

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Introduction to medical virology

(Foundation Block ,_Microbiology : 2017)

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College of Medicine

OBJECTIVES

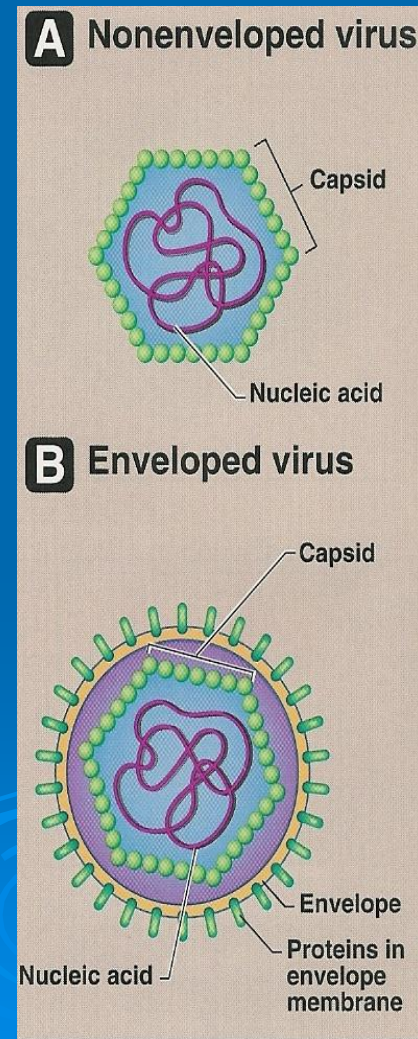
- *Distinguish the viruses from other microorganisms*
- *General characteristics of viruses.*
- *Structure & symmetry of viruses.*
- *Classification of viruses.*
- *Steps of virus replication .*
- *laboratory diagnosis of viral infections.*

Properties of Microorganisms

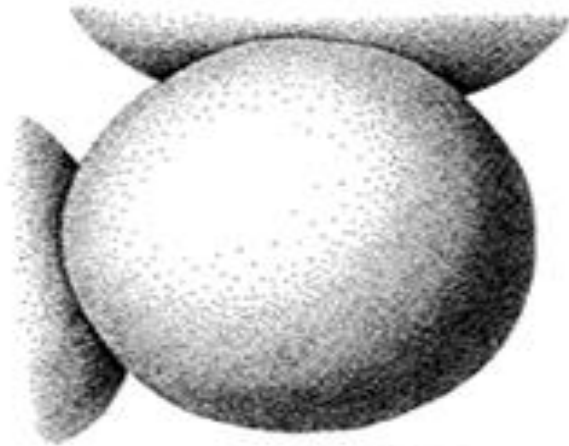
| <i>characteristic</i> | <i>Parasites</i> | <i>Fungi</i> | <i>Bacteria</i> | <i>Viruses</i> |
|------------------------|------------------|--------------------|-----------------|----------------|
| <i>Cell</i> | Yes | Yes | Yes | No |
| <i>Type of nucleus</i> | Eukaryotic | Eukaryotic | Prokaryotic | ----- |
| <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



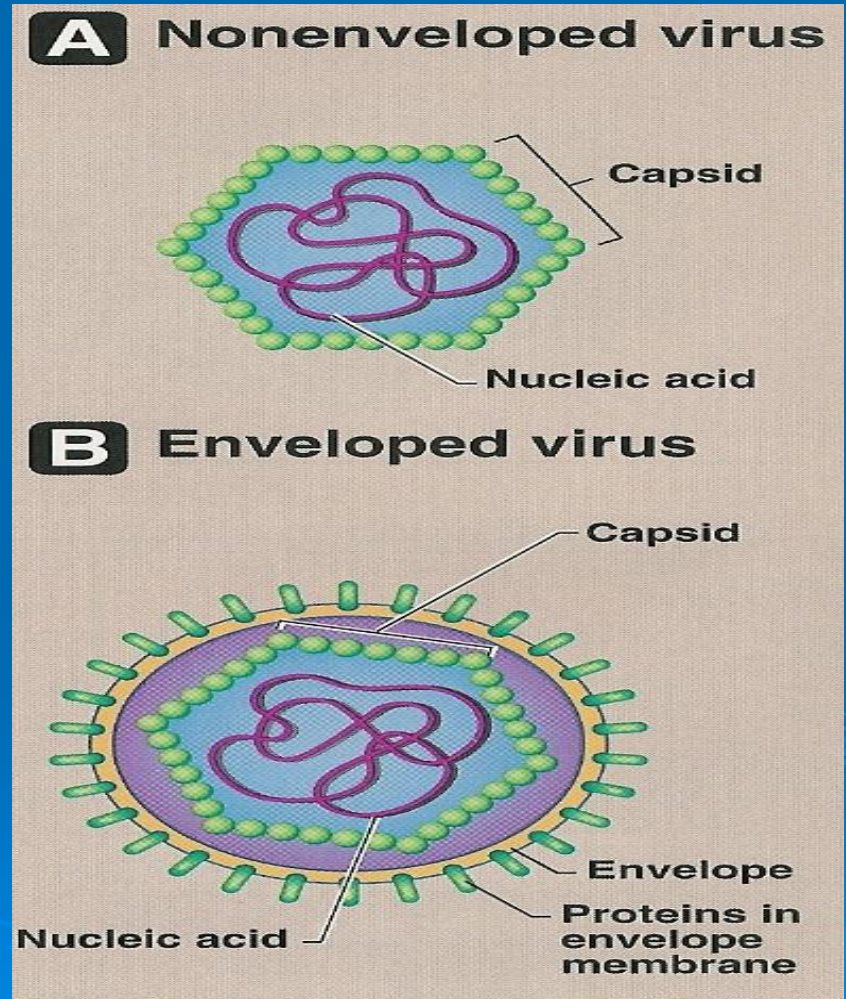
POLIO VIRUS

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)

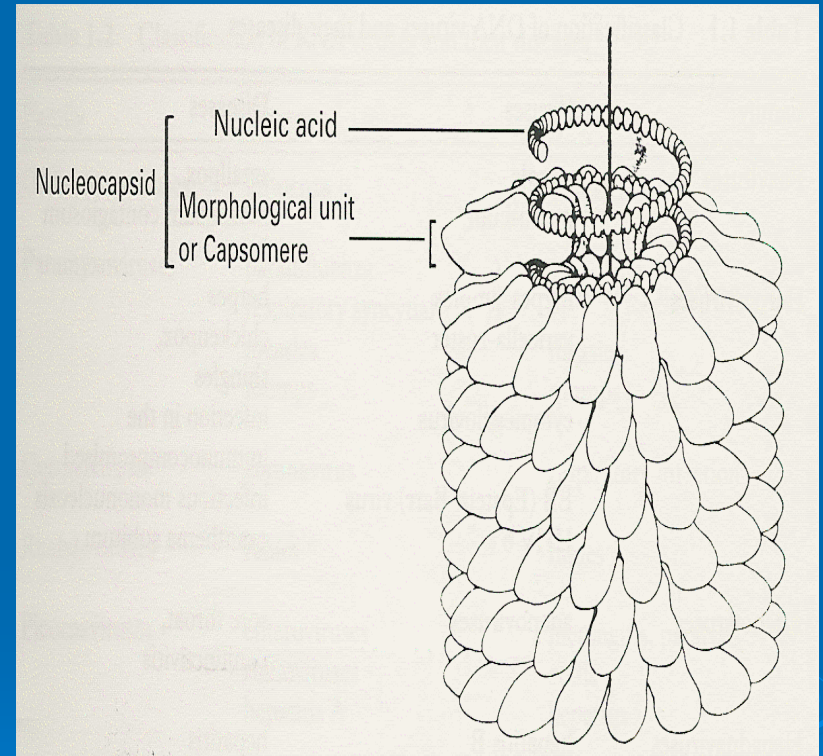
- All RNA Vs have ss except Reoviruses
- single / multiple
- (+) polarity
- (-) polarity

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

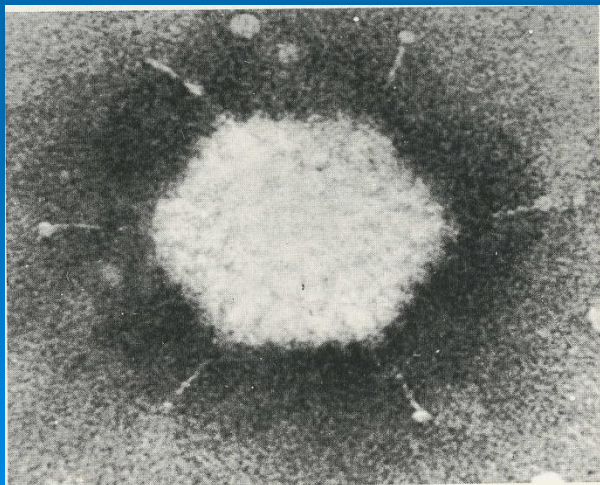
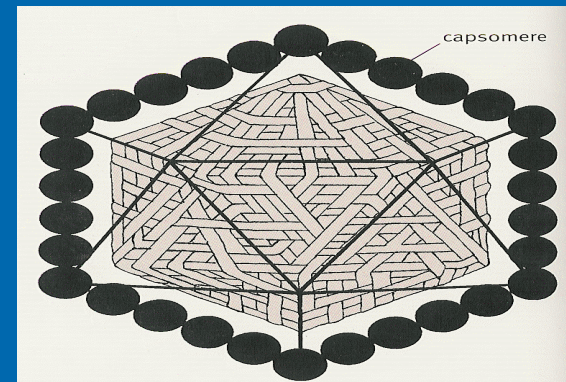
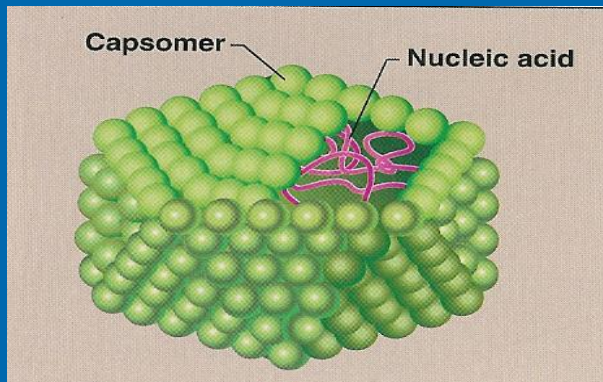
based on arrangement of capsomeres

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

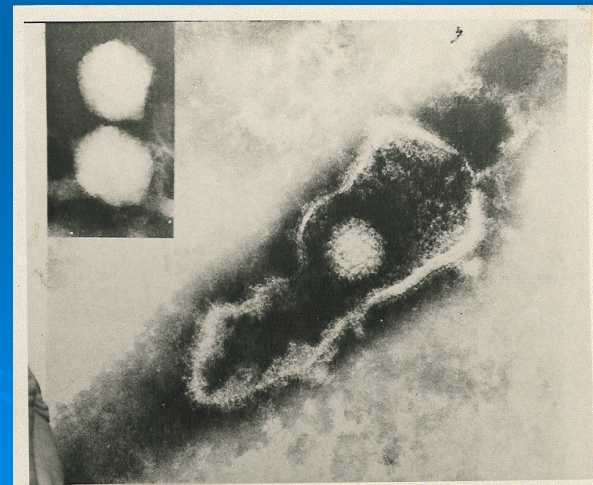
Symmetry

based on arrangement of capsomeres

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



Adenovirus

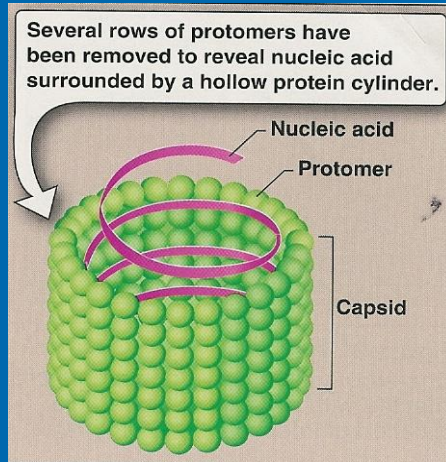


Herpesvirus

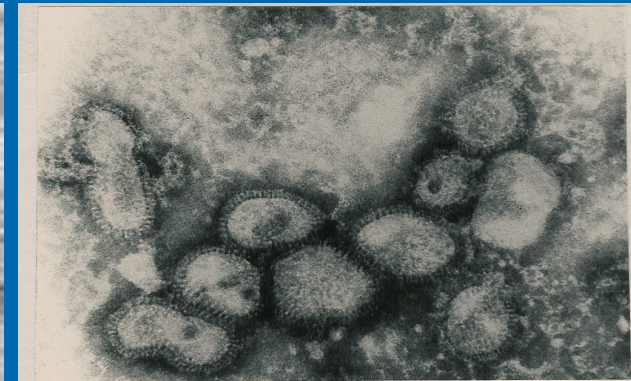
Symmetry

based on arrangement of capsomeres

➤ 2- Helical symmetry



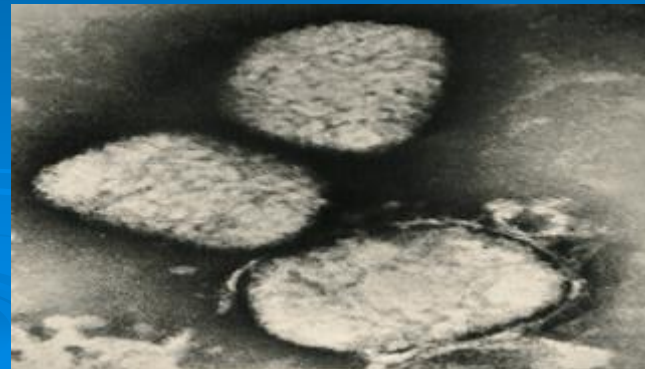
*Elongated
(filoviruses)*



*Pleomorphic
(influenza v.)*

➤ 3- Complex symmetry

poxviruses



Viral structure

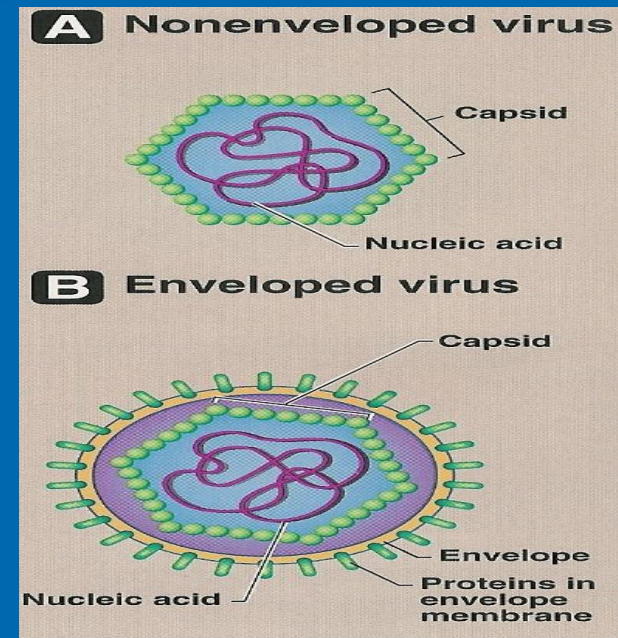
3-Envelope

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



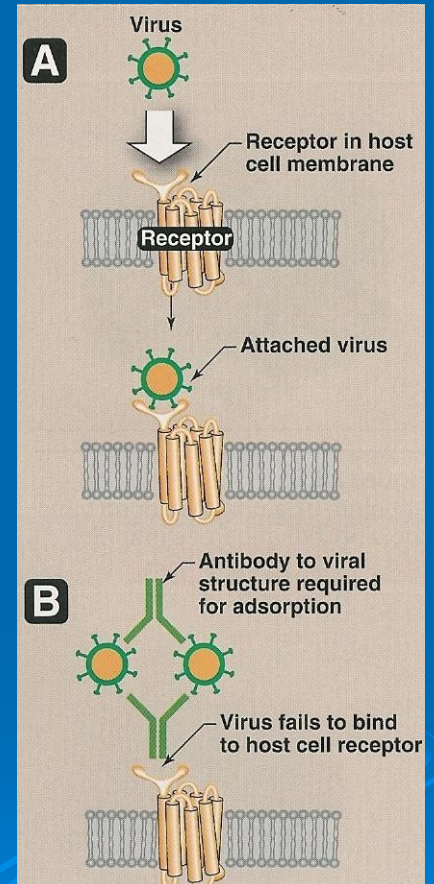
Viral proteins

❖ *The outer viral ps*

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

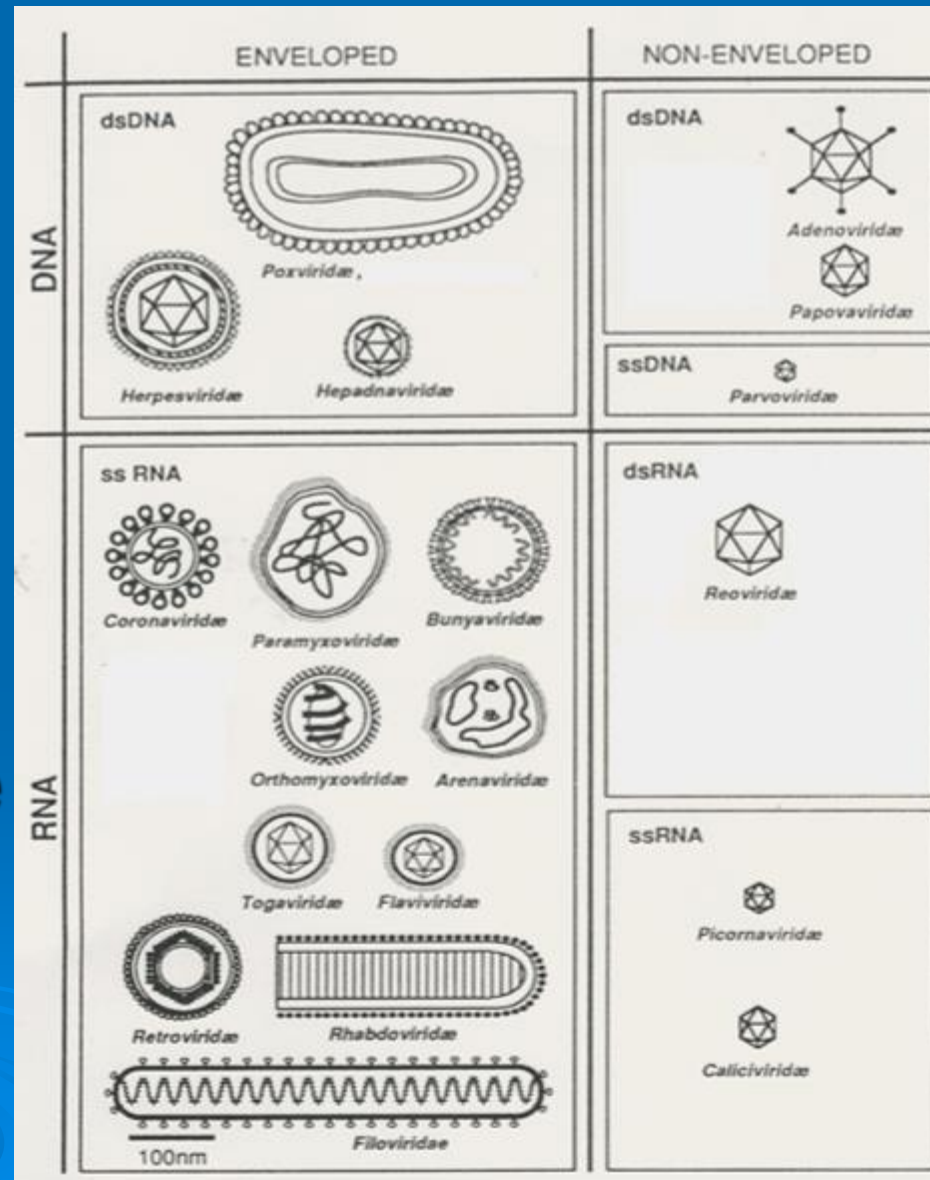
❖ *The internal viral ps*

- 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

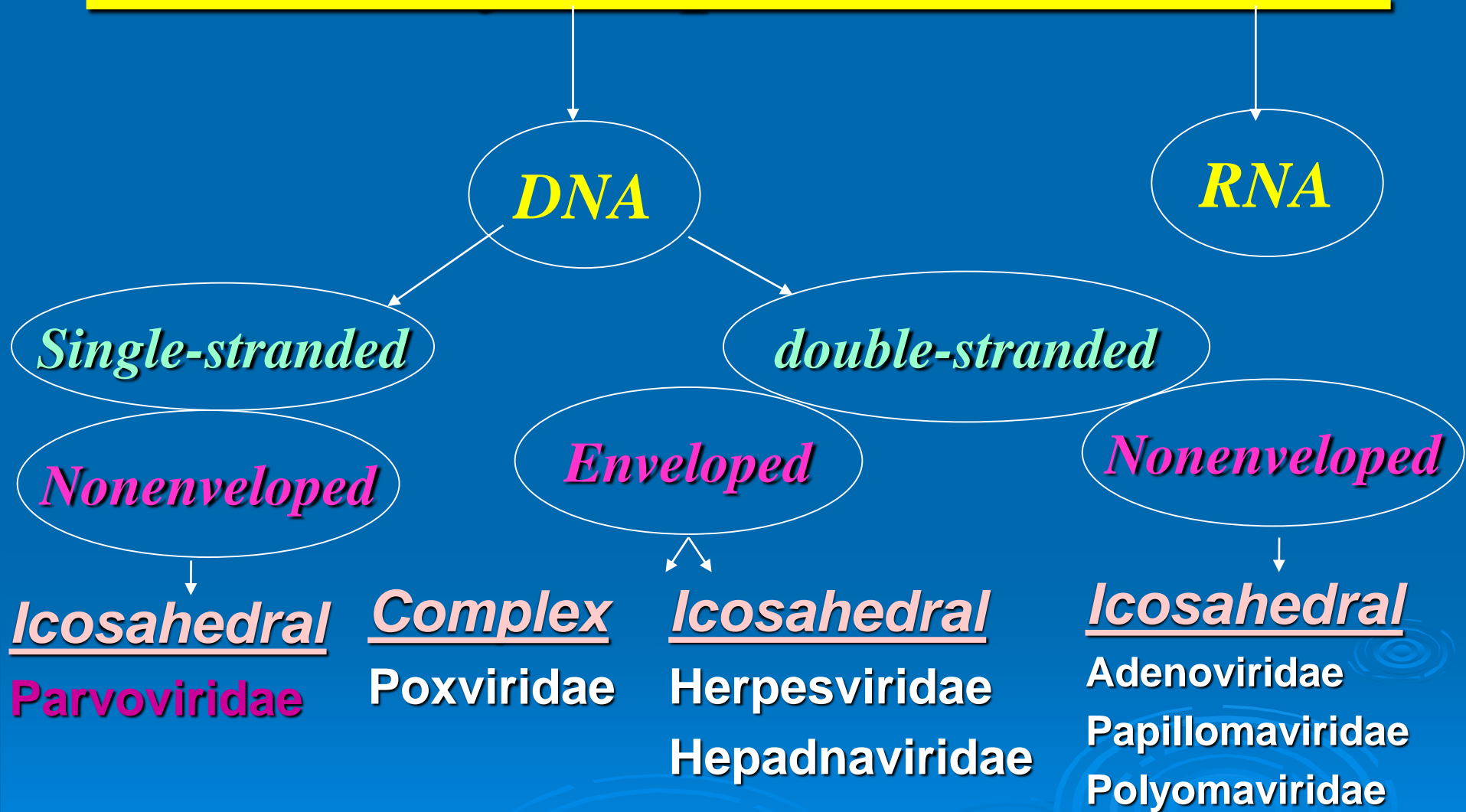


Classification of viruses

- 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

DNA

RNA

Single-stranded

double-stranded

Neg - strand

Pos - strand

Nonenveloped

Enveloped

Enveloped

Nonenveloped

Icosahedral
Reoviridae

Helical

Helical

Icosahedral

Orthomyxoviridae

Paramyxoviridae

Rhabdoviridae

Filoviridae

Bunyaviridae

Arenaviridae

Coronaviridae

Icosahedral

Togaviridae

Flaviviridae

Retroviridae

Picornaviridae

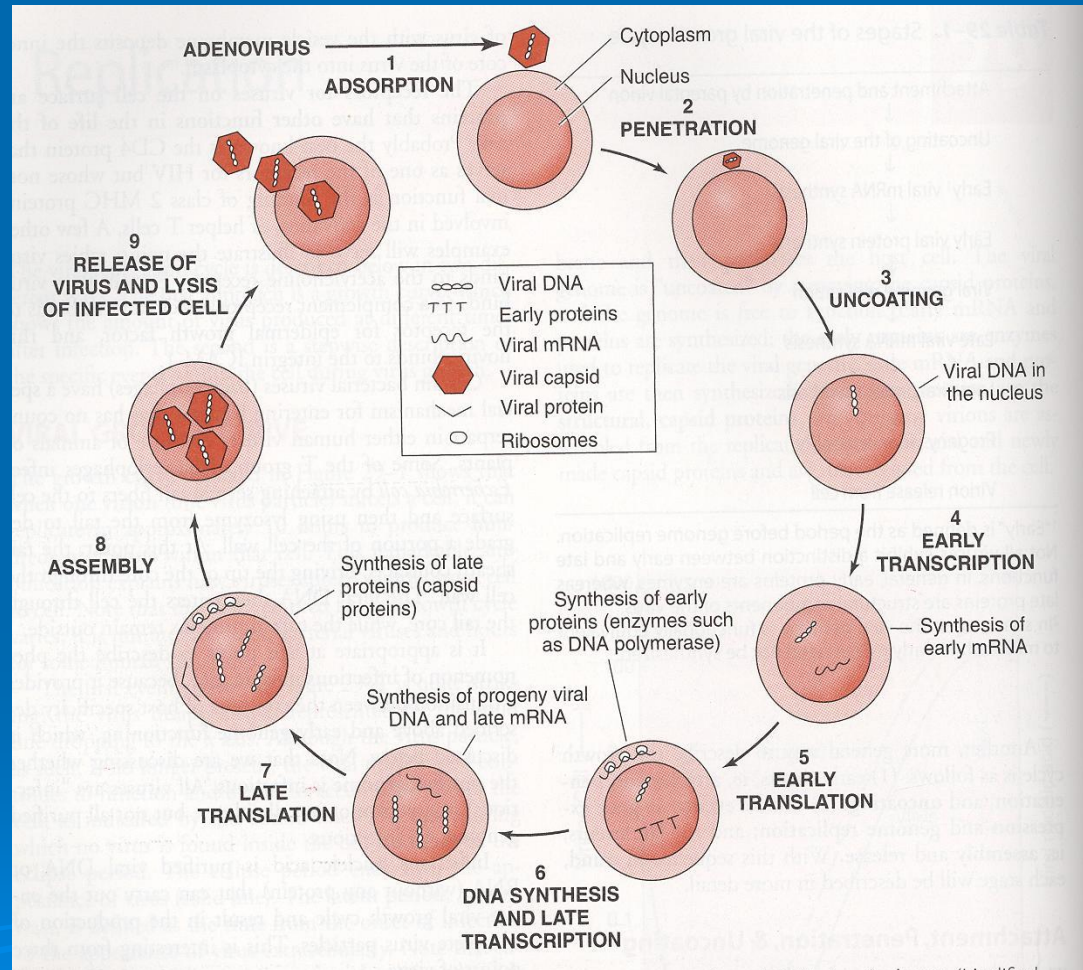
Hepeviridae

Caliciviridae

Astroviridae

Replication

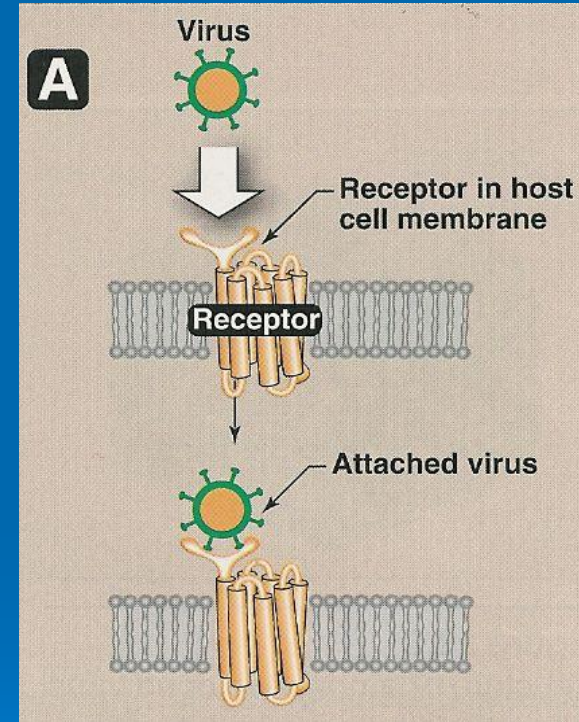
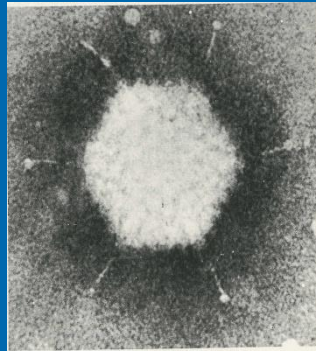
- Adsorption (Attachment)
- Penetration
- Uncoating
- Synthesis of viral components
 - mRNA
 - Viral proteins
 - NA
- Assembly
- Release



Viral growth cycle

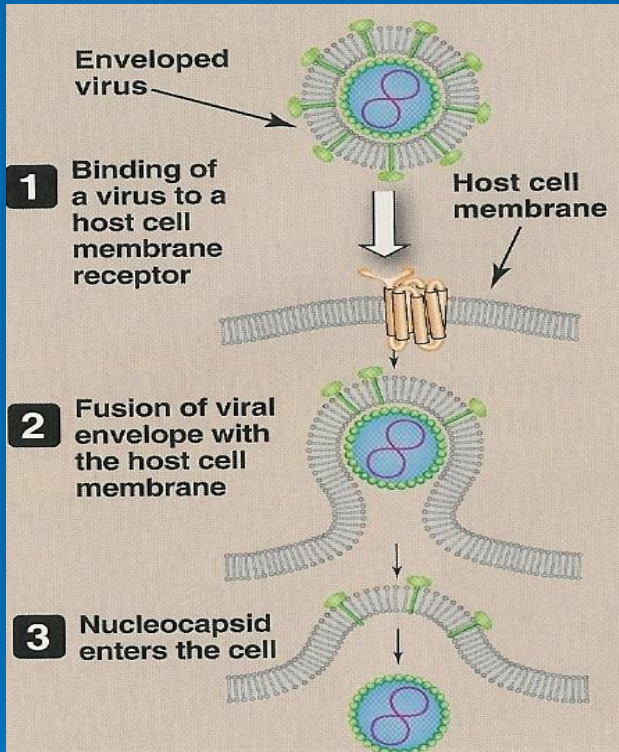
Adsorption

- Attachment site ;
ex- glycoprotein
fiber



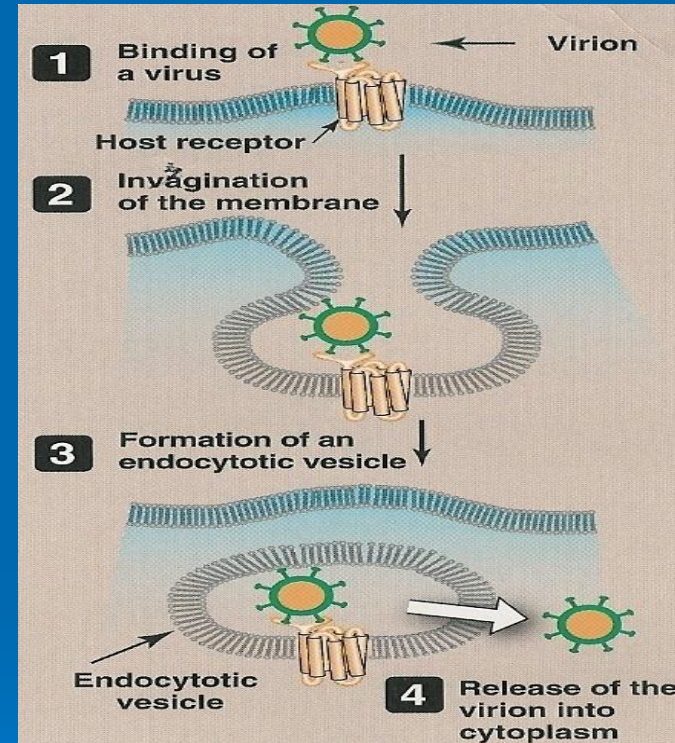
Penetration

1-Fusion



(enveloped Vs)

2-Endocytosis



- Viral envelope fuses with endosome mb
- Nonenveloped 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

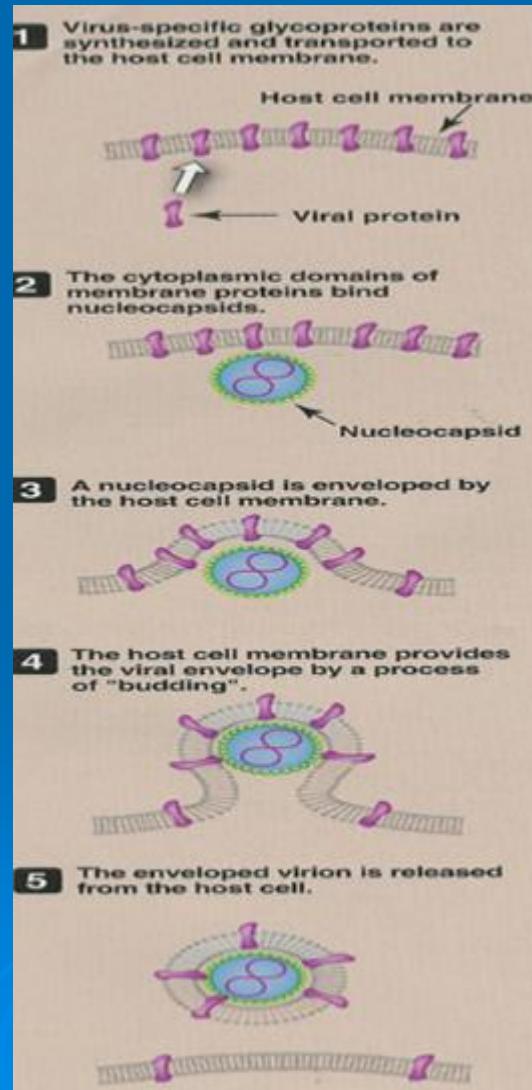
➤ *Assembly*

NA + V. proteins = Virions

- Release

Release

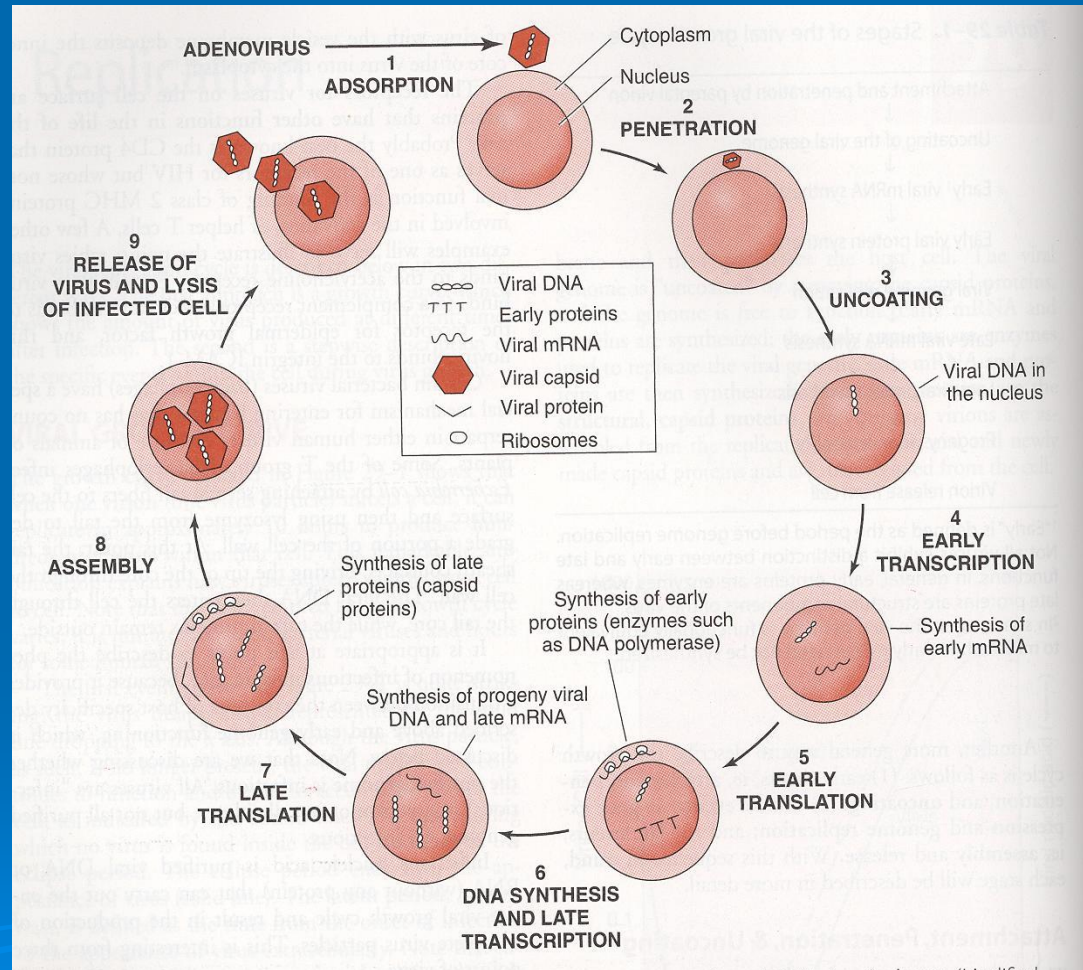
- 1-Budding
(enveloped Vs)
 - cell mb*
 - nuclear mb
(herpesVs)



- 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

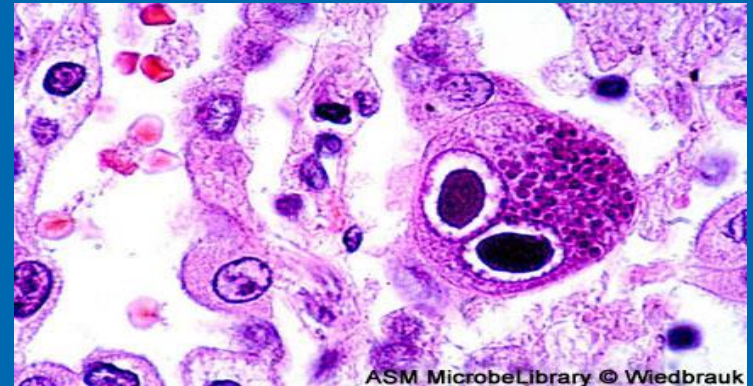
- *Microscopic examination.*
- *Cell culture.*
- *Serological tests .*
- *Detection of viral Ag.*
- *Molecular method .*

Microscopic examination

➤ *Light microscopy;*

Histological appearance

Ex. Inclusion bodies



Owl's eye (CMV)

➤ *Electron microscopy;*

- Morphology & size of virions
- Ex.

Dx of skin lesion caused by herpesv, poxv.

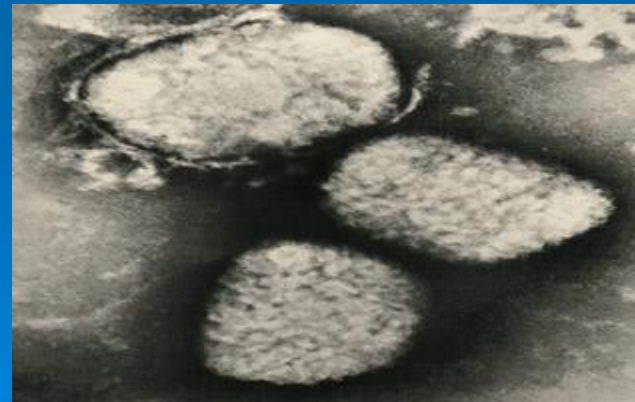
- It is replaced by Ag detection & molecular tests

➤ Electron micrographs

Herpesvirus



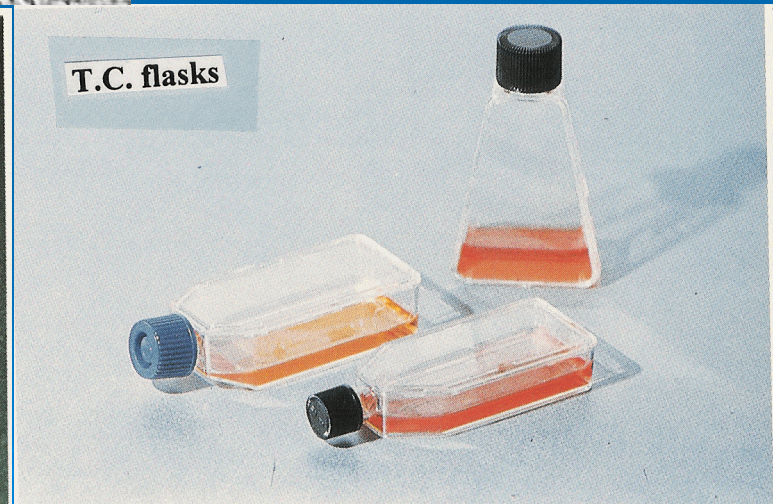
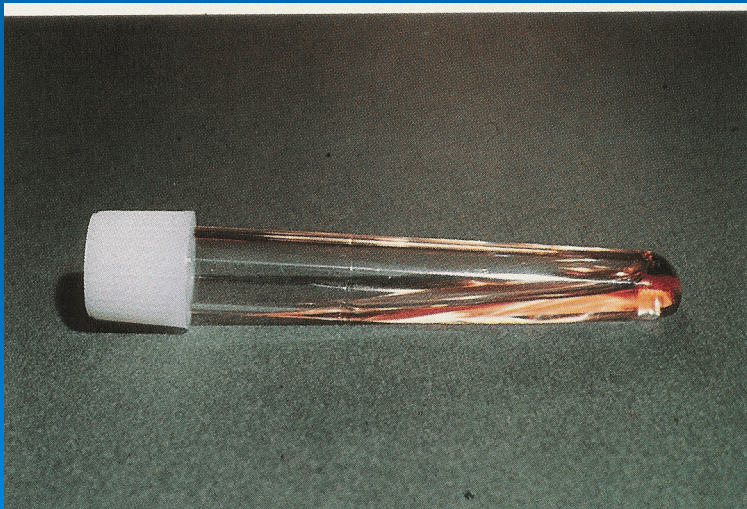
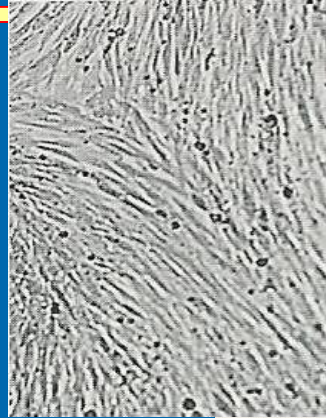
Poxvirus



Virus cultivation

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

Cell culture



Cell culture

1. Primary C/C
2. Diploid C/C
[semi continuous]
1. Continuous cell line

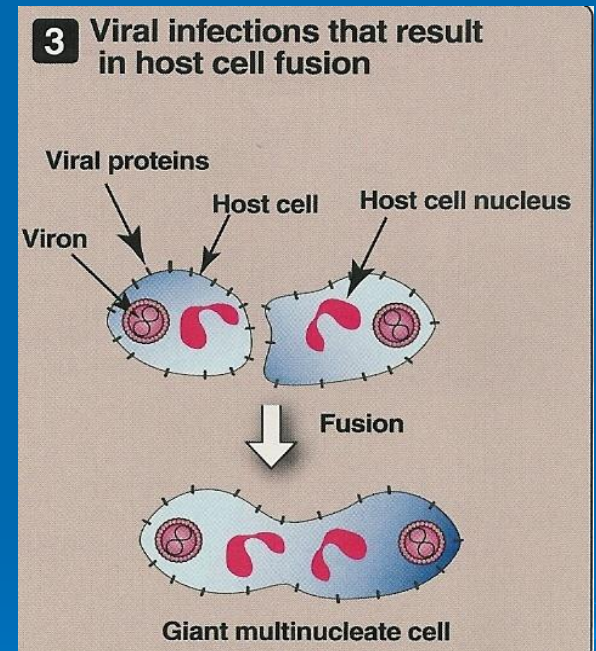
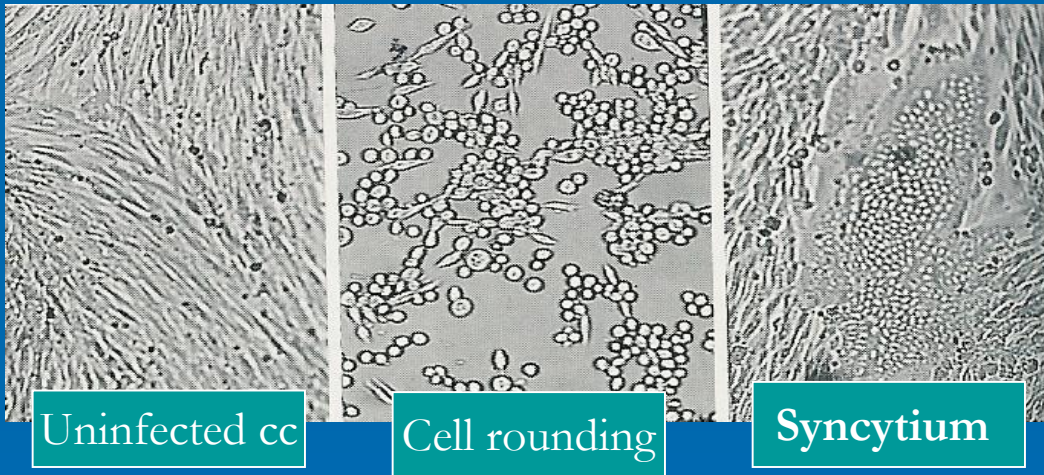
Variation in Sensitivity of cell cultures to infection by viruses commonly isolated in clinical virology laboratories

| 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

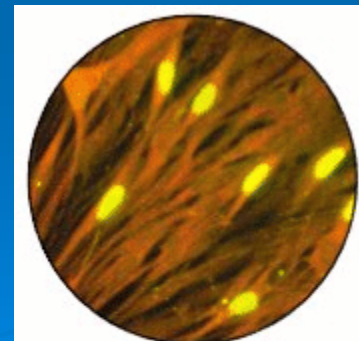
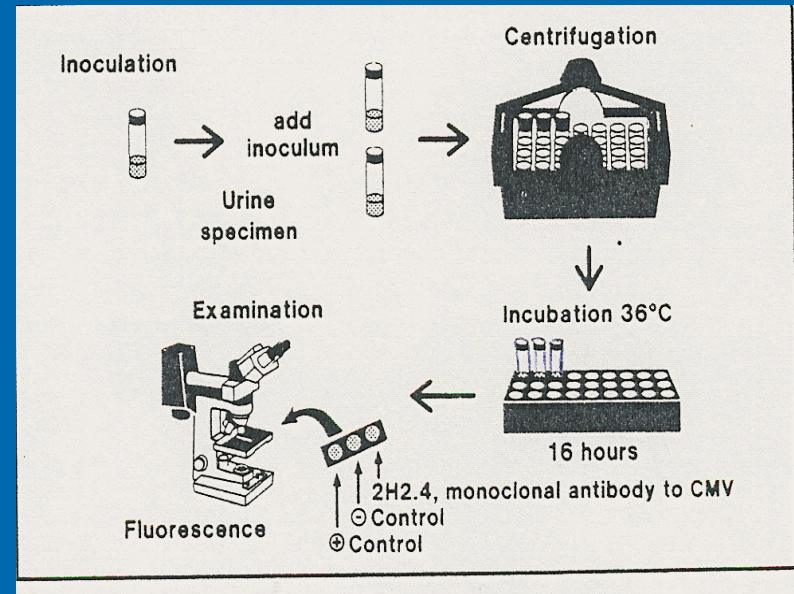


Fig. 2, CMV centrifugation culture fixed and stained 16 hrs after inoculation showing viral proteins in nuclei of infected human fibroblast cells

Serological test; Antigen detection;

sample

virus

test

➤ Skin scrapings

HSV

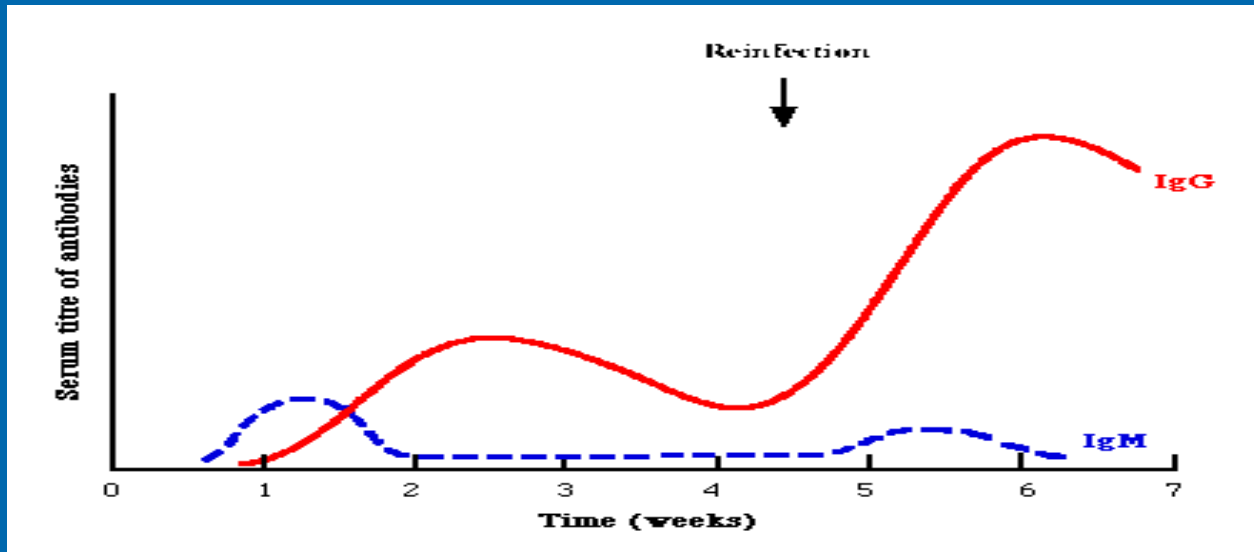
IF

➤ Blood

HBV(HBsAg)

ELISA

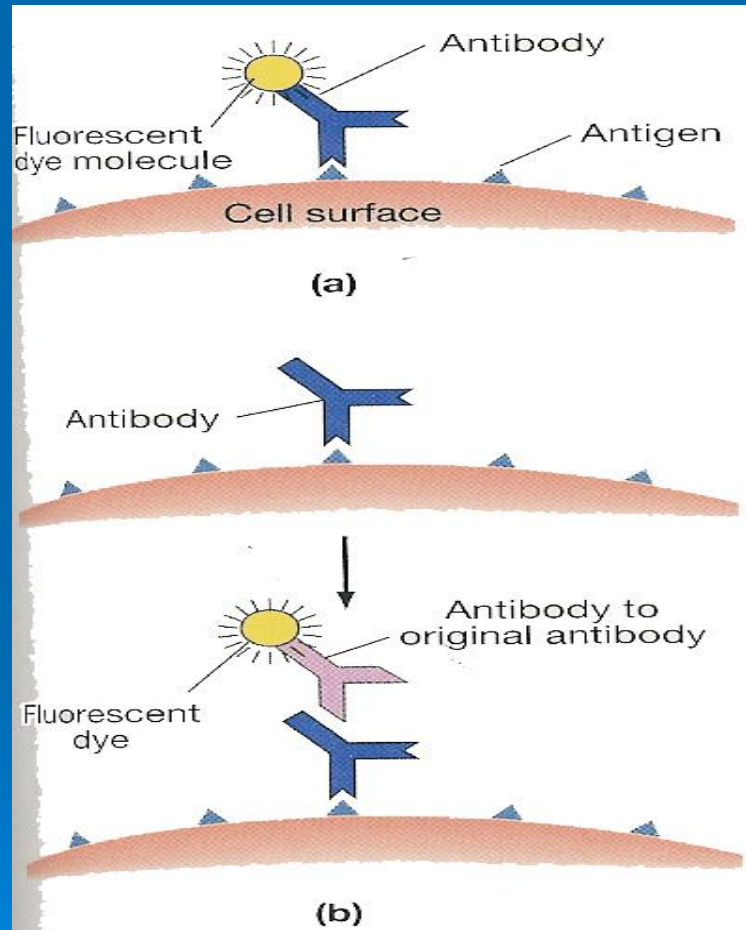
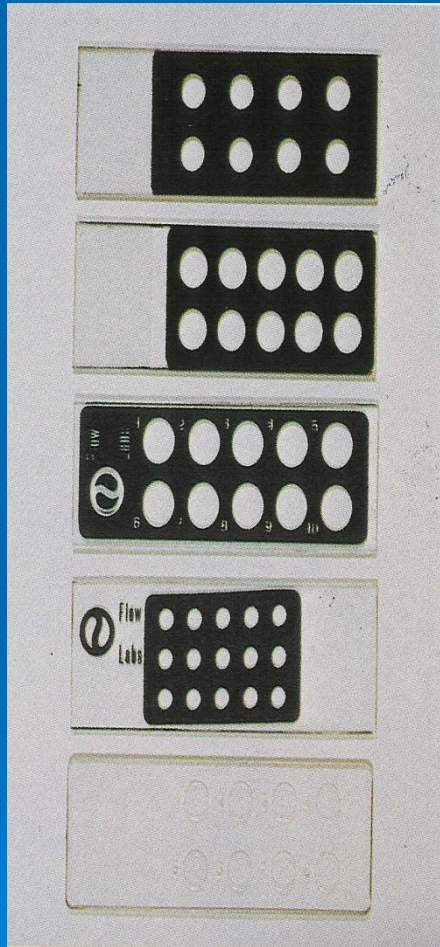
Serological test; Antibody detection;



➤ Ex of techniques

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

Immunofluorescence ; IF



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

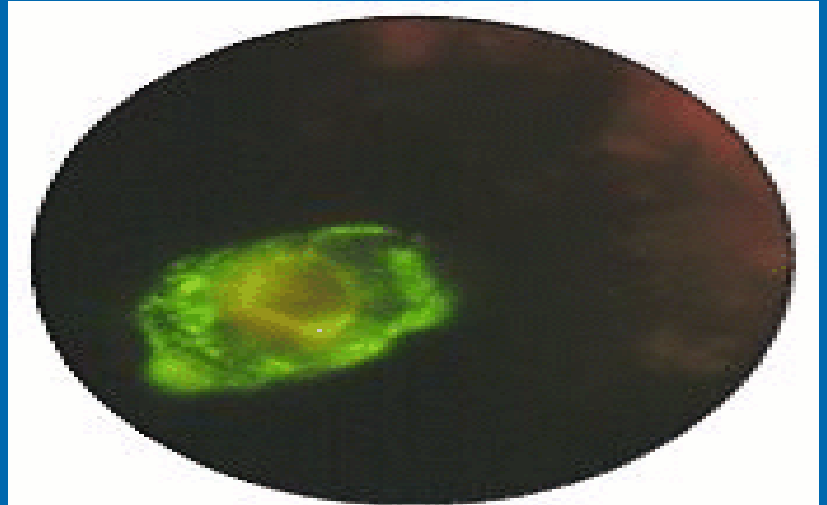
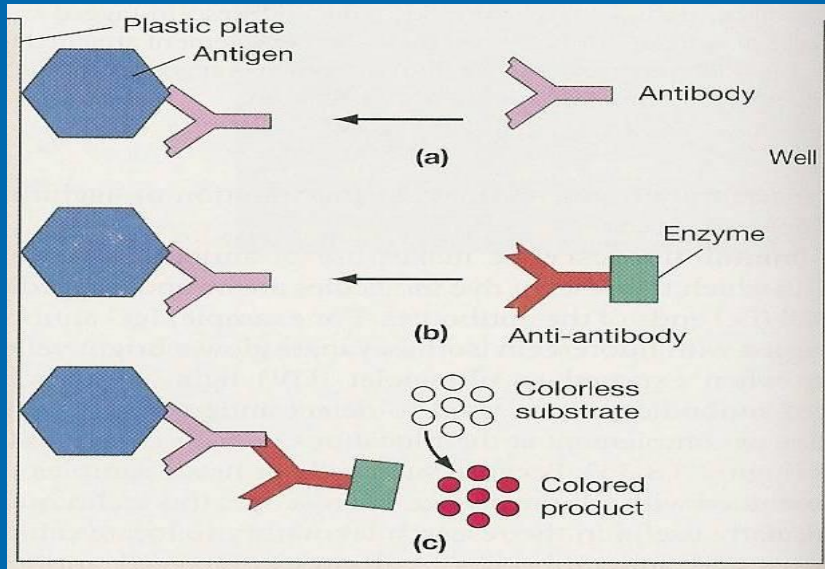


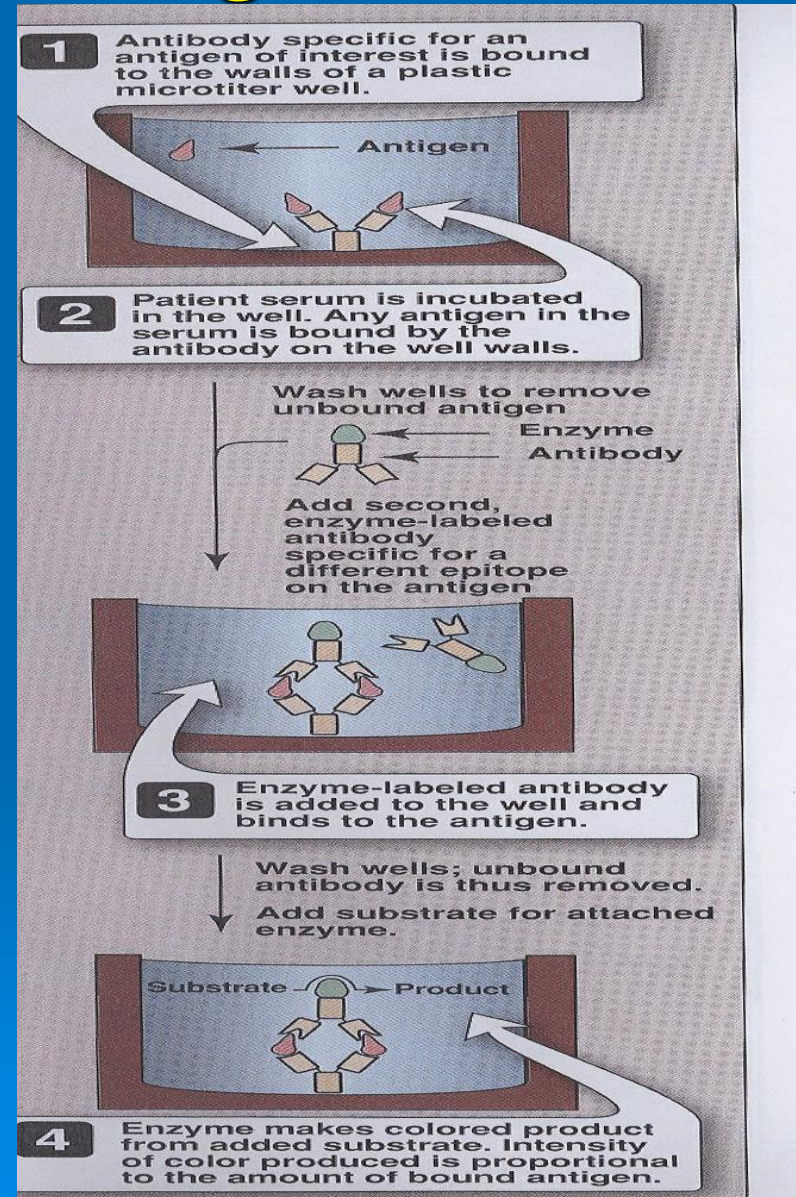
Fig. 3, HSV-infected epithelial cell from skin lesion (DFA)

ELISA

Ab detection



Ag detection

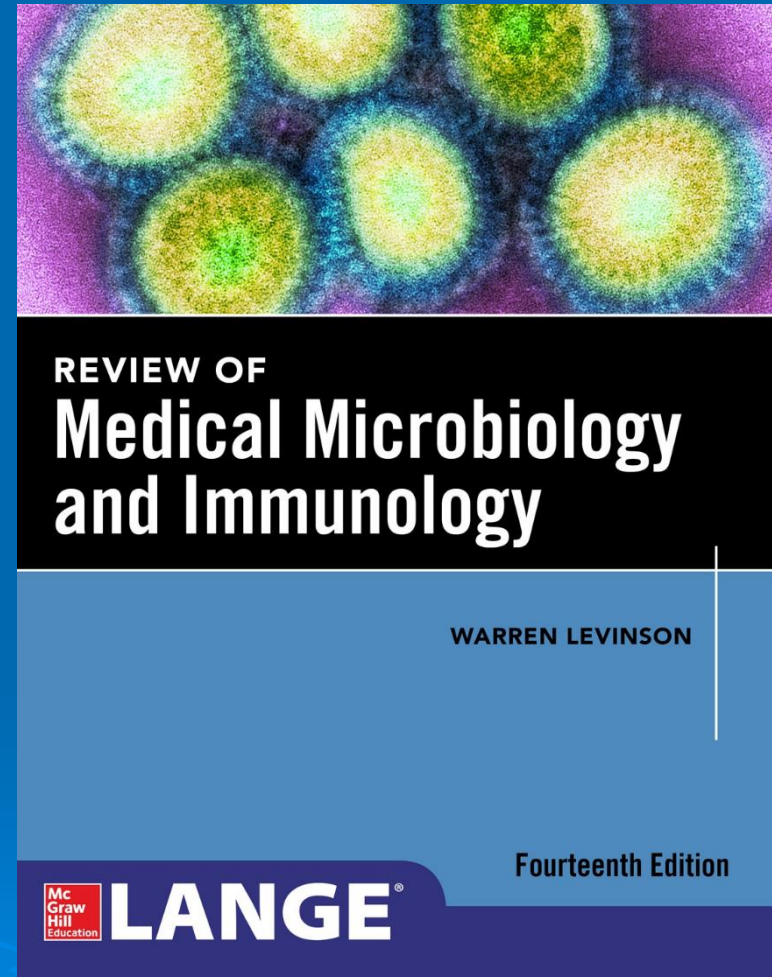
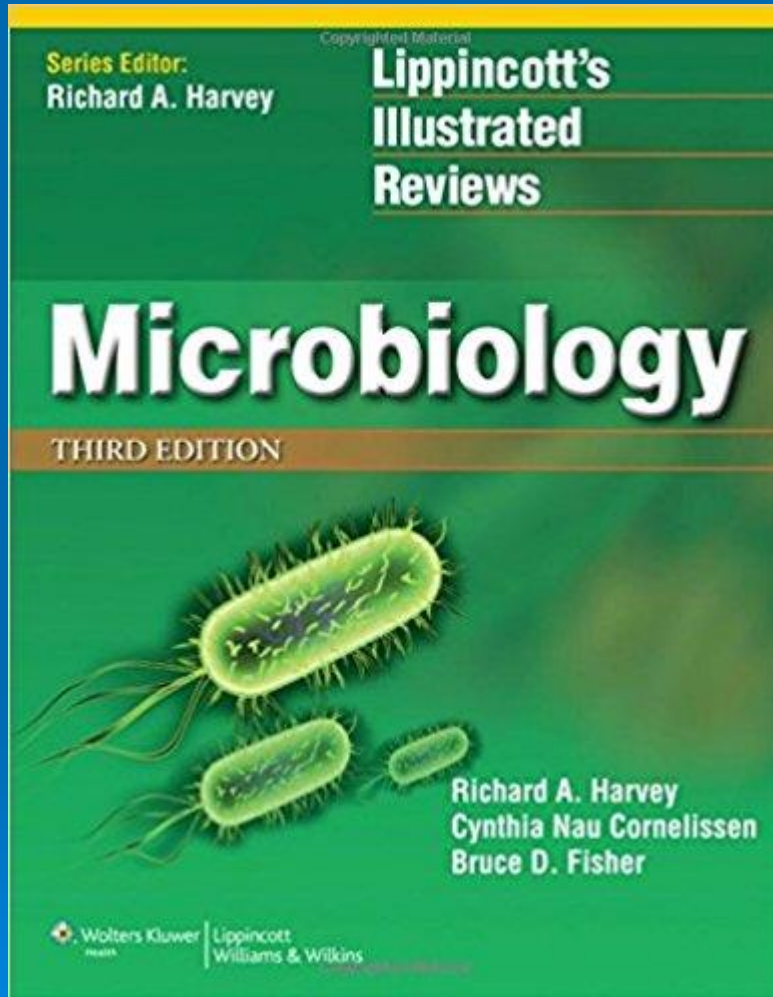


Indirect ELISA for Ab detection ;
coloured wells indicate reactivity

Molecular test;

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

Reference books



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



شروط الحجاب :

- ساتر جميع البدن بما لا يكتشف العورة والستورين إليه أوسع فواتي أهل العفة
- أن يظهر واسعة غير ضيقة حتى لا يشفه عند الحركة
- أن يظهر سميكتاً لا يشفه ما تحته
- أن لا يظهر اللباس زينة به نفسها
- أن لا يظهر مطبقاً يمتص ويضع العطر
- أن لا يشفه ملامح الوجه
- أن لا يشفه ملامح الساقين
- أن لا يظهر البدن بغيره



رسالة هامة : أيها الرجل لا تكن ميوثاً فإن لم تكن رجلاً ، فتشبه بالرجسا

التسام المسلمات في العصر الحاضر



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

**الإماء
وملك اليمين**

**امهات المؤمنين
والصالحات
والجرائر**

Thank you

