

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Introduction to medical virology

(Foundation Block ,_ Microbiology : 2015)

By: Dr.Malak El-Hazmi

OBJECTIVES

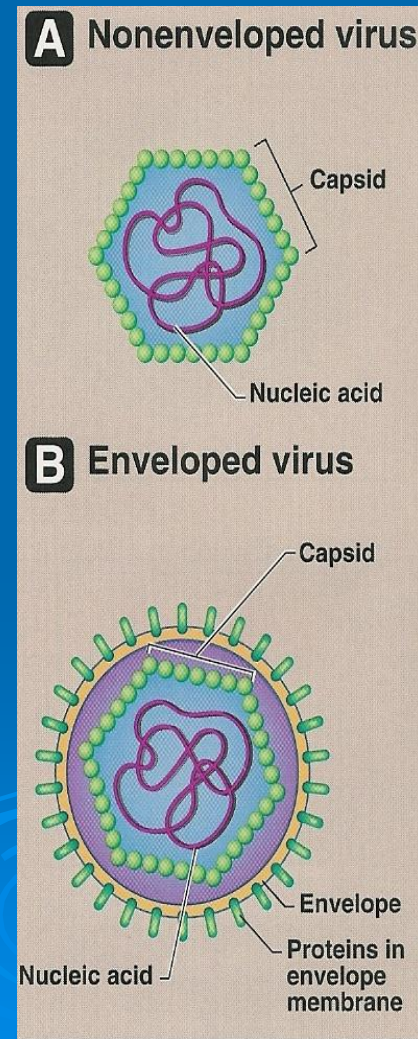
- *General characteristics of viruses.*
- *Structure & symmetry of viruses.*
- *Classification of viruses.*
- *Steps of virus replication .*
- *laboratory diagnosis of viral infections.*

Properties of Microorganisms

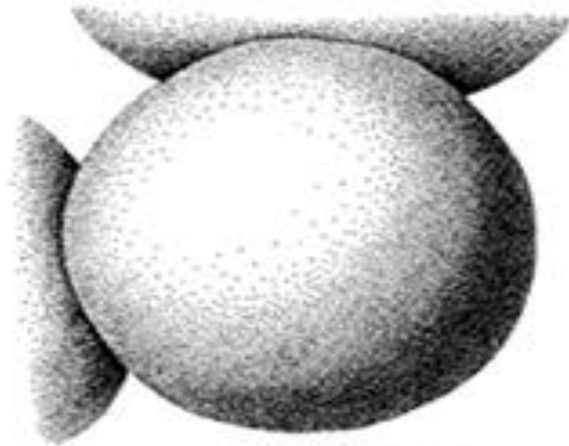
<i>characteristic</i>	<i>Parasites</i>	<i>Fungi</i>	<i>Bacteria</i>	<i>Viruses</i>
<i>Cell</i>	Yes	Yes	Yes	No
<i>Type of nucleus</i>	Eukaryotic	Eukaryotic	Prokaryotic	-----
<i>Nucleic acid</i>	Both DNA & RNA	Both DNA & RNA	Both DNA & RNA	DNA or RNA
<i>Ribosomes</i>	Present	Present	Present	Absent
<i>Mitochondria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



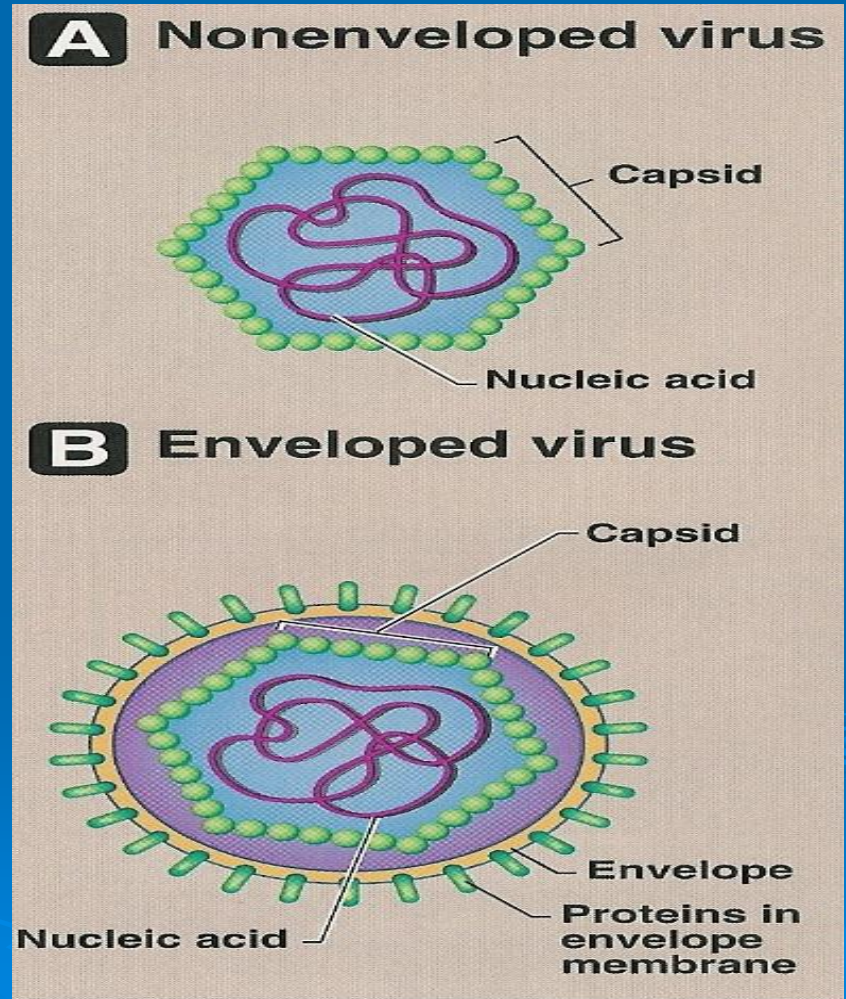
POLIO VIRUS

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)

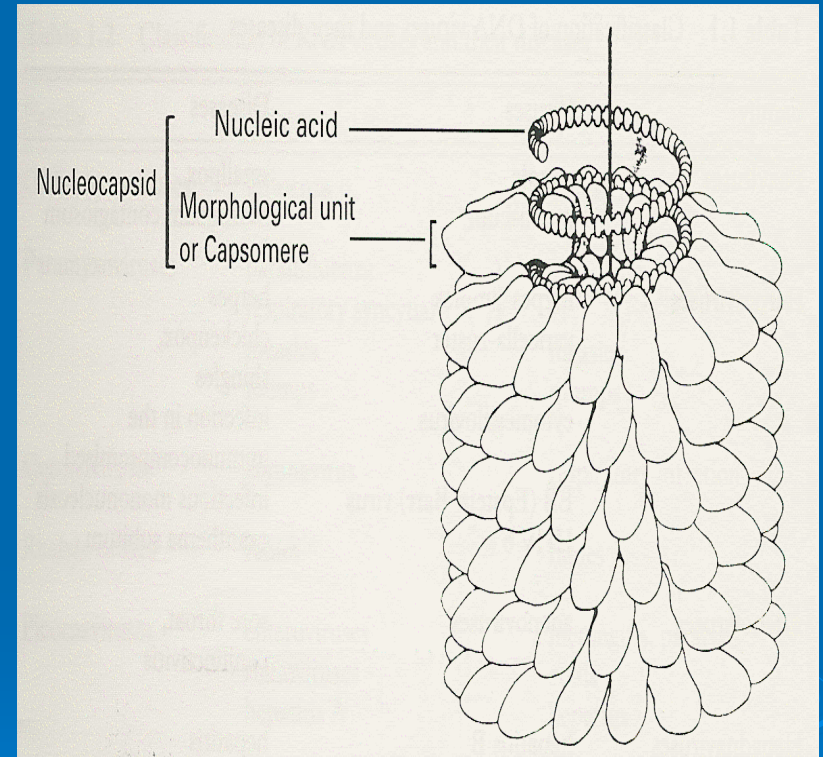
- All RNA Vs have ss except Reoviruses
- single / multiple
- (+) polarity
- (-) polarity

All Vs are haploid ,except retroviruses are diploid

Viral structure

2-Capsid

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



Symmetry

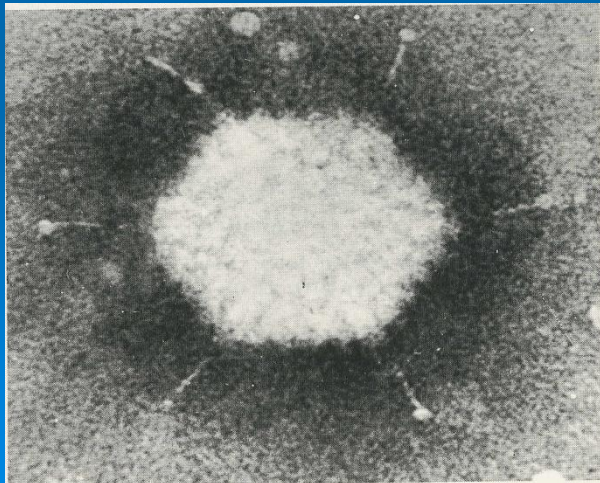
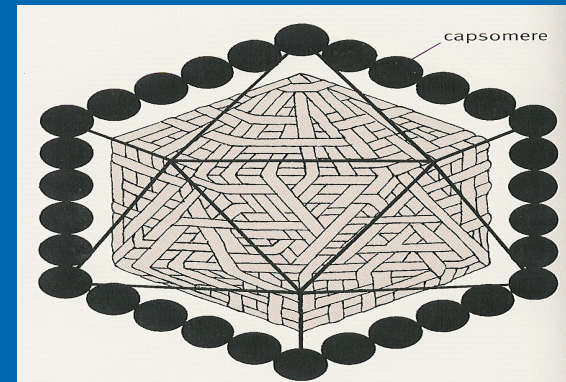
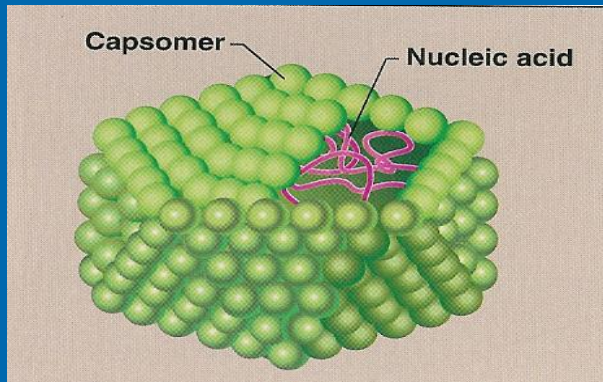
based on arrangement of capsomeres

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

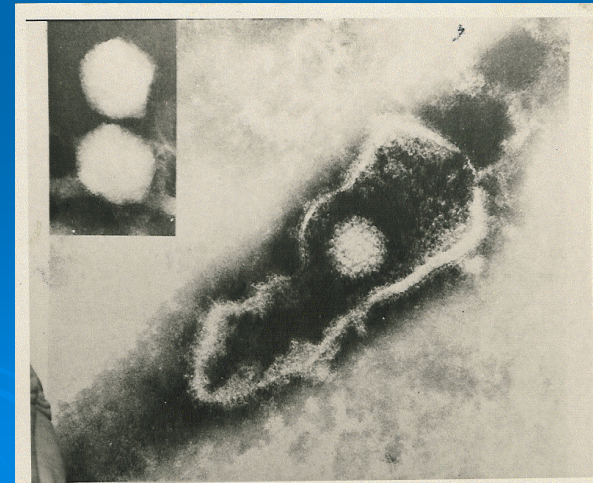
Symmetry

based on arrangement of capsomeres

- **1-Cubic symmetry**
(Icosahedral)



Adenovirus

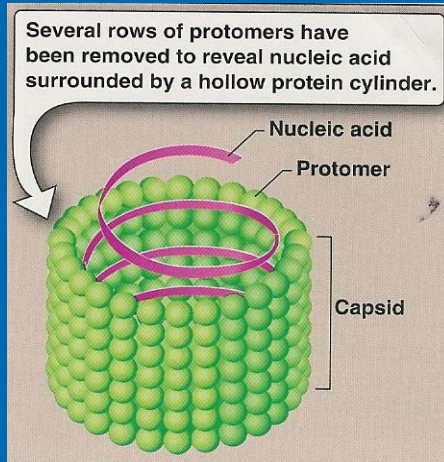


Herpesvirus

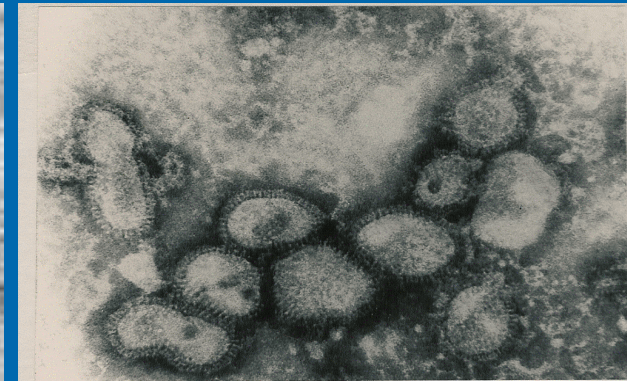
Symmetry

based on arrangement of capsomeres

➤ 2- Helical symmetry



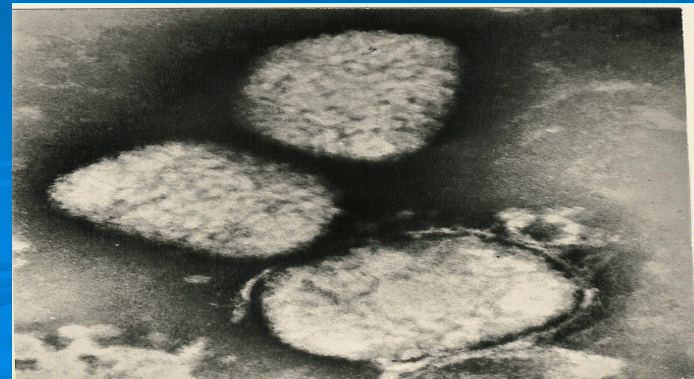
Elongated
(*filoviruses*)



Pleomorphic
(*influenza v.*)

➤ 3- Complex symmetry

poxviruses



Viral structure

3-Envelope

Lipoprotein mb

(host lipid ,virus specific protein)

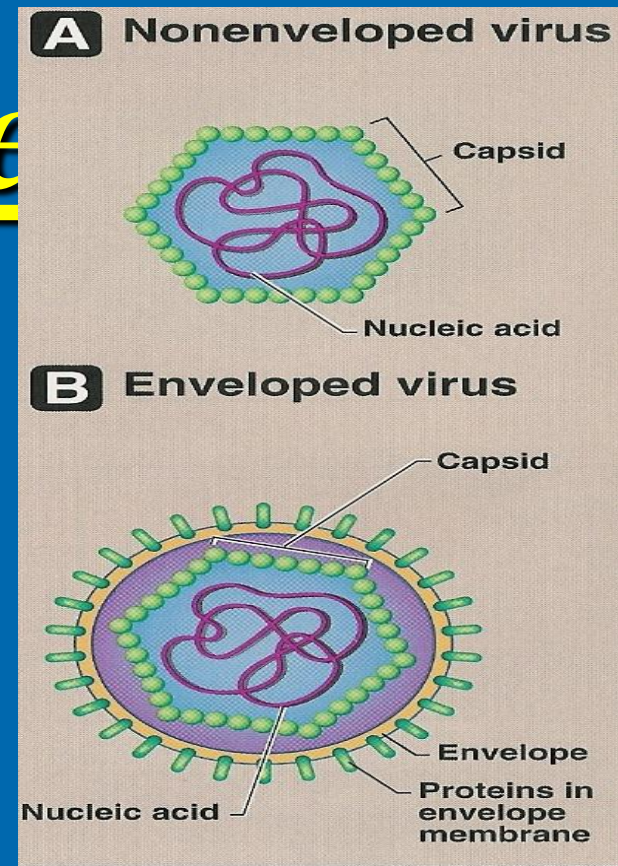
➤ *Budding*

➤ 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



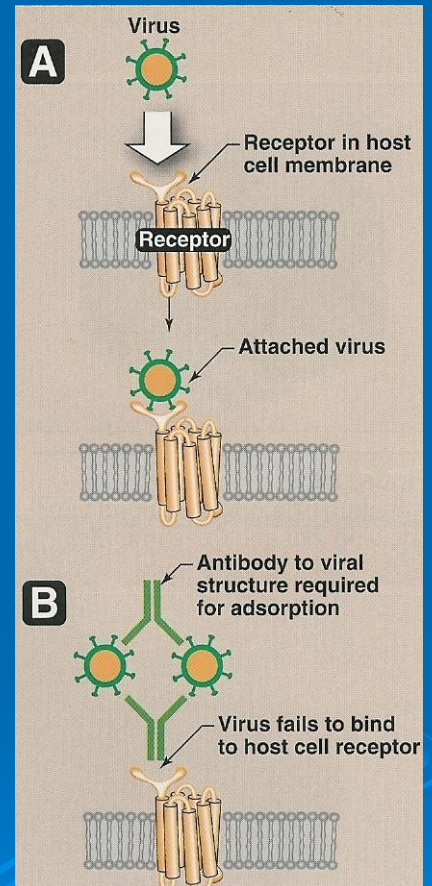
Viral proteins

❖ *The outer viral ps*

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

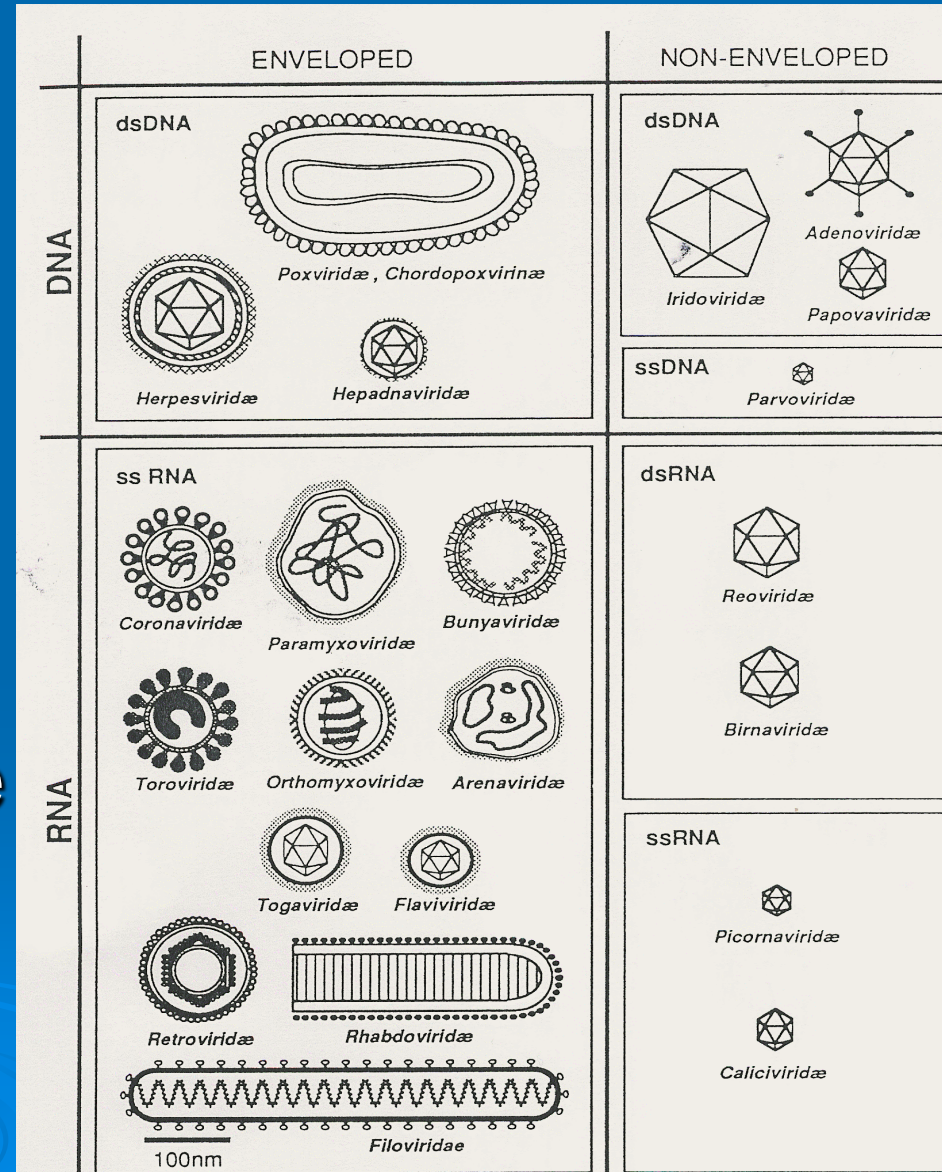
❖ *The internal viral ps*

- 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

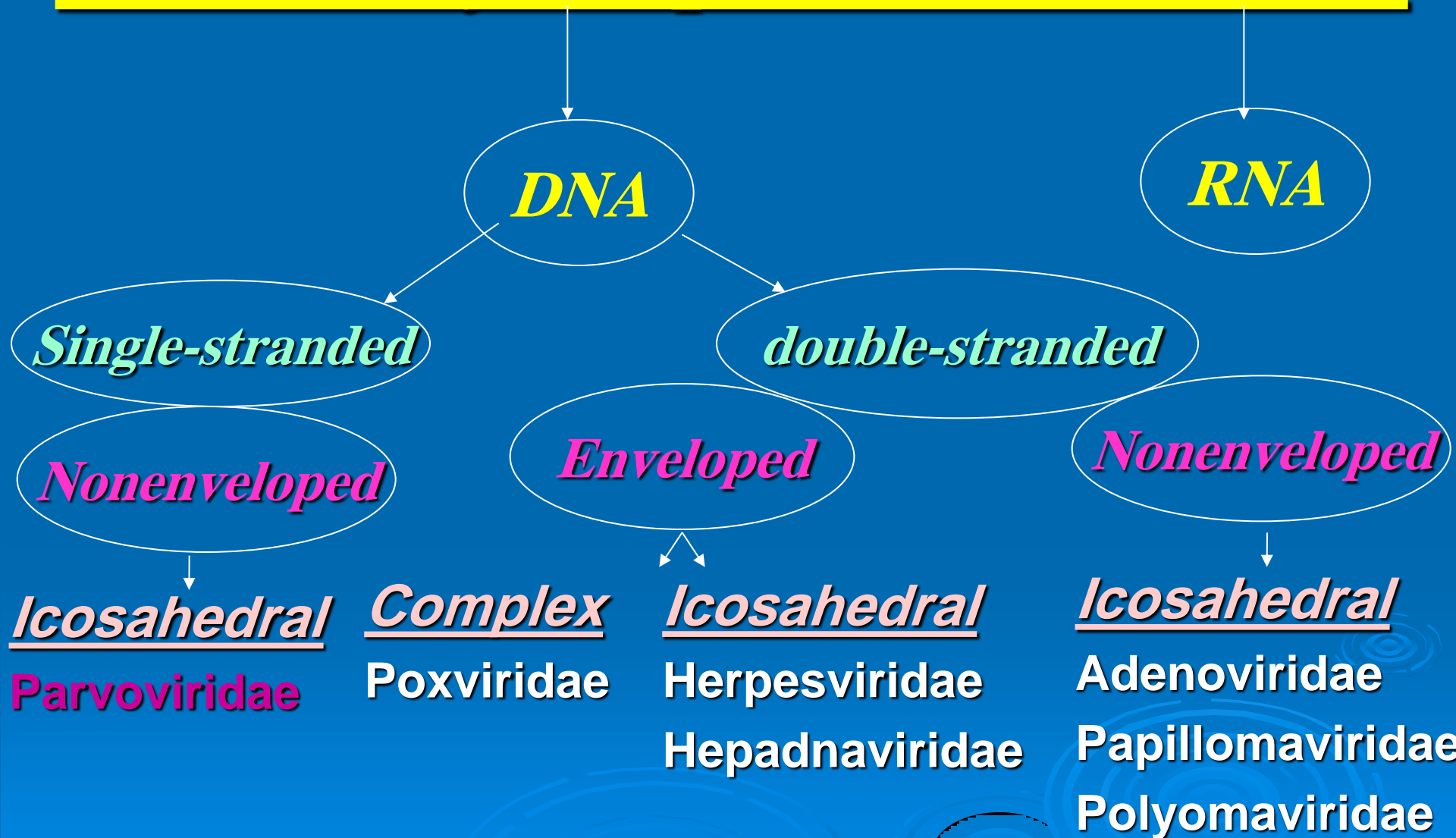


Classification of viruses

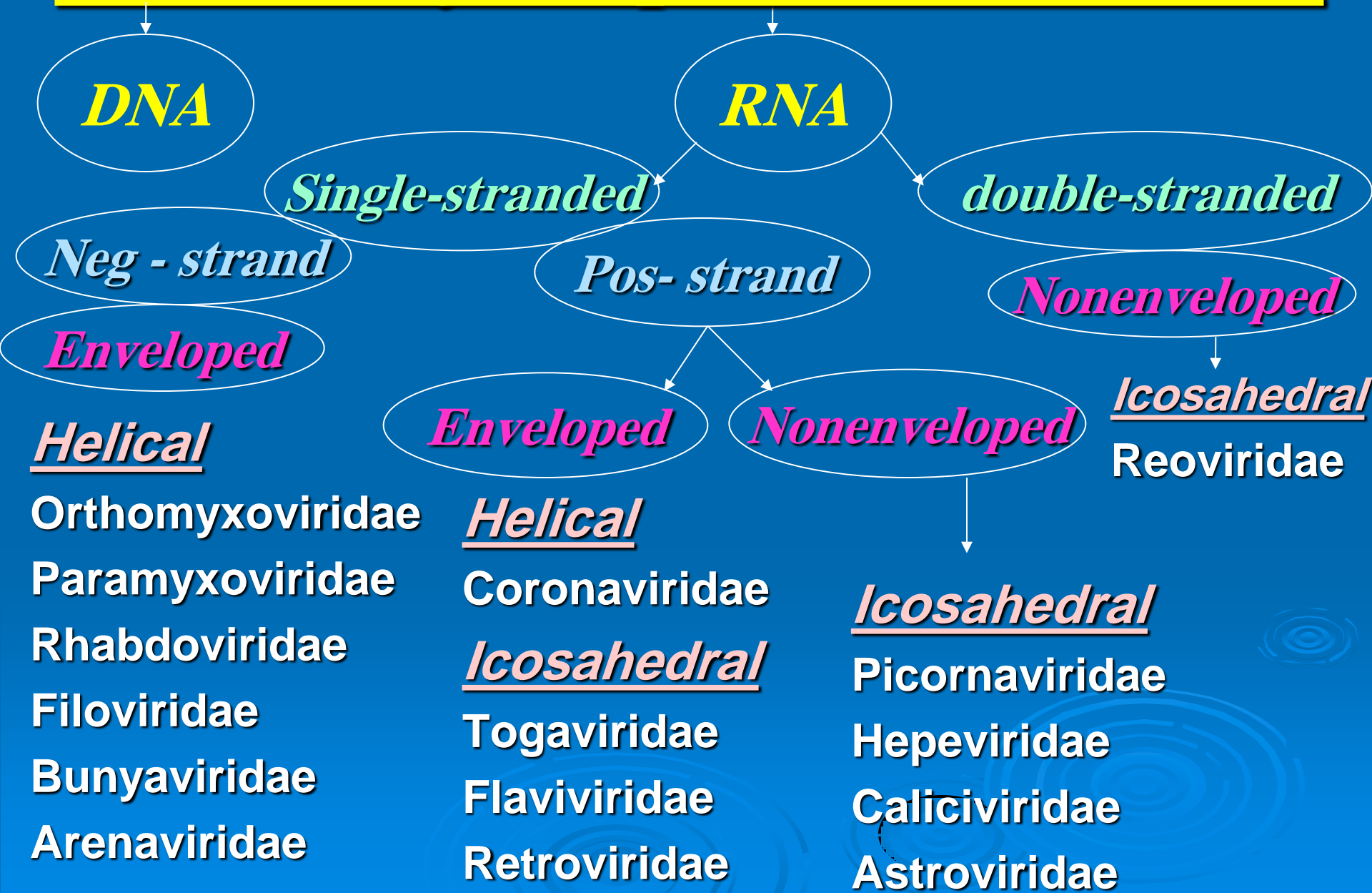
- Type of NA*
- The no. of strand
- The polarity of viral genome
- The presence or absence of envelope
- Type of symmetry



Medically Important Viruses

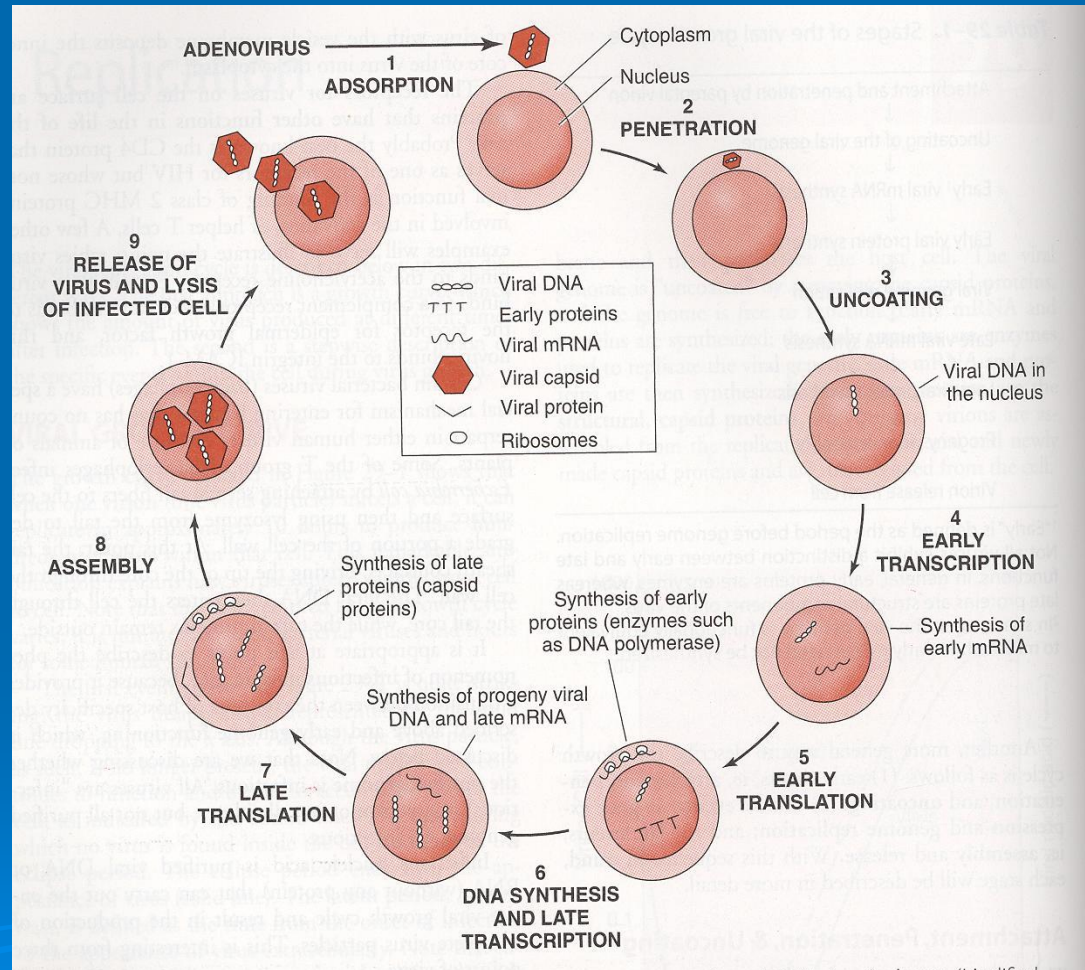


Medically Important Viruses



Replication

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

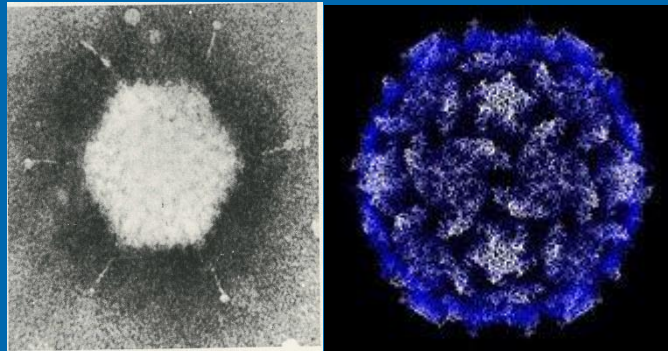


Viral growth cycle

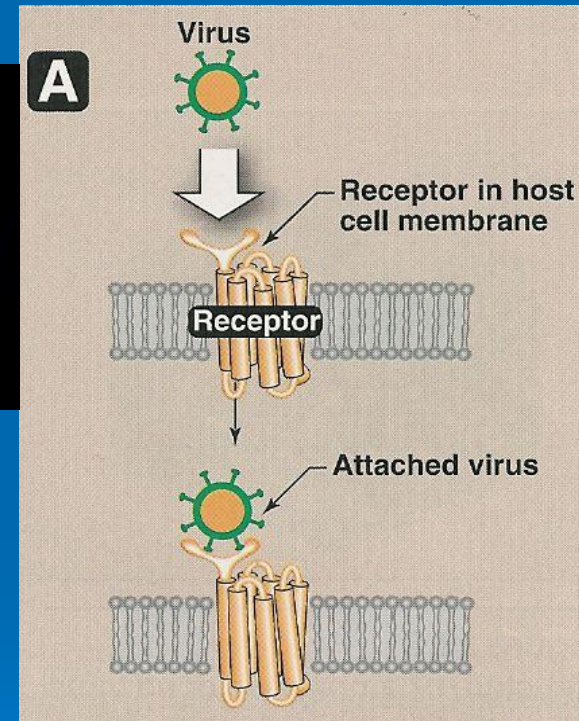
Adsorption

➤ Attachment site ;

- glycoprotein

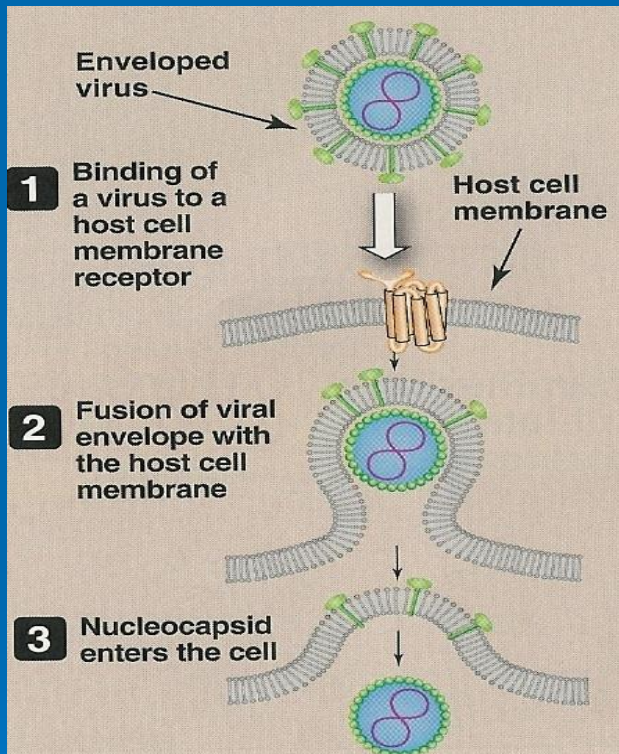


- folding in the capsid proteins.



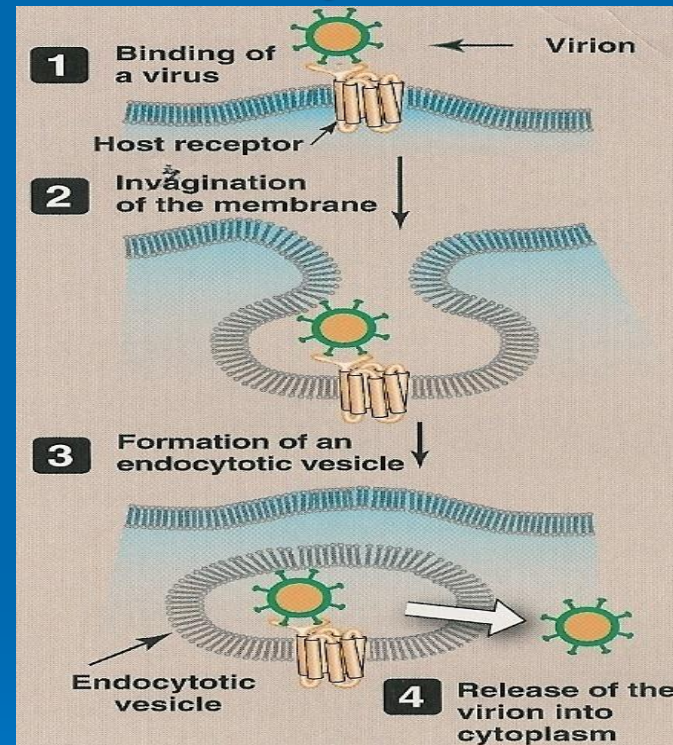
Penetration

1-Fusion



(enveloped Vs)

2-Endocytosis



- Viral envelope fuses with endosome mb
- Nonenveloped V. 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

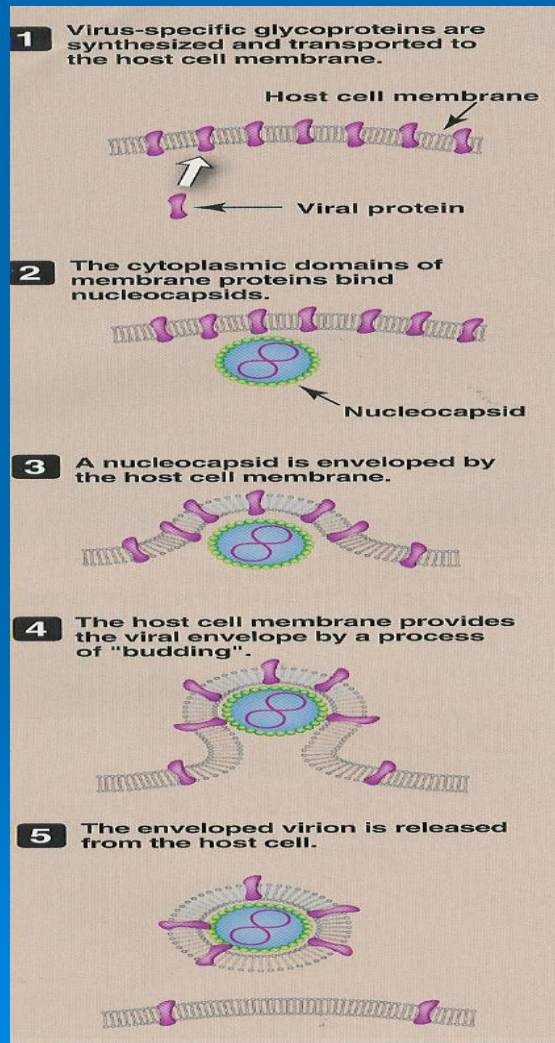
➤ *Assembly*

NA + V. proteins = Virions

- Release

Release

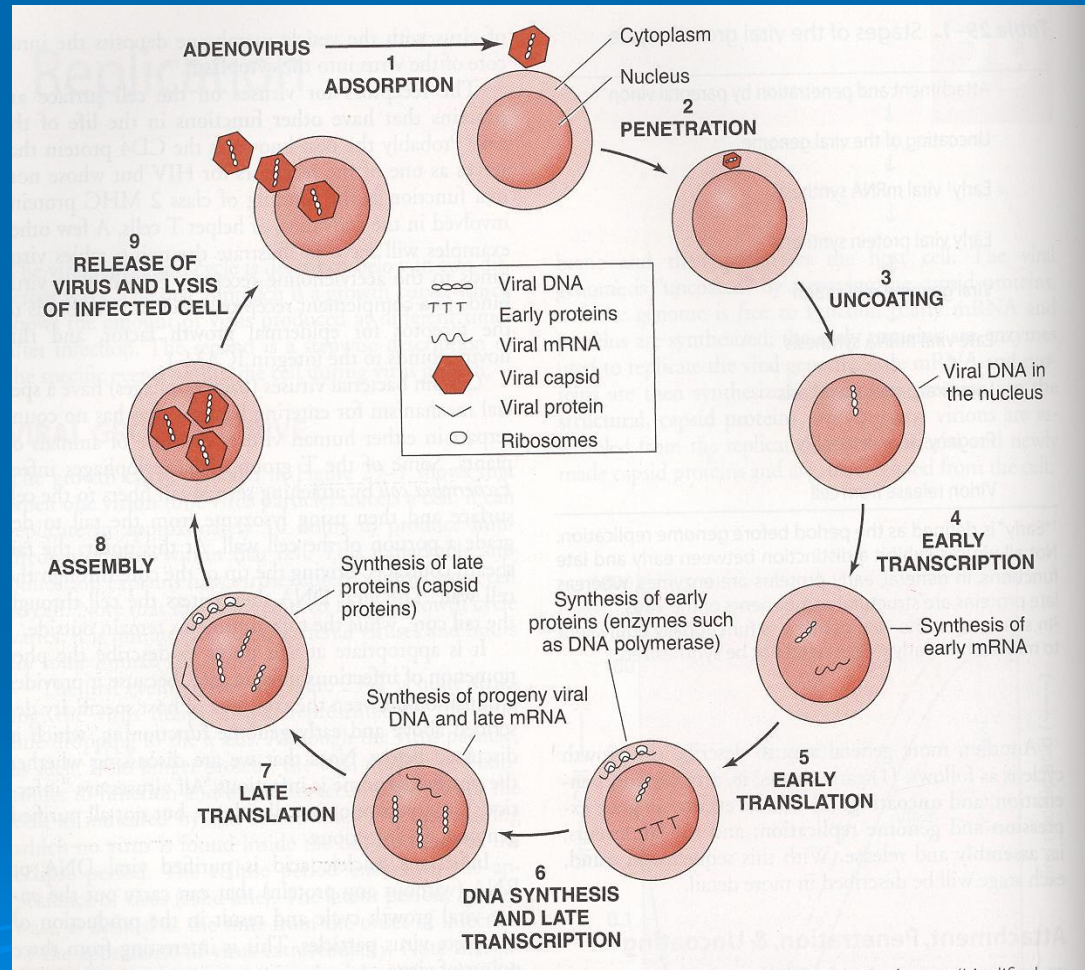
- 1-Budding
(enveloped Vs)
 - cell mb*
 - nuclear mb
(herpesVs)



- 2- Cell lysis
or rupture
(nonenveloped)

Replication

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



Viral growth cycle

laboratory diagnosis of viral infections

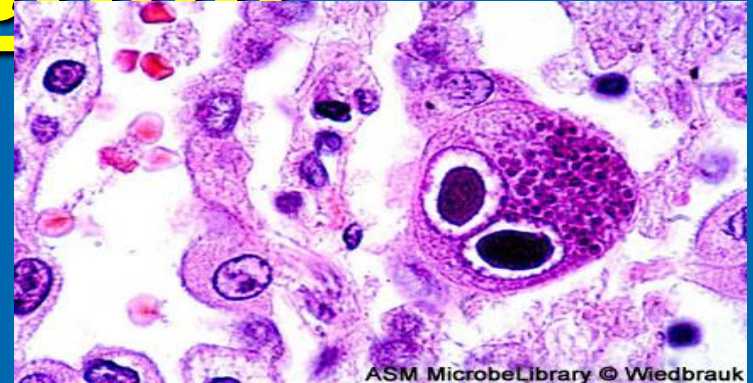
- *Microscopic examination.*
- *Cell culture.*
- *Serological tests .*
- *Detection of viral Ag.*
- *Molecular method .*

Microscopic examination

➤ *Light microscopy,*

Histological appearance

Ex. Inclusion bodies



Owl's eye (CMV)

➤ *Electron microscopy;*

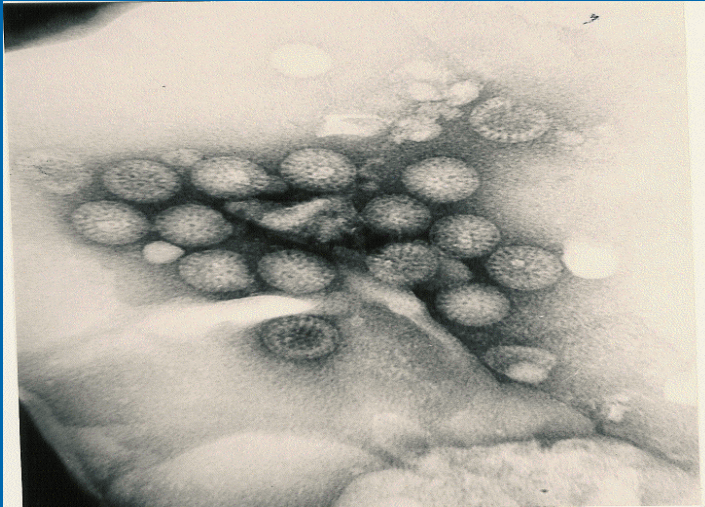
- Morphology & size of virions
- Ex. Dx of viral GE , rotav. , adenov.

Dx of skin lesion caused by herpesv, poxv.

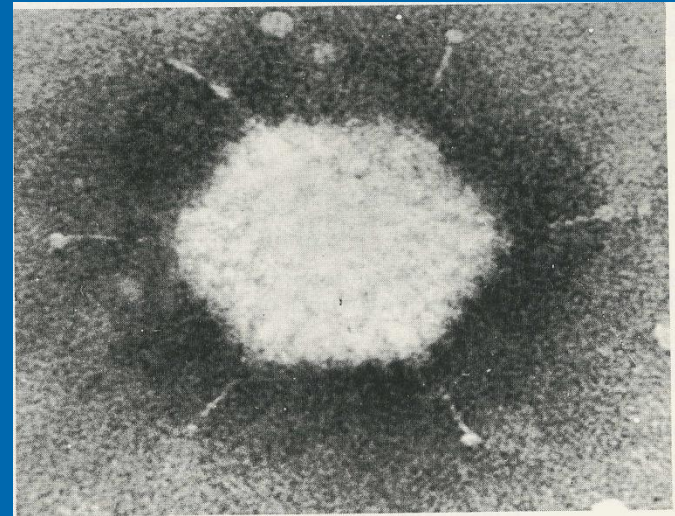
- It is replaced by Ag detection & molecular tests

➤ Electron micrographs

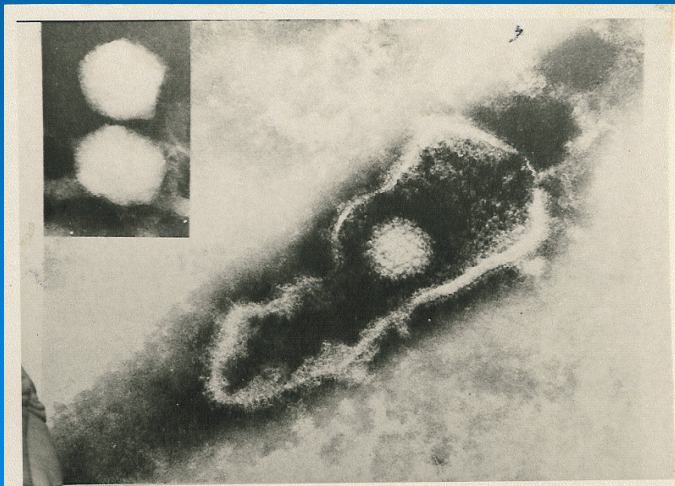
Rotavirus



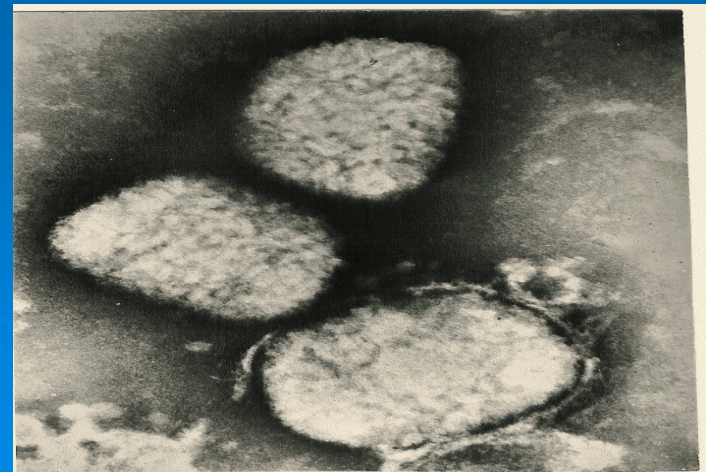
Adenovirus



Herpesvirus



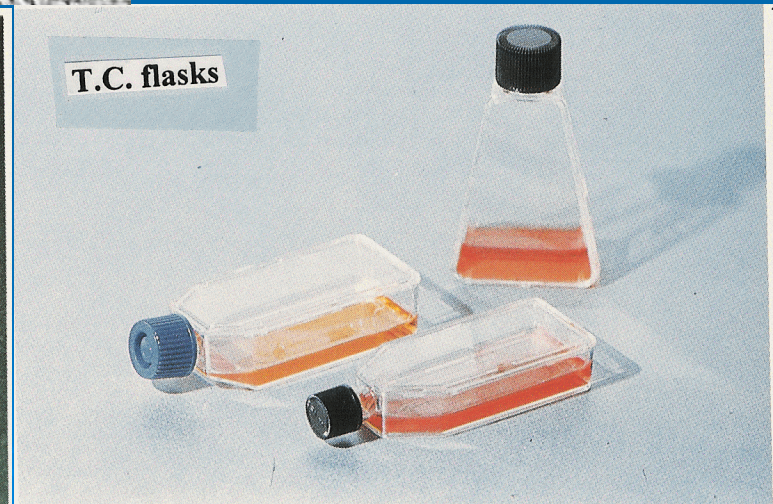
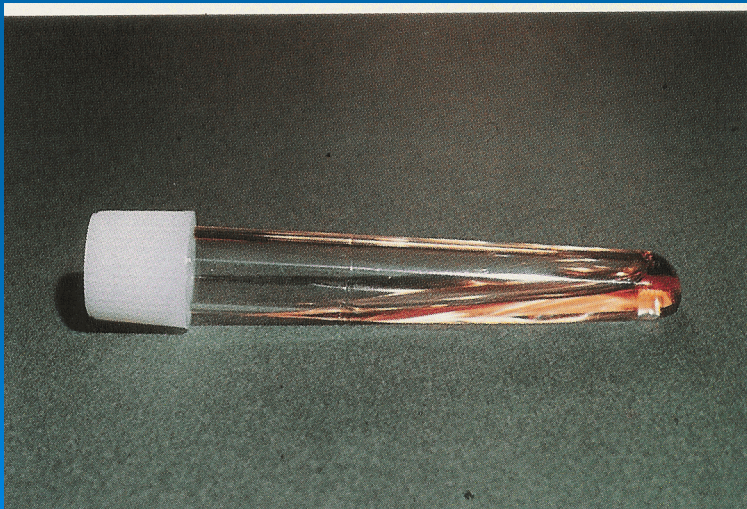
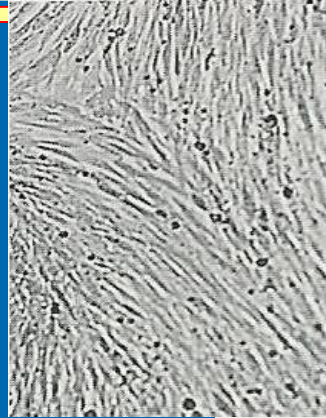
Poxvirus



Virus cultivation

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

Cell culture



Cell culture

1-Primary C/C

2-Diploid C/C
(semi continuous)

3-Continuous cell line

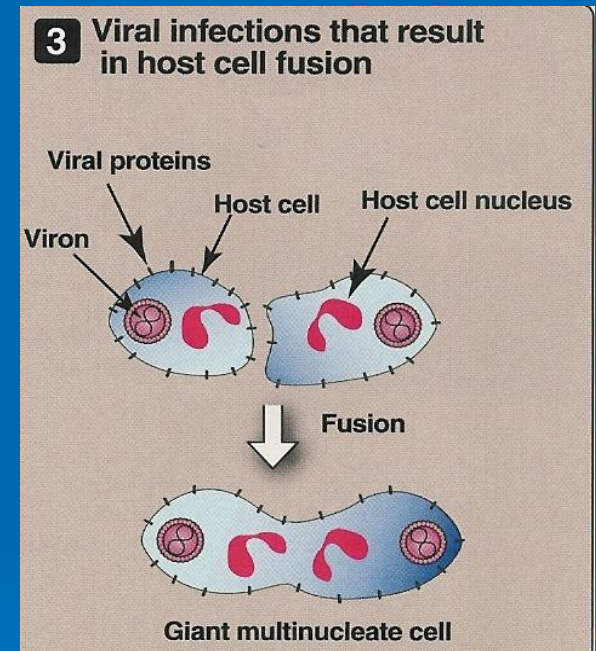
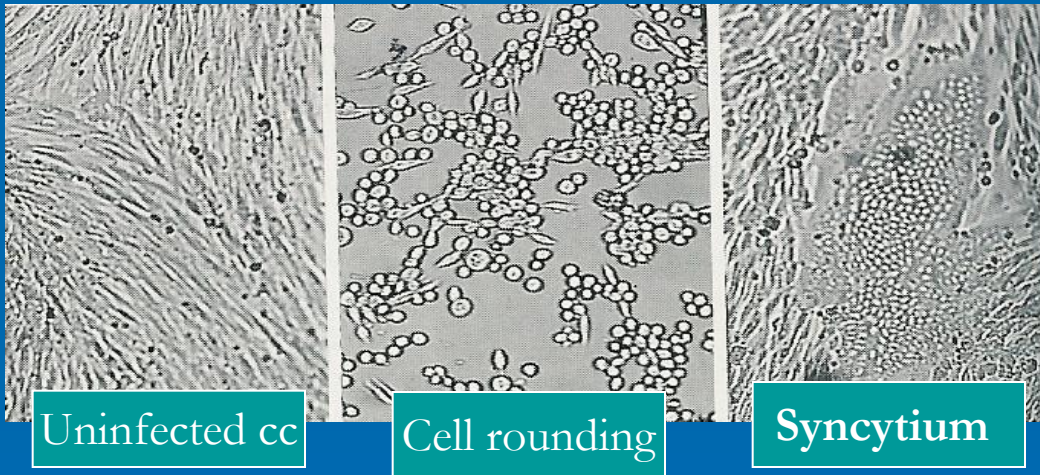
Variation in Sensitivity of cell cultures to infection by viruses commonly isolated in clinical virology laboratories

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



➤ 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

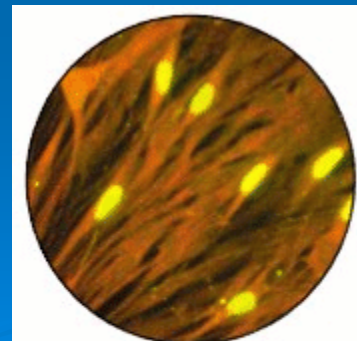
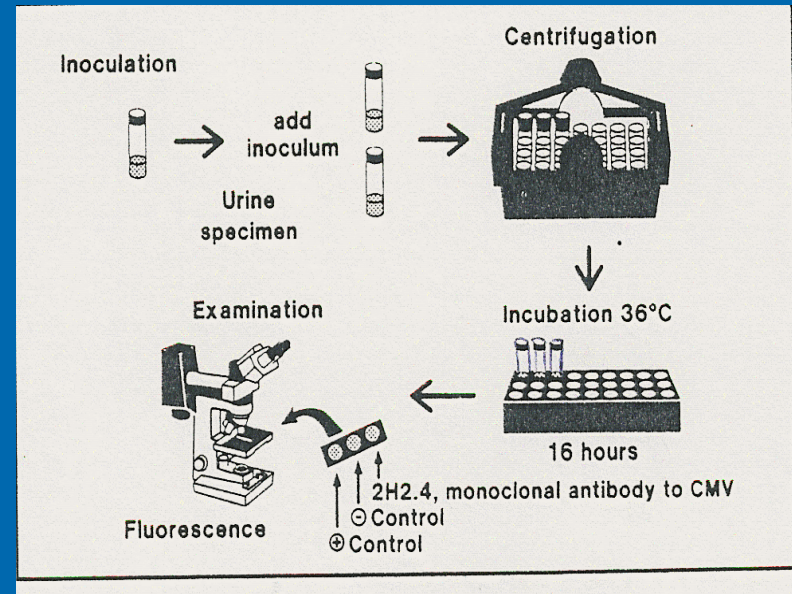


Fig. 2, CMV centrifugation culture fixed and stained 16 hrs after inoculation showing viral proteins in nuclei of infected human fibroblast cells

Serological test; *Antigen detection;*

sample

virus

test

➤ Skin scrapings

HSV

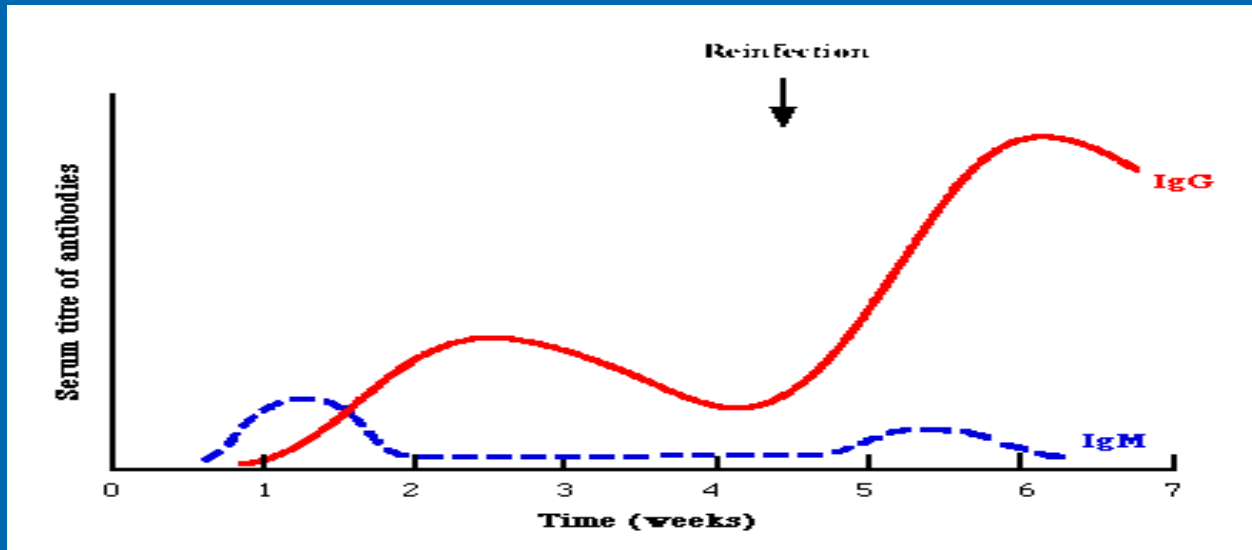
IF

➤ Blood

HBV(HBsAg)

ELISA

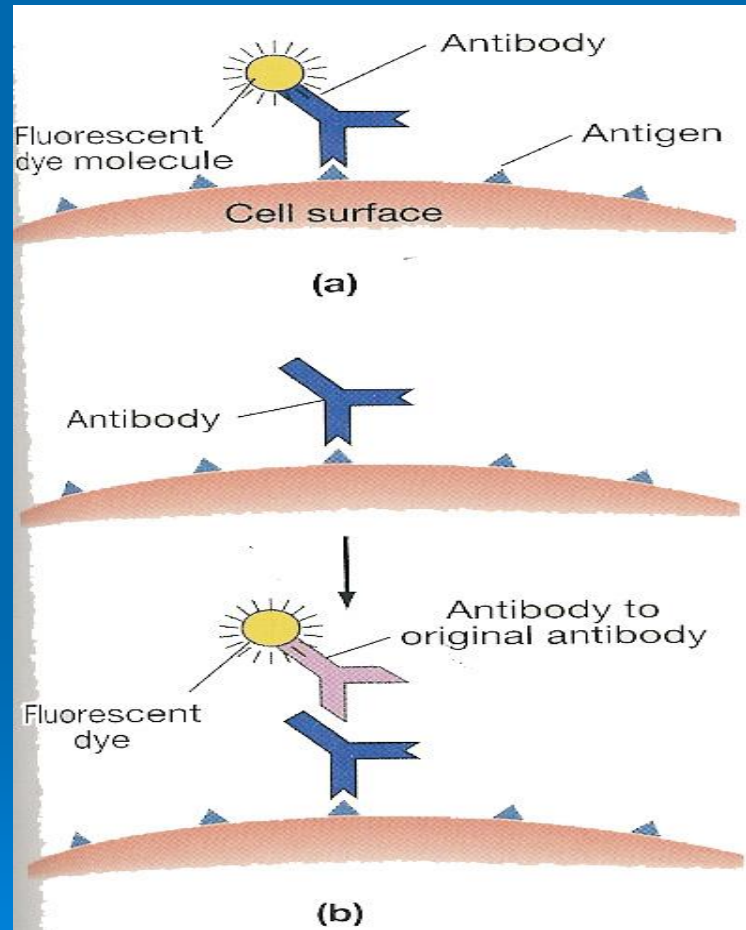
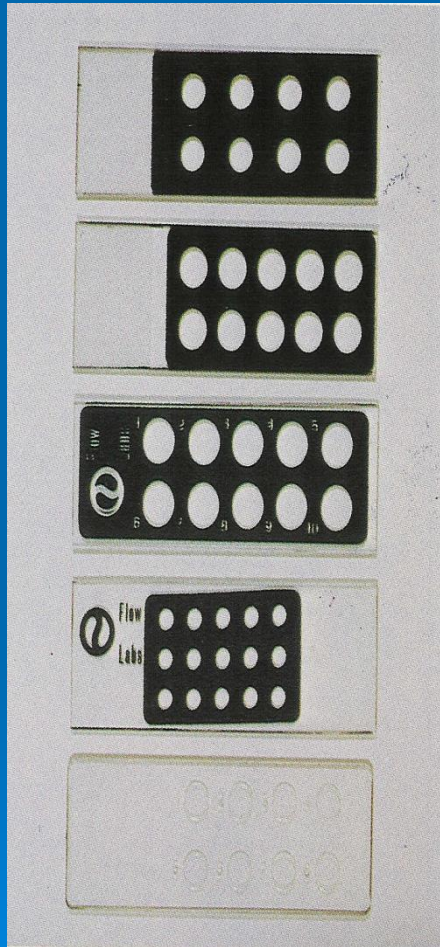
Serological test; Antibody detection;



➤ Ex of techniques

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

Immunofluorescence ; IF



- A- Direct
Ag detection;
 - Sample (Ag)
- B- Indirect
Ab detection;
 - Sample (Ab)

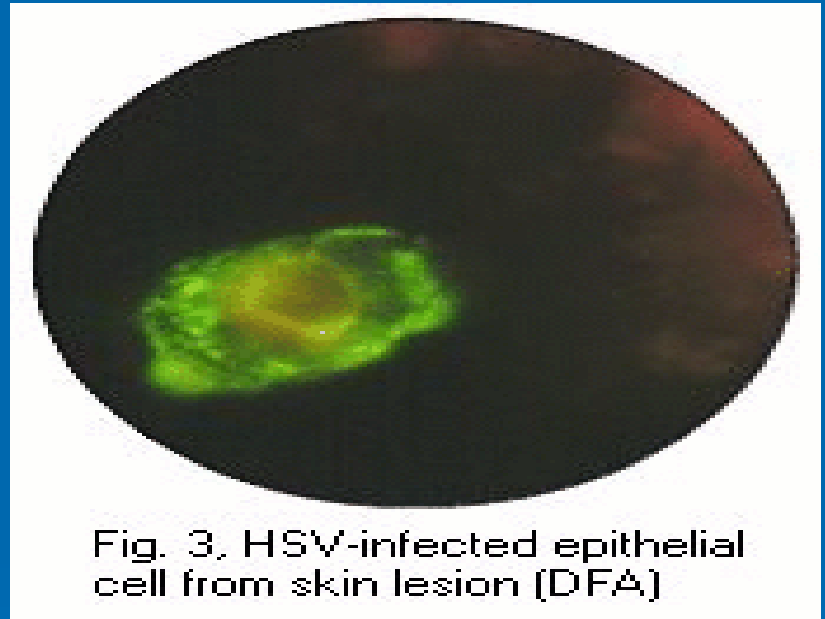
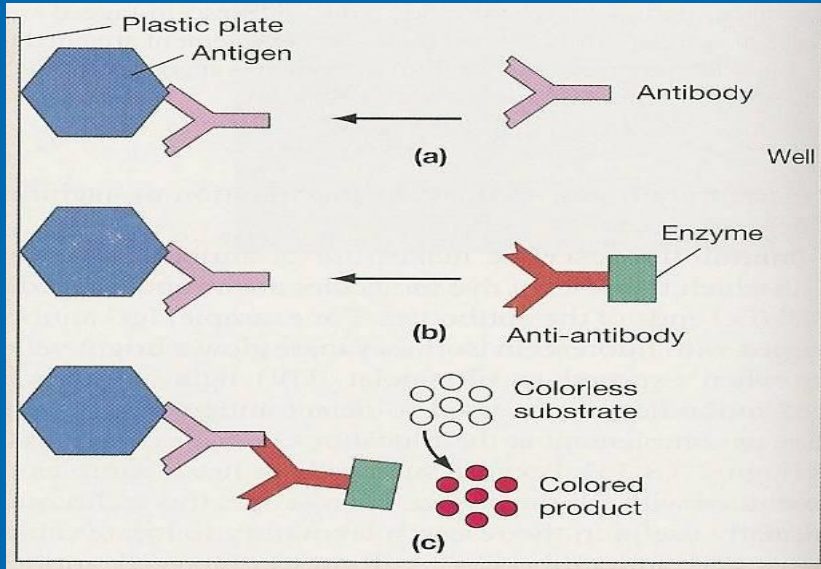


Fig. 3. HSV-infected epithelial cell from skin lesion (DFA)

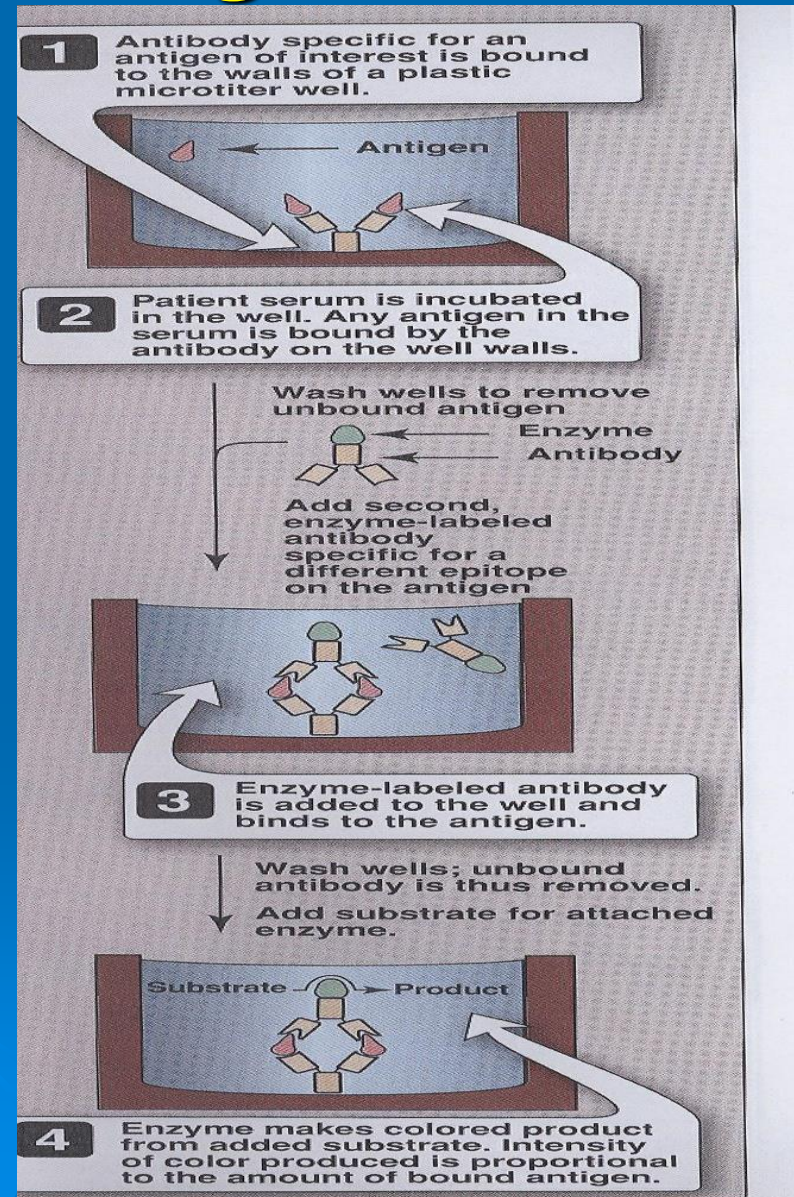
ELISA

Ab detection



Indirect ELISA for Ab detection ;
coloured wells indicate reactivity

Ag detection



Molecular test;

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

قال تعالى : (يَا أَيُّهَا الَّذِينَ آمَنُوا قُوا أَنْفُسَكُمْ وَأَعْلُوا كَمَا رَبَّاتُم)



اختصاصي لنفسك

شروط الحجاب :

- ساتر جميع البدن بما لا يكتشف العورة والستورين إليه أصبح فواتي أهل العفة
- أن يظهر واسعة غير ضيقة حتى لا يصفد جسده المرأة
- أن يظهر ممتددة لا يفتت ملامحه
- أن لا يظهر الملائس زينة له نفسها
- أن لا يظهر مغطياً يمتدح ويضع العطر
- أن لا يظهر ملامح الرجال
- أن لا يظهر ملامح المتكافرات
- أن لا يظهر البدن بغيره



رسالة هامة : ألبس الرجل لا تكن مثيراً فإن لم تكن رجلاً . فتشبهه بالرجسا

التسام المسلمات في العصر الحاضر



التسام المسلمات في عهد النبي صلى الله عليه وسلم



قال الله تعالى :
ولا تبرزن تبرج الجاهلية الأولى
(الأحزاب : 33)

**الإماء
وملك اليمين**

**امهات المؤمنين
والصحابيات
والحرائر**

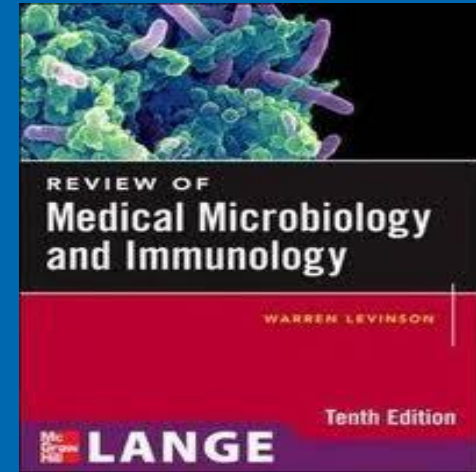
Reference book and the relevant page numbers

➤ Review of Medical Microbiology and Immunology

By: Warren Levinson .

10th Edition, 2008.

Pages;192-195,199-207, 216-220,233-235.

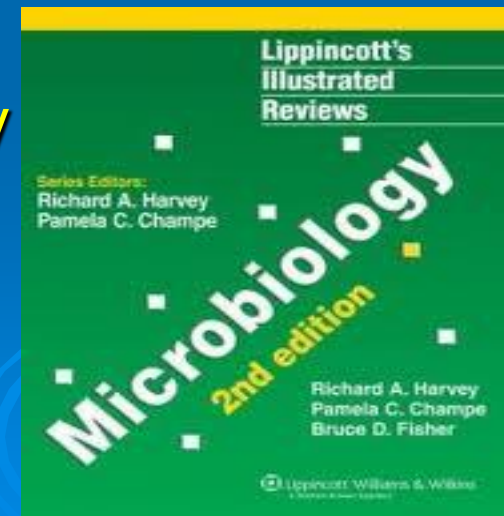


➤ Lippincott's Illustrated Reviews: Microbiology

By: Richard A. Harvey ,
Pamela C Champe &
Bruce D. Fisher

2nd Edition, 2007 .

Pages;233-242



Thank you

