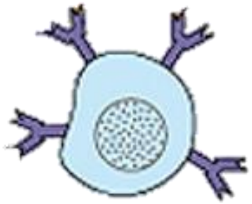
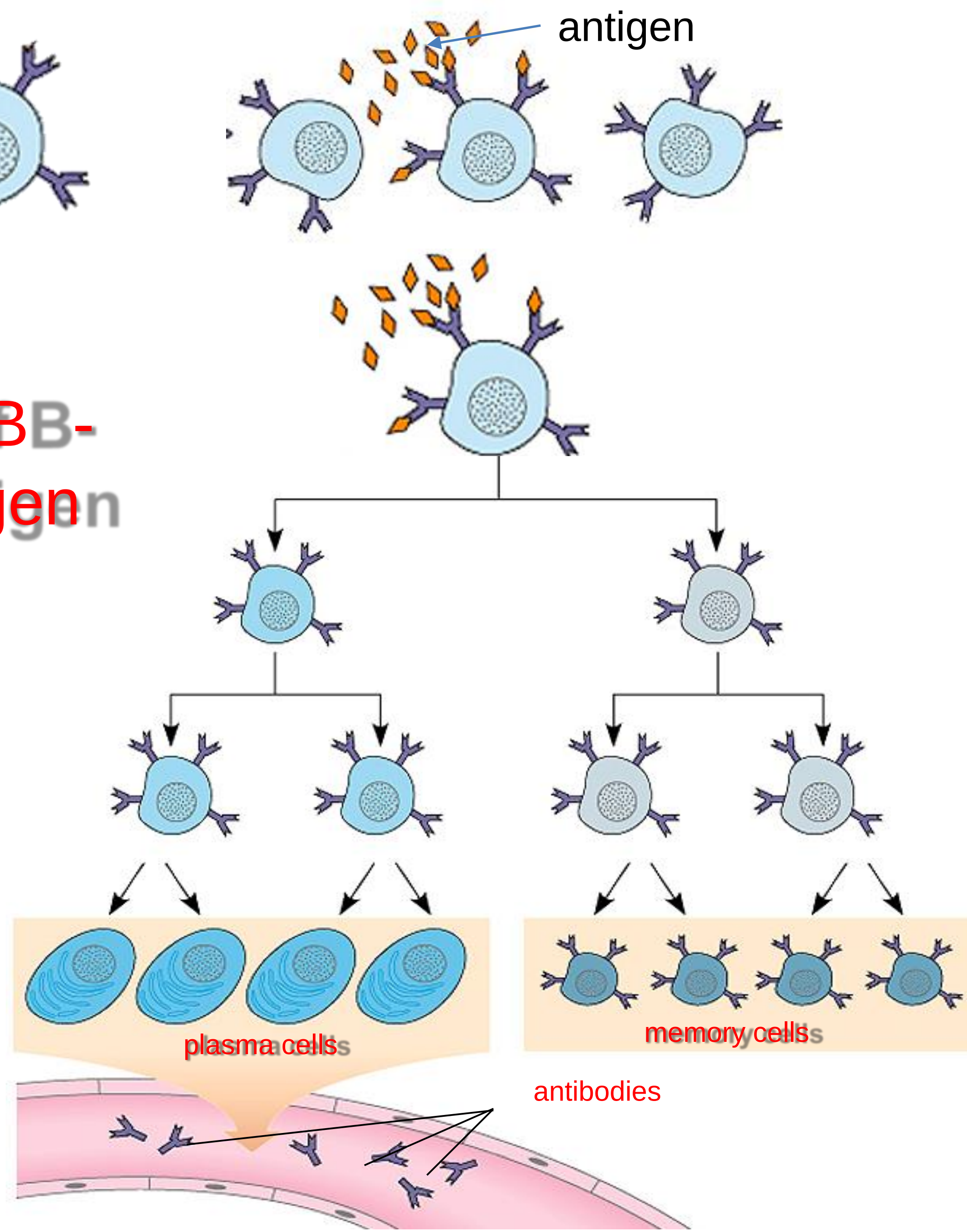

بسم الله الرحمن الرحيم

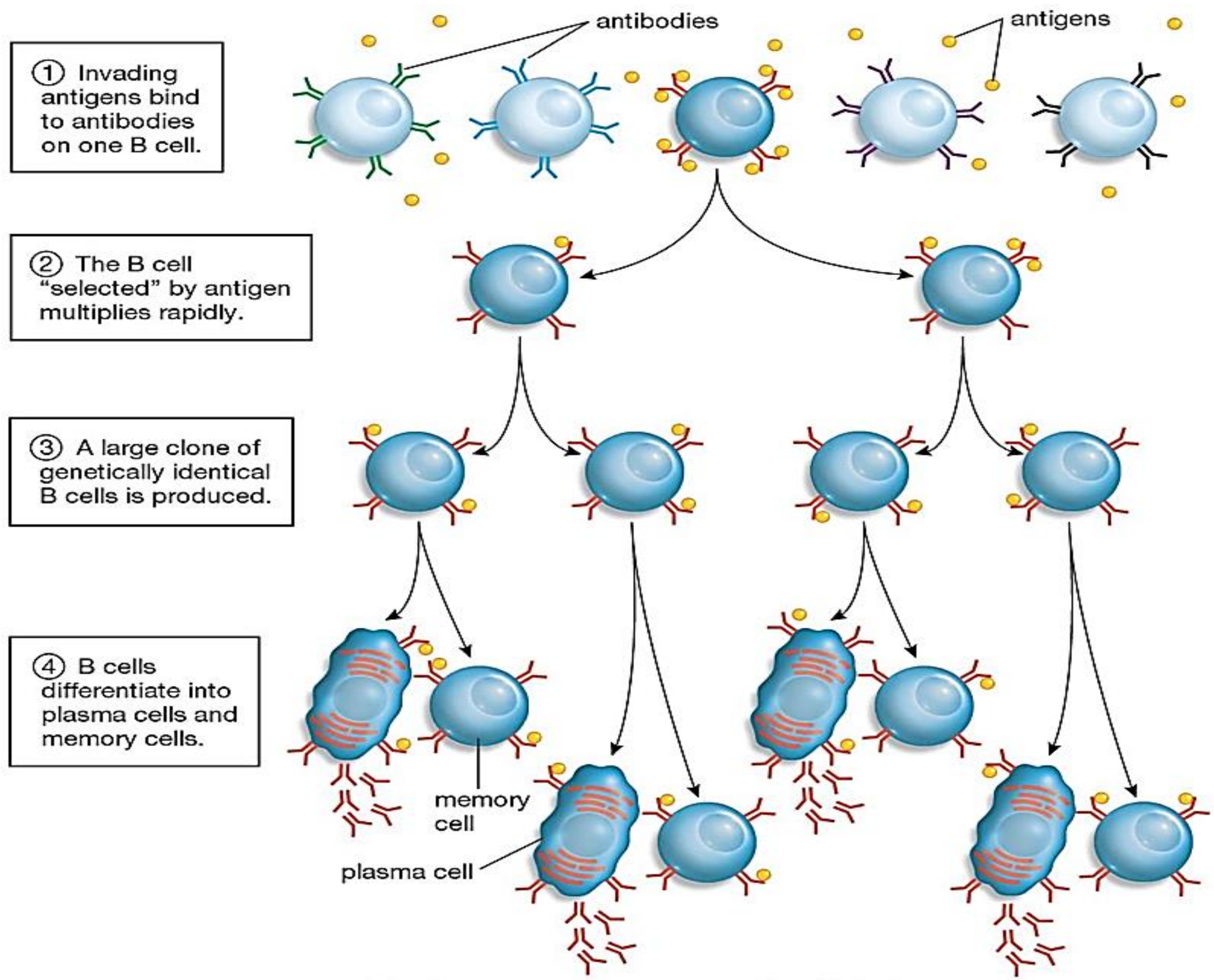
- ‡ B Cells



- ‡ Activation of B-Cells by Antigen
- ‡ Clonal Selection



Clonal Selection



T Lymphocytes

‡ Mature in thymus

‡ Involved in cell-mediated immunity.

‡ 65-80% of Lymphocytes.

‡ Long life span.

‡ Have glycoprotein receptors (CD)

‡ Activated when another cell presents antigen (APC) to them

‡ Generally based on marker CD, there are two main types of T cells, and each responds to one class of MHC molecule.

- CD4+ T Lymphocytes
- CD8+ T Lymphocytes

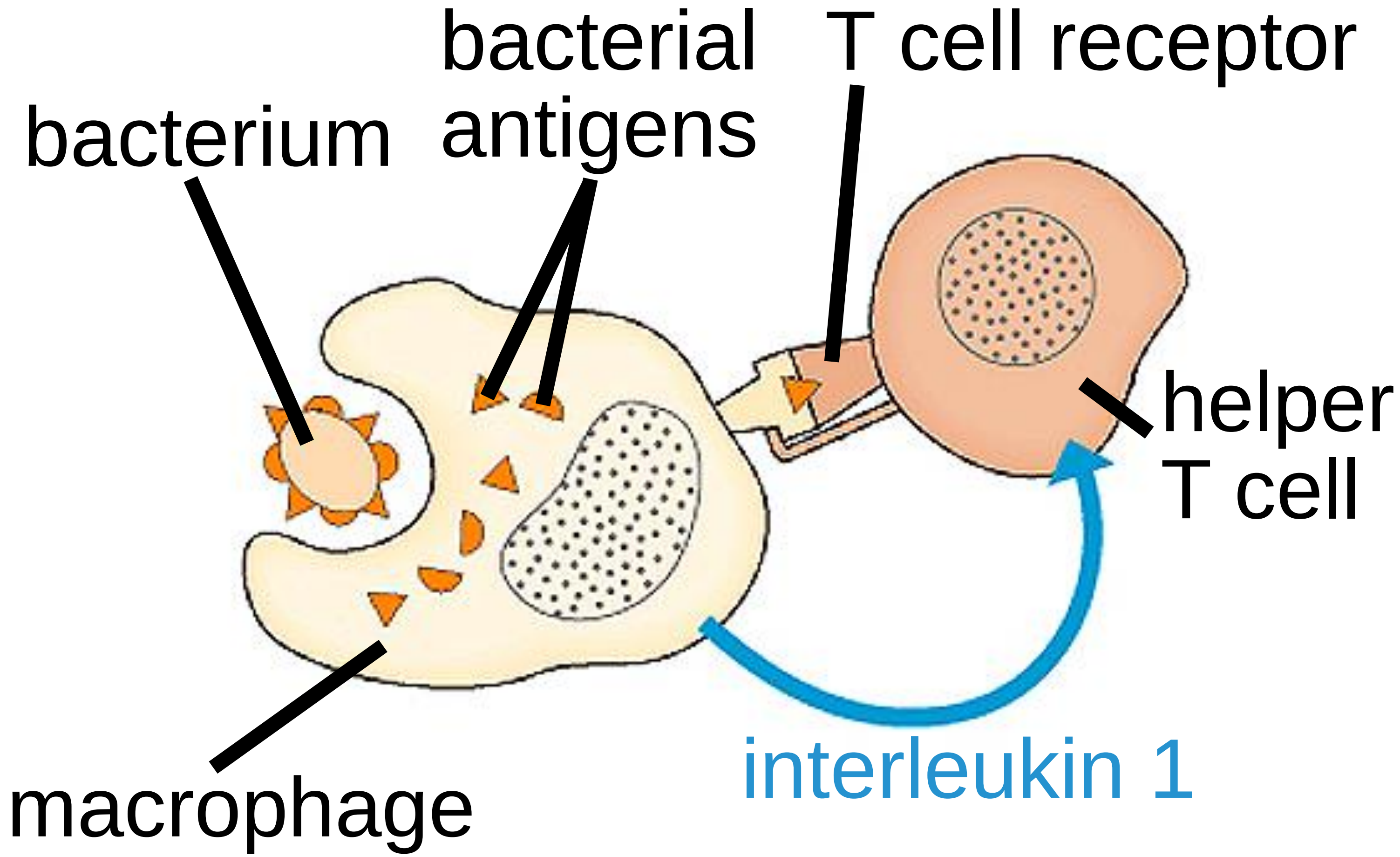
Helper T Lymphocytes, T_H or CD4+

‡ 65% of T-cells predominant in thymus, tonsils and blood.

‡ Helper T-cells have receptors for recognizing antigens on the surface of APC in association with the body $¶ class II MHC molecules. If they are presented with an antigen, they release cytokines to stimulate B-cell division.

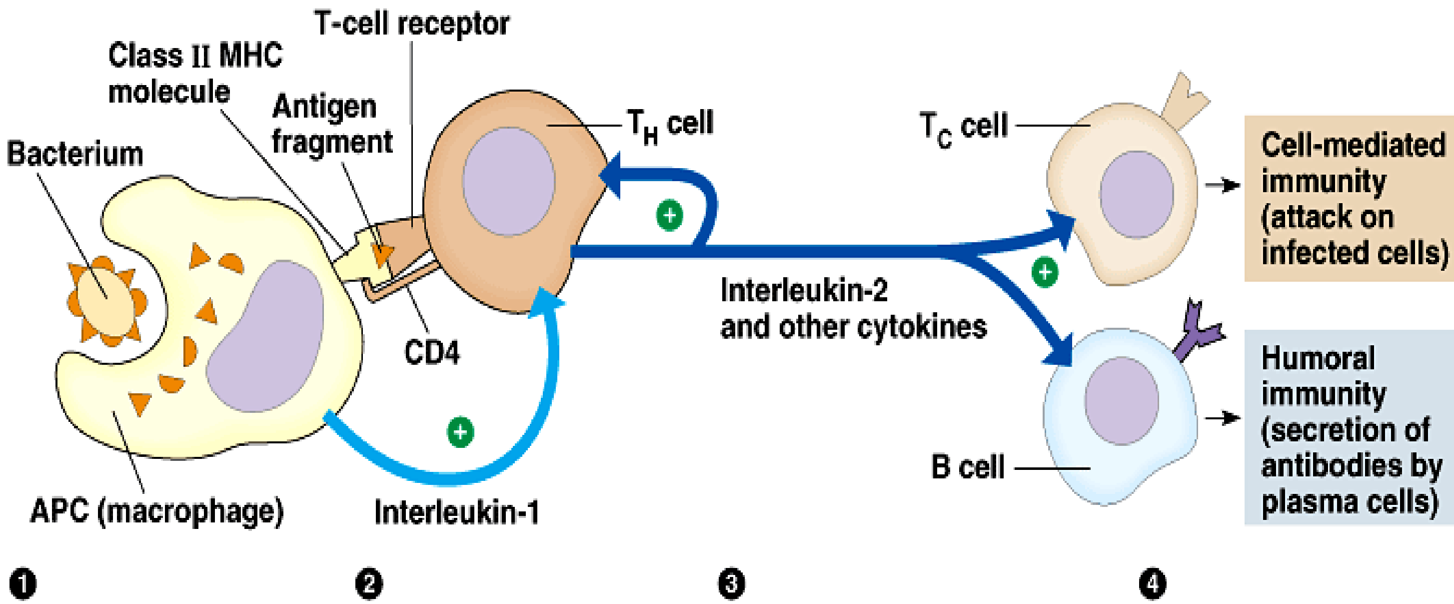
‡ The helper T-cell is the key cell to signal an immune response. If helper T-cells are disabled, as they are in people with AIDS, the immune system will not respond

Helper T Cells



The central role of helper T cells (Functions)

- They release mediators (cytokines) e.g. IL-2 which have stimulatory and proliferative effect on T cells and B cells.
- They help B cells to develop into antibody producing plasma cells.
- They help T_C to cytotoxic the infected cell

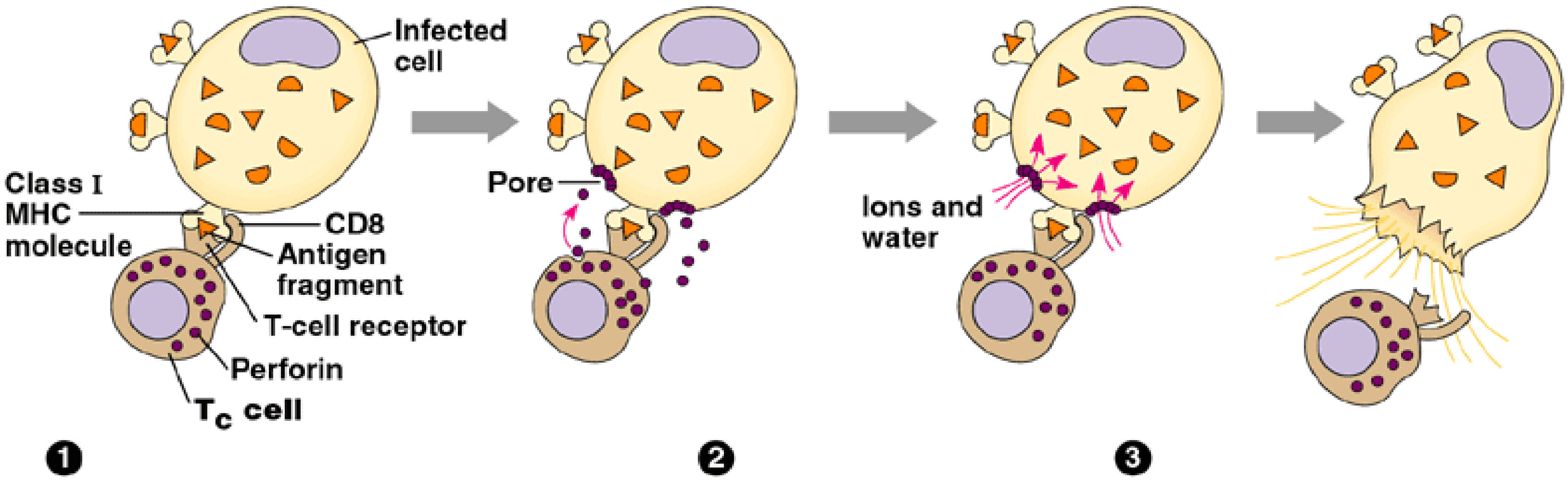


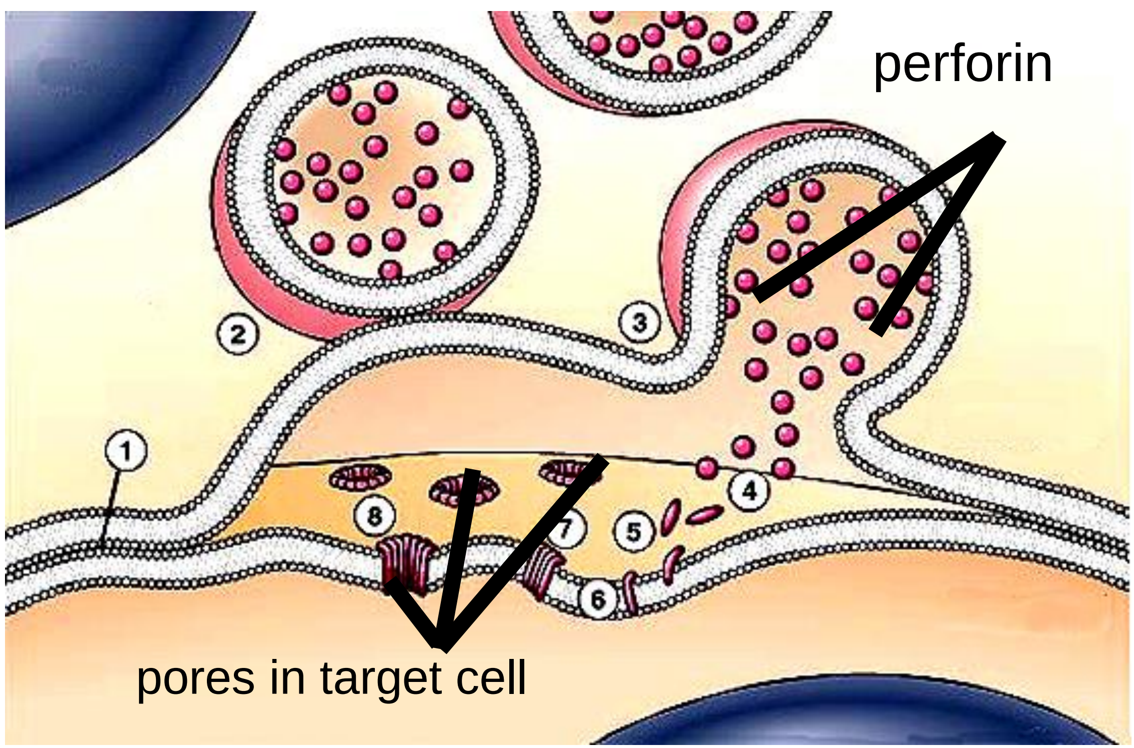
CD8+ T Lymphocytes

±35 % T-cells, two subpopulations

- Cytotoxic T cells (T_C)
  - ‡have antigen receptors that bind to protein fragments displayed by the body¶s class I MHC molecules.
  - ‡Kill directly virus infected, tumor or graft cells.
- Suppressor T cells (T_S)
  - ‡ Suppress T and B cell activities *i.e.* regulation on immune response.

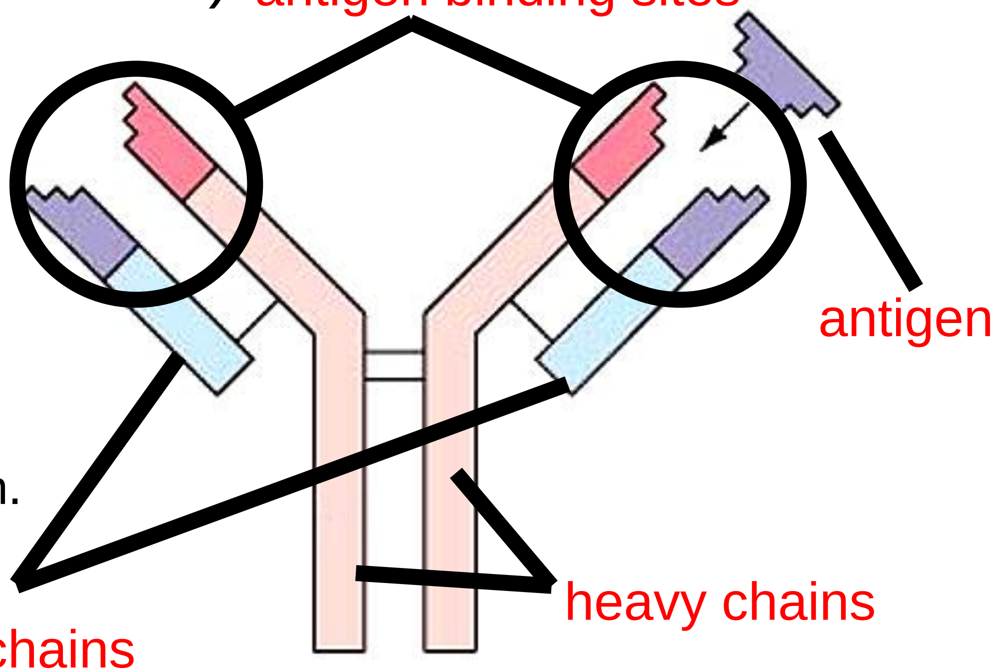
Cytotoxic T Cell





Humoral Immune Response

- Antibodies Essential part of adaptive immunity
- constitute a group of globular serum proteins called immunoglobins (Igs).
- Produced by Plasma cell (B-lymphocytes producing Ab)
- A typical antibody molecule has two identical antigen-binding sites specific for the epitope that provokes its production (also called an antigenic determinant).



Basic Structure of Antibody Molecule

1- Heavy and light chains.

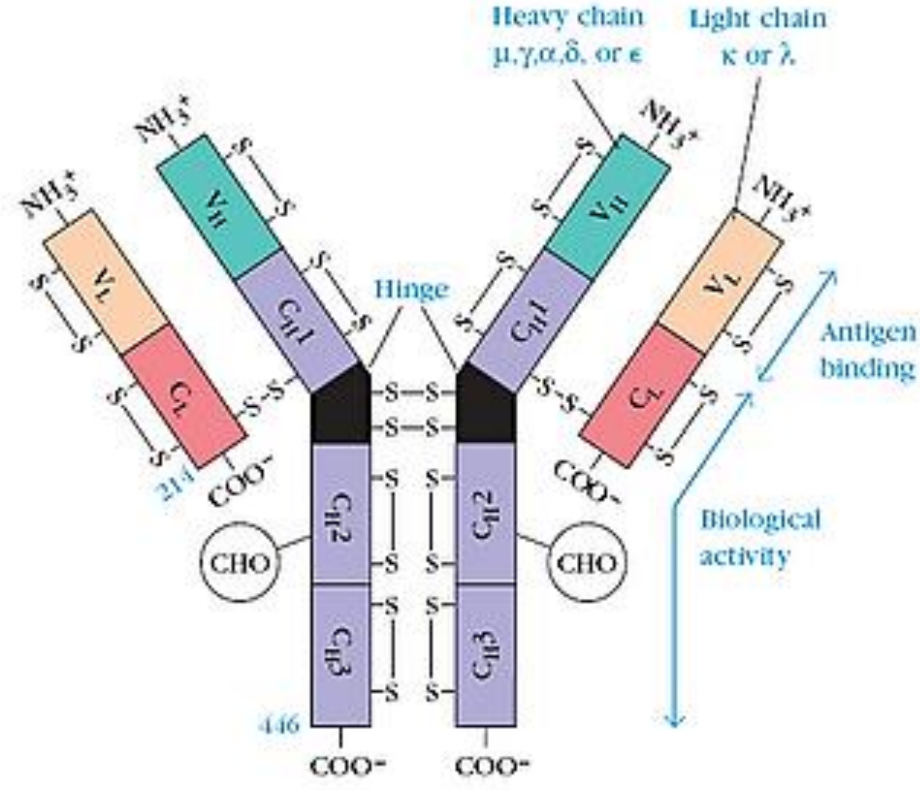
2- Disulphide bonds.

3- Variable and constant region.

4- Hinge region

5- Domains

What does an antibody look like ?

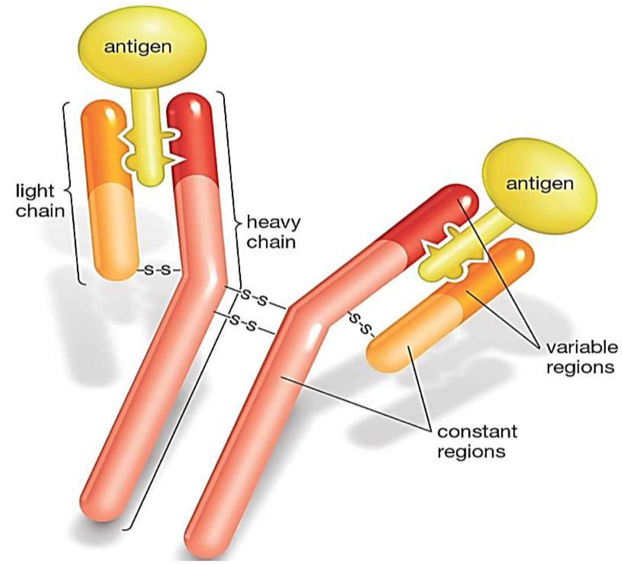


‡ 2 identical heavychains

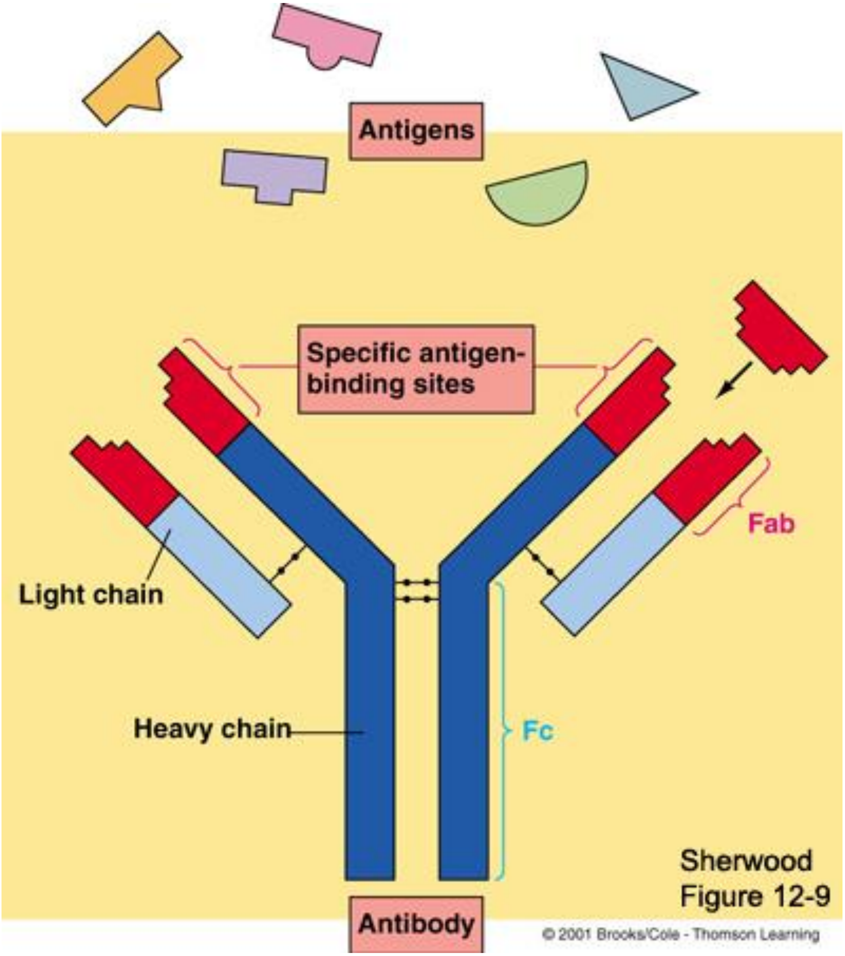
‡ 2 identicallight chains

‡ Each heavy chain ± has a constant and a variable region

‡ Each light chain has a constant and a variable region

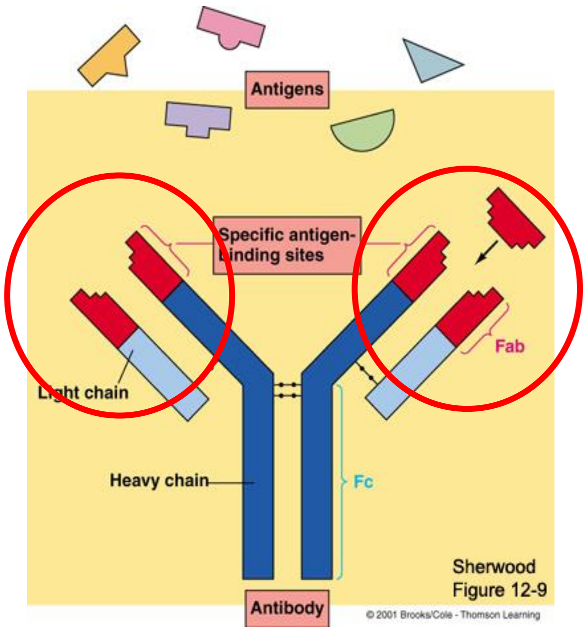


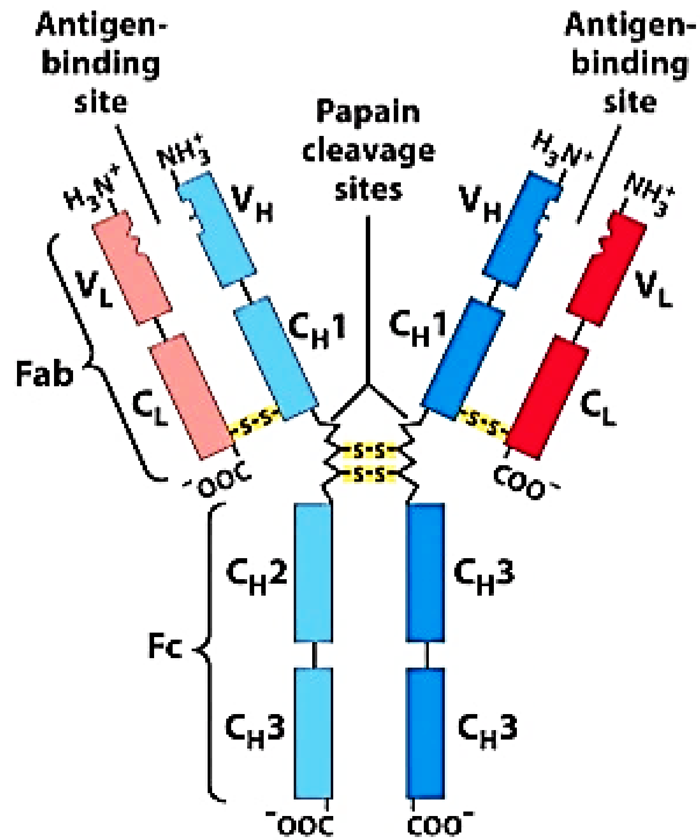
Antibody fragments: structure and function relationship



- Fab t fragment antigen binding
- Fc- Fragment constant

Antibody: Fab

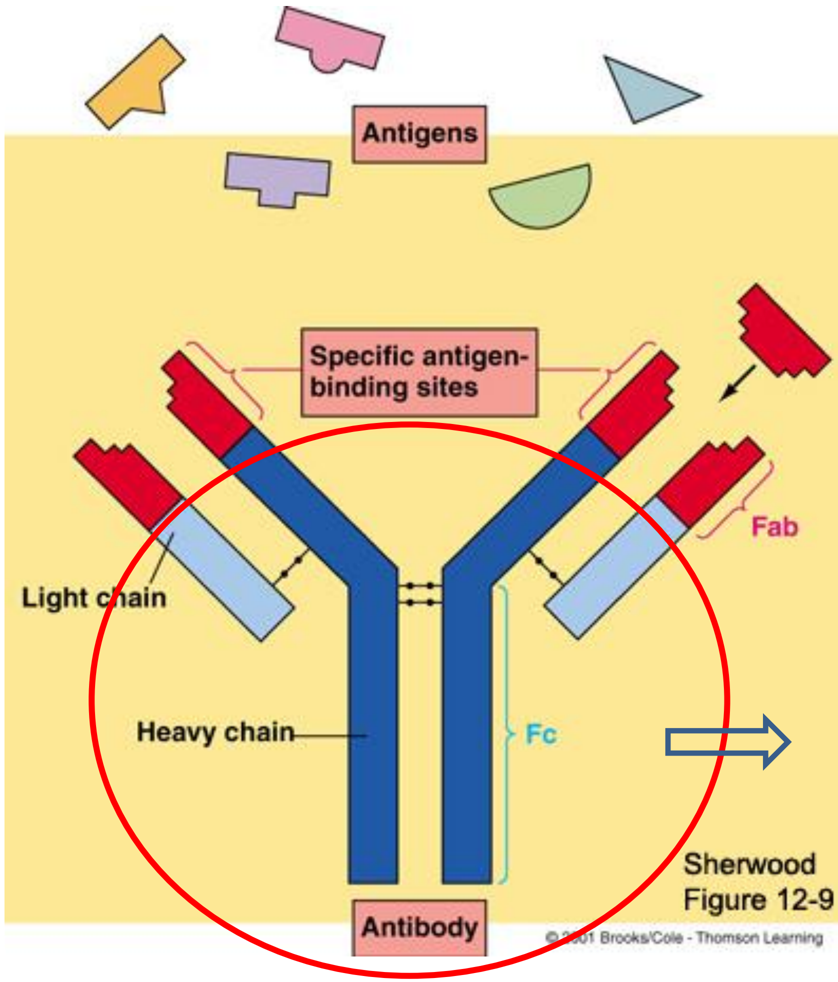




Fab region

- ‡ Variable region of the antibody
- ‡ Tip of the antibody
- ‡ Binds the antigen
- ‡ Specificity of antigen binding determined by V_H and V_L

Antibody: Fc



Fc region

‡ Constant region

‡ Base of the antibody

‡ Can bind cell receptors and complement proteins

Antibodies Types

Isotypes: Immunoglobin Classes

Changes in amino acid sequence in constant region of heavy chains

Allotypes: Immunoglobin Subclasses

Slight differences in amino acid sequence in constant region of heavy chains

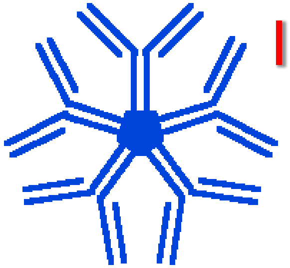
Idiotypes: Immunoglobin

Variation in amino acid sequence in variable region

‡ Polyclonal antibodies:

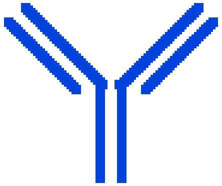
‡ Monoclonal antibodies:

Isotypes: Immunoglobin Classes



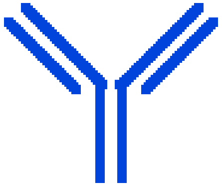
IgM

‡1st response to antigen
‡Effective in agglutination
‡Can t¶cross placenta



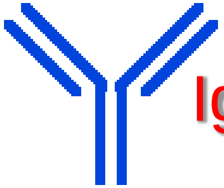
IgD

‡B cell activation
‡Can t¶cross placenta



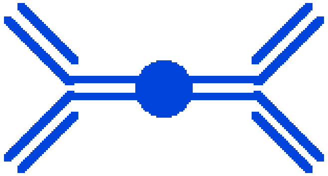
IgG

‡ Most common form
‡ Crosses blood vessels
‡ Crosses placenta (passive immunity to fetus)



IgE

‡Histamine reactions and allergies



IgA

‡Secreted from mucus membranes.
‡Prevents attachment of bacteria to epithelial surface
‡In colostrum

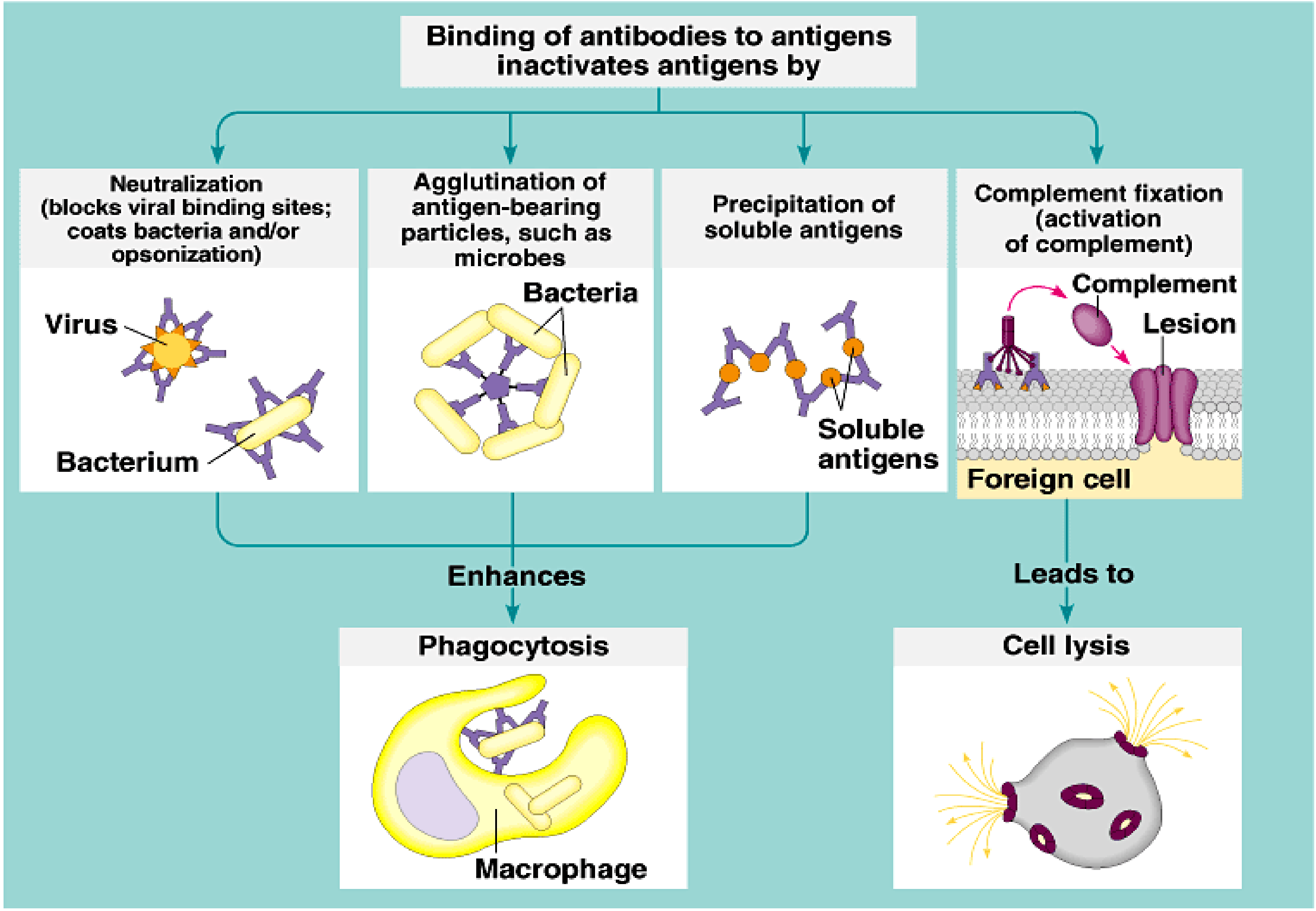
General functions of immunoglobins

- ‡Antigen binding
- ‡Effector function
  - ➢Fixation of complement
  - ➢Binding to various cell types

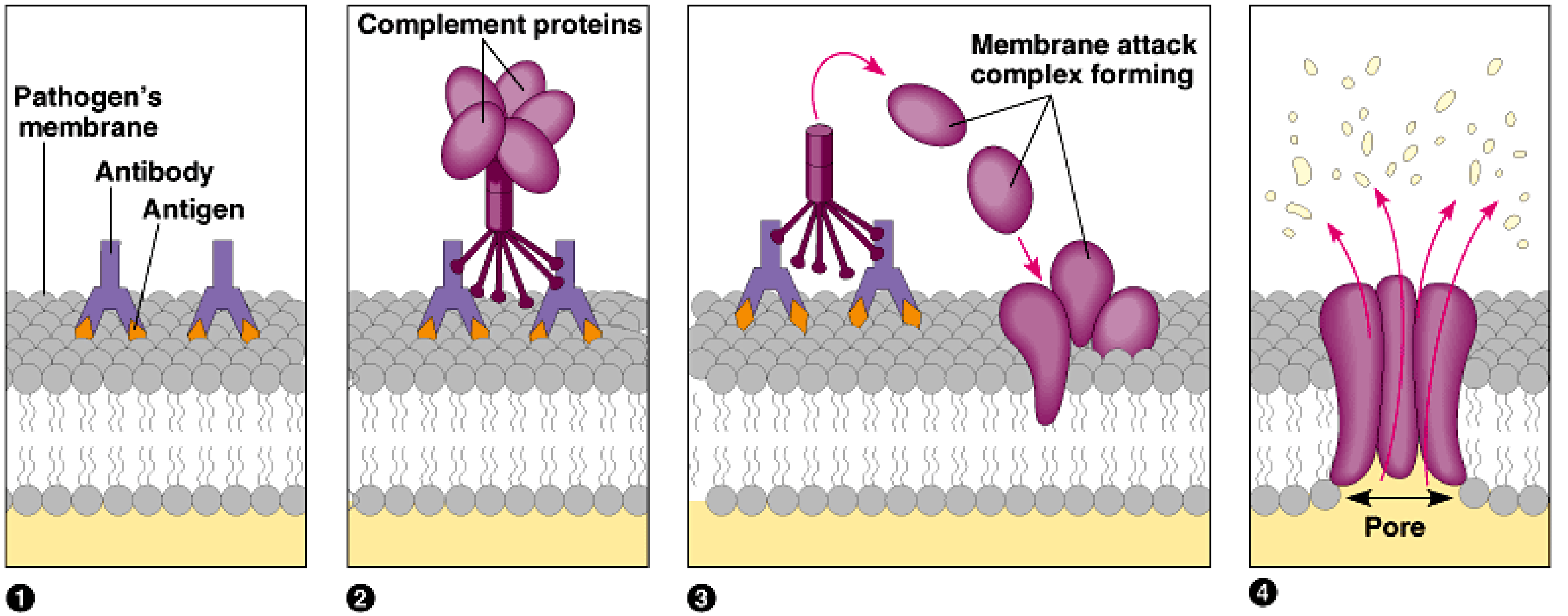
Mechanisms on Antibody Action

- ‡ Precipitation of soluble antigens
- ‡ Agglutination of foreign cells
- ‡ Neutralization
- ‡ Enhanced phagocytosis
- ‡ Complement activation leading to cell lysis
- ‡ Stimulates inflammation

- The binding of antibodies to antigens to form antigen-antibody complexes is the basis of several antigen disposal mechanisms.



The classical complimentary pathway, resulting in lysis of a target cell



Immunogens and antigens

- Immunogen / antigen : a substance that elicits an immune response [i.e. a humoral (antibody response) or cell-mediated immune response]

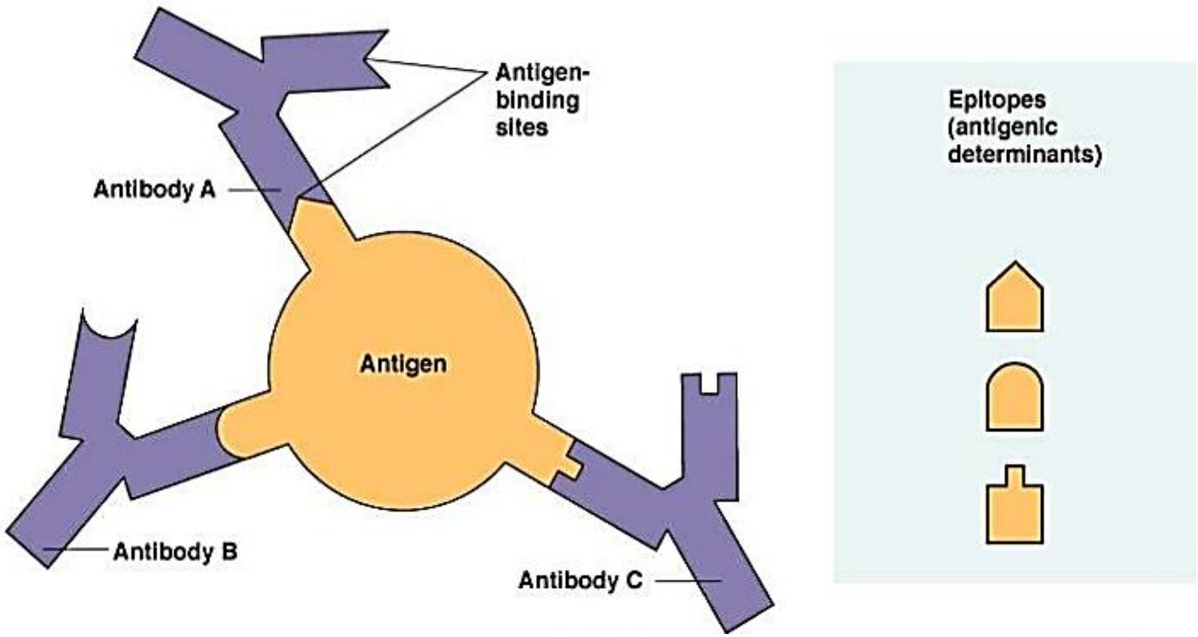
⇨ Immune response generator

Though the two terms are used interchangeably, there are differences between the two

- Immunogen : a substance that elicits an immune response.
- Antigen : a substance that elicits an immune response that react in reverse with this substance.

Epitopes

Epitope = antigenic determinant: the portion of an antigen that is recognized and bound by an antibody (Ab) or a T-cell receptor (TCR)



One protein may have multiple antigenic determinant

Haptens

- Haptens are small molecules which are non-immunogenic, thus could never induce an immune response by themselves.

Immunogenicity

- Immunogencity: is the ability to induce a humoral (antibody) and/or cell-mediated immune response

  - Weak immunogens
  - Strong immunogens

What determines immunogenicity ?

- Foreignness: essential for immunogenicity (self-responsive immune cells are eliminated during lymphocyte development)
- Size: Bigger>Smaller
- Chemical composition: Proteins> polysaccharides /nucleic acids / lipids
- Structure: Primary/secondary/tertiary structures play a role
- Physical form: Particulate>Soluble
- Dose:
- Route of administration

Host factors affecting immunogencit

‡ Difference across species (interspecies)

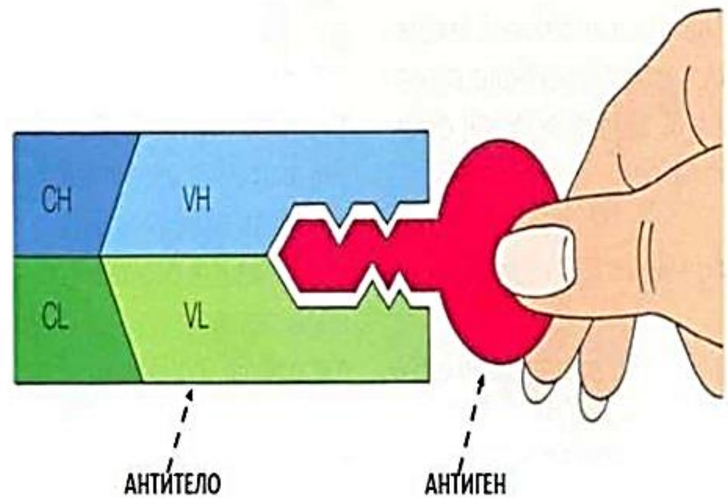
‡ Differences within a species (intraspecies)

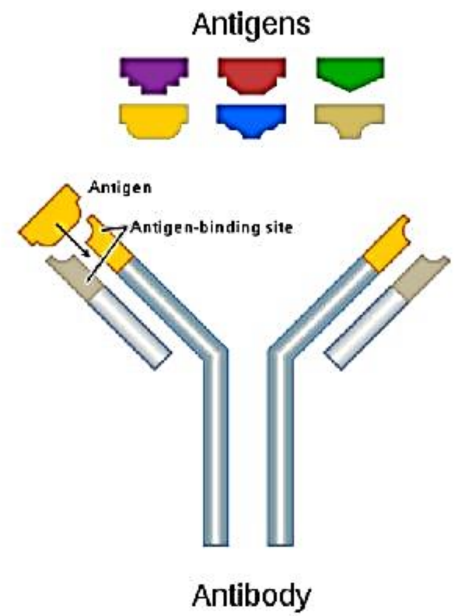
- Responders / non-responders to vaccine
- differences in disease severity in epidemics

Genetics factors

Age

NATURE OF ANTIGEN-ANTIBODY REACTIONS
Lock and Key Concept





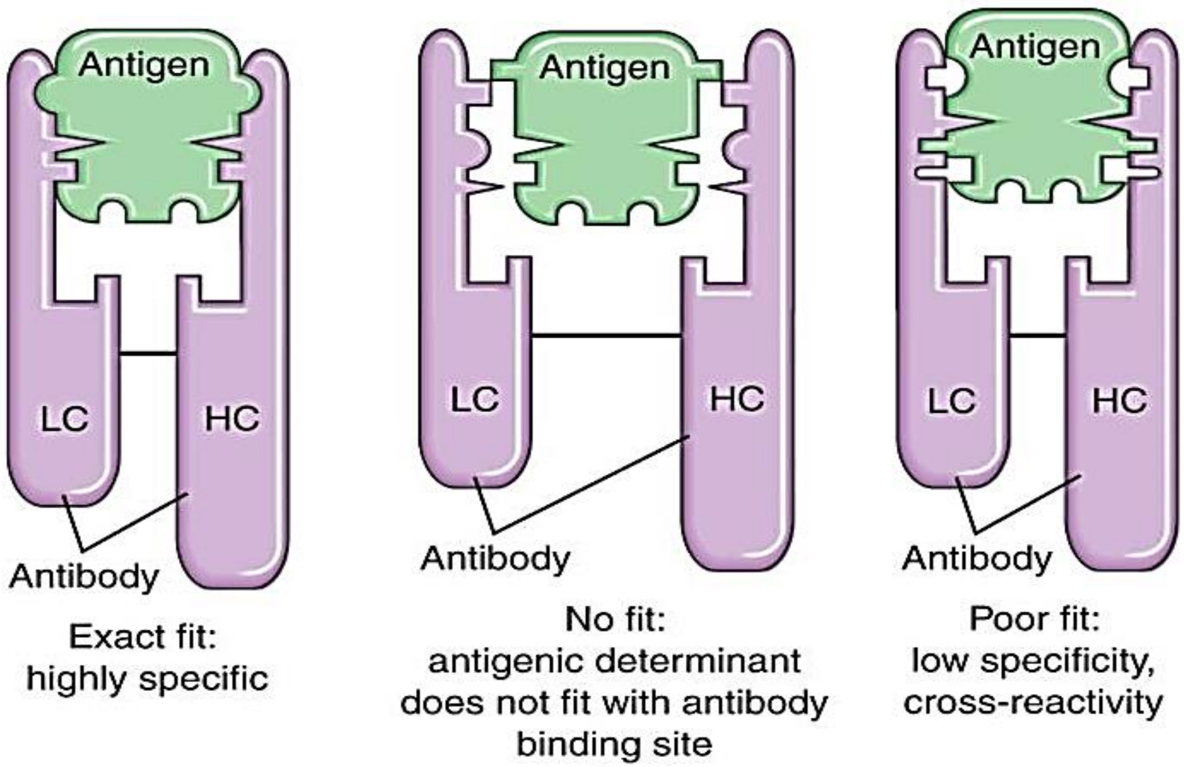
The combining site of an antibody is located in the Fab portion of the molecule and is constructed from the hypervariable regions of the heavy and light chains. Thus, the concept of antigen-antibody reactions is one of a key (*i.e.* the antigen) which fits into a lock (*i.e.*the antibody).

Antigen –antibody binding

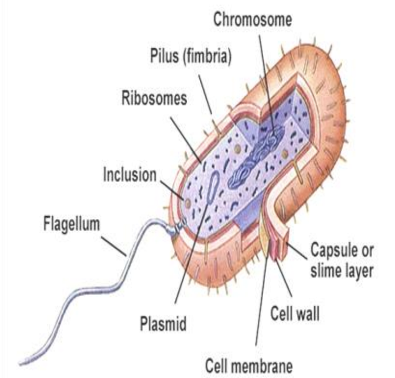
Lock and key concept

Antigen –antibody binding determine the immunological responses efficiency:

- ‡ Good fit means most efficient immunological responses
- ‡ Poor fit means less most efficient immunological responses
- ‡ No fit means No reaction

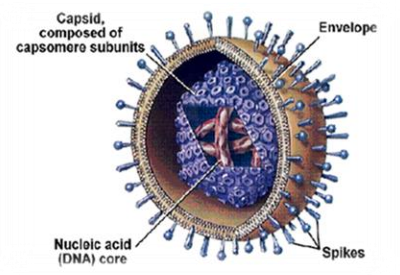


Types of antigen



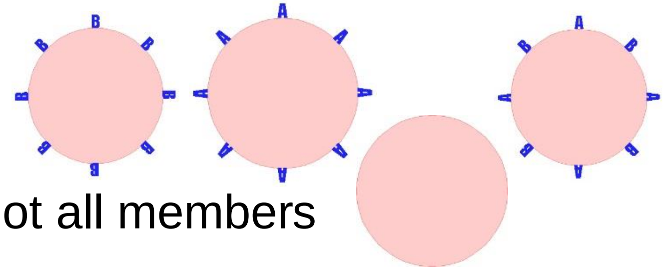
Bacterial antigens

‡Soluble antigens
‡Cellular antigens



Viral antigens

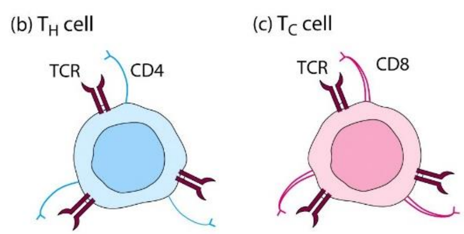
‡Soluble (diffused) antigens
‡Protein coat antigens



Human tissue antigens (Isoantigens)

Isoantigens – Antigens present in some but not all members of a species

‡Blood group antigens – basis of blood grouping
‡MHC (major histocompatibility complex) – cell surface glycoproteins

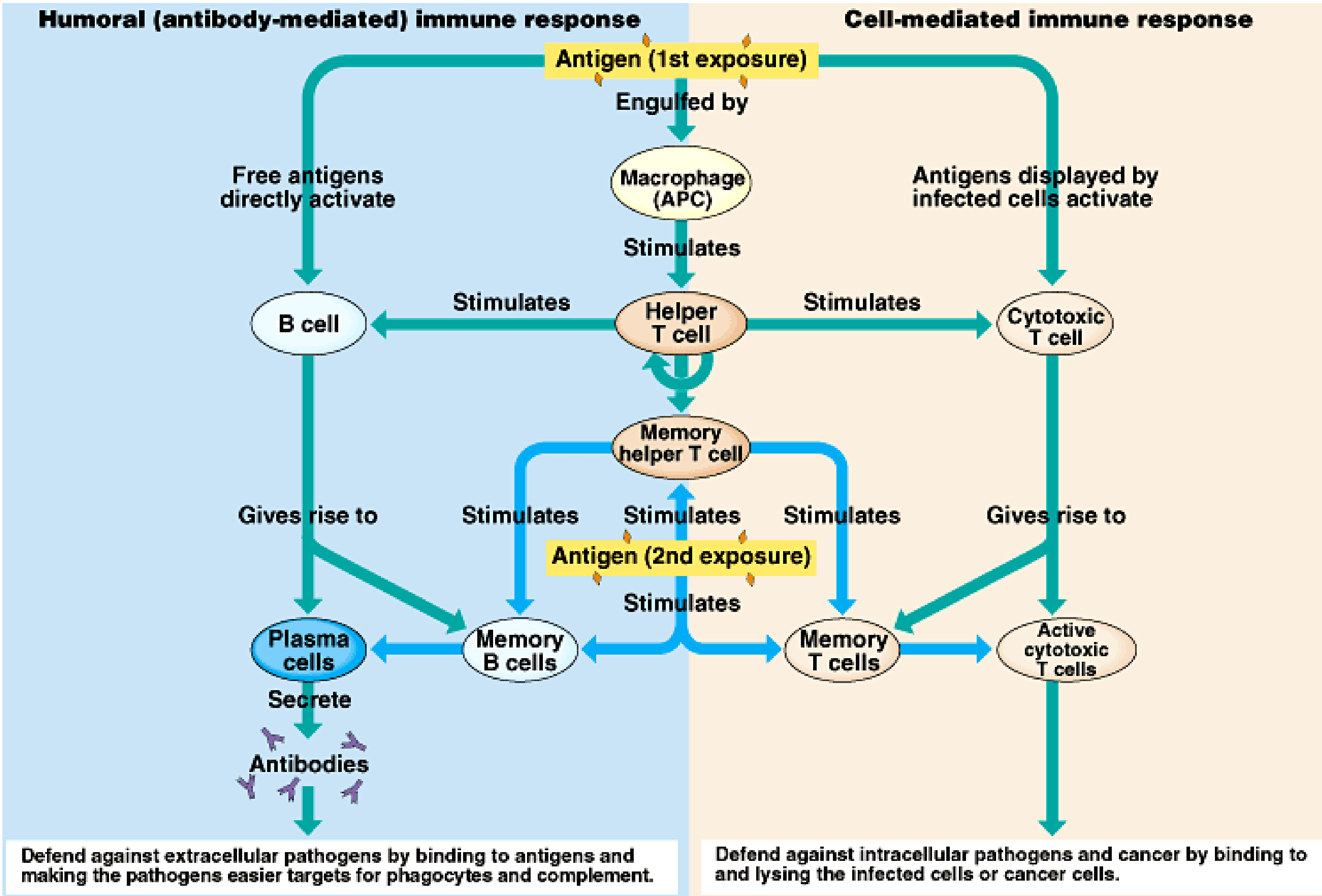


Autoantigens

Substances capable of immunizing the host from which they are obtained.

Although self antigens are ordinarily non-antigenic but modifications of self-antigens are capable of eliciting an immune response

Overview of Immune System Responses



Thanks