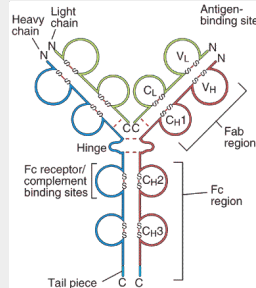


Antibody structure

Basic structure of an antibody (immunoglobulin) molecule

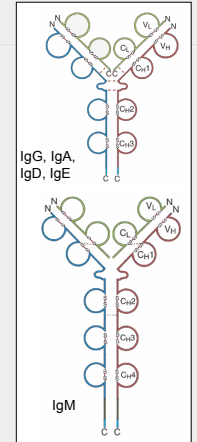
- 4 protein chains (2 H, 2 L)
 - multiple Ig fold domains
- $V_L + V_H$ domains make up 2 identical Ab binding sites
 - 3 hypervariable (CDR) regions in each V domain
- Constant portion binds complement, macrophage receptors, etc.



Antibody structure

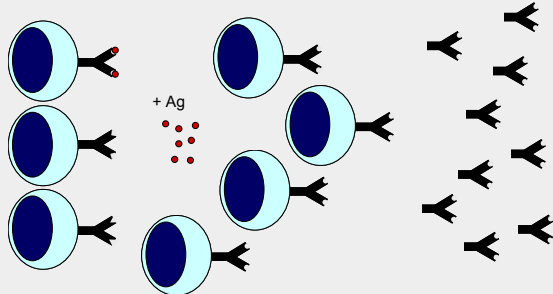
Antibody classes:

- 2 light-chain genes: κ and λ
 - Each Ab has either κ or λ light chains
- 1 heavy-chain gene but different constant regions (different isotypes):
 - $C\gamma \rightarrow$ IgG – major Ab, monomer
 - $C\mu \rightarrow$ IgM – first Ab made, pentamer (monomer BCR)
 - $C\alpha \rightarrow$ IgA – secreted Ab, dimer
 - $C\epsilon \rightarrow$ IgE – parasites & allergies, monomer
 - $C\delta \rightarrow$ IgD – BCR, monomer



Clonal expansion

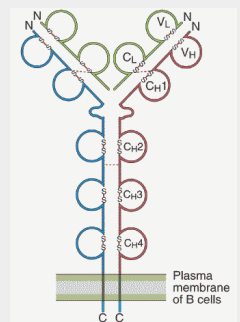
- Each B cell recognizes one specific Ag (in fact, one epitope)
- When Ag is encountered, matching B cell proliferates
 - "Clones" – genetically identical cells produced
- After differentiation, produce appropriate Ab



Antigen recognition

How do B and T cells recognize Ab?

- BCR is a membrane-bound Ab
 - IgD or IgM
- TCR is not an Ab but related



Antibody diversity

How to produce diversity:

(1) Ig genes are composed of multiple segments

During B cell development, V(D)J recombinase cuts DNA

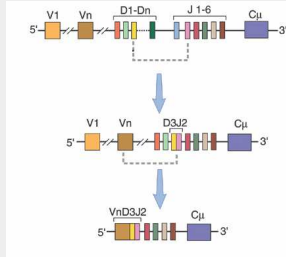
- Recognizes sequence at segment borders
- Random selection of segment to cut/join

light chain heavy chain

V joined to J D joined to J

D+J joined to V

After transcription, V(D)J is spliced onto C

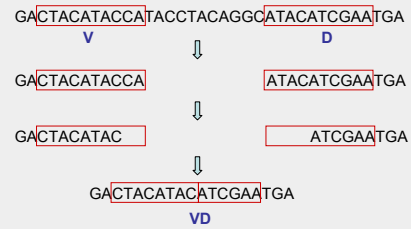


Antibody diversity

How to produce diversity:

(2) Exonucleases remove nucleotides during recombination

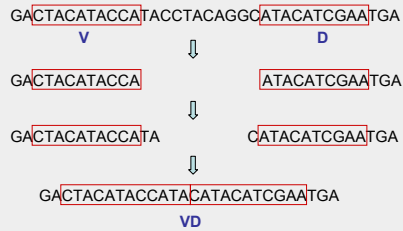
- DNA cut by V(D)J recombinase
- Ends exposed to exonucleases
- Random removal of bases before rejoining



Antibody diversity

How to produce diversity:

(3) Terminal deoxyribonucleotidyl transferase (TdT) adds nucleotides during recombination



Antibody diversity

How to produce diversity:

(4) Overhangs are filled in with P-nucleotides during recombination

