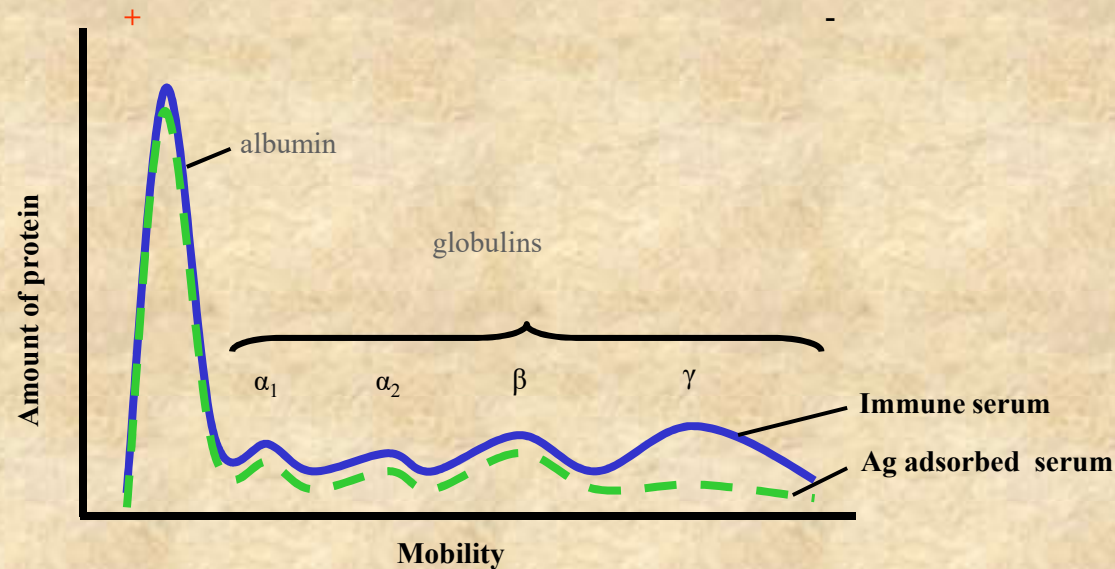


# Immunoglobulins: Structure and Function

# Immunoglobulin: Structure and Function

- Definition: Glycoprotein molecules that are produced by plasma cells in response to an immunogen and which function as antibodies



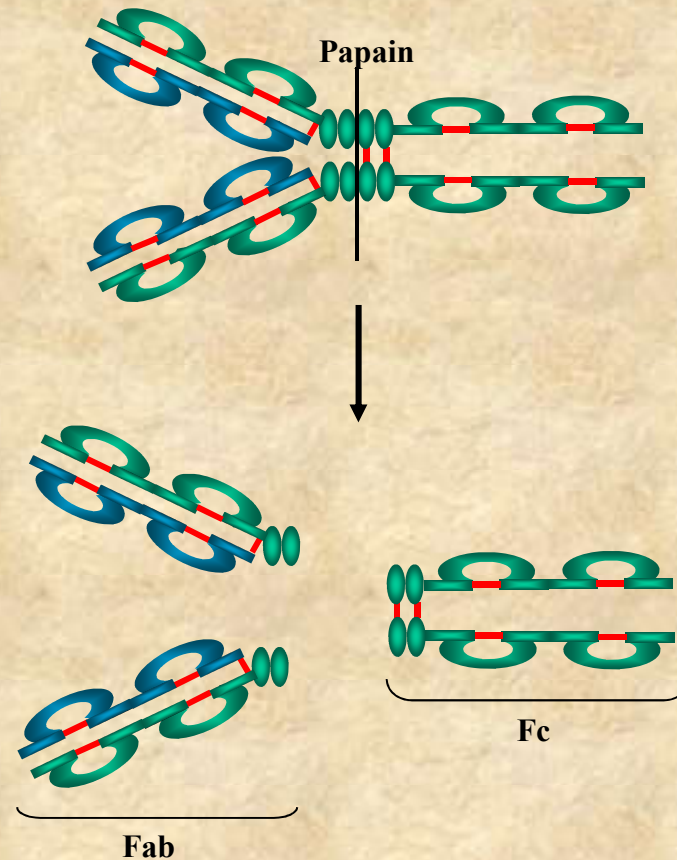
# General Functions of Immunoglobulins

- Ag binding
  - Can result in protection
  - Valence
- Effector functions (Usually require Ag binding)
  - Fixation of complement
  - Binding to various cells



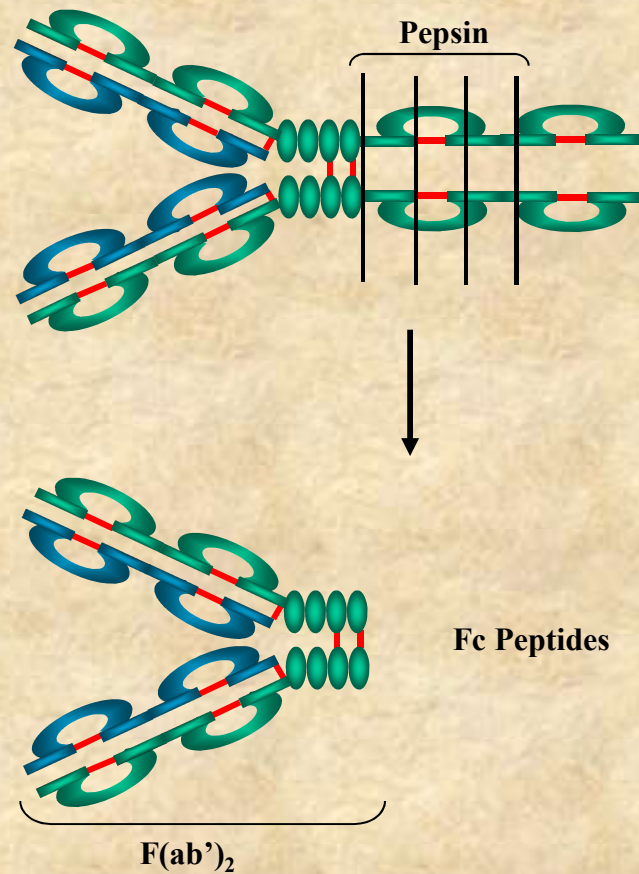
## Immunoglobulin Fragments: Structure/Function Relationships

- Fab
  - Ag binding
  - Valence = 1
  - Specificity determined by  $V_H$  and  $V_L$
- Fc
  - Effector functions



# Immunoglobulin Fragments: Structure/Function Relationships

- Fab
  - Ag binding
- Fc
  - Effector functions
- $F(ab')_2$

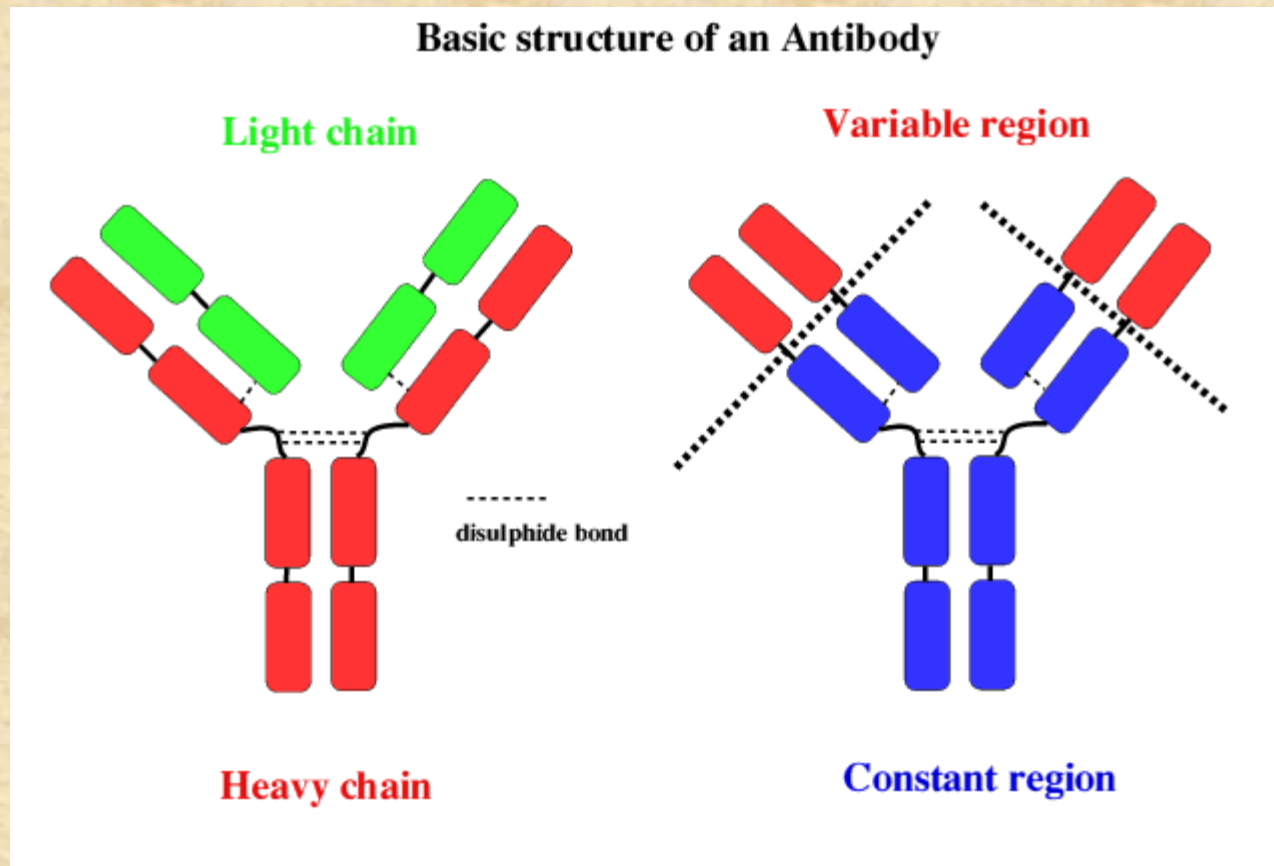


# Basic Immunoglobulin Structure

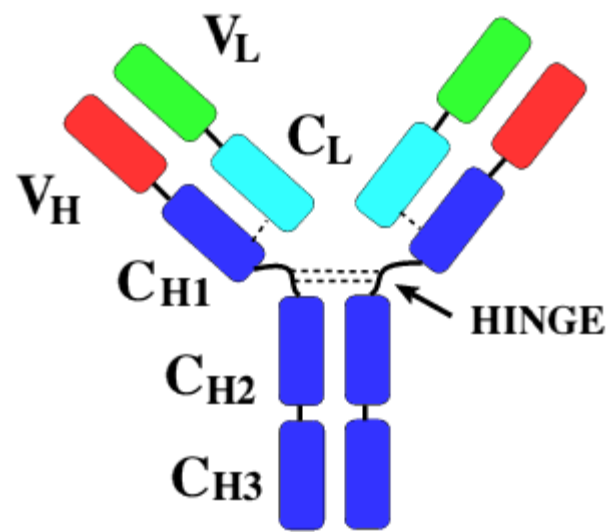
- Immunoglobulins - heterogeneous
- Myeloma proteins - homogeneous immunoglobulins



# Immunoglobulin Structure

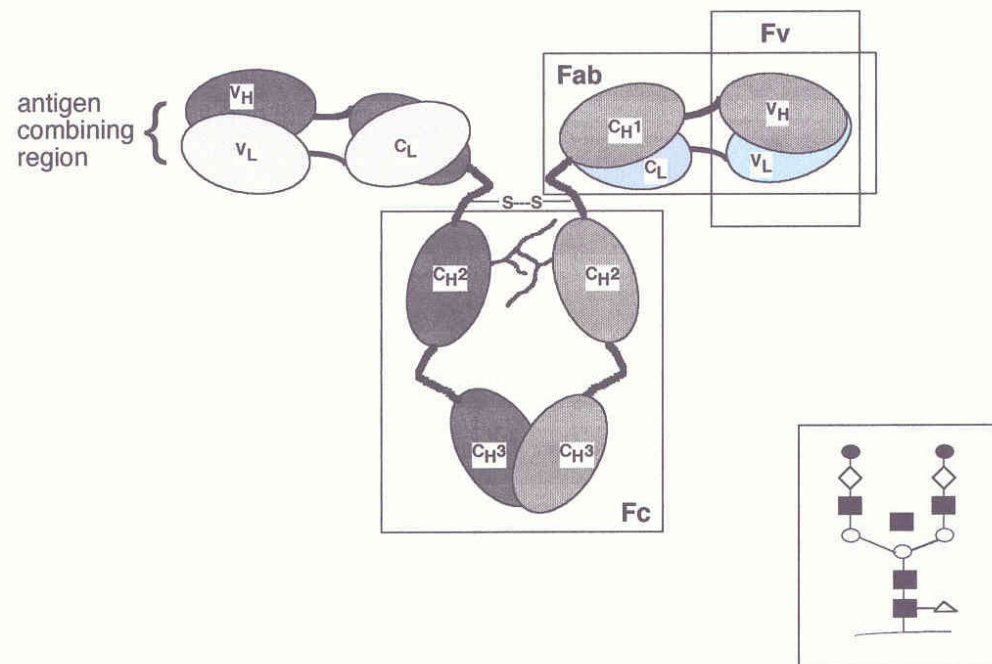


## ANTIBODY DOMAIN STRUCTURE

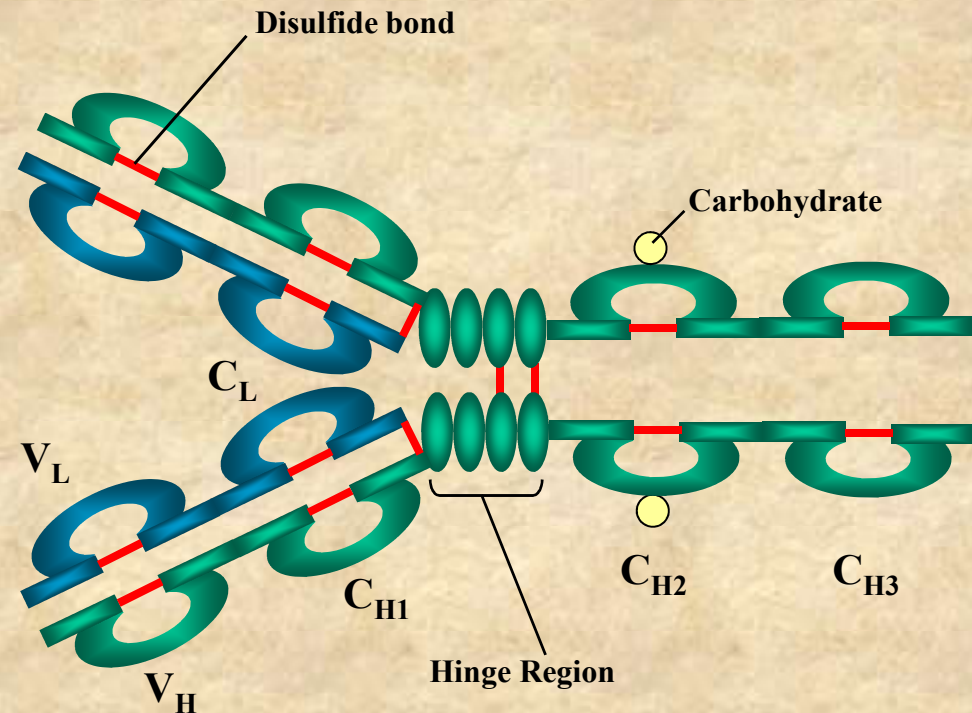




- Immunoglobulin domains
  - each chain has about 110 amino acids
  - intrachain disulfide bonds
  - Discrete compactly folded region
- 4 (or 5) in heavy chain, 2 in light chain.
- Both heavy and light chains have
- 1 variable domain at the N-terminus
- Chains held together by
- disulfide bonds
- noncovalent interactions

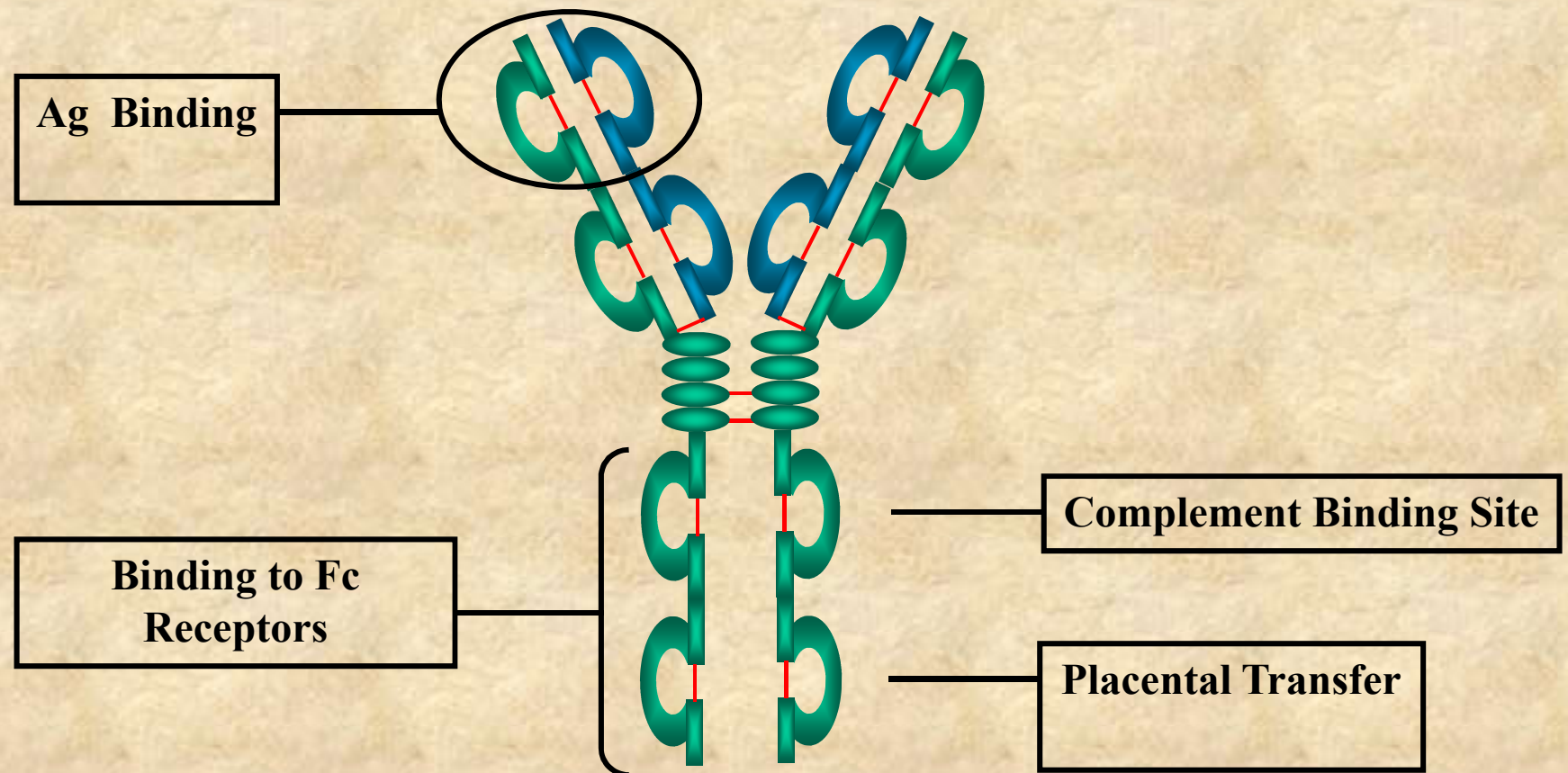


- Heavy & Light Chains
- Disulfide bonds
  - Inter-chain
  - Intra-chain
- Variable & Constant Regions
  - $V_L$  &  $C_L$
  - $V_H$  &  $C_H$
- Hinge Region
- Domains
  - $V_L$  &  $C_L$
  - $V_H$  &  $C_{H1} - C_{H3}$   
(or  $C_{H4}$ )
- Oligosaccharides





# Immunoglobulin Fragments: Structure/Function Relationships



# Human Immunoglobulin Classes

- IgG - Gamma ( $\gamma$ ) heavy chains
- IgM - Mu ( $\mu$ ) heavy chains
- IgA - Alpha ( $\alpha$ ) heavy chains
- IgD - Delta ( $\delta$ ) heavy chains
- IgE - Epsilon ( $\epsilon$ ) heavy chains

# Human Immunoglobulin Subclasses

- IgG Subclasses
  - IgG1 - Gamma 1 ( $\gamma$ 1) heavy chains
  - IgG2 - Gamma 2 ( $\gamma$ 2) heavy chains
  - IgG3 - Gamma 3 ( $\gamma$ 3) heavy chains
  - IgG4 - Gamma 4 ( $\gamma$ 4) heavy chains
- IgA subclasses
  - IgA1 - Alpha 1 ( $\alpha$ 1) heavy chains
  - IgA2 - Alpha 2 ( $\alpha$ 2) heavy chains



# Human Immunoglobulin Light Chain Types

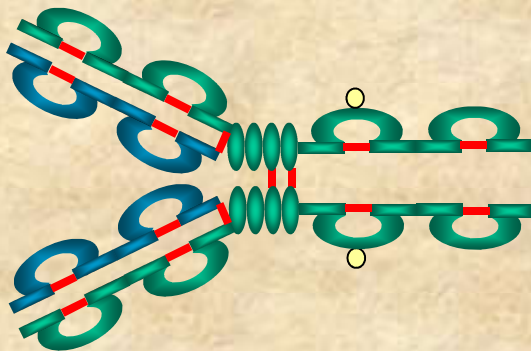
- Kappa ( $\kappa$ )
- Lambda ( $\lambda$ )

# Human Immunoglobulin Light Chain Subtypes

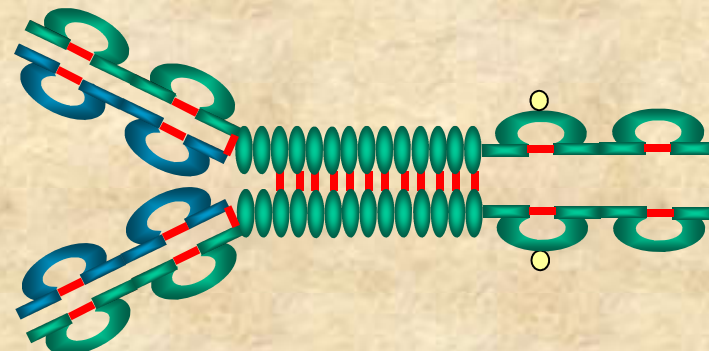
- Lambda light chains
  - Lambda 1 ( $\lambda 1$ )
  - Lambda 2 ( $\lambda 2$ )
  - Lambda 3 ( $\lambda 3$ )
  - Lambda 4 ( $\lambda 4$ )

IgG

- Structure
  - Monomer (7S)



## IgG1, IgG2 and IgG4

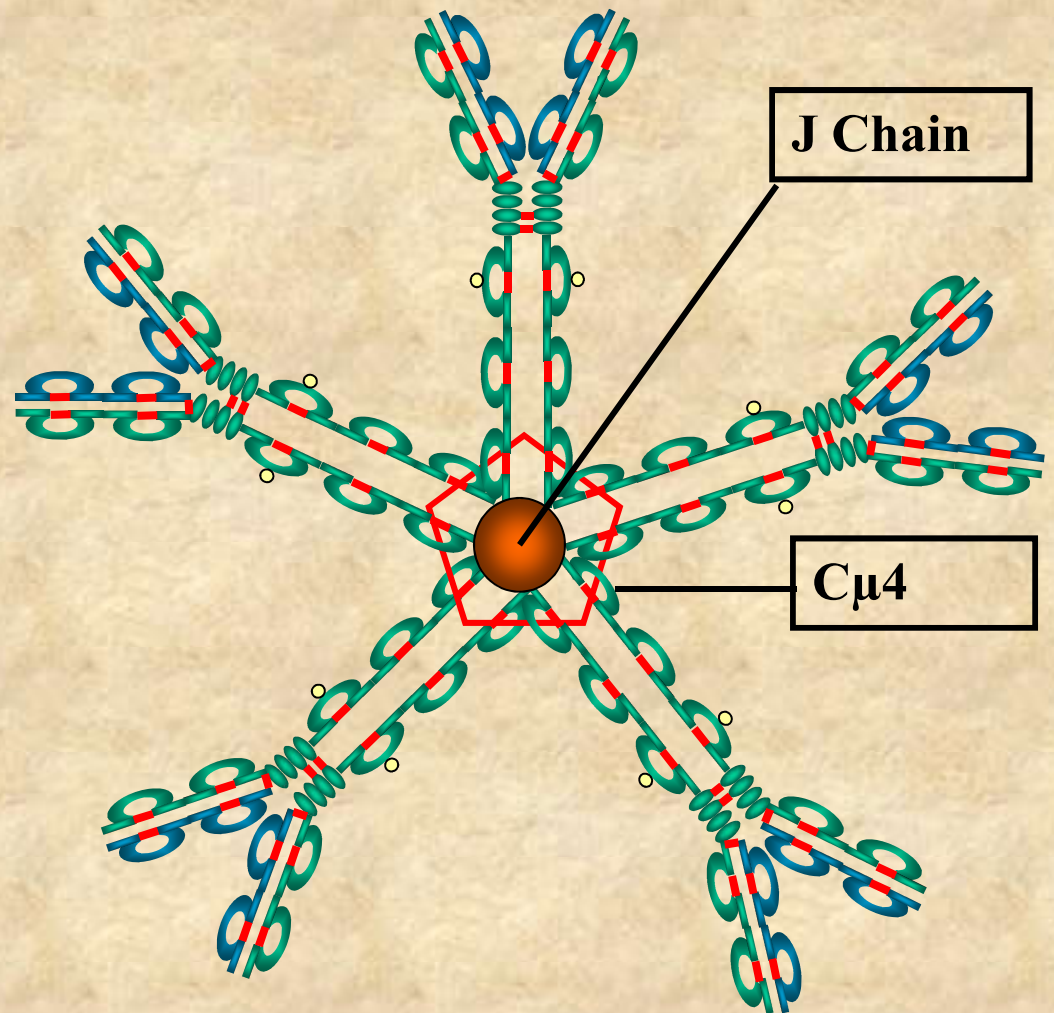


## IgG3

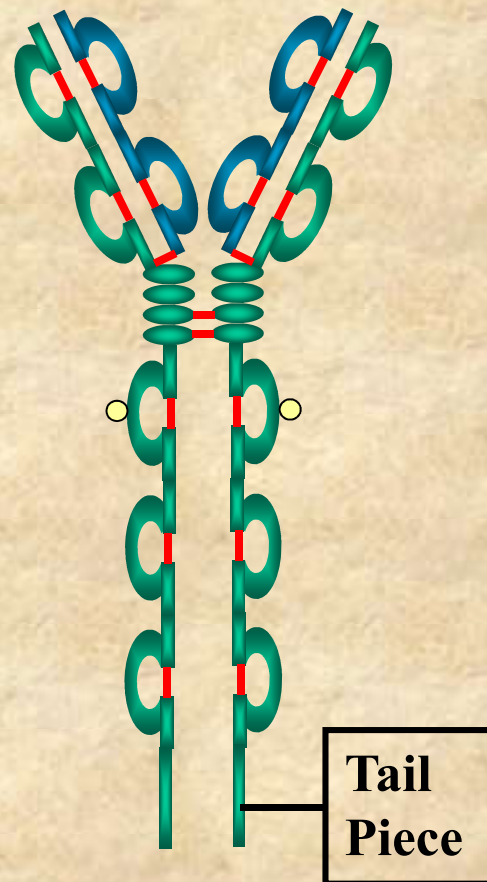


IgM

- Structure
  - Pentamer (19S)
  - Extra domain ( $C_{H4}$ )
  - J chain

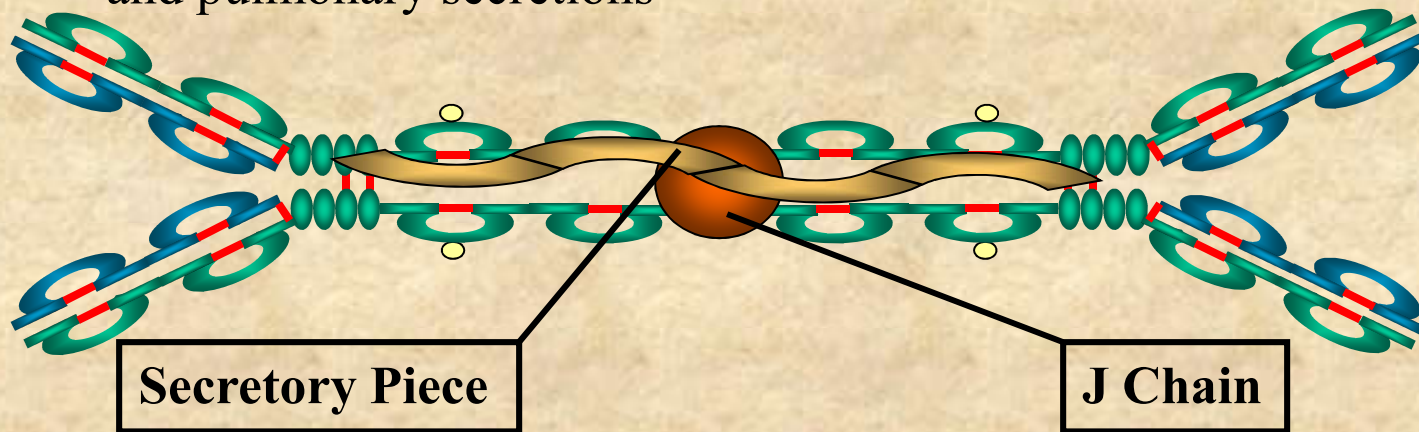


IgM



# IgA

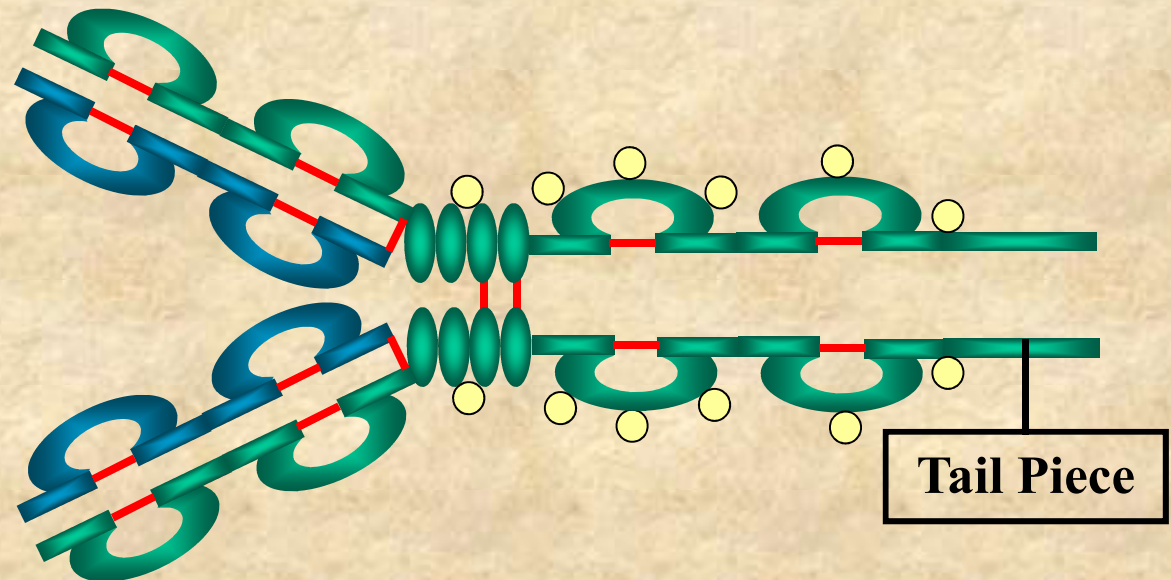
- Structure
  - Serum - monomer
  - Secretions (sIgA)
    - Dimer (11S)
    - J chain
    - Secretory component- Major secretory Ig (Mucosal or Local Immunity) Tears, saliva, gastric and pulmonary secretions





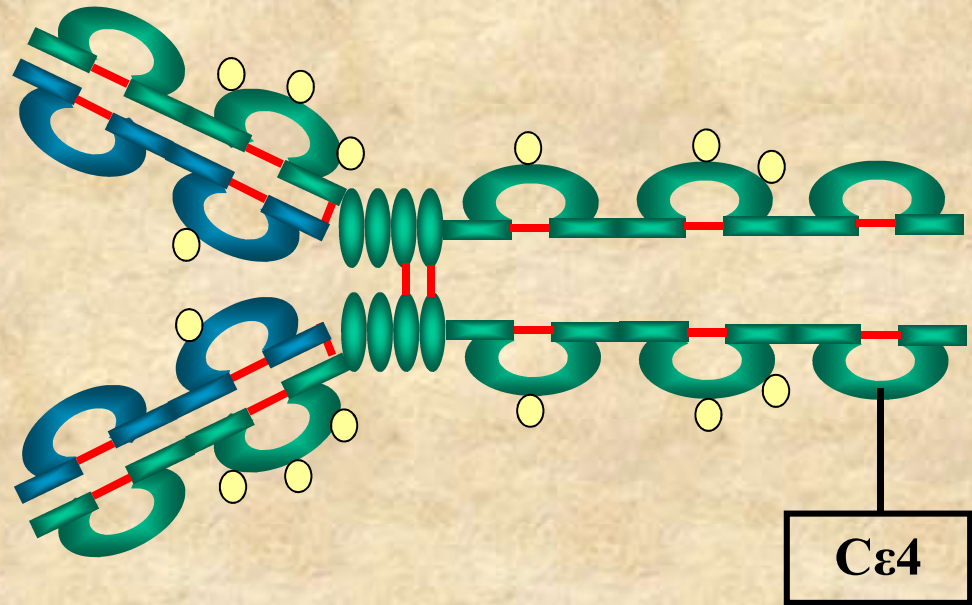
# IgD

- Structure
  - Monomer
  - Tail piece



# IgE

- Structure
  - Monomer
  - Extra domain ( $C_{H4}$ )



# IgE

- Structure
- Properties
  - Least common serum Ig
    - Binds to basophils and mast cells (Does not require Ag binding)
  - Allergic reactions
  - Parasitic infections (Helminths)
    - Binds to Fc receptor on eosinophils
  - Does not fix complement



## Immunoglobulin subclasses differ in structure and function

	IgM	IgG1	IgG2	IgG3	IgG4	IgA1,2	IgE	IgD
form	pentamer	mono	mono	mono	mono	dimer	mono	mono
serum level (mg/ml)	1.5	9	3	1	0.5	3.5	0.00005	0.03
Complement activation	+++	+++	+	+++	-	-	-	-
Placental transfer	-	+	+	+	+	-	-	-
macrophage (Fc receptor) binding	-	+	-	+	-	-	-	-
present in external secretions	mucus etc	milk	milk	milk	milk	mucus etc	-	-