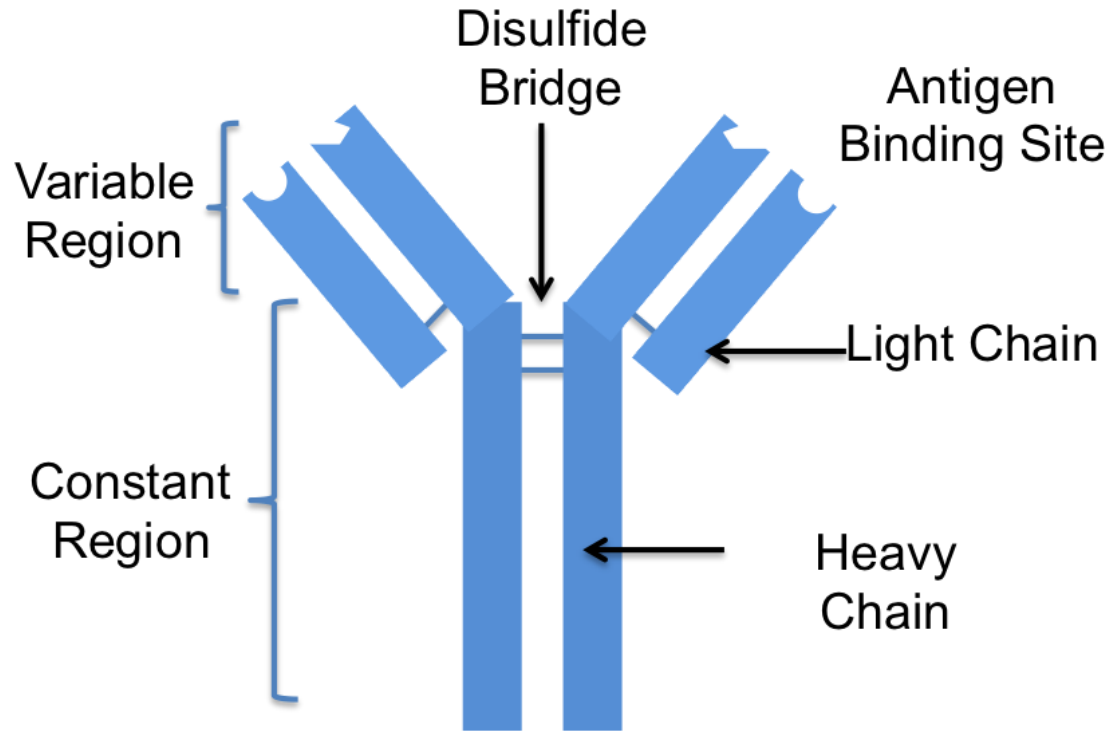


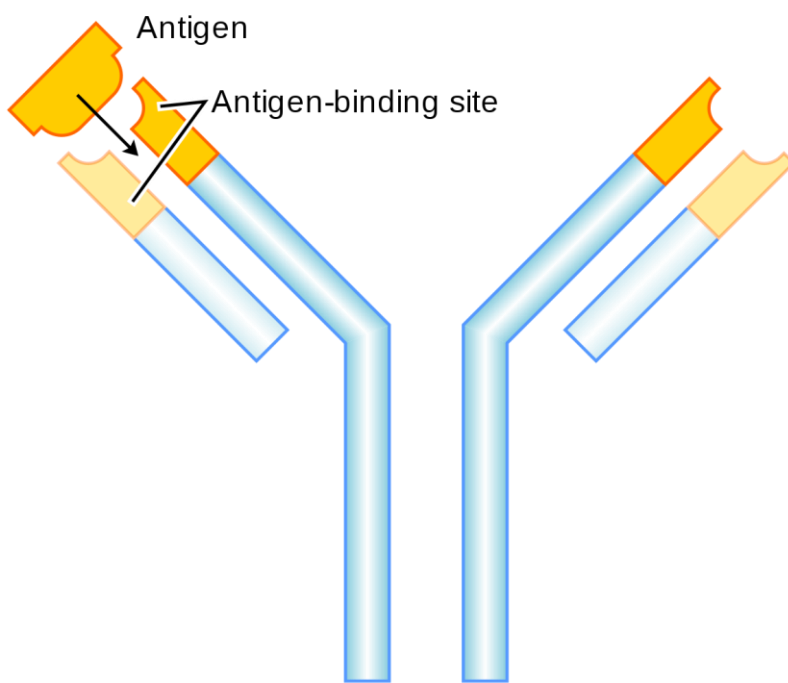
# **Antibodies**

- The immune system is a host defense system comprising many biological structures and processes within an organism that protects against disease. To function properly, an immune system must detect a wide variety of agents, known as pathogens, from viruses to parasitic worms, and distinguish them from the organism's own healthy tissue.
- Antibody (AKA immunoglobulin or Ig) is a protein that is used by the immune system to recognize and neutralize pathogens such as pathogenic bacteria and viruses.



**The Ig protein is a "Y"-shaped molecule that consists of four polypeptide chains; two identical heavy chains and two identical light chains connected by disulfide bonds.**

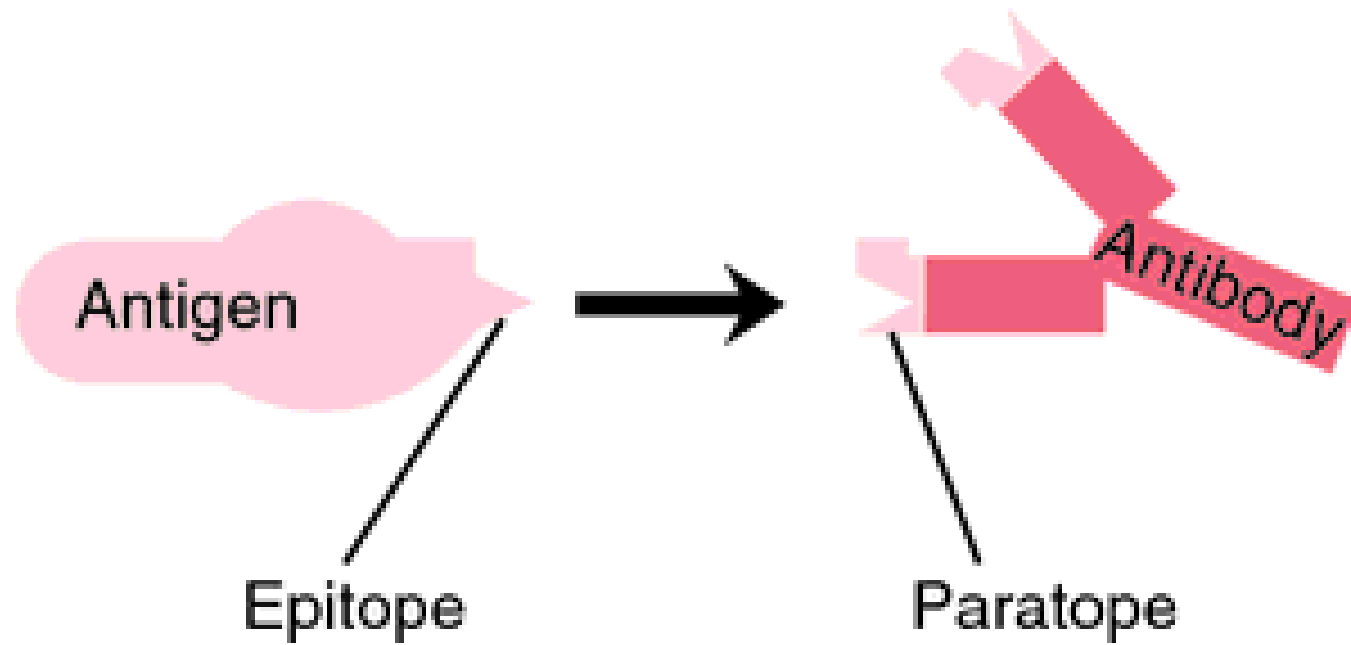
## Antigens

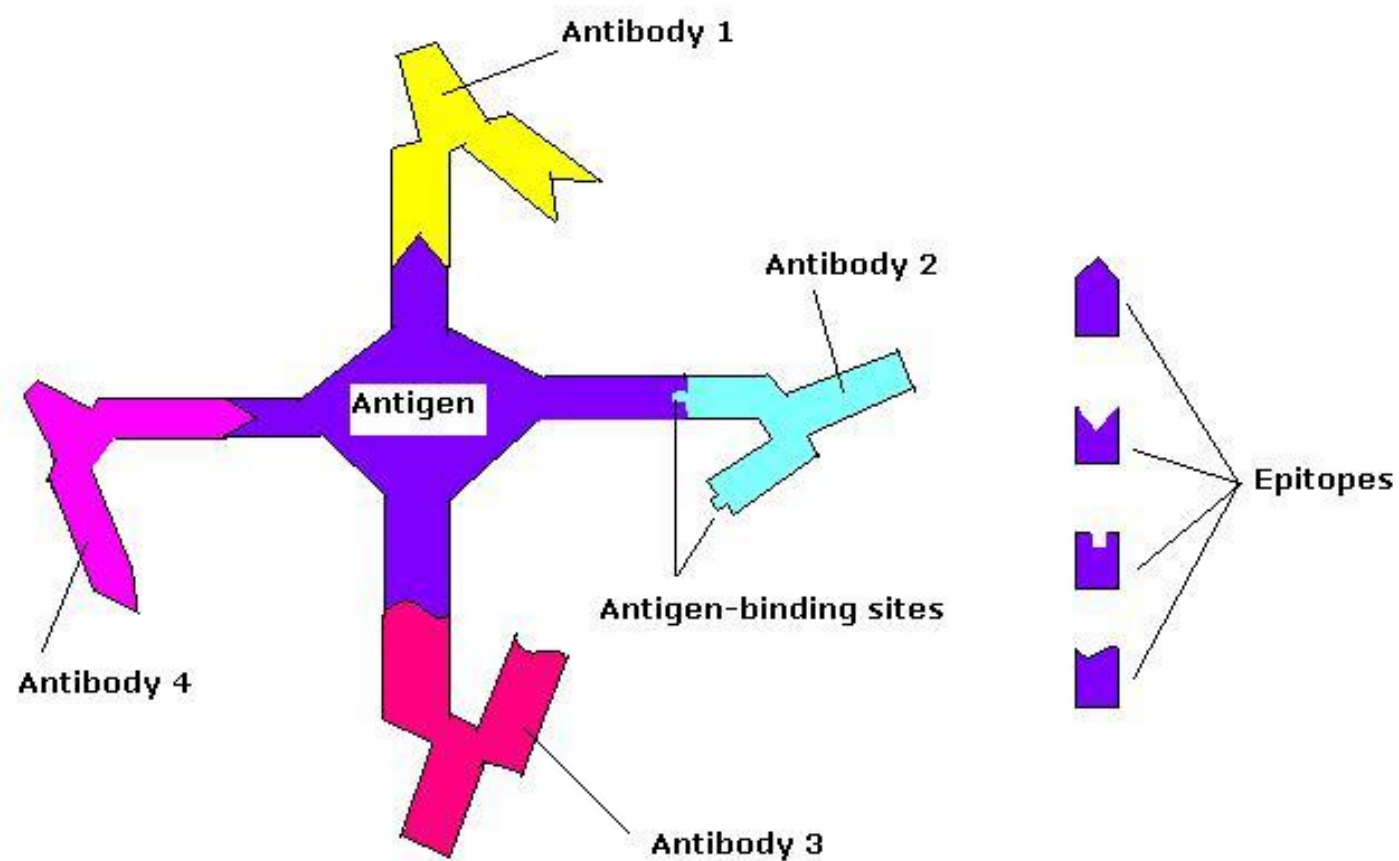


## Antibody

# Epitope

- Antibody interacts with a part of antigen called epitope
- epitope is the specific piece of the antigen to which an antibody binds. The part of an antibody that binds to the epitope is called a paratope.
- Antigen can contain many epitopes each recognized by a different antibody





# Antibody variability

- It has been estimated that humans generate about 10 billion different antibodies, each capable of binding a distinct epitope of an antigen
- The variability is the result of the process called somatic recombination or V(D)J recombination
- Somatic recombination is an alteration of the DNA of a somatic cell that is inherited by its daughter cells.

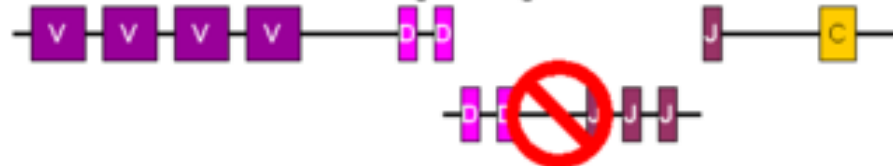


- The variable region of each immunoglobulin heavy or light chain is encoded in several pieces—known as gene segments (subgenes). These segments are called variable (V), diversity (D) and joining (J) segments
- Multiple copies of the V, D and J gene segments exist, and are tandemly arranged in the genomes of mammals. In the bone marrow, each developing B cell will assemble an immunoglobulin variable region by randomly selecting and combining one V, one D and one J gene segment (or one V and one J segment in the light chain). As there are multiple copies of each type of gene segment, and different combinations of gene segments can be used to generate each immunoglobulin variable region, this process generates a huge number of antibodies, each with different paratopes, and thus different antigen specificities.

Genes in heavy chain locus



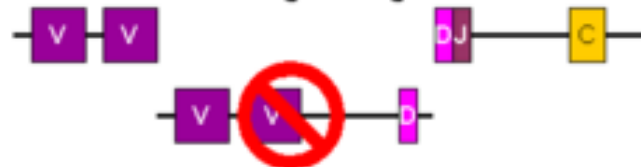
Removal of unwanted D and J gene segment



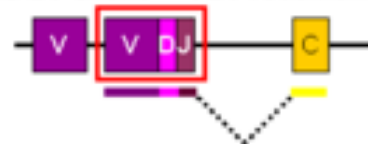
Recombination of D and J exons – DJ recombination



Removal of unwanted V and D gene segment



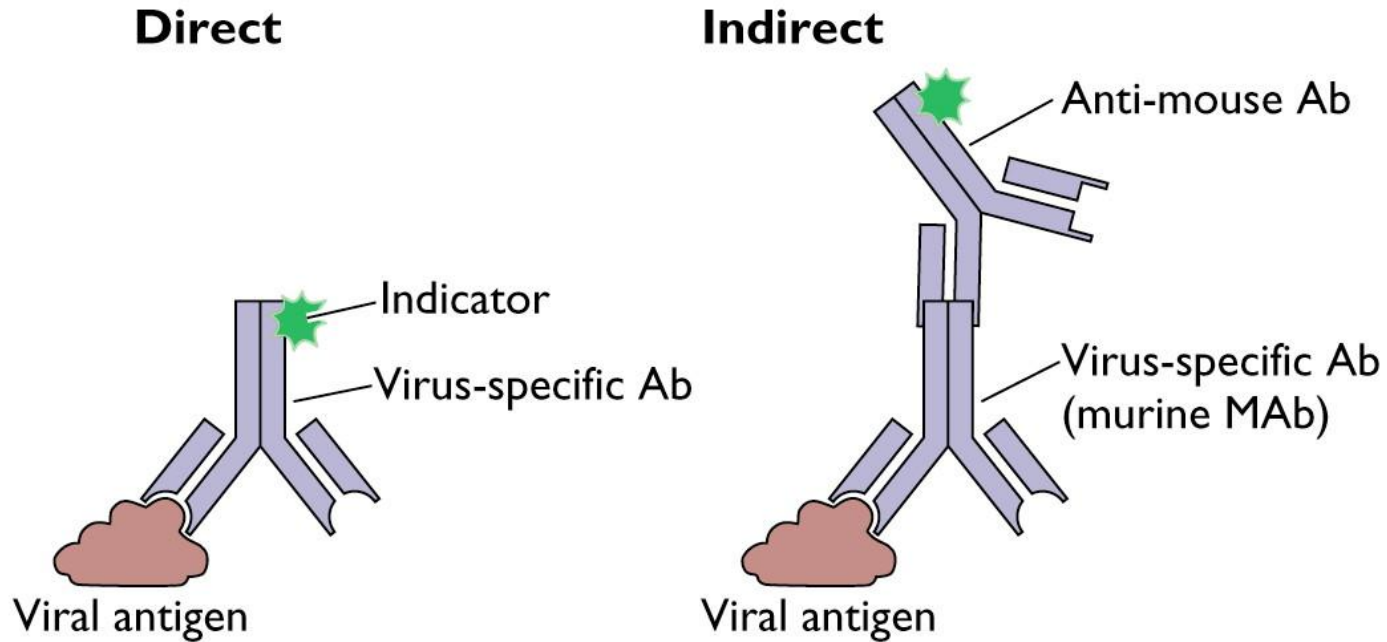
Recombination of V and DJ exons – VDJ recombination

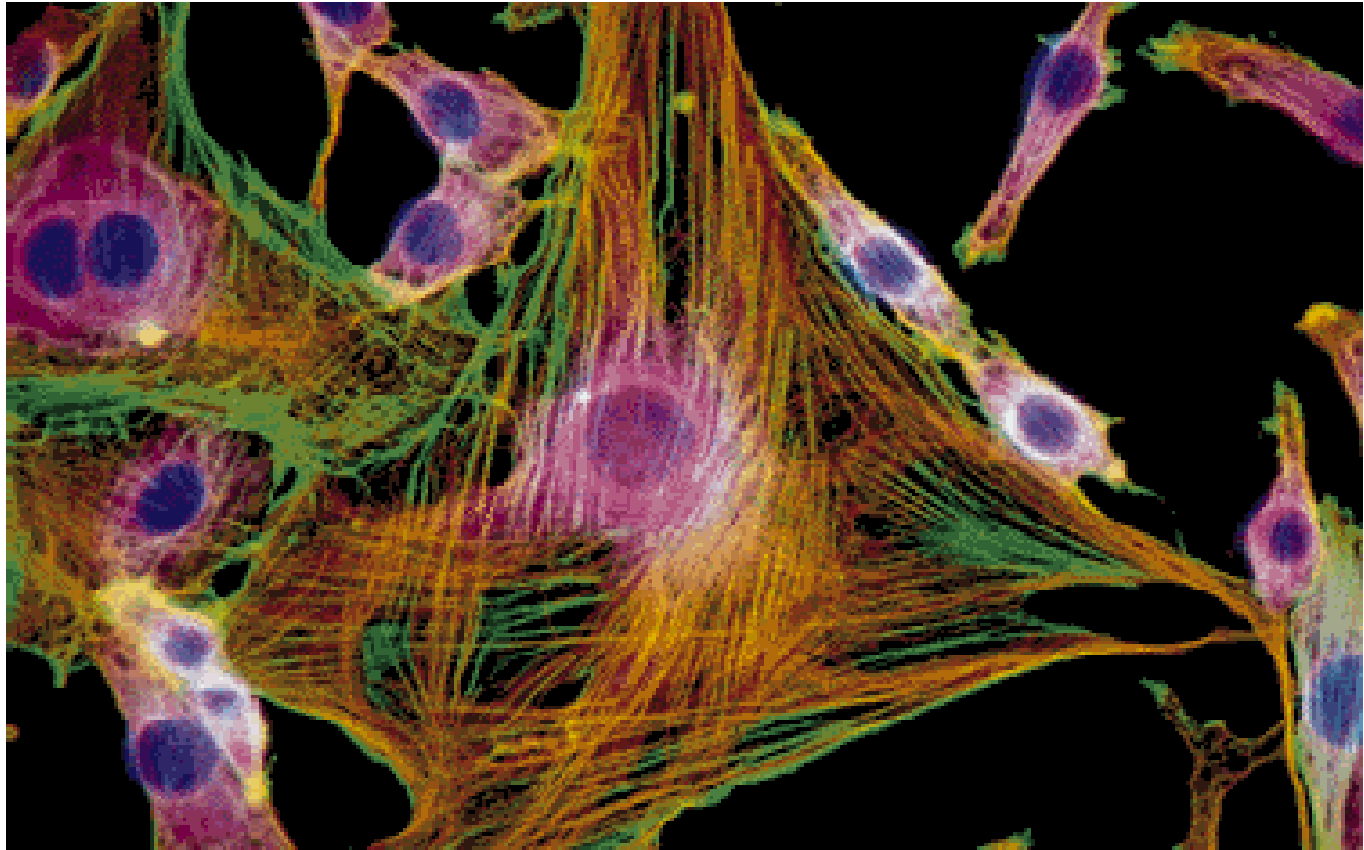


Antibody transcript will also include constant domain gene

- There are many applications for antibodies in medicine and research
- In microscopy immunostaining and immunofluorescence are used.

# Immunostaining





- Specific antibodies for research are produced by injecting an antigen into a mammal, such as a mouse, rat, rabbit, goat, sheep, or horse for large quantities of antibody. Blood isolated from these animals contains **polyclonal antibodies** in the serum, which can now be called antiserum. Polyclonal antibodies are a mix of multiple different antibodies that bind to the same antigen
- Antigens can be also injected into chickens for generation of polyclonal antibodies in serum and egg yolk.

# Monoclonal antibodies

- Monoclonal antibodies (mAb or moAb) are antibodies that are made by identical immune cells that are all clones of a unique parent cell. Monoclonal antibodies can have monovalent affinity, in that they bind to the same epitope (the part of an antigen that is recognized by the antibody).

