

# *Pathogenesis of viral infection*

*(Foundation Block, Microbiology :2017)*

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# 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

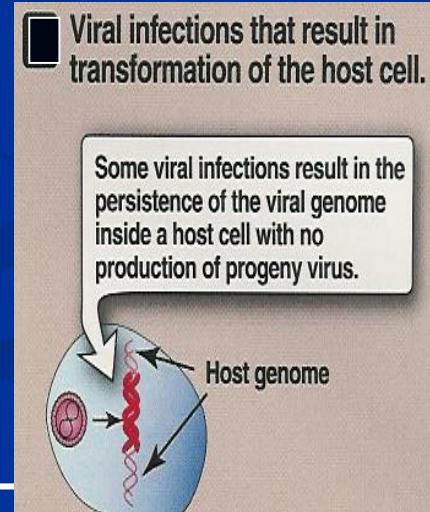
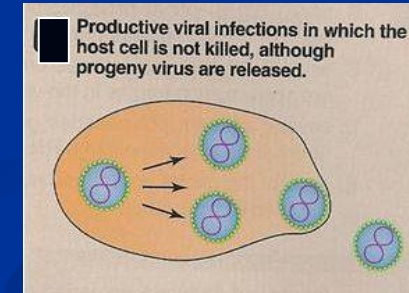
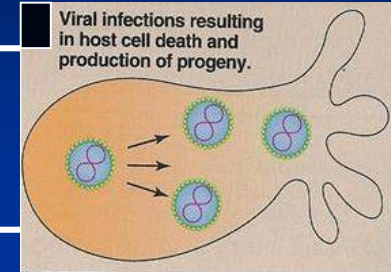
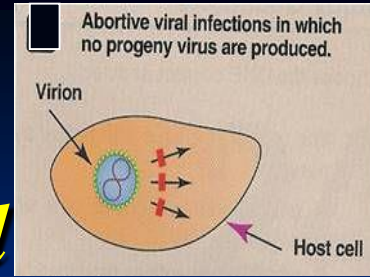
➤ Non-productive

Vs not Produced

- Latent
- Transformation

Viral NA present

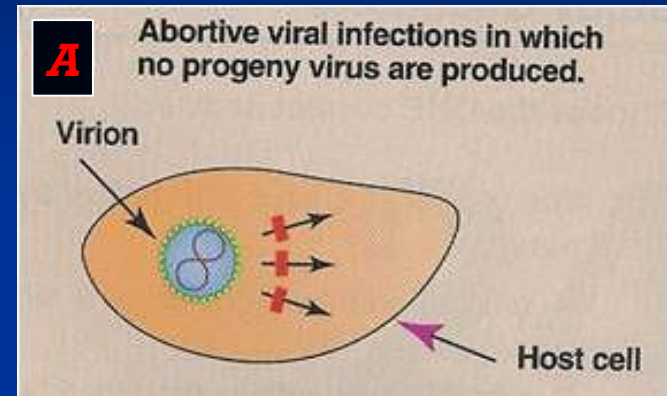
Viral NA present



# The types of viral infections at cellular level

## **A) Abortive Infections:**

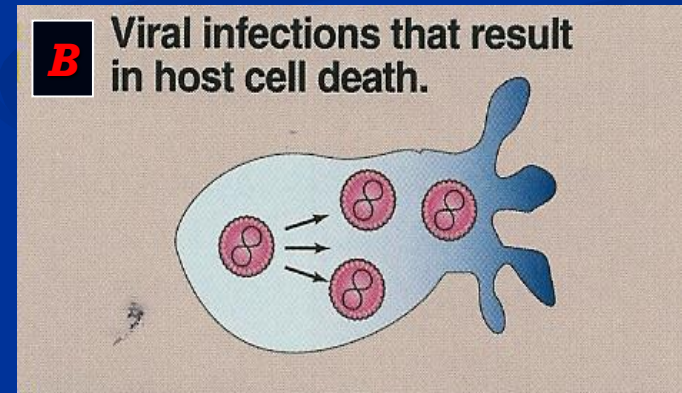
- Viruses don't complete the replication cycle
- Due to mutation, defective interfering particles & the action of IFNs



## **B) Productive Infections:**

### 1. Cytolytic Infections

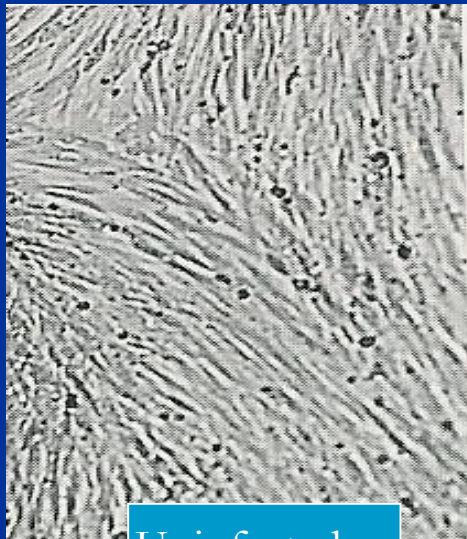
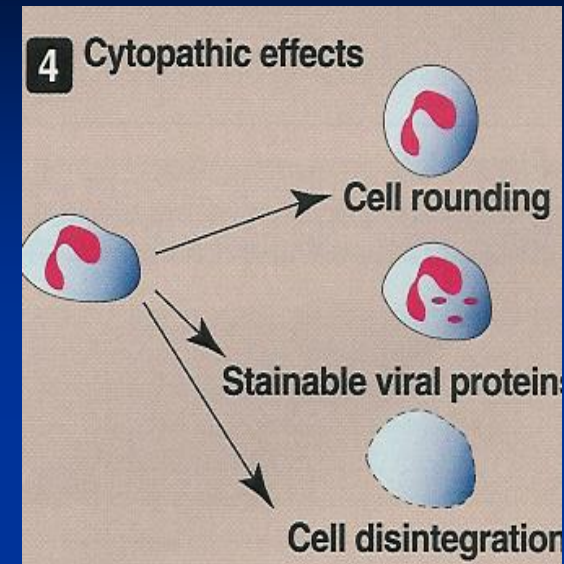
- Viruses replicate & produce progeny
- Cell death & Cytopathic effects [CPE]
- Inhibition of cellular protein & NA synthesis



# Cytopathic Effects

■ CPE can take several forms:

1. Cell lysis
2. Cell rounding
3. Syncytium formation
4. Inclusion bodies formation



Uninfected cc



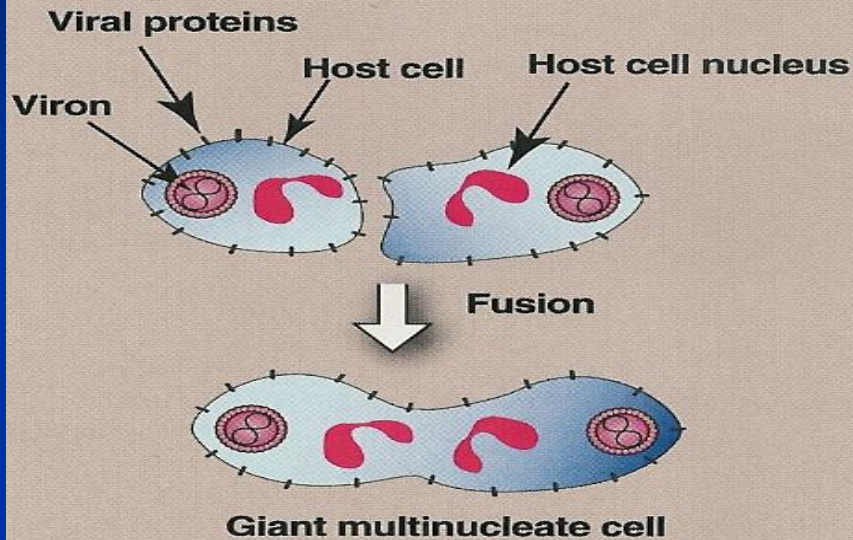
Cell rounding



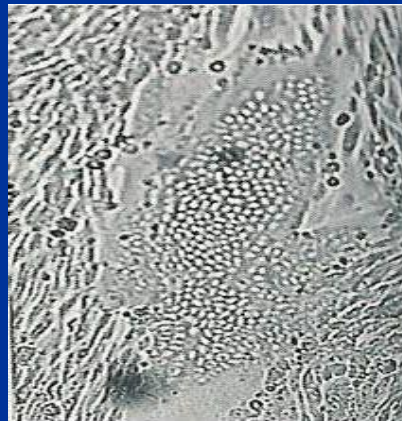
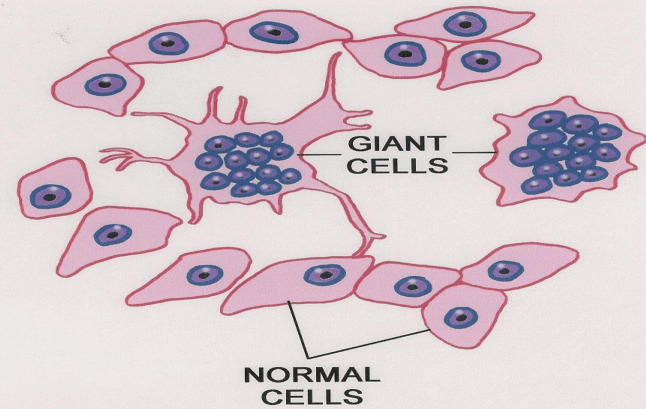
Syncytium

# 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.]

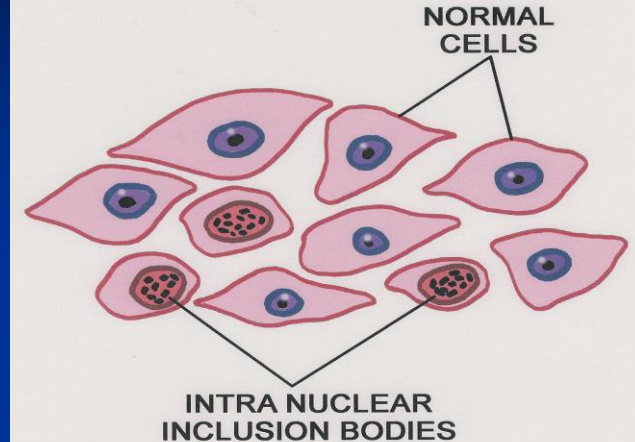


## Take several forms:

- Small/large
- Single/multiple
- Round/irregular

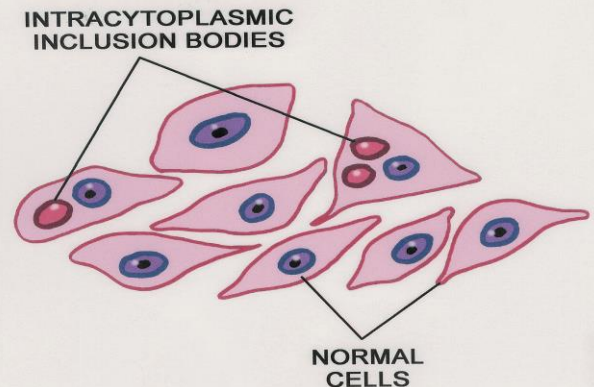
### **INCLUSION BODIES:**

The site of VIRAL multiplication and protien synthesis



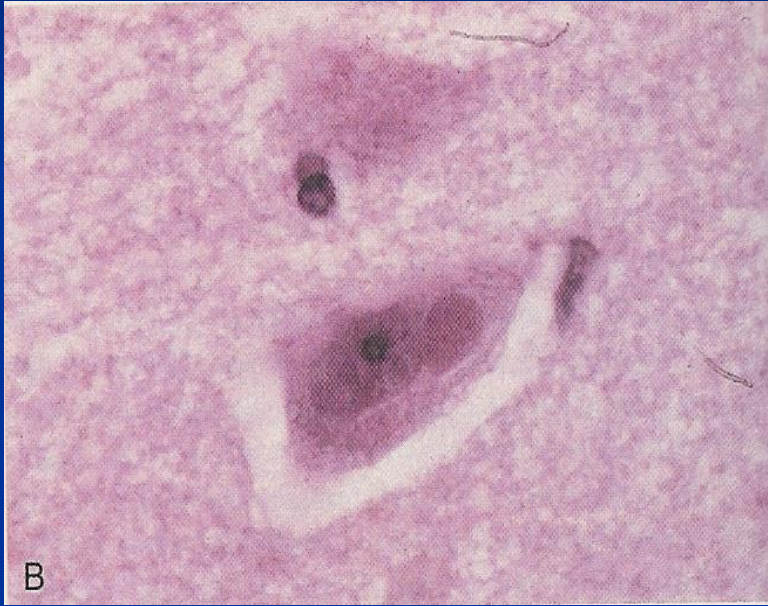
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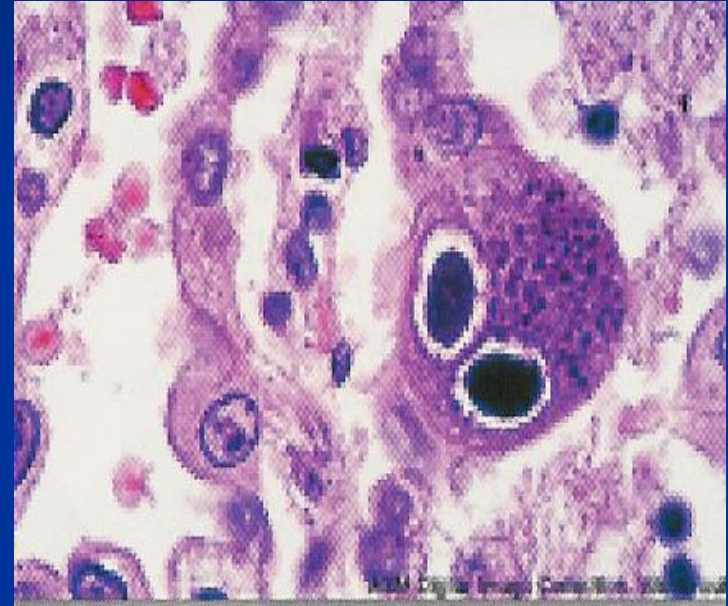




# *Inclusion bodies formation*



*Negri bodies caused by  
Rabies virus*



*Owl's eye inclusions  
caused by CMV*

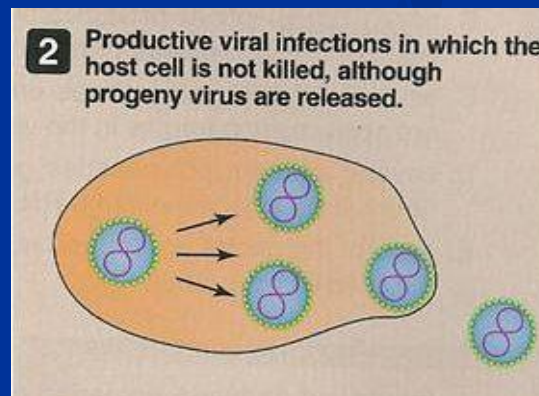
# The types of viral infections at cellular level

## **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.

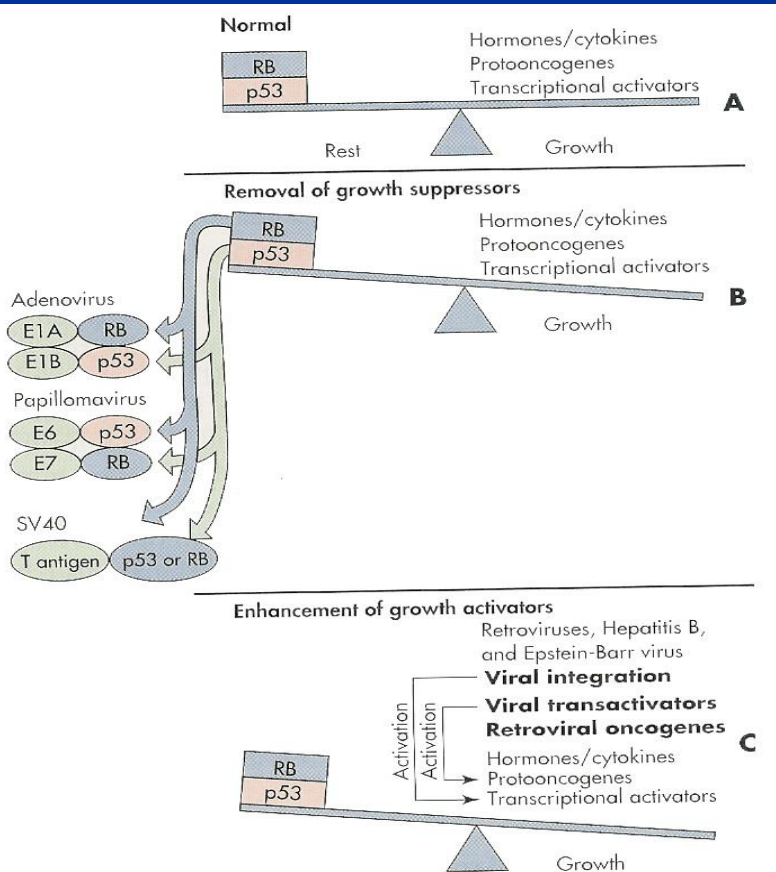
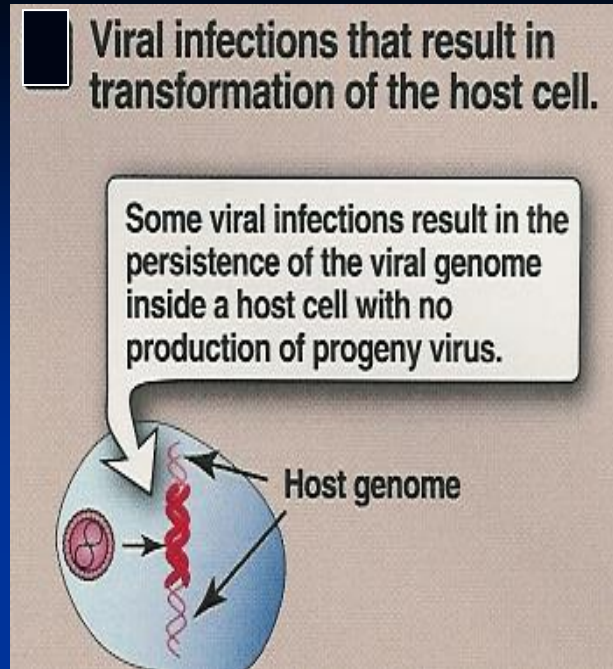
### *1) Latent Infection:*

- 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

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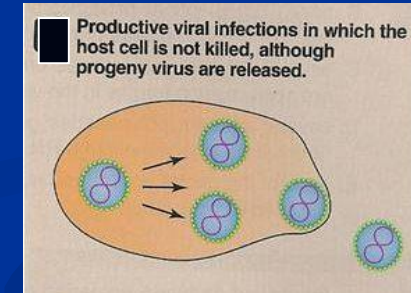
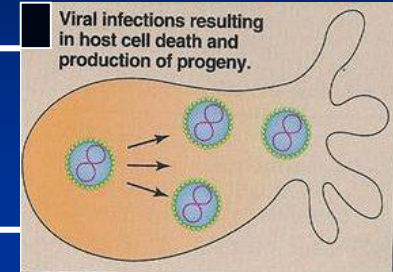
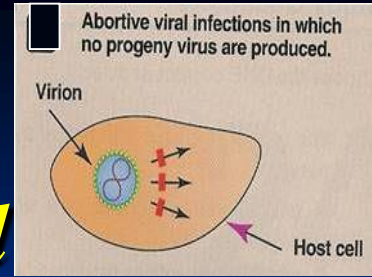
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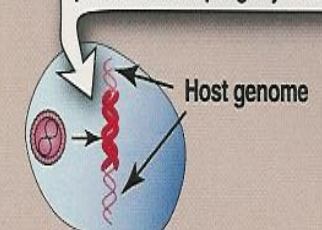
Viral NA present

Viral NA present



Viral infections that result in transformation of the host cell.

Some viral infections result in the persistence of the viral genome inside a host cell with no production of progeny virus.



# *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

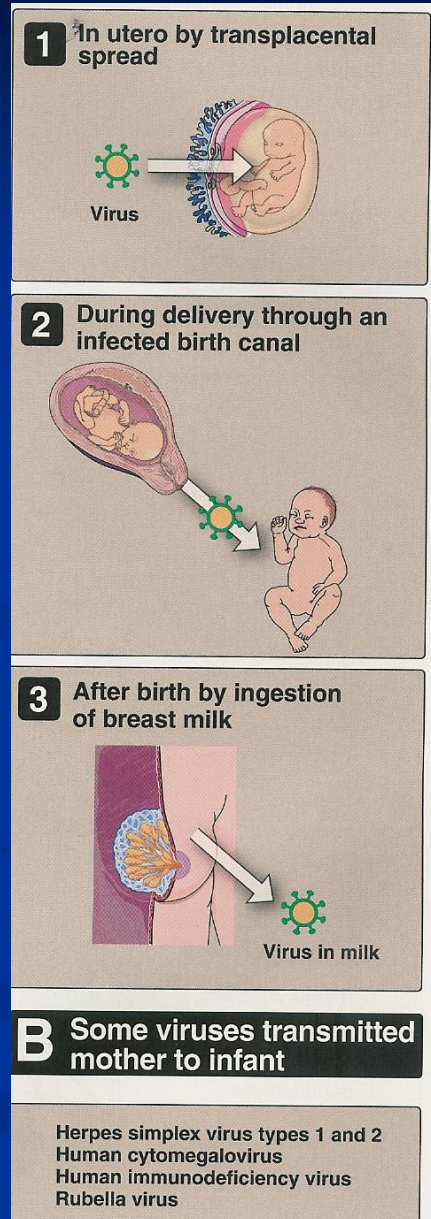
- Skin contact , Blood
- Respiratory route
- Fecal - oral route
- Genital contact

### b) Vertical transmission

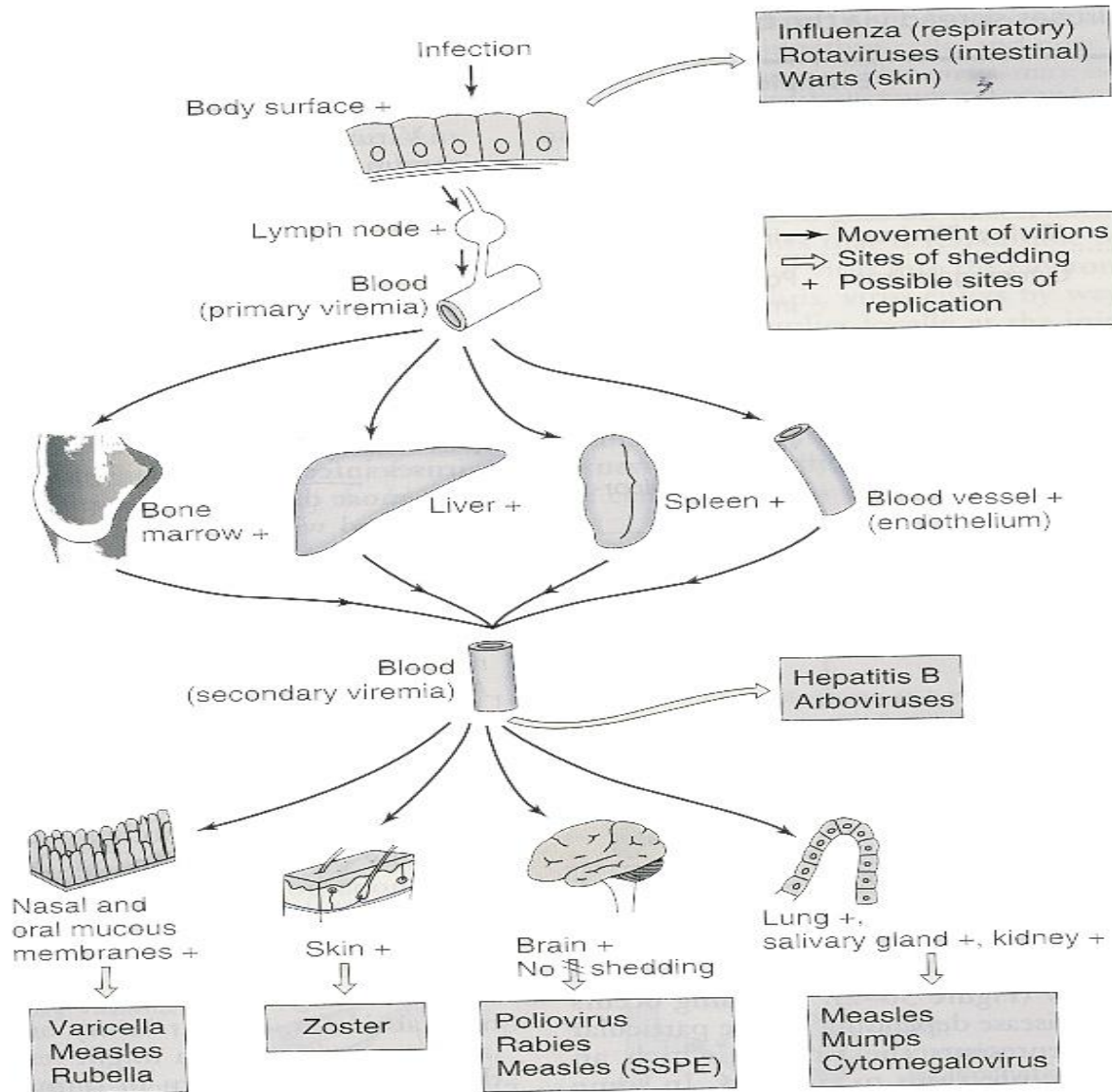
## 2. Animal to person

*Reservoir*  $\longrightarrow$  *Human (Rabies v. )*

*Reservoir*  $\xrightarrow{\text{vector}}$  *Human (YFV)*



# Mechanisms of spread of virus through the body



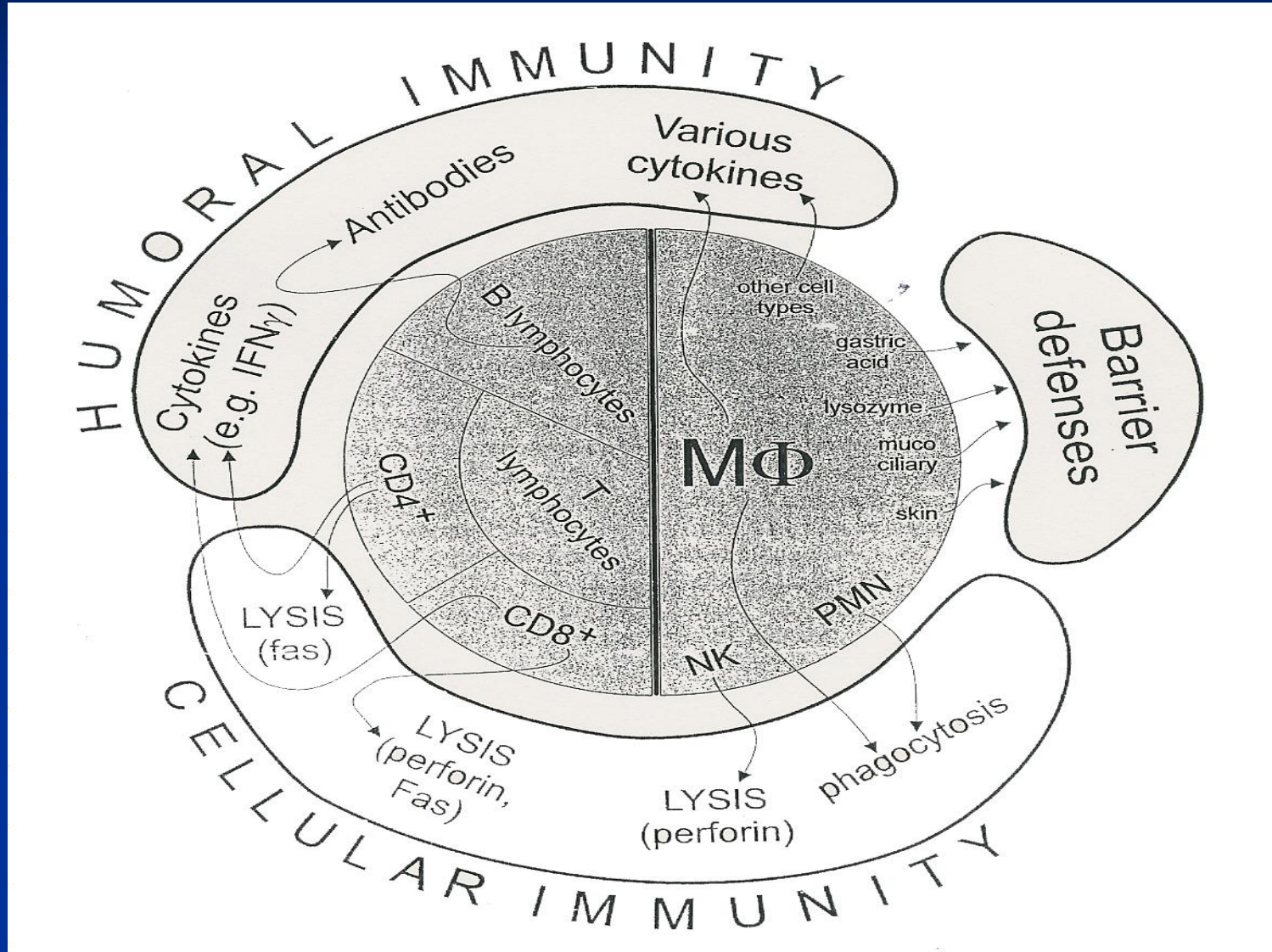
**Virus  
shedding**



# 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



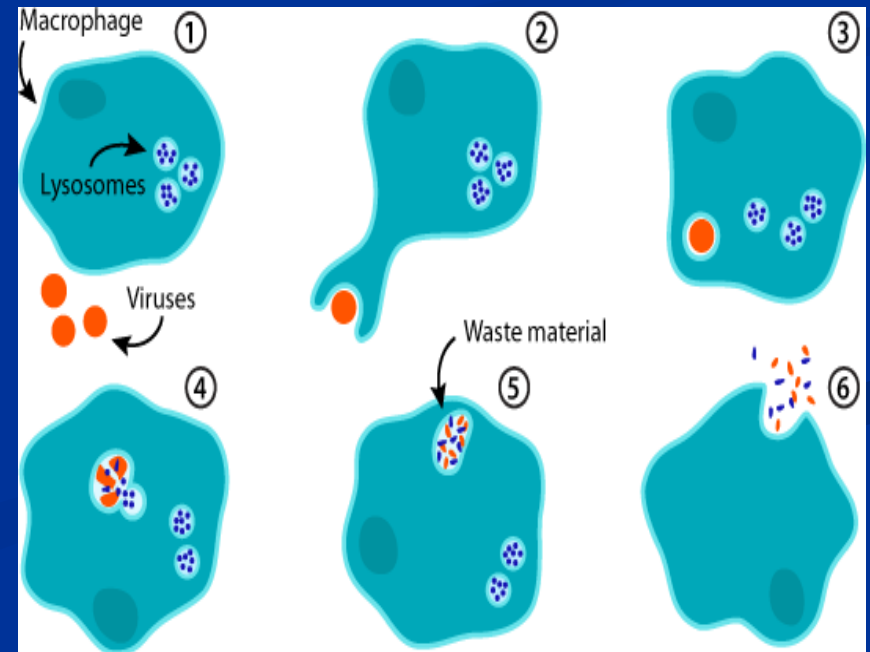
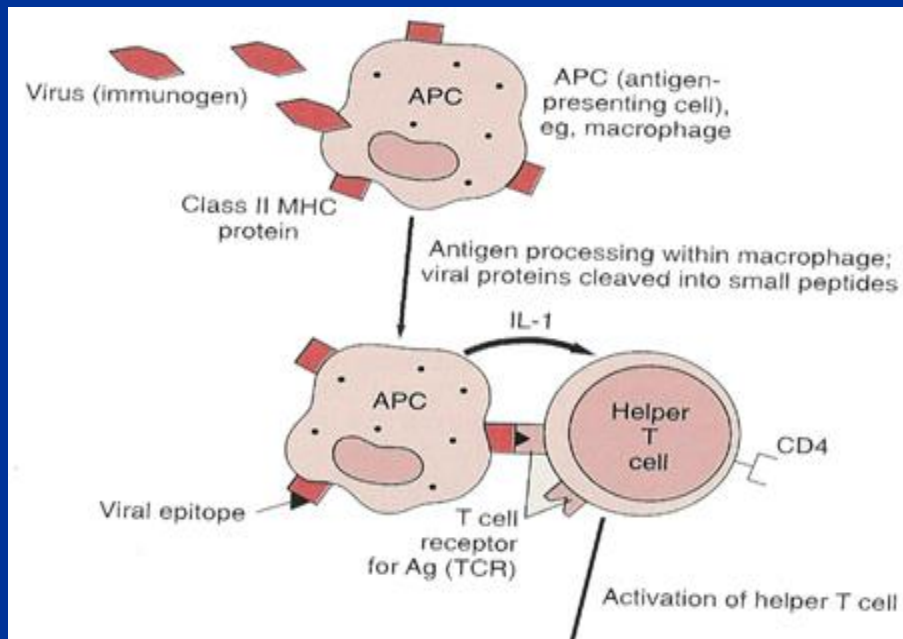
# The immune response to virus

❖ Natural killer (NK) cells :

Lysis of VICs

❖ Macrophages:

APC, Cytokines production ,Phagocytosis



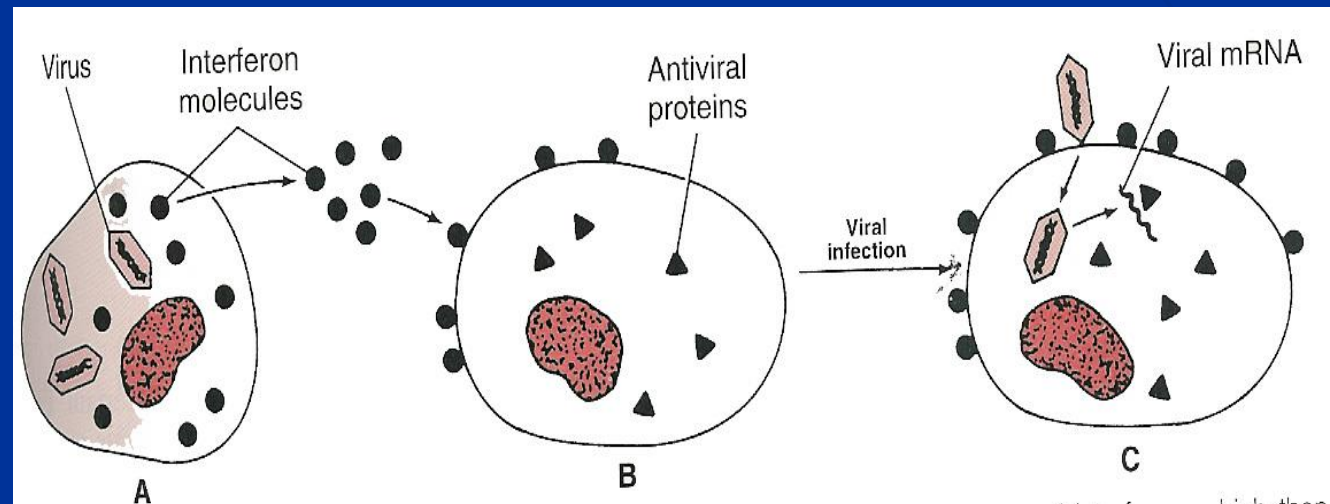
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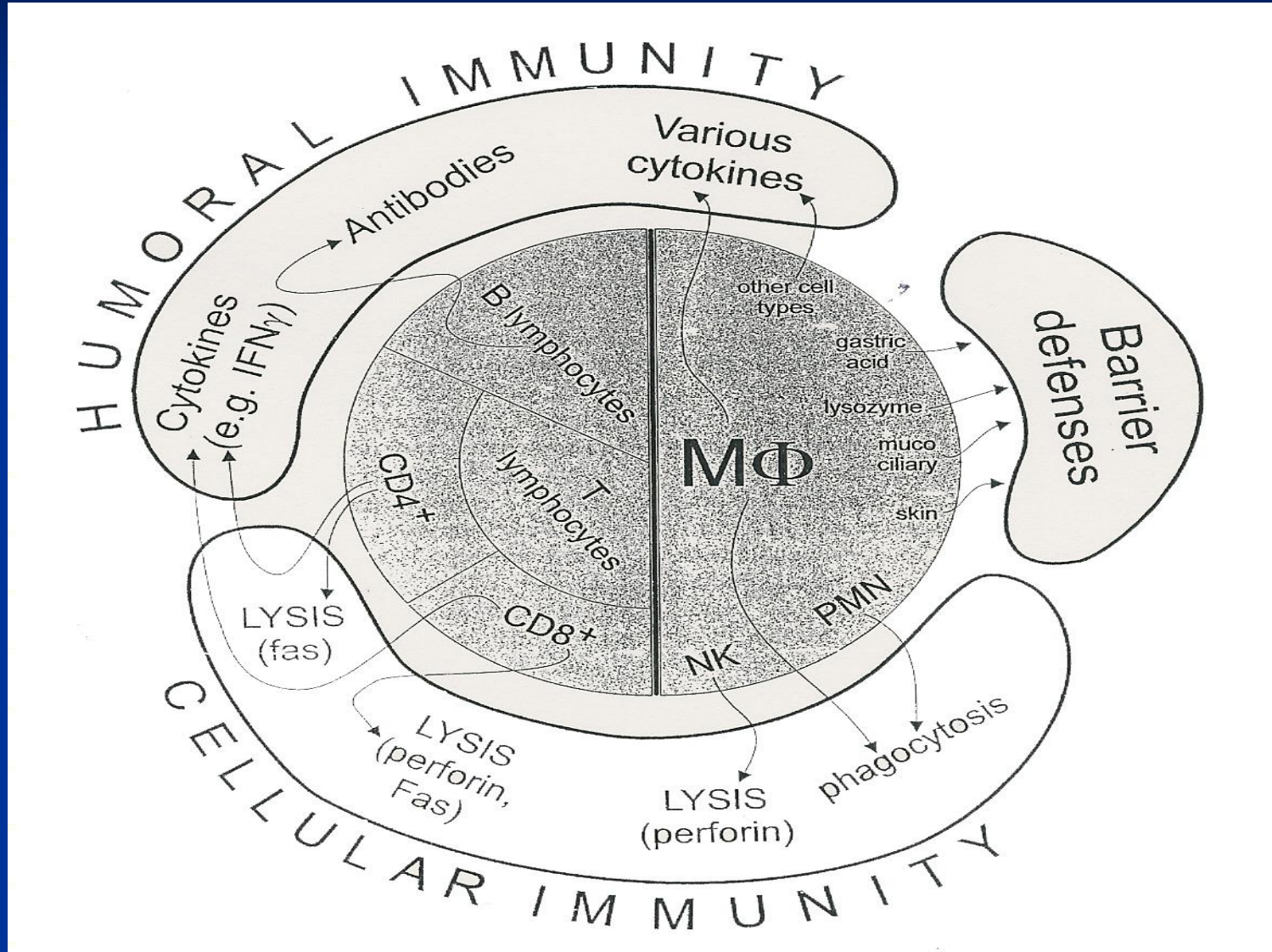
❖ **Cytokines:**

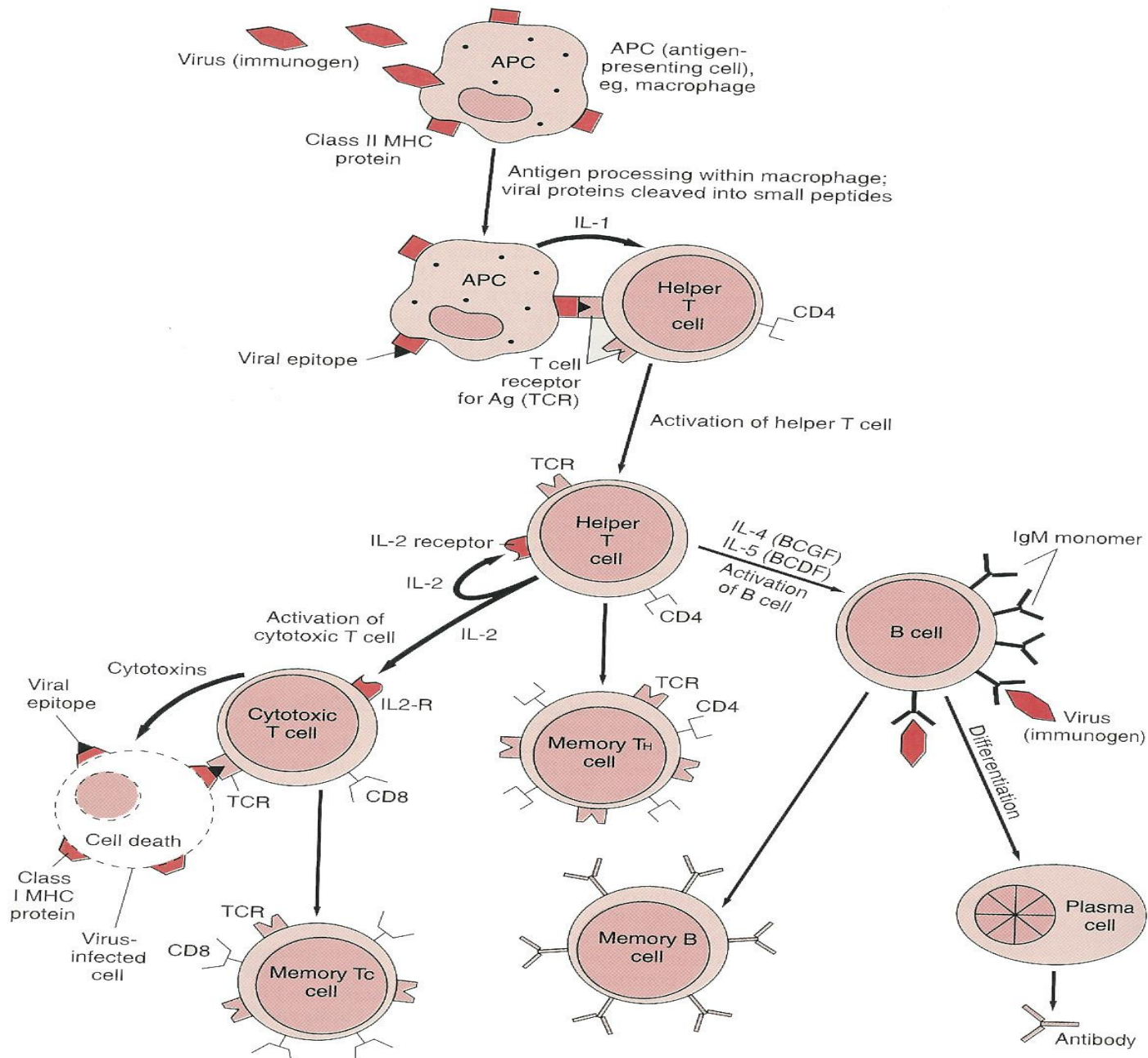
➤ Interferons  
(IFN)



- $\alpha$  ,  $\beta$  IFN  $\longrightarrow$  inhibit viral translation
- $\gamma$  IFN  $\longrightarrow$  stimulate phagocytosis and killing by macrophage & NK cells

# The immune response to virus



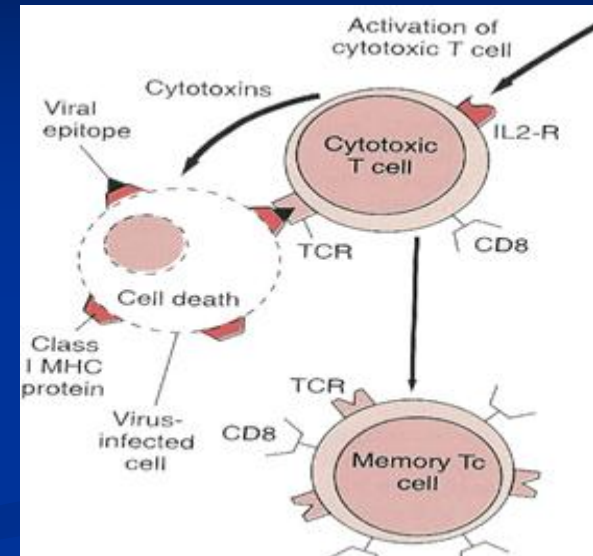


# The immune response to virus



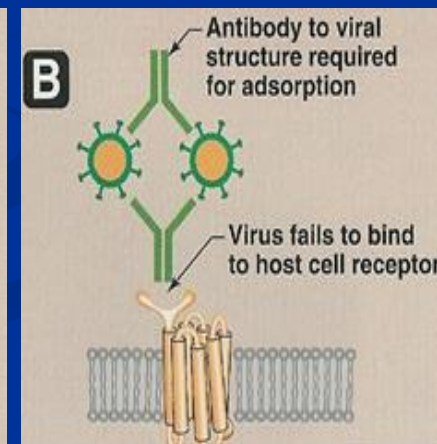
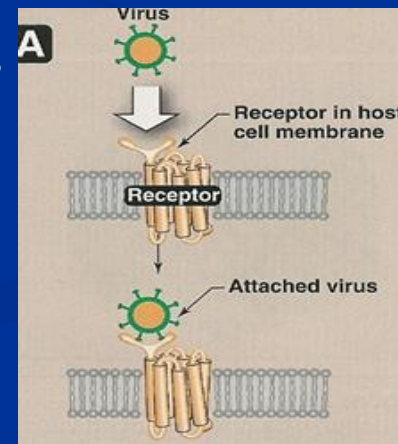
## **CMI:**

- 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)

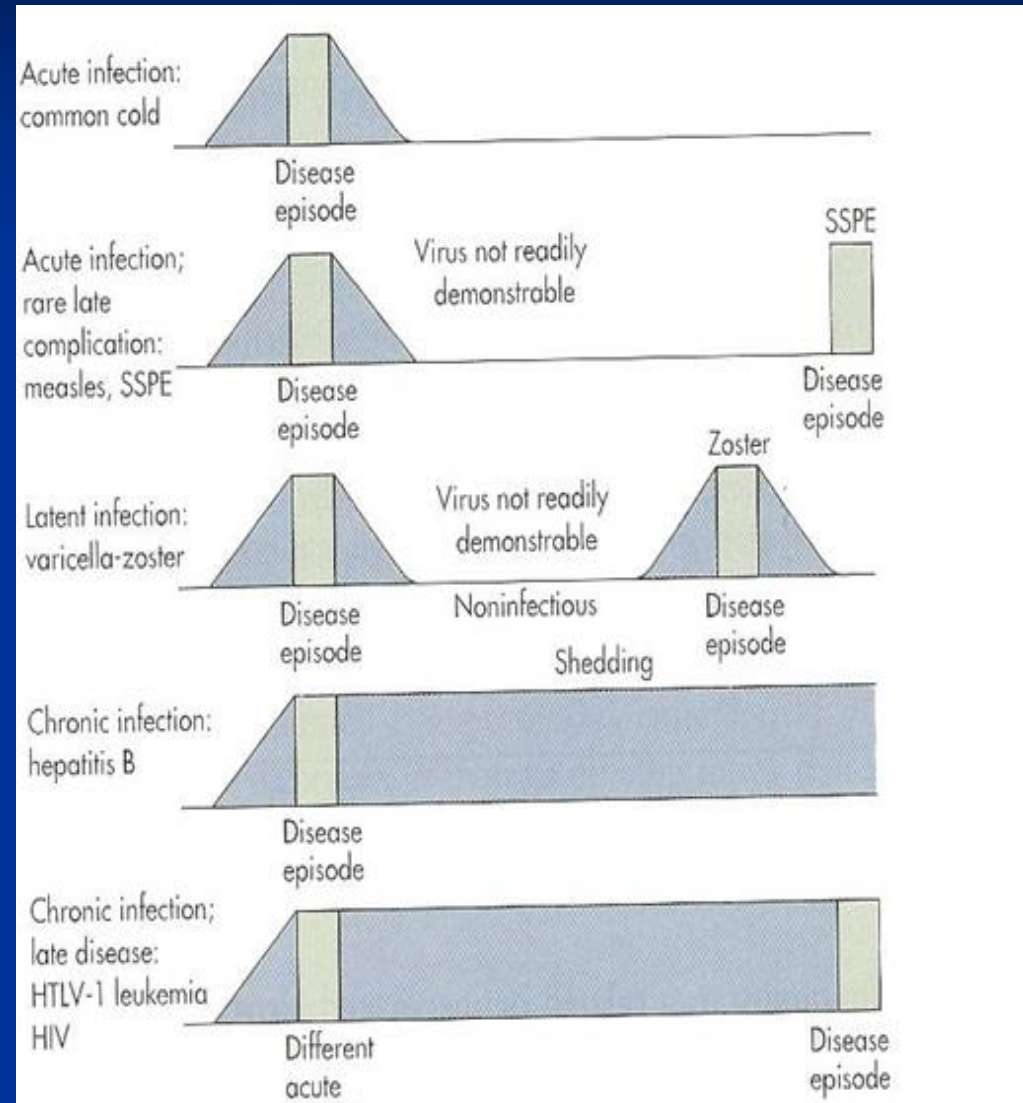
Cytotoxic T cells e.g. Hepatitis (HAV, HBV, HCV)

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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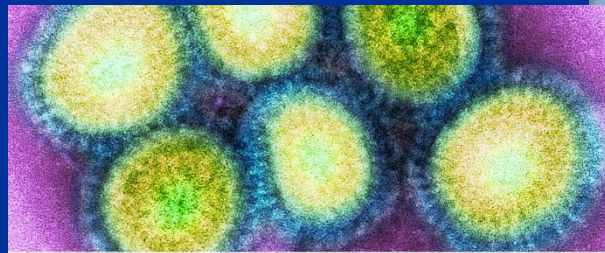
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# Reference books

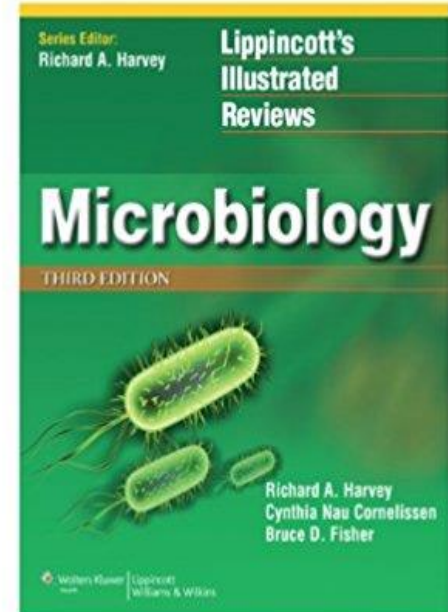


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