Intro. to Medical Virology

LECTURE FIVE

Objectives:

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

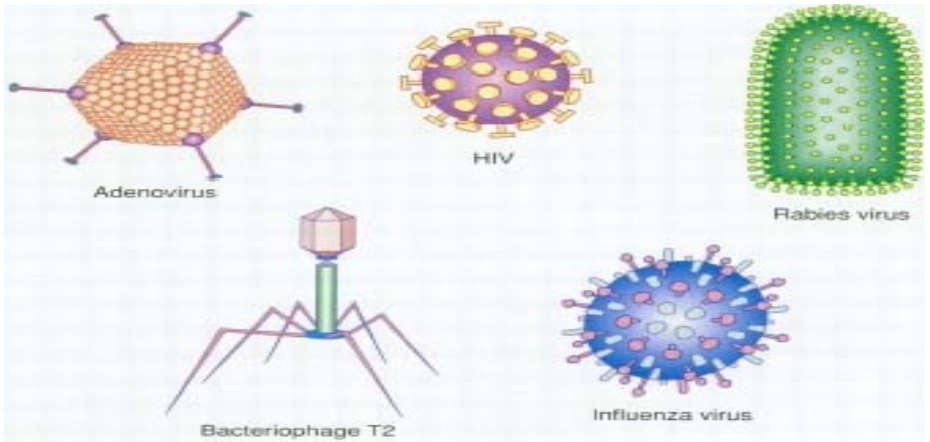
PROPERTIES OF MICROORGANISMS:

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

CHARACTERISTICS OF VIRUSES

- A cellular organisms
- Tiny particles
- Obligate intracellular organisms
- Replicate in a manner diff from cells

Size ; 20-300 nm



VIRAL STRUCTURE

1-Viral genome
2-Capsid
3-Envelope

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

(-) pol

2-Capsid

a protein coat

Subunits (capsomere)

Genome (NA) + capsid

= nucleocapsid

Function:

Protects NA

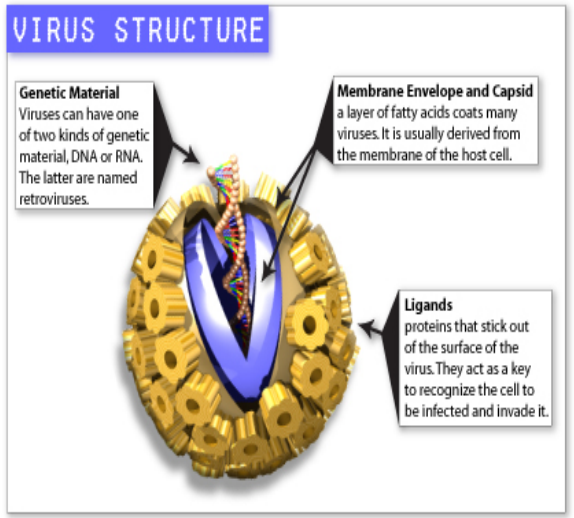
Facilitates its entry into cell

3-Envelope

Lipoprotein mb (host lipid ,virus specific protein)

- Budding

Envelope is derived from cell mb except herpesviruses from nuclear mb



All Vs are haploid ,except retroviruses are diploid

SYMMETRY (shape of the virus):

- **based on arrangement of capsomere**

1-Cubic symmetry (Icosahedral):

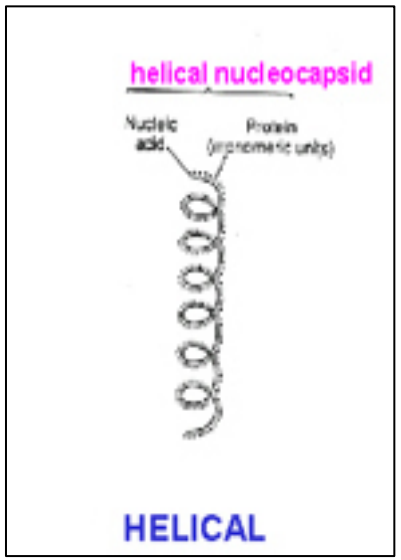
- Herpes virus
- Adenovirus

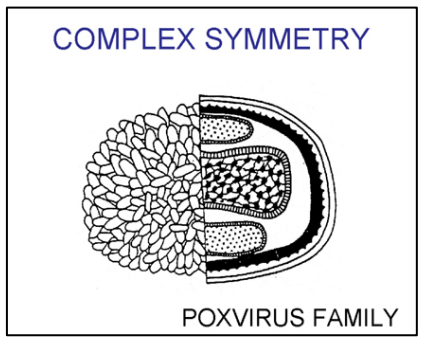
2-Helical symmetry:

- Pleomorphic(influenza v)
- Elongated (filoviruses)

3- Complex symmetry:

- poxviruses





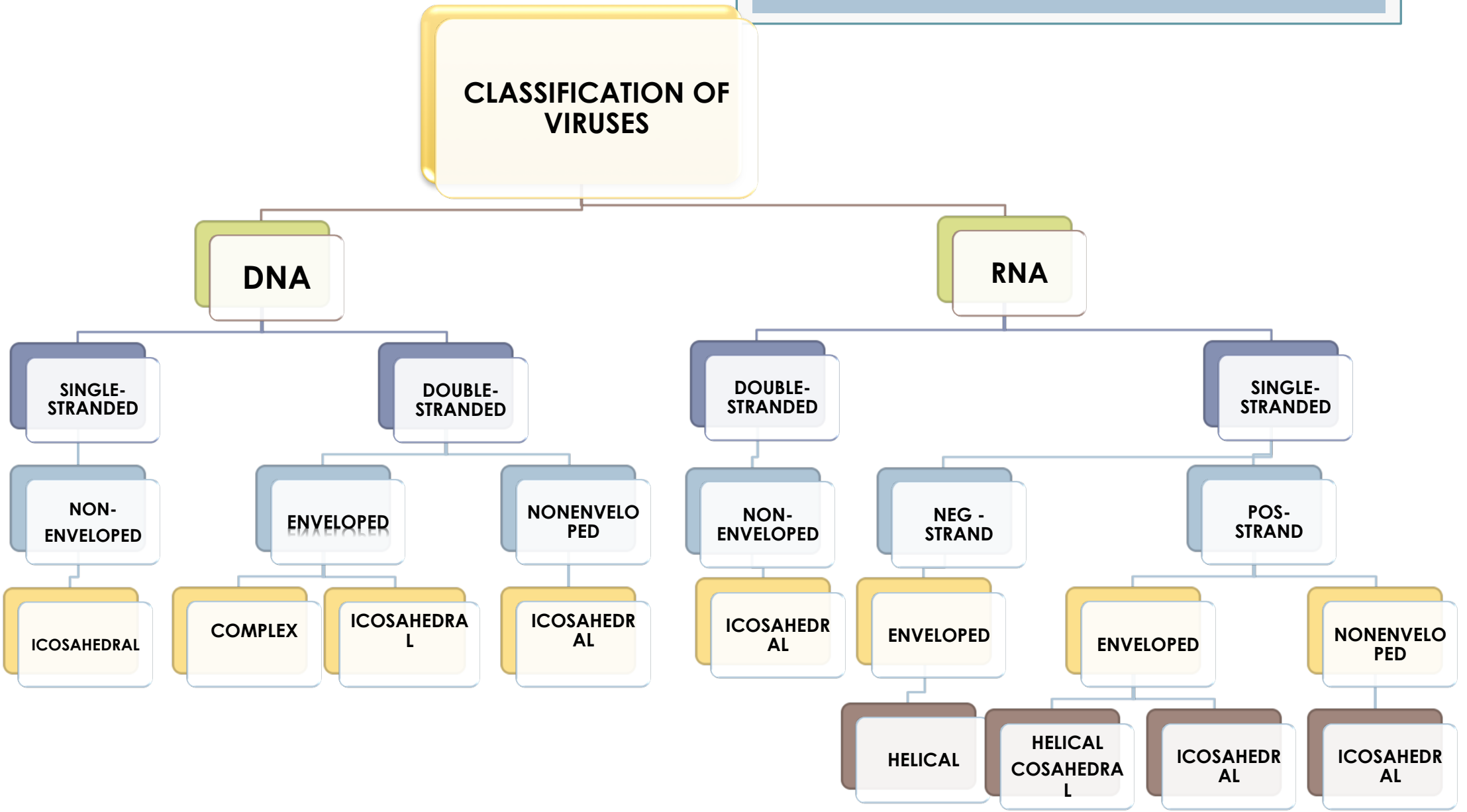
VIRAL PROTEINS:

The outer viral proteins:

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

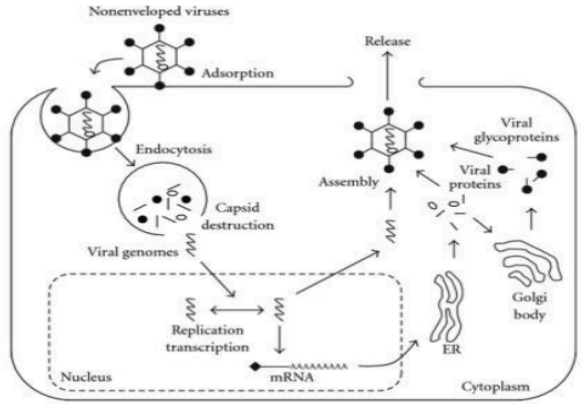
The internal viral proteins:

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


CLASSIFICATION OF VIRUSES
DNA
RNA
SINGLE-STRANDED
DOUBLE-STRANDED
DOUBLE-STRANDED
SINGLE-STRANDED
NON-ENVELOPED
ENVELOPED
NONENVELOPED
NON-ENVELOPED
NEG - STRAND
POS-STRAND
ICOSAHEDRAL
COMPLEX
ICOSAHEDRAL
ICOSAHEDRAL
ICOSAHEDRAL
ENVELOPED
ENVELOPED
NONENVELOPED
HELICAL
HELICAL COSAHEDRAL
ICOSAHEDRAL
ICOSAHEDRAL

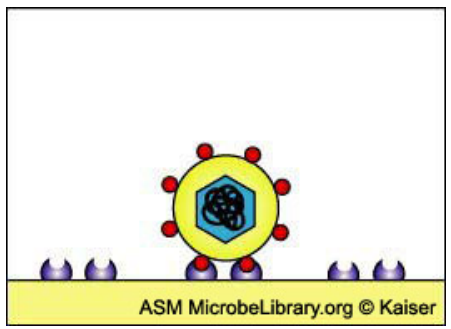
REPLICATION:

1. Adsorption (attachment)
2. Penetration
3. Uncoating
4. Synthesis of viral components
   - mRNA
   - Viral proteins
   - NA
5. Assembly
6. release



ADSORPTION (ATTACHMENT SITE) :

1 - some cells will have GLAYCOPROTIEN
2 - some will have SPECIAL FOLDING IN THE CAPSID PROTEINS.



WILL ATTACH TO A RESPTOIRER IN THE HOST CELL MEMBRAN .

PENETRATION :

ENDOCYTOSIS :
The host cells membrane will engulf the virus inside forming a ENDOCYTOTIC VESICULE :

FUSION :
The Envelope of the virus will fuse with the host cells membrane then the virus will enter the cytoplasm.

ENVOLPED VIRUSES :
Will break the vesicle throw fusion with membrane

NON-ENVOLPED VIRUSES :
Will break through the vesicle By lysis which will create pores

UNCOATING :

Either stay in the CYTOPLASM to continue to replicate

Or enter the NUCLUES

Release of viral genome

SYNTHESIS OF VIRAL COMPONENTS :

1/ mRNA :
Viral Genome (+) → mRNA
Direct transcription of + single strand RNA

2/ Viral Protein :
mRNA→ Enzymes/ structural protein (Capsomere)
Translated by the cells ribosomes

3/ replication of viral Genome:
The mechanism will continue for the replication, as we side, one virus will produce in one cell millions of viruses

ASSEMBLY:

NA + V. proteins = Virions

RELEASE:

1-Budding
(enveloped Vs)
-all Vs require their envelope from the cell mb*
-expect (herpes Vs.)
Require their envelope from the nuclear mb

2- Cell lysis or rupture
for (no enveloped)Vs

LABORATORY DIAGNOSIS OF VIRAL INFECTIONS:

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

MICROSCOPIC EXAMINATION

Light microscopy:

to see the effect of the virus in the host cell "Histological appearance"

Ex. Inclusion bodies

Owl's eye (CMV)

Electron microscopy:

To detect and identify the virus based on Morphology& size of virions

Ex.

- Diagnosis of viral GE such as rota, adenoviruses.
- Diagnosis of skin lesion caused by herpes, poxviruses.

This micro scope has many disadvantages

Ex:

- very expensive It is replaced by Ag detection & molecular tests

VIRUS CULTIVATION

Laboratory animal

Very expensive
Very hard to handle

Embryonated egg

Cell culture	No of sub passages
Primary C/C	1 or 2
Diploid C/C (semi continuous)	20 or 50
Continuous cell line	indefinite

Cell culture
Cells obtained from animals or humans

It is very IMP That we use a combination methods of cell culture

Detection of viral growth:

- Cytopathic effects
- Others

Any possible change In the cell culture

Ex: cell rounding
Syncytium .
"fusion of The inflected cells together → One Giant cell

PROBLEMS WITH CELL CULTURE:

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

RAPID CULTURE TECHNIQUE :

Since the normal cell culture had to take a month to grow they came up with a new method :

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

SEROLOGICAL TEST:

*Very common *Very fast 1- 2 hours

Antigen detection:

sample	virus	test
Nasopharyngeal aspirate	Influenza V	IF
Skin scrapings	HSV	IF
Faces	Rotavirus	ELISA
Blood	HBV (HBsAg)	ELISA

Antibody detection:

Ex of techniques

Immunofluorescence (IF)

A- Direct Antigen detection using an antigen Sample

B- Indirect Antibody detection by using an antibody Sample

Enzyme-linked Immunosorbent test (ELSA)

A- Direct antigen Detection Or specific IgM, IgG

B- Indirect antibody detection It uses an enzyme to react with an enzymatic substrate to show color

- **colored wells indicate reactivity**

MOLECULAR *TEST:*

- **Polymerase chain reaction (PCR)**
  - Amplification tech.
  - Viral genome
- **Uses of molecular test:**
  - Diagnosis of viral disease
  - Monitoring response to treatment

Thank you

قال تعالى: ﴿وَالَّذِينَ تَبَوَّءُوا الدَّارَ وَالإِيمَانَ مِنْ قَبْلِهِمْ يُحِبُّونَ مَنْ هَاجَرَ إِلَيْهِمْ وَلاَ يَجِدُونَ فِي صُدُورِهِمْ حَاجَةً مِمَّا أُوتُوا وَيُؤْثِرُونَ عَلَى أَنْفُسِهِمْ وَلَوْ كَانَ بِهِمْ خَصَاصَةٌ وَمَنْ يُوقَ شُحَّ نَفْسِهِ فَأُولَئِكَ هُمُ الْمُفْلِحُونَ﴾

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MCQs:

- **The genetic material in viruses is:**

a) DNA only b) Either DNA or RNA c) Both DNA & RNA d) RNA only

- **Which one of the following is type of virus symmetry:**

a) Complex symmetry b) Columnar symmetry c) Simple symmetry

- **Molecular test is used for:**

a) Prognosis b) Pathogenesis c) Diagnosis

- **…… is an example of a virus that doesn't grow in cell culture :**

a) HCV b) HIV c) CMV

- **Viruses have organelles such as mitochondria.**

a) T b) F

Related Videos:

- http://youtu.be/uwiPidO7K2s
- http://youtu.be/s8jhJXgC-bk
- http://youtu.be/L8oHs7G_syI
- http://youtu.be/eS1GODinO8w