



# Host Parasite Relationship

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# OBJECTIVES

- Define core terms related to host-parasite relationship.
- Recall host response to parasite invasion (specific and non-specific responses).
- Know important examples of primary and secondary pathogens.
- Recognize the differences between virulence and pathogenicity and how virulence measured.
- Recall the transmissibility of pathogens.
- Describe the attributes of pathogenicity (*including: adherence, survival, multiplication and tissue destruction*) invasion )and recall examples.
- Know Koch's postulates

# Host-Parasite Relationship

- Human host is normally in contact with many microorganisms (*normal flora*)
- Only a small number of these microorganism (primary and opportunistic pathogens) can cause disease.
- Host-parasite relationships (interaction) is characterized by fighting the organism to invade the body and the body defending itself by protective measures.
- Host-parasite relationship is discussed under :  
pathogenicity & normal flora

# Definitions

- **Host** : human (or animal or others) that support the growth and survival and protection of the parasite .
- **Parasite** :bacteria, viruses, fungi or parasites which live in or within the host ,may cause disease or live mutually with the host.

# Definitions

- **Pathogenicity** : the ability of a microorganism to cause disease.
- **Pathogen** : a microorganism having the capacity to cause disease in a particular host. Pathogen may infect one body organ or multiple organs. Some pathogens enter into latent state ( infection but no symptoms) eg. tuberculosis , Herpes virus.
- **Infection** : invasion of cells and multiplication by microorganisms without tissue destruction.
- **Disease** : is the end product of an infectious process

# Definitions

## **Resistance:**

The ability of the host to prevent establishment of infection by using its defense mechanisms.

## **Susceptibility:**

Lack of resistance to organism and establishment of disease.

## **Transmissibility:**

The ability to **spread** from one host to another. This enables the microorganism to maintain continuity of its species in the event of death of original host.

**Modes of transmission** :airborne, contact, vehicle or vector

**Virulence** is the degree of pathogenicity ,or the ability to invade and destroy tissue to produce disease.

**Virulence is measured** by the *Lethal dose 50 (LD50)* which is the number of organisms or mg of toxins that will kill 50% of susceptible lab animals ( usually mice ) when injected into such animals. When the **LD 50** is small, the microorganism is considered highly virulent and when it is high the organism is considered having low virulence.

eg. *Shigella* spp. is more virulent than *Salmonella* spp.

# Pathogens

Can be divided according to the degree of pathogenicity into:

a) **Primary pathogens:**

an organism that is able to cause disease in an apparently healthy individual who is non-immune to that organism. e.g. ~ *Bordetella species*

~ *Mycobacterium tuberculosis*

b) **Opportunistic (secondary) pathogens:**

Having low pathogenicity and infect people with low immunity. eg. *Pseudomonas & S.epidermidis*



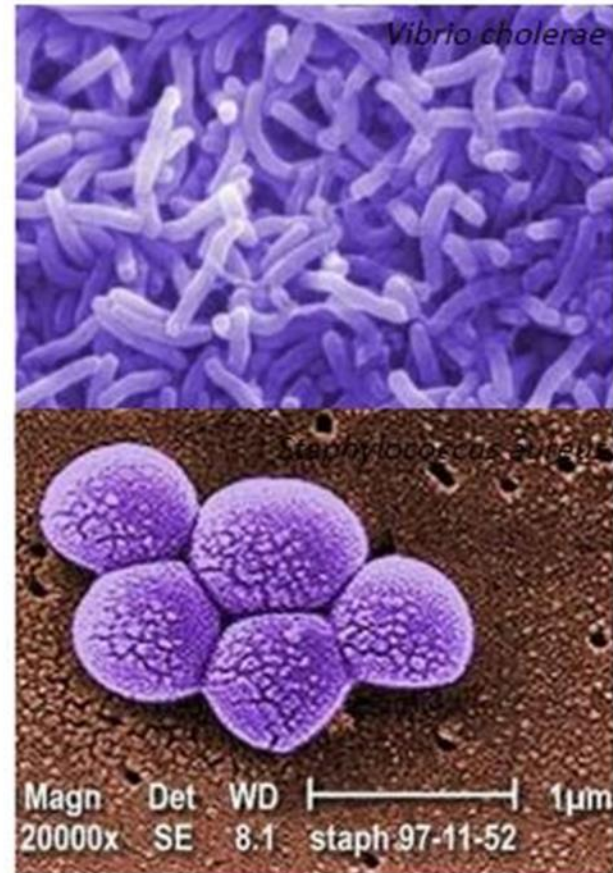
# True vs. Opportunistic Pathogen

## True pathogen

- Causes disease in healthy individuals
- Associated with a specific and recognizable disease

## Opportunistic pathogen

- Causes disease in immune compromised host
- Gain access (injury) to sterile regions



# Host Resistance To Parasite Invasion

1. Non specific defense is part of **natural** constitution of the host. Examples:
  - Skin mechanical barrier
  - Ciliated epithelium of respiratory tract
  - Competition by normal flora
  - Low pH of the stomach
  - Cough
  - Peristalsis
  - Lysozymes
  - Neutrophils
2. Specific defense is acquired resistance to certain organism: e.g. Antibodies

# Determinants of Pathogenicity

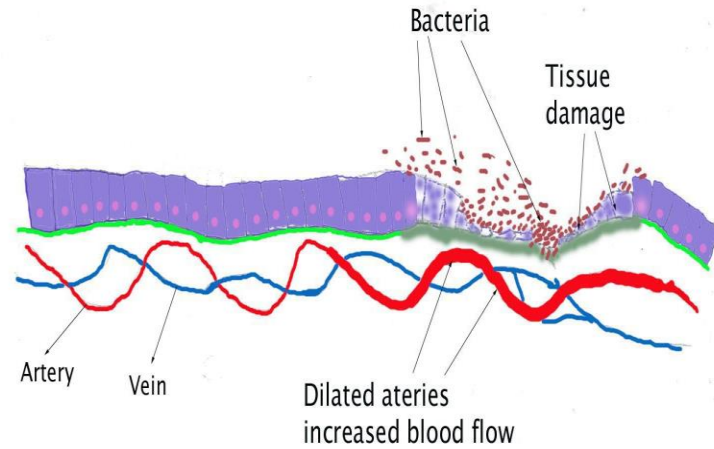
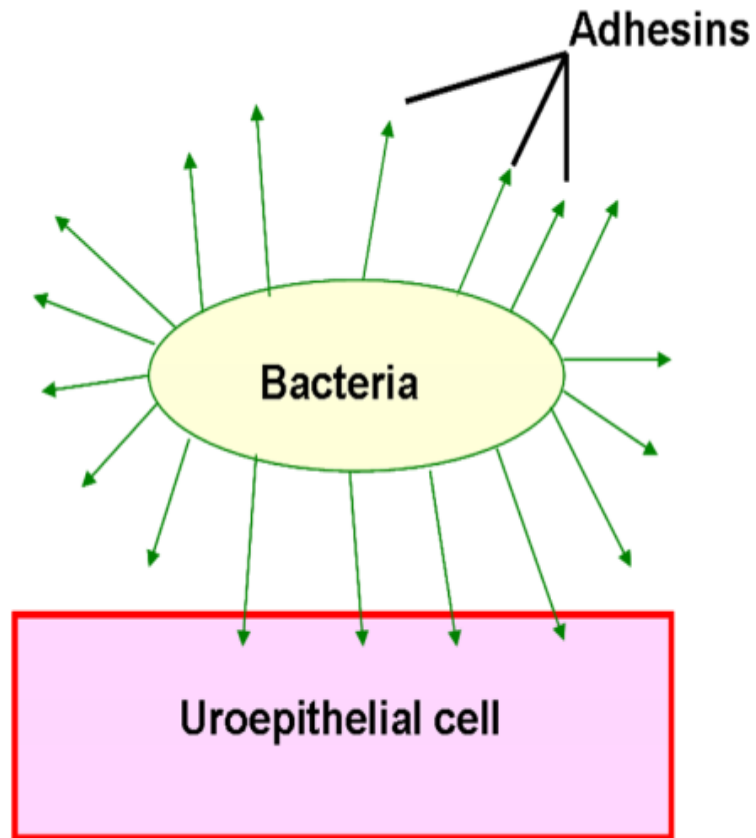
Before causing disease, the microorganism should have the ability to:

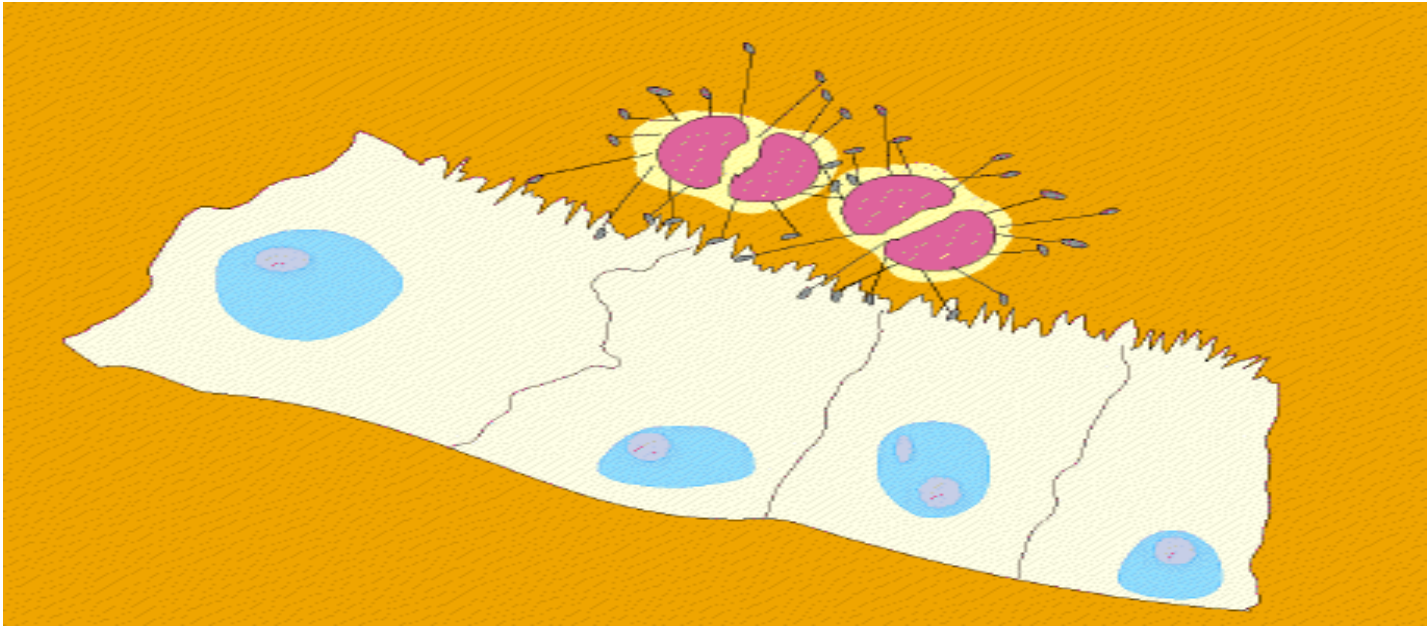
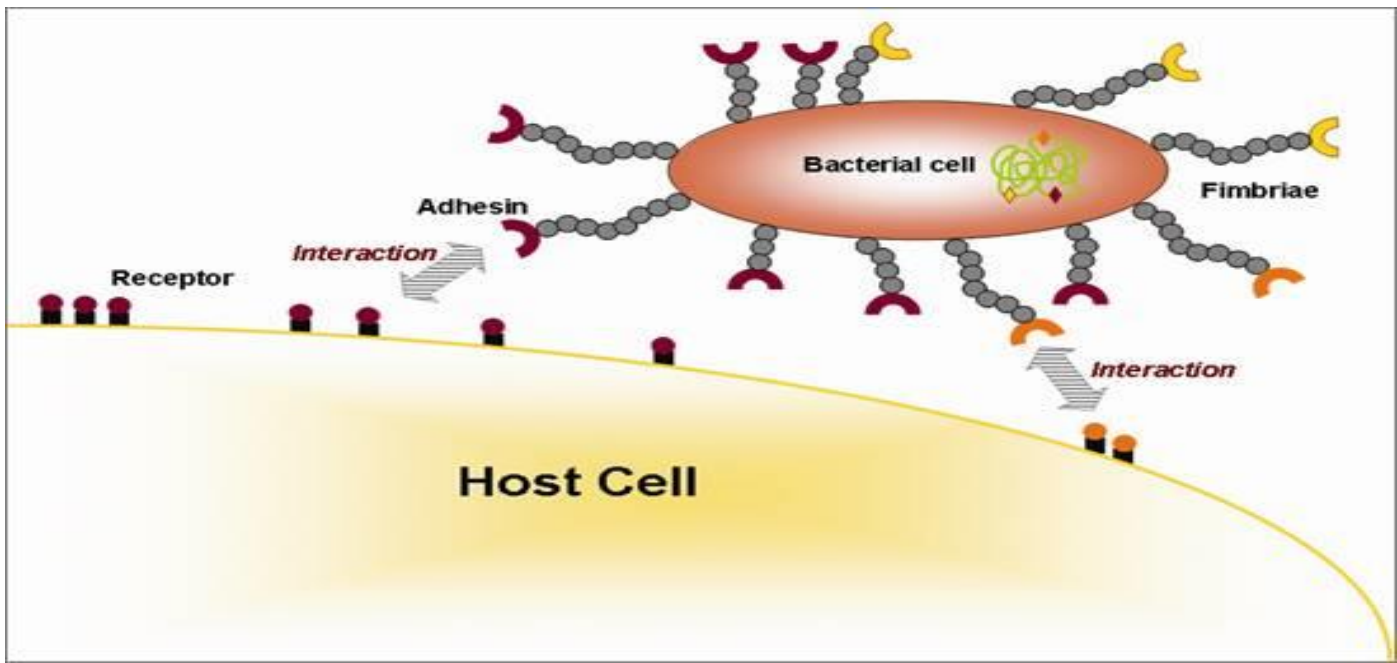
- a) **Adherence & colonization:** attachment to host epithelial surface .
- b) **Survive ( resist )** host natural defense mechanisms.
- c) **Multiply** to large numbers.
- d) **Tissue Destruction:** the ability to overcome host defense , invade the tissues and cause destruction to produce clinical disease.

## **Adherence:**

- By means of **adhesins** (adherence factors) found on bacterial surfaces.
  - a) Pili
  - b) Other protein surface structures
  - c) Capsid spikes of viruses
  
- Structures **on host cells** involved in adhesion include:
  - a) Fibronectin
  - b) Proteins and Glycopeptide parts

# Adhesion & Tissue Destruction





## Tissue destruction by:

- a) **Toxin** production ,either:
  - **Exotoxin**: produced outside the gram positive and gram negative bacteria eg. cholera toxin, **or**
  - **Endotoxin**: only found in gram negative bacteria
  
- b) **Invasion** by:
  - Capsulated ,or
  - Non-capsulated organisms

- **Capsulated organisms** : bacteria that have capsule.

Bacterial capsules are **polysaccharide** except the capsule of ***Bacillus anthracis*** (is polypeptide).

**Capsule prevents phagocytosis and capture by immune system.**

The organisms are readily killed once phagocytosed. So called extracellular (EC) organisms

eg. ***S.pneumoniae*** (*Pneumococcus*)

***Haemophilus influenzae***



- **Non capsulated organisms** resist intracellular killing so called intracellular ( IC) organisms.

*e.g. Mycobacterium tuberculosis, Salmonella typhi, Brucella species, etc.*

- **Exotoxin** can be:

a) **A – B type exotoxins** eg. Cholera toxins

**A** : Active unit

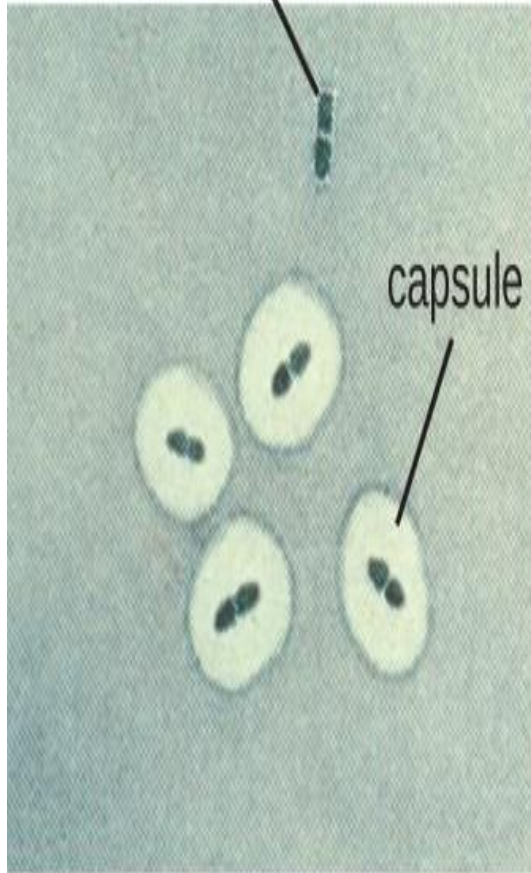
**B** : Binding unit for attachment

Or:

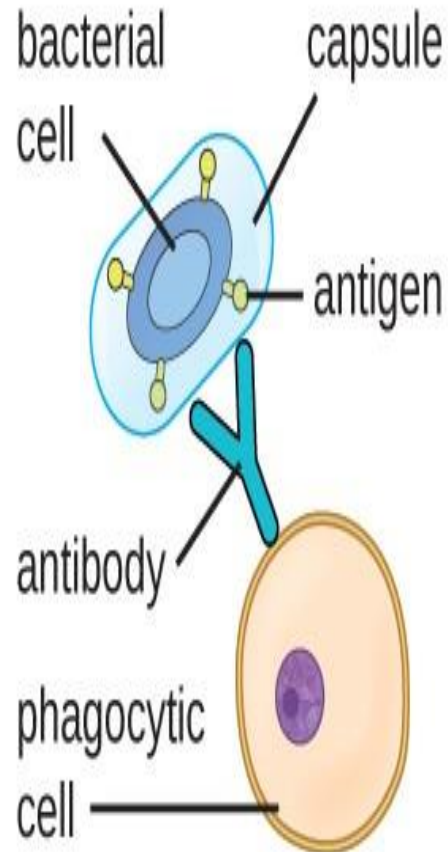
b) **Membrane active exotoxin**

eg. Haemolysin of group A Streptococci

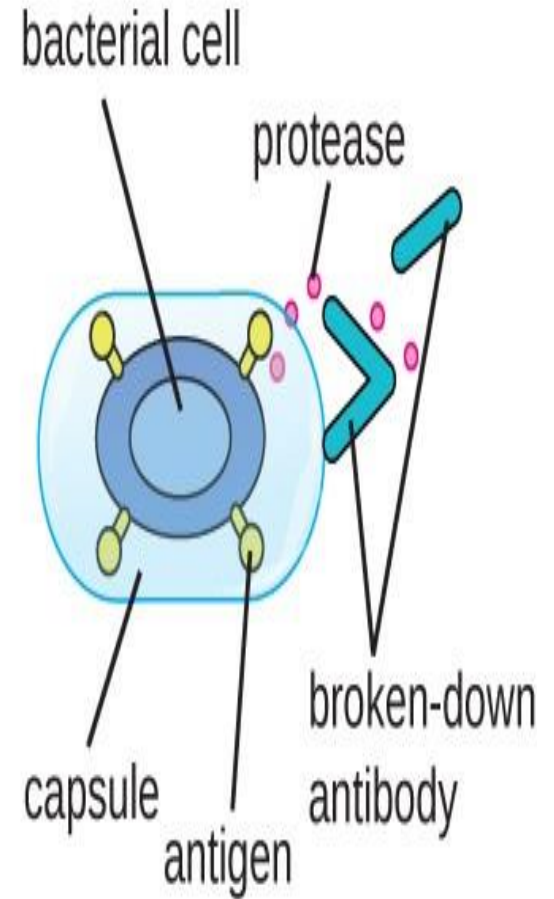
nonencapsulated bacteria



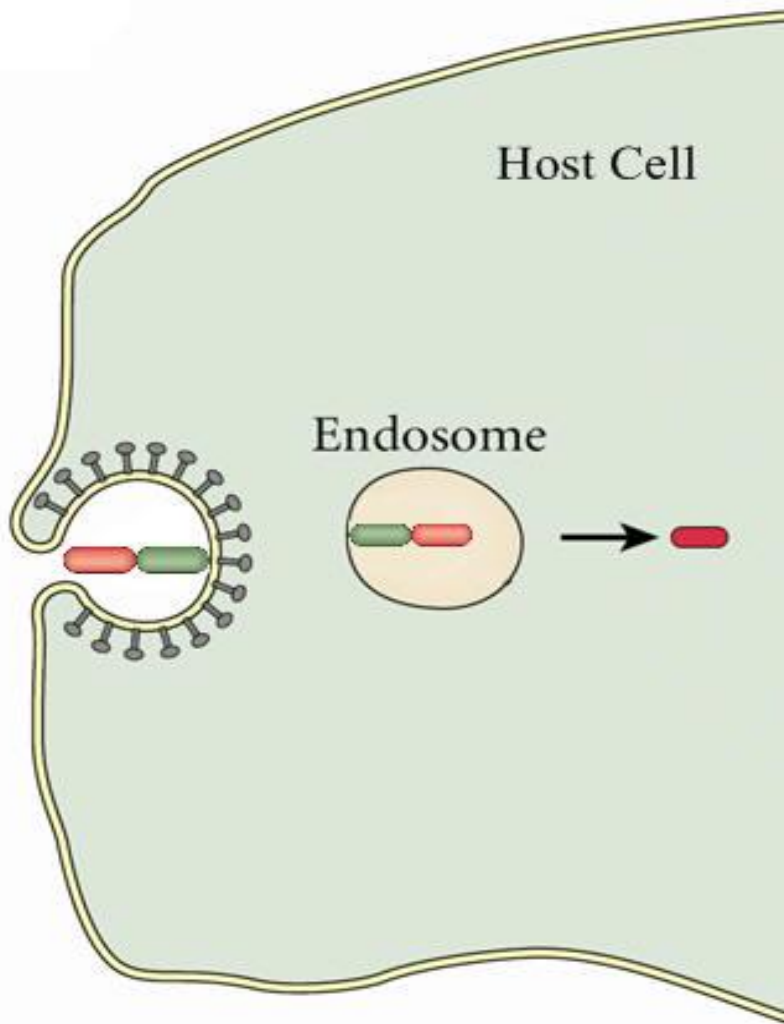
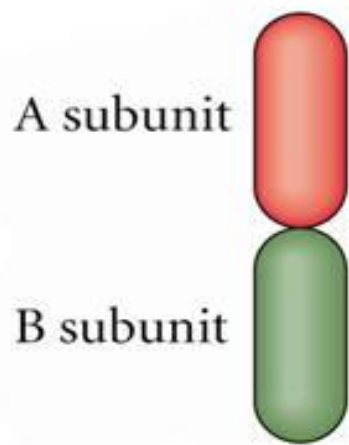
(a)



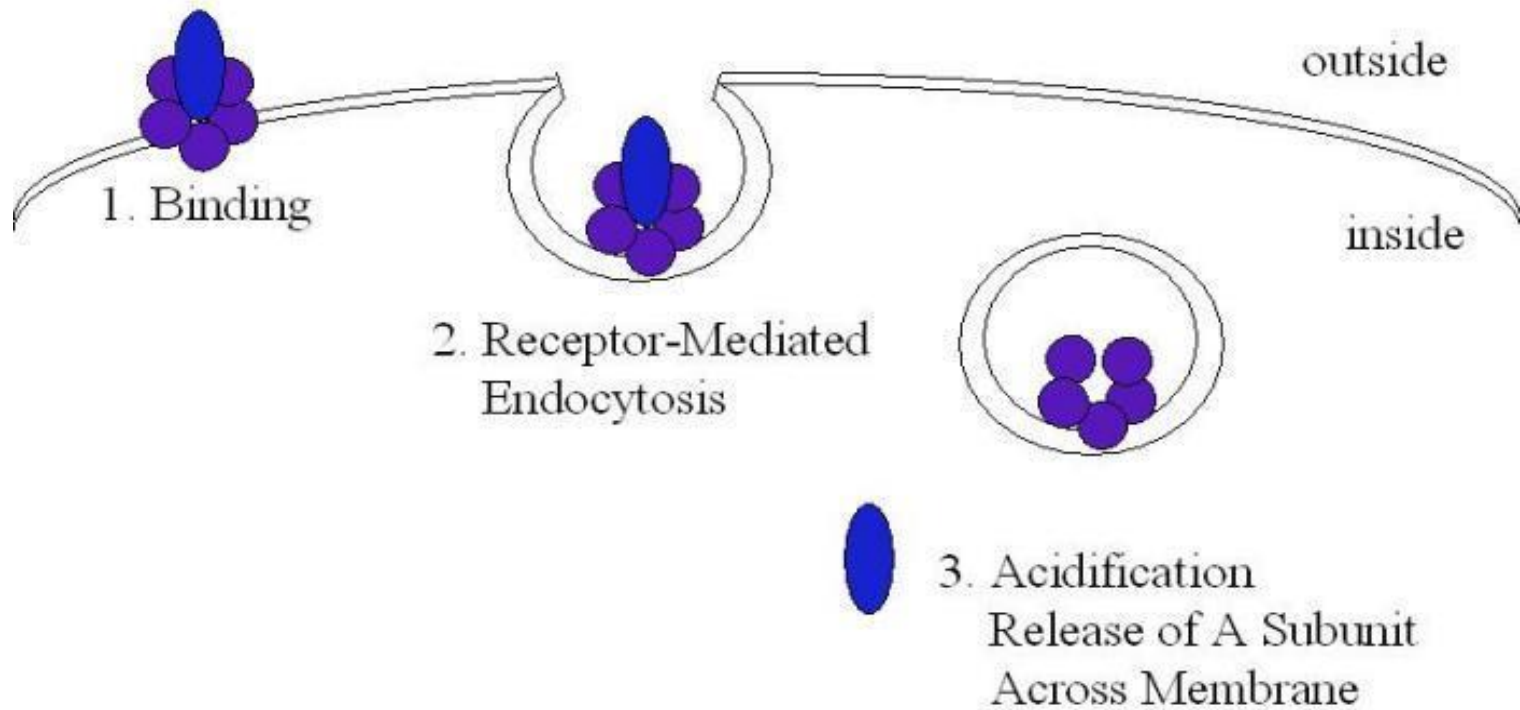
(b)



(c)



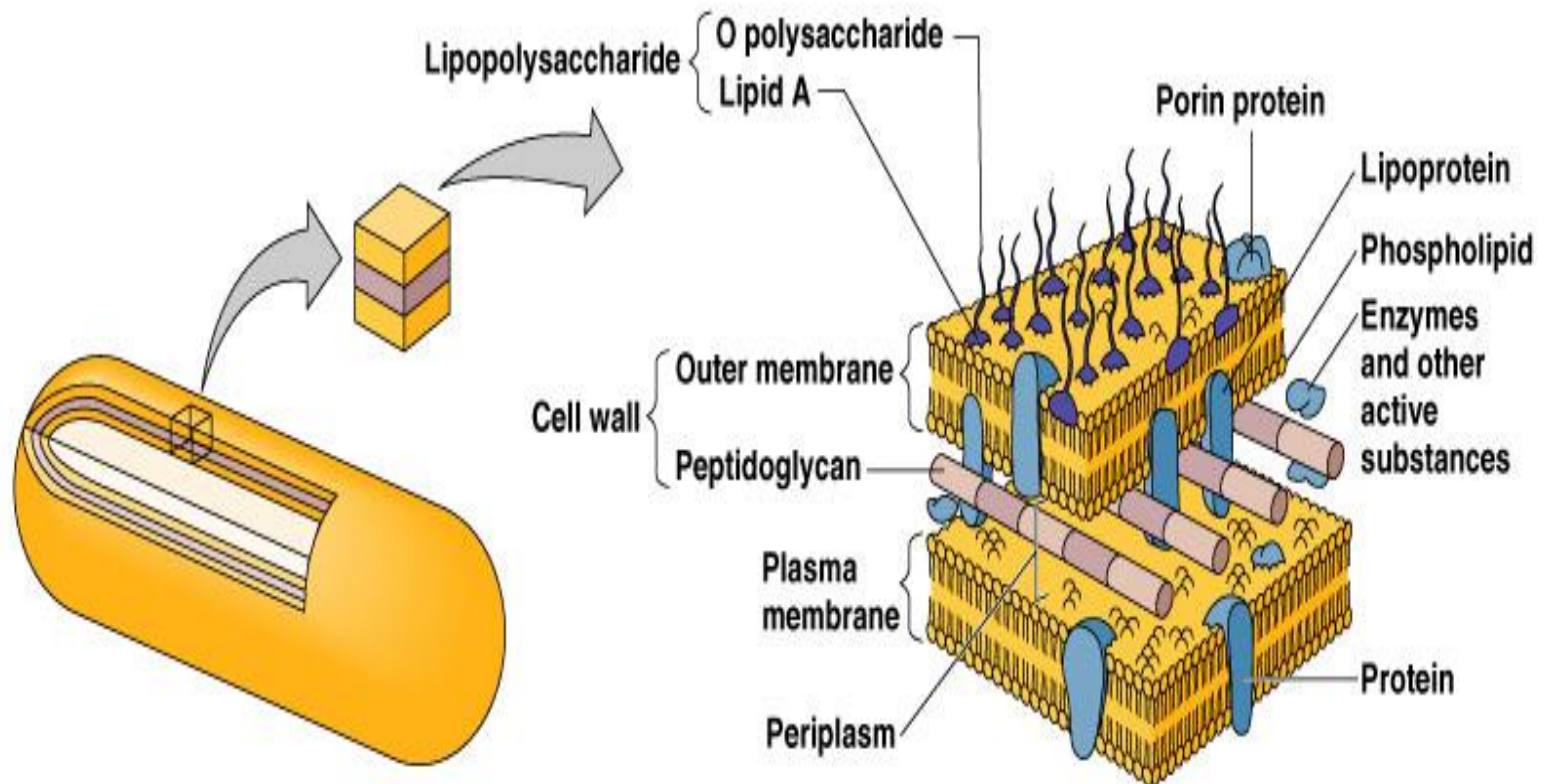
## A-B Toxin Entry



# Exotoxin vs Endotoxin

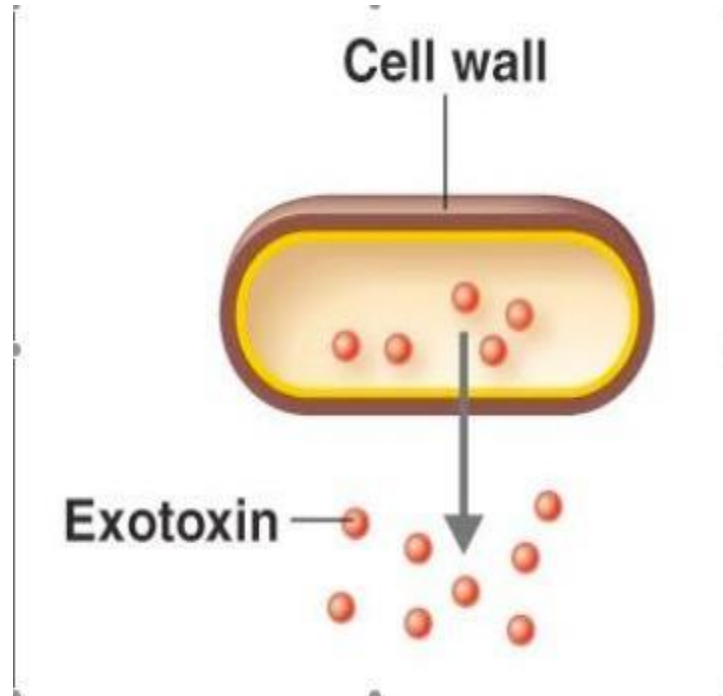
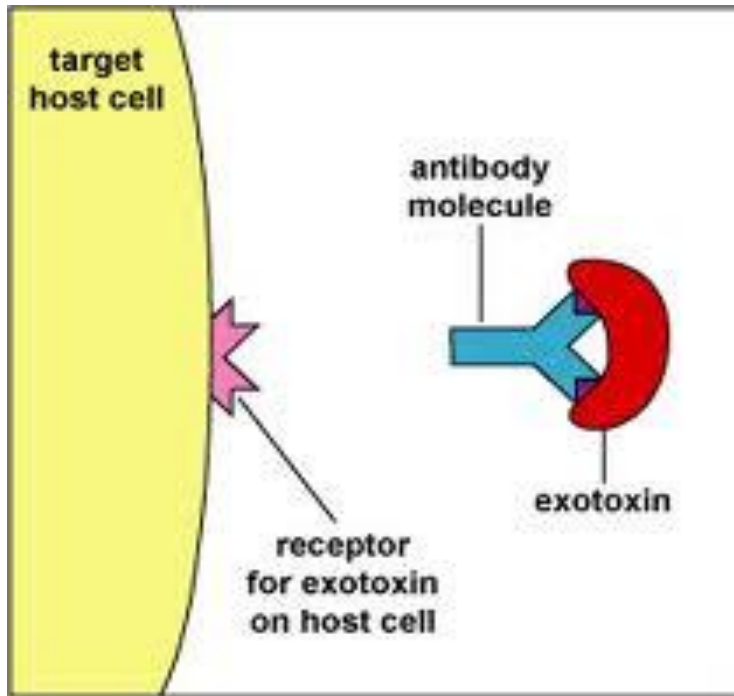
<b>Exotoxin</b>	<b>Endotoxin</b>
1~ Protein	Lipopolysaccharide
2~ Soluble	Part of cell wall
3~ Heat Labile	Heat stable
4~ Pharmacologically specific action	Non-Specific
5~ High Immunogenicity	Low Immunogenicity
6~ Inactivated by chemicals to toxoids	Do not form toxoids
7~ No Fever	Induce Fever

# Endotoxin



**(c) Gram-negative cell wall**

# Exotoxin



# **Koch's Postulates**

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- In order to identify what organism causes a specific disease, certain rules are followed.
- Koch Postulates:
  - 1) pathogen must be found in subject with disease but never in a healthy subject
  - 2) pathogen can be isolated from sick person and grown in lab
  - 3) pathogens injected into healthy person will cause the individual to become infected with the same disease
  - 4) injected pathogens can be isolated from newly infected individual and are identical to original pathogens



# Koch's Postulates

- For a microorganism to be accepted as the cause of an infectious disease it must satisfy all or most of these criteria:
  - 1) The organism must be found in all cases of the disease and its distribution in the body must correspond to that of the lesions observed in the host.

## Koch's Postulates (continued)

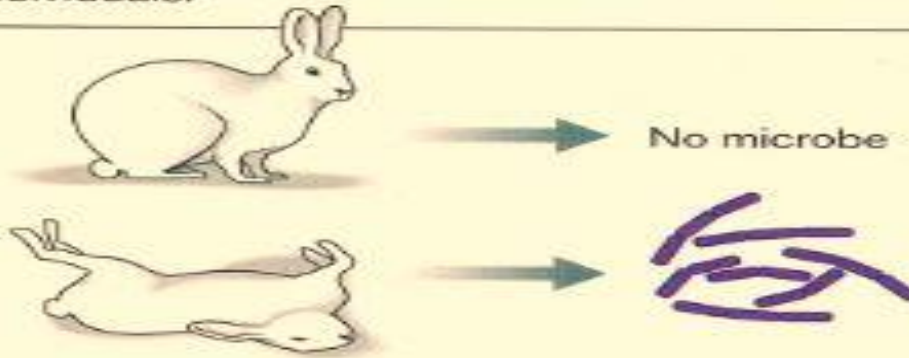
2) The organism should be cultured in pure culture from all cases of the disease.

**N.B.** Some organisms are yet to be cultured in the lab.  
*e.g.* *Treponema pallidum*, *M. leprae*.

3) The organisms should reproduce the disease in other susceptible animal hosts.

4) The organism should be cultured and antibodies to the disease usually develop in the course of the disease.

**1. The microbe is found in all cases of the disease but is absent from healthy individuals.**



**2. The microbe is isolated from the diseased host and grown in pure culture.**



**3. When the microbe is introduced into a healthy, susceptible host, the same disease occurs.**



**4. The same strain of microbe is obtained from the newly diseased host.**



Reference book and the  
relevant page numbers..

Sherries page 149-172

*SHERRIS* MEDICAL MICROBIOLOGY, AN  
INTRODUCTION TO INFECTIOUS DISEASES.

*KENNETH RYAN / GEORGE RAY.*

LATEST EDITION.

PUBLISHER MC GRW HILL

CHAPTER 10, PAGE 149- 172