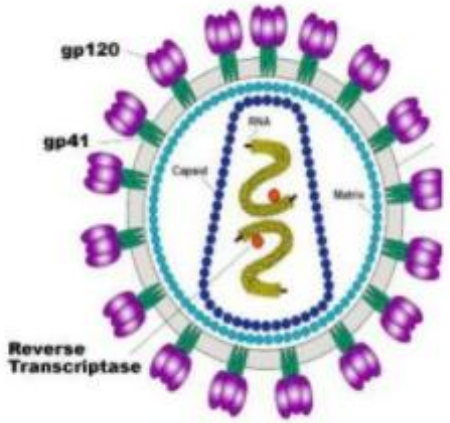
- The intact virus unit or infectious particle is called the virion. Each virion consists of a nucleic acid core surrounded by a protein coat called capsid.



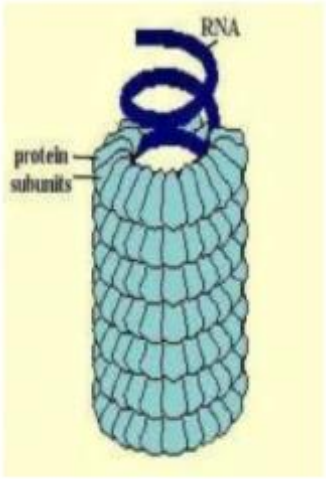
- It is composed of a number of subunits called capsomeres. The nucleic acid and capsid is called nucleocapsid. The nucleocapsid may be naked or surrounded by a loose membrane called envelope.

Morphology

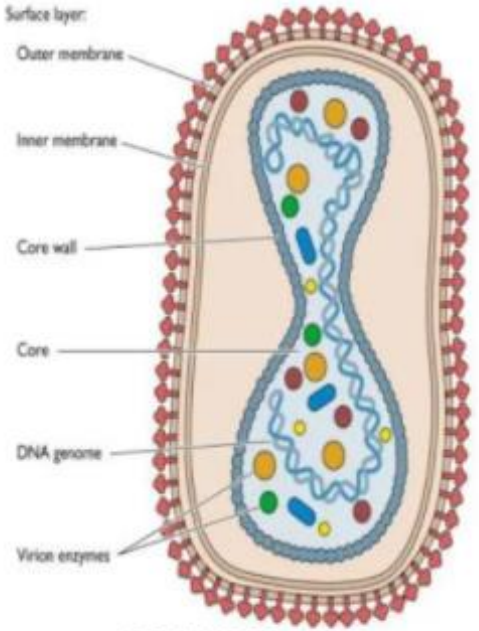
Viruses occur in three shapes: spherical, helical and complex



HIV

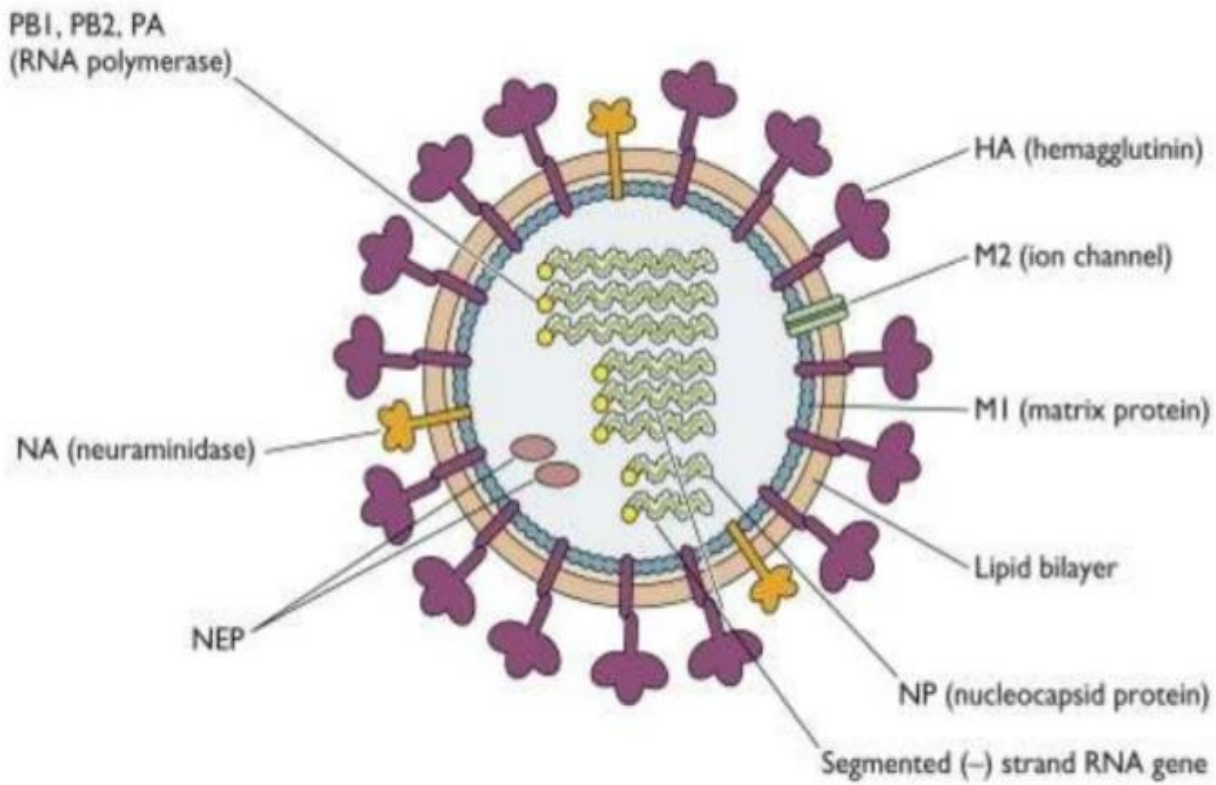


TMV

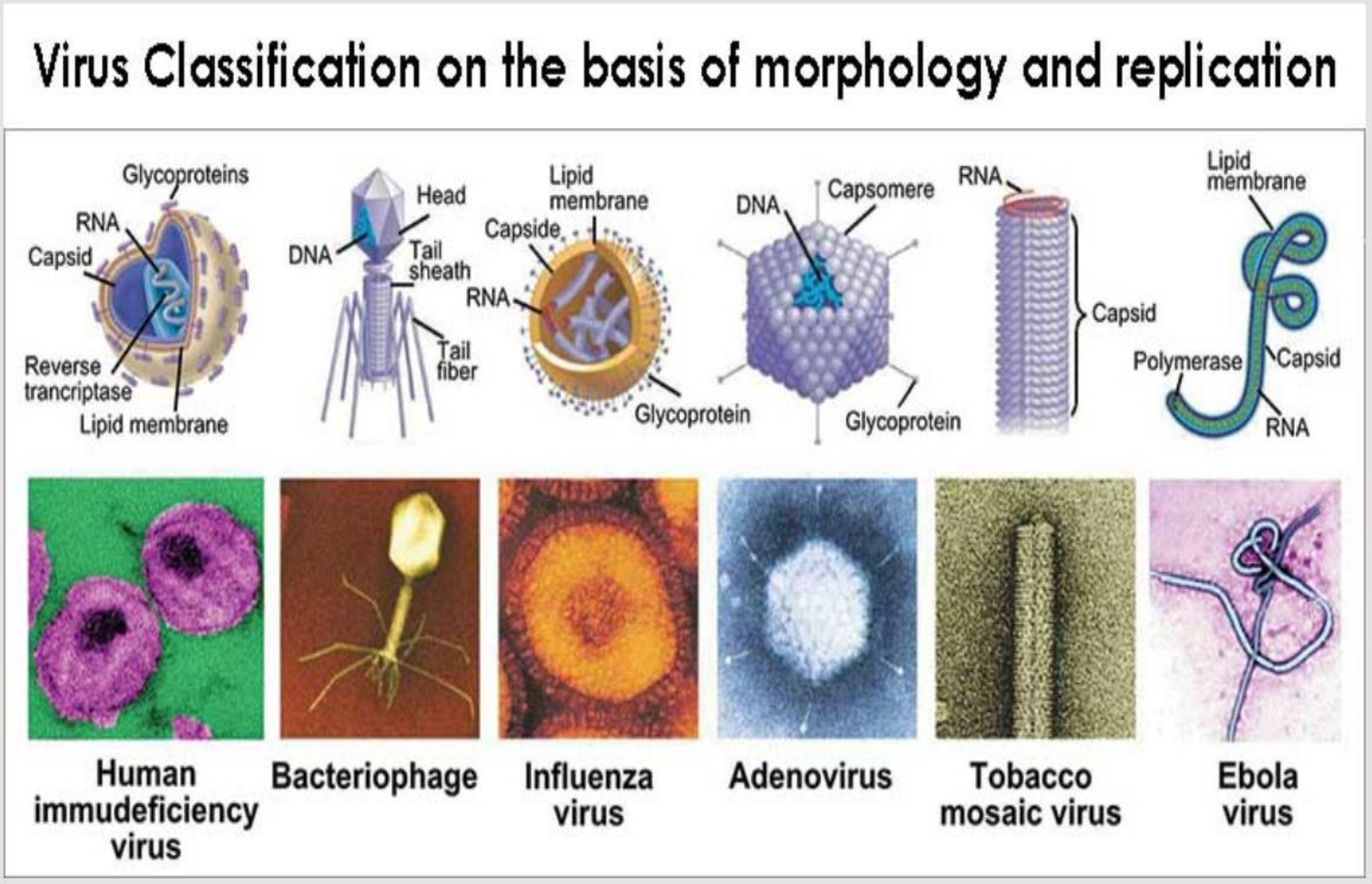


POX VIRUS

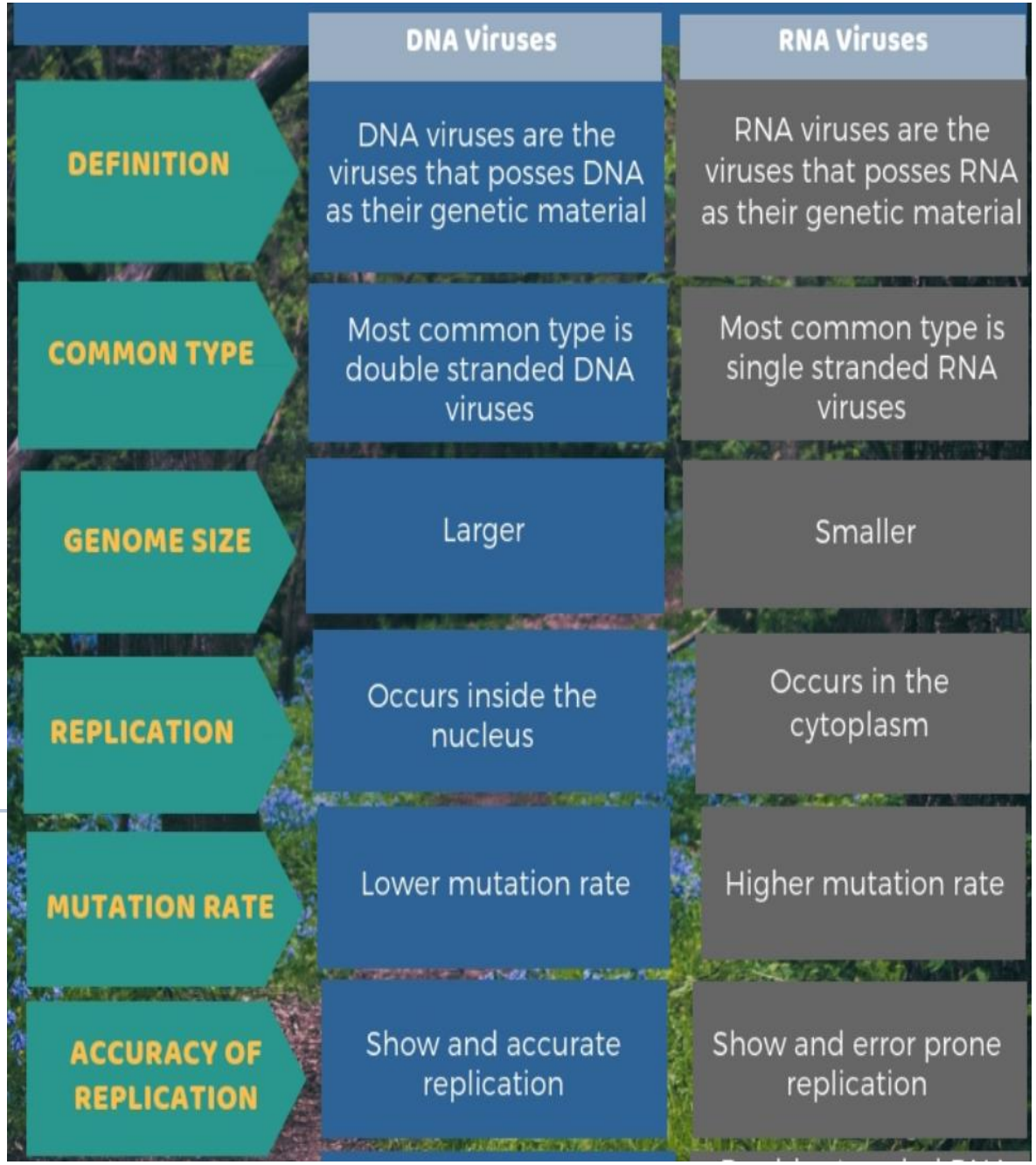
Enveloped with helical nucleocapsid (influenza)



Morphology & replication of viruses



DNA & RNA viruses



DNA vs RNA Viruses

DNA

- Very stable
- B-form double helix
- dsDNA is rigid
- Accurate replication
  - large genomes
- Protected by cell

- VIRAL DNA IS USUALLY PACKAGED INTO PREFORMED CAPSID SHELLS (PROCAPSIDS)

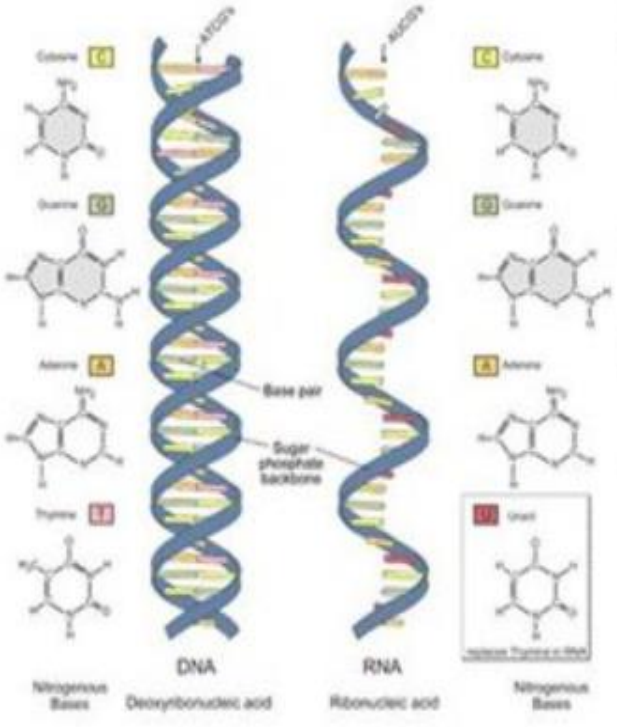


Image adapted from: National Human Genome Research Institute.

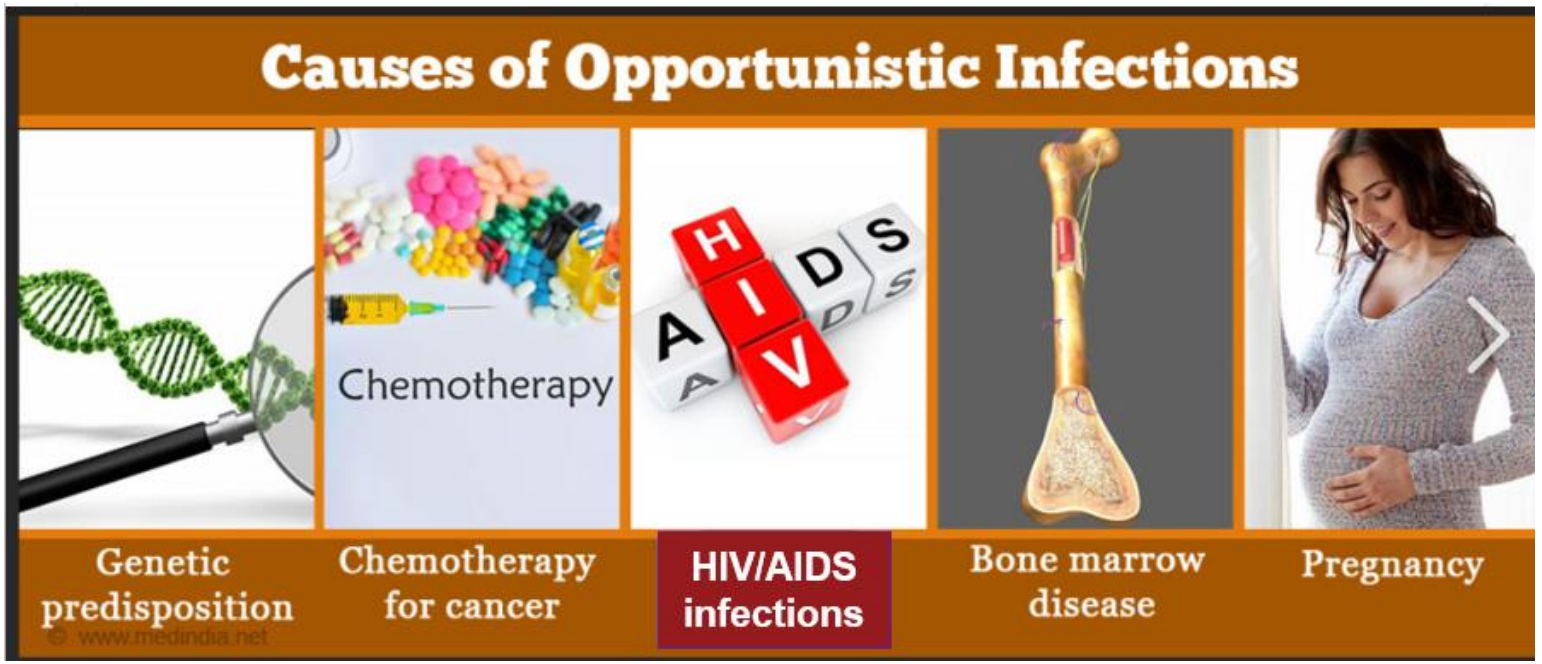
RNA

- Less stable
- Mixture of ss and ds forms; extensive secondary structure
- ssRNA is flexible; dsRNA is rigid
- Error-prone replication
  - small genomes
- dsRNA actively degraded by cell
  - RNA MUST BE PROTECTED DURING REPLICATION AND ASSEMBLY!

- VIRAL RNA USUALLY CO-ASSEMBLES WITH CAPSID PROTEIN

Opportunistic infections (OIs)

- OIs are infections that occur more often or are more severe in people with weakened immune systems than in people with healthy immune systems.
- OIs are caused by a variety of germs (viruses, bacteria, fungi, and parasites).

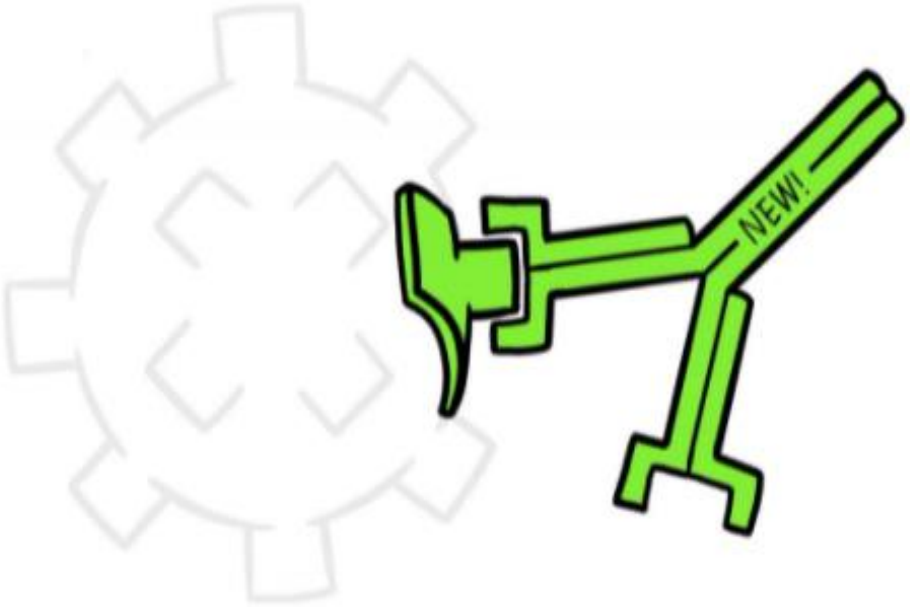


Vaccination

- Train the immune system to create antibodies, just as it does when it's exposed to a disease.
- Vaccines contain only killed or weakened forms of germs like viruses or bacteria, they do not cause the disease or you at risk of its complications.

VACCINE

NEW ANTIBODY



A VACCINE is a tiny weakened non-dangerous fragment of the organism and includes parts of the antigen. It's enough that our body can learn to build the specific antibody. Then if the body encounters the real antigen later, as part of the real organism, it already knows how to defeat it.

Any questions?

Homework.

- List in the table of vaccines for baby from Association of Indonesian pediatricians. Produce table with the name of vaccine and time of injection!
- Deadline: 28 March 2022 at 9 am.
- Send to my email: wi2t_probo@yahoo.com