

I. Antibodies (Abs) are serum proteins. They are also called immunoglobulins (Igs). Abs are secreted by mature B cells and spread throughout the body via the blood and they can exit the blood through the endothelium and enter the tissues. Abs are also abundant in mucosal secretions.

Antibody structure.

Abs are composed of two identical pairs of polypeptide chains held together by disulfide bonds.
 2 heavy chains approx 50,000 MW 2 light chains approx 25,000 MW.

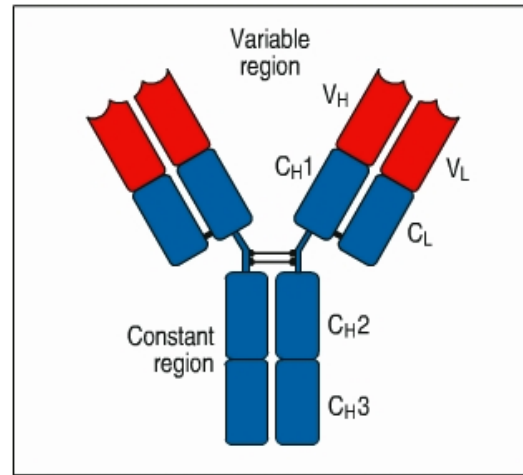
Abs can be split into different regions based on function.

The **Fab region** is the antigen binding portion of the ab molecule.

The **Fc region** is where the effector function of different antibodies is located.

Both the light chain and heavy chain have Variable (V) and constant (C) regions.

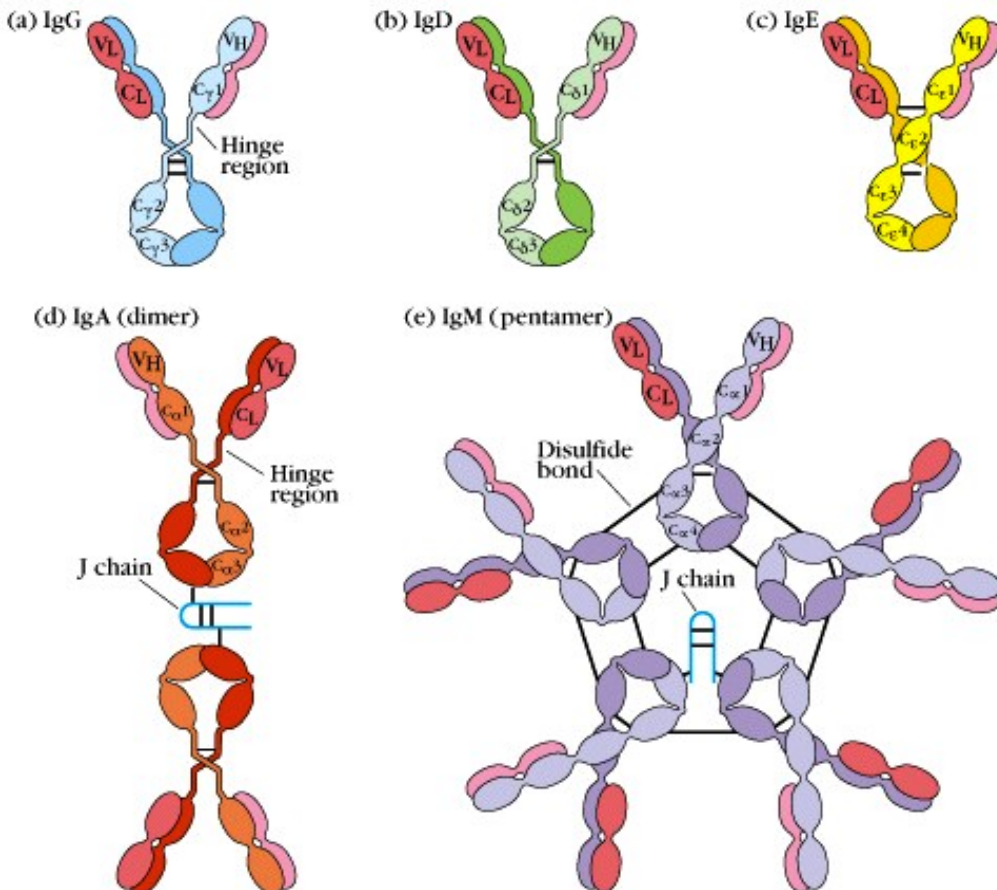
Light chains have 2 domains 1 V domain and 1 C domain only 2 kinds of light chains κ and λ .



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Heavy chain. Each heavy chain is different in amino acid sequence, size, and functions. The heavy chains of the ab determine the class (isotype) of the antibody.

The 5 classes are: IgM, IgG, IgA, IgE, IgD all classes can have either κ or λ light chains.
 Human IgG has 4 subclasses IgG1, IgG2, IgG3, IgG4.
 mouse has 4 subclasses IgG1, IgG2a, IgG2b, IgG3.



II. Antigens

T cells and B cells do not recognize entire large complex pathogen but pieces of proteins or carbohydrate structures. These small discrete peptides or structures recognized by the immune system are called **epitopes**. These epitopes or antigenic determinants are the immunologically active regions of a complex antigen or protein.

Antibodies recognize 3-D structure.

T cells recognize linear peptide sequences only with MHC when presented on an antigen presenting cell (APC).

Immunogens are antigens that when injected into animals are able to elicit the adaptive immune response. For humans immunogens are pieces of pathogens that elicit an immune response and make good vaccine candidates. (Immunogens are a subset of antigens).

What makes a good immunogen?

1. Size. Large enough to be seen by adaptive immune system.
2. Antigen dose. Intermediate works best.
3. Complexity. More complex is better to give more options for immune system to see as foreign.

III. Lymphocytes.

These are the cells of the adaptive immune response. These cells provide the ability to help fight an infection the first time and provide memory for the protection from reinfection.

B cells the antigen receptor or B cell receptor (BCR) is membrane antibody.

B cells mature in bone marrow and each B cell when it leaves the bone marrow has unique antigen receptor.

T cells each T cell has a unique T cell receptor (TCR) which binds to a unique antigen.

Bone marrow ----> thymus---> peripheral blood.

Two types of T cells

Helper T cells (T_h) usually have CD4 coreceptor

T_h secrete **cytokines** which regulate and control immune system.

Cytotoxic T cells (T_c) have CD8 coreceptor.

T_c can kill virally infected cells or tumor cells.

T cells only recognize antigen in association with MHC molecules.

MHC is the major histocompatibility. (self molecules on all cells of the body).

Lymphocyte stages

1. **Activation** ----> caused by interaction with antigen and costimulation.
2. **Proliferation** ----> divides rapidly to make many copies of same cell. Clonal expansion.
3. **Differentiation** ----> into effector cells to fight infection and memory cells.

These lymphocyte stages are distinguished by the expression of surface markers called CD antigens (CD stands for Cluster of Differentiation).

B cell binds antigen gets costimulation which results in proliferation (making many copies of the same B cell) followed by differentiation into plasma cells or memory cells.

T cell binds antigen with MHC with costimulation which causes proliferation and differentiation into effector cells. Effector T cells can either be CTLs--kills infected cells and memory cells.

or effector cells--Th cells secrete cytokines and become memory cells.