



Introduction to medical virology

(Foundation Block , Microbiology : 2018)

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OBJECTIVES

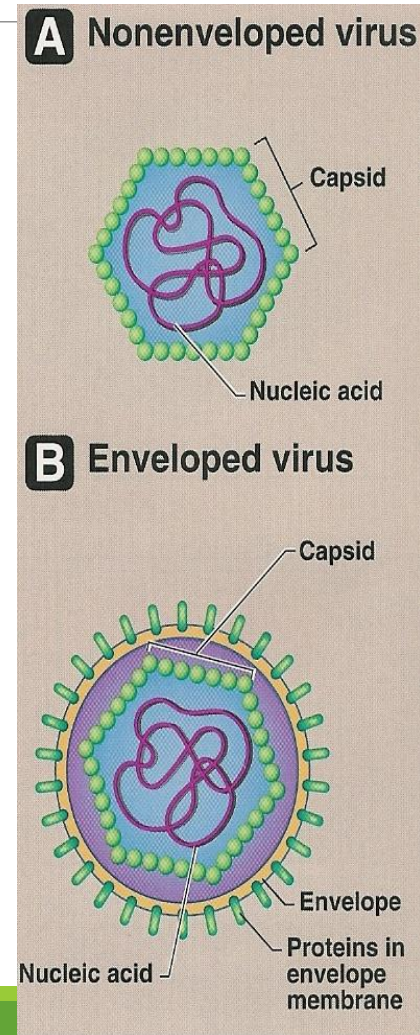
- ***Distinguish the viruses from other microorganisms***
- ***General characteristics of viruses.***
- ***Structure & symmetry of viruses.***
- ***Classification of viruses.***
- ***Steps of virus replication .***
- ***laboratory diagnosis of viral infections.***

Properties of Microorganisms

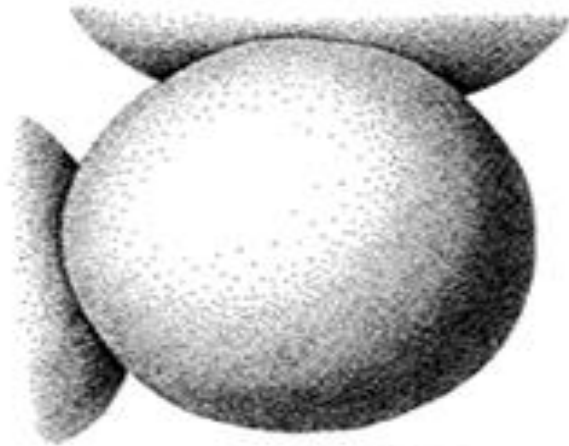
<i>characteristic</i>	<i>Parasites</i>	<i>Fungi</i>	<i>Bacteria</i>	<i>Viruses</i>
<i>Cell</i>	Yes	Yes	Yes	No
<i>Type of nucleus</i>	Eukaryotic	Eukaryotic	Prokaryotic	-----
<i>Nucleic acid</i>	Both DNA & RNA	Both DNA & RNA	Both DNA & RNA	DNA or RNA
<i>Ribosomes</i>	Present	Present	Present	Absent
<i>Mitochondria</i>	Present	Present	Absent	Absent
<i>Replication</i>	Mitosis	Budding or mitosis	Binary fission	<i>special</i>

Characteristics of viruses

- Acellular organisms
- Tiny particles
 - Internal core
 - Protein coat
 - Some Vs have lipoprotein mb
- Obligate intracellular organisms
- Replicate in a manner diff from cells
(1V many Vs)



Size ; 20-300 nm



STAPHYLOCOCCUS



HERPES VIRUS



CHLAMYDIA
ELEMENTARY
BODY



INFLUENZA VIRUS

0.2 μm



POX VIRUS



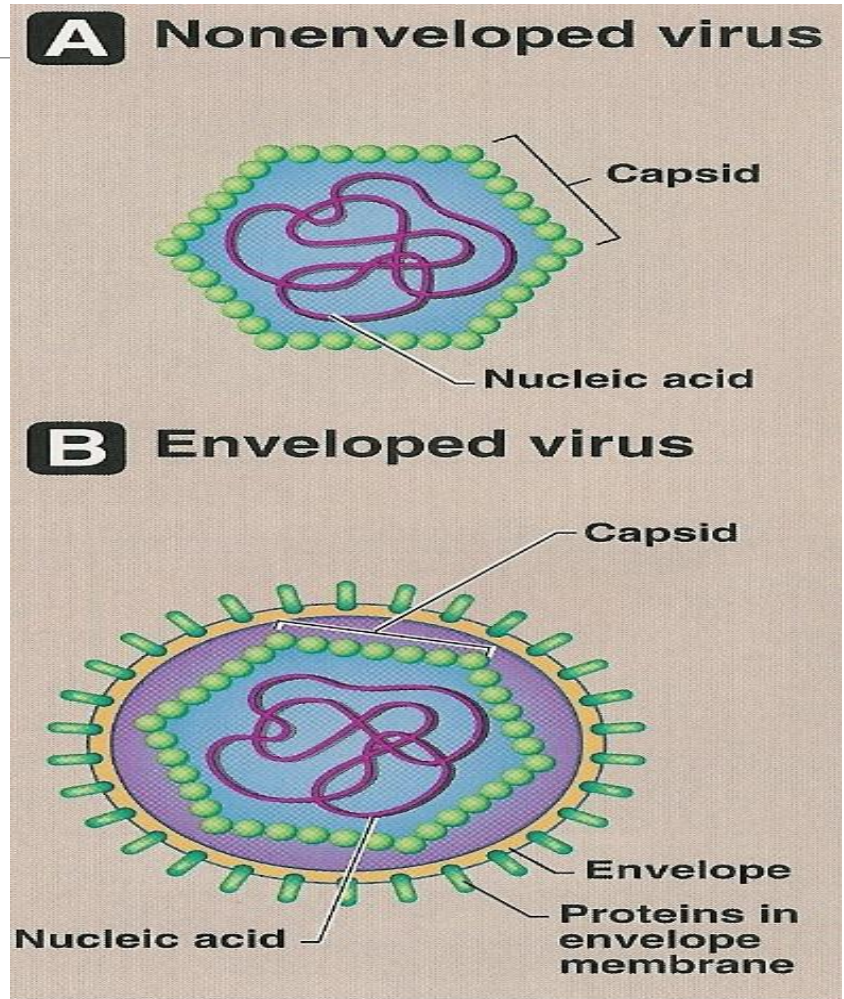
POLIO VIRUS

Viral Structure

1-Viral genome

2-Capsid

3-Envelope



Viral Structure

1-Viral genome

DNA

(Deoxyribonucleic acid)

- All DNA Vs have ds except Parvoviruses
- Single molecule

or

RNA

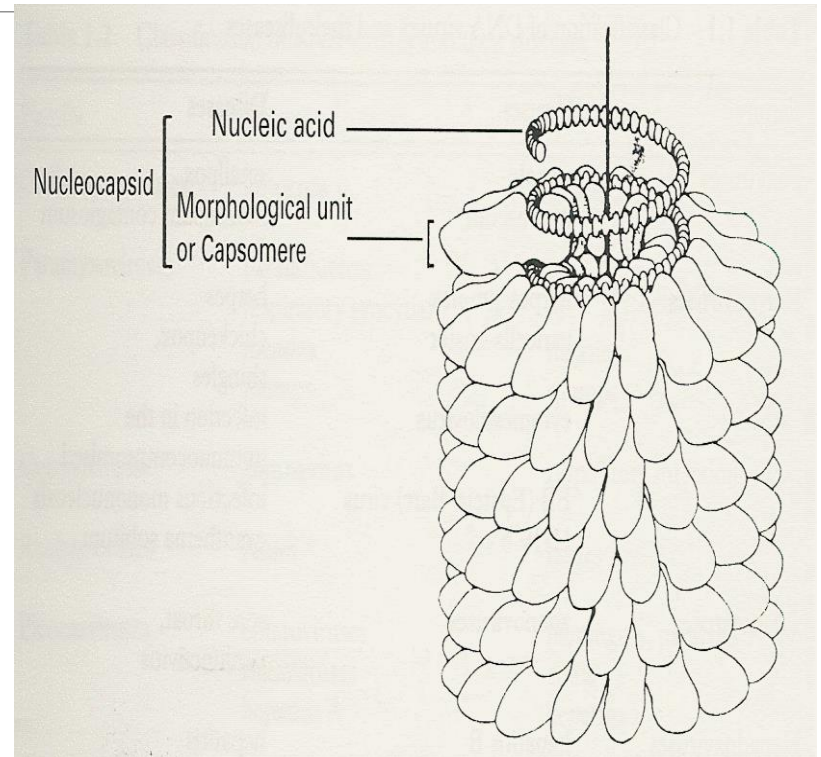
(Ribonucleic acid)

- All RNA Vs have ss except Reoviruses
- single / multiple
- (+) polarity
- (-) polarity

Viral structure

2-Capsid

- a protein coat
- Subunits (capsomeres)
- Genome (NA) + capsid
= nucleocapsid
- Function;
 - Protects NA
 - Facilitates its entry into cell



Symmetry

based on arrangement of capsomeres

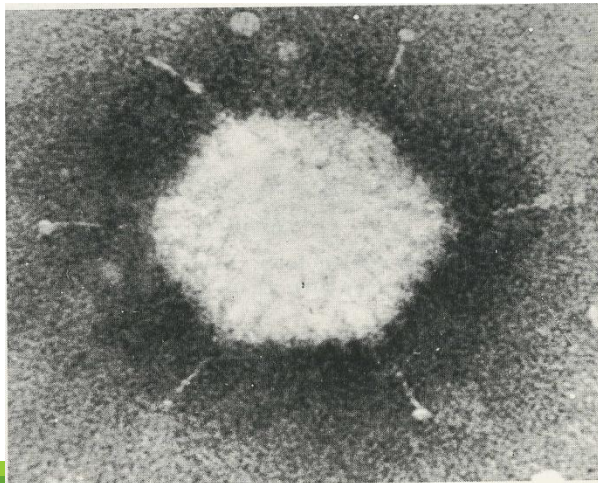
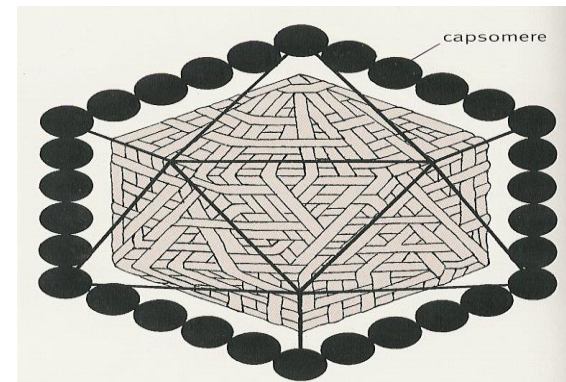
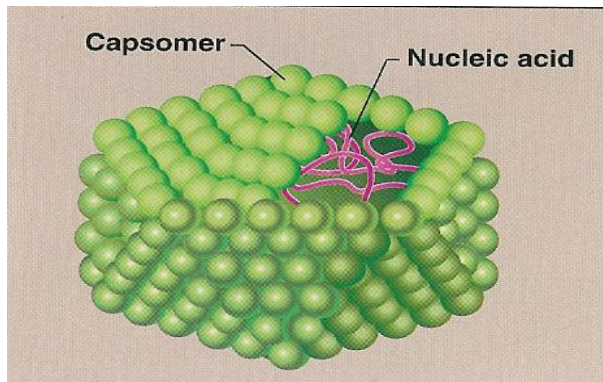
- ***Cubic symmetry
(Icosahederal)***
- ***Helical symmetry***
- ***Complex symmetry***

Symmetry

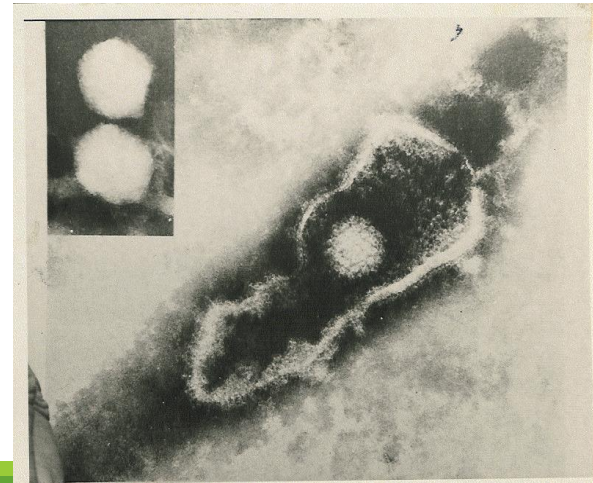
based on arrangement of capsomeres

➤ **1-Cubic symmetry**

(Icosahedral)



Adenovirus

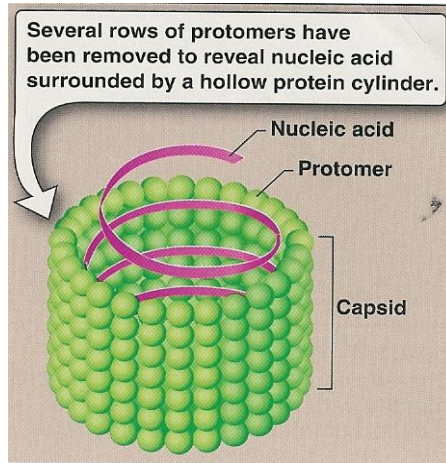


Herpesvirus

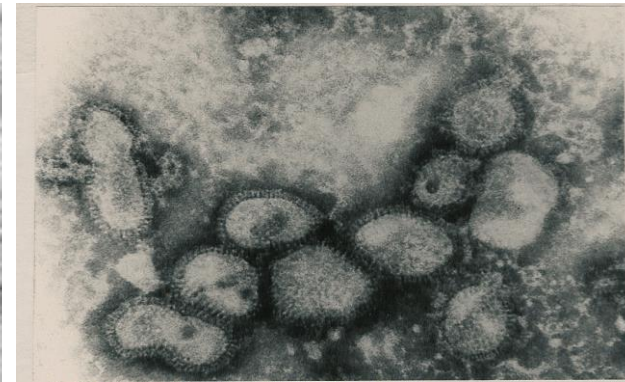
Symmetry

based on arrangement of capsomeres

➤ **2- Helical symmetry**

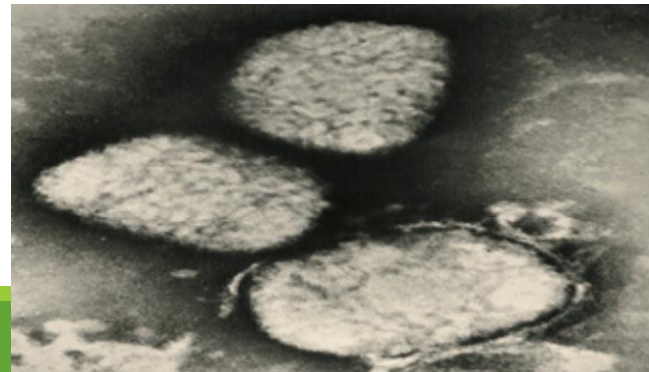


*Elongated
(filoviruses)*



*Pleomorphic
(influenza v.)*

➤ **3- Complex symmetry** poxviruses



Viral structure

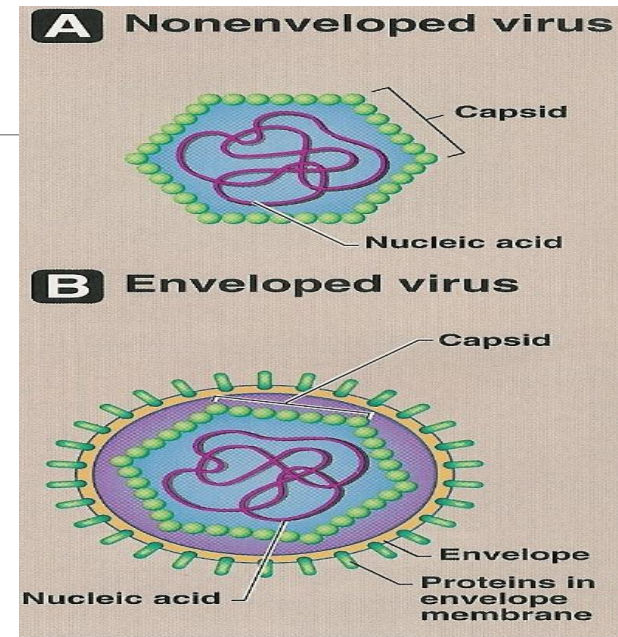
3-Envelope

Lipoprotein mb

(host lipid ,virus specific protein)

➤ *Budding*

- Envelope is derived from cell mb
except herpesviruses from nuclear mb
- Enveloped Vs are more sensitive to
heat ,dry & ether than nonenveloped Vs
- Glycoprotein attaches to host cell receptor



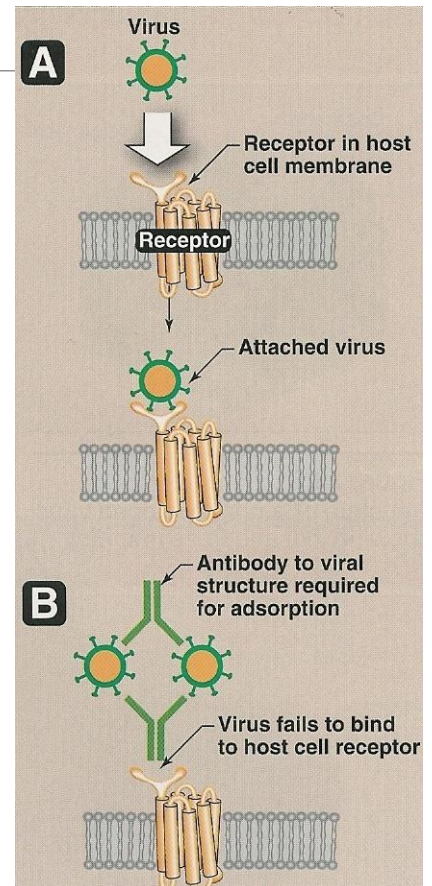
Viral proteins

❖ *The outer viral ps*

- ❖ Mediate attachment to specific Rs
- ❖ Induce neutralizing Abs
- ❖ Target of Abs

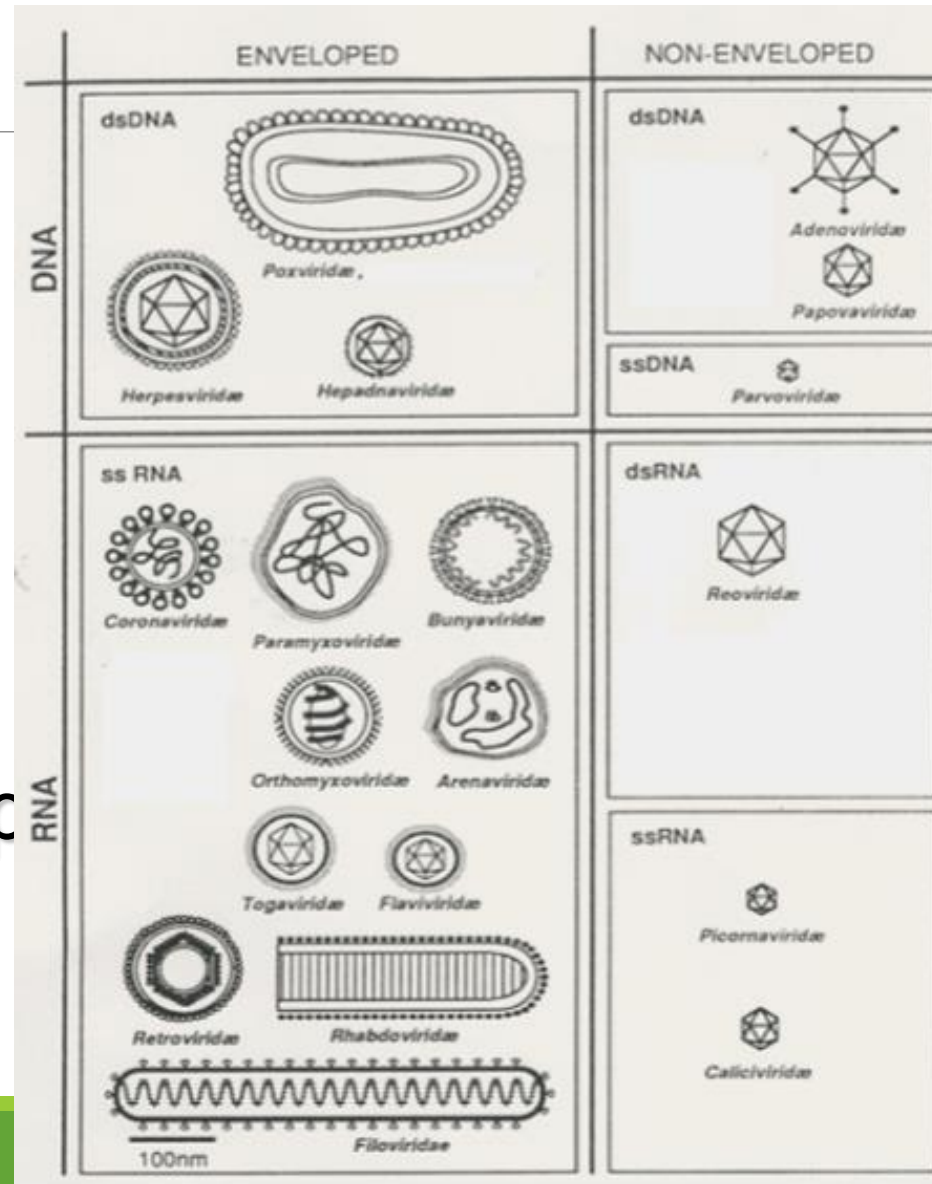
❖ *The internal viral ps*

- ❖ Structural ps (capsid ps of enveloped Vs)
- ❖ Nonstructural ps (enzymes)
 - All ssRNA Vs (-) polarity have transcriptase (RNA dependent RNA polymerase) inside virions
 - RetroVs & HBV contain reverse transcriptase

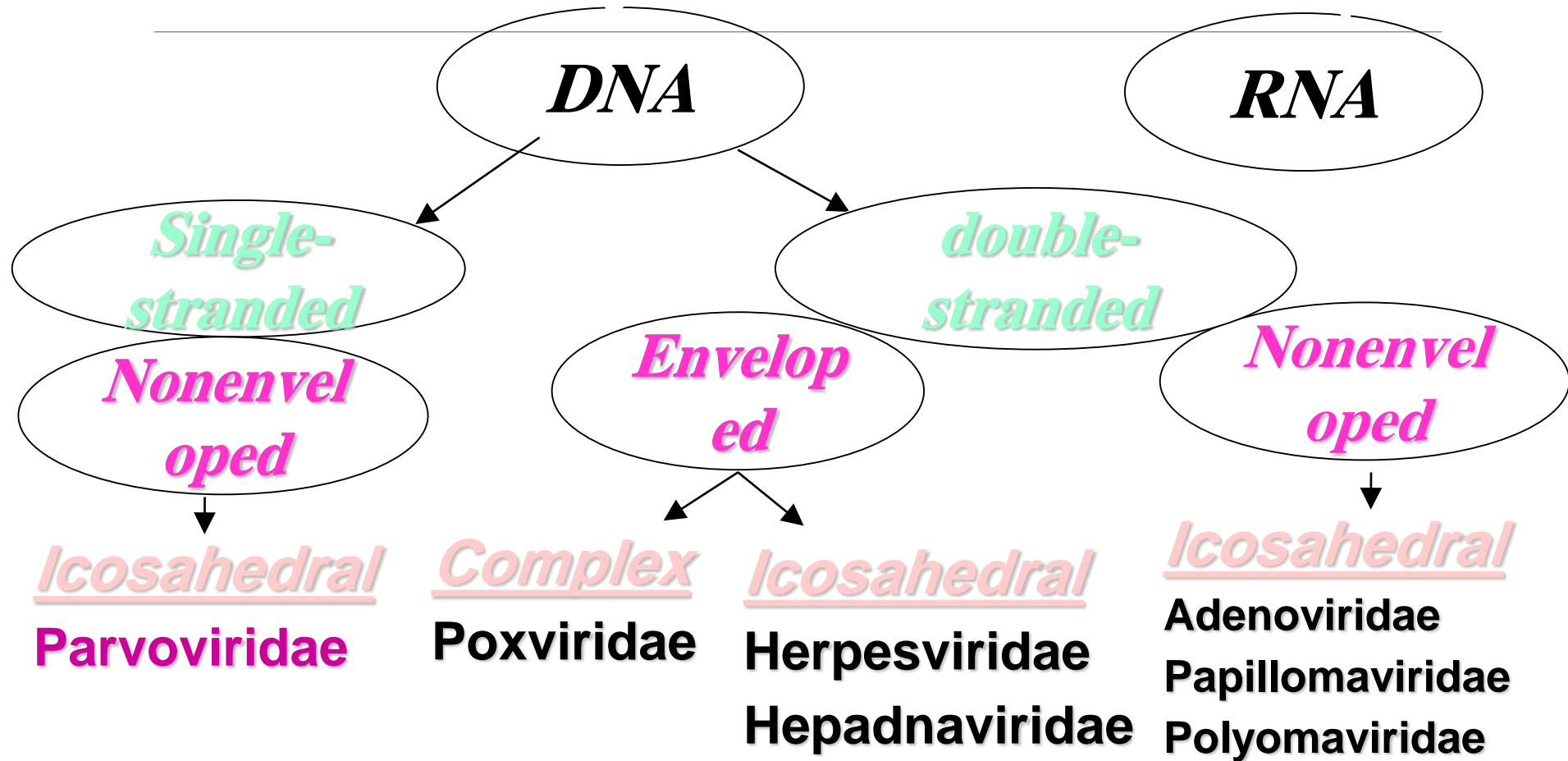


Classification of viruses

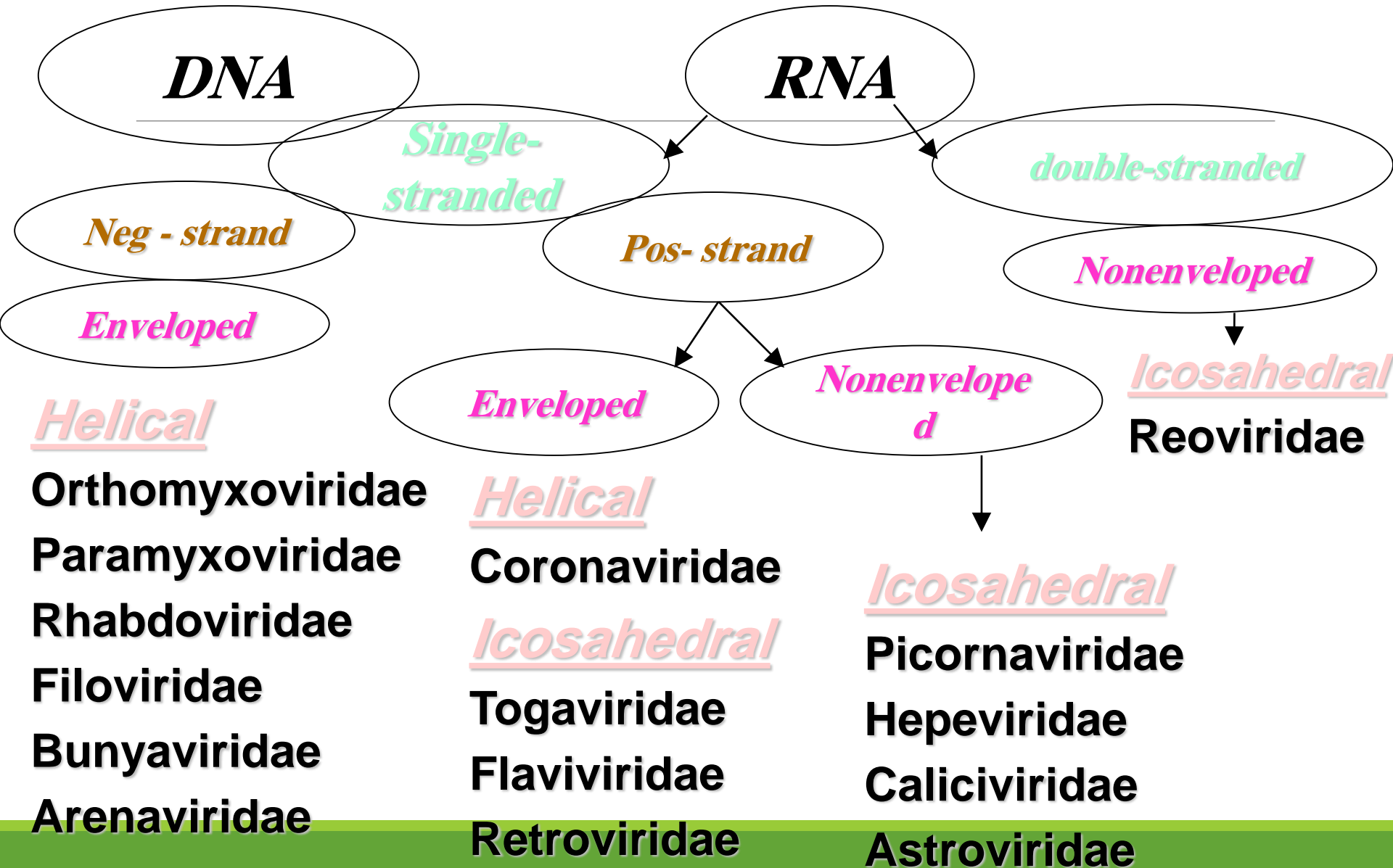
- Type of NA*
- The no. of strand
- The polarity of viral genome
- The presence or absence of envelope
- Type of symmetry



Medically Important Viruses

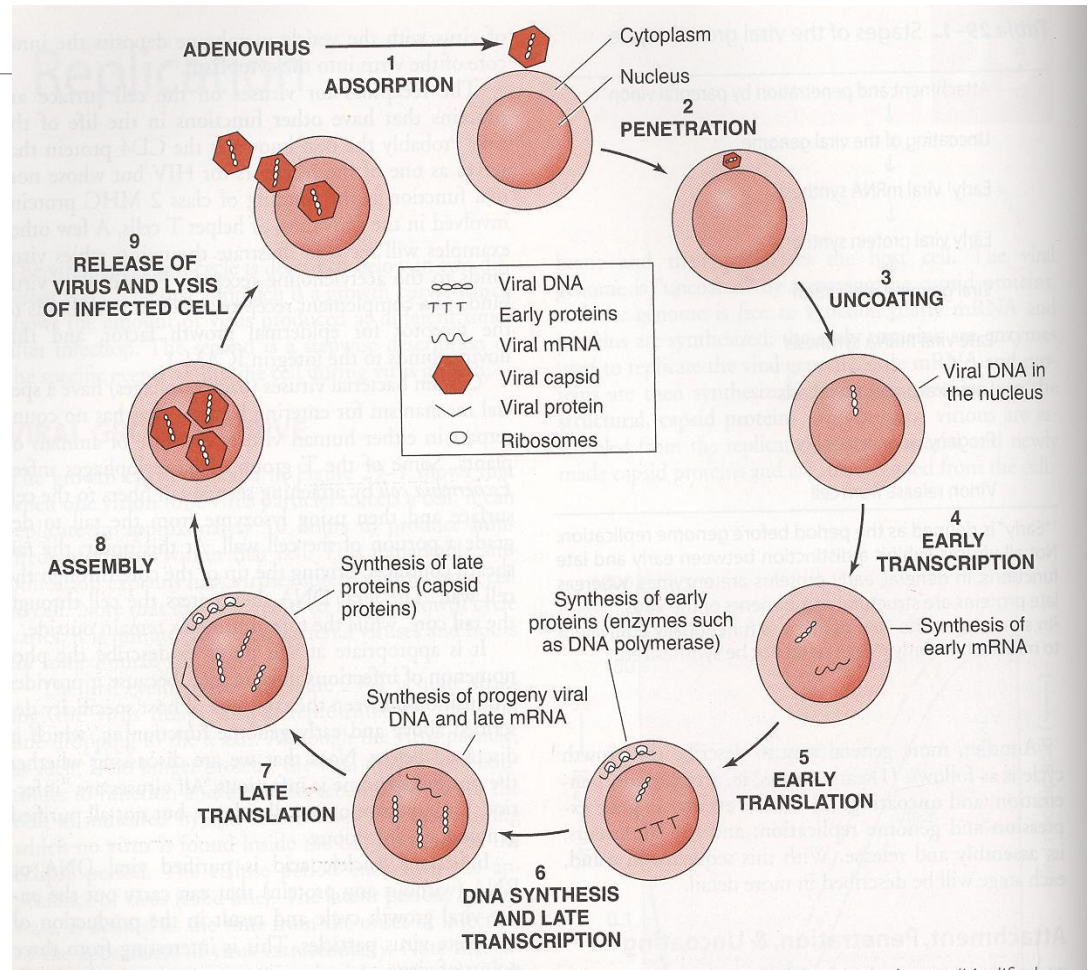


Medically Important Viruses



Replication

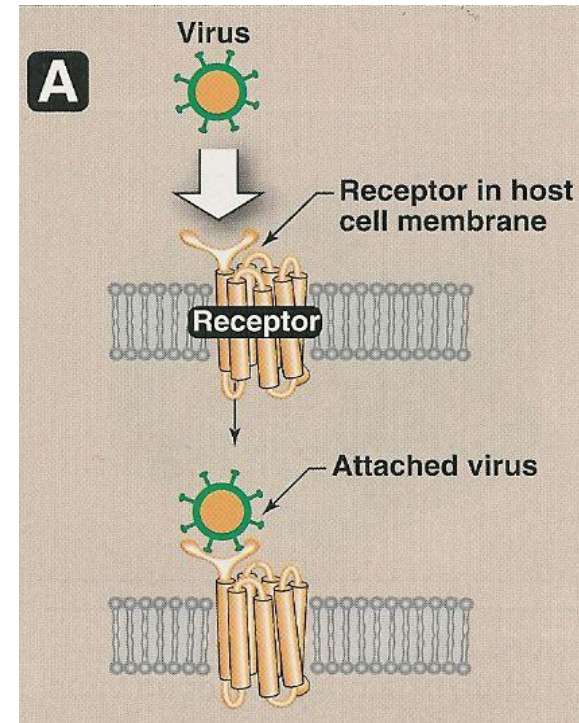
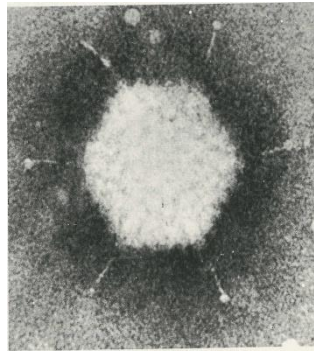
- Adsorption (Attachment)
- Penetration
- Uncoating
- Synthesis of viral components
 - mRNA
 - Viral proteins
 - NA
- Assembly
- Release



Viral growth cycle

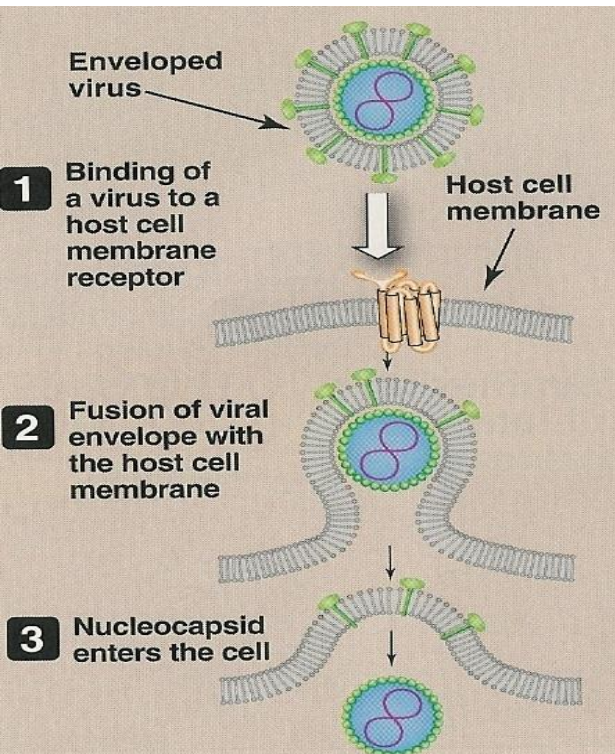
Adsorption

- Attachment site ;
ex- glycoprotein
fiber



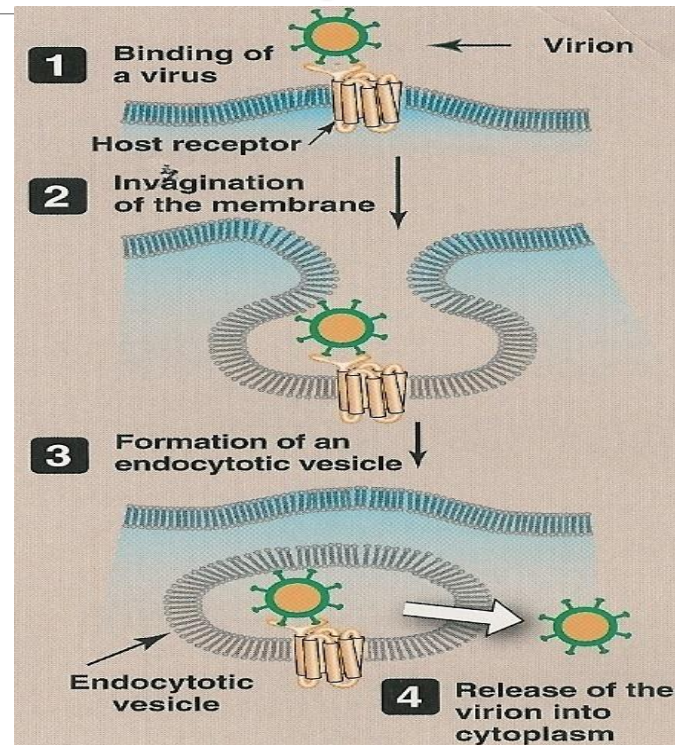
Penetration

1-Fusion



(enveloped Vs)

2-Endocytosis



- Viral envelope fuses with endosome mb
- Nonenveloped \ / lysis , pore

Replication

➤ Adsorption (Attachment)

➤ Penetration

➤ **Uncoating**

Release of viral genome - cytoplasm
- nucleus

Synthesis of viral components

➤ mRNA

Viral genome $\xrightarrow[\text{+ssRNA acts directly}]{\text{transcription}}$ mRNA

➤ Viral proteins

mRNA $\xrightarrow[\text{cell ribosome}]{\text{translation}}$ viral proteins
- enzymes
- structural ps

➤ replication of viral genome

Replication

- Adsorption (Attachement)
- Penetration
- Uncoating
- Synthesis of viral components
 - mRNA
 - Viral proteins
 - NA

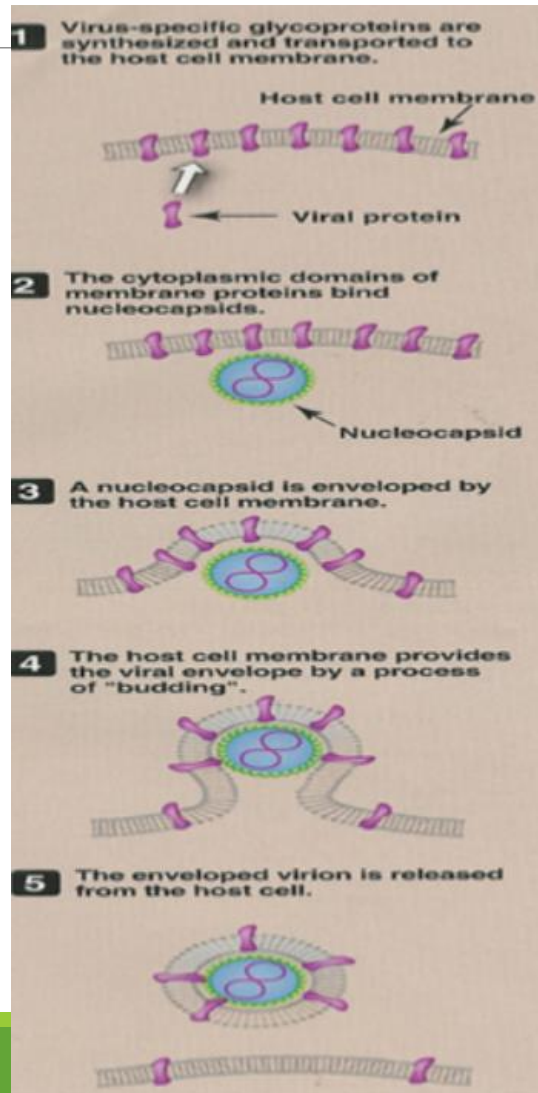
➤ *Assembly*

NA + V. proteins = Virions

- Release

Release

- 1-Budding
(enveloped Vs)
 - cell mb*
 - nuclear mb
(herpesVs)



- 2- Cell lysis
or rupture
(nonenveloped)

laboratory diagnosis of viral infections

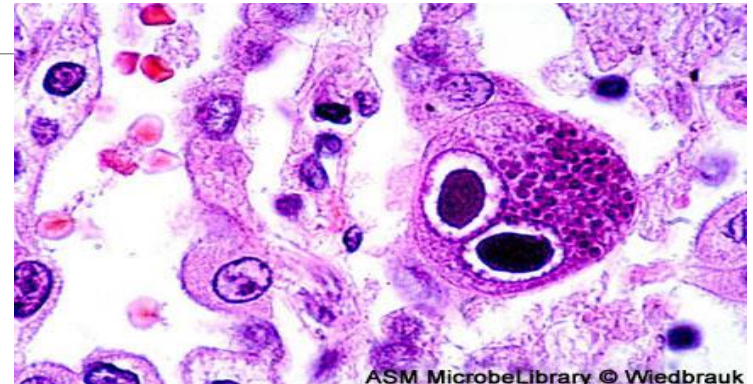
- ***Microscopic examination.***
- ***Cell culture.***
- ***Serological tests .***
- ***Detection of viral Ag.***
- ***Molecular method .***

Microscopic examination

➤ *Light microscopy,*

Histological appearance

Ex. Inclusion bodies



Owl's eye (CMV)

➤ *Electron microscopy;*

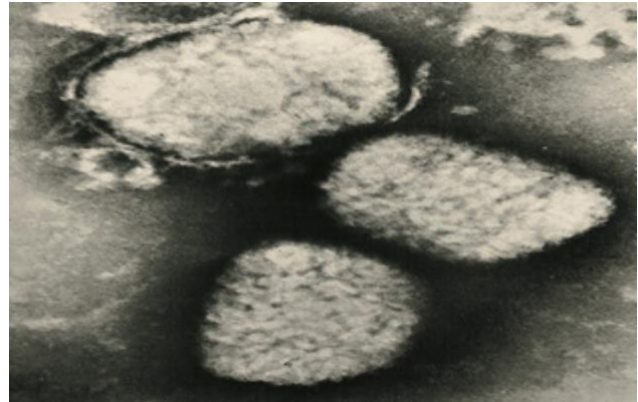
- Morphology & size of virions
- Ex.
 - Dx of skin lesion caused by herpesv, poxv.
- It is replaced by Ag detection & molecular tests

➤ Electron micrographs

Herpesvirus



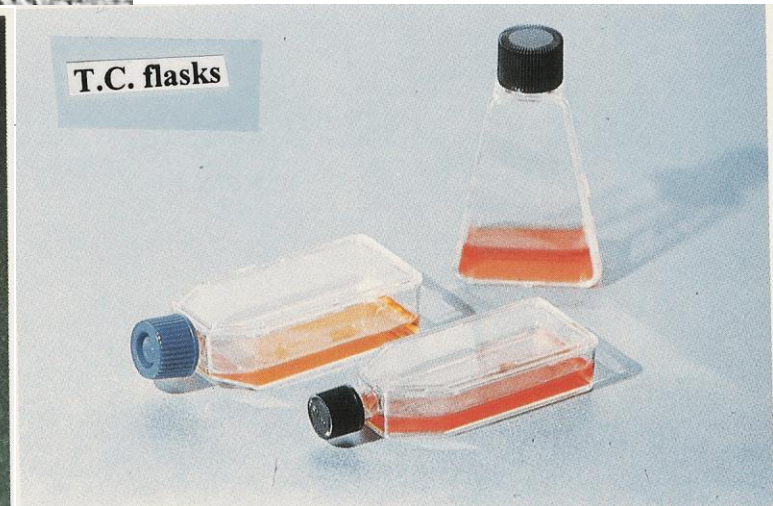
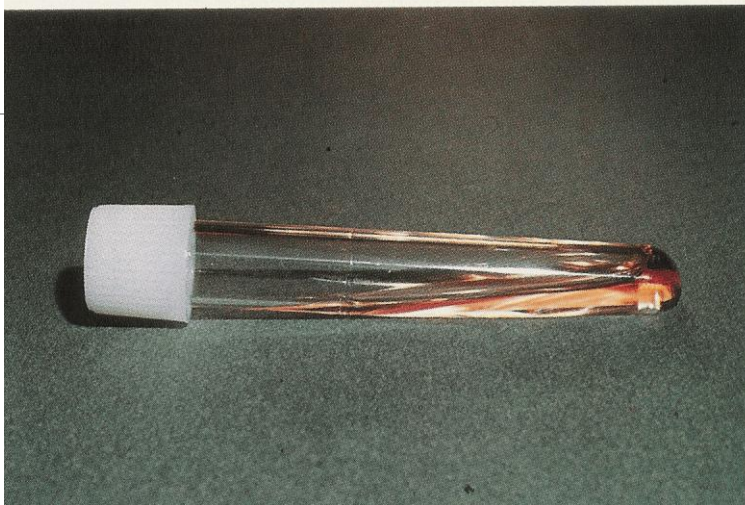
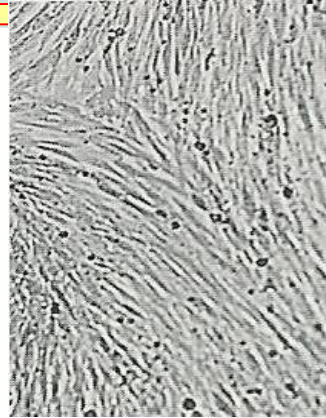
Poxvirus



Virus cultivation

- ***Laboratory animal***
- ***Embryonated egg***
- ***Cell culture***

Cell culture



Cell culture C/C)

1-Primary C/C

2-Diploid C/C

[semi continuous]

3-Continuous cell line

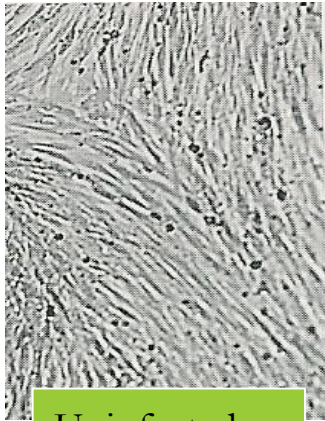
Variation in Sensitivity of cell cultures to infection by viruses commonly isolated in clinical virology laboratories

Virus	Cell culture ^a		
	PMK	HDF	HEp-2
RNA virus			
Enterovirus	+++	++	+/-
Rhinovirus	+	+++	+
Influenza virus	+++	+	-
RSV	++	+	+++
DNA virus			
Adenovirus	+	++	+++
HSV	+	++	++
VZV	+	+++	-
CMV	-	+++	-

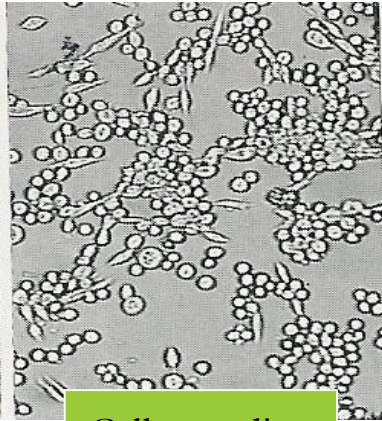
PMK, primary MK. Degree of sensitivity: +++, highly sensitive; ++, moderately sensitive; +, low sensitivity; +/-, variable; -, not sensitive

Detection of viral growth

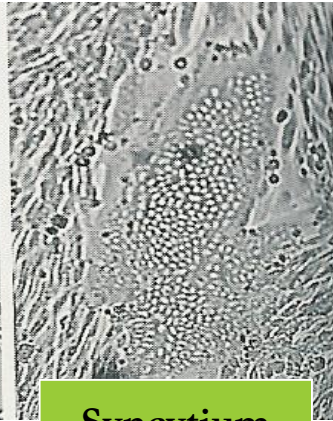
➤ Cytopathic effects



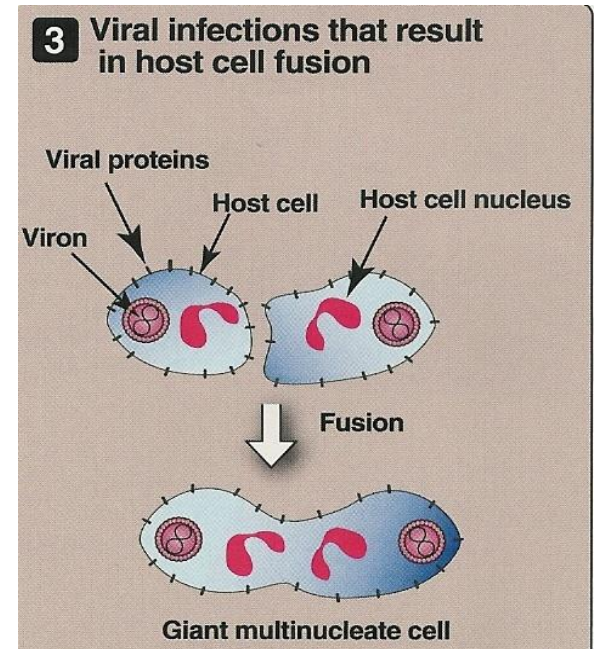
Uninfected cc



Cell rounding



Syncytium



➤ Others

Problems with cell culture ;

- Long incubation
- Sensitivity is variable
- Susceptible to bacterial contamination
- Some Vs do not grow in c/c ex. HCV

Rapid culture technique

- Shell Vial Assay
- Detect viral antigens
- 1-3 days

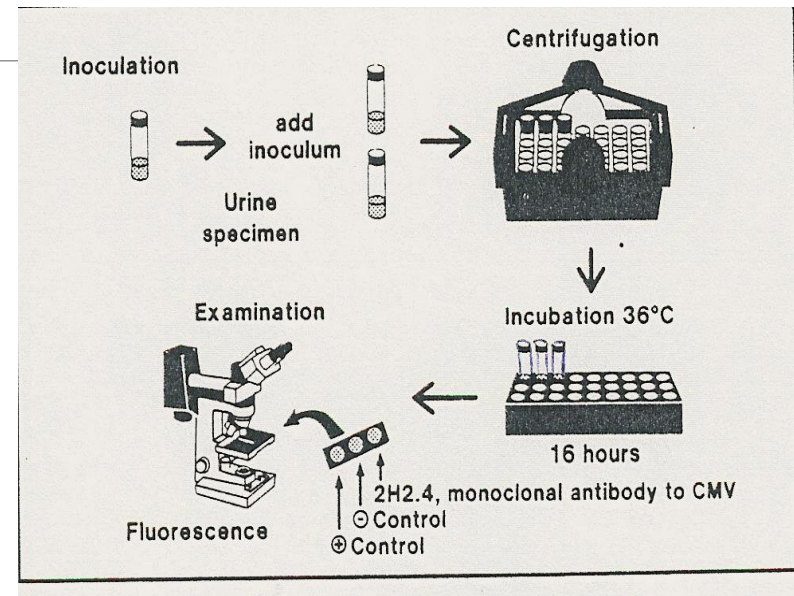


Fig. 2, CMV centrifugation culture fixed and stained 16 hrs after inoculation showing viral proteins in nuclei of infected human fibroblast cells

Serological test;

Antigen detection;

sample

virus

test

➤ Skin scrapings

HSV

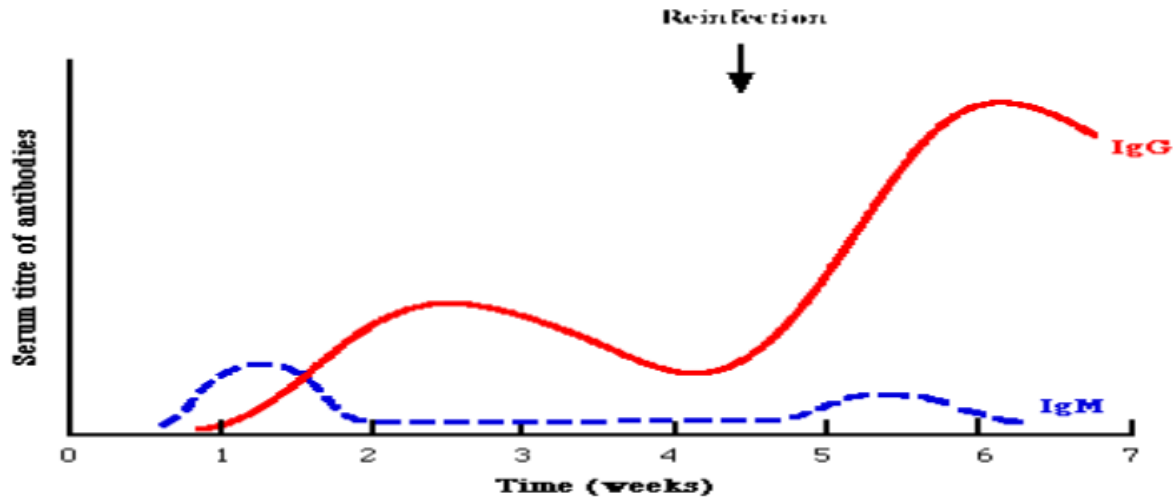
IF

➤ Blood

HBV (HBsAg)

ELISA

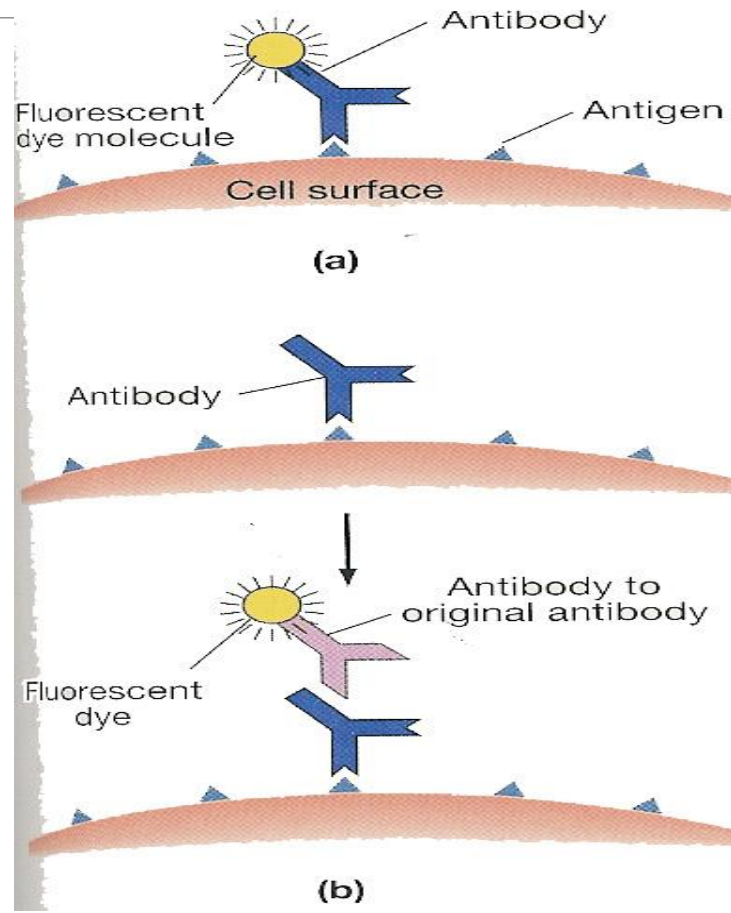
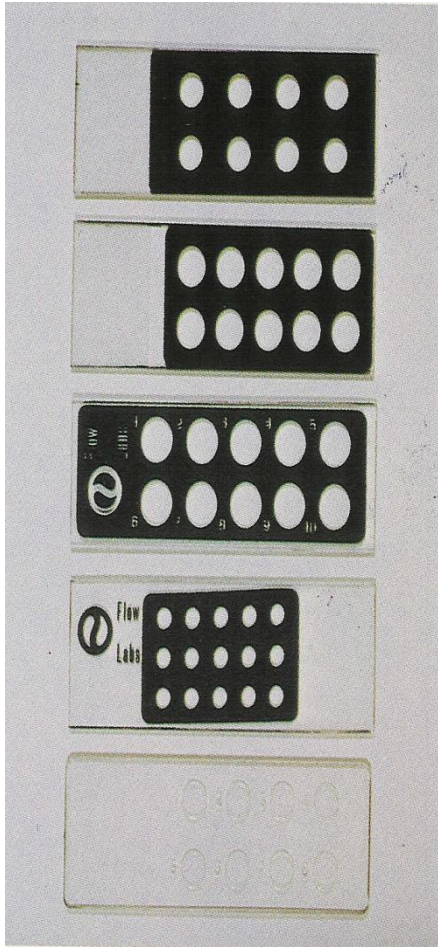
Serological test; *Antibody detection;*



➤ Ex of techniques

- Immunofluorescence (IF)
- Enzyme-linked immunosorbent assay (ELISA)

Immunofluorescence ; IF



- A- Direct
Ag detection;
 - Sample (Ag)

- B- Indirect
Ab detection;
 - Sample (Ab)

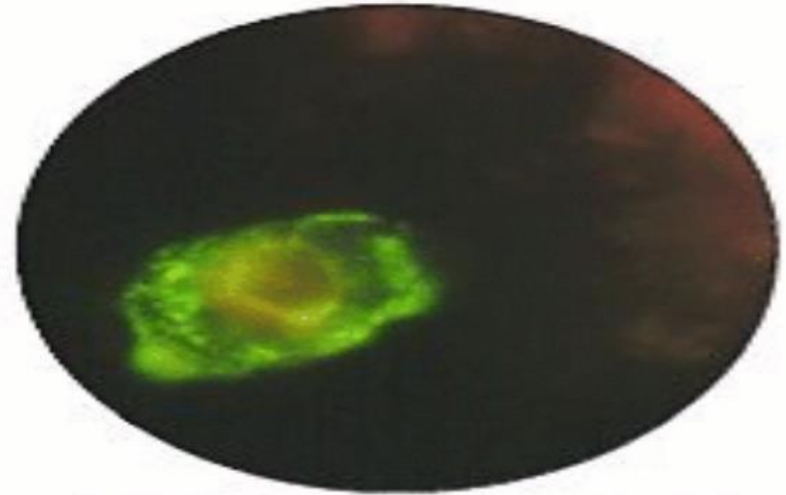
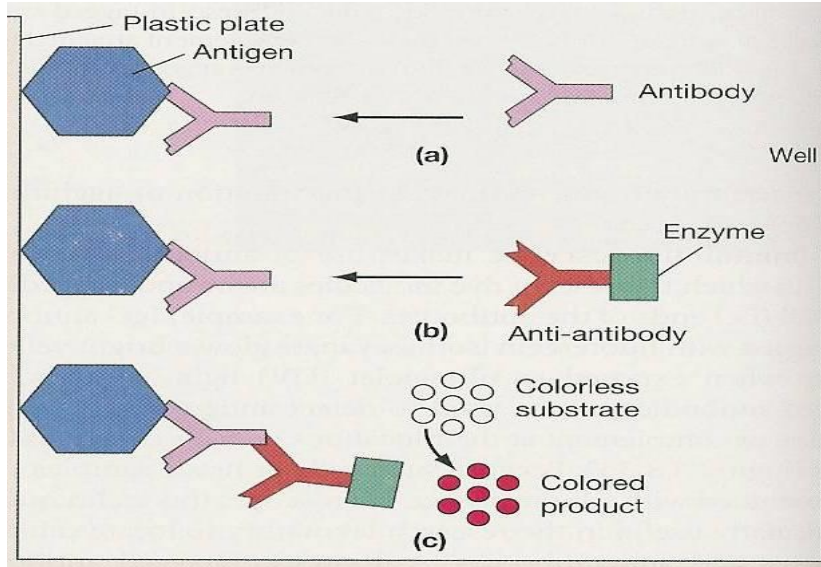


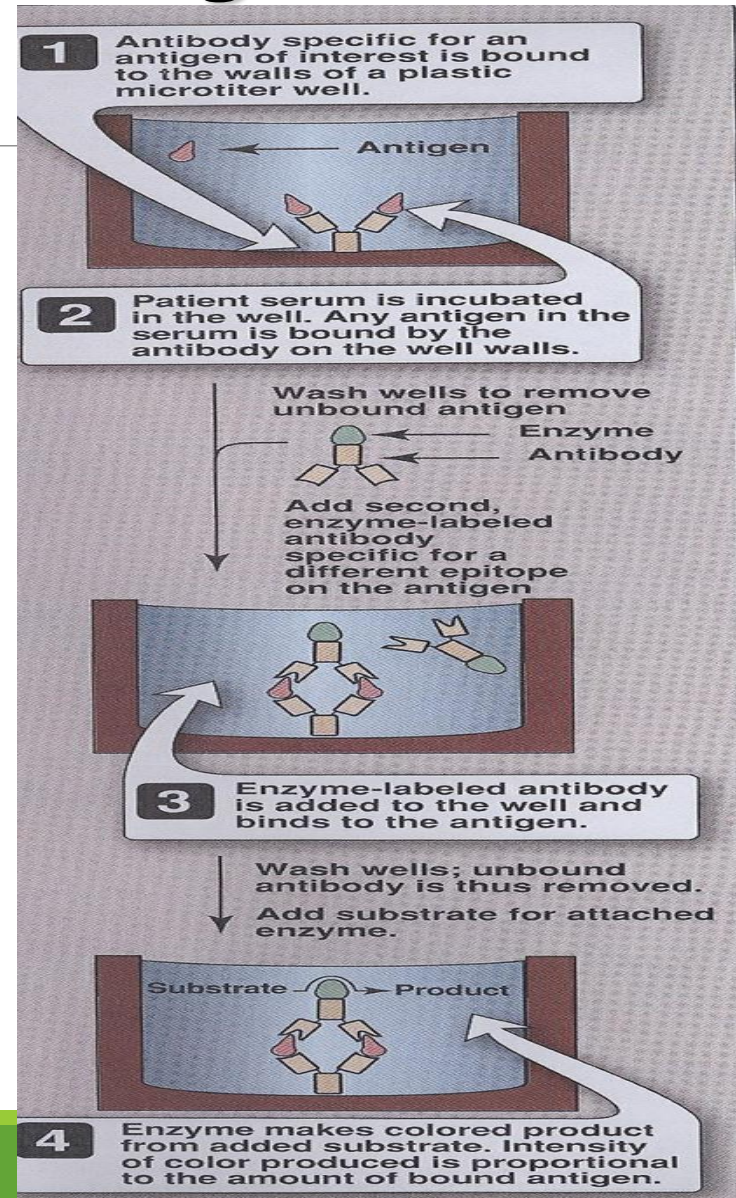
Fig. 3, HSV-infected epithelial cell from skin lesion (DFA)

ELISA

Ab detection



Ag detection



Indirect ELISA for Ab detection ;
coloured wells indicate reactivity

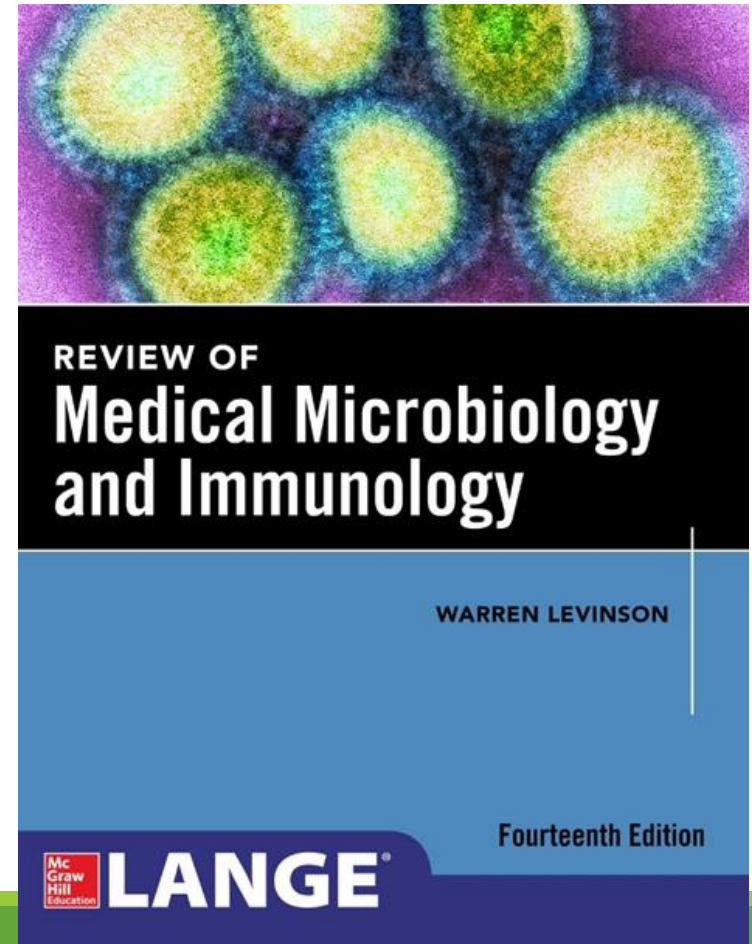
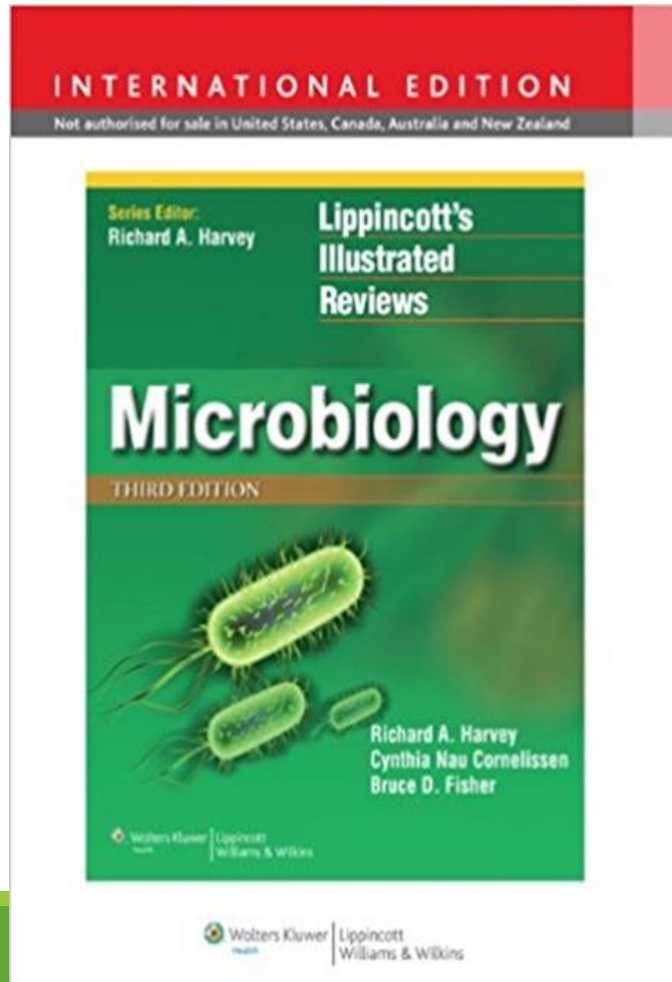
Molecular test;

- Polymerase chain reaction (PCR)
 - Amplification tech.
 - Viral genome
- Uses;
 - Dx
 - Monitoring response to Rx

الطريق إلى الجنة

من سلك طريقا يلتمس فيه علما
سهل الله له به طريقا إلى الجنة
رواه مسلم

Reference books



Thank you