

Pathogenesis of viral infection

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Dr.Malak M. El-Hazmi

Associate professor

Consultant Virologist

College of Medicine &

King Saud University Medical City

OBJECTIVES

- *definition and levels of viral pathogenesis.*
 - cellular level.*
 - host level.*
- *The immune response to viral infection.*
- *The stages of viral infection.*
- *The types of viral infections at host level.*

Pathogenesis of viral infection

- ❖ Viral disease at the cellular level
 - Cytopathogenesis
- ❖ Viral disease at the host level
 - Mechanism of the disease

Cytopathogenesis:

The types of viral infections at cellular level

The effects on cells/
Type of Infection

Virus Production

➤ Abortive

Vs not produced

➤ Productive

- Cytolytic
- Non-cytolytic

Vs Produced

Vs Produced

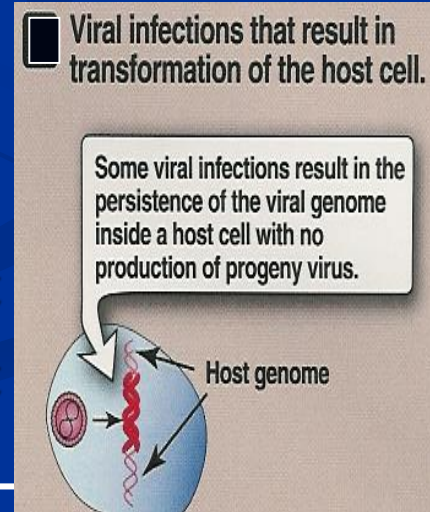
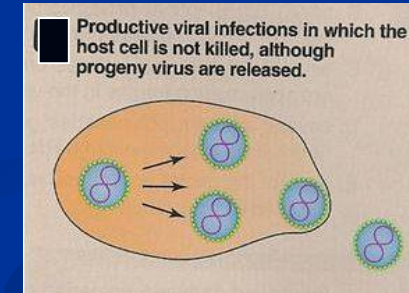
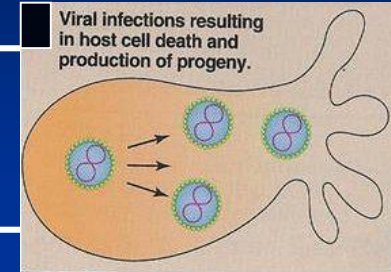
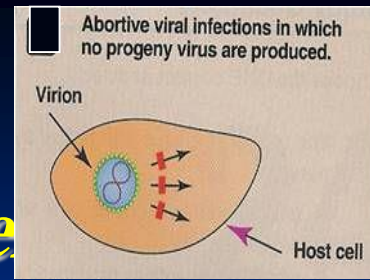
➤ Non-productive

Vs not Produced

- Latent
- Transformation

Viral NA present

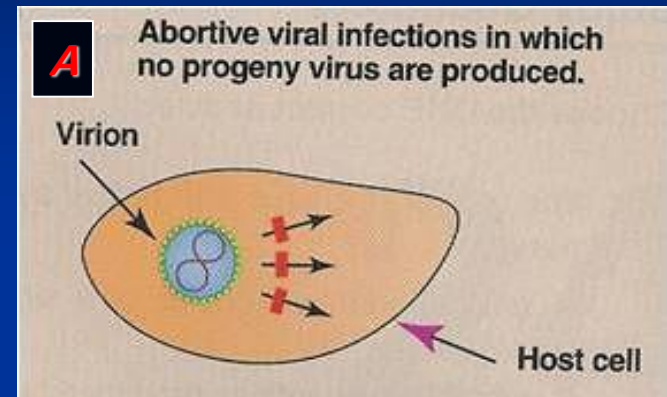
Viral NA present



The types of viral infections at cellular level

A) Abortive Infections:

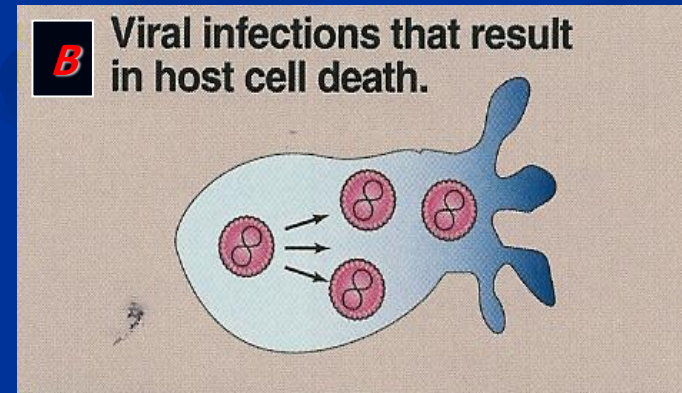
- Viruses don't complete the replication cycle
- Due to mutation, defective interfering particles & the action of IFNs



B) Productive Infections:

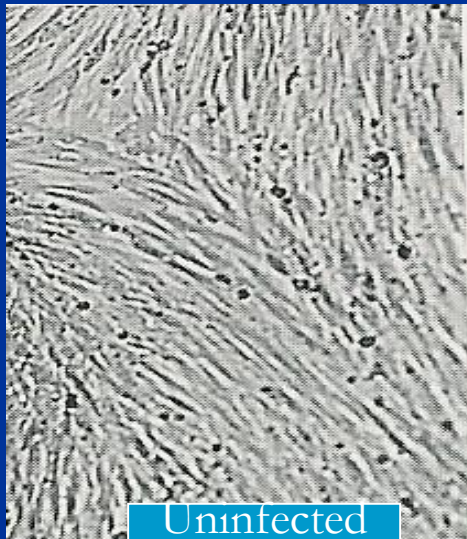
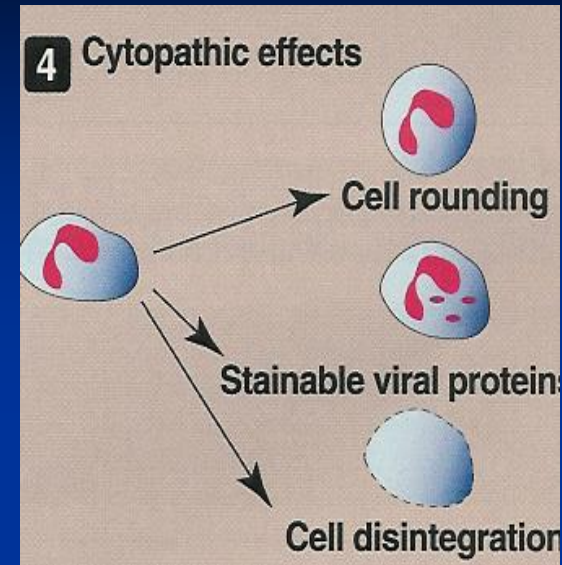
1. Cytolytic Infections

- Viruses replicate & produce progeny
- Cell death & Cytopathic effects [CPE]
- Inhibition of cellular protein & NA synthesis

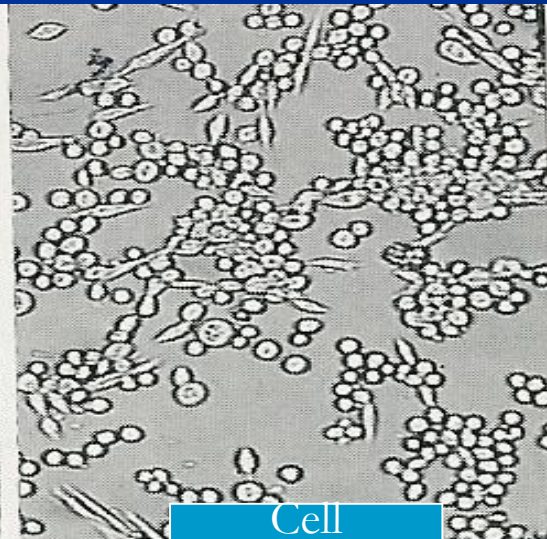


Cytopathic Effects

- CPE can take several forms:
 1. Cell lysis
 2. Cell rounding
 3. Syncytium formation
 4. Inclusion bodies formation



Uninfected
cc



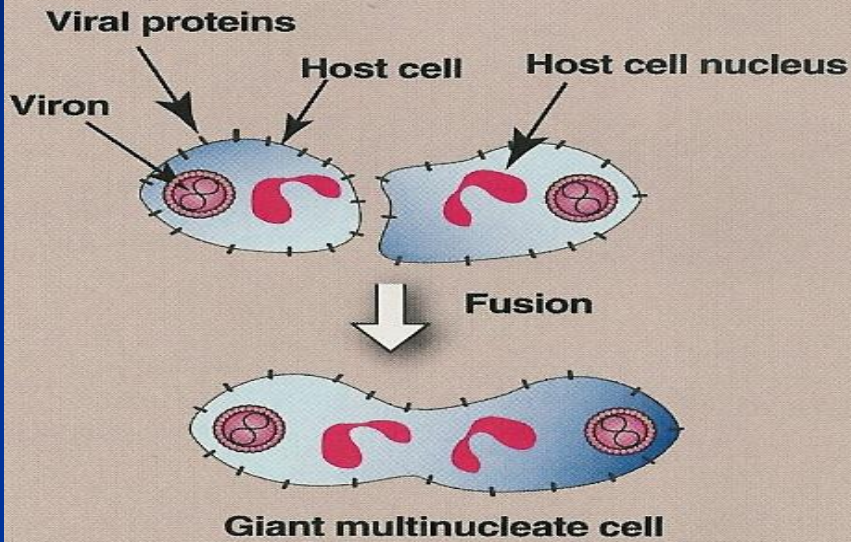
Cell
rounding



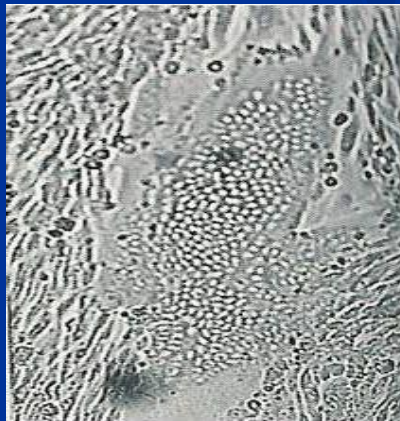
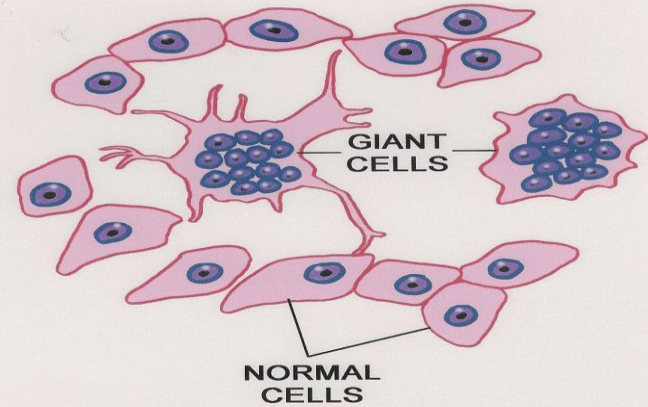
Syncytium

Syncytium formation

3 Viral infections that result in host cell fusion



GIANT CELL FORMATION (SYNCETIUM)



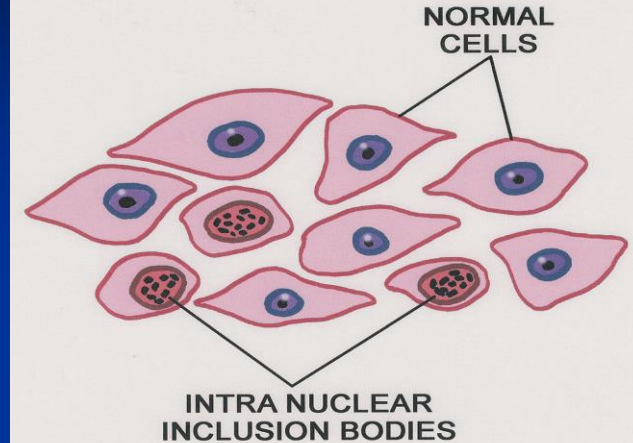
Syncytium

Inclusion bodies formation

- ❖ **Site:**
 - Intranuclear [Herpes V.]
 - Intracytoplasmic [Rabies V.]
- ❖ **Take several forms:**
 - Small/large
 - Single/multiple
 - Round/irregular

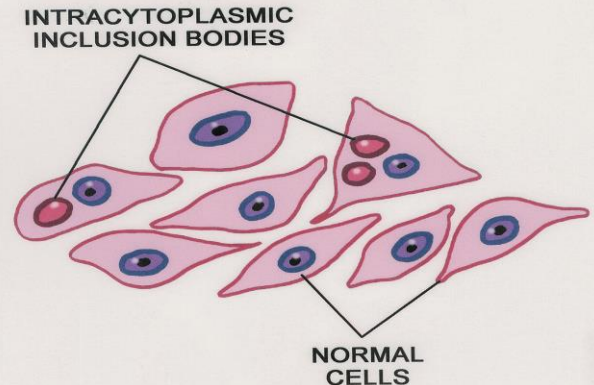
INCLUSION BODIES :

The site of VIRAL multiplication and protien synthesis

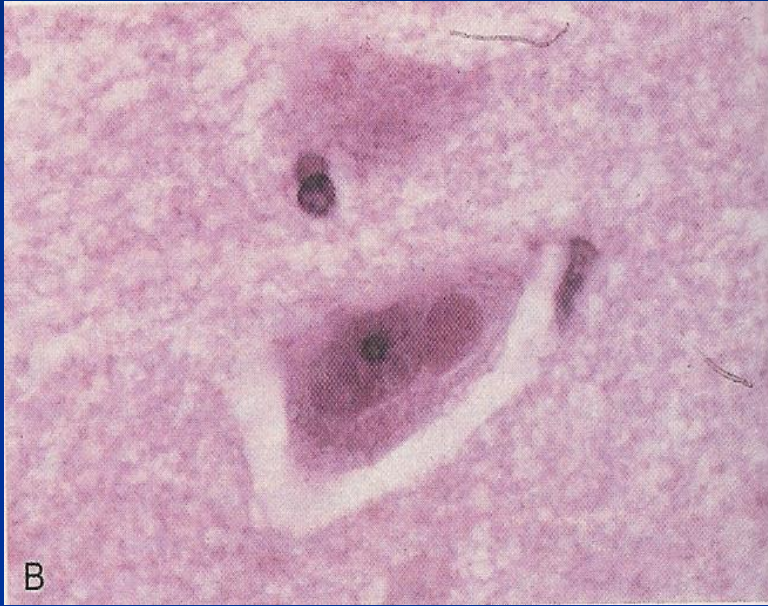


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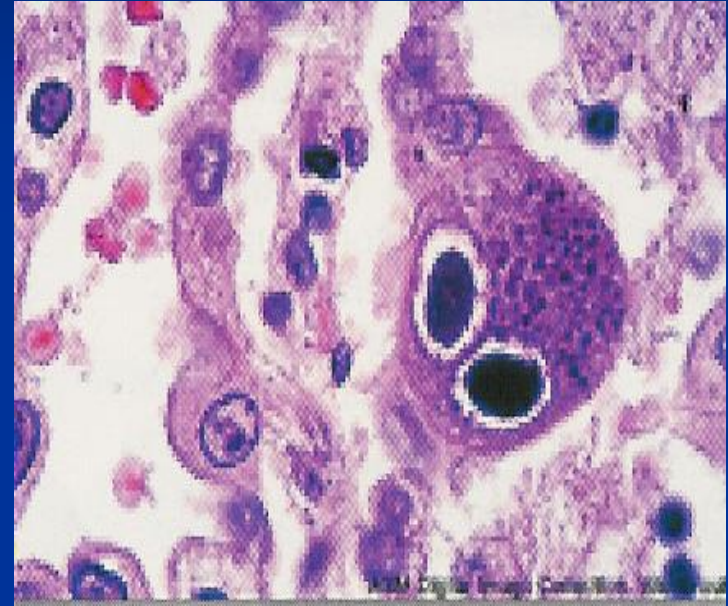
The site of VIRAL multiplication and protien synthesis



Inclusion bodies formation



*Negri bodies caused by
Rabies virus*



*Owl's eye inclusions
caused by CMV*

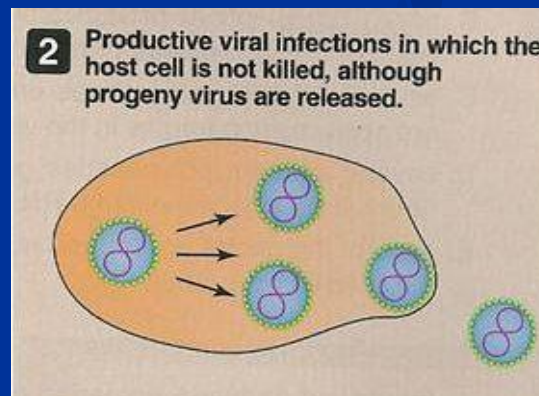
The types of viral infections at cellular level

B) Productive Infections:

1. Cytolytic Infections

2. Non-cytolytic infections :

- Viruses replicate & produce progeny
- Vs released by cell budding & little or no CPE



The types of viral infections at cellular level

C) Non-productive Infections:

- Vs infect cells that restrict or lack the machinery for transcribing viral genes.
- Viral genome is found either integrated into cell DNA or as a circular episome or both.

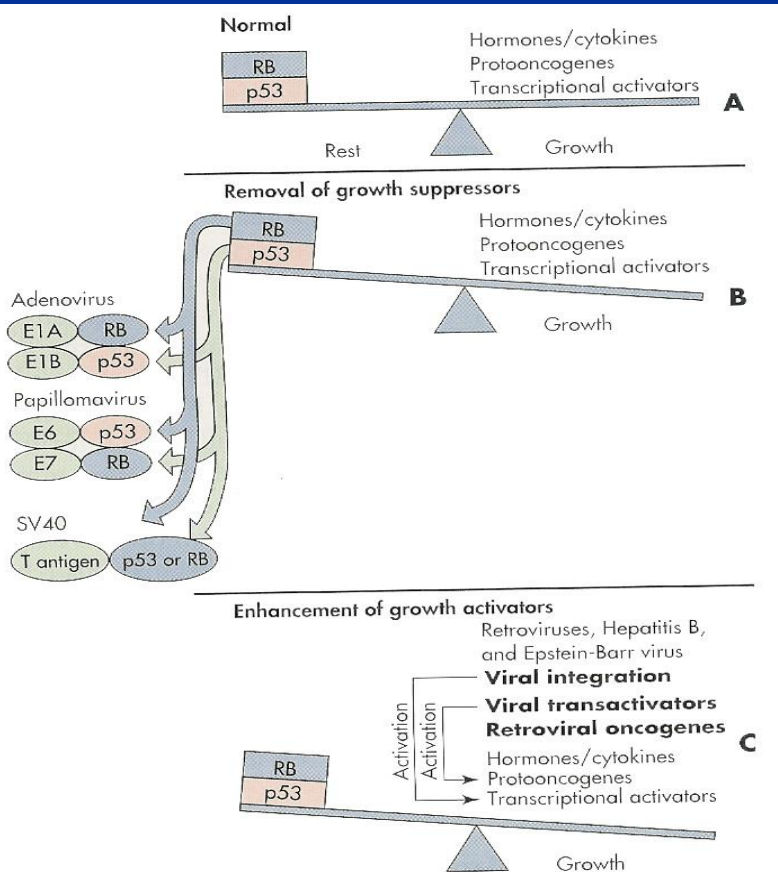
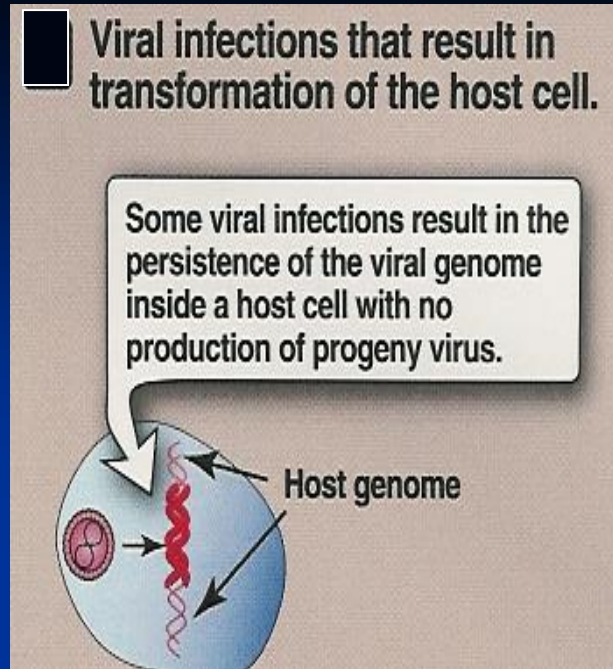
1) Latent Infection:

- Persistent inf b/c
there is limited expression of viral genes
- Ex: HSV

2) Transformation:

Transformation:

- Ex ; EBV, HPV and HTLV
- Cause tumor in animals & H and can transform cell culture



Vs can stimulate uncontrolled cell growth causing Tf by alternating the balance between growth activators & growth suppressors gene products

Cytopathogenesis:

The types of viral infections at cellular level

The effects on cells/
Type of Infection

Virus Production

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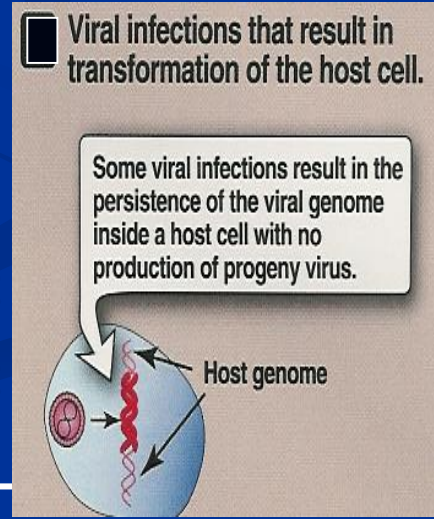
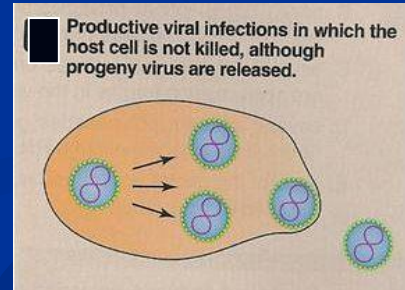
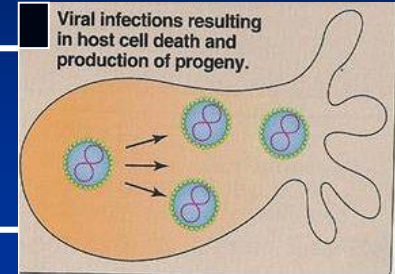
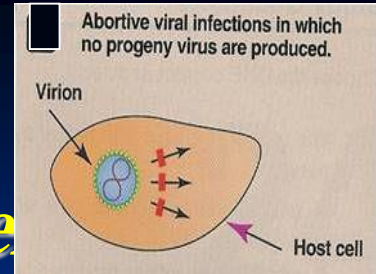
➤ Non-productive

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Viral NA present

Viral NA present



Pathogenesis at Host

Level

- Transmission of the virus & its entry into the host.
- Replication of the virus
- Vs remain localized or spread to other organs
- Viral shedding

- The immune response as
 - Host defense
 - Immunopathogenesis

Transmission

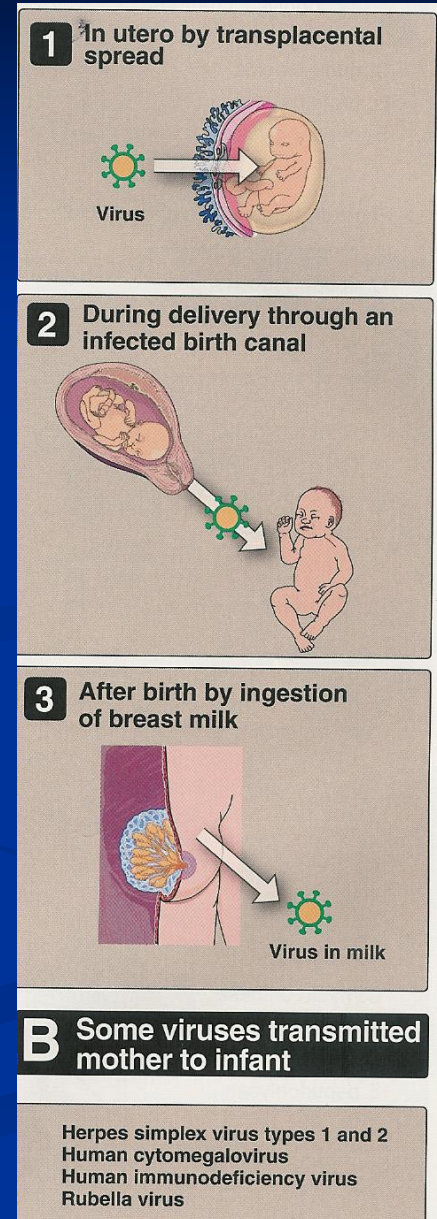
1. *Person to person*

- a) Horizontal transmission
- Skin contact , Blood
 - Respiratory route
 - Fecal - oral route
 - Genital contact
- b) Vertical transmission

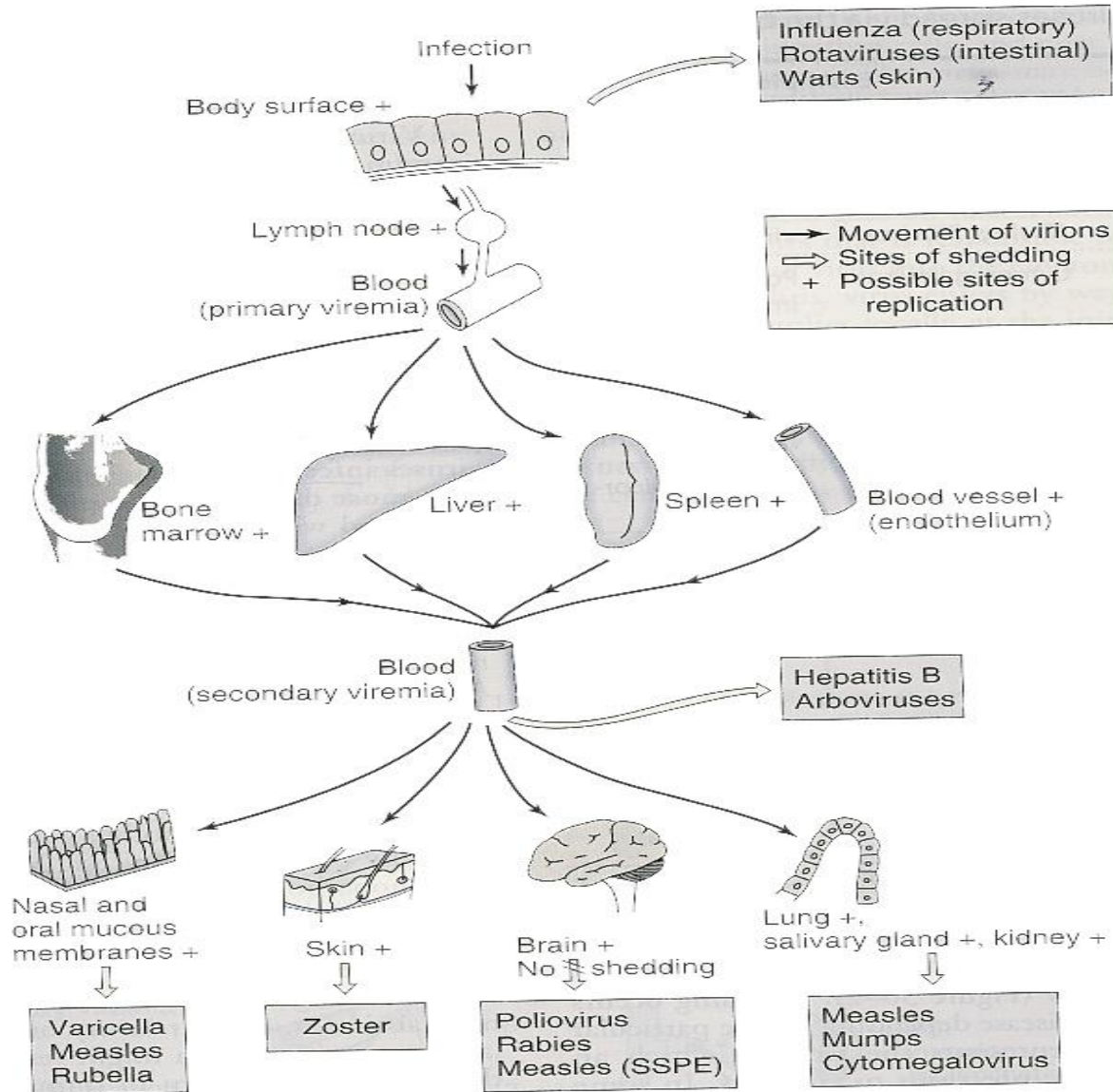
2. *Animal to person*

Reservoir → *Human (Rabies v.)*

Reservoir → *vector* → *Human (YFV)*



Mechanisms of spread of virus through the body

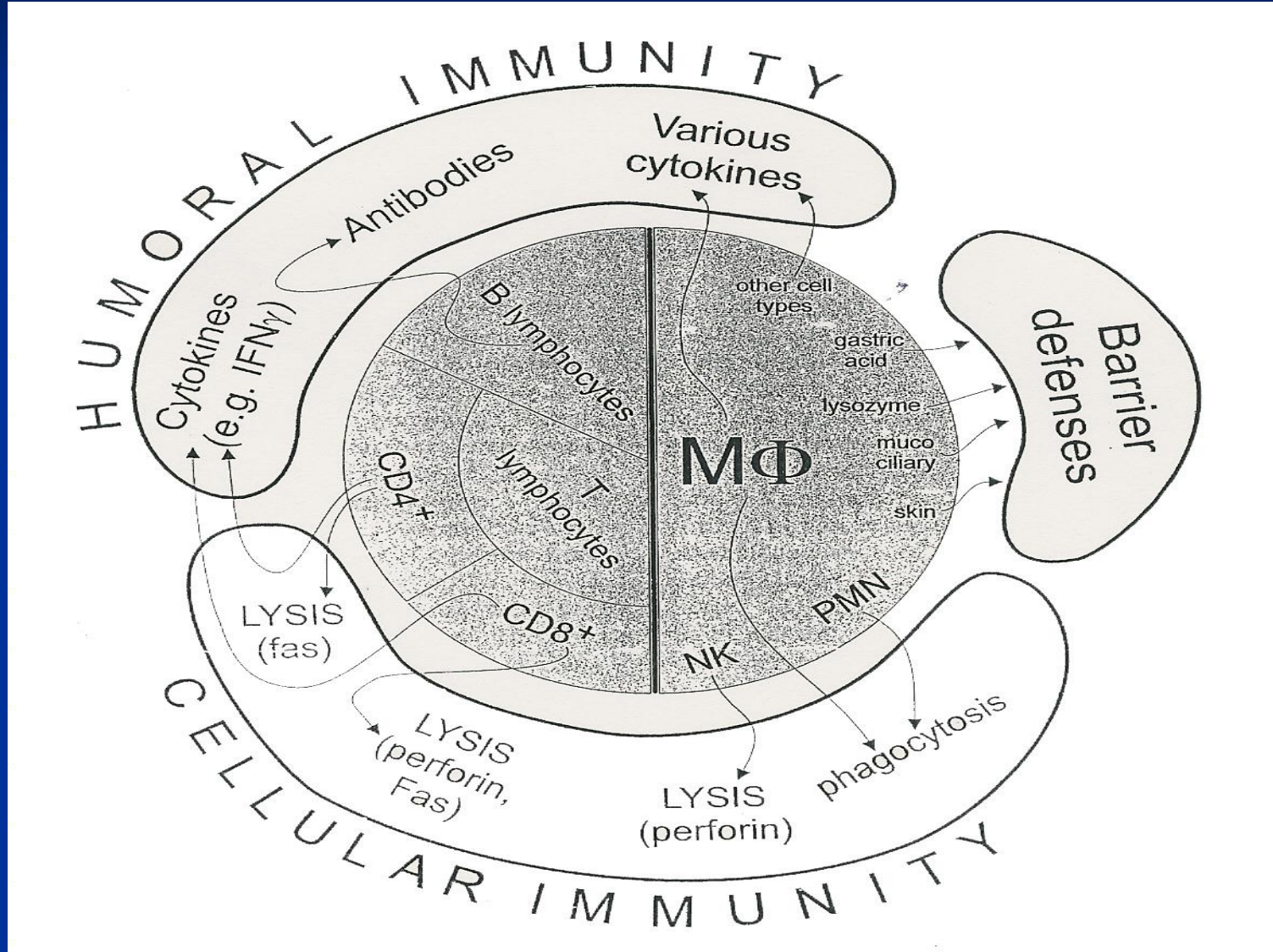


Virus shedding

Important features of Acute Viral Diseases

	<i>Local Infections</i>	<i>Systemic Infections</i>
<i>Ex. of specific Disease</i>	<i>Rhinovirus</i>	<i>Measles</i>
<i>Site of Pathology</i>	<i>Portal of entry</i>	<i>Distant site</i>
<i>IP</i>	<i>Relatively short</i>	<i>Relatively long</i>
<i>Viremia</i>	<i>Absent</i>	<i>Present</i>
<i>Duration of Immunity</i>	<i>Variable- may be short</i>	<i>Usually life long</i>
<i>Role of Secretory AB [IgA] in resistance</i>	<i>Usually important</i>	<i>Usually not important</i>

The immune response to virus



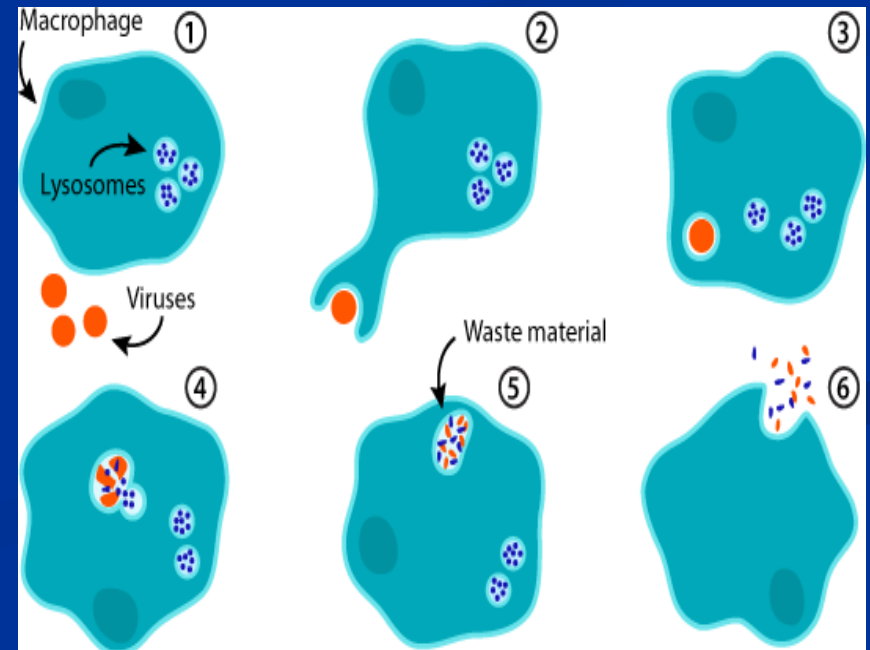
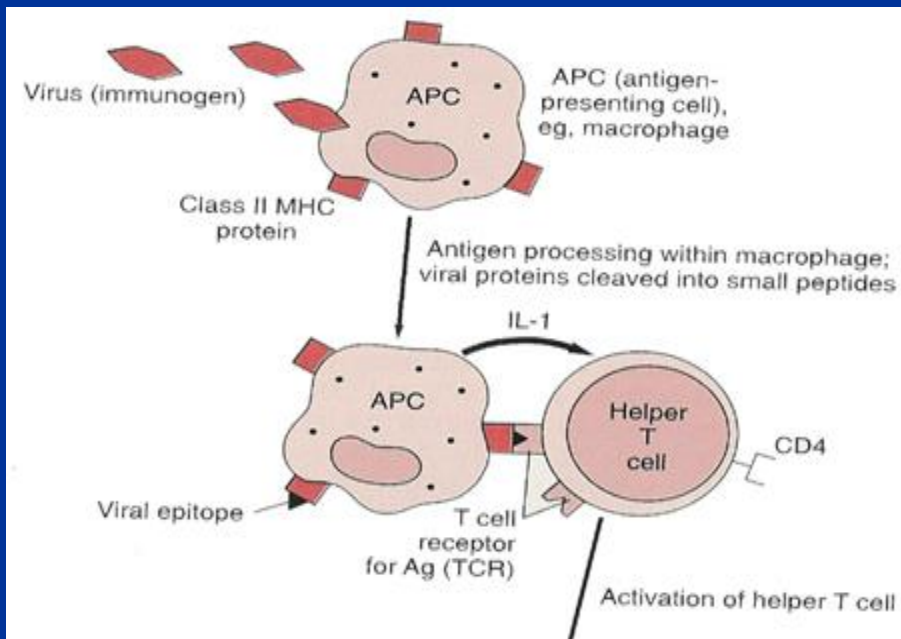
The immune response to virus

❖ Natural killer (NK) cells :

Lysis of VICs

❖ Macrophages:

APC, Cytokines production , Phagocytosis



The immune response to virus

❖ **Natural killer (NK) cells :**

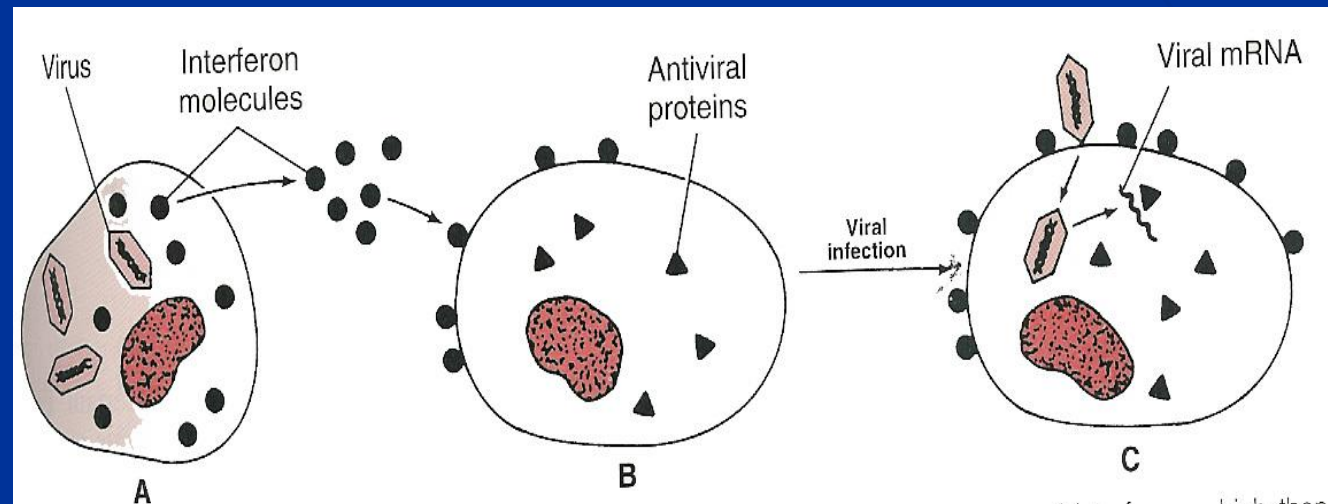
Lysis of VICs

❖ **Macrophages:**

APC, Phagocytosis , Cytokines production

❖ **Cytokines:**

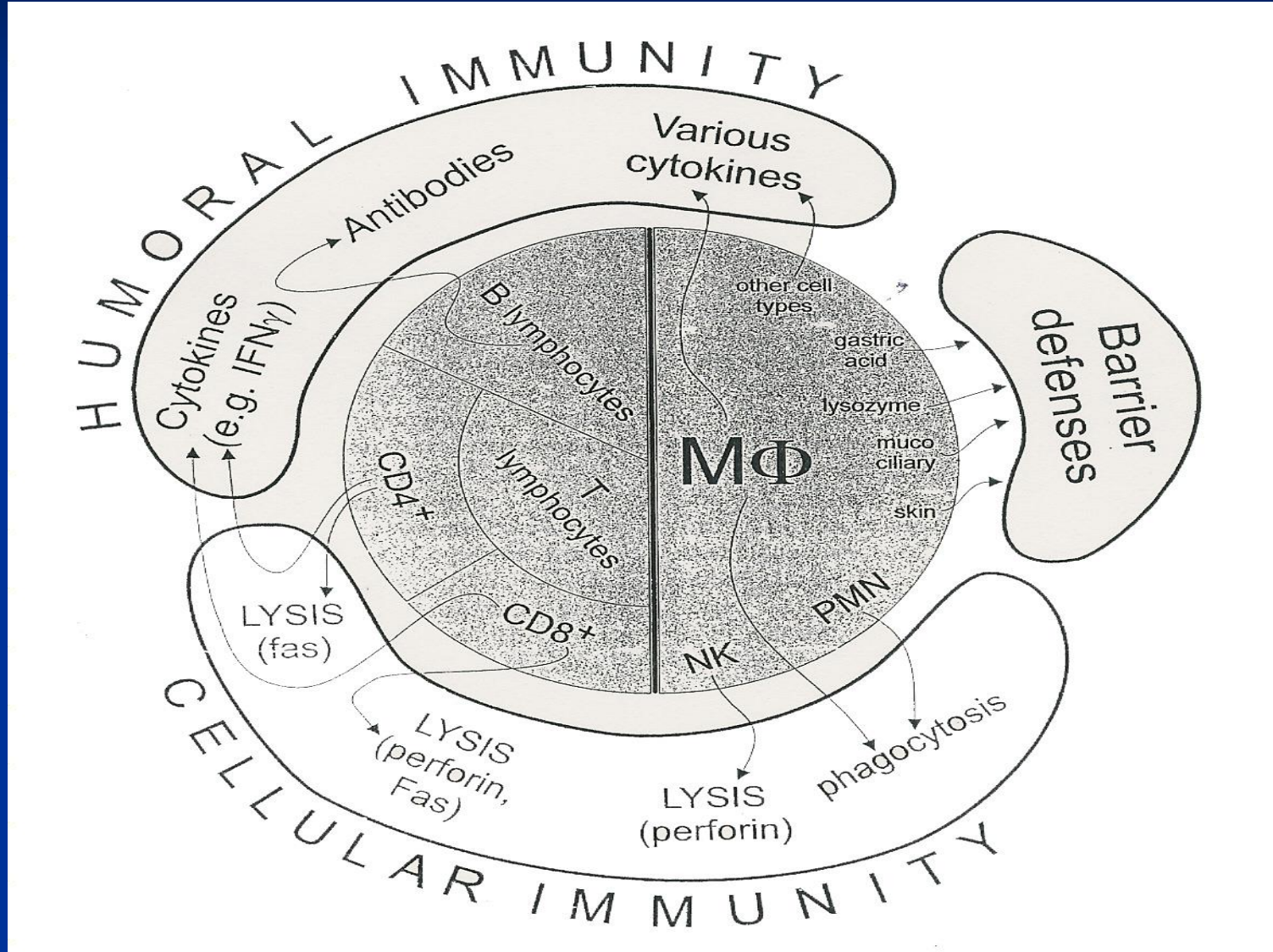
➤ Interferons (IFN)

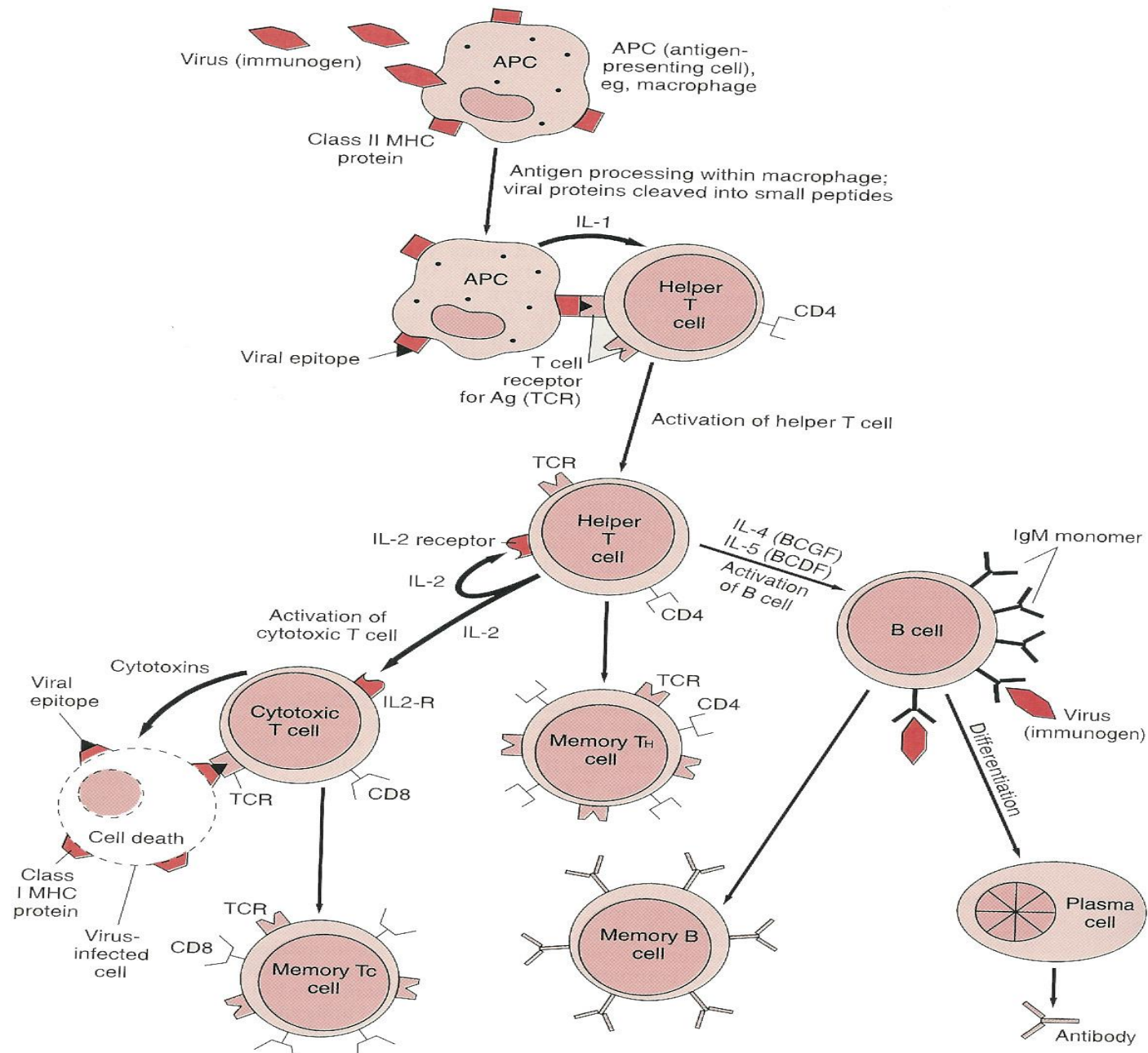


➤ α , β IFN \longrightarrow inhibit viral translation

➤ γ IFN \longrightarrow stimulate phagocytosis and killing by macrophage & NK cells

The immune response to virus

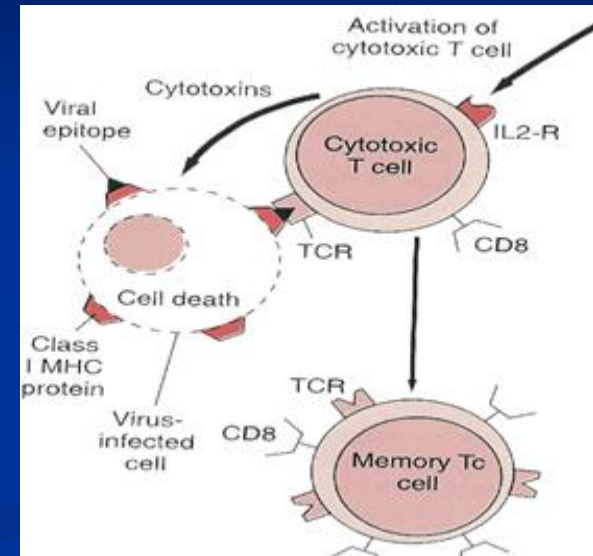




The immune response to virus

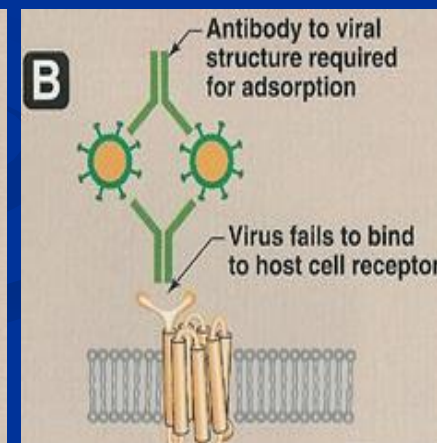
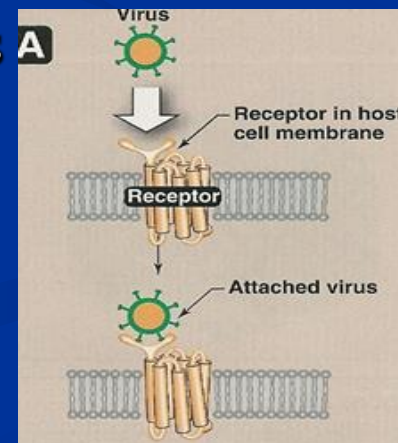
CMI:

- Effective against **intracellular** viruses
- Lysis of virally infected cells by CTCs [CD8]



Humoral Immunity:

- Effective on **extracellular** viruses
- [viremia]
- Neutralization



The stages of a typical viral infection:

1. The incubation period
2. Prodromal period
3. The specific-illness period:

The signs & symptoms of viral diseases are the result of Cell killing by:

A) Inhibition of cellular macromolecular synthesis

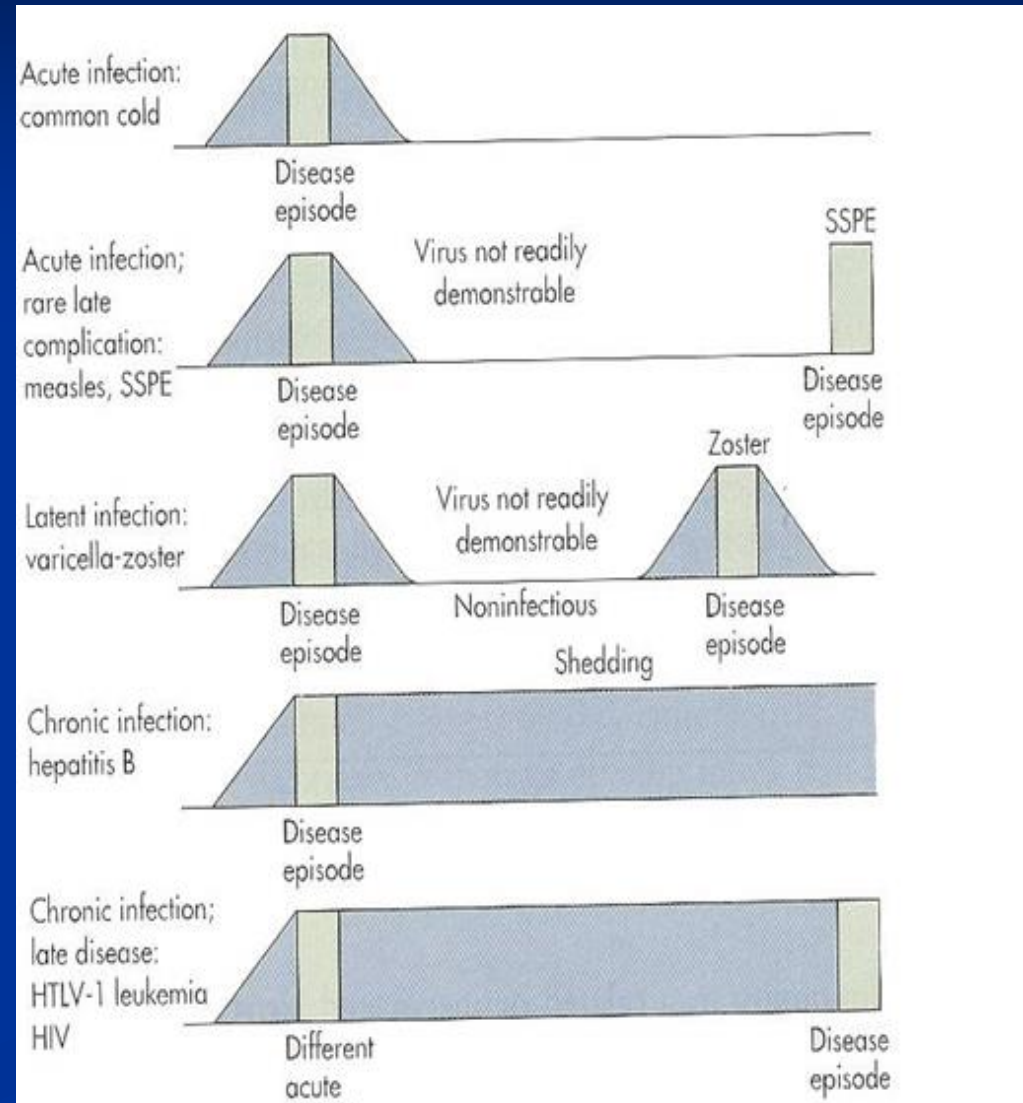
B) Immunologic attack (Immunopathogenesis)

Cytotoxic T cells e.g. Hepatitis (HAV, HBV, HCV)

4. The recovery period

Types of viral infections at host level:

1. Asymptomatic infection
2. Acute infection
3. Persistent infection
 - Late complication of acute infection
 - Latent infection
 - Chronic infection



- **RSV** = Respiratory syncytial virus
- **HAV** = Hepatitis A virus
- **HBV** = Hepatitis B virus.
- **HCV** = Hepatitis C virus
- **HIV** = Human immunodeficiency virus
- **HPV** = Human papillomavirus
- **HSV** = Herpes simplex virus
- **HTLV** = The human T-lymphotropic (leukemia) virus
- **YFV** = Yellow Fever Virus
- **VZV** = Varicella zoster virus

فضل العلم

من سلك طريقا يلتمس فيه علما سهل الله له طريقا إلى الجنة وإن الملائكة لتضع أجنحتها
رضا لطالب العلم وإن طالب العلم يستغفر له من في السماء والأرض حتى الحيتان في الماء وإن
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إن الأنبياء لم يورثوا دينارا ولا درهما إنما ورثوا العلم فمن أخذه أخذ بحظ وافر

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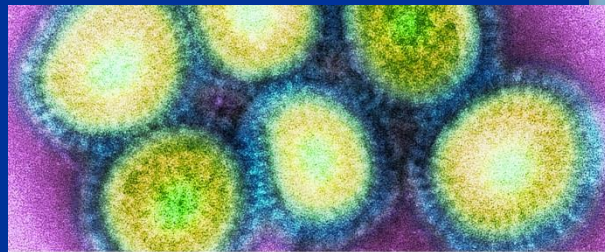
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Reference books

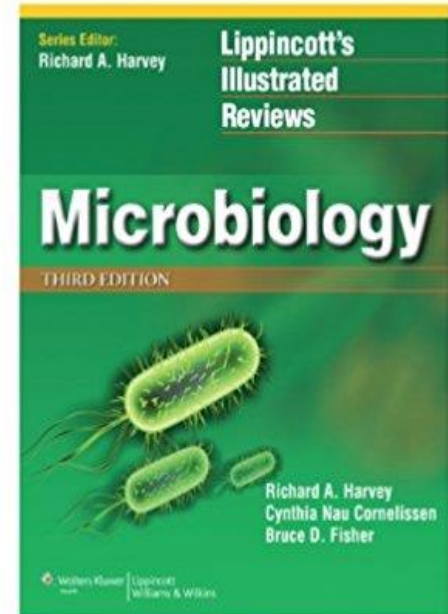


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