

## Antigens, Immunogens , Epitopes, and Haptens:

**Antigen:** a molecule or part of a molecule that is recognized by the immune system.

The term is associated with those **molecules recognized** by the **diverse receptors** found on **T** and **B lymphocytes**.

**Immunogen:** is a substance or antigen that evokes a specific, positive immune response.

### **Example:**

Injection of laboratory animal by human chromosome.

Anti-DNA antibodies and anti-Histon Antibodies will be produced.

# Immunogenicity and Properties of immunogen:

Immunogenicity is the capability of immunogen to activate immune response.

**In general, there are several properties of immunogen:**

## **1- Foreignness:**

- Immune system can discriminate foreign substance.
- foreign substance only stimulate immune response.

**2- Size:** it usually has a molecular weight of at least 10,000 Dalton.

## **3- It has a specific chemical nature:**

- Mainly proteins (polypeptide)
- Carbohydrates, steroids, and lipids are poor immunogens.

## 4- The chemical complexity:

- Complexity is defined as a diversity in the chemical structure of organic polymers.
- As the chemical complexity increase; the immunogenicity will be increased.

### Example:

**Homopolymers** are poor immunogens regardless of size, while **heteropolymers** are considered strong immunogens.

## Epitopes: The Antigenic determinants:

The smallest part of an antigen or immunogen that can be recognized by somatically generated B and T receptors.

-**B cell receptors** can discriminate epitopes whether they are:

1-free soluble molecules.

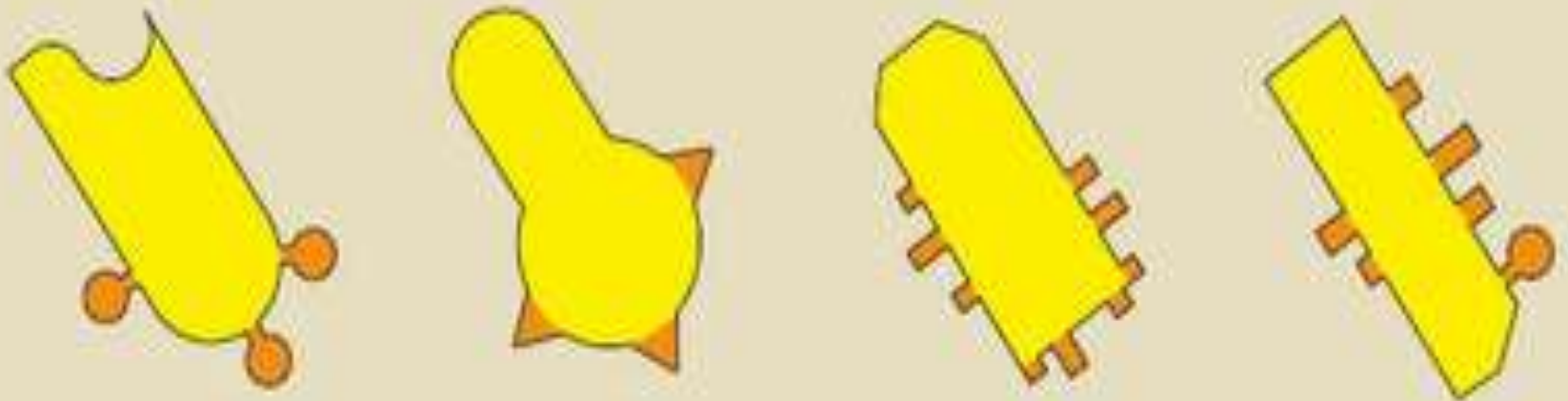
2-Surface-bound molecules.

3-Degraded fragments.

-**T cell receptors** can bind only to epitopes which integrated with host cell surface molecules.

# Epitopes: the basic recognition unit:

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 Antigen

 Marker molecule

 Antibody

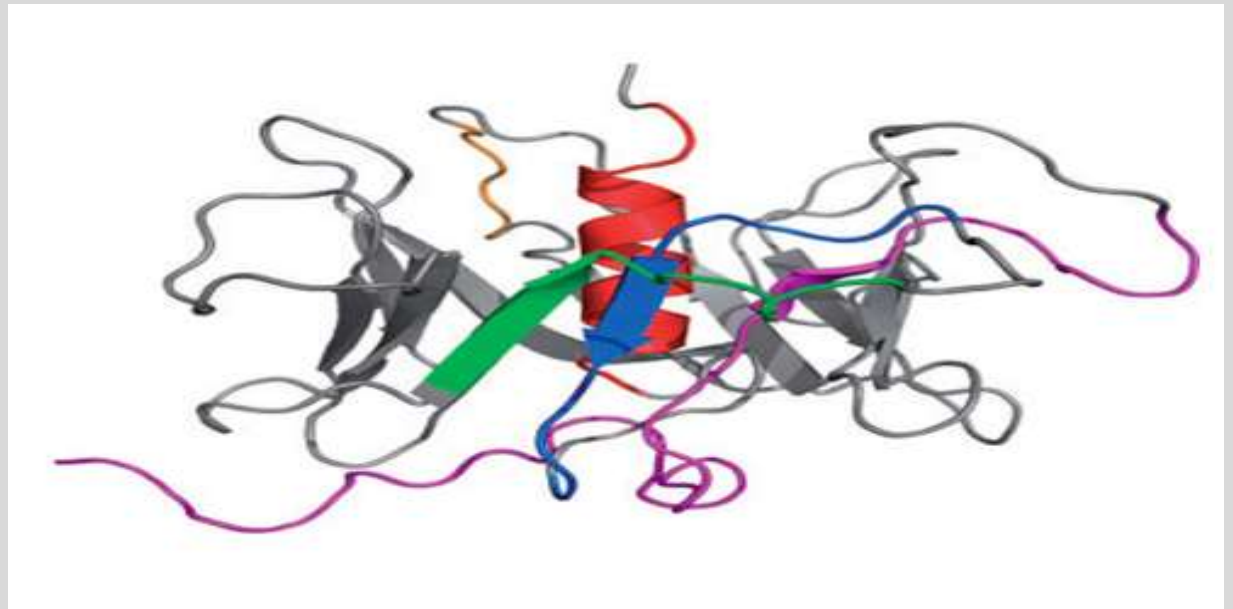
## The conformational and linear Epitopes:

A single antigen molecule may have several different epitopes.

Antigenic determinants may be either **Conformational** or **Linear**.

A Conformational determinant is produced by **folding of amino acid residues** from **different segments** of linear amino acids.

**Conformational  
and linear  
Epitopes.**



Conformational determinants usually are **natural** rather than **denatured** proteins.

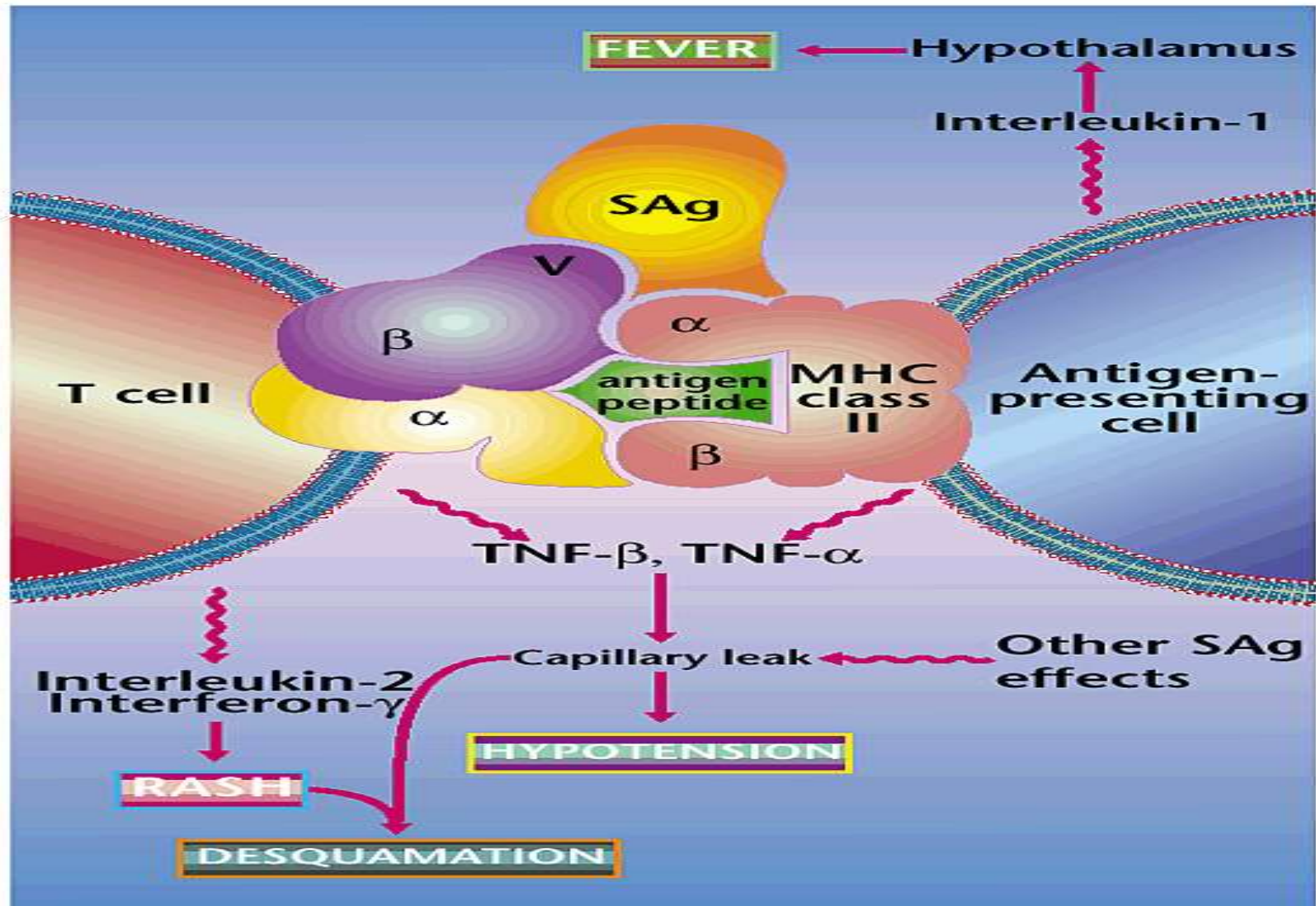
**Immunodominant epitope** is an epitope that can stimulate a greater antibody response than others.

### **Superantigen:**

is a substance such as **a bacterial toxin** that is **capable of stimulating multiple T lymphocytes**, leading to release of relatively **large quantities** of **cytokines**.

**Phagocytosis process** is **not required** for this type of activation.

# Superantigen:









## Haptens:



Small, non-biologic molecules that bind to immune cells receptors but cannot by themselves induce a specific immune response.

### Example:

Land-Steiner's experiment.

Hapten  injected in mice  No immune response.  
(2,4-dinitrophenyl-tyrosine)

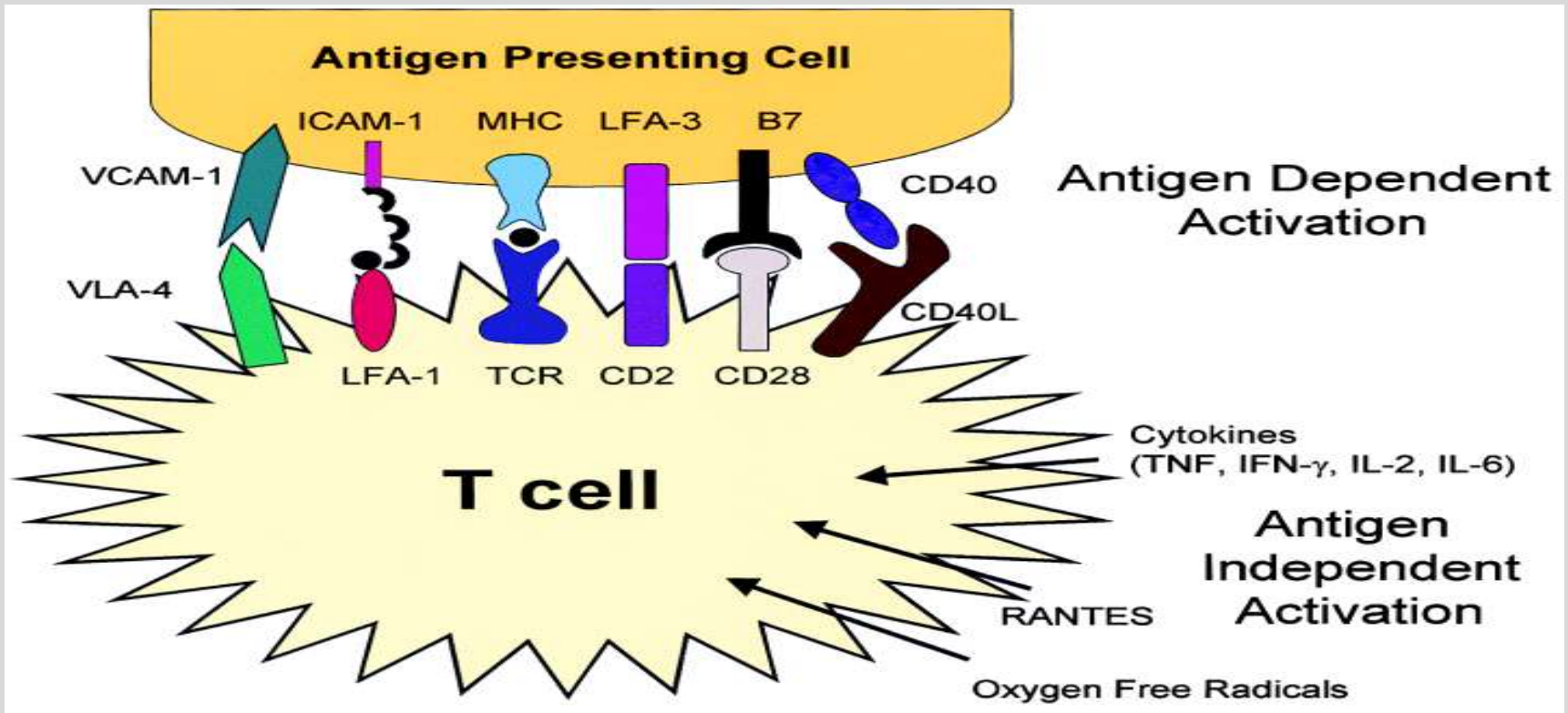
Carrier (protein)  injected in mice  Positive immune response.

Hapten-Carrier Conjugate  injected in mice  Anti-Hapten, and Anti-Carrier Abs

## T-cell dependent and T-cell independent Antigens:

Antigens are classified as either **T-cell dependent (TD)** or **T-cell independent (TI)**.

T cell dependent antigen activates immune system depending on the immune system T-lymphocytes.



# T-cell dependent and T-cell independent Antigens:

N

	T-cell dependent antigen	T-cell independent Antigen
<b>Structural properties</b>	<b>Complex</b>	<b>Simple</b>
<b>Chemical nature</b>	<b>Proteins, glycoprotein, and lipoproteins</b>	<b>Polysaccharide ; bacterial Lipopolysaccharide.</b>
<b>Antibody - class induced</b>	<b>IgG, IgM, IgA, IgD, and IgE</b>	<b>Only IgM</b>
<b>Immunological Memory response</b>	<b>yes</b>	<b>No</b>
<b>Present in most Pathogenic microbes.</b>	<b>yes</b>	<b>No</b>

# Innate and adaptive immunity:

## Innate (Natural) Immunity:

Any **inborn resistance** that is present the first time a pathogen is encountered; it **does not require** prior exposure and is **not modified** significantly by **repeated exposure** to the pathogen over the life of individual.

## Acquired Immunity:

A **resistance** that is **weak** or **absent** at the first exposure but **increases** dramatically **with subsequent exposures** to the same specific pathogen.

# Soluble mediators of innate immunity:

## 1-Proteins and enzymes:

A variety of proteins and enzymes (present in human blood and tissue fluids) are considered as the first part of innate immunity.

### Examples:

Proteins and enzymes	Major microbial targets	Effects
<b>Lysozyme and defensins</b>	Bacterial wall and memb.	digestion
<b>Mannose binding proteins</b>	High Mann glycoprotein	Opsonization and complement activation
<b>CRP</b>	Polysaccharides of microbes	Opsonization
<b>Soluble CD14</b>	LPS	Opsonization.

## 2-Cytokines, and Type I interferons:

**Cytokines:** IL-1, IL-6, IL-12, and TNF $\alpha$  produced by activated phagocytes.

**Type I interferons:** IFN-  $\alpha$  produced by Dendritic cells.

IFN- $\beta$  Produced by fibroblasts.

-INFs are rapidly produced, within 5 minutes by the infected cells (virus infection).

-INFs activate phagocytosis of APCs, and apoptosis of infected cells.

## 3-Complement fragments C3b:

Opsonization.

## Cells of Innate immunity:

Innate immune response depends on the following blood leukocytes action:

### 1-Phagocytes:

A-Monocytes and macrophages: blood stream and others

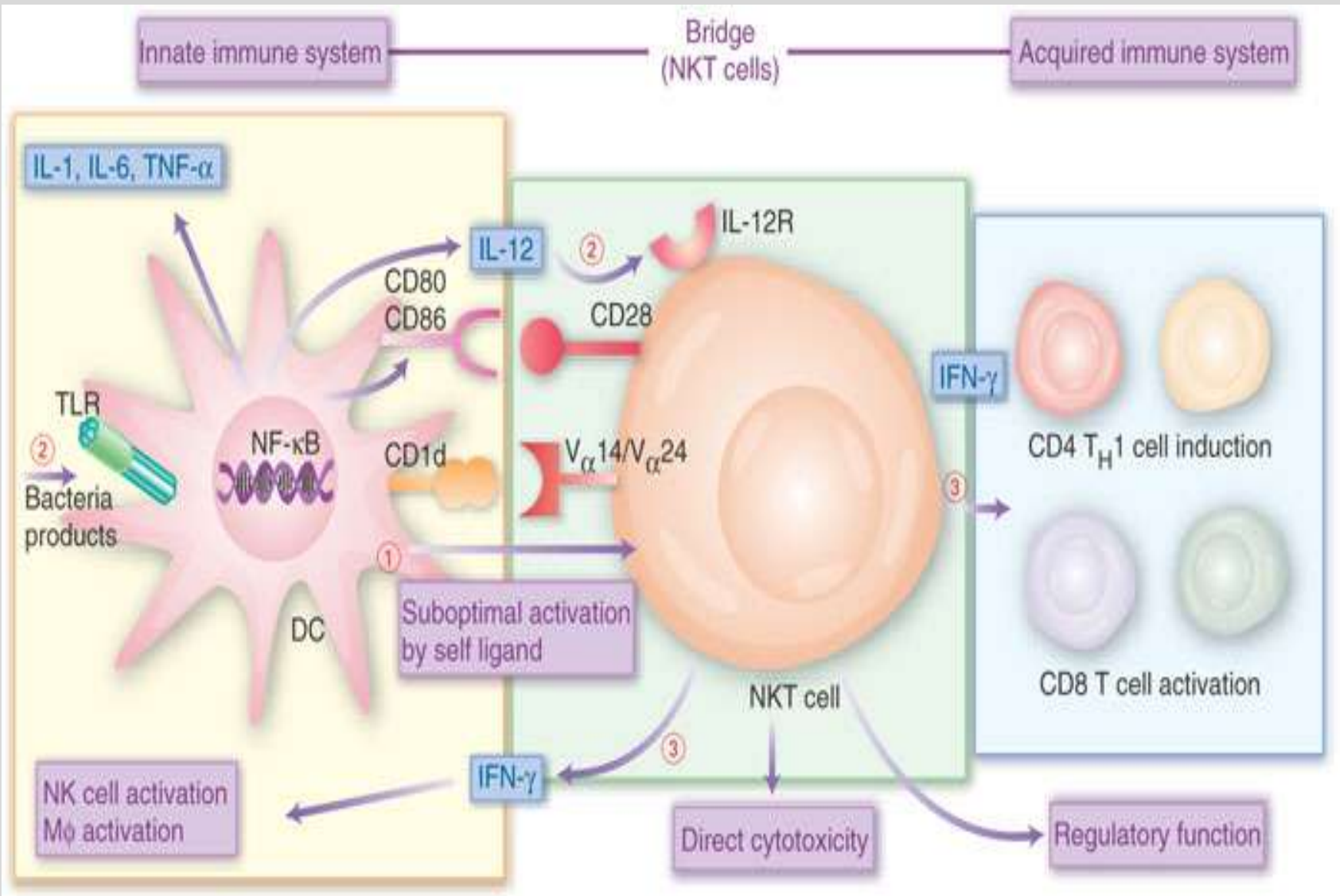
B-Dendritic cells: lung, and GIT mucosa.

### 2-Granular leukocytes:

A-Neutrophils, and eosinophils.

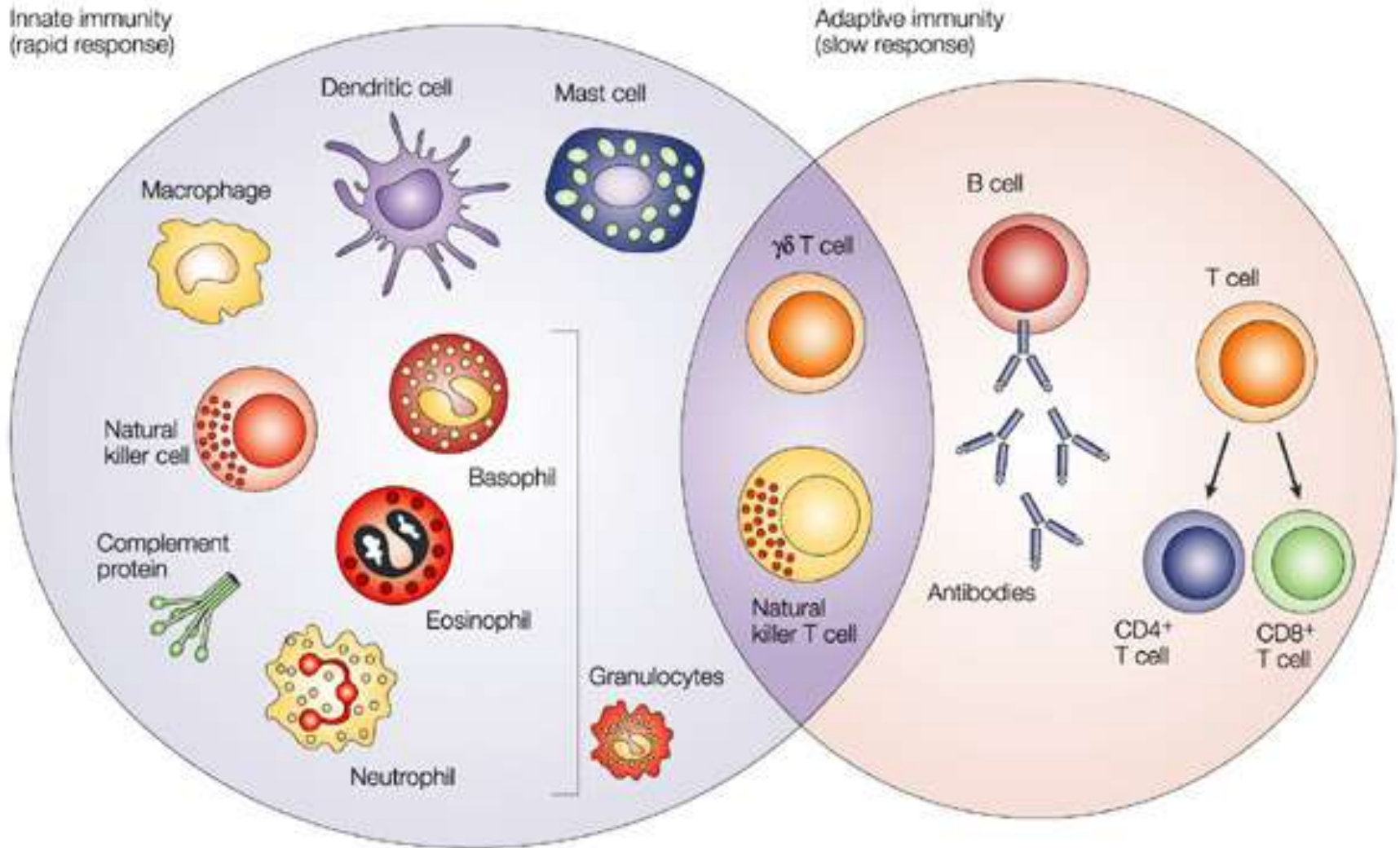
B-Basophils and mast cells.

# Innate immune cells and cytokines interaction:





# Innate and adaptive immunity:



# Adaptive Immunity:

## Soluble mediators of adaptive immunity:

### 1-Cytokines and Interferons:

- Cytokines: IL-2, IL-3, IL-10,IL-13.
- Interferons: INF- $\gamma$  (Gamma).

### 2-Immune cells:

- Activated T cells
- Activated B cells
- N.K cells.

### 3- Soluble and cell-bounded proteins:

- The Immunoglobulins.