Immunology

Antibody Structure and Function

Lecture 5

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Our targets

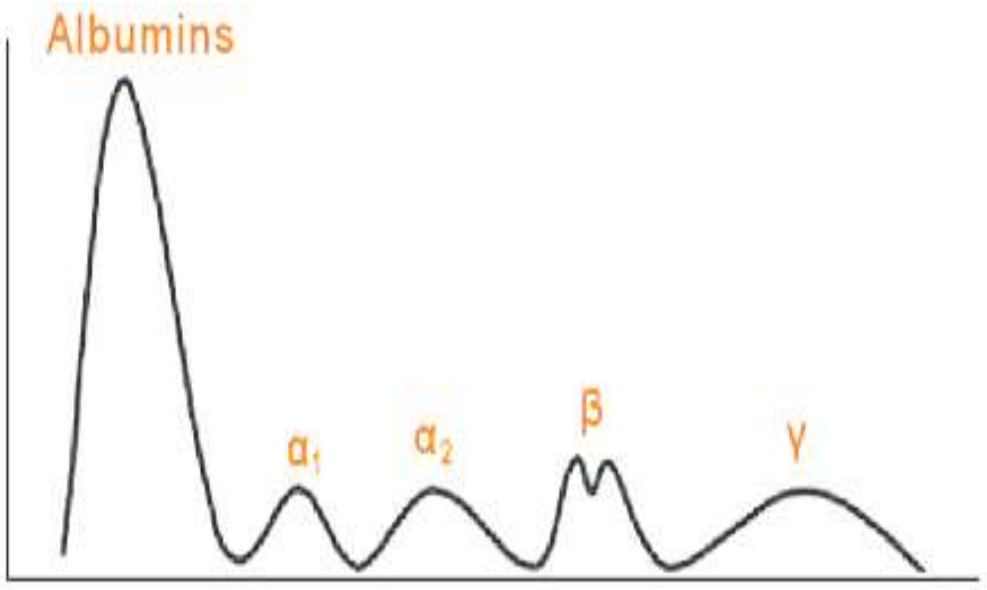
Students should understand the followings

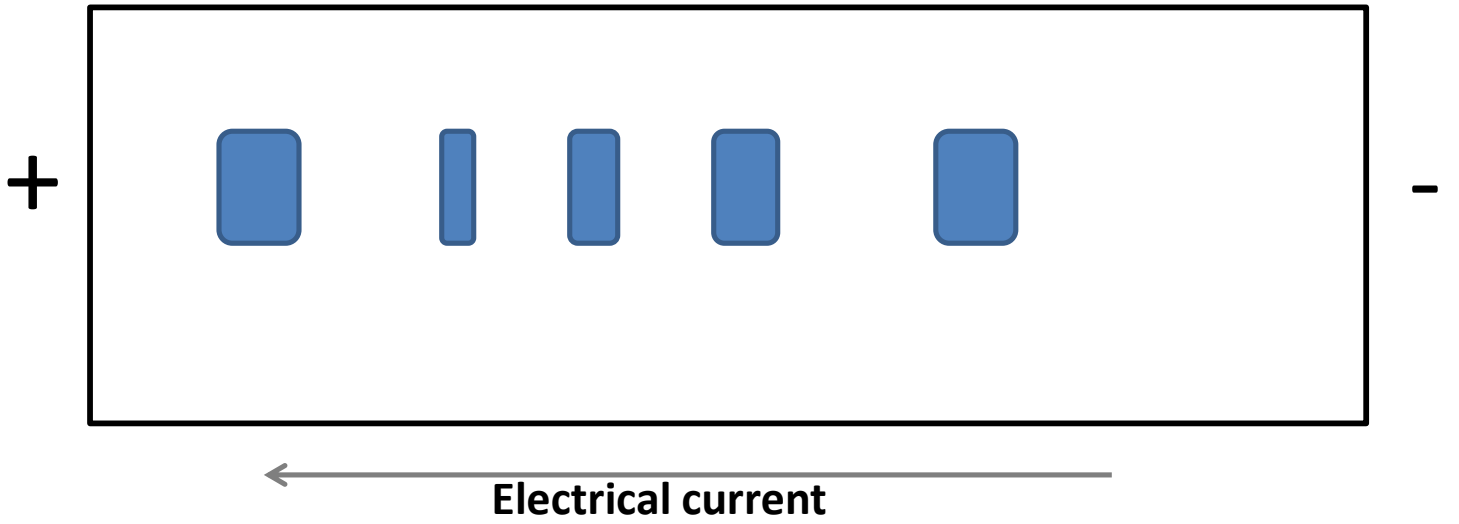
- The **meaning** of an antibody
- The **structure** of an antibody
- The **function** of each particular part
- The **different types** of antibodies
- The **mechanisms** behind the production of antibodies with **different antigen binding site**
- The mechanism of **class switching**

Introduction

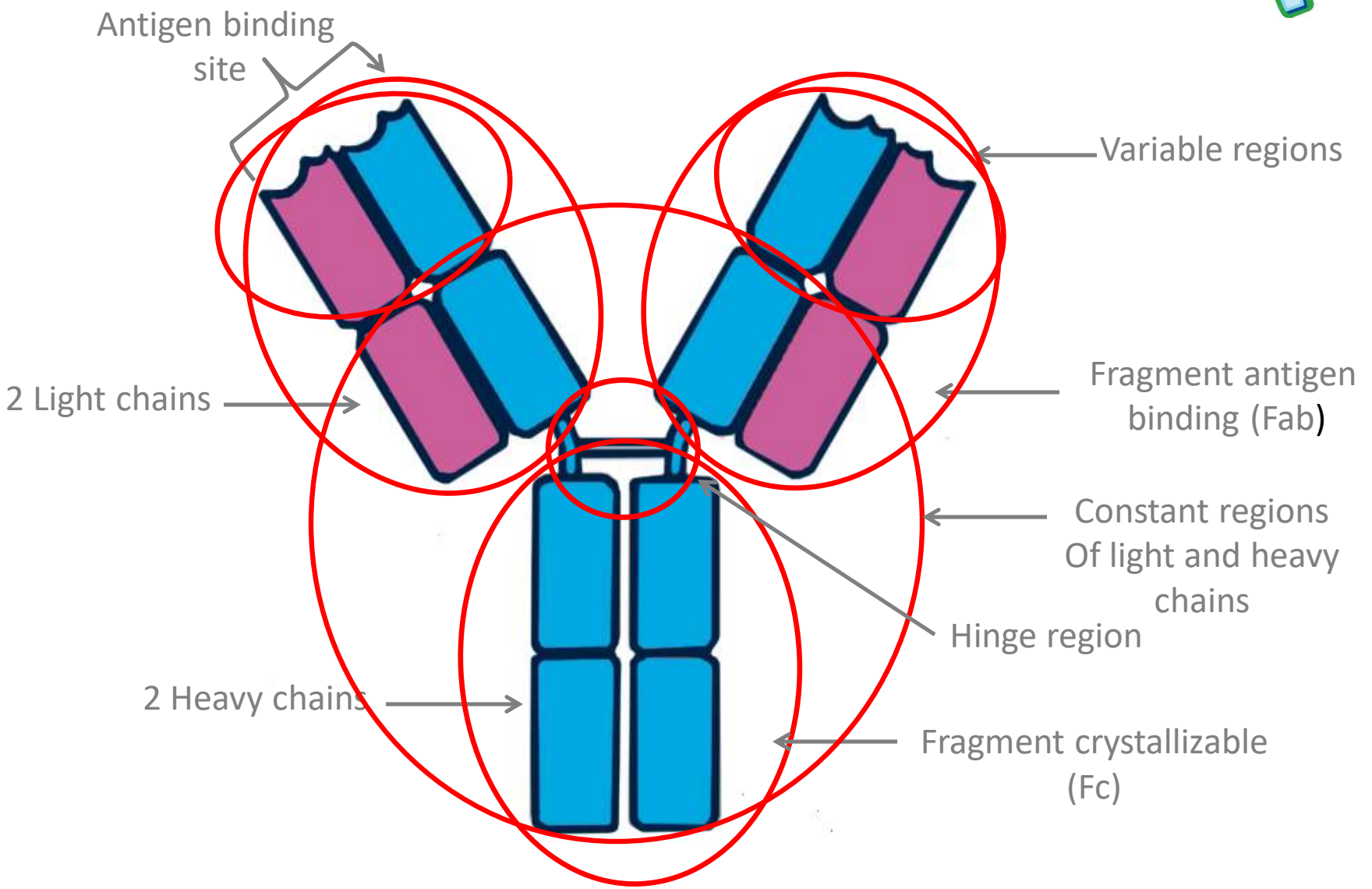
Isolation and Characterization

- Normal plasma proteins electrophoresis
- Antibodies are in the gamma portion therefore they are called gammaglobulin



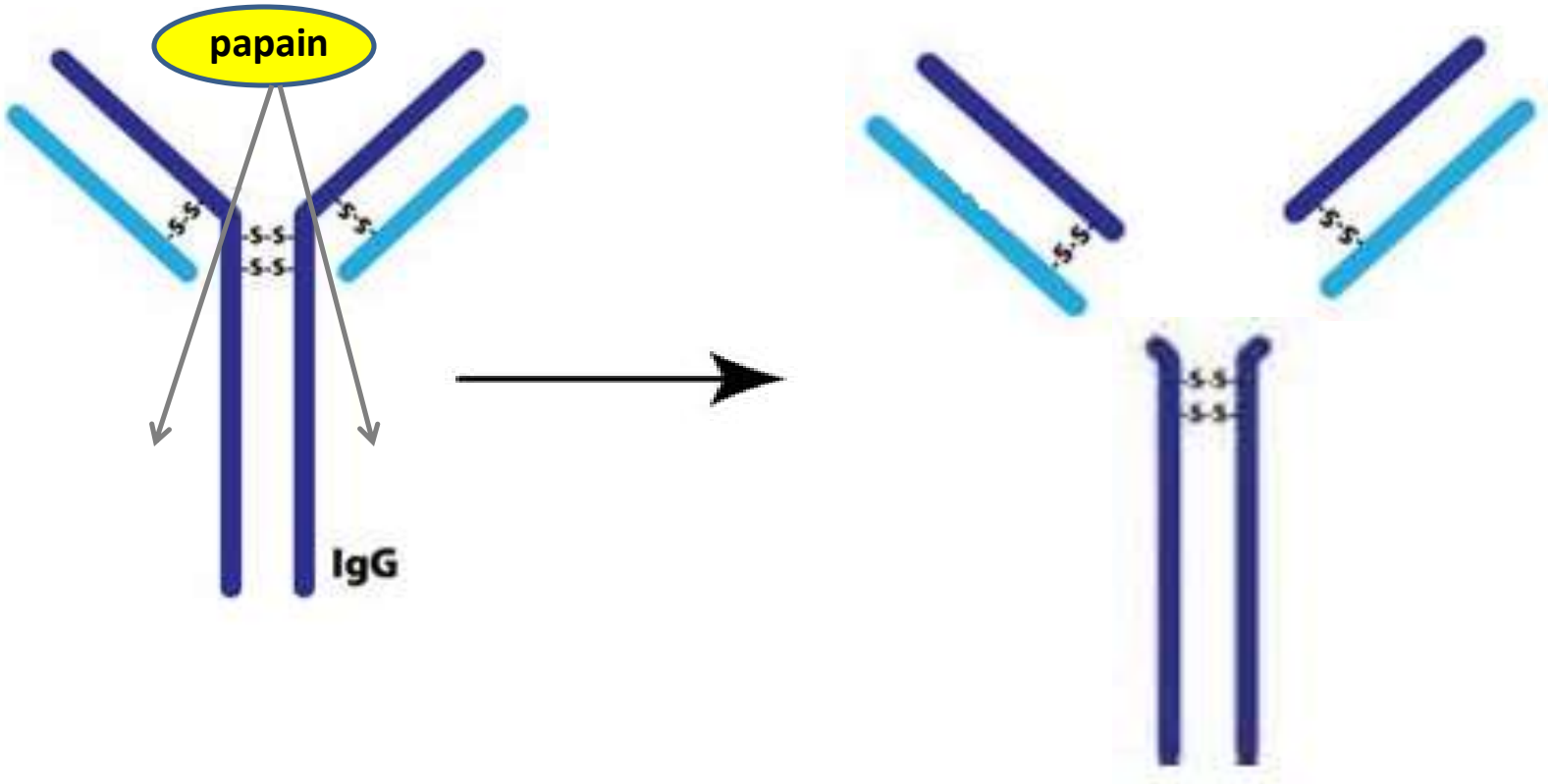


Antibody Structure



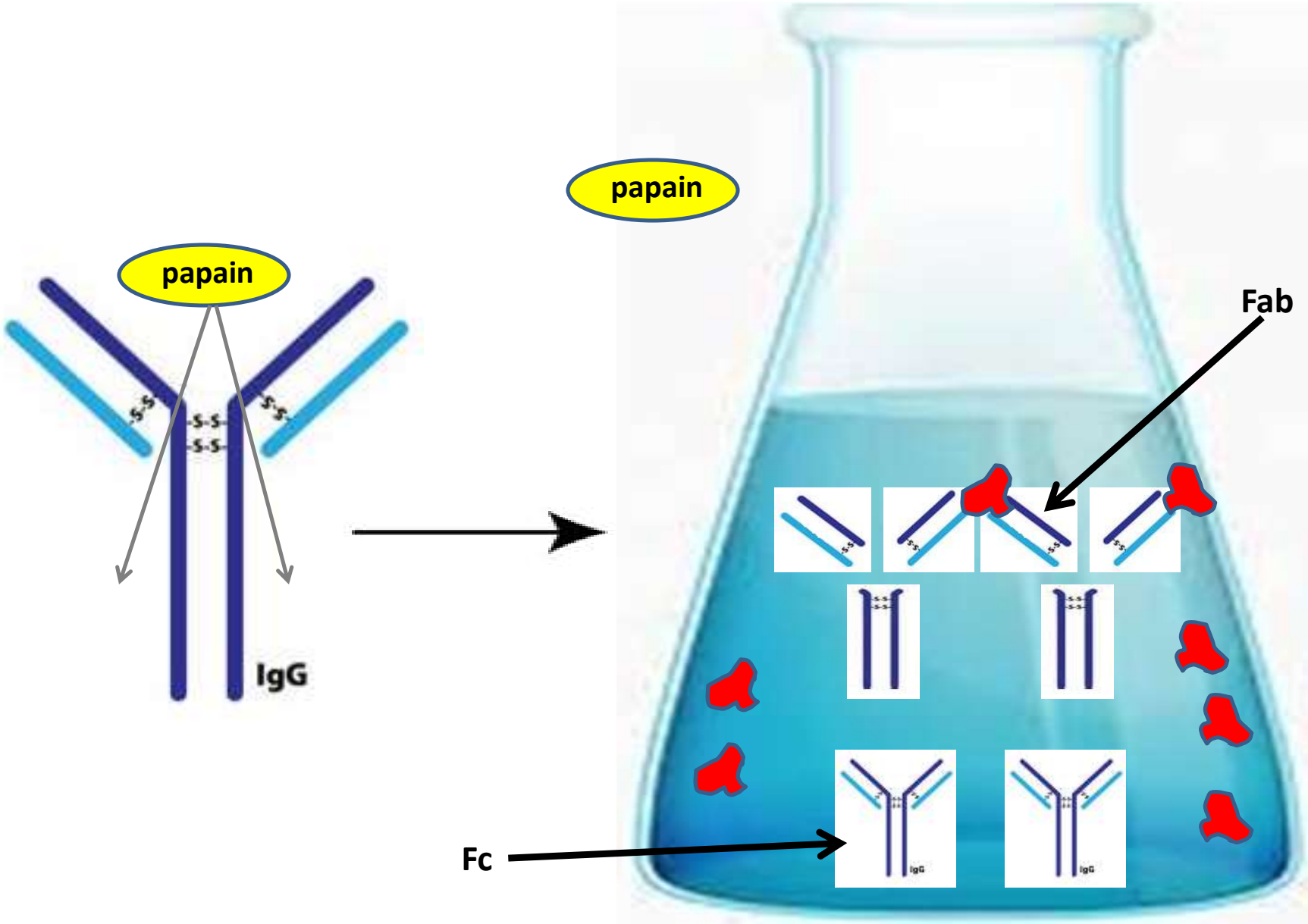
Antibody Structure

Discovery of the Fab and Fc regions



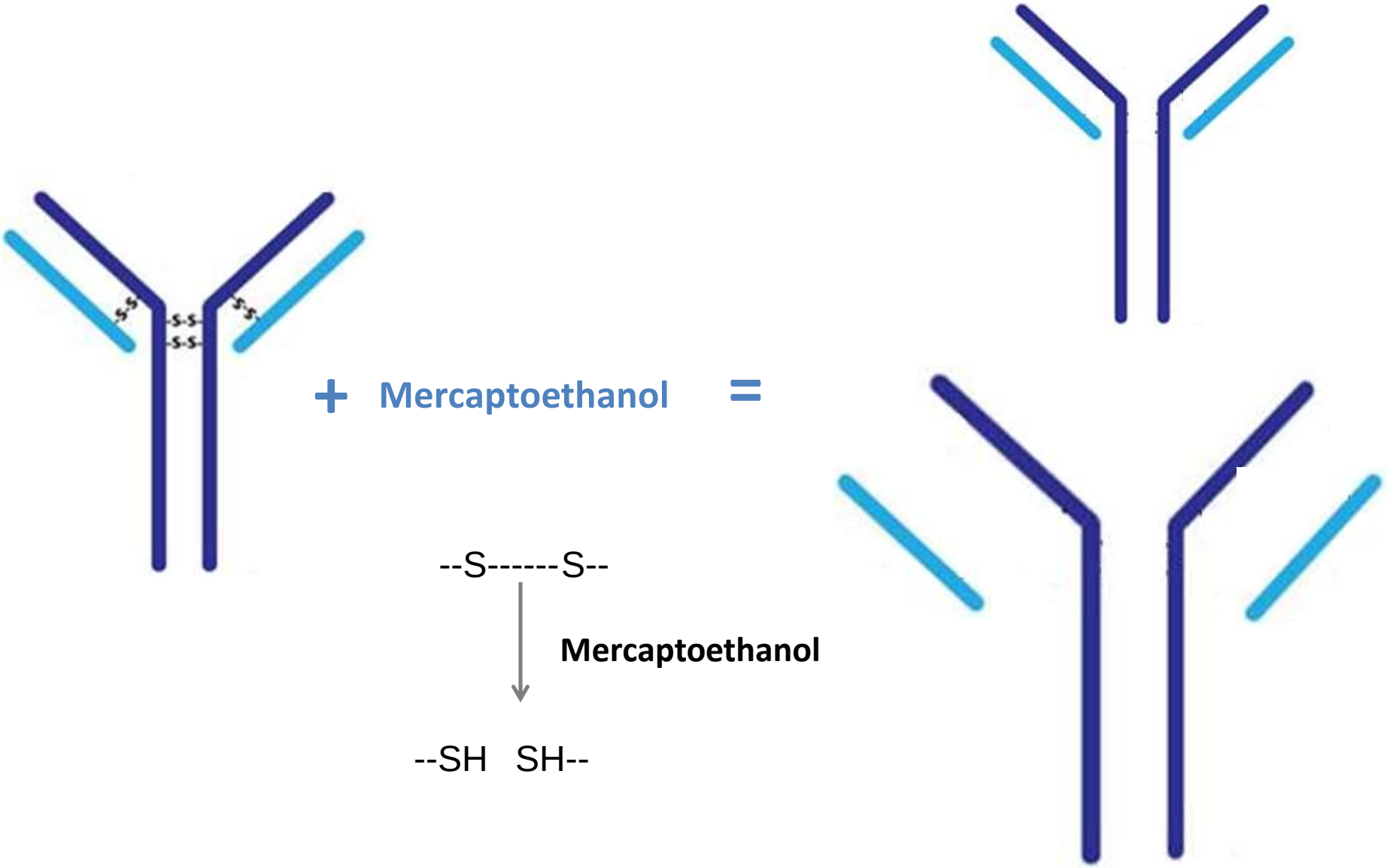
Antibody Structure

Discovery of the Fab and Fc regions



Antibody Structure

Discovery of the Ab tetrapeptide structure

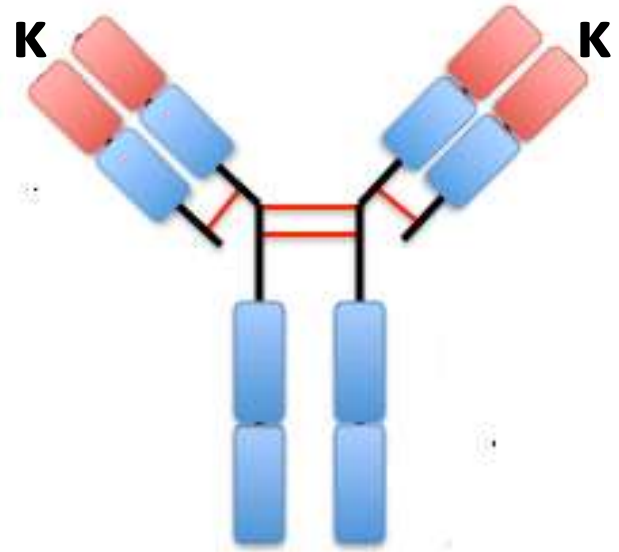


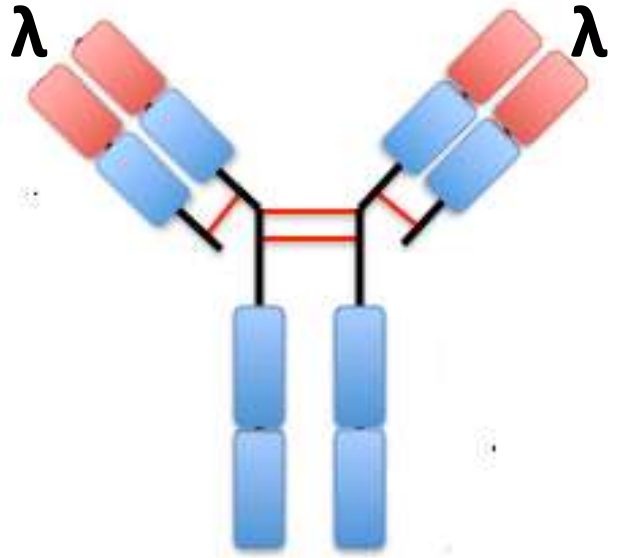
Antibody Structure

Structure of the light chain

Two classes of light chains :

- ✓ Kappa (κ) chain
- ✓ Lambda (λ) chain



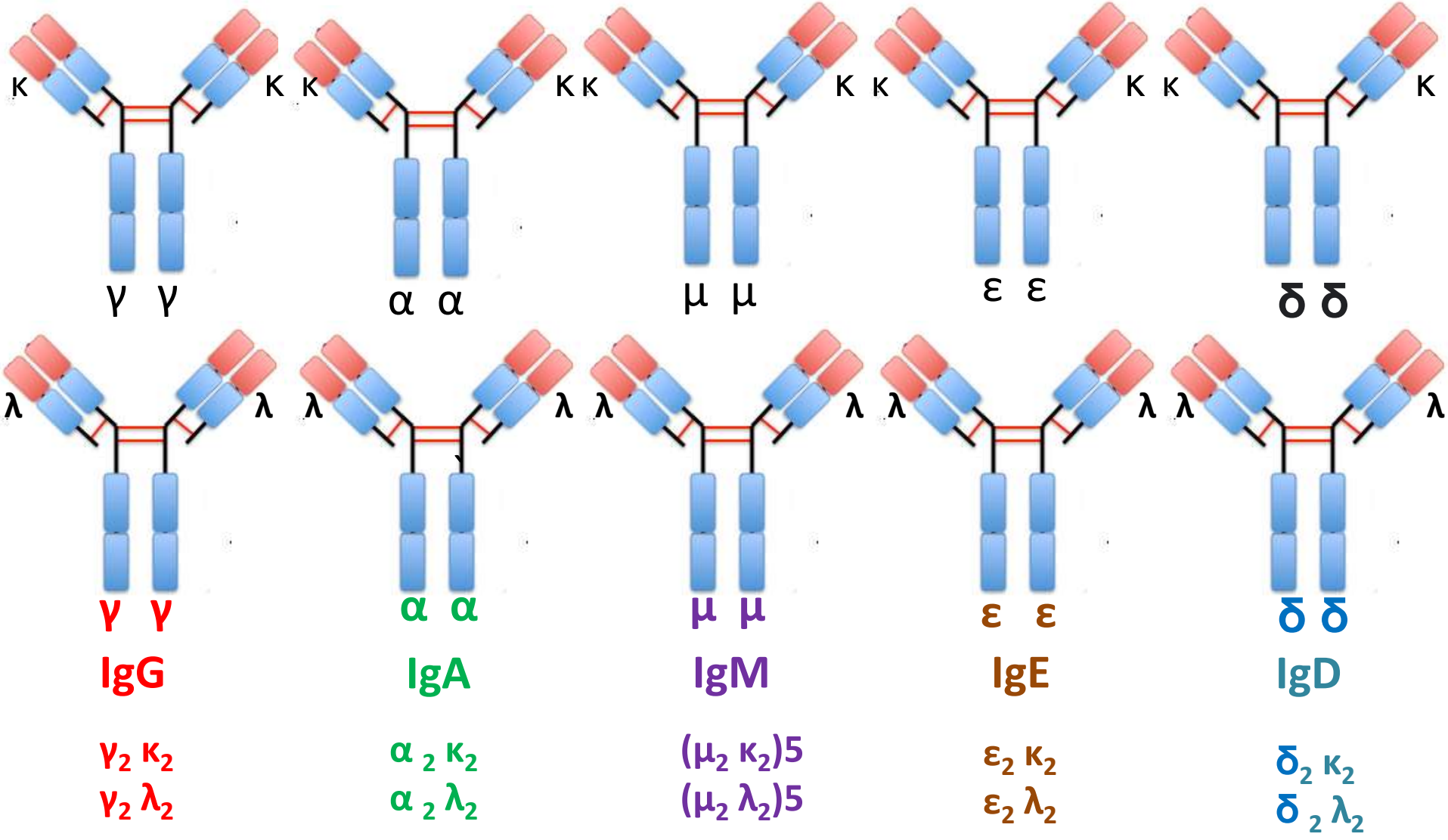


Antibody Structure

Structure of the heavy chains

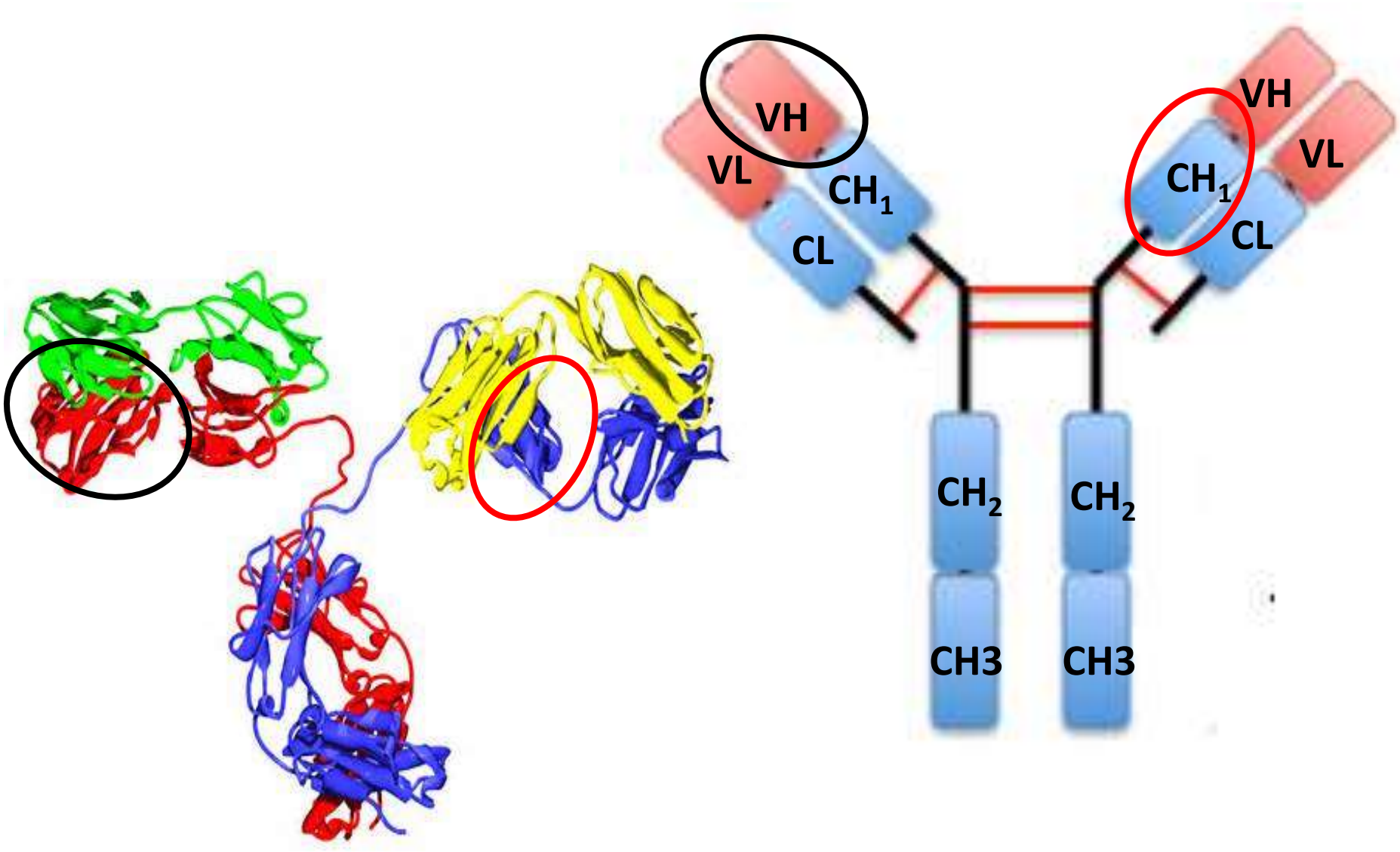
From the highest to the lowest concentration

G A M E D



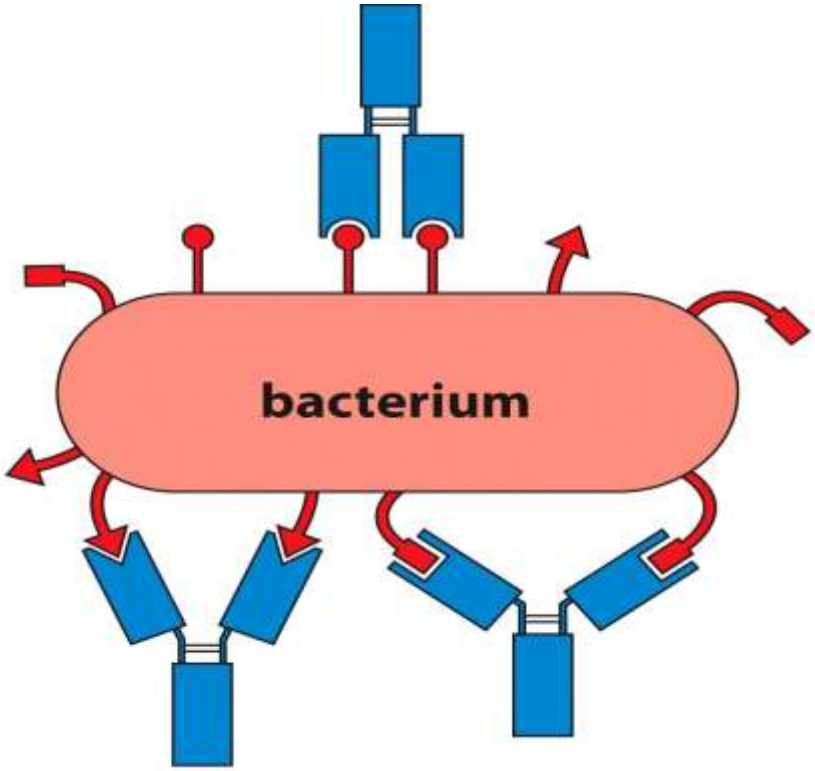
Antibody Structure

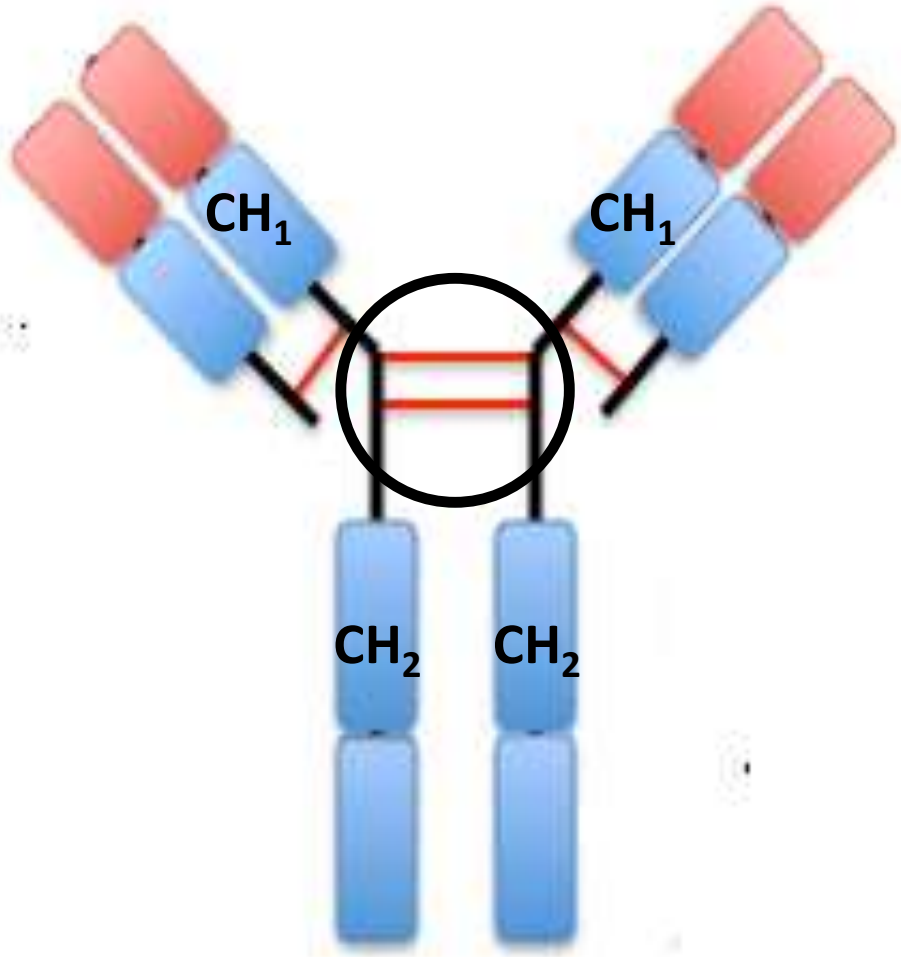
Domains



Antibody Structure

Hinge region



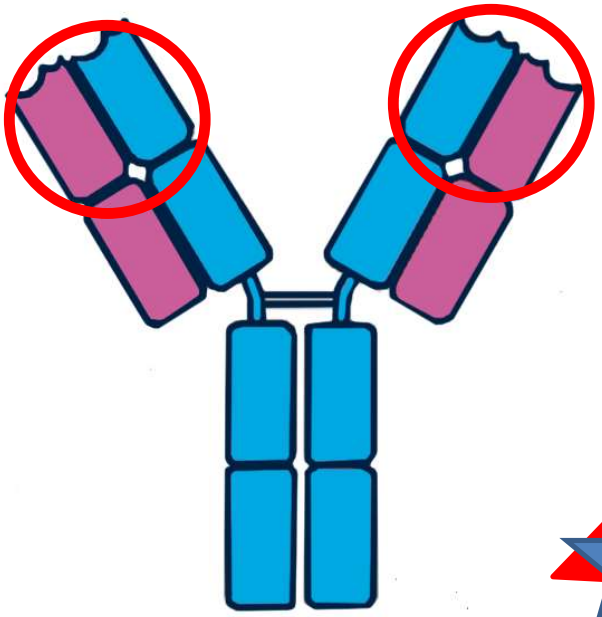


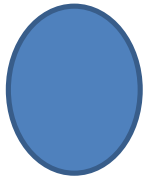
Antibody Structure

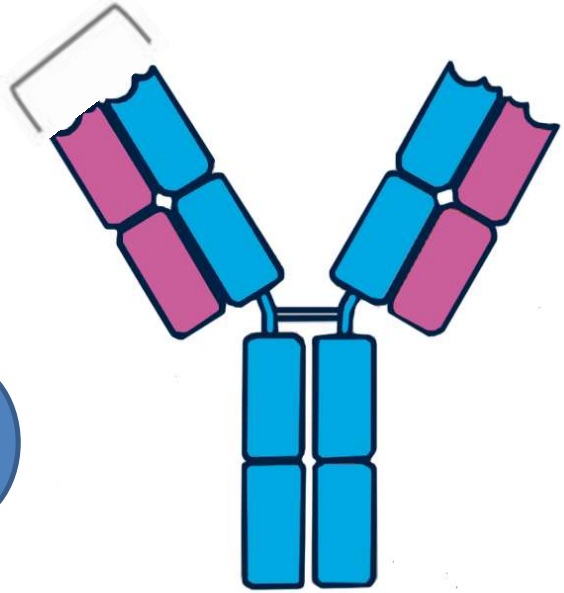
Variable region

Antigen binding site

Antigen binding site





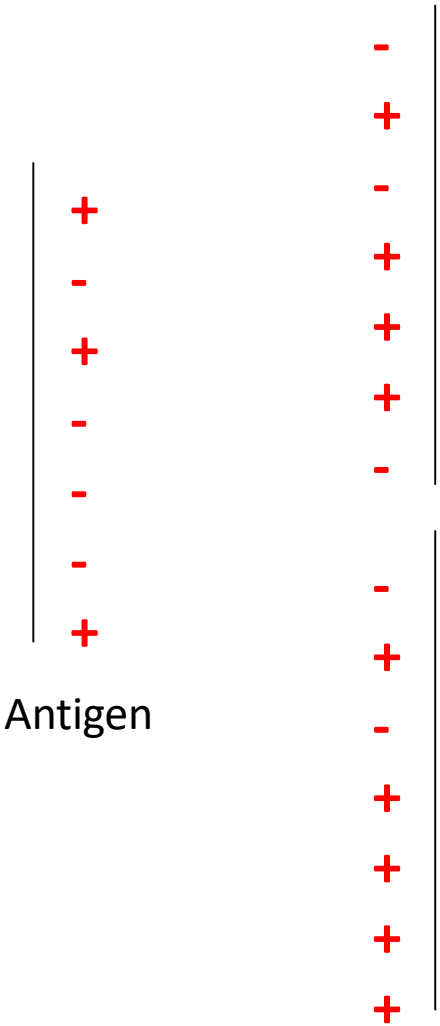


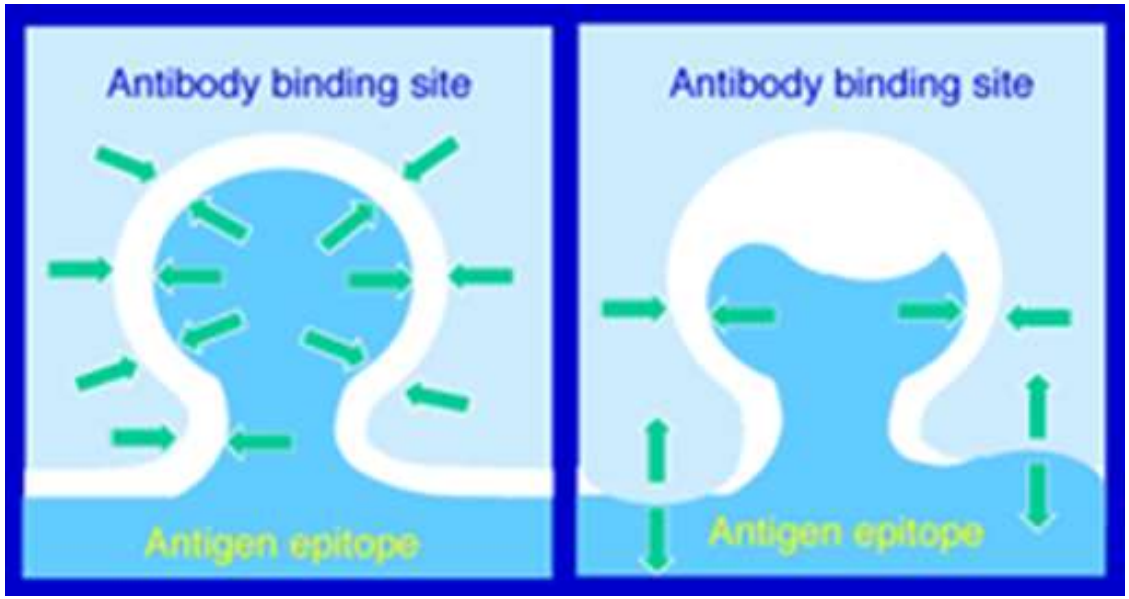
Antibody Structure

Antigen binding site

Affinity

measures the strength of interaction between an epitope and an antibody's antigen binding site.



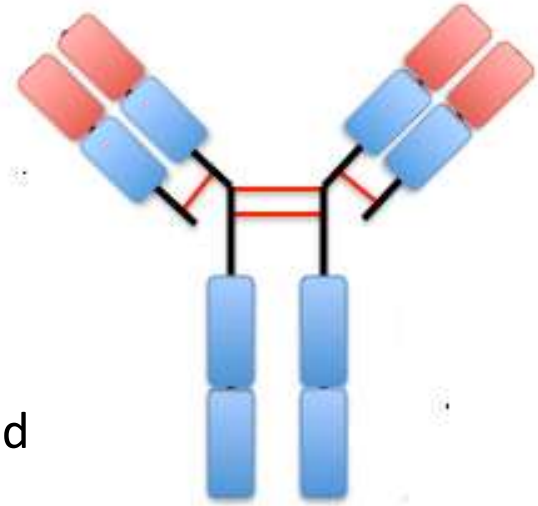


Good fit=
Many interactive forces=
Strong binding=
High affinity

Poor fit=
Few interactive forces=
Weak binding=
Low affinity

Forces: Van der Waal, Hydrogen, and ionic bond forces)

IgG



Monomermic antibody

Half life is about 23 days

The predominant Ab in blood, lymph fluid, CSF, and peritoneal fluid

Has four subclasses (IgG1 to IgG4)

Half-life

100 IgG molecules → (23 days) 50 → (23 days) 25 → (23 days) 12.5 → (23 days) ..etc

IgG

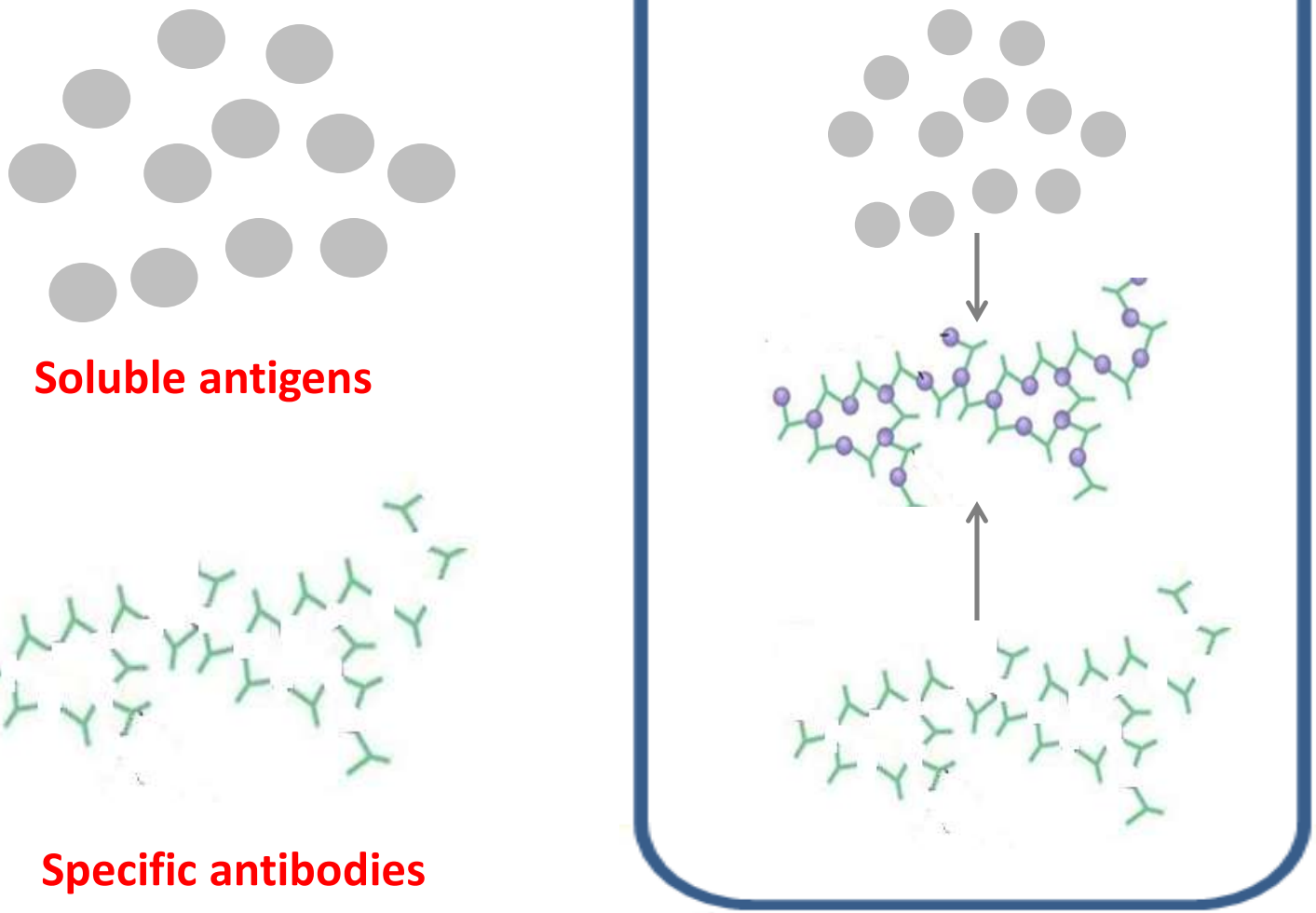
Functions

1. Precipitation reaction
2. Agglutination
3. Fetal and neonatal protection
4. Opsonization
5. Immobilization of bacteria
6. Neutralization of bacteria
7. Neutralization of toxins

IgG

Functions

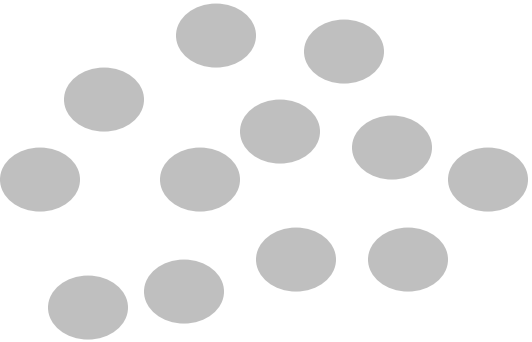
1. Precipitation reaction



IgG

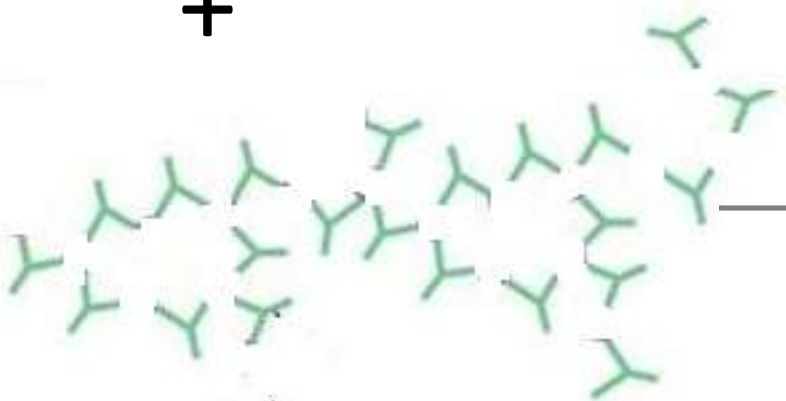
Functions

1. Precipitation reaction

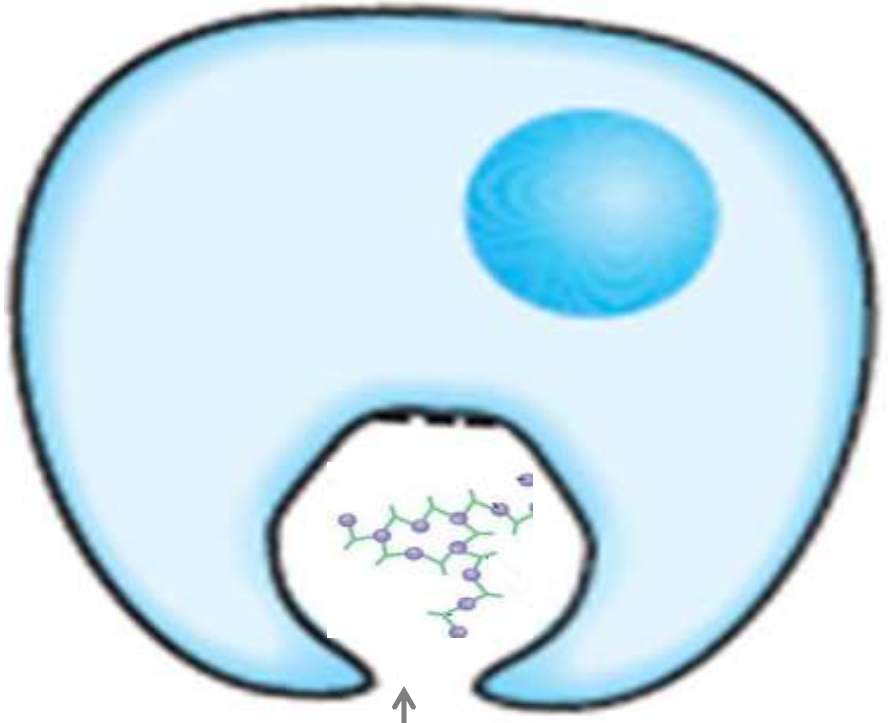


Soluble antigens

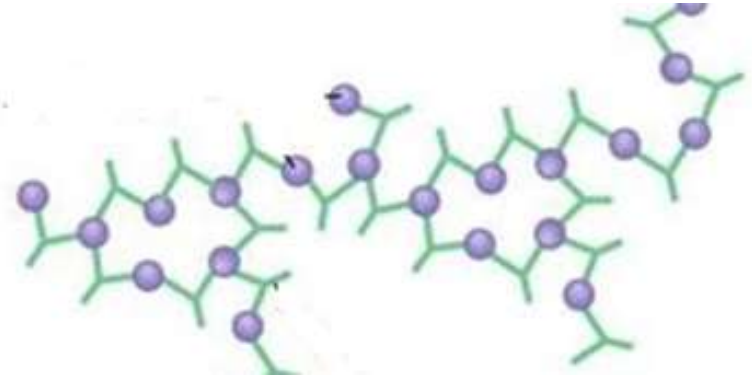
+



Specific antibodies



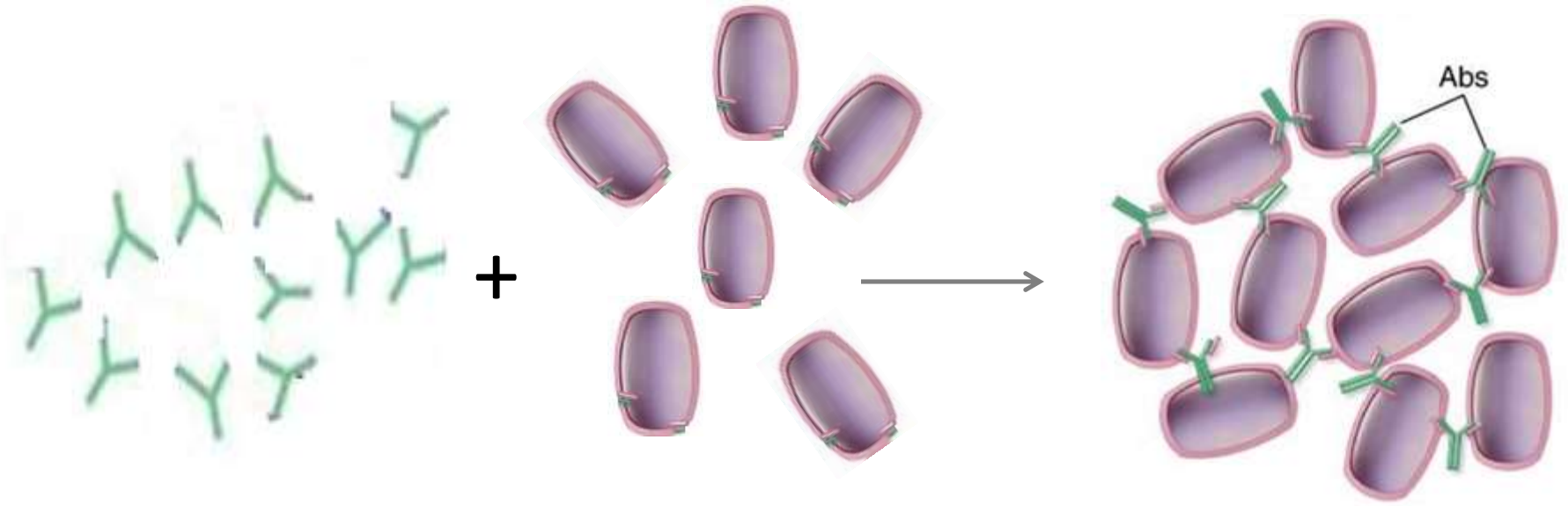
Facilitate phagocytosis



Functions

2. Agglutination:

Is the clumping of large particles



Specific antibodies

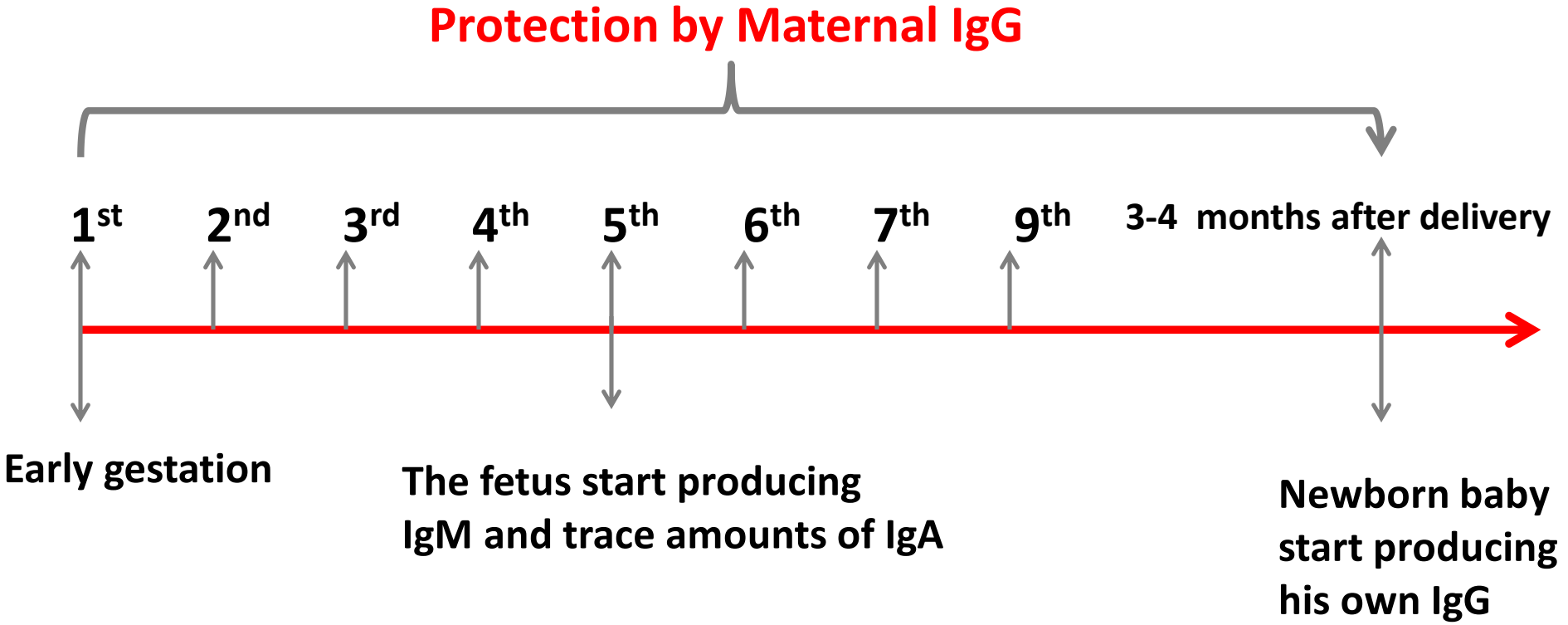
Bacteria

Agglutination

IgG

Functions

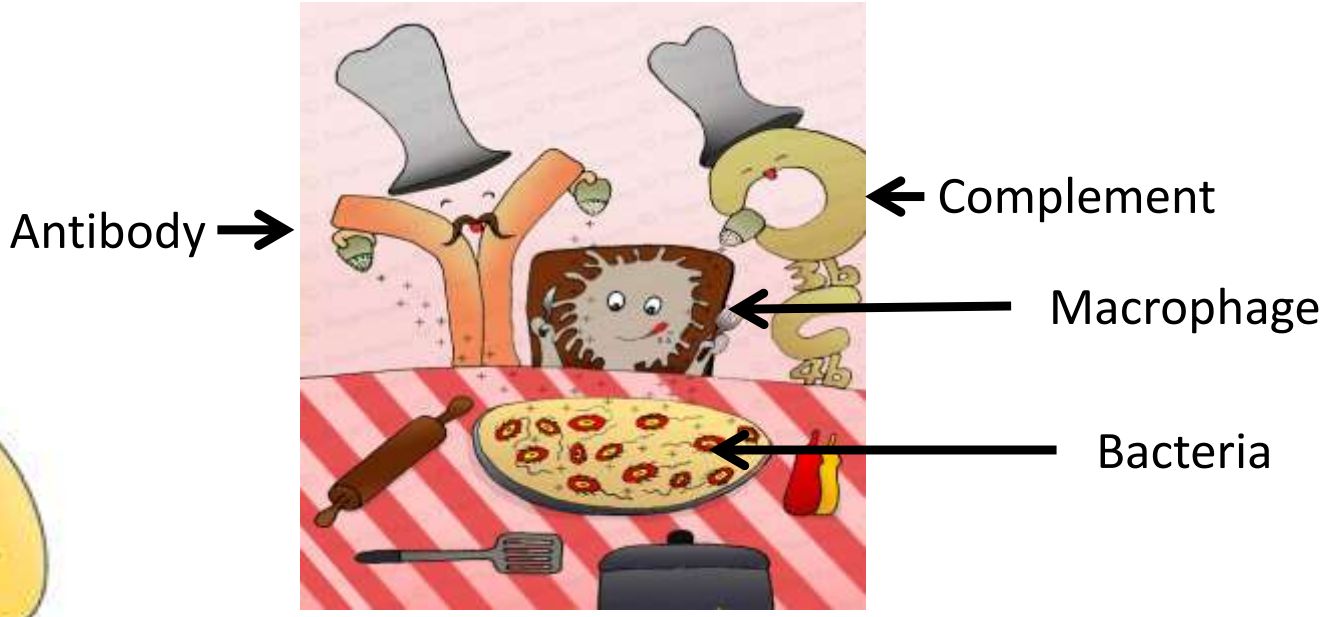
3. Fetal and neonatal protection

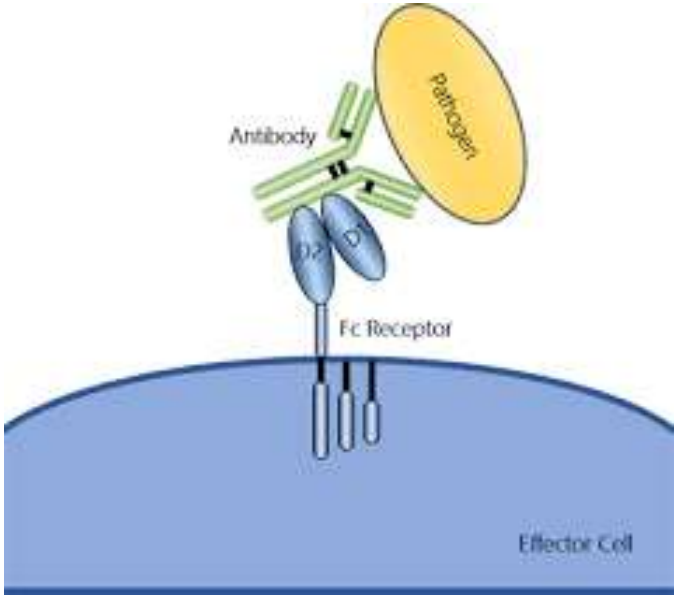


IgG

Functions

4. Opsonization: from Greek to prepare for eating

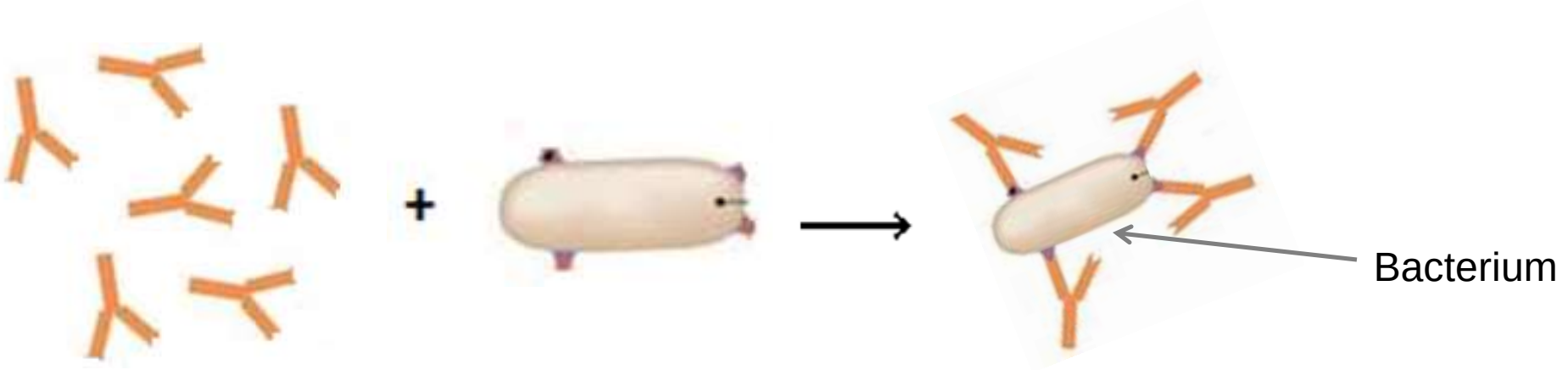


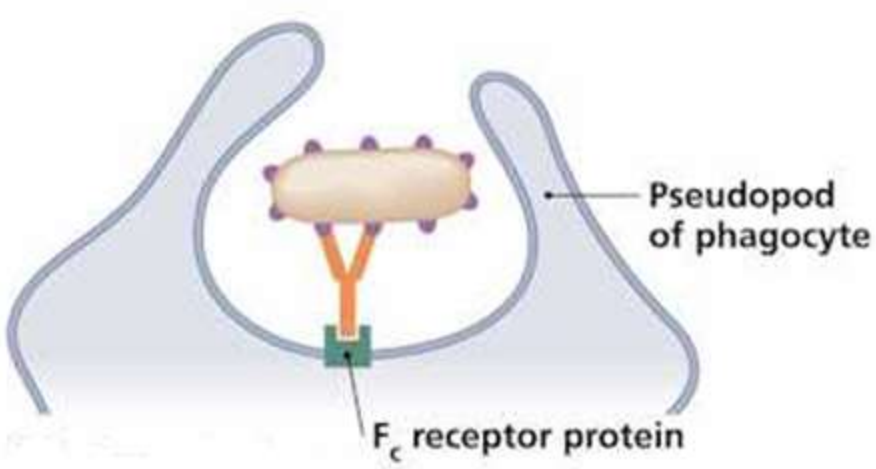


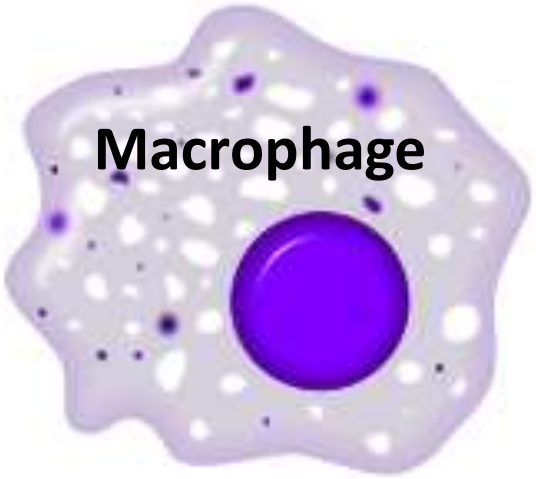
IgG

Functions

4. Opsonization: from Greek to prepare for eating





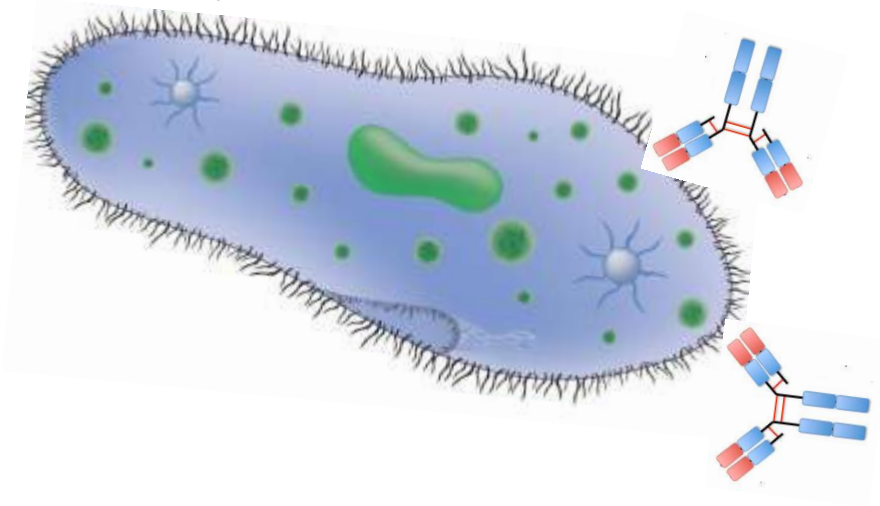


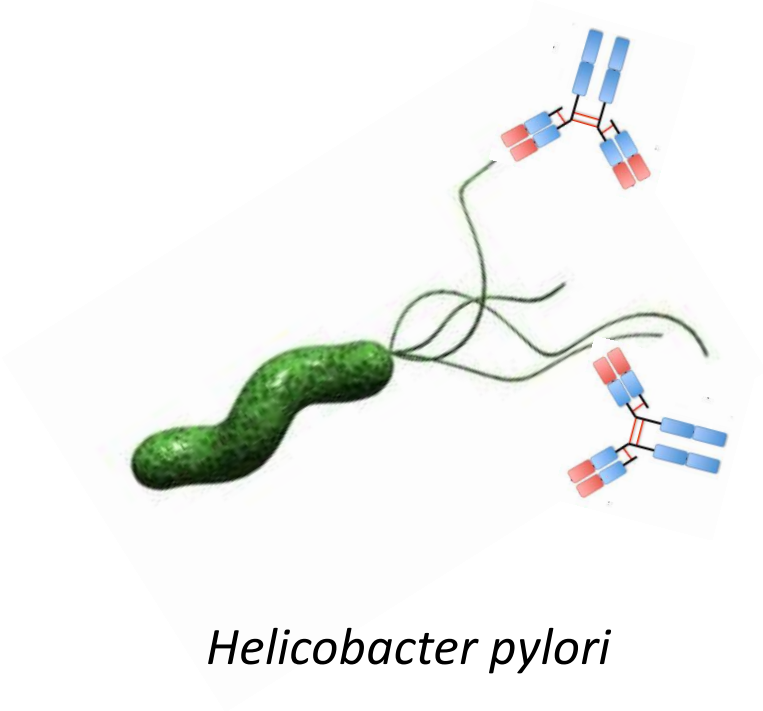
IgG

Functions

5. Immobilization of bacteria

paramecium





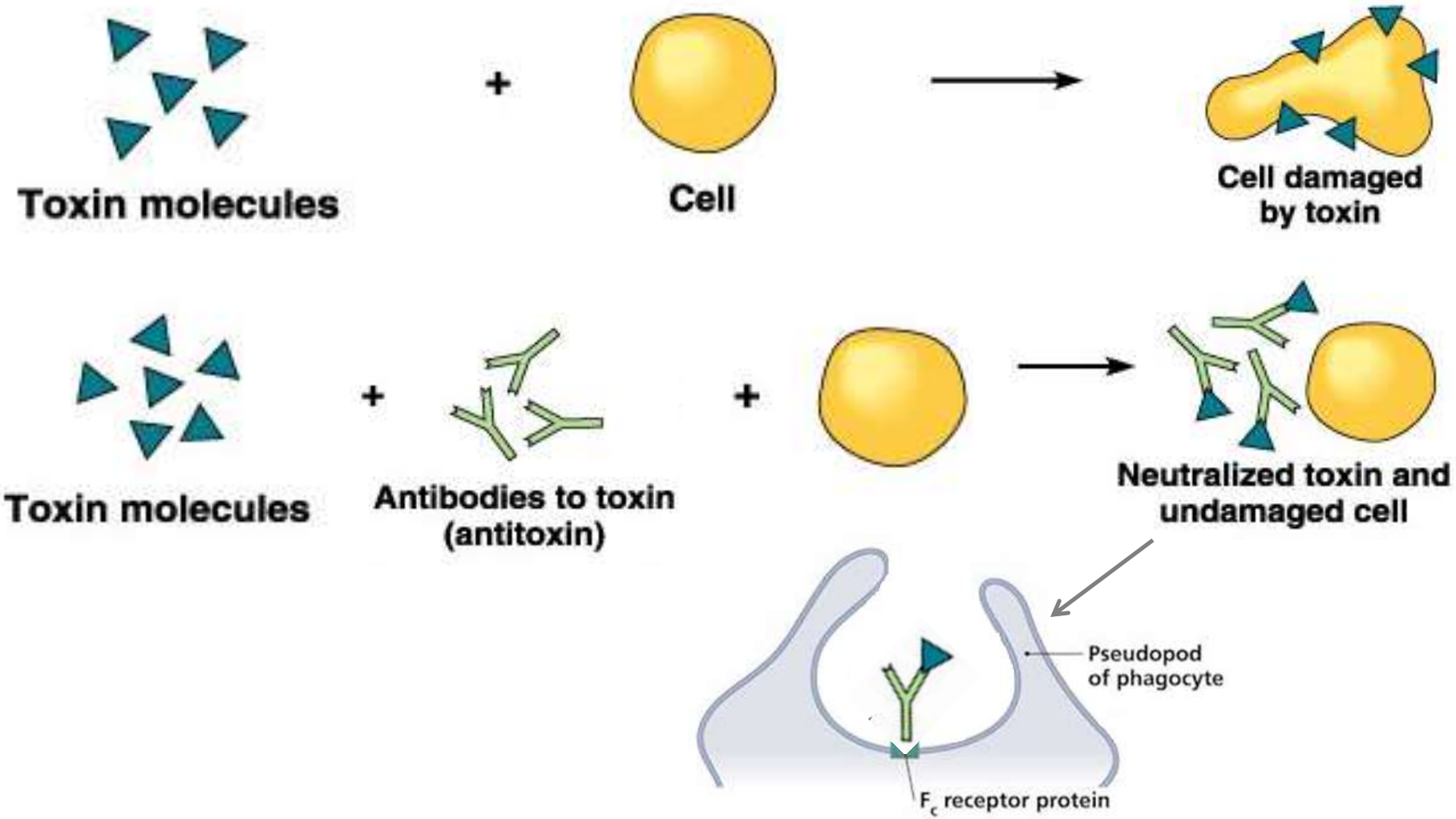
Helicobacter pylori

Antibodies against cilia and flagella leave them immotile

IgG

Functions

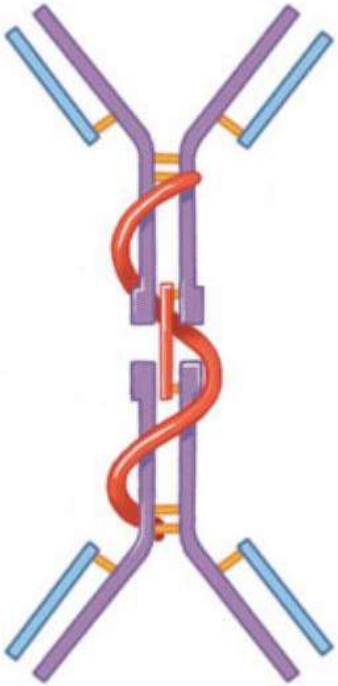
6. Neutralization toxins



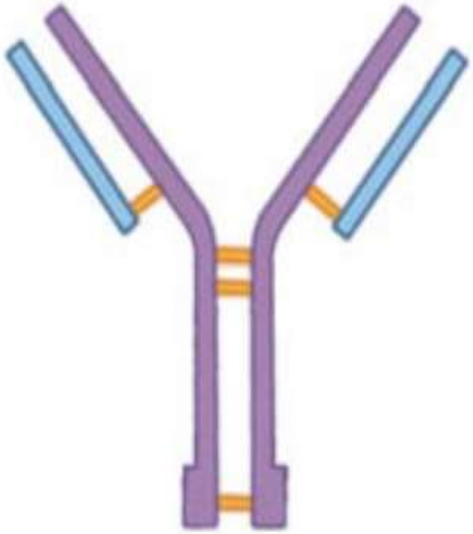
IgA

Forms

Plasma cells produced and released two forms of IgA



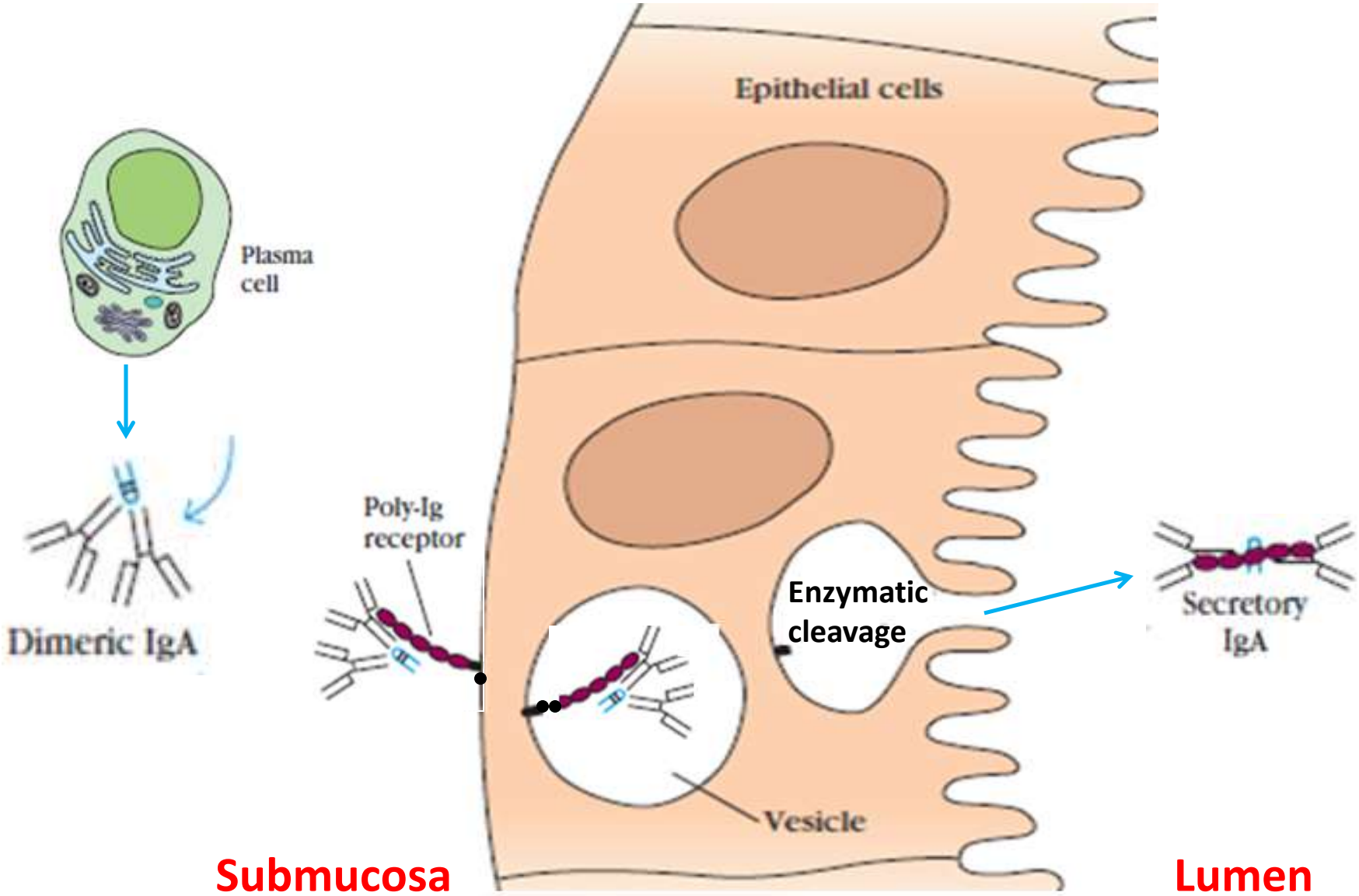
Dimeric IgA



Serum IgA: has a monomeric form with unknown function

IgA

Formation of secretory IgA

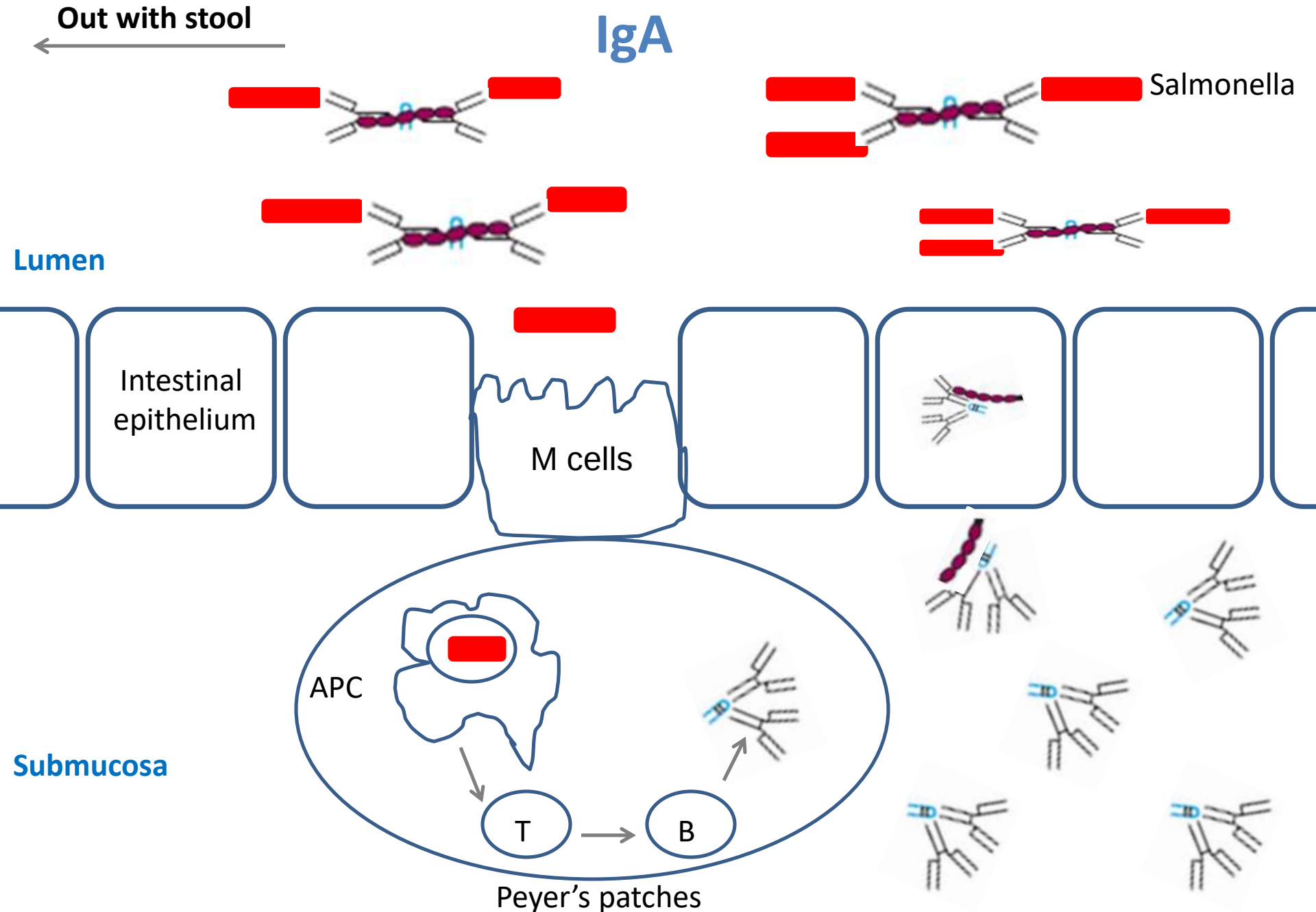


IgA

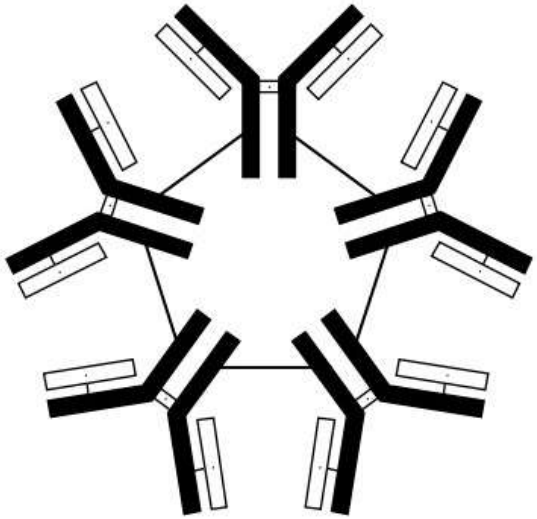
Functions:

- Provides neonates a protection against respiratory and GIT infections
- Efficient antiviral and agglutinating Ab
- Cannot fix complement
- Half-life 6 days

Antibody Classes (isotypes)



IgM



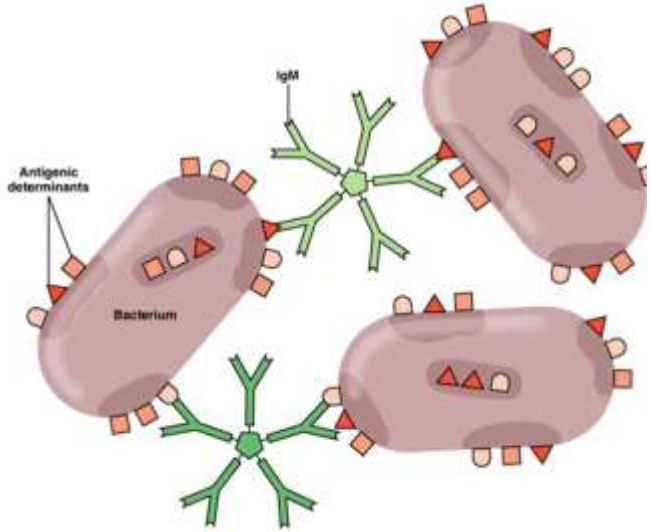
The first Ab produced in response to an antigenic stimulation

The half life is 10 days

First Ab produced after 5 months of gestation

Efficient agglutinating and complement fixing Ab

Cannot pass placenta



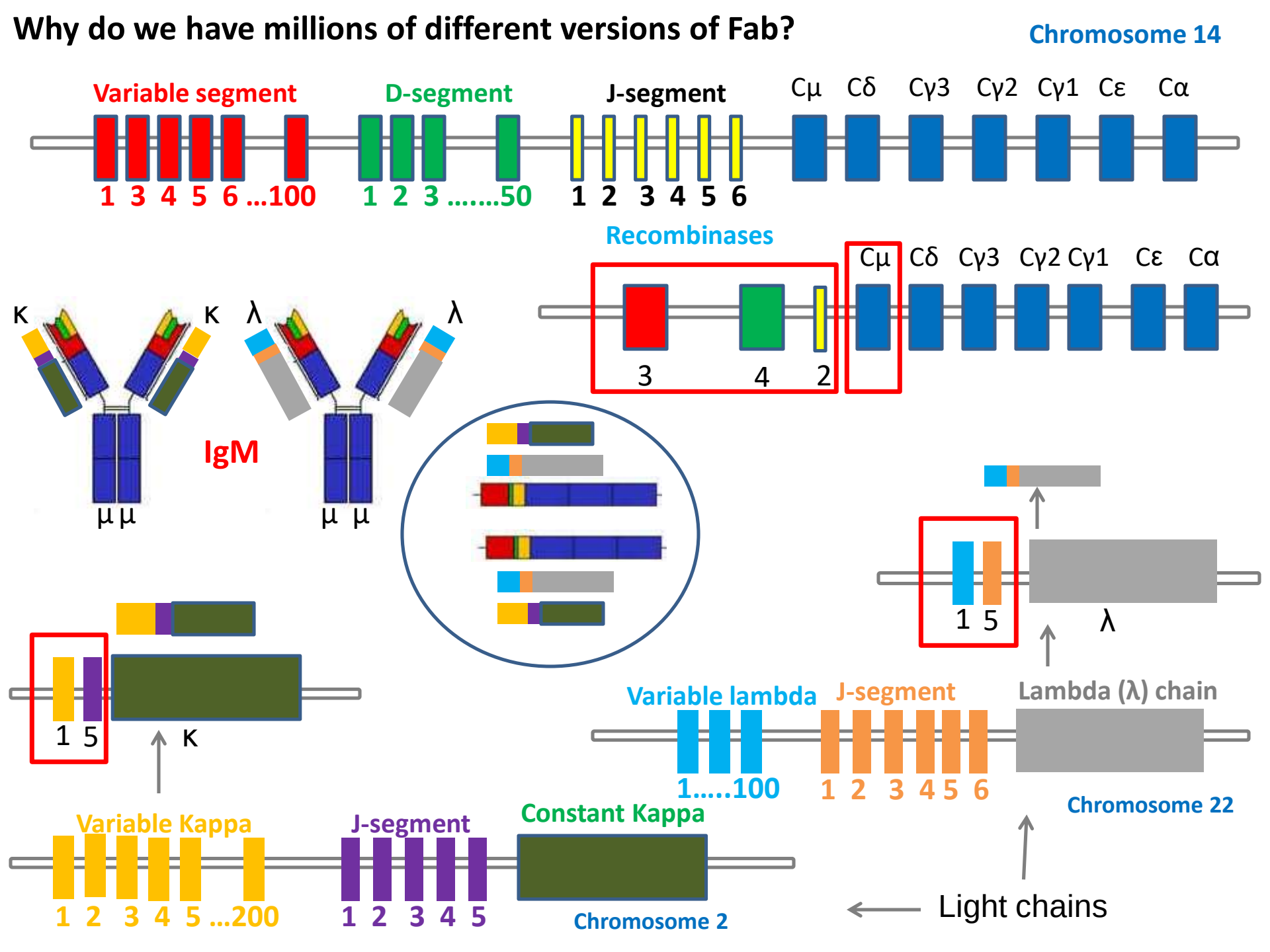
IgD

Have unknown protection function

IgE

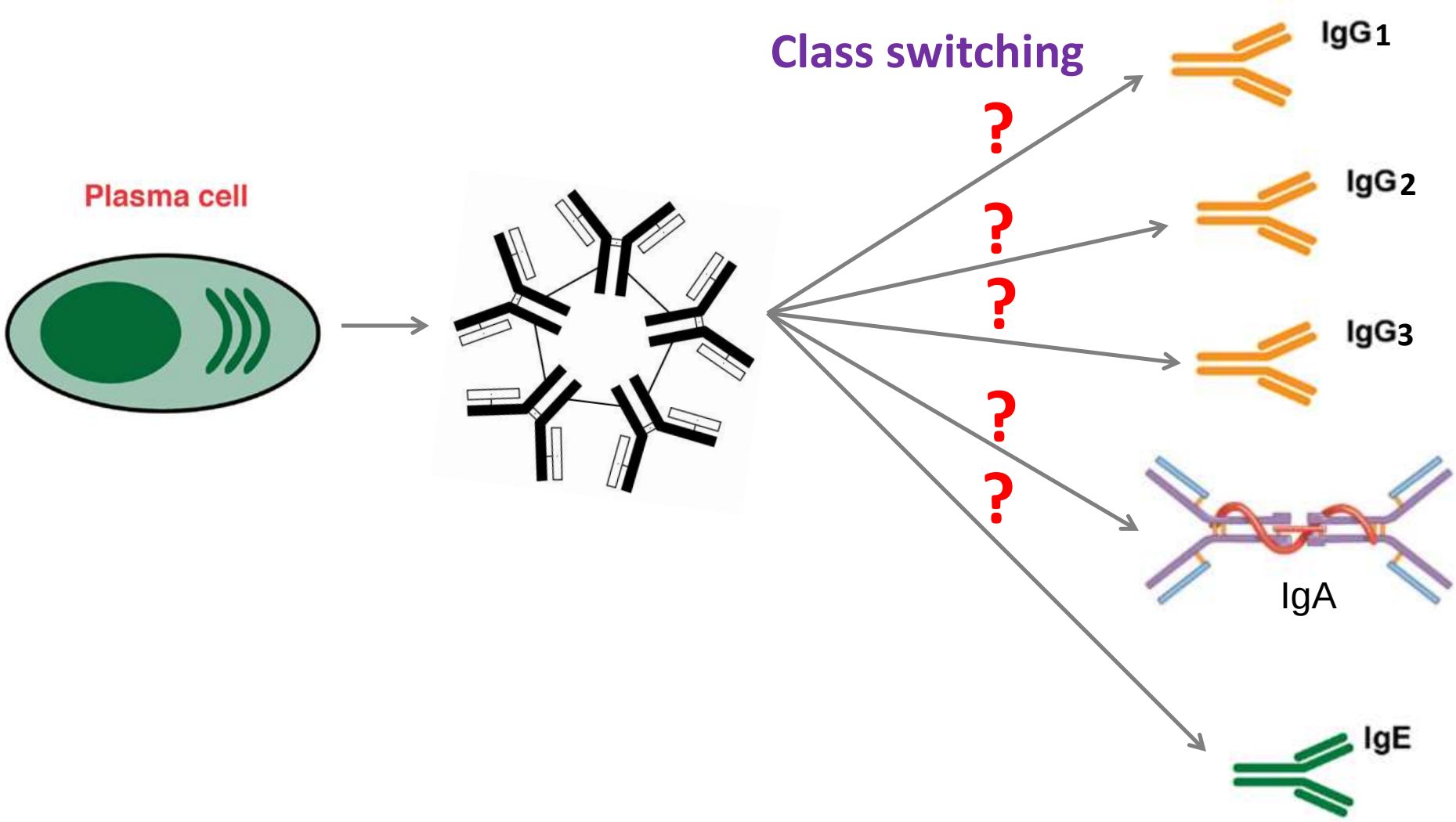
- Not agglutinating and complement fixing Ab
- Increasing levels of IgE in serum have been shown to occur during infections with certain parasites
- Has a high affinity receptor on the surface of eosinophils
- Associated with hypersensitivity or allergy reactions
- Half life is 2 days

Why do we have millions of different versions of Fab?

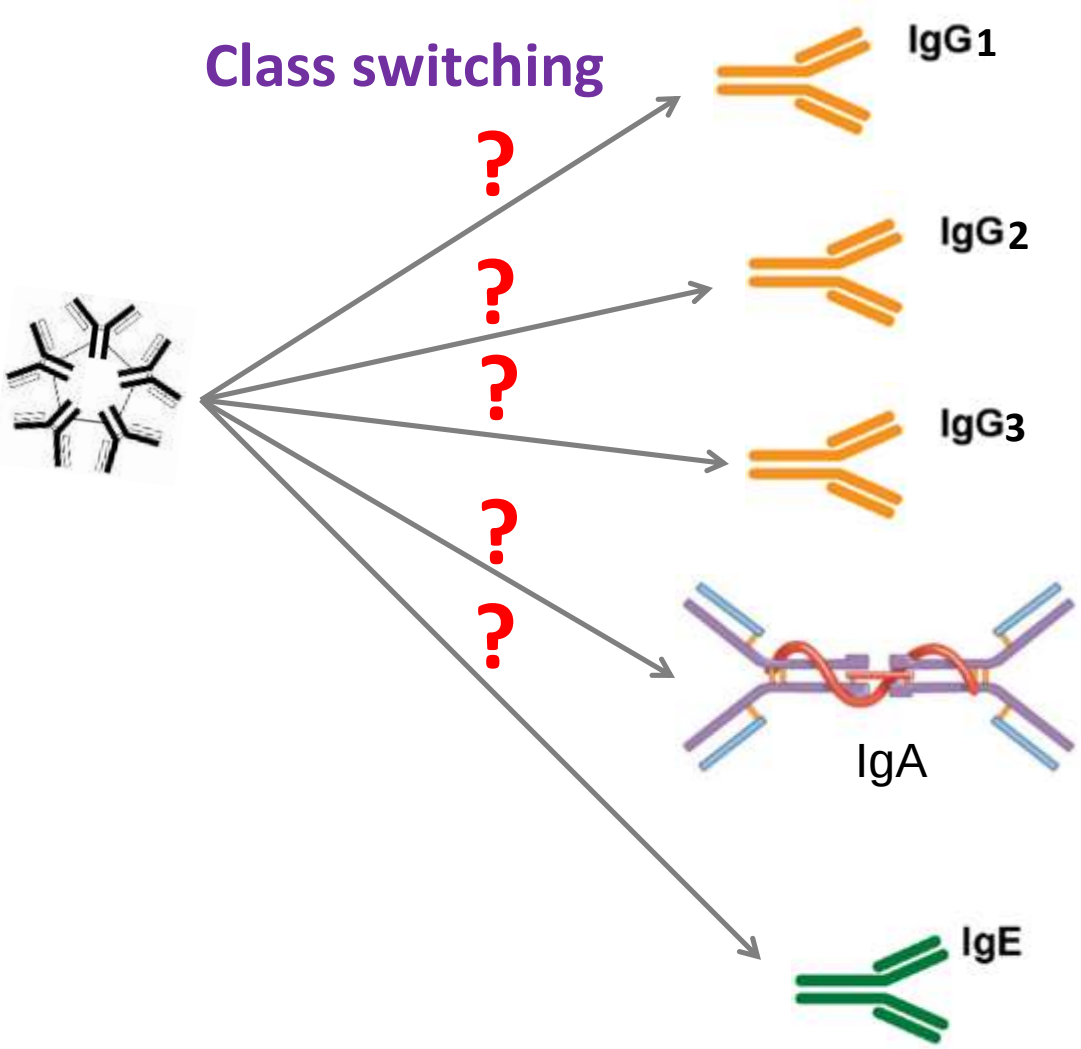


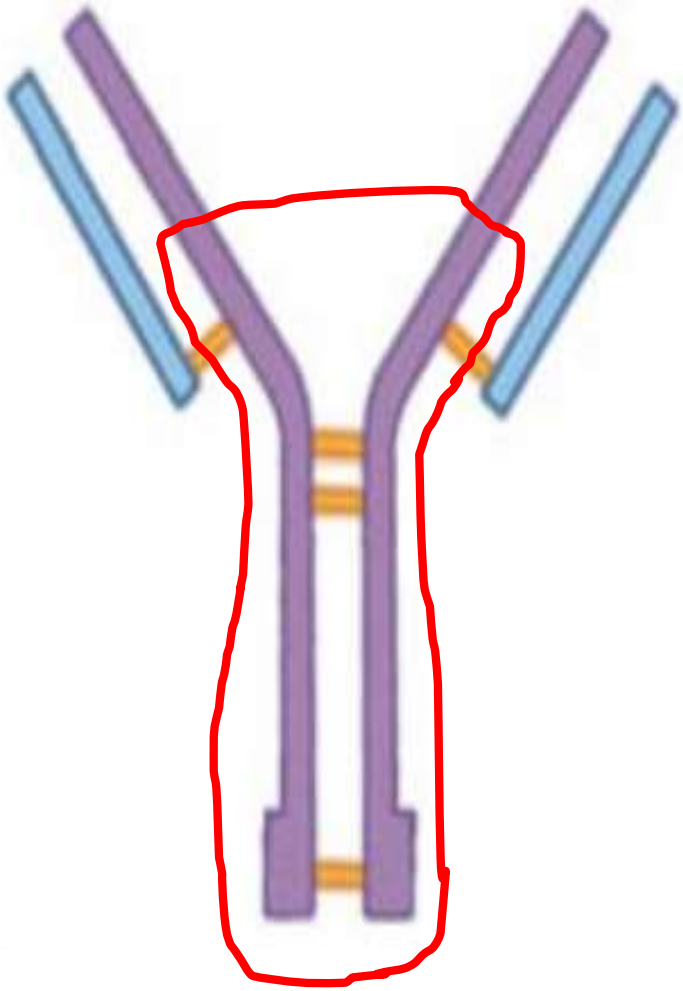
The process of class switching

How to produce more than type of antibodies from one response?



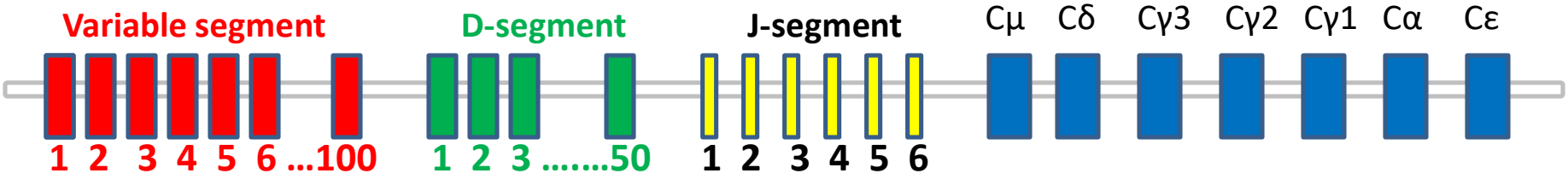
The process of class switching

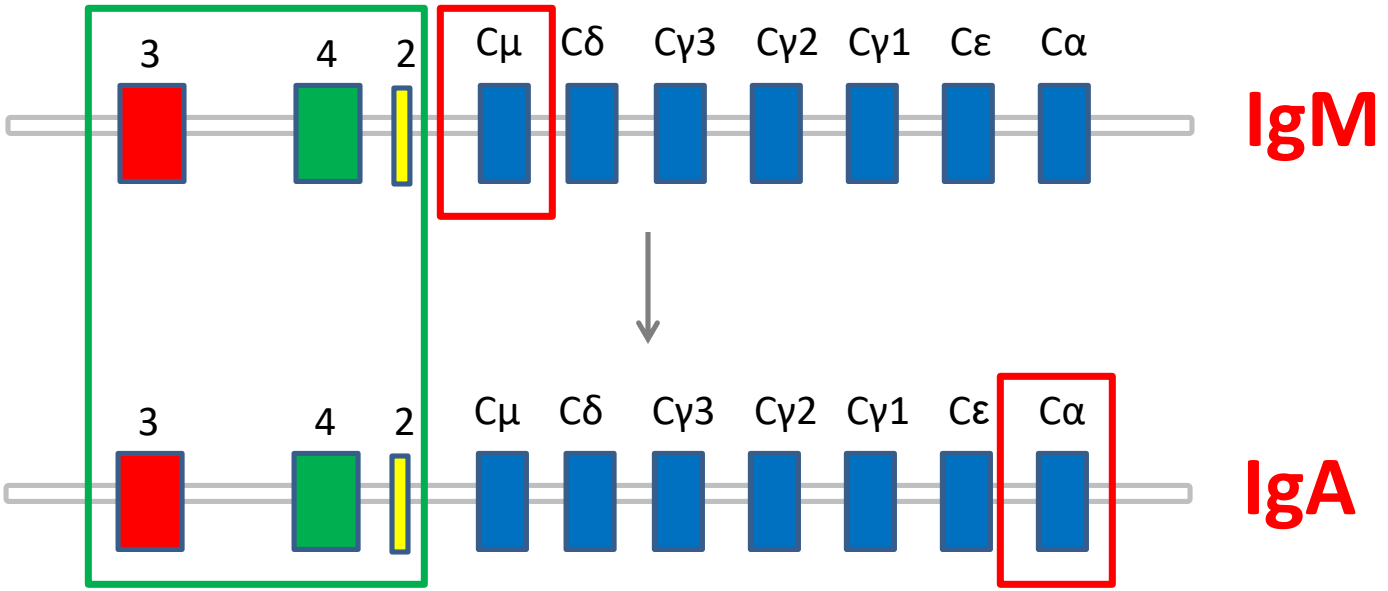




Class switching is determined only by change in the type of the constant region

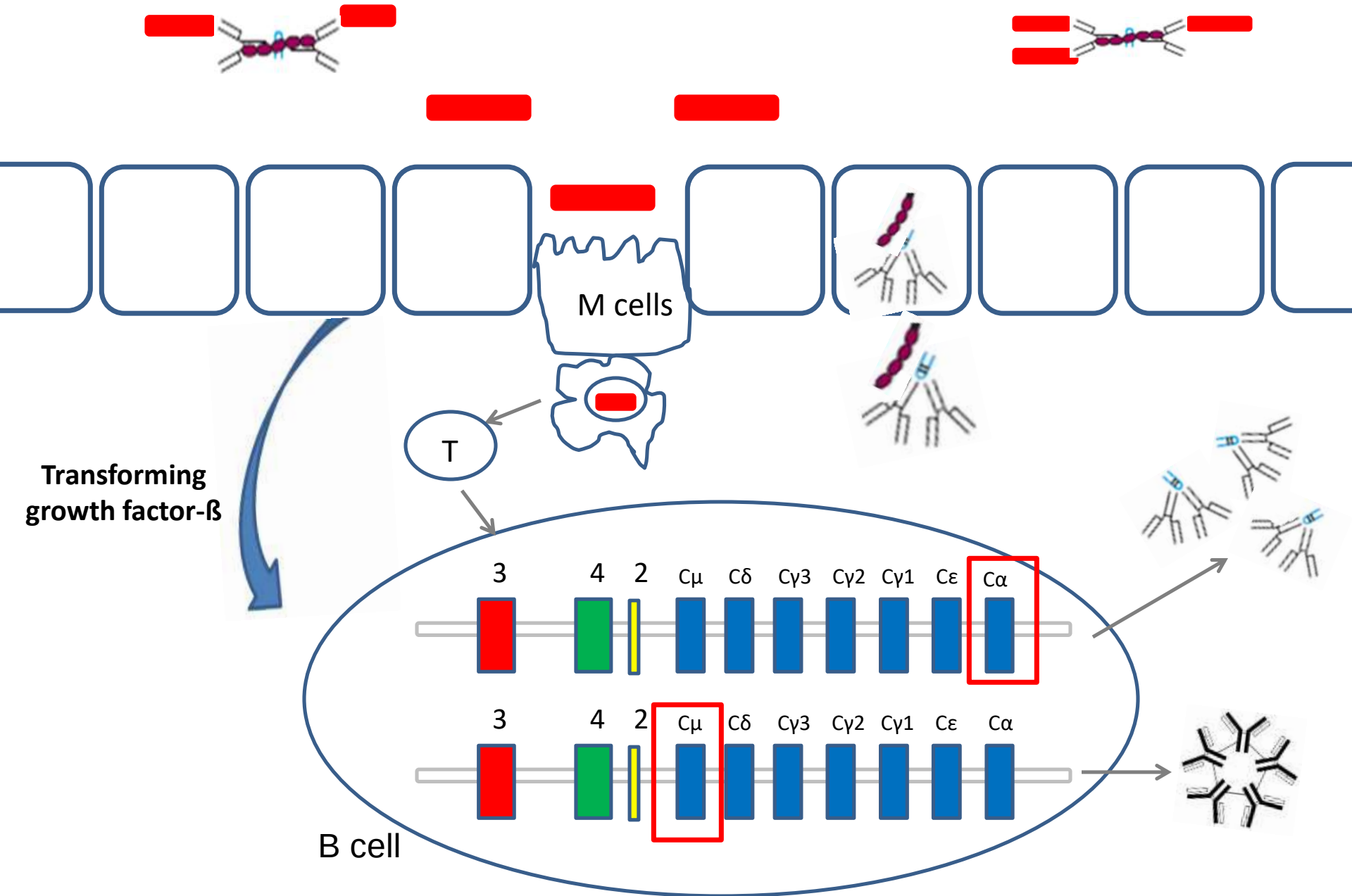
The process of class switching



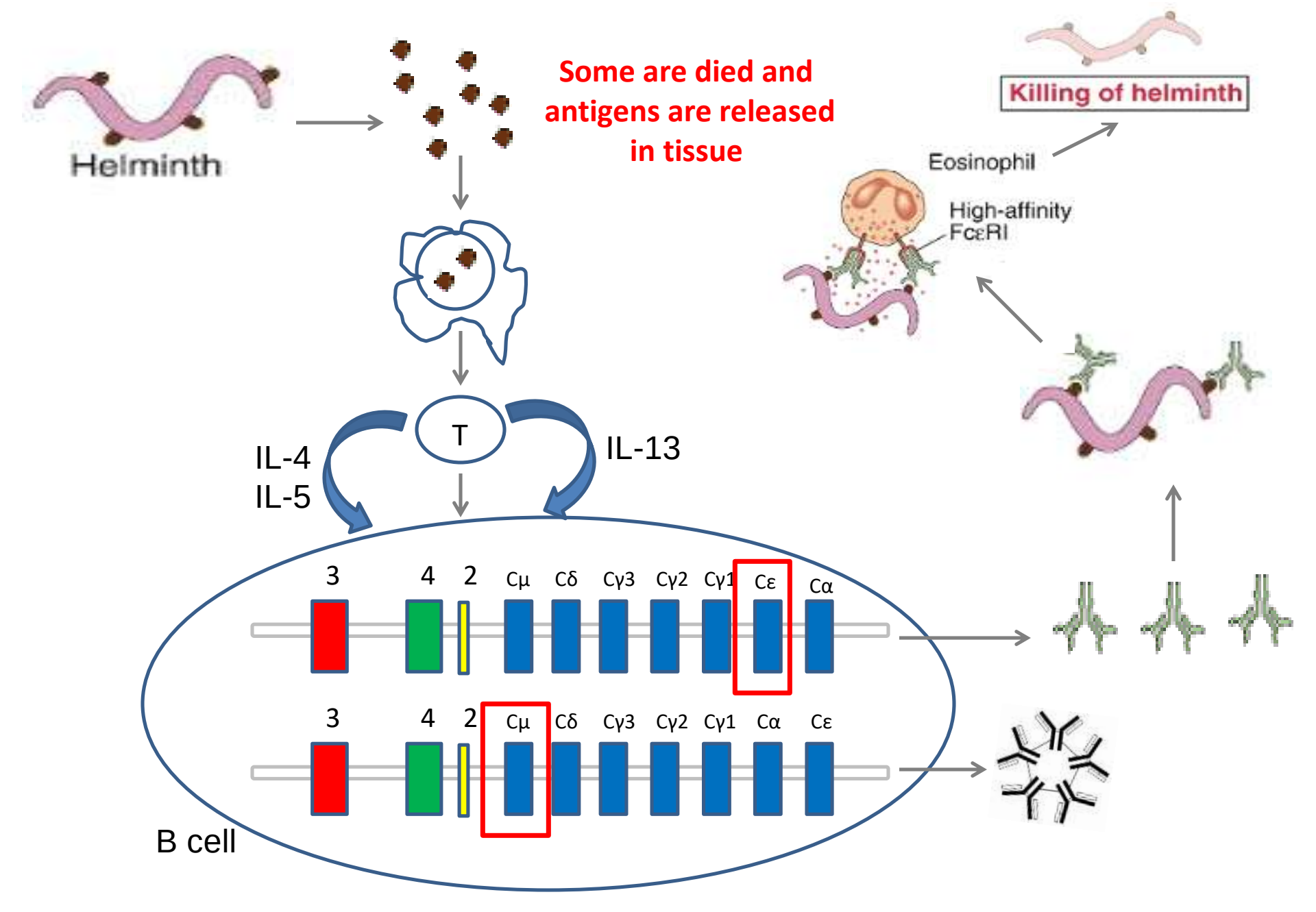


More than one type of antibodies from one response

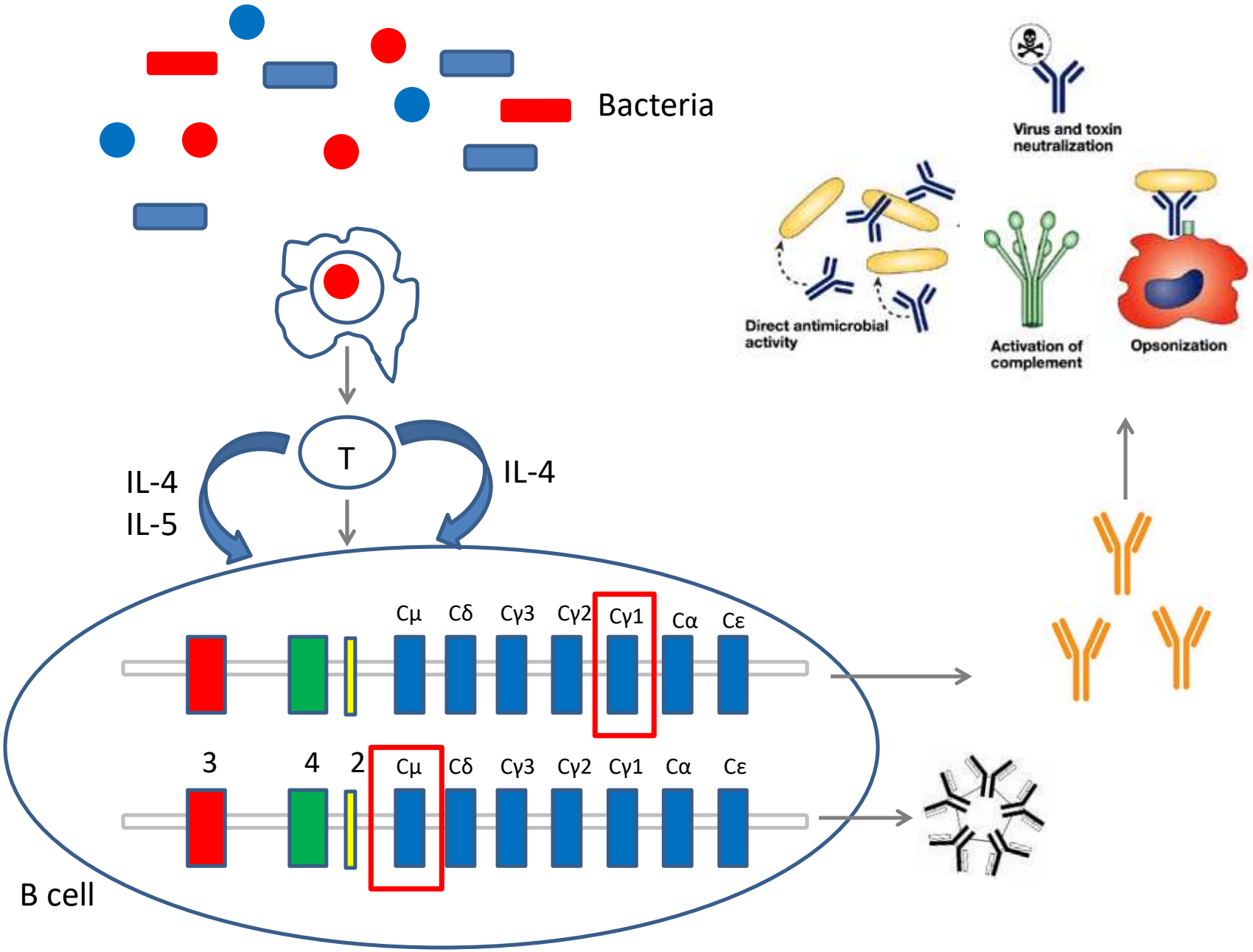
IgM to IgA


M cells
T
Transforming growth factor-ß
3
4
2
Cμ
Cδ
Cγ3
Cγ2
Cγ1
Cε
Cα
3
4
2
Cμ
Cδ
Cγ3
Cγ2
Cγ1
Cε
Cα
B cell

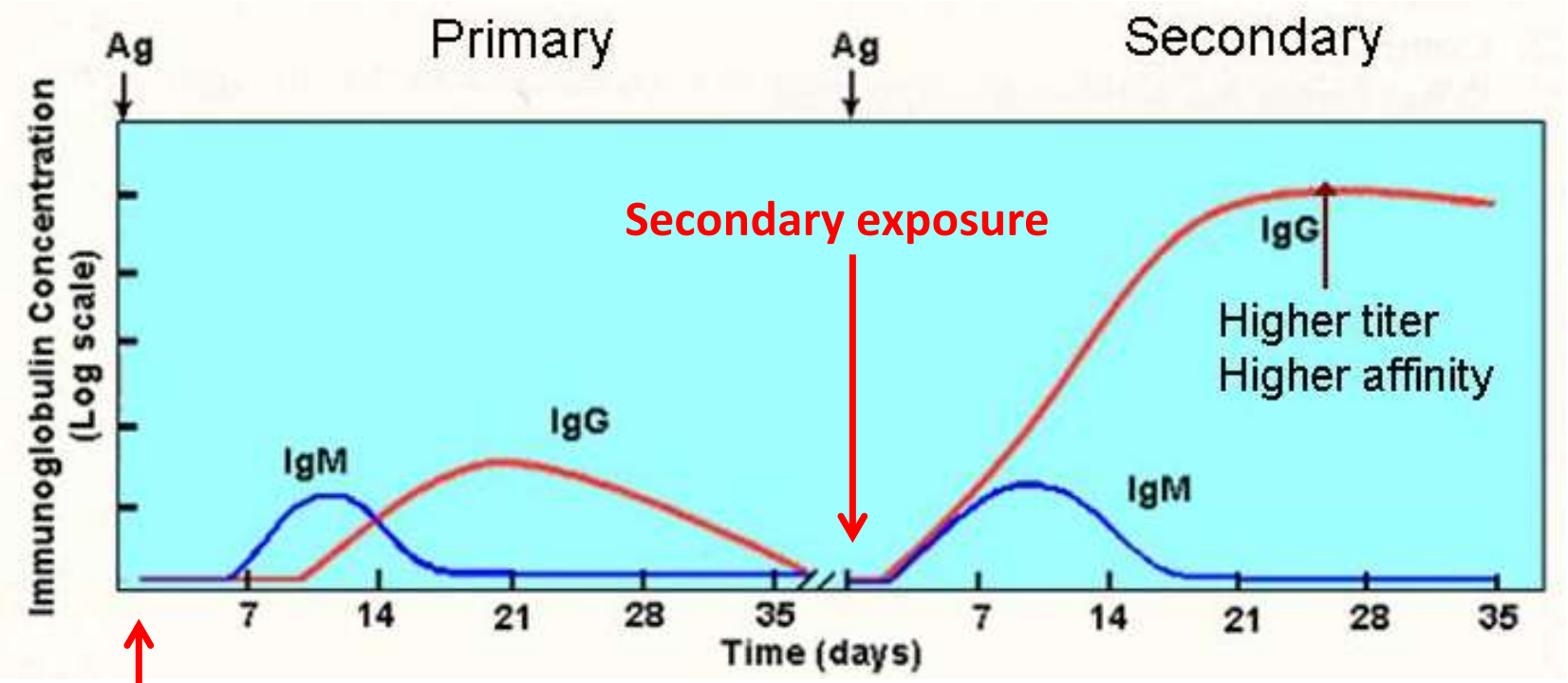
IgM to IgE


Helminth
Some are died and antigens are released in tissue
Killing of helminth
Eosinophil
High-affinity FcεRI
T
IL-4
IL-5
IL-13
3
4
2
Cμ
Cδ
Cγ3
Cγ2
Cγ1
Cε
Cα
B cell

IgM to IgG1


Bacteria
Virus and toxin neutralization
Direct antimicrobial activity
Activation of complement
Opsonization
T
IL-4
IL-5
IL-4
Cμ
Cδ
Cγ3
Cγ2
Cγ1
Cα
Cε
3
4
2
Cμ
Cδ
Cγ3
Cγ2
Cγ1
Cα
Cε
B cell

Kinetics of antibody response following immunization



Primary exposure