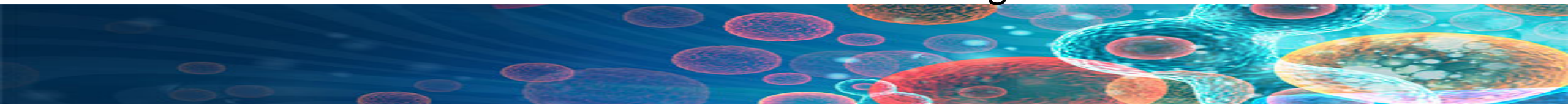


Antibody Mediated Immunity



Objectives

- To describe B-cells as the mediators of humoral immunity, (antibody-mediated immunity)
2. To describe activation of B-cells which involve:
 - Antigen recognition
 - T-dependent & T-independent antigens
 - Requirement for T-helper cells
 3. To explain clonal selection, clonal expansion & generation of plasma cells & memory cells
 4. To describe primary & secondary immune responses
 5. To describe the structure & function of Immunoglobulins

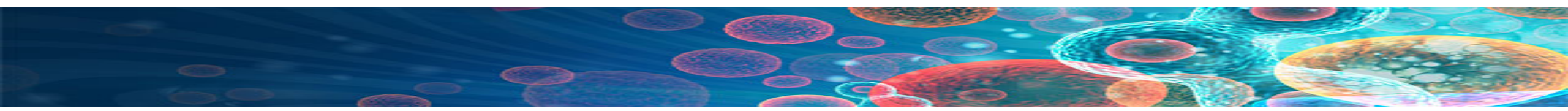




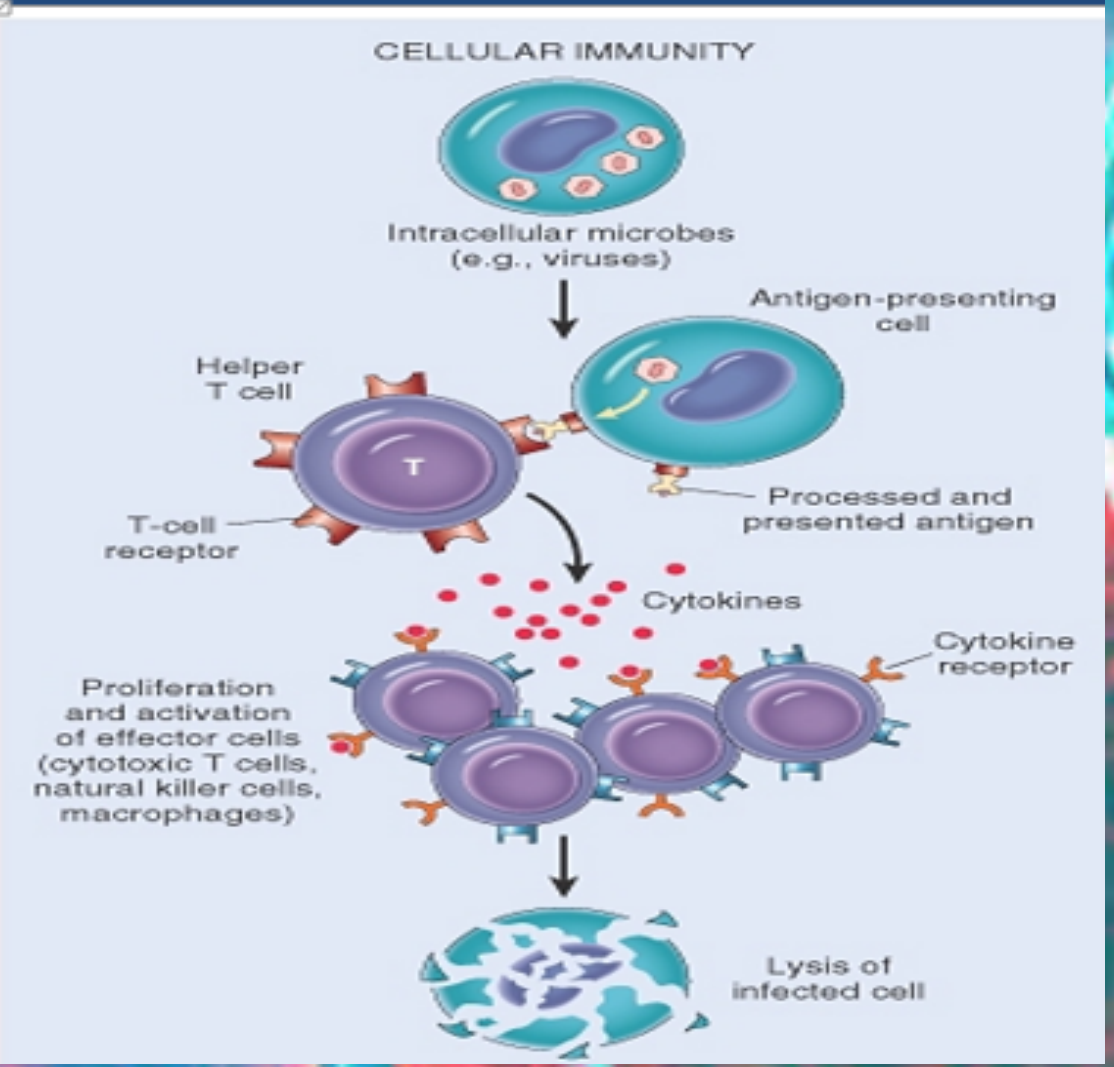
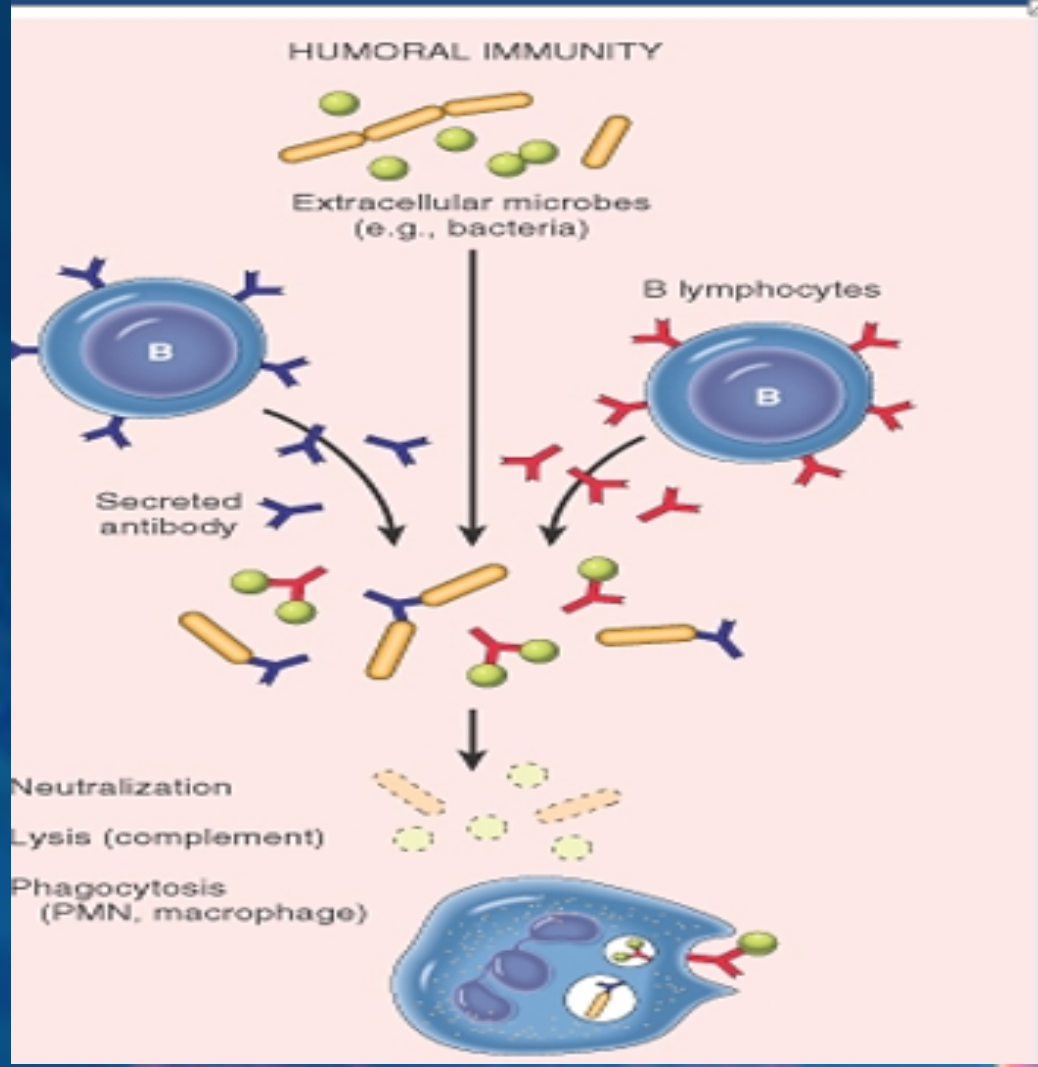
- Humoral immunity is named because it involve substances found in the:

(**Humours or body fluids**)

- The Humoral Immune Response is the aspect of immunity that is mediated by secreted **antibodies**.



Nature of antigen determine type of response either **EXTRACELLULAR** or **INTRACELLULAR**





Activation of B cells by antigens

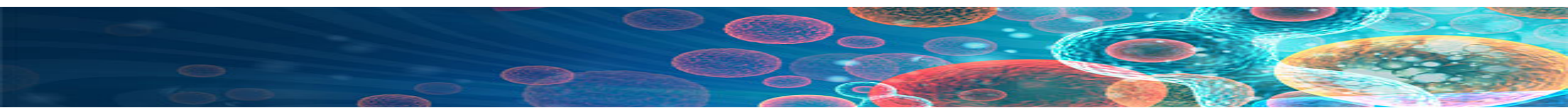
There are two types of antigens:

1. T- dependant:

- **Requires** T helper cells .

2. T- independent antigens:

- **Don't require** T helper cells.





T-dependent :

- They depend on T-cells to produce antibodies .
- Macrophages recognize antigens & presents them to T-helper cells.
- T-dependant antigens are mainly **proteins** on viruses, bacteria & other foreign materials.

T-helper cells are
required for :

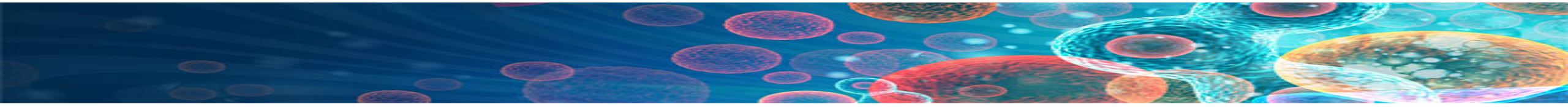
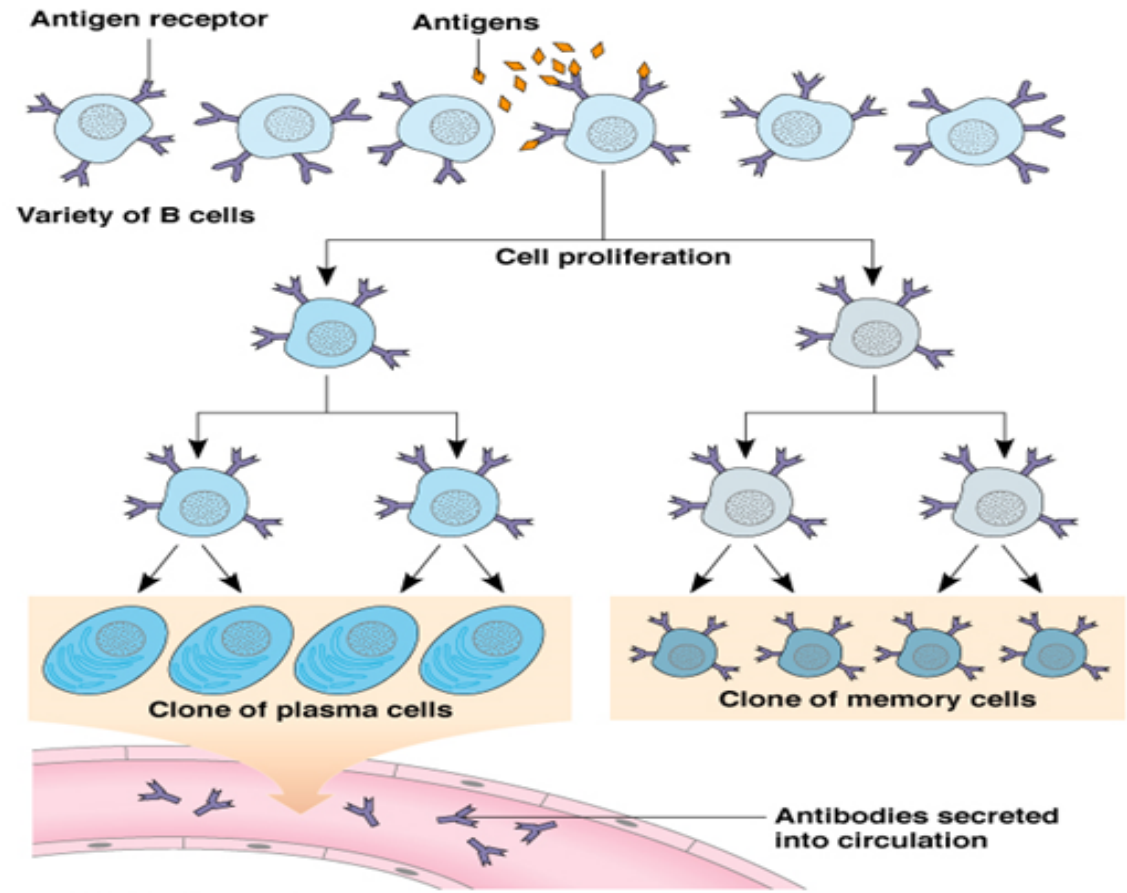
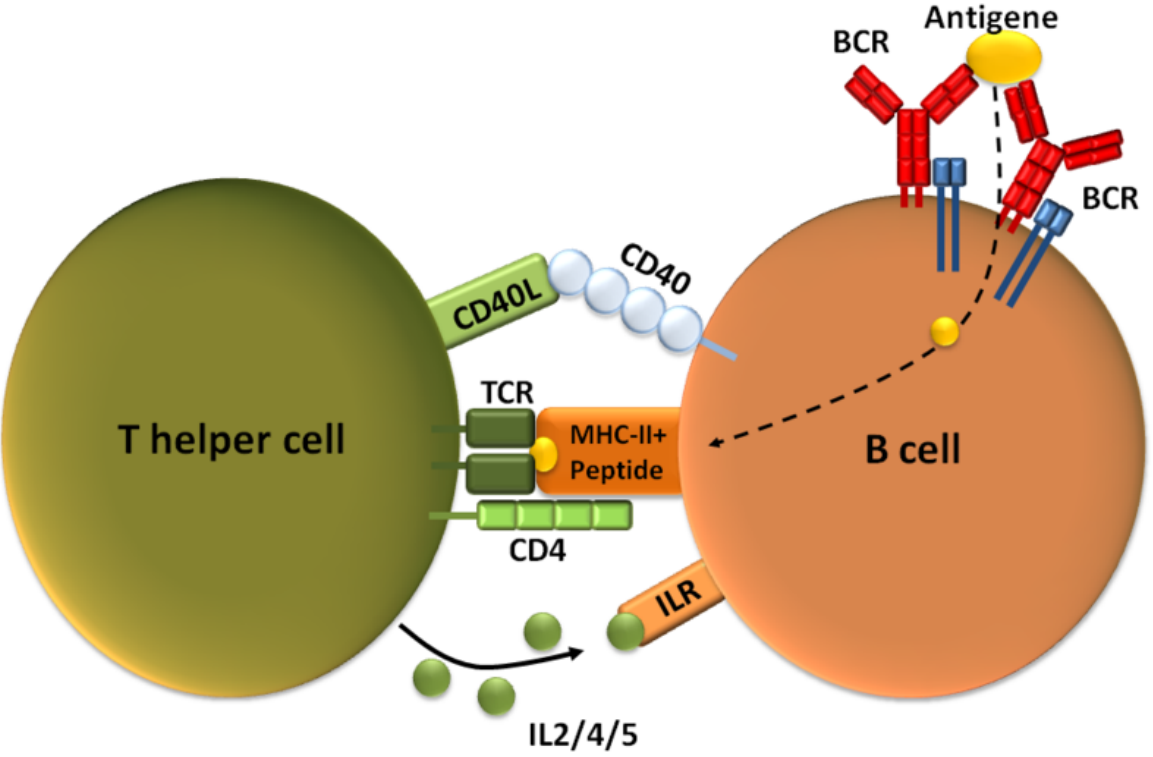
Antibody production by B-cells .

stimulate B-cells specific for
that antigen to become
plasma cells.

T- independent antigens:

1. They do not depend on T-cells to produce antibodies.
2. B-cells do not require T-helper cells to produce antibody.
3. Antigens are mainly **polysaccharides or lipopolysaccharides** with repeating subunits. e.g. (**bacterial capsules**)
4. Immune responses are weak compared to T-dependant responses.

Clonal selection and clonal proliferation





Clonal selection and clonal expansion

Click for further explanation



- **Clone:**

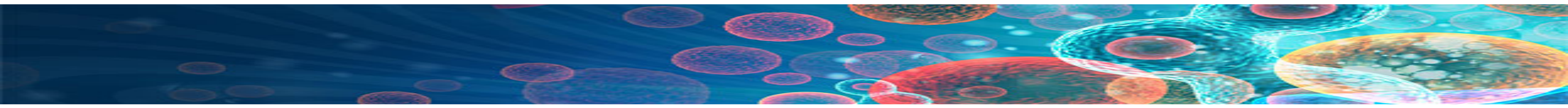
A group of identical cells derived from a single cell.

- **Clonal Selection:**

A hypothesis which states that an individual lymphocyte (specifically, a B cell) expresses receptors specific to the distinct antigen, determined before the antibody ever encounters the antigen. Binding of Ag to a cell activates the cell, causing a proliferation of clone daughter cells.

- **Clonal Expansion:**

Production of daughter cells all arising originally from a single cell. In a clonal expansion of lymphocytes, all progeny share the same antigen specificity.



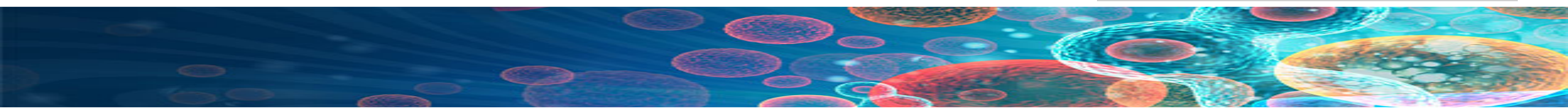
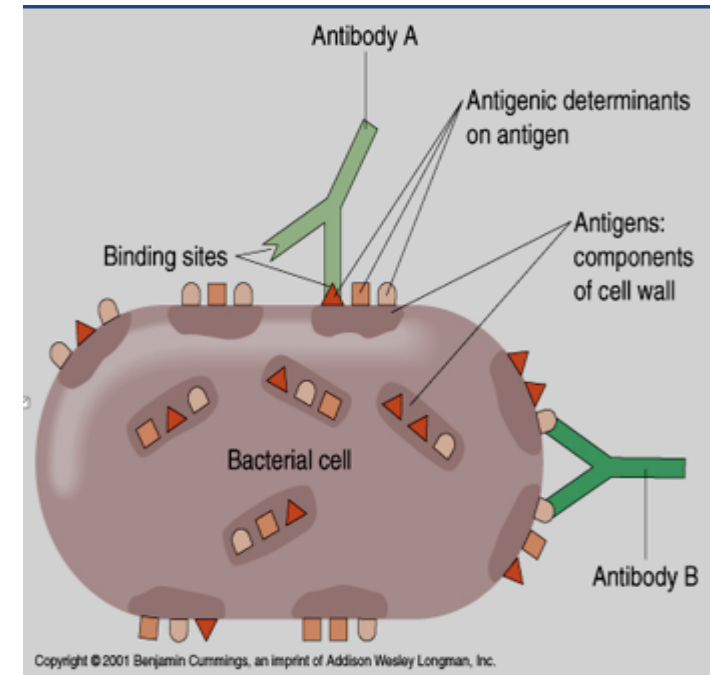
Antigens

- “Self” versus “non-self”
- T cells and B cells removed if they recognize self proteins

Antigens are mostly proteins or polysaccharides

Antigenic determinants (**epitopes**)

Each bacterial cell has many different epitopes.





Antibodies

- *What are they ?*

Antibodies are immunoglobulins (Ig) with specific functions.

- *Where are they found ?*

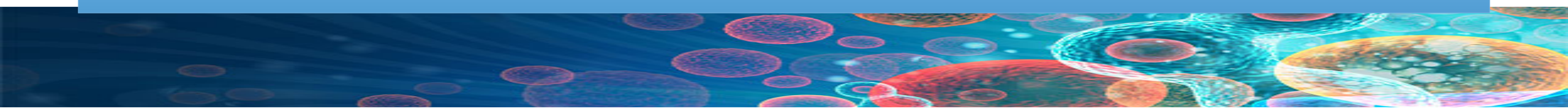
Antibodies are found in extracellular fluids (**blood plasma, lymph, mucus, etc.**) and on **the surface of B cells.**

- *How do they work ?*

Antibodies bind to specific sites on antigen surfaces and perform protective functions by different mechanisms.

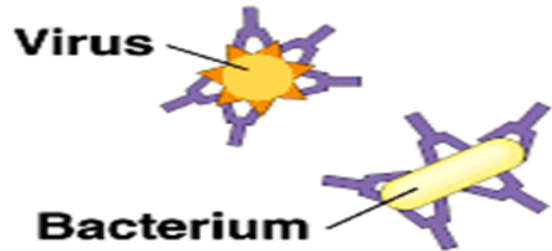
- Note: the part of the antigen that interacts with the antibodies is called **epitopes**.
- Each antigen has its own Specific antibody.

There is a specific antibody for each antigen that stimulates an immune response.

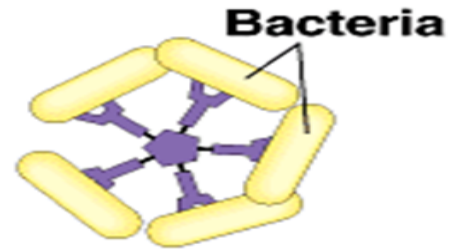


Binding of antibodies to antigens inactivates antigens by

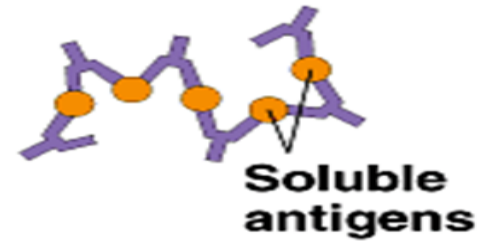
Neutralization
(blocks viral binding sites;
coats bacteria and/or
opsonization)



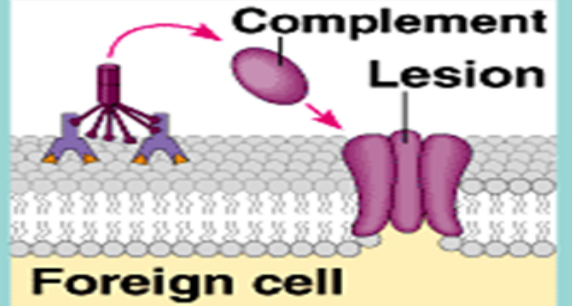
**Agglutination of
antigen-bearing
particles, such as
microbes**



**Precipitation of
soluble antigens**



**Complement fixation
(activation
of complement)**



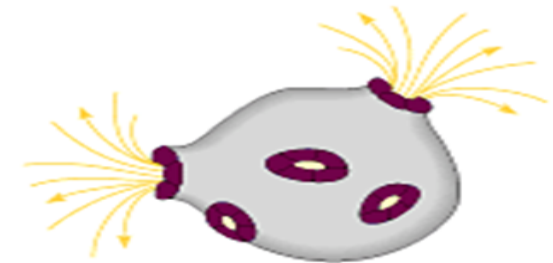
Enhances

Phagocytosis



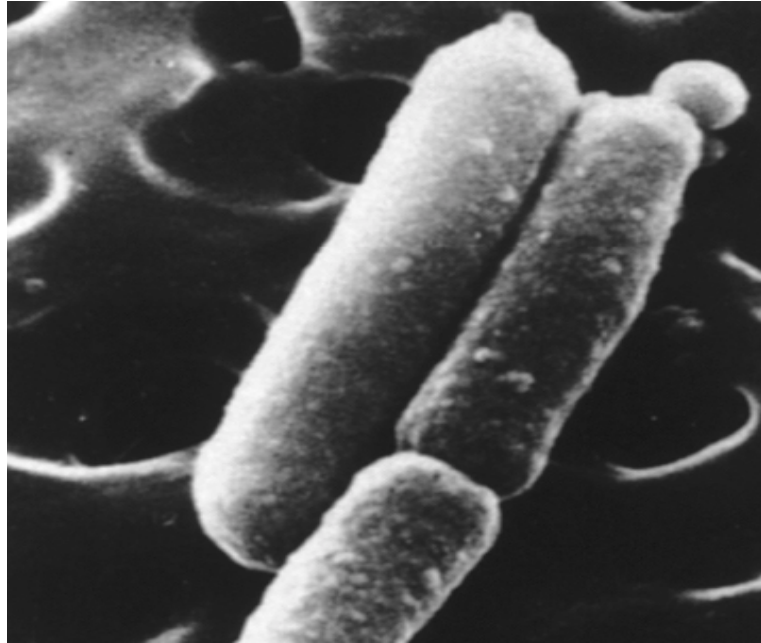
Leads to

Cell lysis





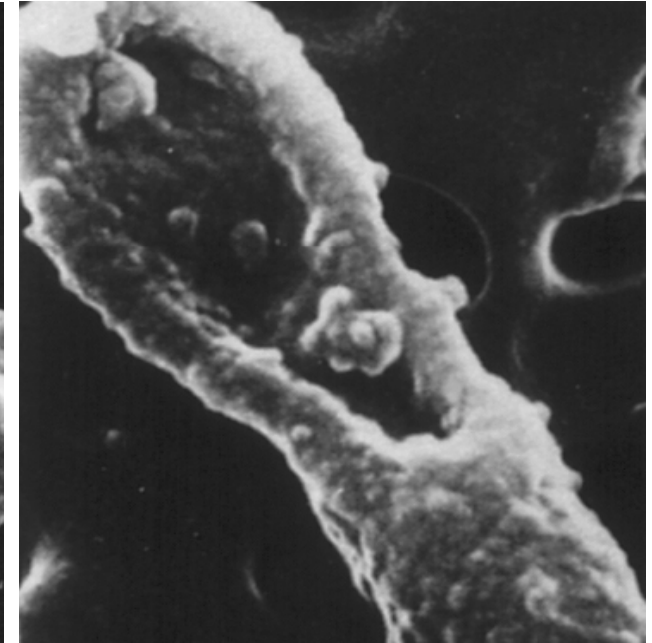
Electron micrographs of the effect of antibodies and complement upon bacteria.



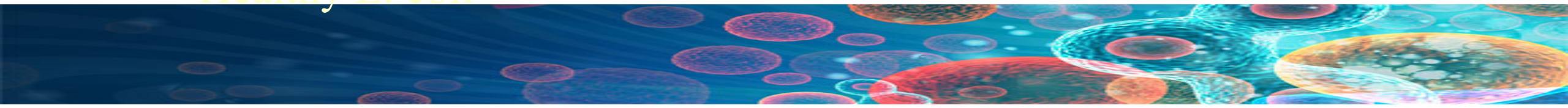
Healthy E. coli



Antibody + complement-mediated damage to E. coli

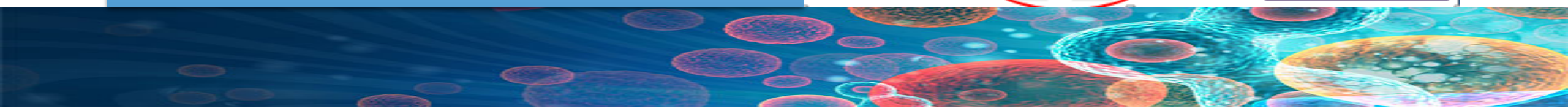
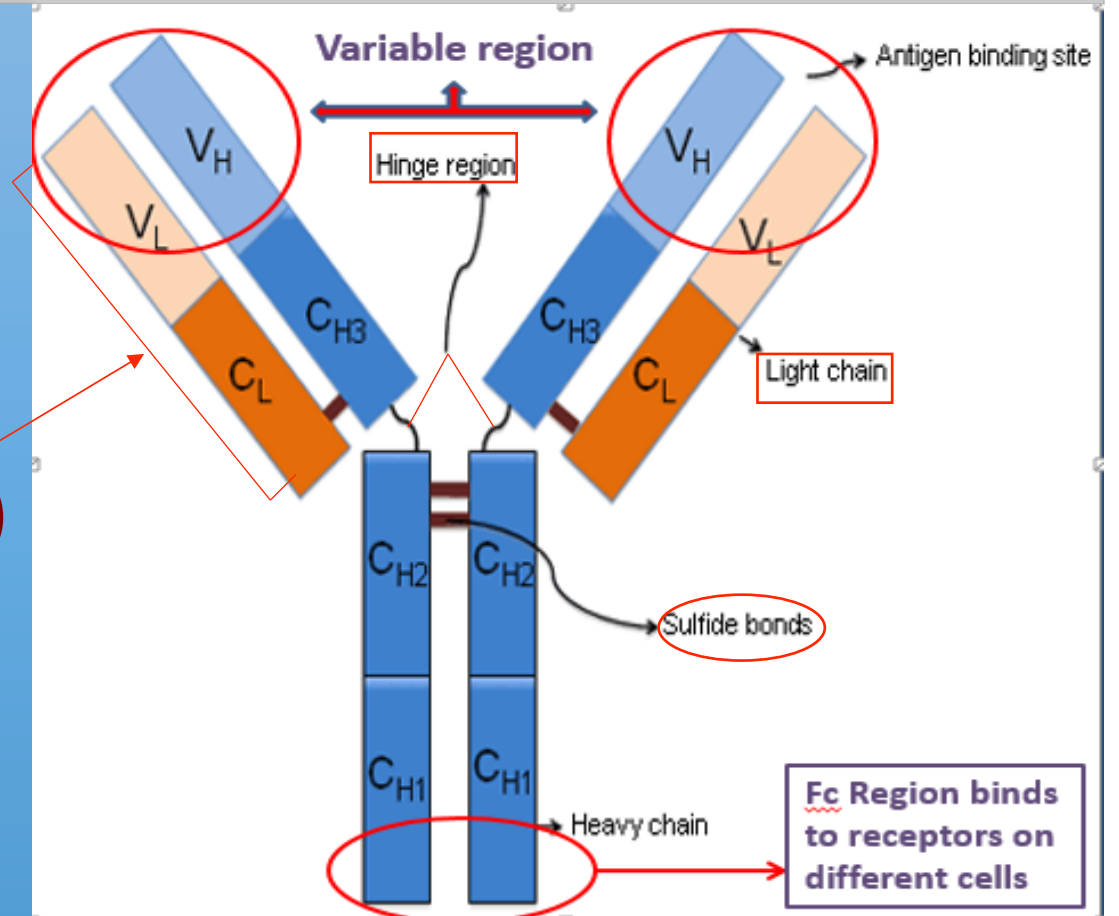


Healthy E. coli



Antibody structure and function

1. Made up of four polypeptides (amino acid chains).
2. Two longer and larger (heavy chains) and the other two shorter and smaller (light chains)
3. Have the shape of the letter "Y".



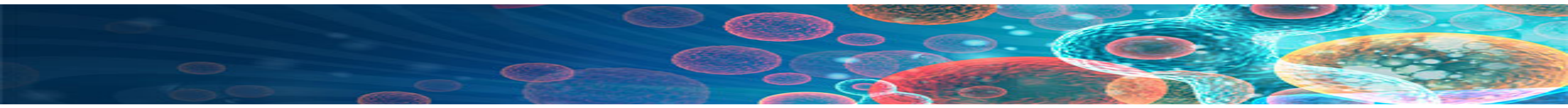
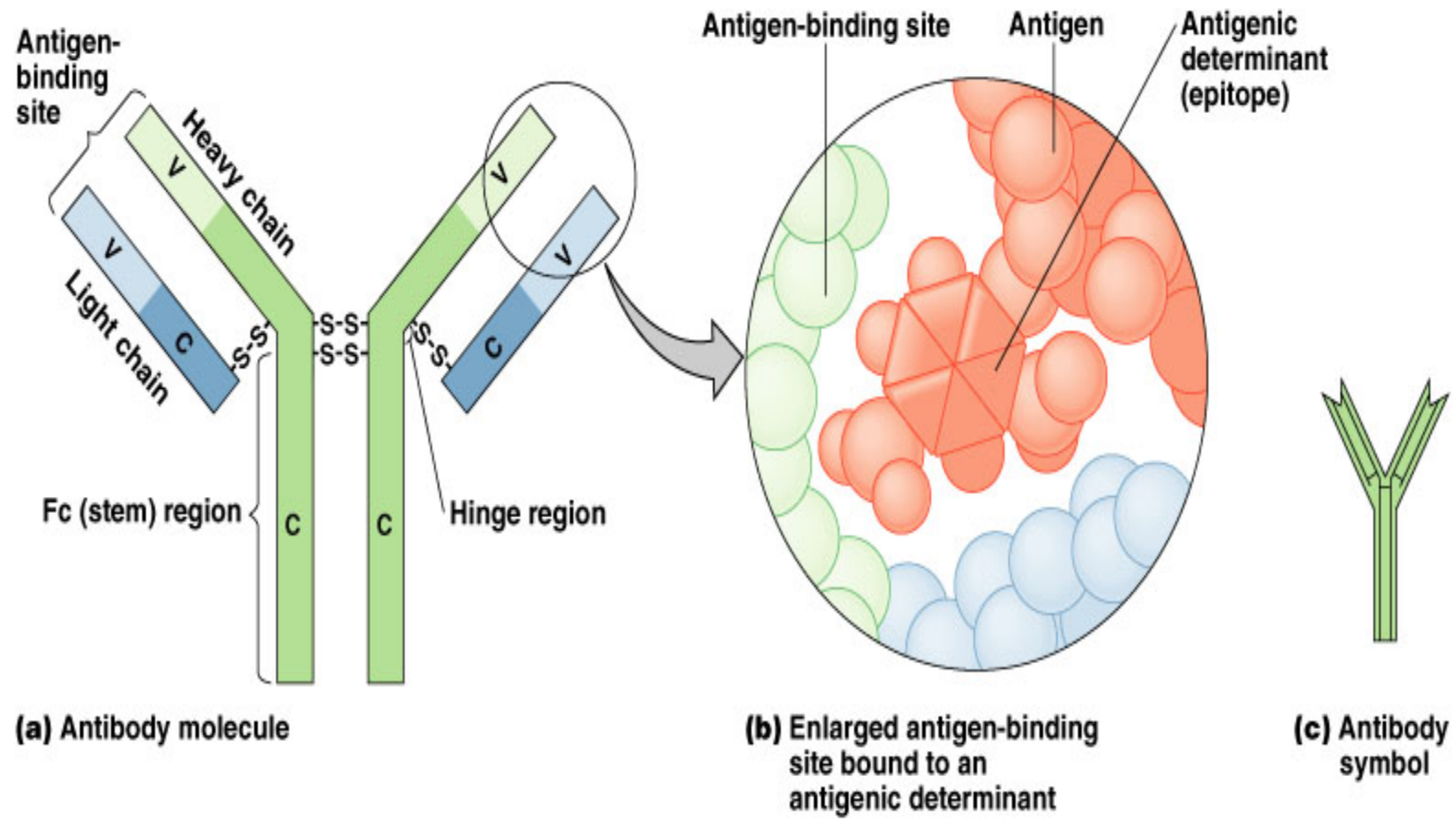
Antibody structure and function

- Variable region

has the potential to bind with particular classes of antigens. Once a raw antibody is stimulated to fit onto a specific antigen, it can then react with **ONLY** that antigen .

- This is known as SINGLE SPECIFICITY.
- Can fit as precisely as a lock-and-key to an antigen.
- Constant regions.
- Fc region (stem) - can bind complement





Antibody structure and function

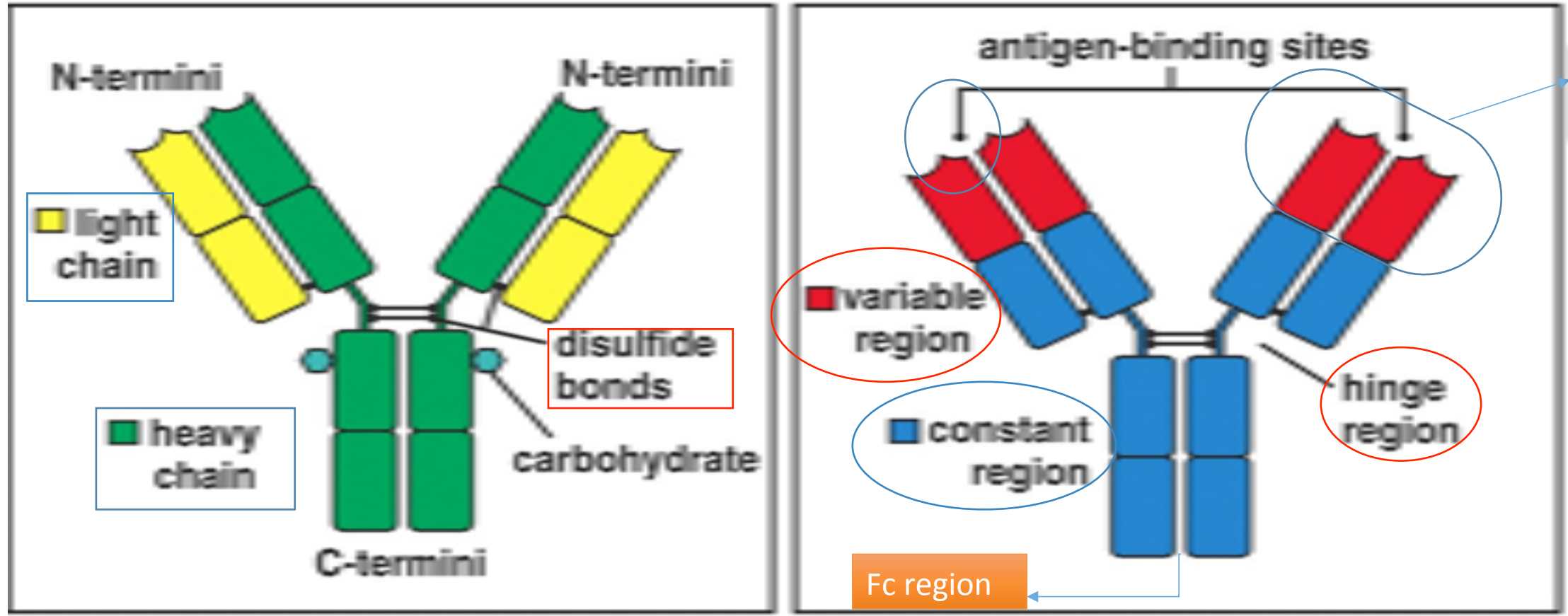
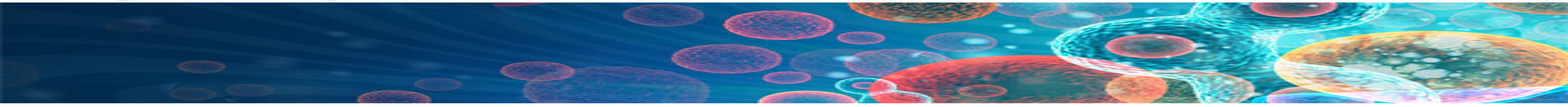


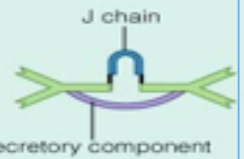




Figure 2-2: The Immune System, 2/e (© Garland Science 2005)



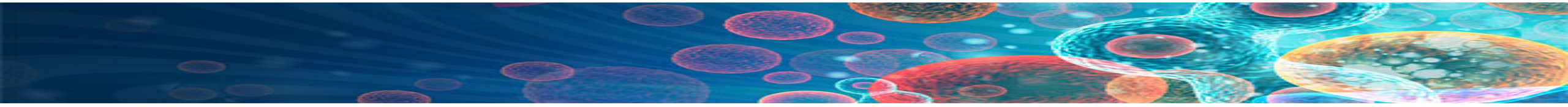
Characteristics	IgG	IgM	IgA	IgD	IgE
Structure	Monomer 	Pentamer 	Dimer (with secretory component) 	Monomer 	Monomer 
Percentage of total serum antibody	80%	5–10%	10–15%*	0.2%	0.002%
Location	Blood, lymph, intestine	Blood, lymph, B cell surface (as monomer)	Secretions (tears, saliva, mucus, intestine, milk), blood, lymph	B cell surface, blood, lymph	Bound to mast and basophil cells throughout body, blood
Molecular weight	150,000	970,000	405,000	175,000	190,000
Half-life in serum	23 days	5 days	6 days	3 days	2 days
Complement fixation	Yes	Yes	No [†]	No	No
Placental transfer	Yes	No	No	No	No
Known functions	Enhances phagocytosis; neutralizes toxins and viruses; protects fetus and newborn	Especially effective against microorganisms and agglutinating antigens; first antibodies produced in response to initial infection	Localized protection on mucosal surfaces	Serum function not known; presence on B cells functions in initiation of immune response	Allergic reactions; possibly lysis of parasitic worms

Most abundant

Only in IgG & IgM

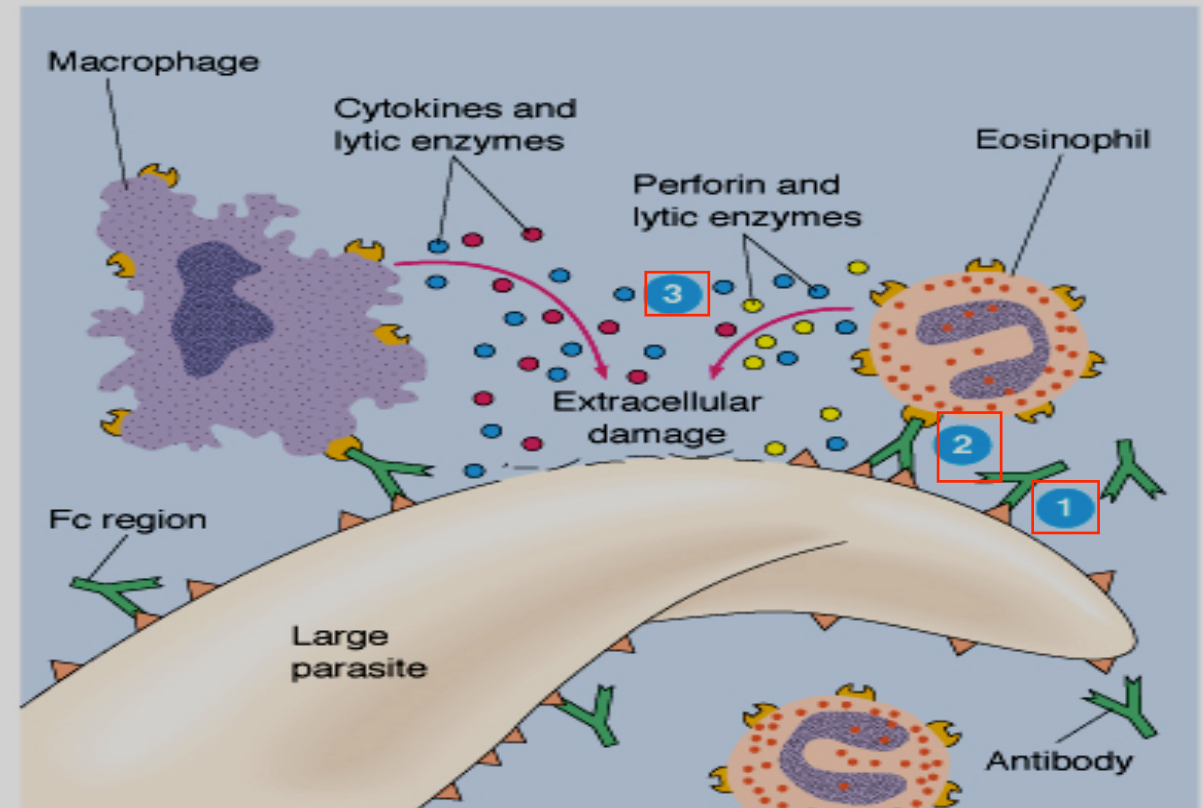
Only in IgG

*Percentage in serum only; if mucous membranes and body secretions are included, percentage is much higher.
[†] May be yes via alternate pathway.



Antibody dependent cell-mediated cytotoxicity

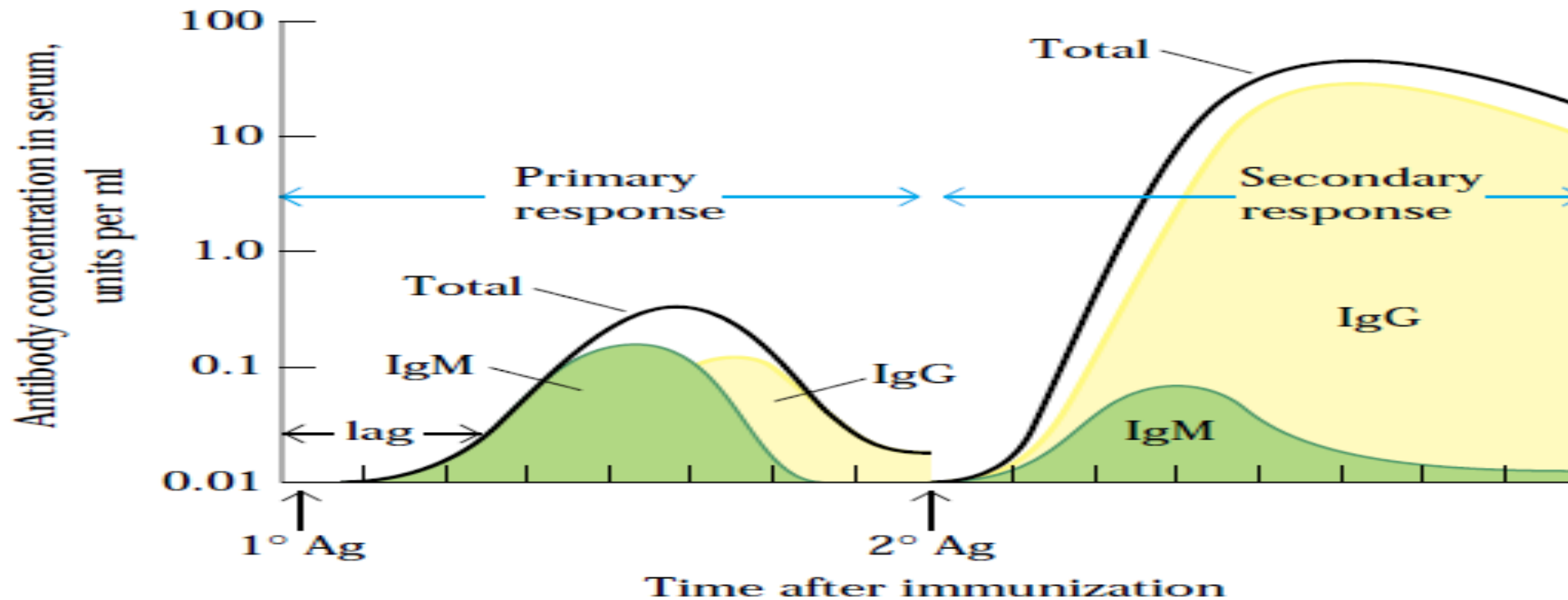
- (1) Antibodies coat infecting cell (large parasite usually) - FC facing outwards.
- (2) NK (lysing ability), Macrophage, neutrophils, and eosinophils have receptors for FC region of antibody.
- (3) Secretion of lytic enzymes to destroy parasite.



(a)

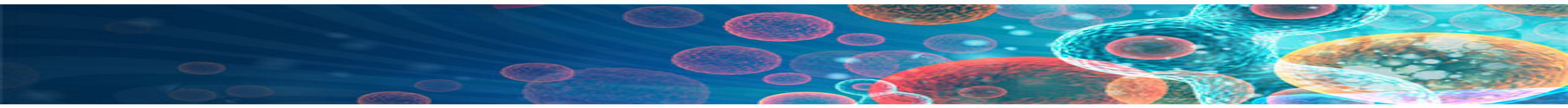
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Concentration & type of antibody in primary & secondary immune responses



Primary & Secondary immune responses:

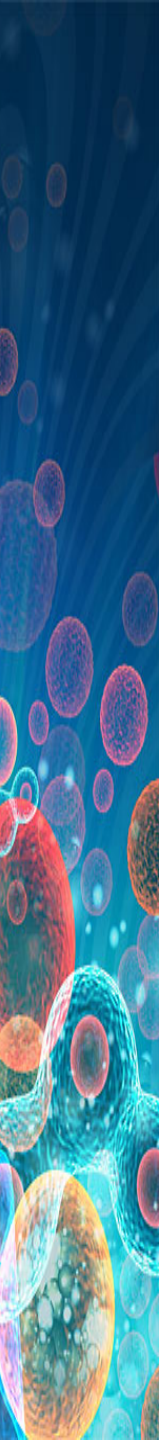
- Initial encounter with antigen produce primary immune response .
- Subsequent challenge with same antigen produce secondary immune response.





Comparison between primary & secondary responses

Property	Primary response	Secondary response
Responding B cell	Naive (virgin) B cell	Memory B cell
Lag period following antigen administration	Generally 4–7 days	Generally 1–3 days
Time of peak response	7–10 days	3–5 days
Magnitude of peak antibody response	Varies depending on antigen	Generally 100–1000 times higher than primary response
Isotype produced	IgM predominates early in the response	IgG predominates
Antigens	Thymus-dependent and thymus-independent	Thymus-dependent
Antibody affinity	Lower	Higher





summary

- B cells can be activated by antigens to produce antibodies either with the assistance of helper T cells or directly by the antigen itself.
- Antibodies are made up of two heavy and two light amino acid chains and take the shape of the letter “Y”.
- Different types of antibodies are located at various sites to provide protection by agglutination, precipitation, complement fixation etc.
- Secondary humoral immune response is swift and a stronger immune response mediated by IgG class of antibodies because of the memory cells.





Thank you!

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Abdulelah Abukhalaf

Nasser Almuqbil

Majed Alasbali

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