CONCEPT: ANTIBODY STRUCTURE AND VARIETY

Antibody Structure

● Antibodies, also called **immunoglobulins**, are proteins secreted by B cells to _____ pathogens for destruction

□ Antibodies have a characteristic Y shape

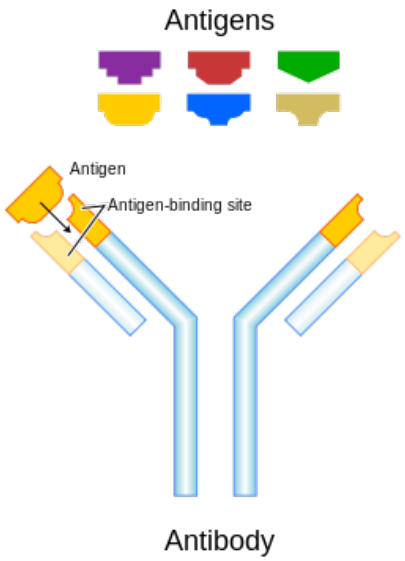
- Has two light chains, and two heavy chains

- Both light and heavy chains interact to form the antigen binding surface

□ Activated B cells secrete around 5000 antibodies per second

- Each B cell produces only one type of antibody

EXAMPLE:



● There are five classes of antibodies based upon different heavy chains

Antibody	**Location**	**Function**
IgM	Plasma Membrane	Present before activation
IgD	Plasma Membrane	Can respond initially to antigens
IgA	Secreted	Tears, saliva, milk, intestinal secretions
IgE	Secreted	Blood; allergic reactions
IgG	Secreted	Blood; Can be passed to fetus (bind **F_c receptors)**

□ There are two types of light chains (κ are λ) and they are virtually indistinguishable

● Antibodies bind antigens in their antigen binding _____

□ Affinity (strength) of bond depends on collection of non-covalent bonds in light and heavy chains

□ The light and heavy chains have two regions

- **Constant** regions is around ~110 amino acids long, and remains constant in the same class of antibody

- **Variable** regions are around ~110 amino acids long, and vary between each B cell

- **Hypervariable regions** are three 5-10 aa long locations of the variable region the antigen binds

EXAMPLE:

IgG

Antibody Variety

● **V (D) J recombination** is responsible for forming the hypervariable regions

□ Cells use special gene _____ to produce antibodies against as many antigens as possible

□ The antibody genes contain three main segments, and each is encoded in a different genomic location

- **V gene segment** encodes for light chain variable regions

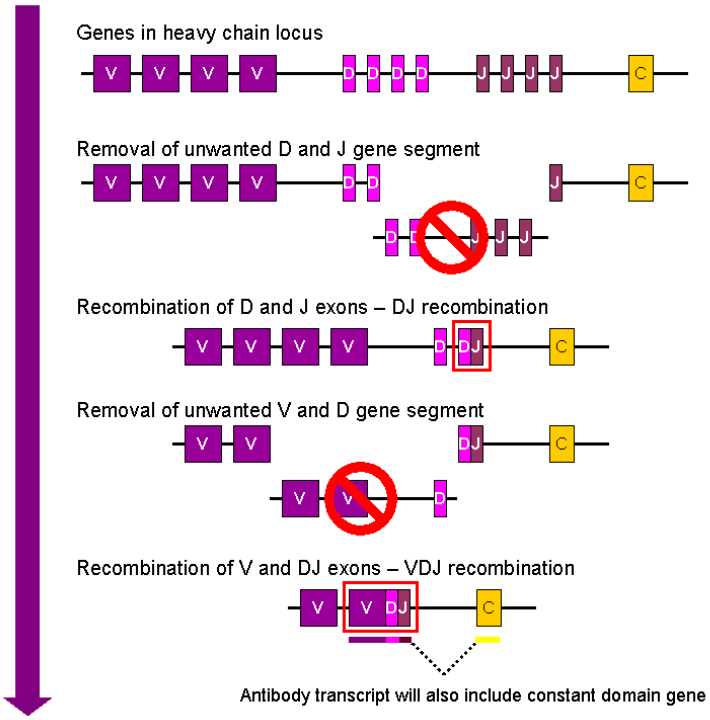
- **J gene segment** encodes for light chain variable regions

- **D gene segment** encodes for heavy chain variable regions

□ Organisms have multiple V, J, and D regions which are recombined to form new antigen binding sites

- Humans have 50 V segments, 5 J segment, and 35 D segments ~ 1.9×10^6 antigen binding sites

EXAMPLE:



● Variation also arises in other _____

□ **Somatic hypermutation** occurs at the variable gene segments

- B cells mutated the variable region segments about once per division

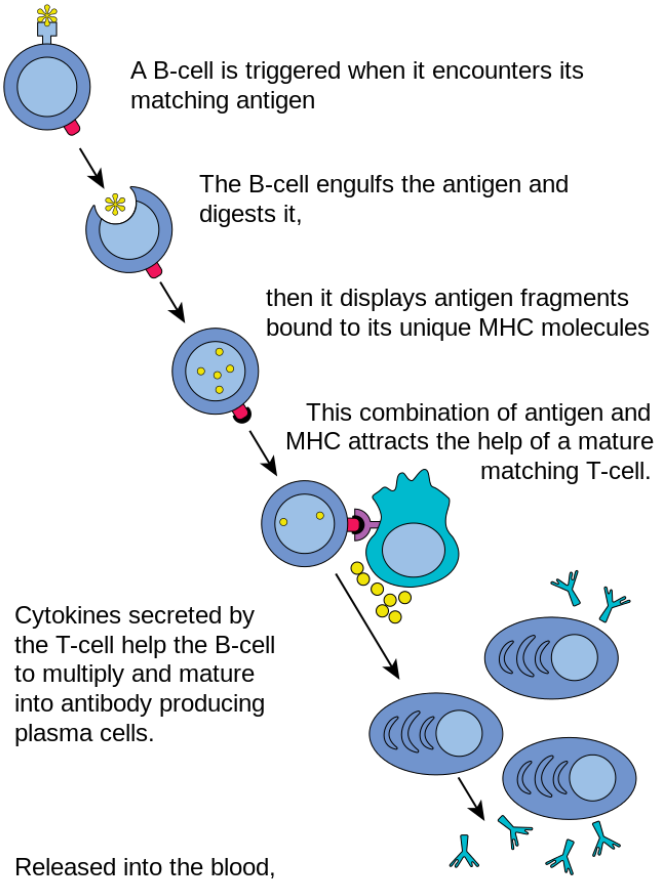
- Some will have increased antigen affinity

□ All B cells undergo class switching during development

- B cells first only produce IgM or IgD (*Primary antibody repertoire)*

- Somatic hypermutation will trigger the B cell to produce IgE, IgA, or IgG (*Secondary antibody repertoire)*

EXAMPLE:


A B-cell is triggered when it encounters its matching antigen
The B-cell engulfs the antigen and digests it,
then it displays antigen fragments bound to its unique MHC molecules
This combination of antigen and MHC attracts the help of a mature matching T-cell.
Cytokines secreted by the T-cell help the B-cell to multiply and mature into antibody producing plasma cells.
Released into the blood, antibodies lock onto matching antigens. The antigen-antibody complexes are then cleared by the complement cascade or by the liver and spleen.

PRACTICE:

1. Which of the following processes allows for the creation of so many diverse antibodies?
    a. V(D)J recombination
    b. V(J) recombination
    c. Class switching
    d. Constant regions

2. Which of the following antibodies is secreted into the blood for an allergic reaction?
    a. IgM
    b. IgD
    c. IgA
    d. IgE
    e. IgG

3. Which of the following variable gene segments encodes for the variable sequence on the heavy chain?
    a. V
    b. D
    c. J
    d. M