

# Antigen

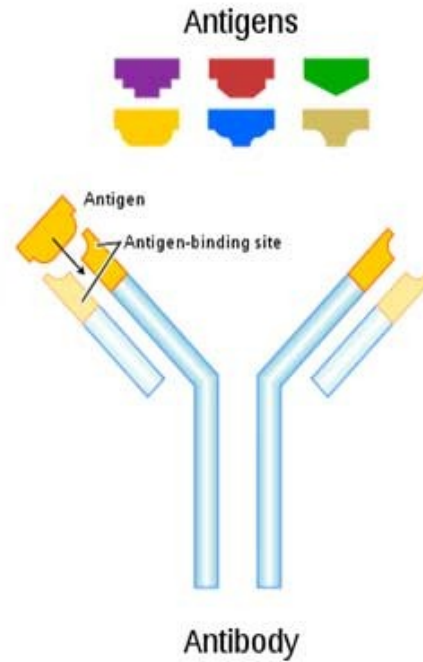
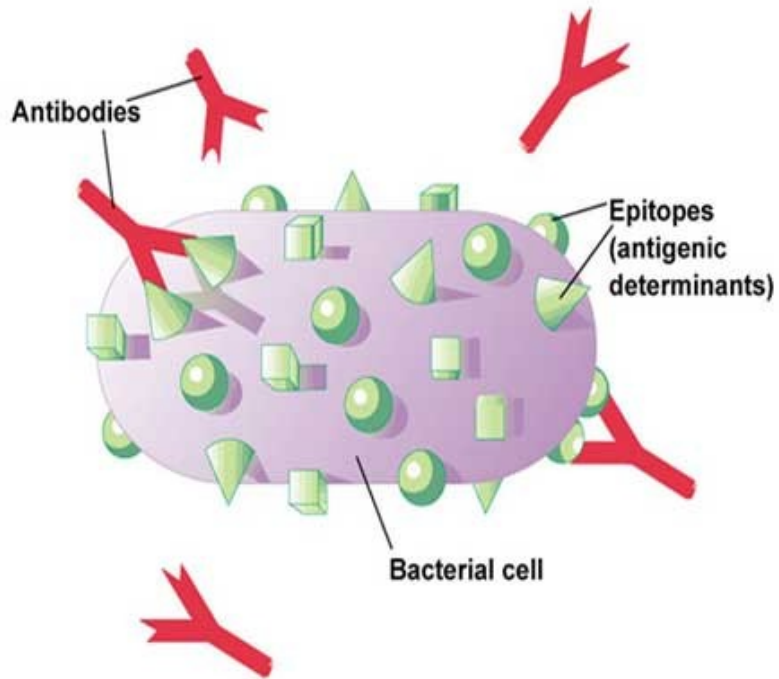
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- In general, host immune system mounts immune response against any foreign substance.
- The adaptive immune response generated, is mediated through:
  - **Antibodies,**
  - **Cytotoxic T cells**

*(that react specifically with the foreign substance which induces their production)*

- These foreign agents are considered as “antigens”.



# Definitions

- ***Antigenicity:*** The ability of a substance to react with the specific antibodies or T cells is called “Antigenicity”.
- ***Immunogenicity:*** The ability of a substance to induce humoral or cellular immune response is called Immunogenicity.
- ***Hapten:*** A compound, usually of low molecular weight, that is not itself immunogenic but can bind / react specifically to the antibodies or cells produced against them.

- All Immunogens are antigens whereas all antigens are not immunogen
- Antigen = Immunogen + Haptane

# **Factors contributing immunogenicity**

- The antigenicity of a substance dependent on various factors like:

- **Factors intrinsic to the antigen molecule**

- **Host related factors**

- **Other factors**

# Intrinsic factors

- **Foreignness:** In general, immune response is induced only to non-self substances.
- Higher the degree of foreignness better is the Immunogenicity.
- **Size:** Substances with molecular weight less than 1000 D are not immunogenic
- Whereas substances of higher molecular weight (10000 D) show better Immunogenicity.

## Intrinsic factors

- **Chemical nature:** Proteins of higher molecular weight are quite immunogenic
  - Polysaccharides, Lipids and ~~Nucleic acids~~ are poorly immunogenic.
- **Chemical complexity:** The more complex substance is more immunogenic.
- **Stability:** Highly unstable substances are not good Immunogens
- Similarly, highly stable substances like steel and plastics are also non immunogenic.



# Host related factors

- **Age:** In general, younger and older animals react poorly and mount weak immune response upon antigenic stimulation.
- **Nutritional status:** A healthy animal induces better immune response than a debilitated animal.
- **Genetics:** Genetic makeup of individual also plays important role in immune response generated / induced against an immunogen.

# Other factors

- **Dose:** Inoculation of immunogen in very low or dose high dose induces a state of “anergy” or “tolerance”, respectively. And thus do not yield immune response.
- **Route of inoculation:** Route of inoculation has profound effect on generation of immune response.
- In general, parenteral inoculation of immunogen induces better response.

*The antigen inoculated through I. V. route are trapped in spleen while that inoculated through S.C. routes are trapped in local lymph nodes.*

# Definitions

- ***Carrier Molecules:*** A macromolecule when conjugated / bound to a hapten makes hapten immunogenic.
- ***Adjuvant:*** A substance when administered along with antigen enhances the magnitude of immune response to that antigen.

# Epitope

- ***Epitope or Antigenic Determinants:***
  - Part of antigen molecule which binds to products of immune system  
(*i.e., antibody or B cell receptor or T cell receptor*).
  - Epitopes are also termed as “**Antigenic determinants**”
  - usually consist of 4-8 residues (amino acids or sugars).

***B cell epitope:*** These epitopes are recognized by B cell receptors or antibody molecules.

B cell epitopes are usually made up of 3-7 amino acids.

# Important terms

- ***Cross reactivity***: Is a measure of relatedness between two different antigenic substances.
- ***Heterophile antigens***: Antigens with cross-reacting epitopes present in unrelated species.
  - Forssman antigen is an example of Heterophile antigen
- ***Forssman Antigen***: Forssman antigen is a **lipid-carbohydrate complex** widely distributed in many animals, birds, plants and bacteria.

## Exogenous and Endogenous antigen

- **Endogenous antigens:**
  - The antigens produced within host cells are considered as “endogenous antigens”.
  - example: Self antigens, viral antigens, tumor antigens
- **Exogenous antigens:**
  - The antigens which are produce outside the host cells are considered as exogenous antigen.
  - Exogenous antigens are acquired by the cells due to the process of phagocytosis.
  - Example: Bacterial antigen, Parasitic antigen etc.

Antigens of bacterial origin:

- ***K antigen***: Capsular antigen of bacteria is designated as “K” antigen.
- ***O antigen***: Bacterial somatic antigens are designated as “O” antigens.
- ***H antigen***: Flagellar antigens of bacteria are designated as “H” antigens.

*These K, O and H antigens are important because variation in these antigens form the basis for sero-grouping of various bacterial species.*

# Allergens

- Any substance that induces allergic reactions is called “Allergen”.
- Allergic reactions are classified as “type I hypersensitivity” which is mediated by IgE type of antibodies
- Example - dust (contain mites, animal dander etc), pollen, gluten, peanut, mould, latex, poison ivy etc.
- The sensitivity for any allergen could vary from person to person.
- People are also allergic to various drugs like “penicillin”.
- An extreme form of allergy is called “Anaphylaxis”.



# Important terms

Antigenic Determinants present on *Antibody* Molecules:

- ***Isotype***: Antigenic determinants which arise due to gene duplication and thus form different classes and sub classes of same protein.
- ***Allotype***: Antigenic determinants which arise due to allelic variation. These antigens are present in different individuals of the same species.
- ***Idiotype***: Idiotype is the collection of antigenic determinants present in the variable region of the immunoglobulin molecule.

# Superantigen

- Antigens that can **non-specifically** stimulate a plenty of T-helper cells
- Induce a very strong Immune response
  - (production of cytokines) with a extremely low concentration

*Examples: Staphylococcal enterotoxins, Streptococcal pyrogenic exotoxins, staphylococcal protein A, HIV:gp120*

# Mitogen

- Mitogens are agents that are able to induce cell division (mitosis) in a high percentage of T or B cells.
- There are T cell mitogens and B cell mitogens.
- A number of common mitogens are lectins.

Lectin Examples:

- Con A & PHA (T cell mitogen),
  - PWM (T and B cell mitogen)
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- Another important mitogen which is NOT a lectin is LPS (lipopolysaccharide).
  - LPS is a very potent mitogen for B cells.

# T- dependent and T –independent antigen

- **T-dependent antigen:**

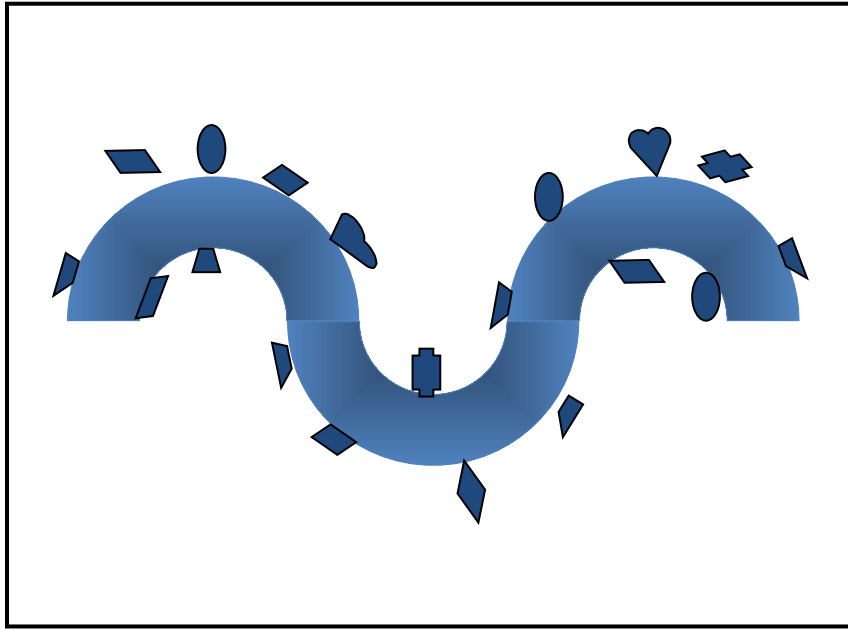
- Antigens that need T cell help for response.
- Need processing and presentation by antigen presenting cells (APCs).
- Capable of inducing production of IgM, IgA, IgG type of antibodies.

- **T-Independent antigens:**

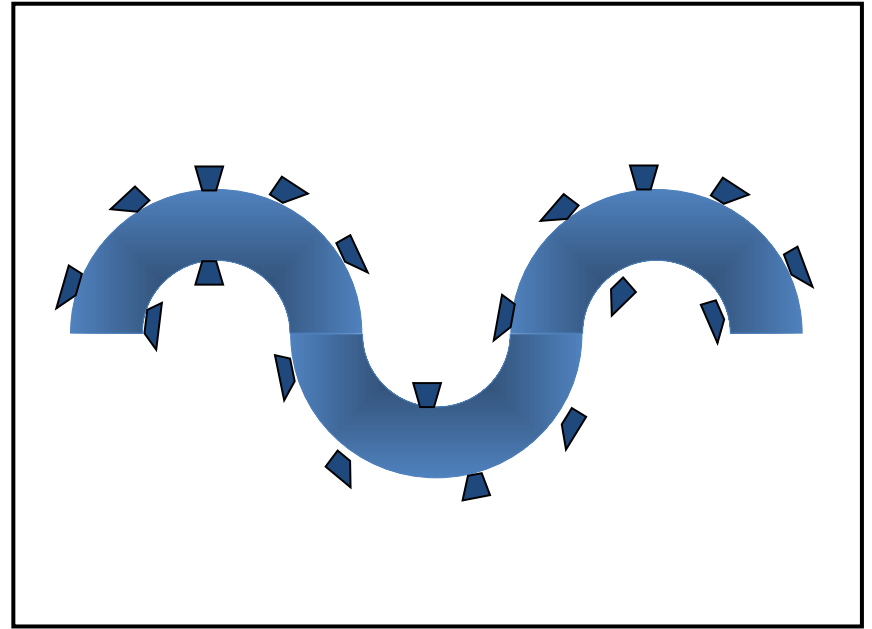
- T-independent antigens directly stimulate B cells and don't require help from T cells for production of antibody by B cells.
- These antigens are characterized by their polymeric nature (have same antigenic determinant repeated many times).
- Example: Polysaccharides.

# T- dependent and T –independent antigen

**T- dependent**



**T –independent antigen**



# Important terms

- ***Autograft:*** A tissue or organ graft made between two sites on the same individual.
- ***Allograft:*** A graft between two genetically dissimilar individuals of the same species.
- ***Xenograft:*** A graft between two animals of different species.

THE END

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