Ministry of Higher Education
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# Antigen

By

Lecture-5-

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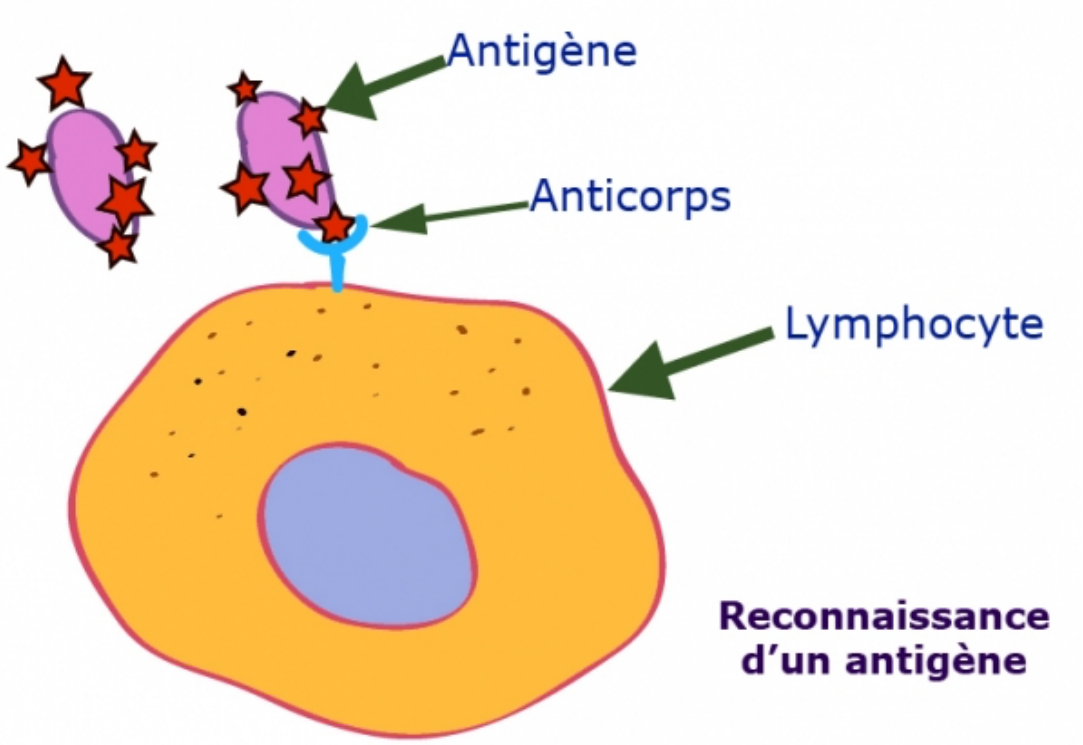
# Antigens

Substances which have the ability to induce immune system when comes to contact, also can react with the products of the specific immune responses.



# Haptens

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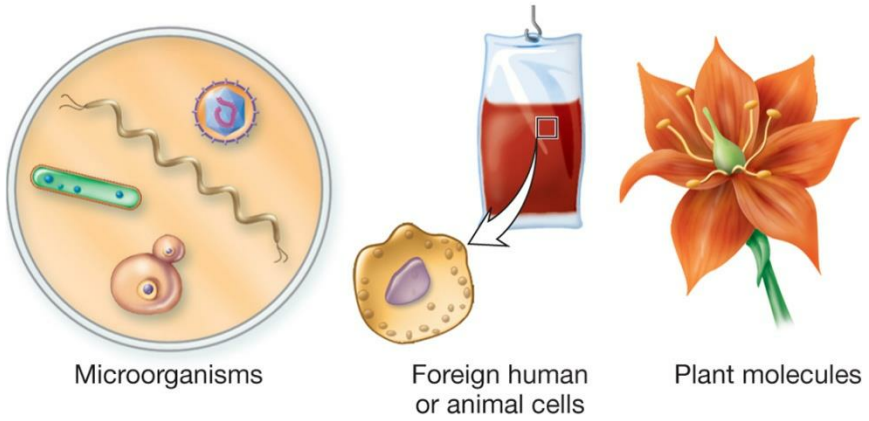
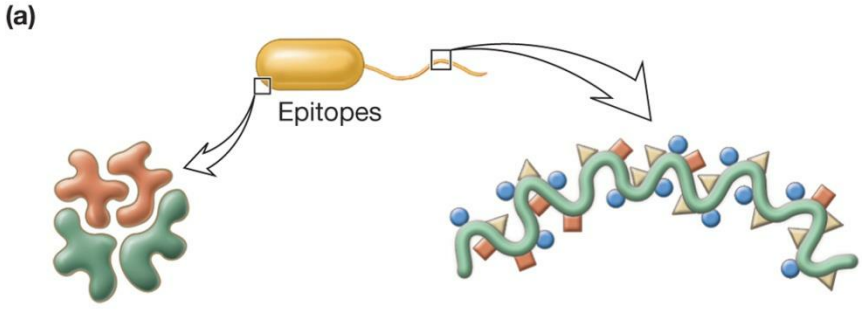
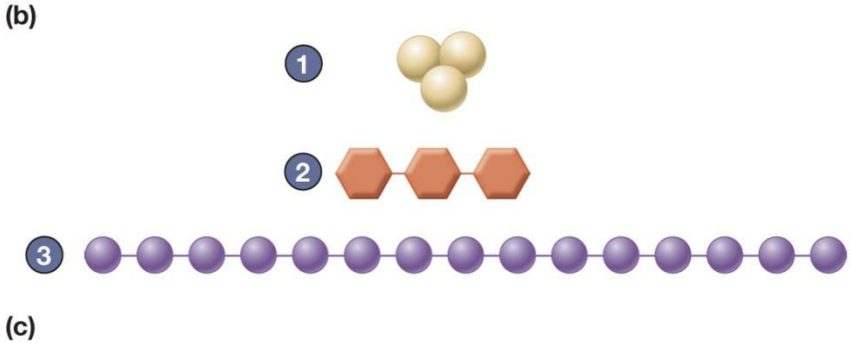


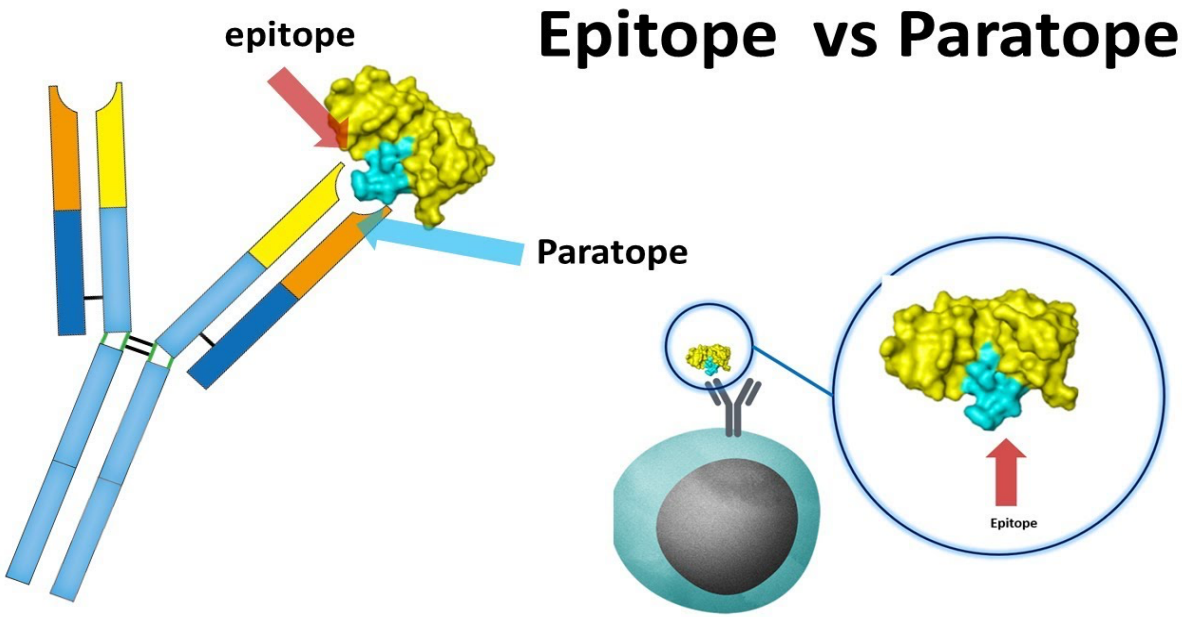

Small molecules which could never induce an immune response when administered by themselves (non-immunogenic) but which can react with the products of a specific immune response.

- e.g., penicillin
- may elicit hapten specific and carrier specific responses

1.Adjuvants: Latin *adjuvare*, to help (Substances that, when mixed with an antigen and injected with it, enhance the immunogenicity of that antigen).

2.Epitope or Antigenic Determinant - That portion of an antigen that combines with the products of a specific immune response.

3.Immunogenicity and Antigenicity: The ability to induce an Ab and/or cell-mediated immune response or the ability to combine specifically with Ab and/or cell-surface receptors (Ig/TCR)



# Factors affecting Immunogenicity

## A. Contribution of the Immunogen

**1. Foreignness** - The immune system normally discriminates between self and non-self such that only foreign molecules are immunogenic.

## 2. Molecular size

• There is a correlation between the size of a macromolecule and its immunogenicity.
• The best immunogens tend to have a molecular mass >100,000 daltons (Da).
• Generally, substances with a molecular mass less than 5,000 – 10,000 Da are poor immunogens.

## 3. Chemical composition and complexity

• **In general, the more complex the substance is chemically the more immunogenic it will be.**

Synthetic homopolymers tend to lack immunogenicity regardless of their size.

**Proteins** are the most potent immunogens. All 4 levels of protein organization – primary, secondary, tertiary and quaternary – contribute to the structural complexity of a protein and hence affect its immunogenicity.

**4. Physical form -** In general particulate antigens are more immunogenic than soluble ones and denatured antigens more immunogenic than the native form.

**5. Degradability -** Antigens that are easily phagocytosed are generally more immunogenic. This is because for most antigens (T-dependant antigens, see below) the development of an immune response requires that the antigen be phagocytosed, processed and presented to helper T cells by an antigen presenting cell (APC).

## B. Contribution of the Biological System

**1.Genetic Factors:** Some substances are immunogenic in one species but not in another. Similarly, some substances are immunogenic in one individual but not in others (*i.e.* responders and non-responders). The species or individuals may lack or have altered genes that code for the receptors for antigen on B cells and T cells or they may not have the appropriate genes needed for the APC to present antigen to the helper T cells.

**2. Age:** Age can also influence immunogenicity. Usually the very young and the very old have a diminished ability to mount and immune response in response to an immunogen.

## C. Method of Administration

1.Dose: The dose of administration of an immunogen can influence its immunogenicity. There is a dose of antigen above or below which the immune response will not be optimal.

2. Route: Generally the subcutaneous route is better than the intravenous or intragastric routes. The route of antigen administration can also alter the nature of the response.

# Chemical nature of Ags

## A. Proteins :

The vast majority of immunogens are proteins. These may be pure proteins or they may be glycoproteins or lipoproteins. In general, proteins are usually very good immunogens.

## B. Polysaccharides :

Pure polysaccharides and lipopolysaccharides are good immunogens.

## C. Nucleic Acids :

Nucleic acids are usually poorly immunogenic. However, they may become immunogenic when single stranded or when complexed with proteins.

## D. Lipids :

In general lipids are non-immunogenic, although they may be haptens.

# Types of Antigens

## 1. T-independent Antigens:

- T-independent antigens are antigens which can directly stimulate B- cells to produce antibody without the requirement for T-cell help.

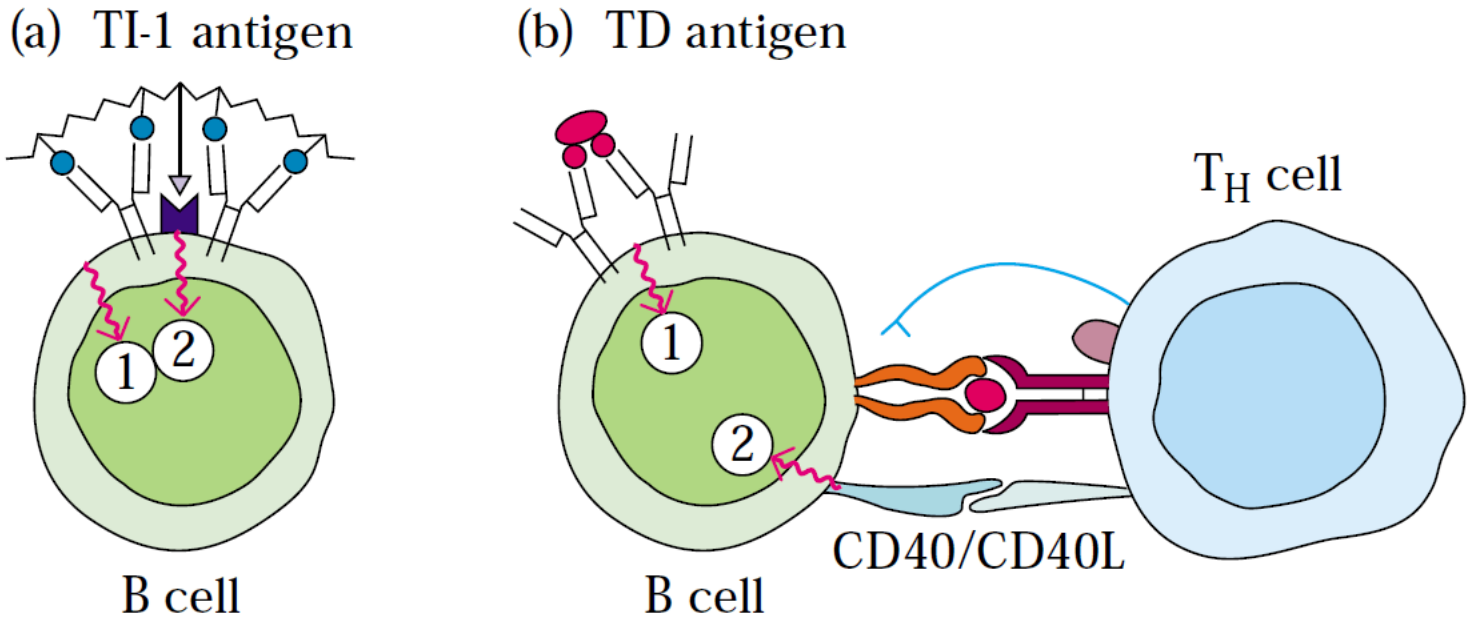
* In general, **polysaccharides** are T-independent antigens. These antigens are characterized by the same antigenic determinant repeated many times. Many of these antigens can activate B-cell clones specific for other antigens (polyclonal activation).

T-independent antigens can be subdivided into two type based on their ability to polyclonally activate B-cells:

a. Type 1 T-independent antigens are polyclonal activators.
b. b. Type 2 are not.

# 2. T-dependent Antigens:

•These antigens are those that do not directly stimulate the production of antibody without the help of T cells.
•Proteins are T-dependent antigens.
•Structurally these antigens are characterized by a few
•c



# Superantigens (SAgs)

- They are antigens which can activate multiple clones of T-
- lymphocytes
- **Like: Bacterial toxins: *Staph. aureus* toxic shock syndrome toxin (TSST) and enterotoxins; *Strpt. pyogenes* pyrogenic toxin A**
- They have the ability to bind both class II MHC molecules and TCR β chain; they are active at very low concentration causing release of large amounts of cytokines
- The massive T-cell activation and release of large amounts of cytokines cause systemic toxicity
- This method of stimulation is not specific for the pathogen
- It does not lead to acquired immunity i.e no memory