Pathogenesis of viral infection

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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.

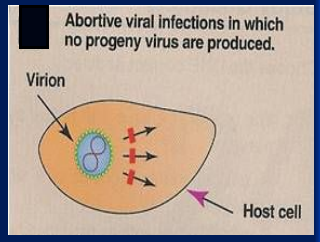
Pathogenesis of viral infection

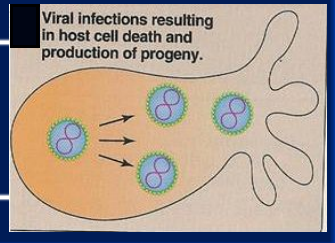
- Viral disease at the cellular level
  - Cytopathogenesis
- Viral disease at the host level
  - Mechanism of the disease

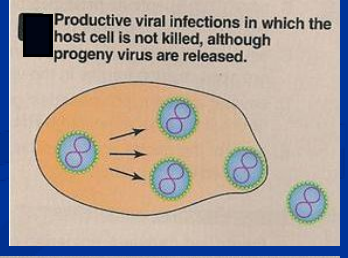
Cytopathogenesis:

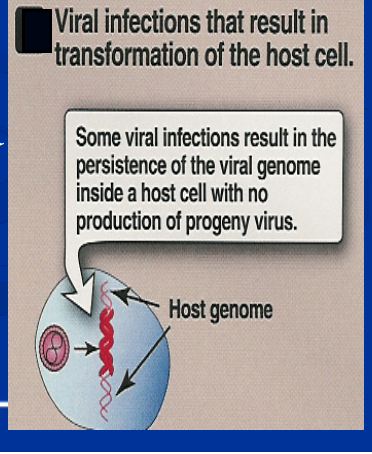
The types of viral infections at cellular level

The effects on cells/ Type of Infection	Virus Production
Abortive	Vs not produced
Productive	
Cytolytic	Vs Produced
Non-cytolytic	Vs Produced
Non-productive	Vs not Produced
Latent	Viral NA present
Transformation	Viral NA present







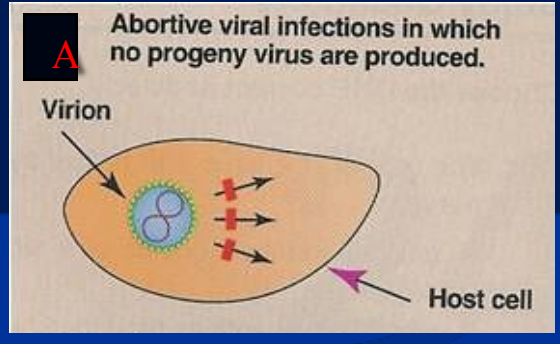


The types of viral infections at cellular level

A) *Abortive Infections:*

Viruses don't complete the replication cycle

Due to mutation, defective interfering particles & the action of IFNs



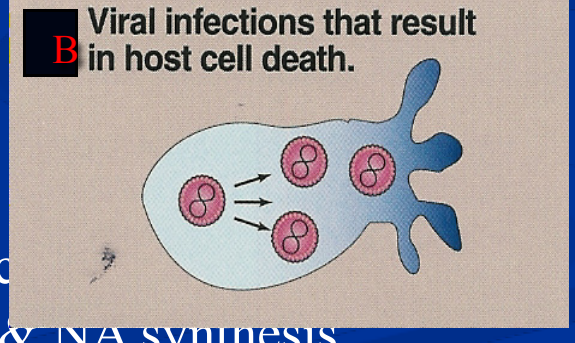
B) *Productive Infections:*

Cytolytic Infections

Viruses replicate & produce progeny

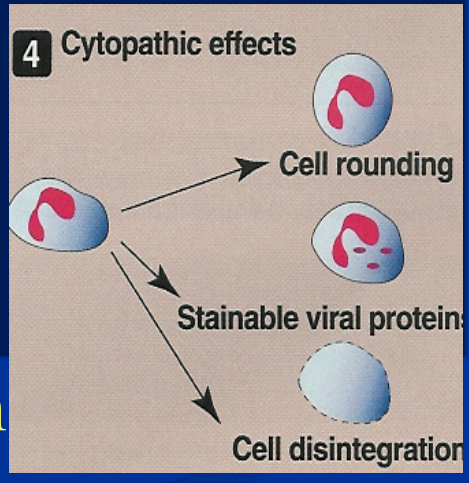
Cell death & Cytopathic effec

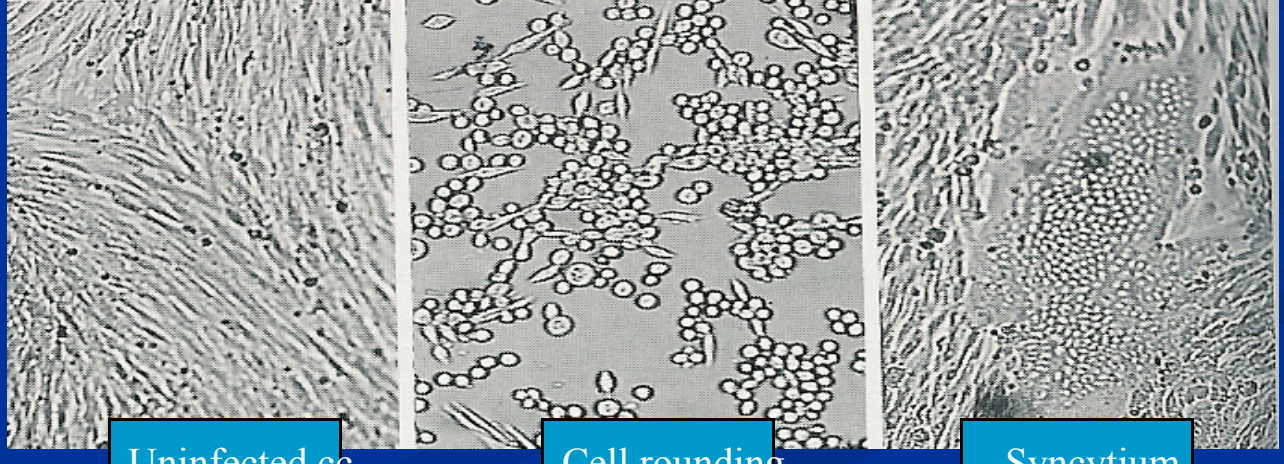
Inhibition of cellular protein & NA synthesis



Cytopathic Effects

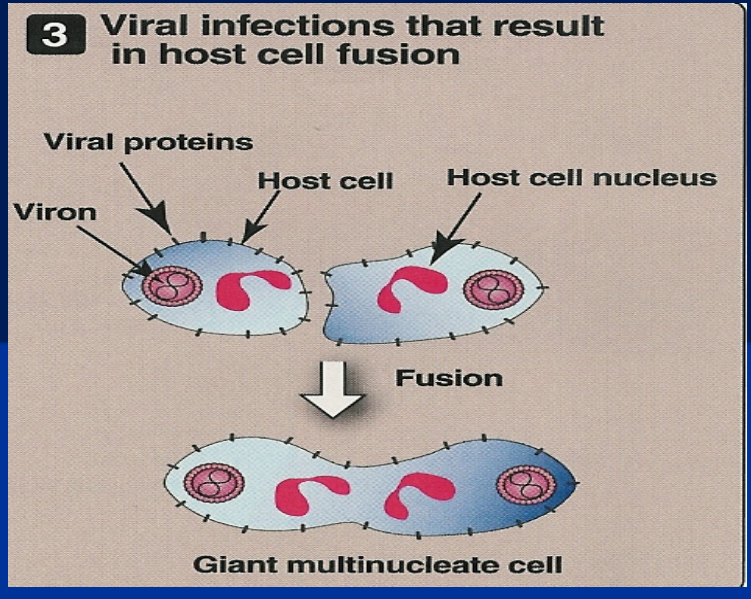
- CPE can take several forms:
  - Cell lysis
  - Cell rounding
  - Syncytium formation
  - Inclusion bodies formation

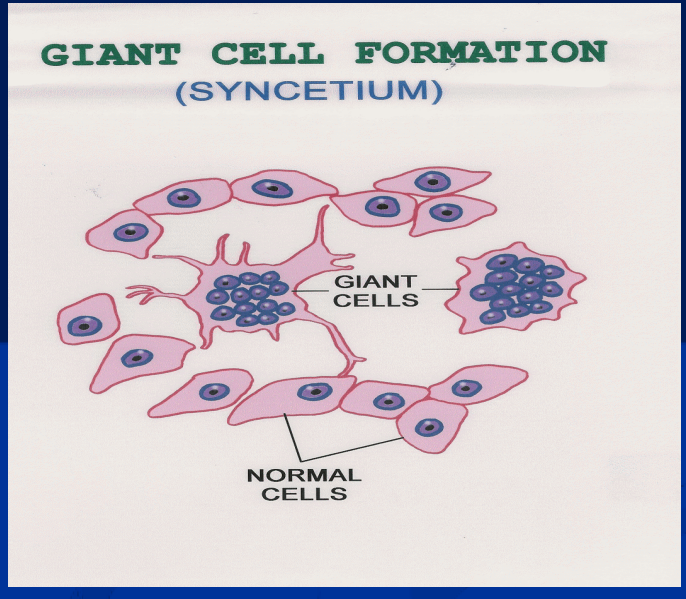




Uninfected cc | Cell rounding | Syncytium

Syncytium formation





Syncytium

Inclusion bodies formation

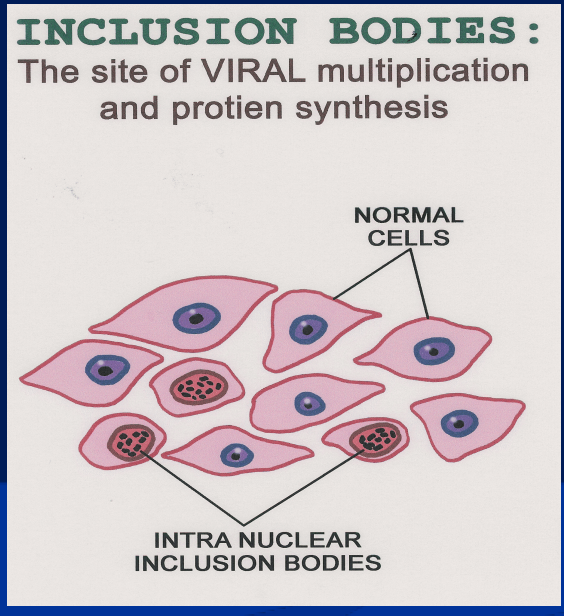
Site:

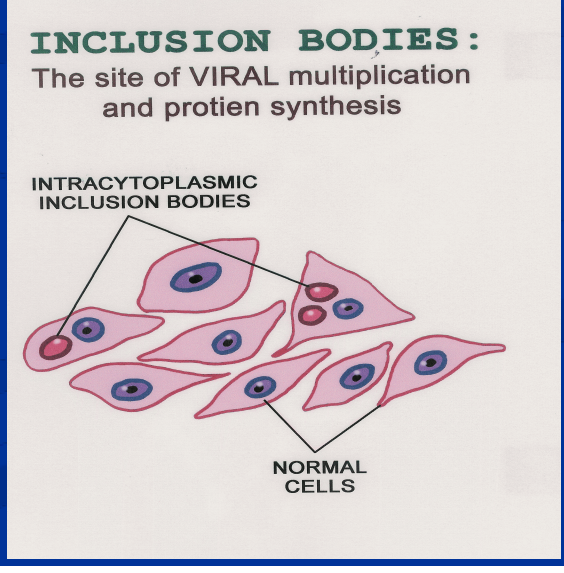
Intranuclear [Herpes V.]

Intracytoplasmic [Rabies V.]

Take several forms:

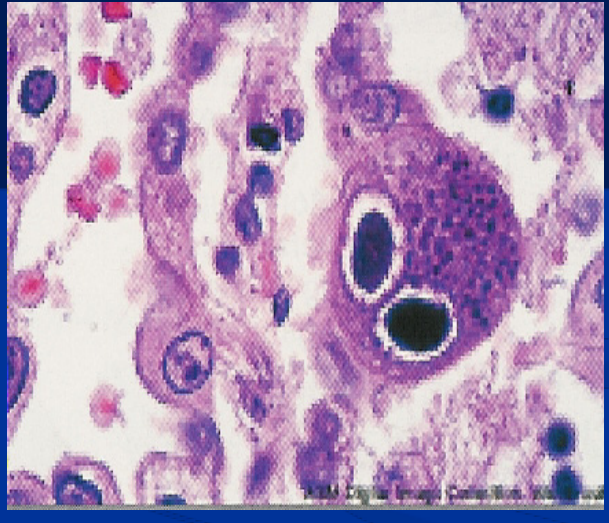
Small/large
Single/multiple
Round/irregular





Inclusion bodies formation

Negri bodies caused by Rabies virus



Owl's eye inclusions caused by CMV

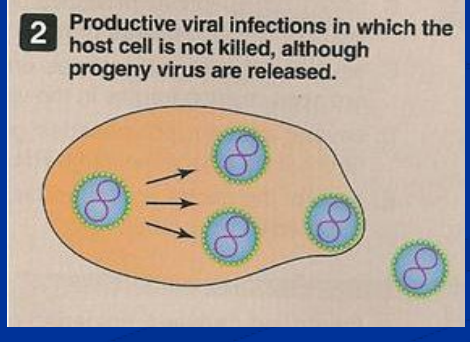
The types of viral infections at cellular level

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

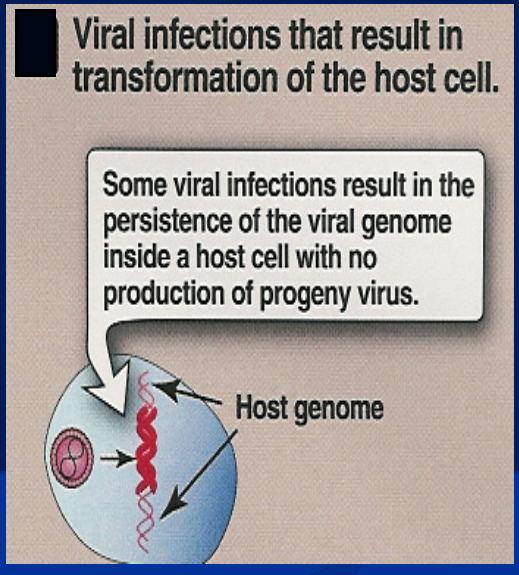
there is limited expression of viral genes

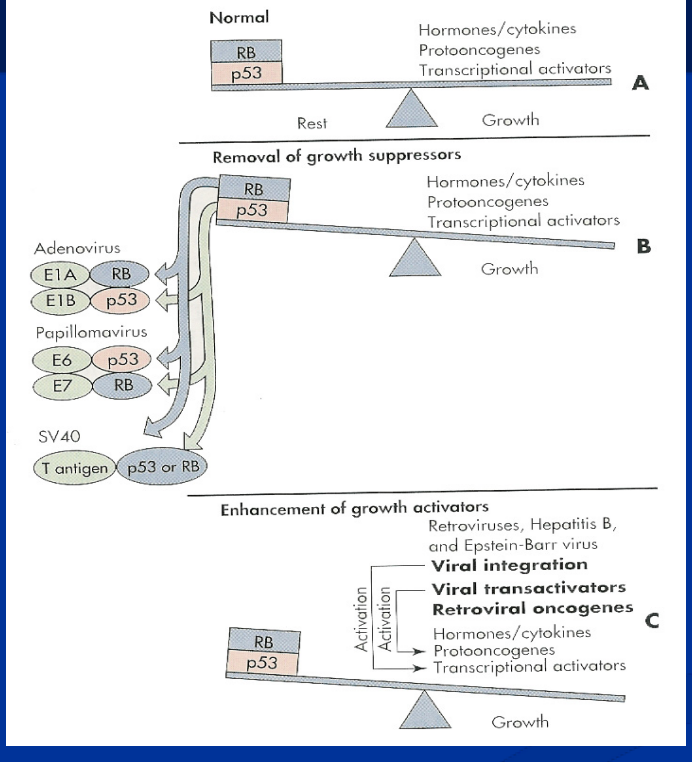
Ex: HSV

2) Transformation:

Transformation:

Ex ; EBV, HPV and HTLV
Cause tumor in animals & H





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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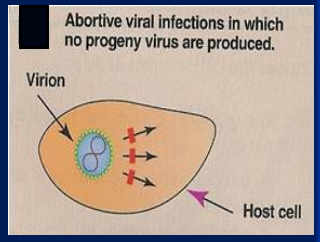
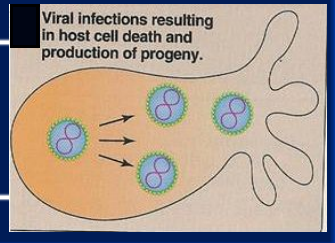
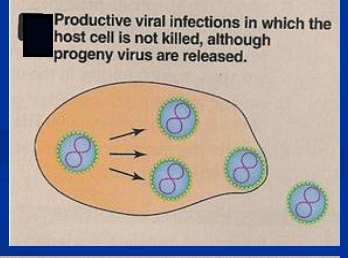
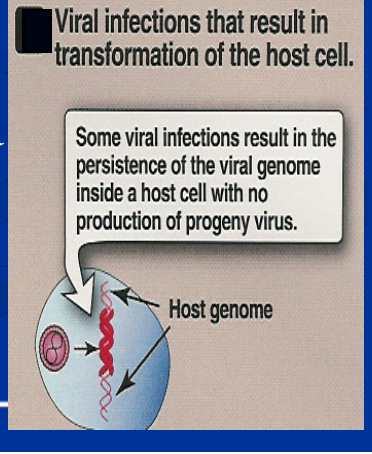








Pathogenesis at Host Level

- 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

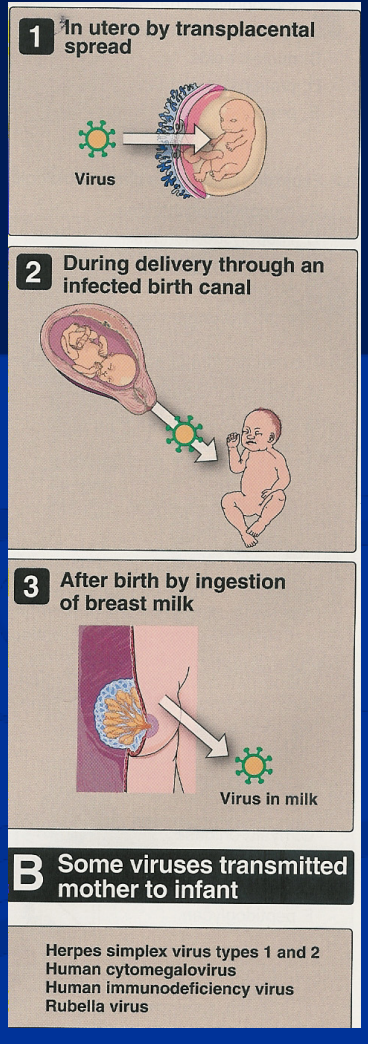
Person to person

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

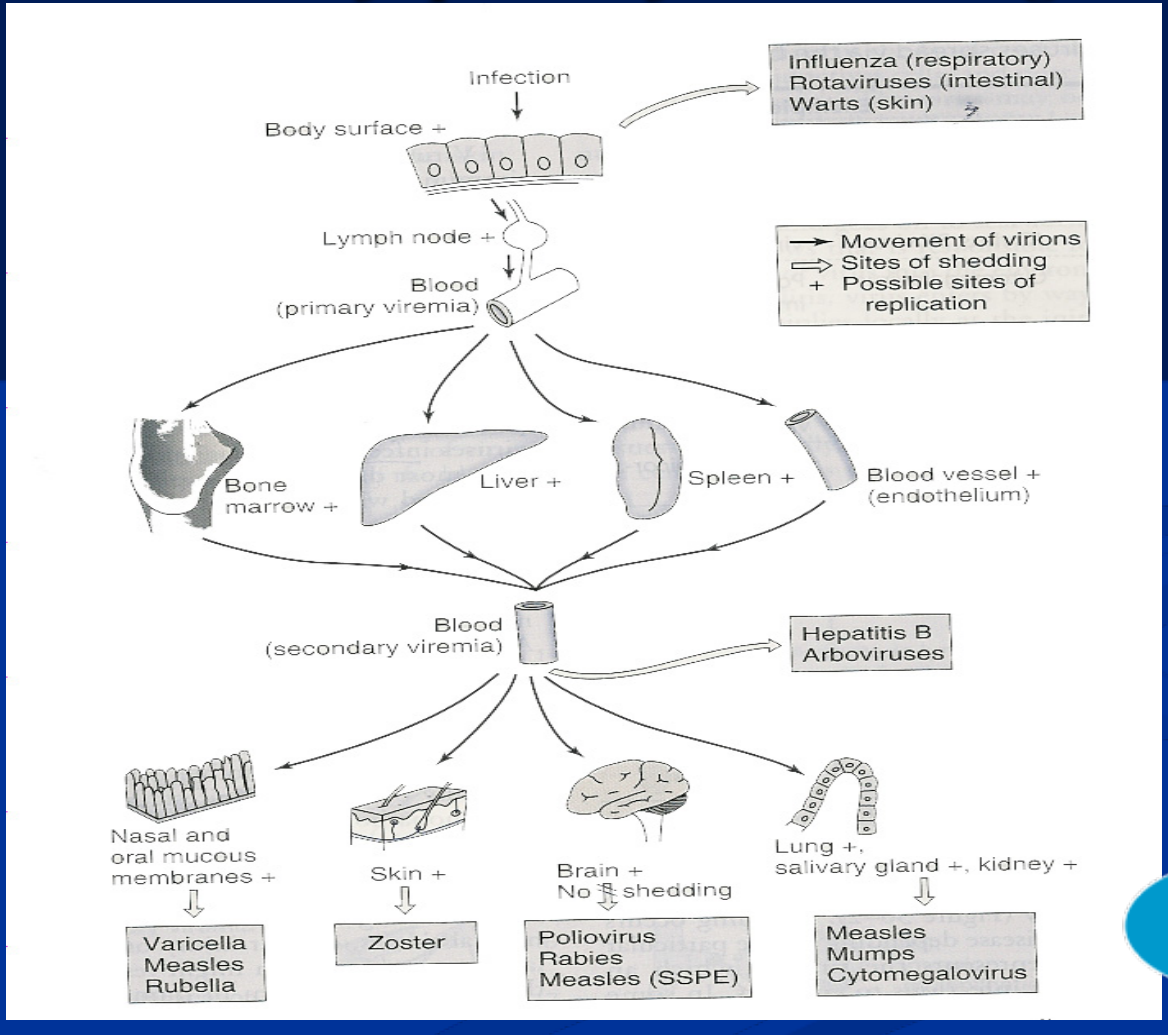
Animal to person

Reservoir ***Human (Rabies v.)***

Reservoir ~~***vector***~~ ***Human (YFV)***



Mechanisms of spread of virus through the body

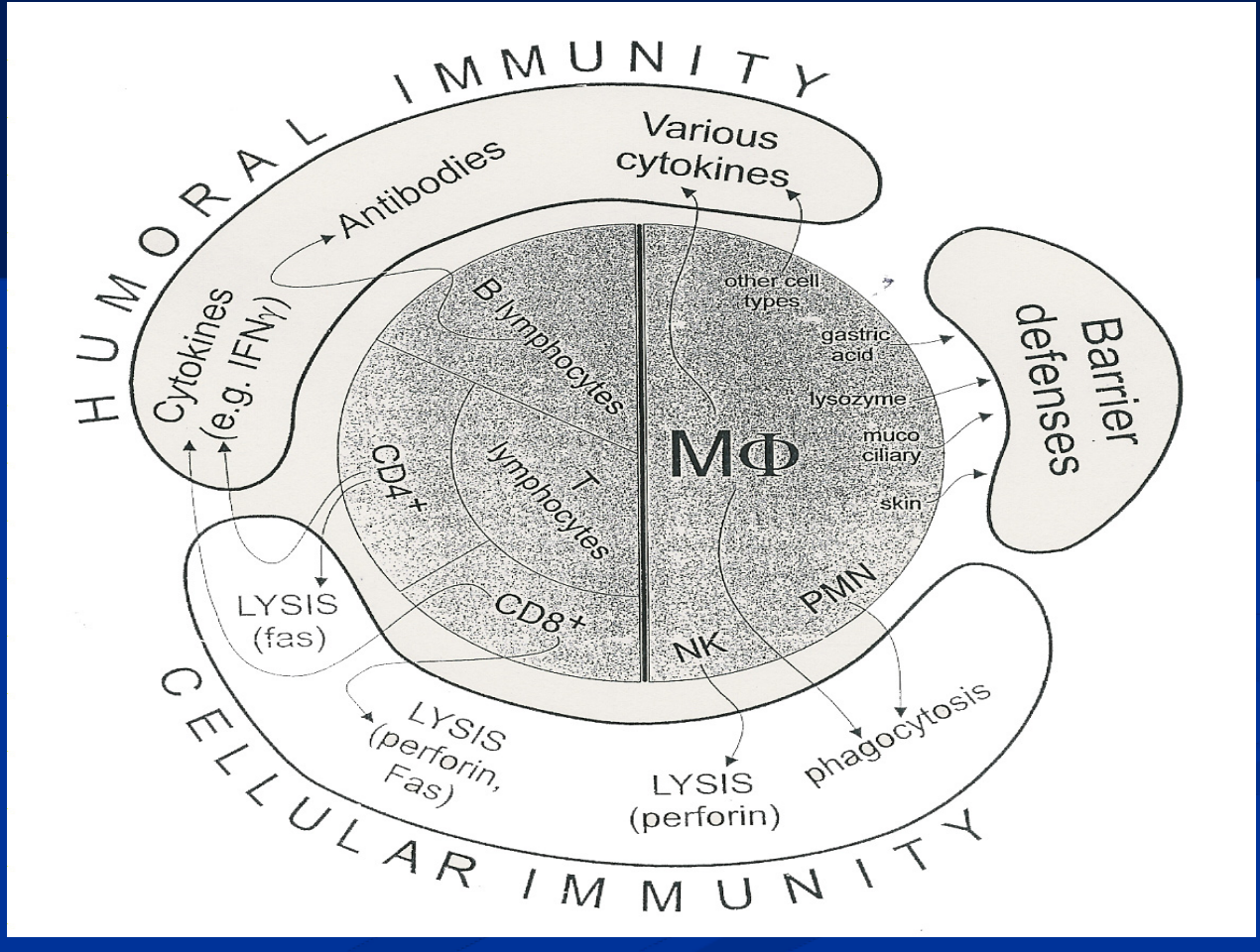


Virus shedding

Important features of Acute Viral Diseases

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

The immune response to virus



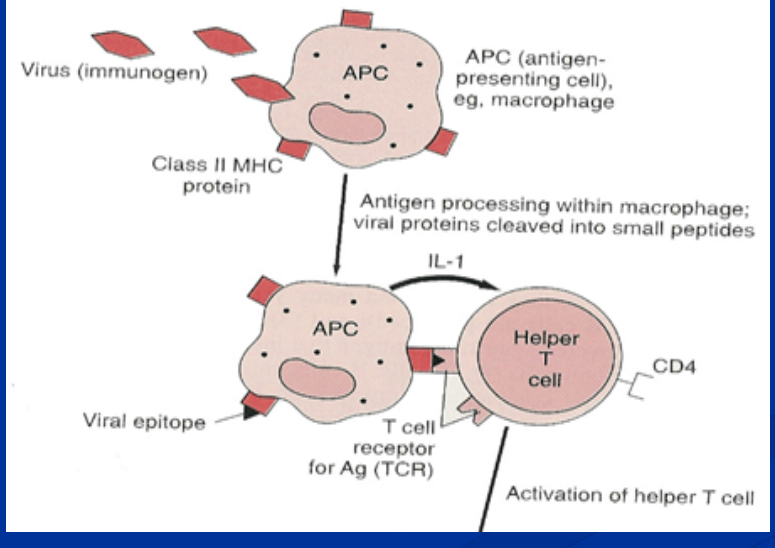
The immune response to virus

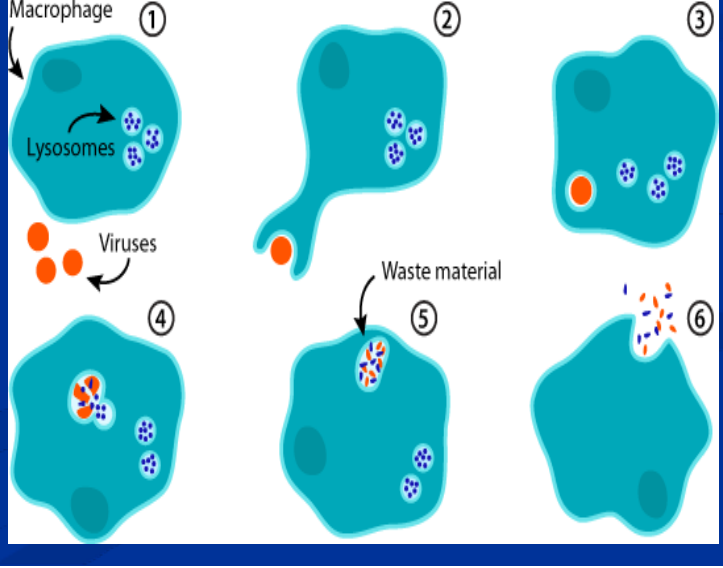
- Natural killer (NK) cells :

  Lysis of VICs

- Macrophages:

  APC, Cytokines production ,Phagocytosis





The immune response to virus

- Natural killer (NK) cells :

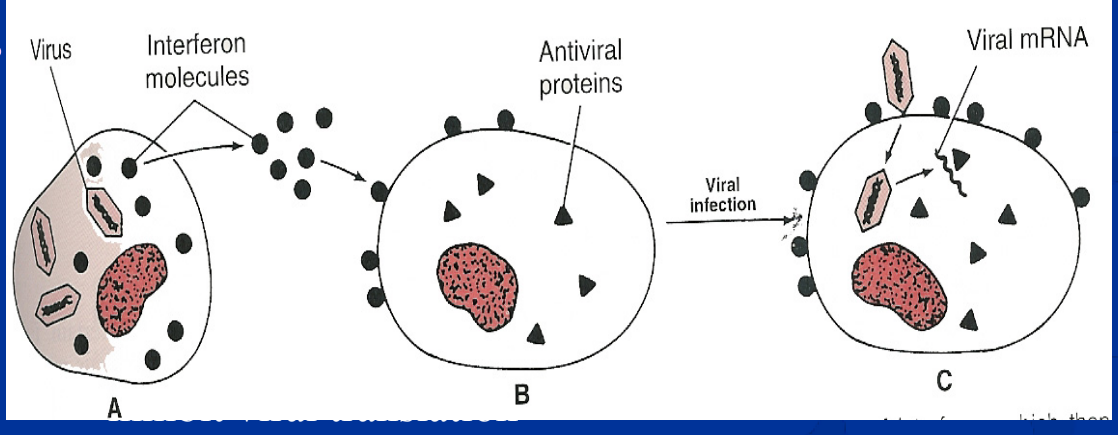
  Lysis of VICs

- Macrophages:

  APC, Phagocytosis , Cytokines production

Cytokines:

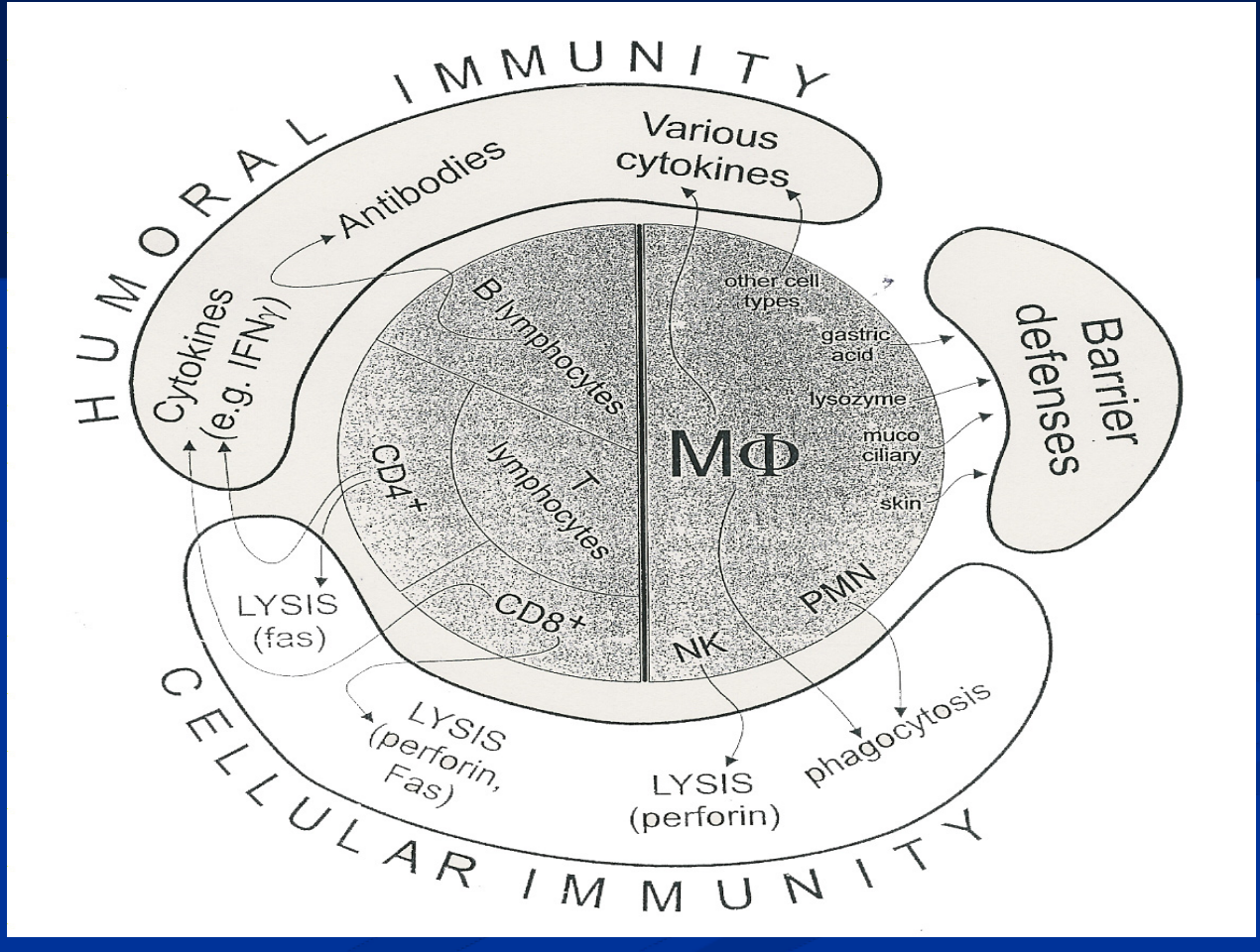
Interferons (IFN)

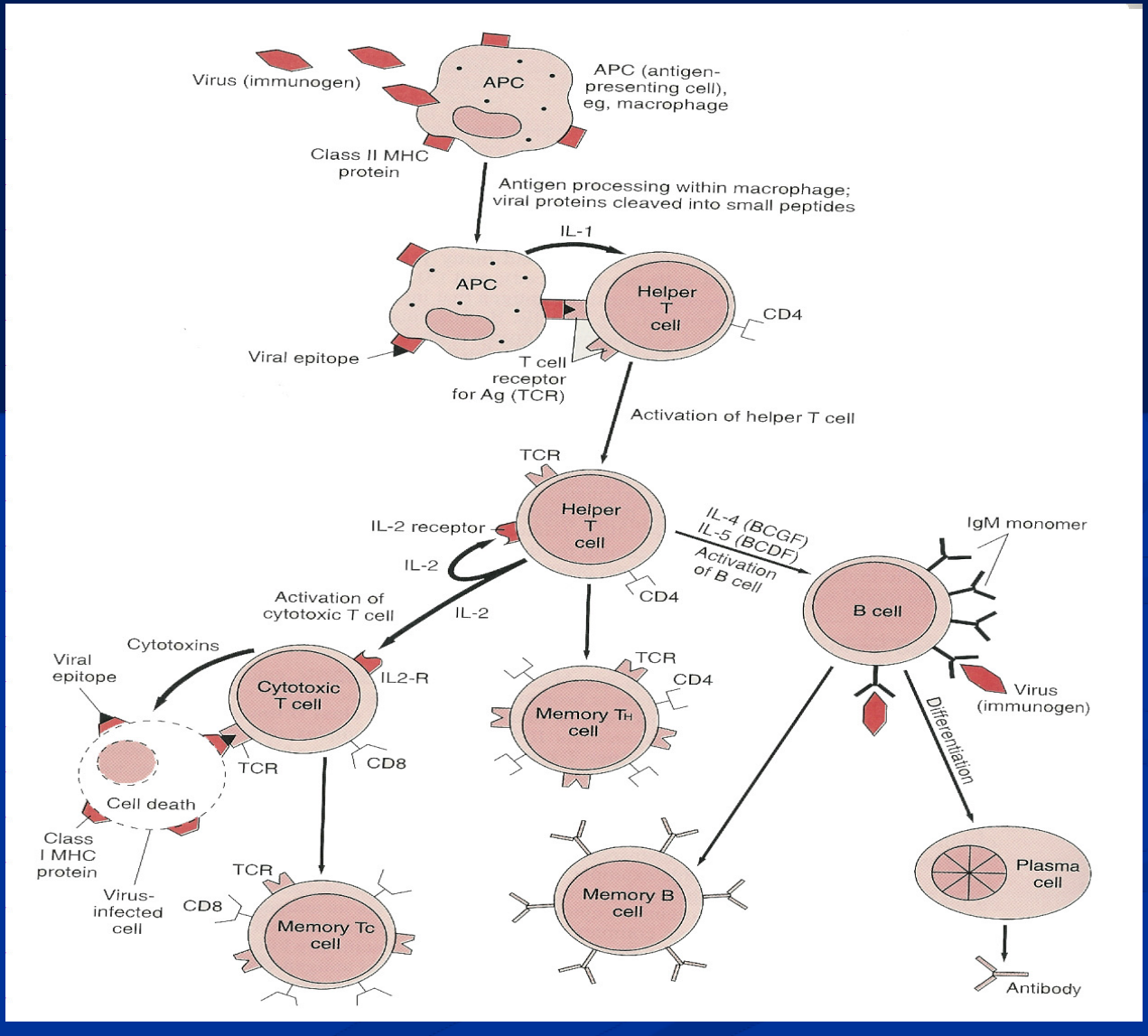


α , β IFN

γ IFN → stimulate phagocytosis and killing by macrophage & NK cel

The immune response to virus

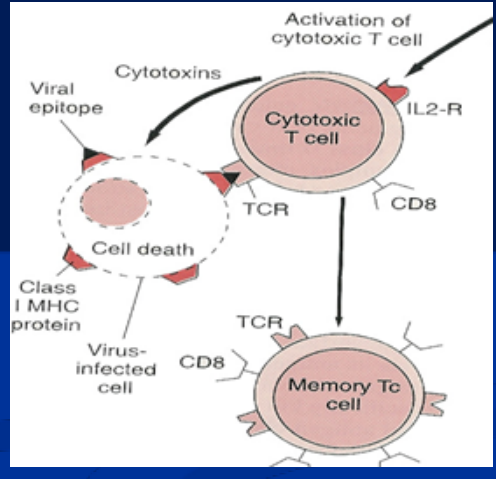



Virus (immunogen)
APC
APC (antigen-presenting cell), eg, macrophage
Class II MHC protein
Antigen processing within macrophage; viral proteins cleaved into small peptides
IL-1
APC
Helper T cell
CD4
Viral epitope
T cell receptor for Ag (TCR)
Activation of helper T cell
TCR
Helper T cell
IL-2 receptor
IL-2
CD4
IL-4 (BCGF)
IL-5 (BCDF)
Activation of B cell
IgM monomer
B cell
Activation of cytotoxic T cell
IL-2
Cytotoxins
Viral epitope
Cytotoxic T cell
IL2-R
TCR
CD8
Cell death
Class I MHC protein
Virus-infected cell
TCR
CD4
Memory TH cell
Virus (immunogen)
Differentiation
TCR
CD8
Memory Tc cell
Memory B cell
Plasma cell
Antibody

The immune response to virus

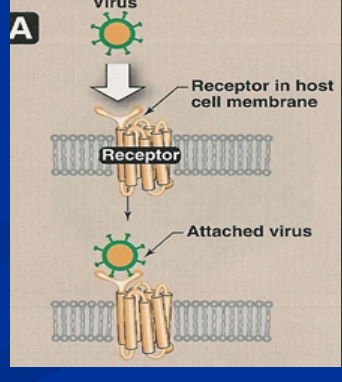
CMI:

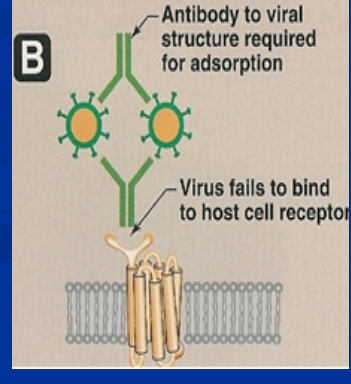
Effective against intracellular viruses
Lysis of virally infected cells
by CTCs [CD8]



Humoral Immunity:

Effective on extracellular viruses
[viremia]
- Neutralization





The stages of a typical viral infection:

- The incubation period
- Prodromal period
- The specific-illness period:

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

A) Inhibition of cellular macromolecular synthesis

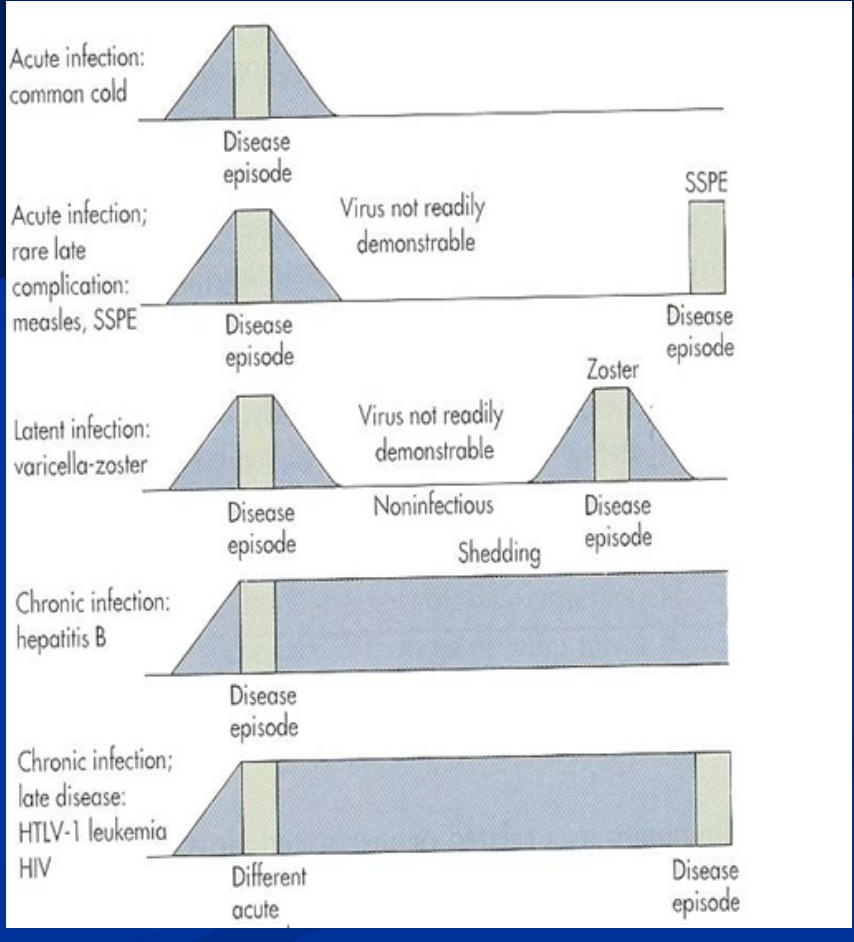
B) Immunologic attack (Immunopathogenesis)

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

- The recovery period

Types of viral infections at host level:

- Asymptomatic infection
- Acute infection
- Persistant 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**


وقل رب زدني علما
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 فضل العالم على العابد كفضل القمر على سائر الكواكب، إن العلماء هم ورثة الأنبياء إن الأنبياء لم يورثوا دينارا ولا درهما إنما ورثوا العلم فمن أخذه أخذ بحظ وافر
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خلاصة حكم المحدث: صحيح
تميم التميمي
سلسلة التصاميم الدعوية 2011
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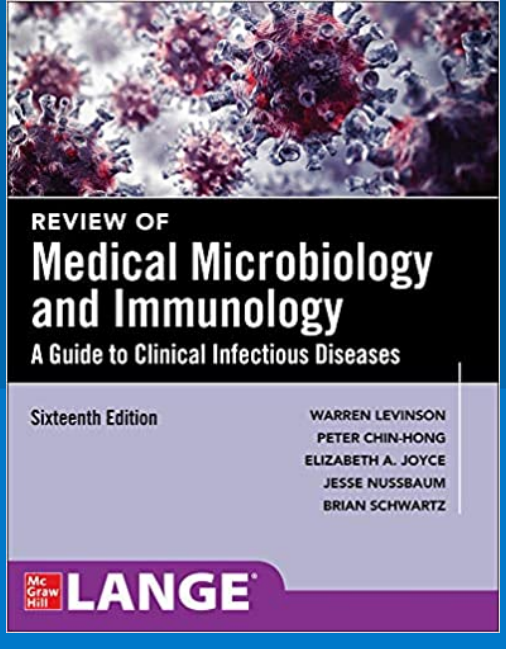
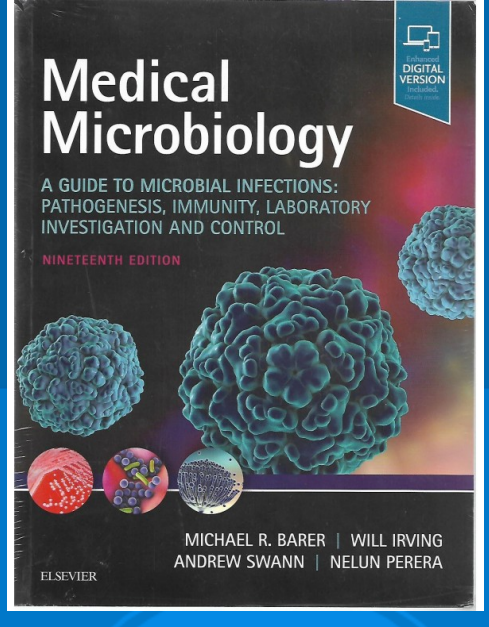
Reference books





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