A.S.D.GOVERNMENT DEGREE COLLEGE FOR WOMEN (AUTONOMOUS) KAKINADA

DEPARTMENT OF MICROBIOLOGY

Properties of Immunoglobulins

II BSc CBMB SEM IV

BY

Dr. K. Aruna

Lecturer in Microbiology

Introduction

- **Glycoprotein In nature**
- **Formed from Plasma cells in response to antigenic stimulations**
- **Structure of antibody was revealed by G.M.Edelman and R.M. Porter in the year 1970**
- **Structure resembles letter "T" before binding antigen**
- **Resembles "Y" after binding to antigen**
- **Stalk of the antibody is called as "Fc"**
- **The top of Y consisting of "antigen-binding fragment"Fab**

Biologic Activity

Neutralize toxins

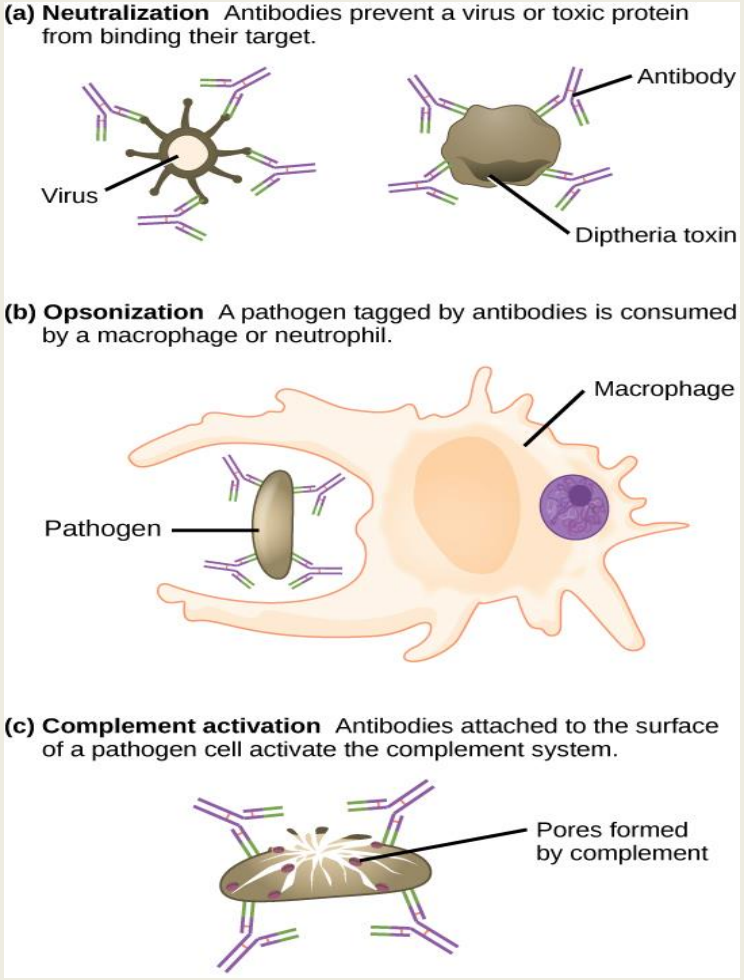
Opsonisation

Activation of complement

Clearance of antigen

Allergic responses

Neutralize viruses and other activities.



STRUCTURE OF IMMUNOGLOBULUIN

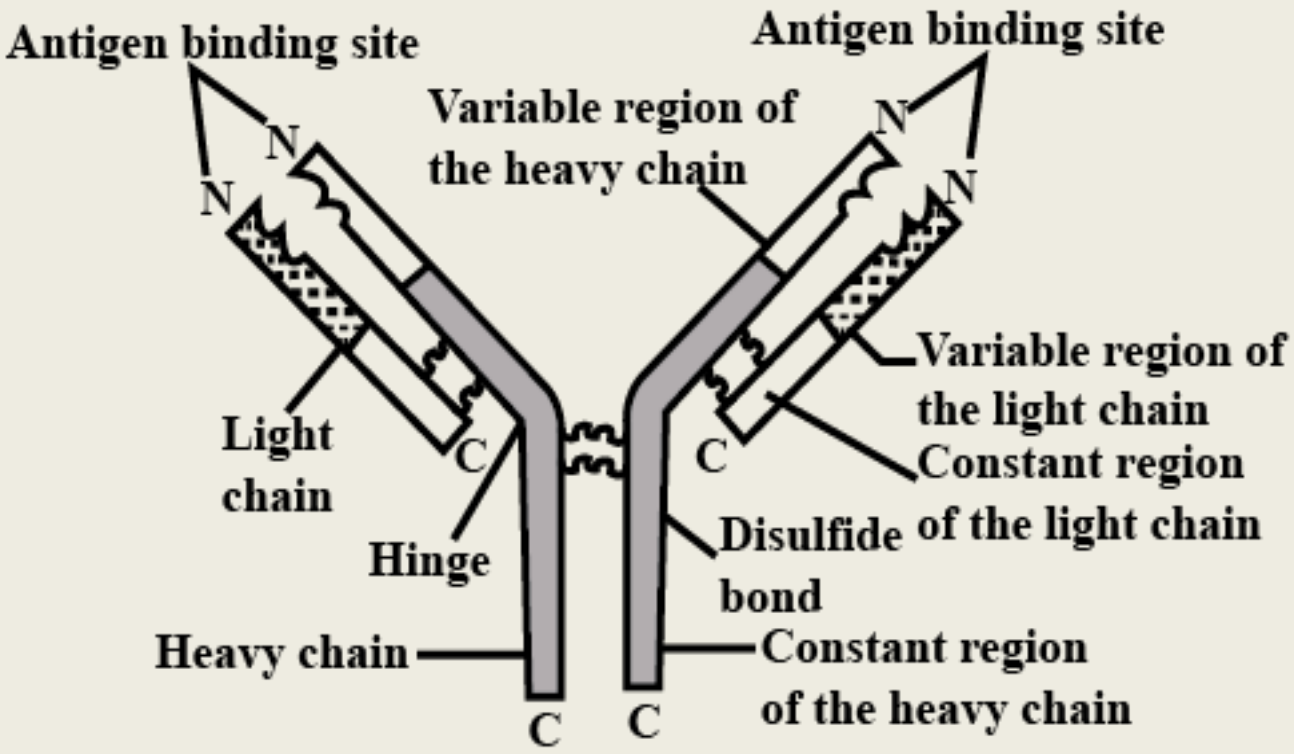
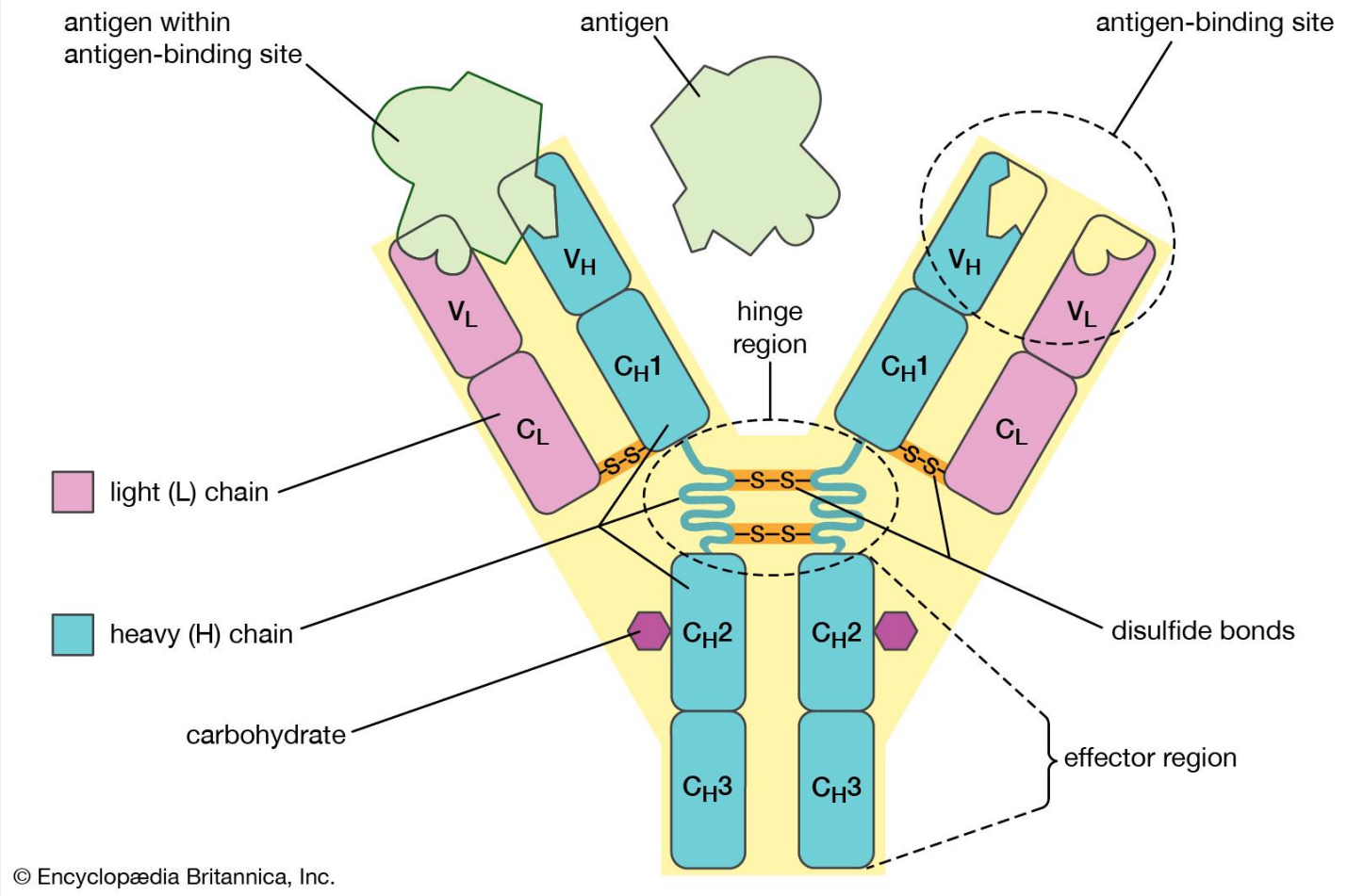
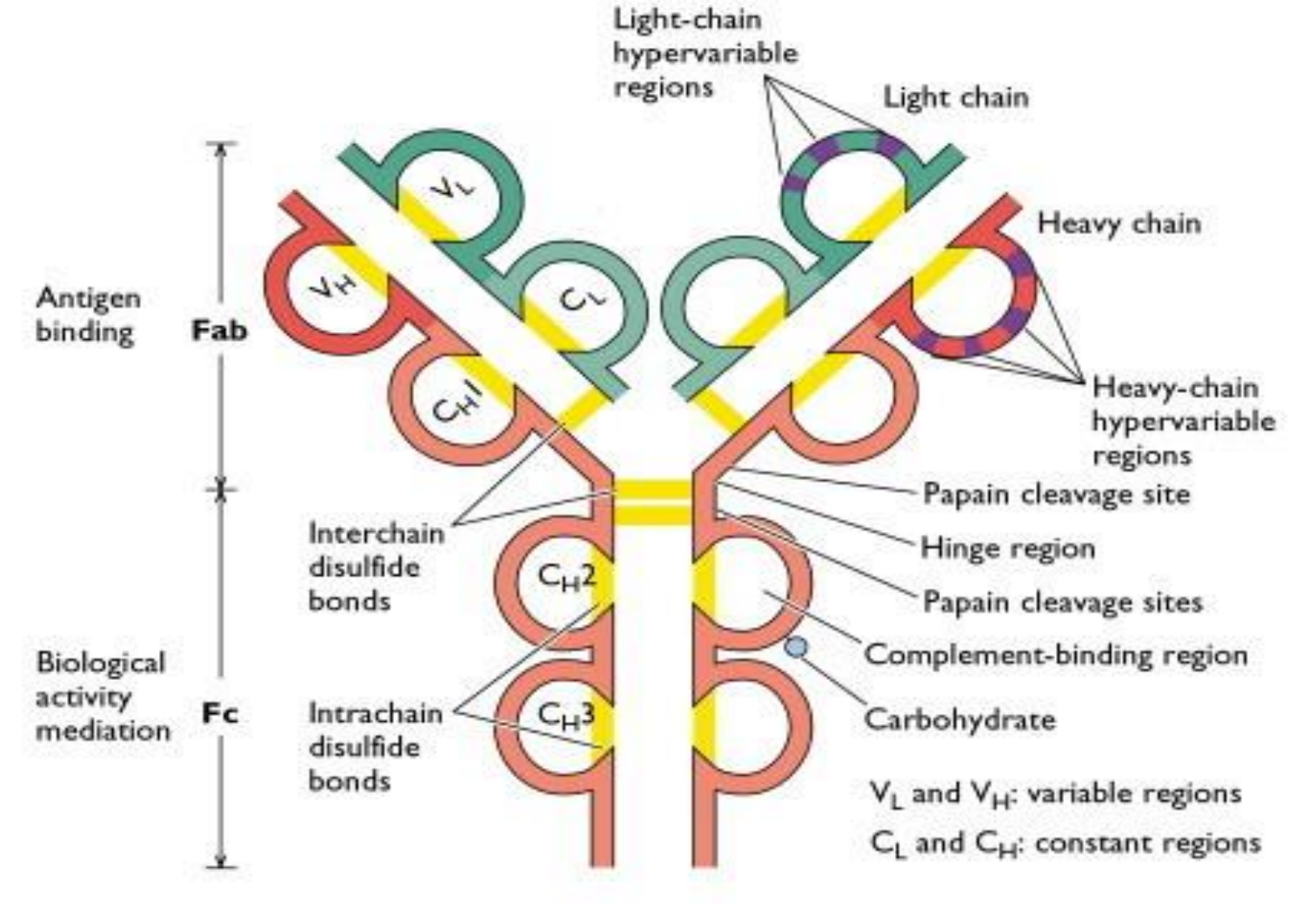


Fig. Structure of antibody

STRUCTURE OF IMMUNOGLOBULUIN

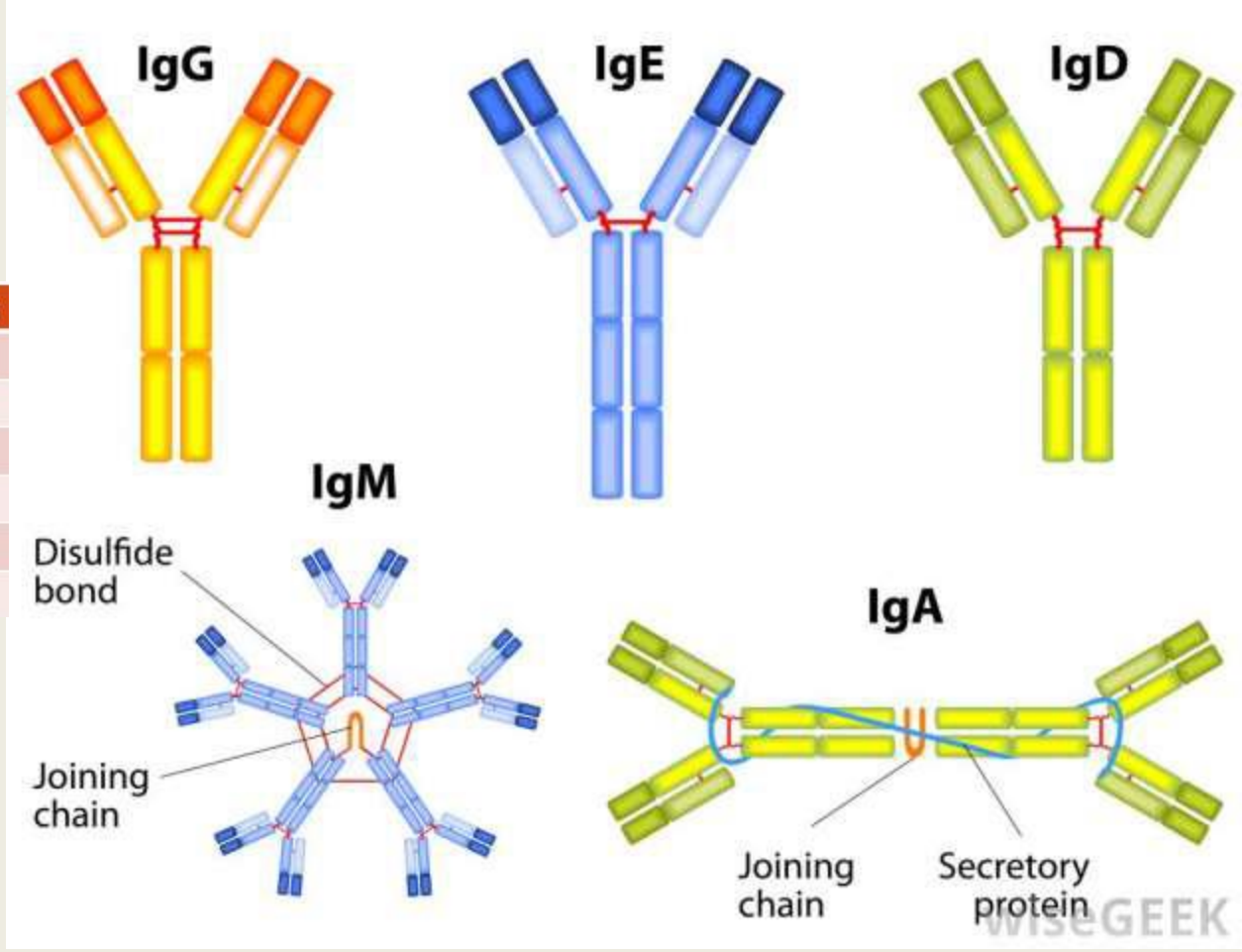


STRUCTURE OF IMMUNOGLOBULUIN

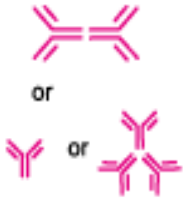


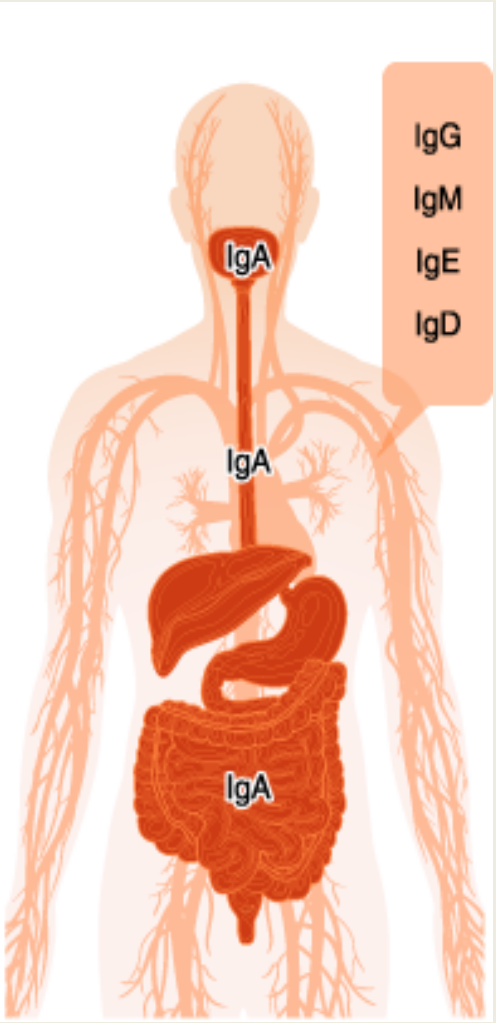
ClASSES OF IMMUNOGLOBULUIN

Type of heavy chain in each Ig class	
Immunoglobulin class	Heavy chain type
IgG	γ (gamma)
IgA	α (alpha)
IgM	μ (mu)
IgD	δ (delta)
IgE	ε (epsilon)



Characteristics of Antibodies

IgG		• Highest opsonization and neutralization activities. • Classified into four subclasses (IgG1, IgG2, IgG3, and IgG4).
IgM		• Produced first upon antigen invasion. Increases transiently.
IgA		• Expressed in mucosal tissues. Forms dimers after secretion.
IgD		• Unknown function.
IgE		• Involved in allergy.



Functions of IgG

- They makes up approximately 80% of the serum antibodies
- They has a half-life of 7-23 days
- IgG is a monomer and has 2-epitope binding sites
- This is the only class of antibodies that can cross the placenta and enter the fetal circulation
- Activates the Complement by Classical pathway
- Molecular weight is 150000 daltons
- There are 4 subclasses of IgG in humans:IgG1, IgG2, IgG3 & IgG4
- IgG1 and IgG3 are Anti Rh antibodies and expressed on Manocyte and Macropharge and make them better phagocytes
- IgG2 are opsonic and developed in response to antitoxins
- IgG4 skin- sensitizing antibody

Functions of IgM

- They makes up approximately 10% of the serum antibodies
- First immunoglobulin made during the B-lymphocyte maturation and expressed on B-Lymphocyte
- They has a half-life of about 5 days Most of the IgM are pentamer and has 10 – Epitope binding sites.
- It is the first immunoglobulin class produced in a primary response to antigen
- Molecular weight is 970000 daltons
- Heavy chain consisiting of 4^{th} domain in heavy chain

Functions:

Activation of classical pathway

Defence against multivalent antigens

Act as Opsonin

Ig M agglutinates the gram negative bacteria

Enhances the phagocytosis

Functions of IgA

- **They makes up approximately 15% of the serum antibodies**
- **They has a half-life of approximately 6 days**
- **IgA is a dimer and has 4-epitope binding sites**
- **They found mainly in body secretions such as sliva, mucous, tears, colostrum and milk.**

Functions

It as a Secretary antibody

Effective against virus , bacteria and Protozoan parasite nd thus prevent their adherence to mucosal surfaces and invasion

Production to Infant gut

Functions of IgD

- They makes up approximately 0.2% of the serum antibodies
- IgD is a monomer and has 2-epitope binding sites
- This class antibodies are found on the surface of B-lymphocytes

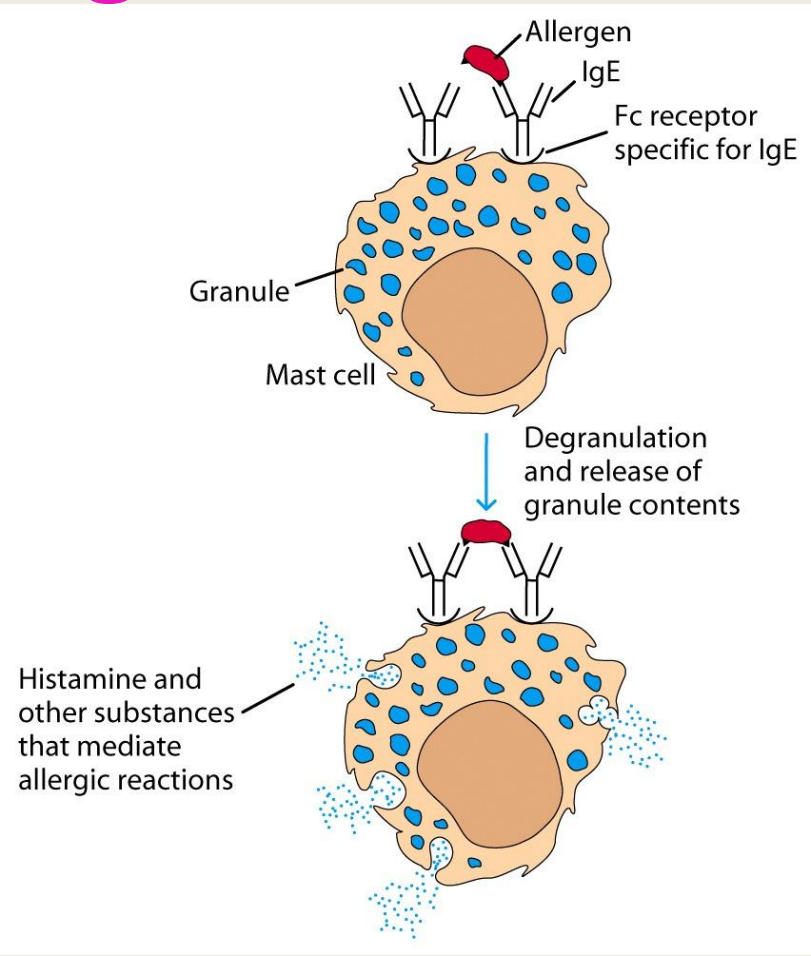
Function

B cell activation.

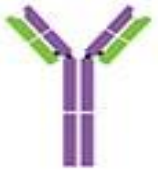
Act a receptor for antigen binding

Functions of IgE

- They makes up approximately 0.002% of the serum antibodies
- Allergic Antibody
- Special receptor on Mast Cells



The Five Immunoglobulin (Ig) Classes

The Five Immunoglobulin (Ig) Classes					
	IgM pentamer	IgG monomer	Secretory IgA dimer	IgE monomer	IgD monomer
					
Heavy chains	μ	γ	α	ε	δ
Number of antigen binding sites	10	2	4	2	2
Molecular weight (Daltons)	900,000	150,000	385,000	200,000	180,000
Percentage of total antibody in serum	6%	80%	13%	0.002%	1%
Crosses placenta	no	yes	no	no	no
Fixes complement	yes	yes	no	no	no
Fc binds to		phagocytes		mast cells and basophils	
Function	Main antibody of primary responses, best at fixing complement; the monomer form of IgM serves as the B cell receptor	Main blood antibody of secondary responses, neutralizes toxins, opsonization	Secreted into mucus, tears, saliva, colostrum	Antibody of allergy and antiparasitic activity	B cell receptor

Properties of immunoglobulins:

	IgG	IgA	IgM	IgD	IgE
1. Serum conc. (%)	85	5-15	5-10	<1	<1
2. Mol. Wt.	160,000	170,000 & 385,000	960,000	184,000	188,105
3.Sed. coeff.	7S	7S	19S	7S	8S
4.Heavy chain class	Gamma	Alpha	Mu	Delta	Epsilon
5.Light chain	K & L	K & L	K & L	K & L	K & L
6. Valency	2	2 or multiple of 2	5 (10)	2	2
7.No of basic 4-polypeptide chains	Monomer	Dimer or Trimer	Pentamer	Monomer	Monomer

	IgG	IgA	IgM	IgD	IgE
8.Placental transport	+	–	–	–	–
9.Present in milk	+	+	–	–	–
10.Selectie secretion by seromucus gland	–	+	–	–	–
11. Intravascular distribution(%)	45	42	80	75	50
12.Carbohydrate (%)	3	11	10	13	12
8.Subclasses	IgG1-4	IgA1-2	–	–	–

	IgG	IgM	IgA	IgD	IgE
14.Comple-ment fixation					
A.Classical	++	_	+++	_	_
B.Alternati ve	_	+	_	_	_
15.Half life (days)	23	6	5	2-3	2-3
16.Princip-al site of action	Serum	Secretion	Serum	Receptor for B cells	Mast cells
17.charact-eristic propert-ies	precipitins, antitoxins, compleme-nt fixation, late Ab	Serum and secretory Abs	Agglutinin, opsonin , lysin , early Ab	Not known (B-cell activation)	Reaginic Ab (anaph-ylaxis)

Review questions

1.The structure of an antibody is similar to the extracellular component of which receptor?

A. MHC I
B. MHC II
C. BCR
D. none of the above

2. The first antibody class to appear in the serum in response to a newly encountered pathogen is _____.

A. IgM
B. IgA
C. IgG
D. IgE

3. What is the most abundant antibody class detected in the serum upon reexposure to a pathogen or in reaction to a vaccine?

A. IgM
B. IgA
C. IgG
D. IgE

4. Breastfed infants typically are resistant to disease because of _____.

A. active immunity
B. passive immunity
C. immune tolerance
D. immune memory

Answers

C
A
C
B

Summery

Antibodies (immunoglobulins) are the molecules secreted from plasma cells that mediate the humoral immune response.

There are five antibody classes; an antibody's class determines its mechanism of action and production site but does not control its binding specificity.

Antibodies bind antigens via variable domains and can either neutralize pathogens or mark them for phagocytosis or activate the complement cascade.


%
£
Thank you!