Immunology/Pharmacy Students

Introduction to Immunity

Lecture 1

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Learning objectives

1- Define and describe the characteristics of:
Antigen
Immunogen
Hapten
Epitope
adjuvant

2- Identify the factors that affect the immunogenicity
3- Understand the concept of antigen cross reactivity
4- Differentiate between active, passive, and adoptive immunity

History of Immunology

The earliest known reference to immunity was during the plague of Athens in 430 BC

In the 18th century, scientist made experiments with scorpion venom and observed that certain dogs and mice were immune to this venom.

Introduction

Immunology: study of the components and function of the immune system.

Immune system: Molecules, cells, tissues and organs which provide non-specific and specific protection against:

- –Microorganisms;
- –Microbial toxins;
- –Tumor cells.

Basic definitions

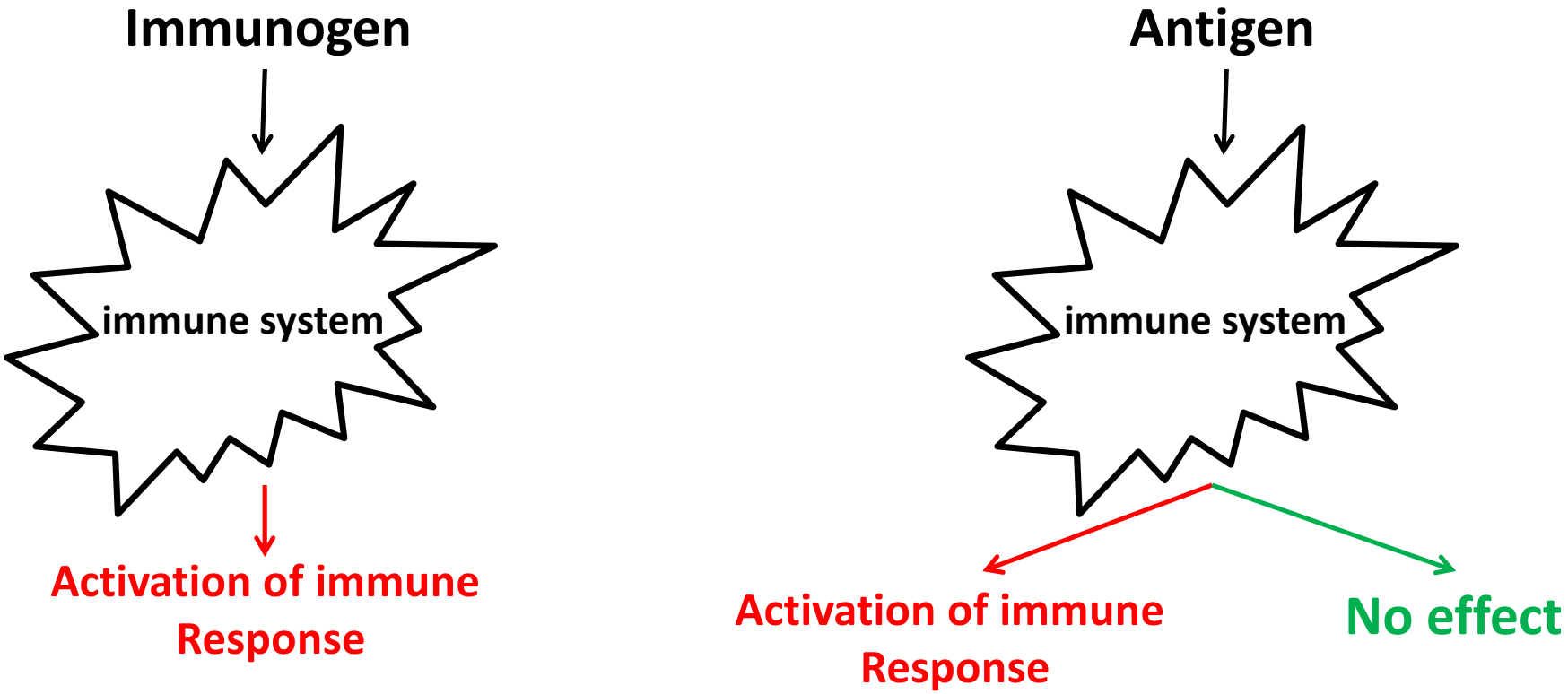
Antigens & Immunogens

Haptens

Epitopes

Adjuvants

Antigens & Immunogens



Immunogen: is a substance capable of inducing a specific immune response, resulting in the formation of antibodies or active white blood cells (WBCs).

Antigen: any molecule that can react with the immune system without the necessary to induce an immune response

Antigens & Immunogens

Antigens (Food particles, dust, microorganisms)

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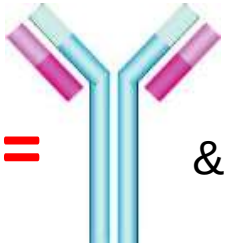

& Active WBCs

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Antigen is considered immunogen

Antigens (Food particles, dust, microorganisms)

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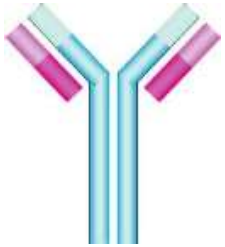


No activation

=

Antigen is considered non-immunogen (Just an antigen)

Antigens & Immunogens

Blood antigens in this case are considered Non-immunogens (Autologous donation)

Blood group A

Blood group B

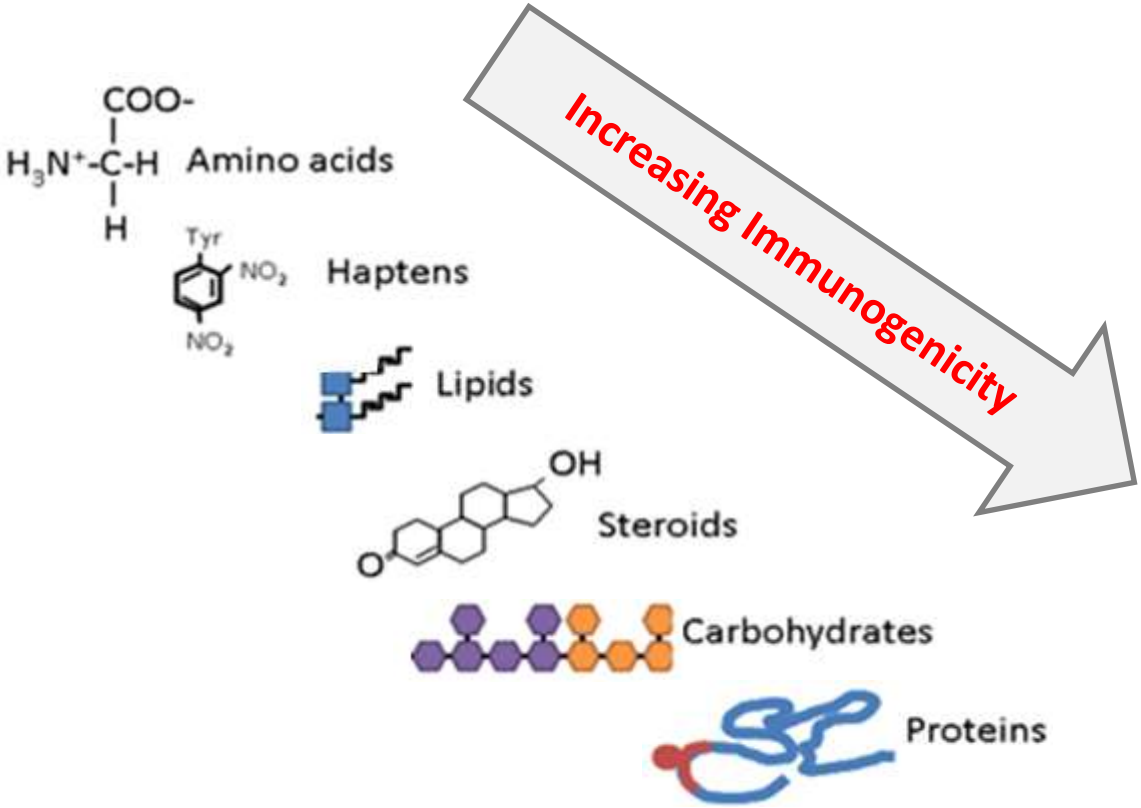
Blood antigens in this case are considered immunogens (Heterologous donation)

Factor affecting Immunogenicity

Two groups of factors determine degree of immunogenicity

Nature of the immunogen

- Foreignness
- Molecular weight
- Chemical structure complexity



Factor affecting Immunogenicity

Two groups of factors determine degree of immunogenicity

Nature of the immunogen

- Foreignness
- Molecular weight
- Chemical structure complexity

Biological factors

- Dosage
- Route of administration
  Subcutaneous > Intravenous > Intragastric
- Individual genetic difference
- Adjuvants

Factor affecting Immunogenicity

Nature of the immunogen which including:

1. Foreignness.
2. Molecular weight: a minimal molecular weight is required for a compound to be immunogenic
   - <1000 daltons: not immunogenic (penicillin, progesterone, aspirin)
   - 1000-6000: may or may not immunogenic (insulin)
   - >6000 daltons: are immunogenic (albumin, tetanus toxin)

- Chemical structure complexity: Immunogens with amino acids homopolymers are less compared to heteropolymers containing two or more different amino acids

Adjuvants

Substances which when mixed with an immunogen enhance the immune response against the **immunogen (Immunopotentiator or Immuno-booster).**

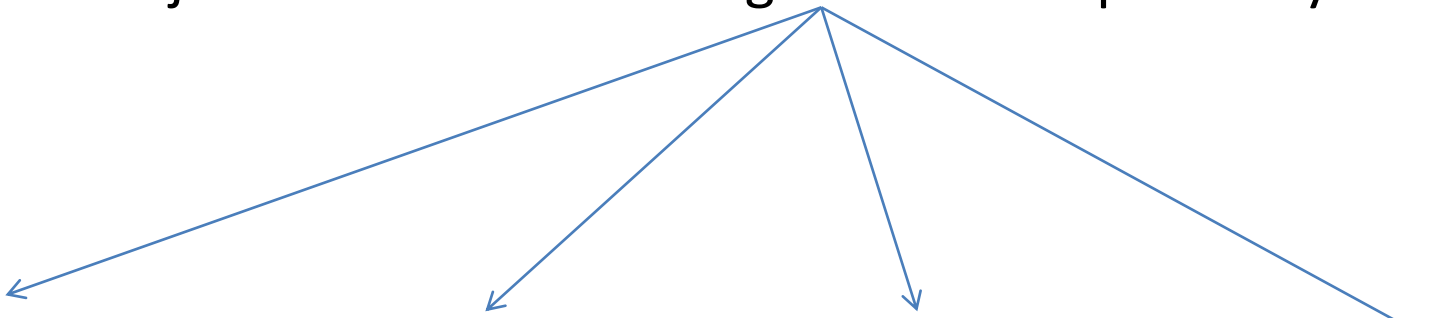
Examples

a. Inorganic compounds: alum, aluminum hydroxide
b. Mineral oil: paraffin oil
c. Bacterial products.

Adjuvants

Mode of action

Vaccine + adjuvant = Potentiating immune response by



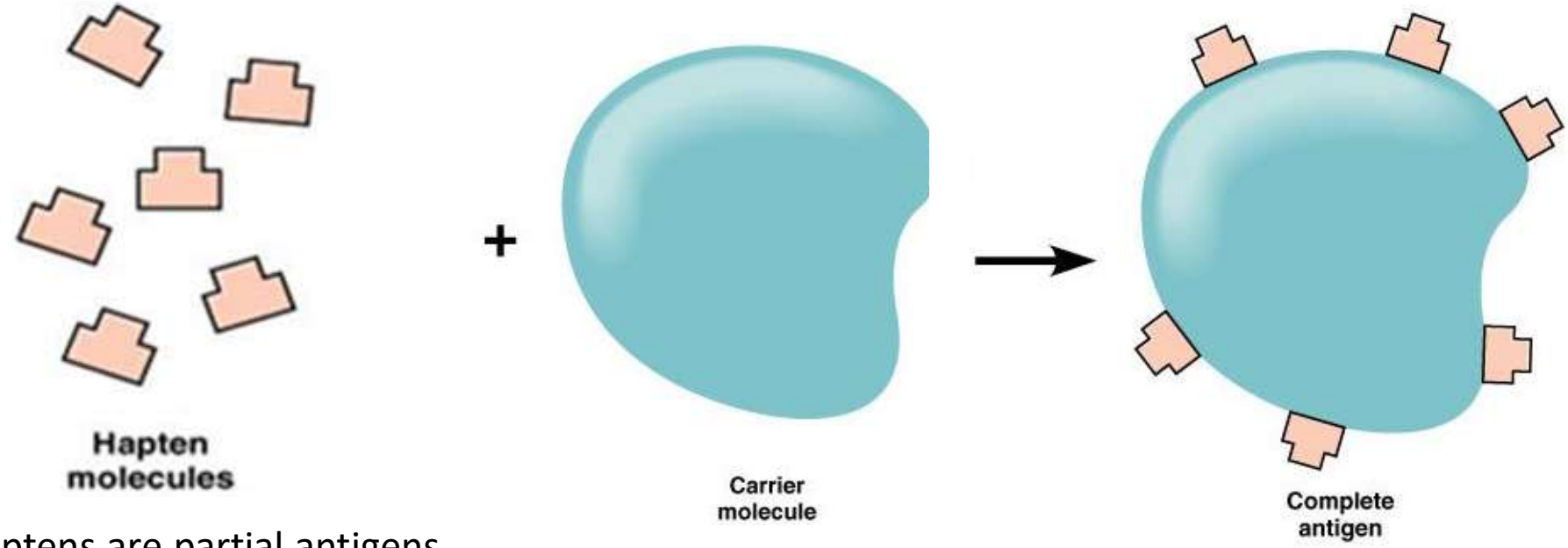
Extend the presence of antigen in the blood

Help the antigen uptake by macrophages

Activate macrophages and lymphocytes

Support the production of cytokines

Haptens



Haptens are partial antigens that themselves cannot cause the production of immune lymphocytes or antibodies (too small to be immunogenic).

e.g., antibiotics, analgesics, and other low-molecular weight compounds.

If a hapten is coupled to a larger carrier molecule as albumins, globulins, or synthetic polypeptides it becomes immunogen

complete antigen (immunogen)

Haptens

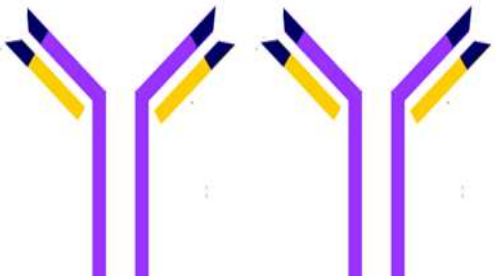
Hapten

No activation for immune response
(No antibody production)

Exposure to hapten and carrier protein

Hapten → **Carrier protein**

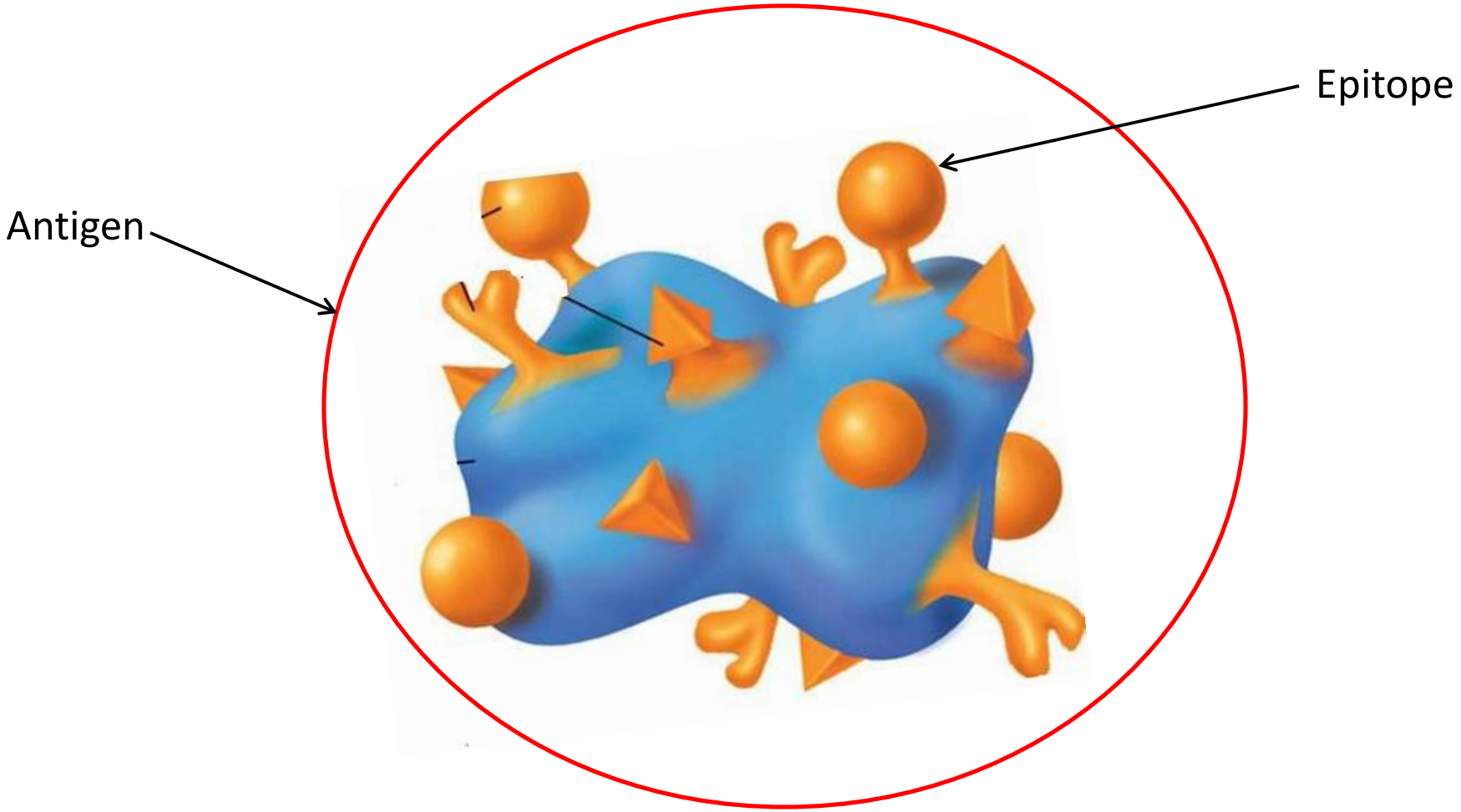
Activation for immune response and antibody production →



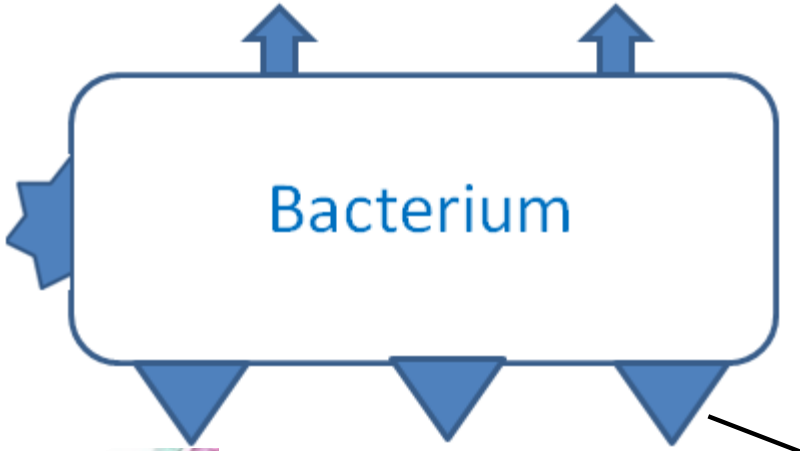
Epitopes

Epitopes

- Called antigenic determinants
- Are very small (e.g., just four or five amino acid or monosaccharide residues)



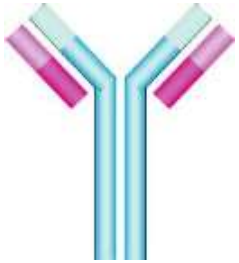
Epitopes

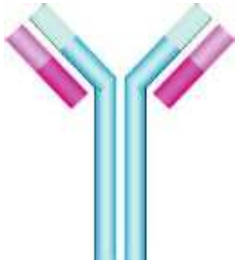


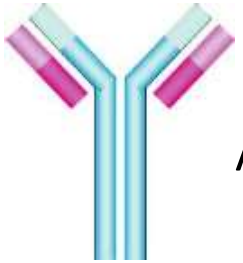
Epitope

virus

Epitope

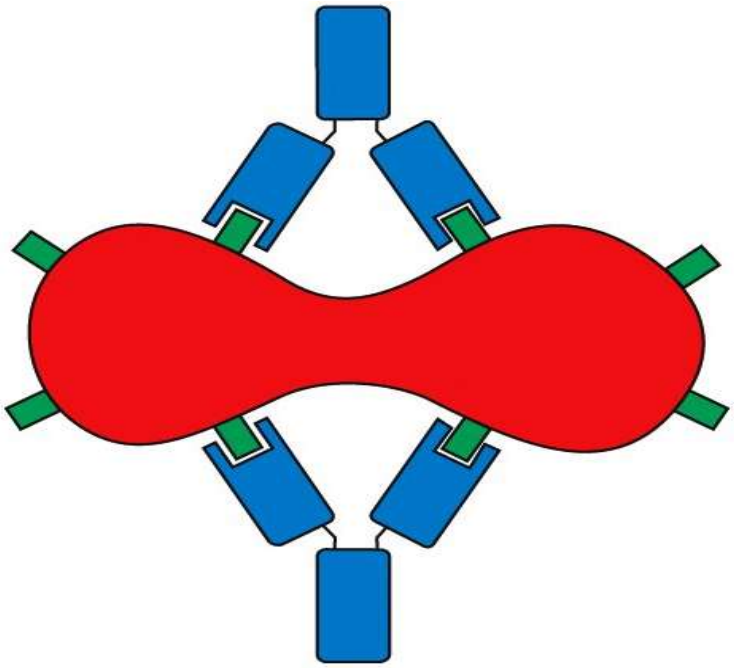




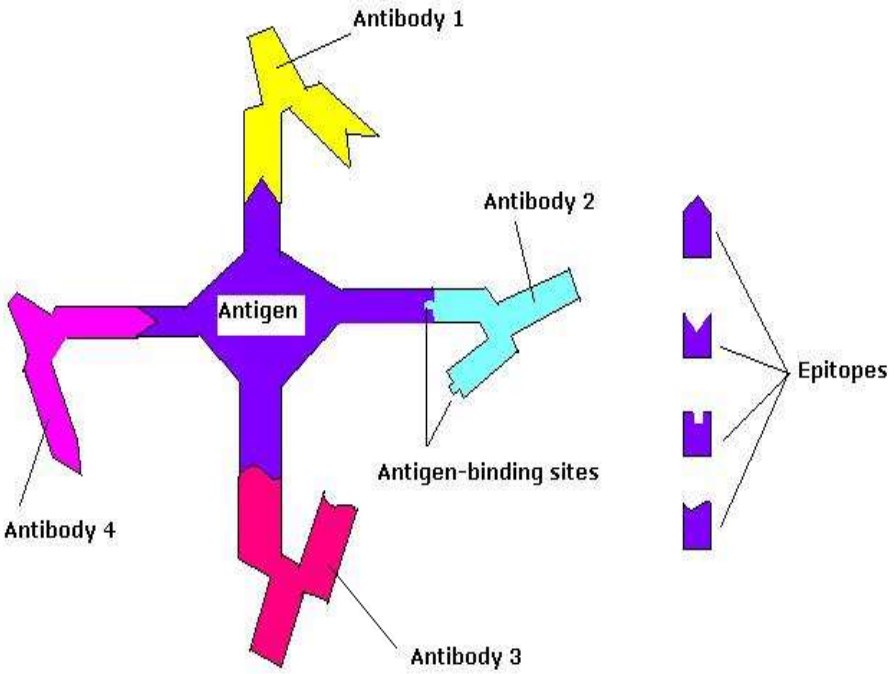


Antibodies are produced after an immune response

Epitopes



multivalent antigen with similar epitopes



Multivalent antigen with different epitopes

Characteristics of the Immune response

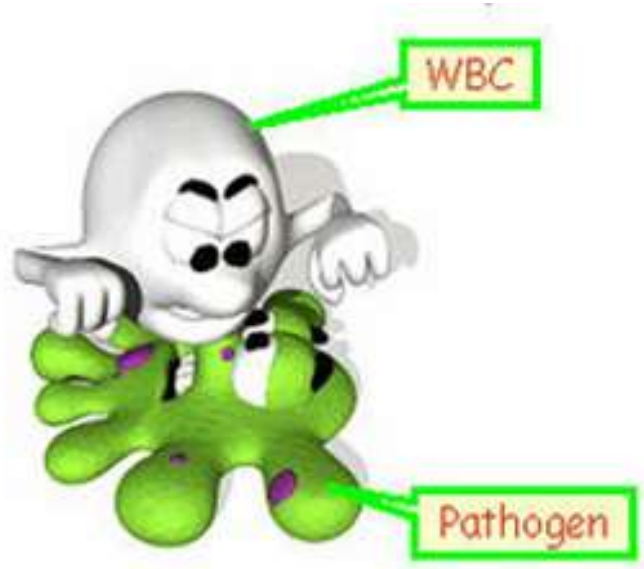
Specificity: The ability to discriminate among different molecular entities rather than making a random, undifferentiated response.

Discrimination between “self” and “nonself” antigens

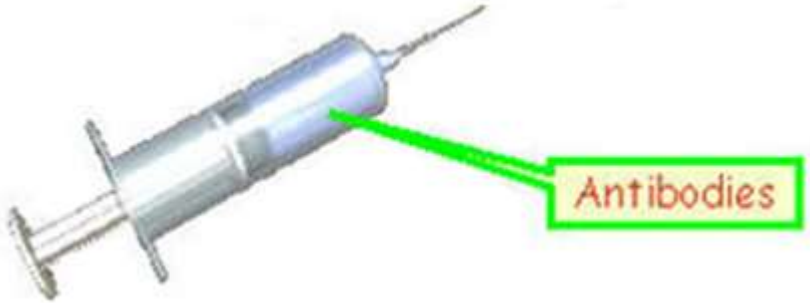
Memory: Is the ability to recall previous contact with a foreign molecules and respond to it in a learned manner (more rapid and larger response)

Routes of acquiring immunity

Active Immunity: Reaction of your own immune system



Passive Immunity: Borrow immune agents from other person



Routes of acquiring immunity