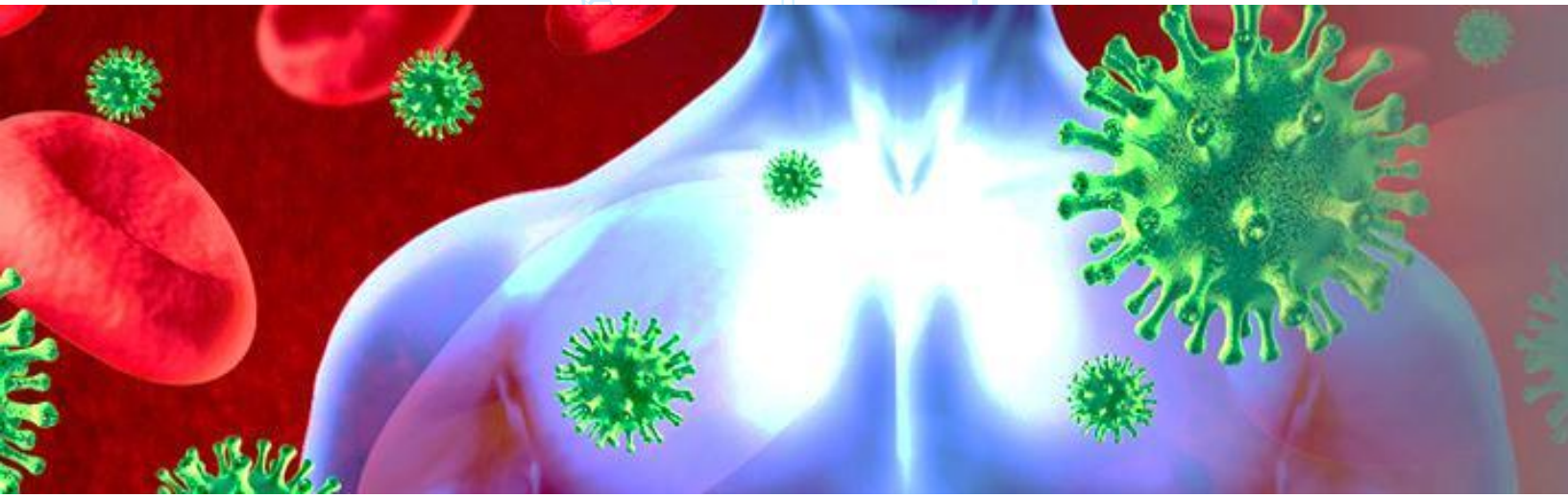
Dr. Adel AlMogren

Antibody-mediated Immunity

Lecture 4



Objectives:

- To describe B-cells as the mediators of humoral immunity, (antibody-mediated immunity).
- To describe activation of B-cells which involve:

1. Antigen recognition.
2. T-dependent & T-independent antigens.
3. Requirement for T-helper cells.

- To explain clonal selection, clonal expansion & generation of plasma cells & memory cells.
- To describe primary & secondary immune responses.
- To describe the structure & function of Immunoglobulins.

Humoral immunity is so named because it involves substances found in the: Humours or Body fluids.

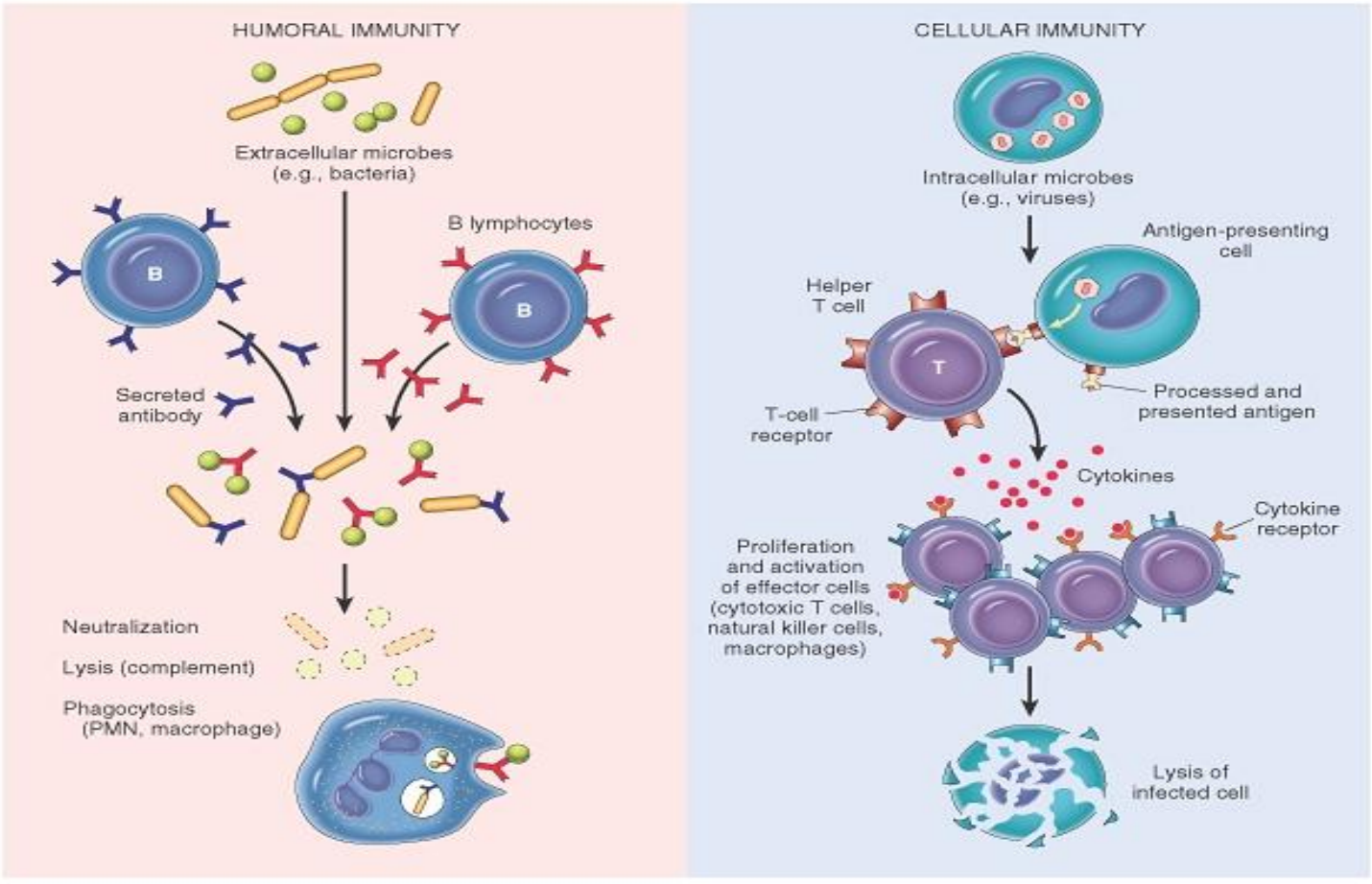
The **Humoral Immune Response** is: the aspect of immunity that is mediated by secreted antibodies.

--((Notes))--

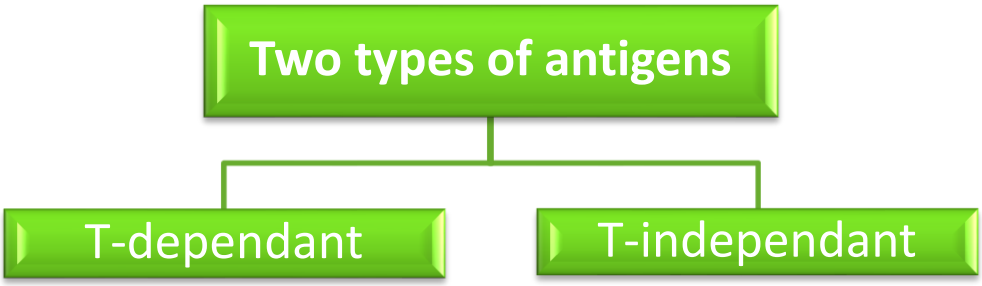
Immune responses mediated by anti bodies. Antibodies can't destroy the organism inside the cell, so we need mediated immune responses. If it is outside it will be attacked by antibodies complement activation phagocyte

Nature of antigen determine type of response either

EXTRACELLULAR **or** **INTERACELLUALR**



Activation of B cells by antigens



1- T-dependant:

Antibody production by B-cells require T-helper cells.

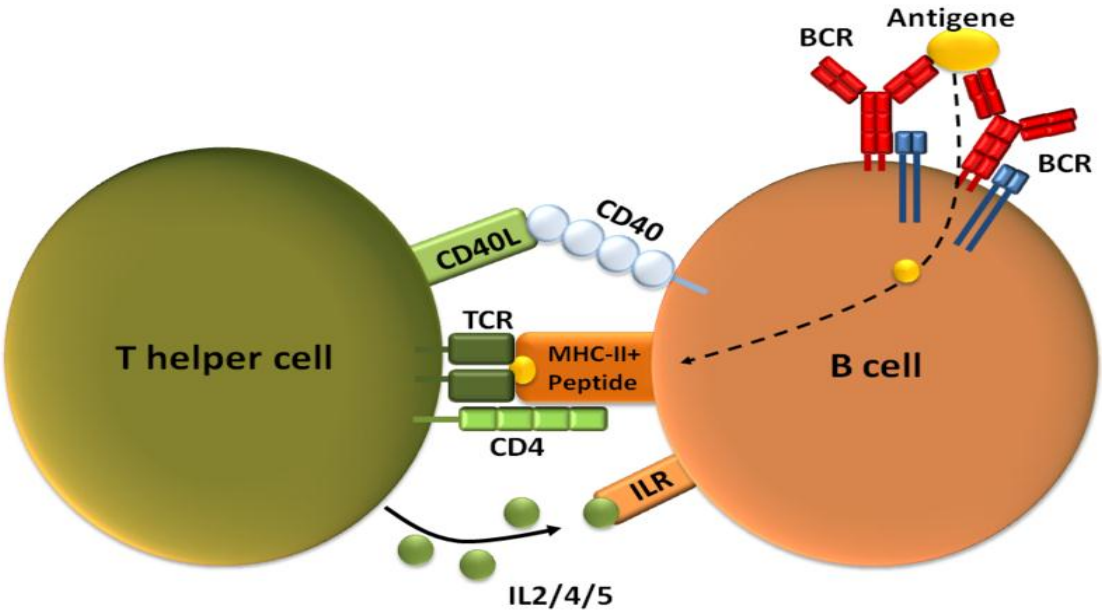
Macrophages recognize antigen & present it to T-helper cells.

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

T-dependant antigens are mainly proteins on viruses, bacteria & other foreign materials.

--((Notes))--

T-dependent antigen is better than T-Independent because it has memory cells which means protection for a long time. One antibody which is produced by particular B-cell which is stimulating against specific antigen will be specific for that antigen (Lock and Key) and those B-cells as long as they live will produce the same antibody. When you vaccinated against a disease you will have antibodies that will destroy the disease very fast without causing any damage. If the antigen is BIG the antibody will do "Aggulation" and if the antigen is

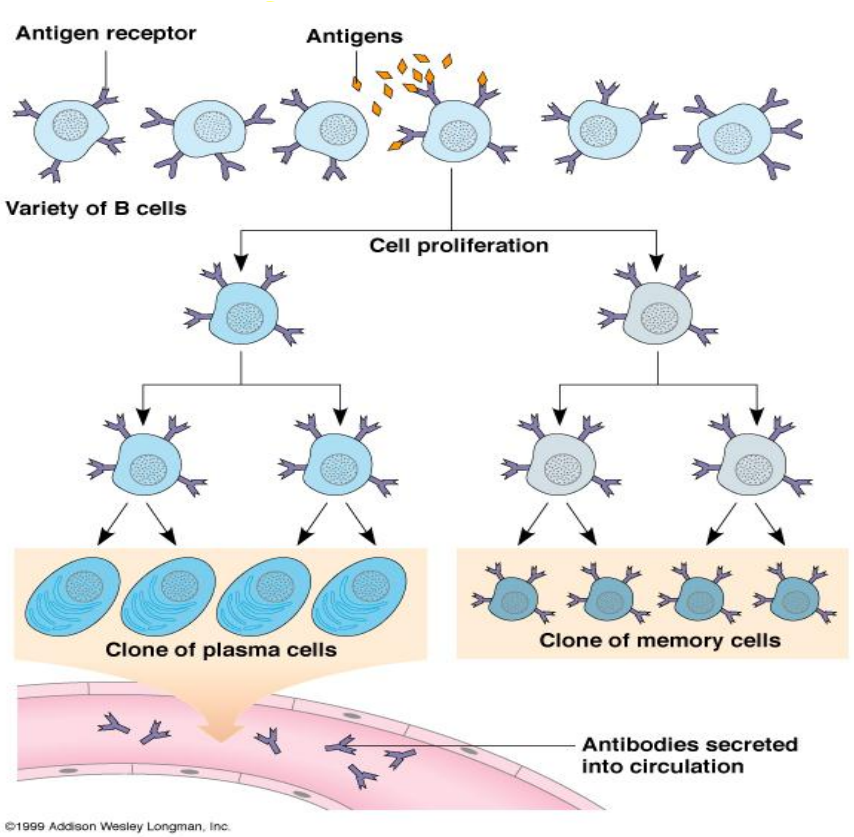


Activation of B cells by antigens

There is two types of antigens:

T-dependent	T- independent
Antibody production by B-cells require T-helper cells (Macrophages recognize antigen & present it to T-helper cells then T-helper cells stimulate B-cells specific for that antigen to become **plasma cells**)	**Antibody production by B-cells do not require T-helper cells**
T-dependent antigens are mainly **proteins** on viruses, bacteria & other foreign materials	**Antigens are mainly polysaccharides OR lipopolysaccrides with repeating subunits(bacterial capsules).**
Immune responses are **stronger** than T- independent response	Immune responses are **weaker** than T-dependent response

Clonal selection and clonal proliferation



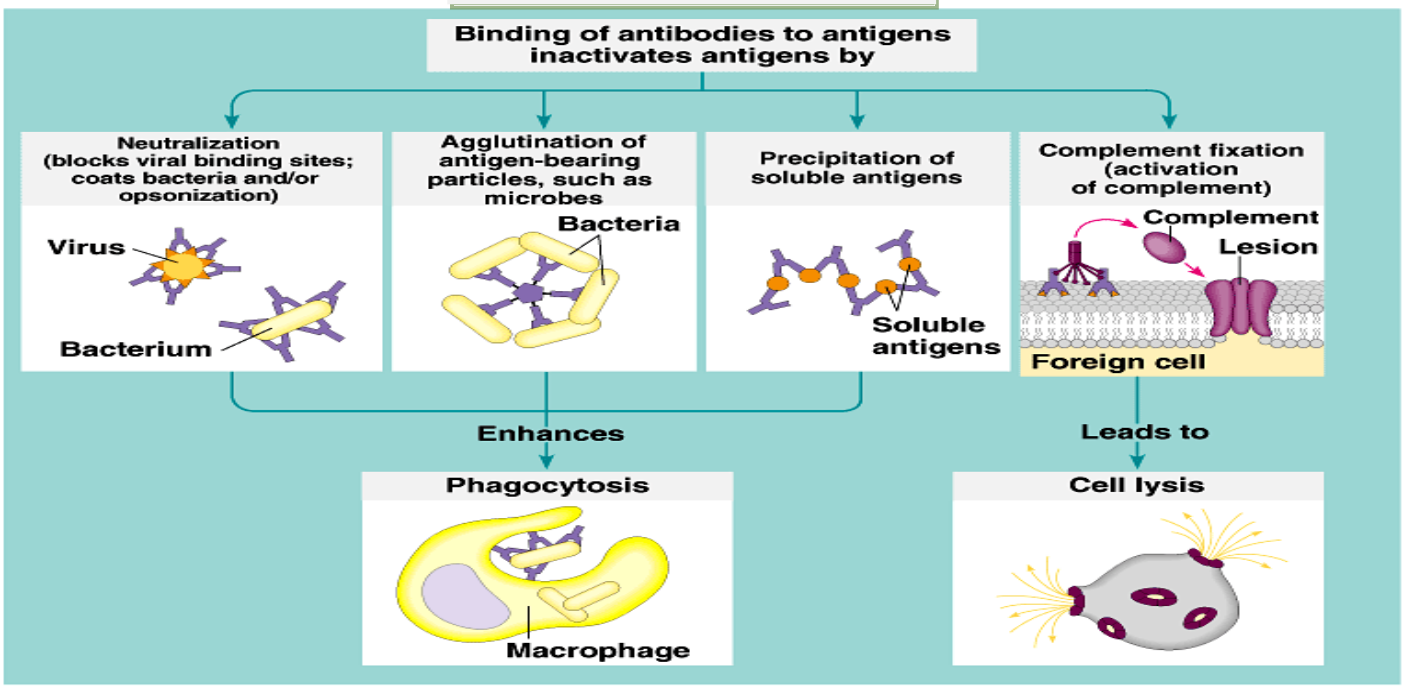
Antibodies

Antibodies are <u>immunoglobulins</u> with specific functions

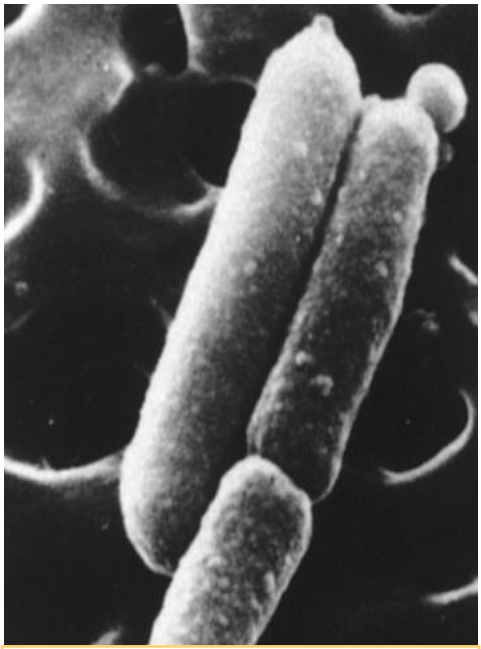
Antibodies bind to specific sites on antigen surfaces and perform protective functions by different mechanisms

There is a **SPECIFIC** antibody for any one given type of an antigen

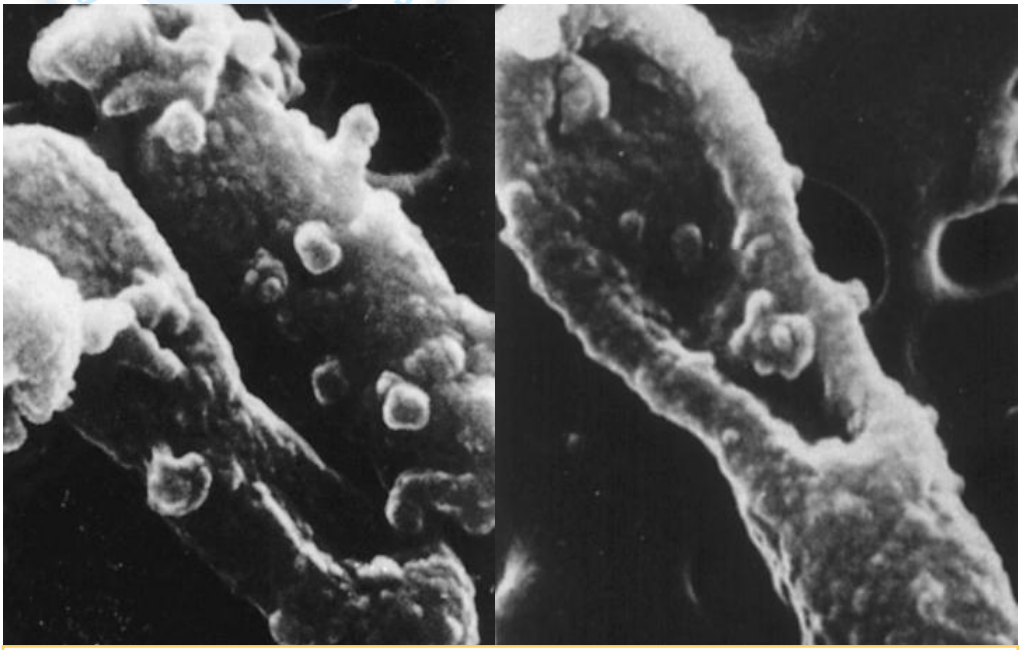
Protective Functions



Electron micrographs of the effect of antibodies and complement upon bacteria

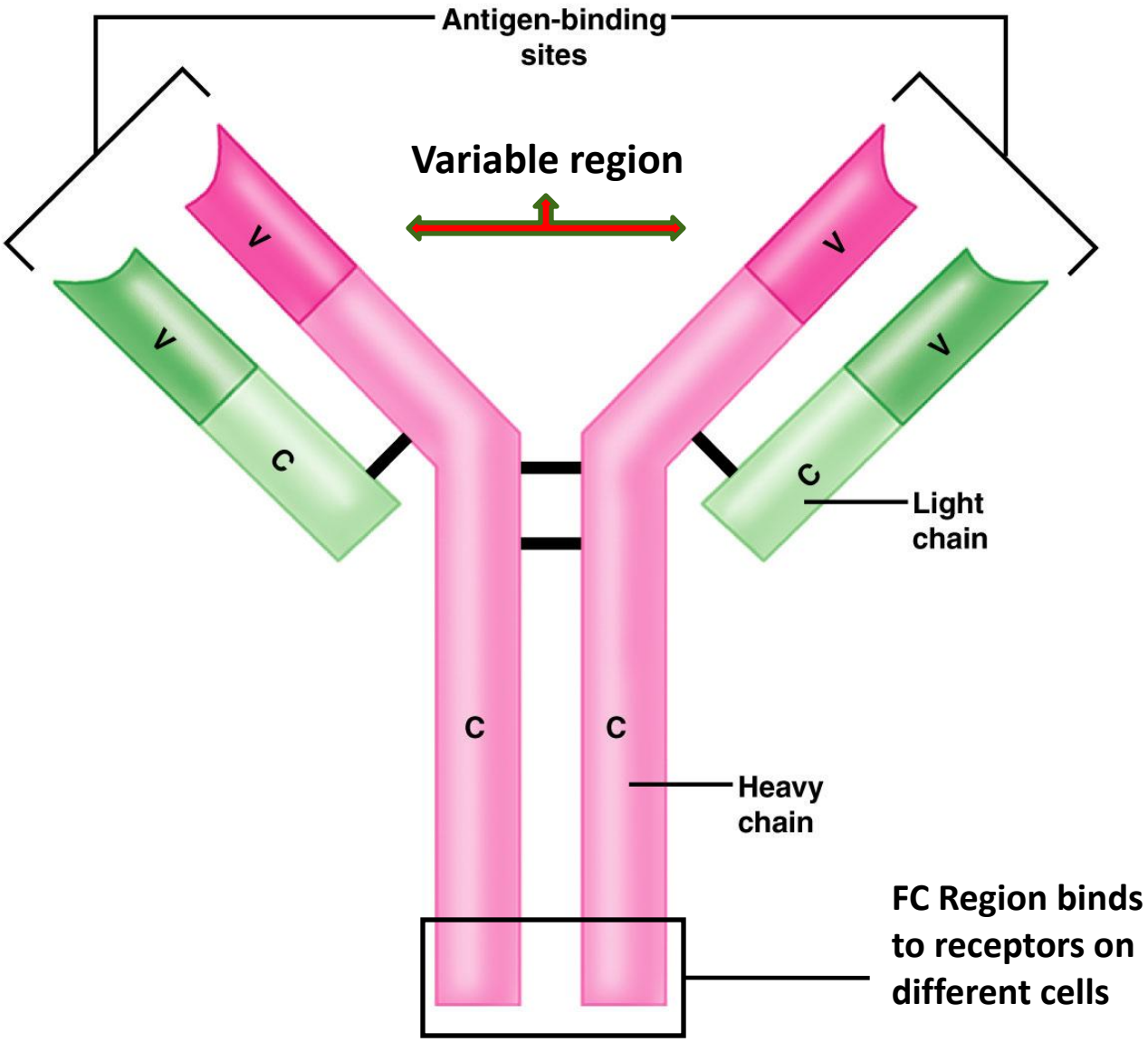


Healthy E. coli



Antibody + complement-mediated damage to E. coli

Antibody structure and functions

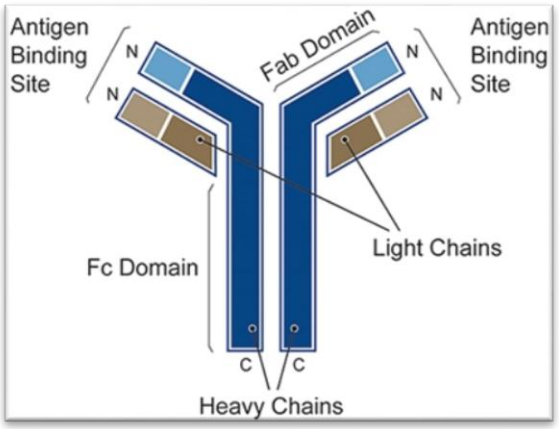


Made up of **FOUR** polypeptides (amino acid chains).

Two longer and larger **(Heavy chains)** and the other two shorter and smaller **(Light chains)**

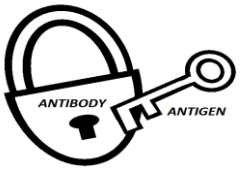
Have the shape of a letter "Y"

Antibody structure and function:



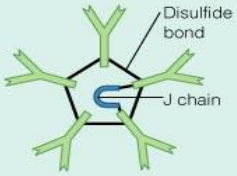
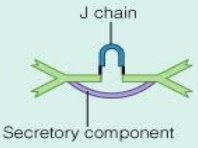
1- it is made up of four polypeptides (amino acid chains).
2- Two longer and larger (heavy chains) and other two shorter and smaller (light chains)
3- Have the shape of letter "Y"
4-

Variable region has the potential to bind with particular classes of antigens.



Once a raw antibody is stimulated to fit to a specific antigen, it can then react with ONLY that antigen. It Can fit as precisely as a lock-and-key to an antigen.

TABLE 17.1 A Summary of Immunoglobulin Classes

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

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

Functions of antibodies:

- **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.

--((Notes))--

The largest Immunoglobulin is IgM then IgA. The most abundant is IgG. If the IgE is high in concentration, that means it's allergic. The mother milk will produce after 48 hours, before that the mother will feed the child with glostern which rich with IgA to protect him.

Concentration & type of antibody in primary &secondary immune responses:

example hepatitis vaccination.

Primary immune responses:

First injection: IgG and IgM is produced because the body and the B cell and the antigen presenting cell look to the antigen, they activate and stimulated T cell relies cytokines help the B cell to produces antipodes and then produce some plasma cell and some memory cell. Small amount of plasma cell produces small of antibody. And there is a development of some memory call
So on this stage there is a caring of memory cell.
The IgM is predominant antibody in the primary immune responses.

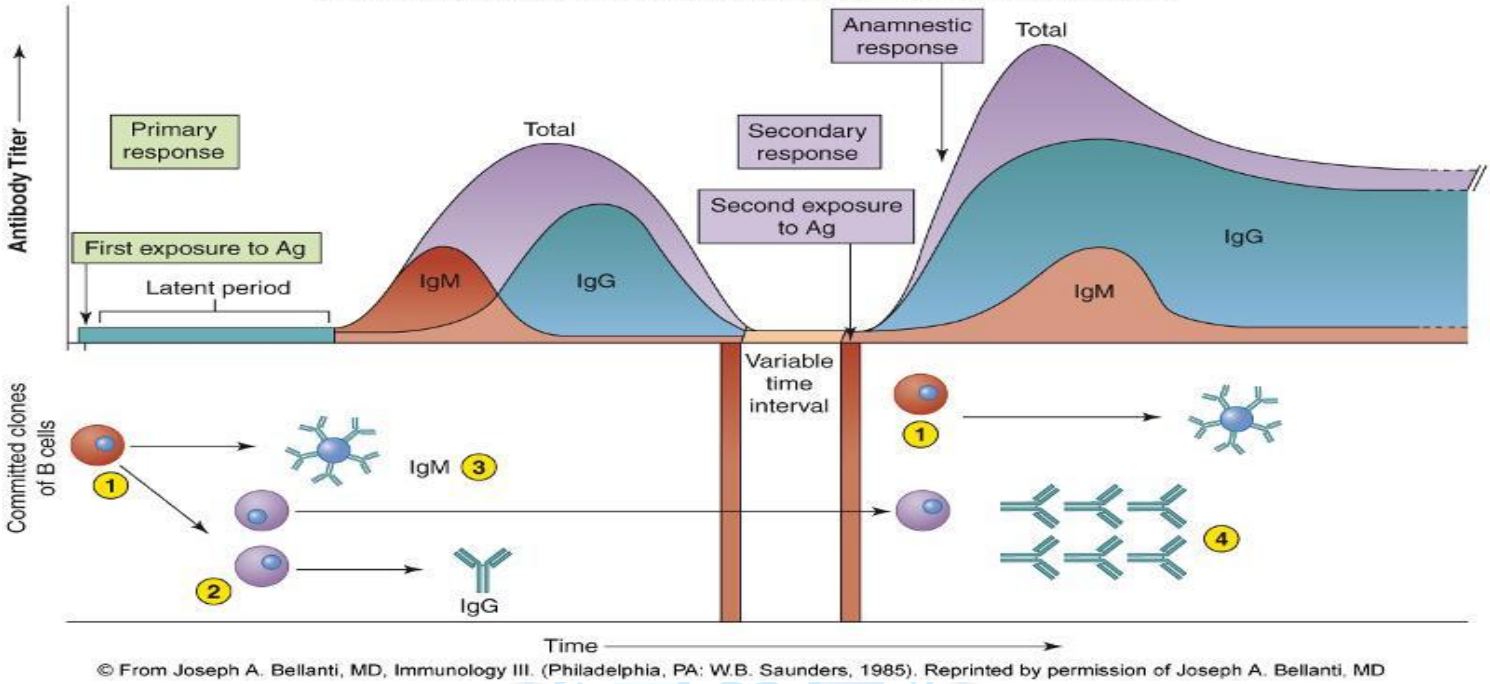
Secondary immune responses:

Second ingsction: IgG is going sky high because of the memory cell is reacted to the antigen vary quickly so they produce small amount of IgM and a lot of IgG.
The IgG is predominant antibody in the primary immune responses.

Through the antibody we can determination the type of the inflammation. (-) = There isn't & (+) = There is

- IgG	**- IgM**	**No infection**
+IgG	**- IgM**	**Infection in the past.**
+IgG	**+ IgM**	**Acute infection**

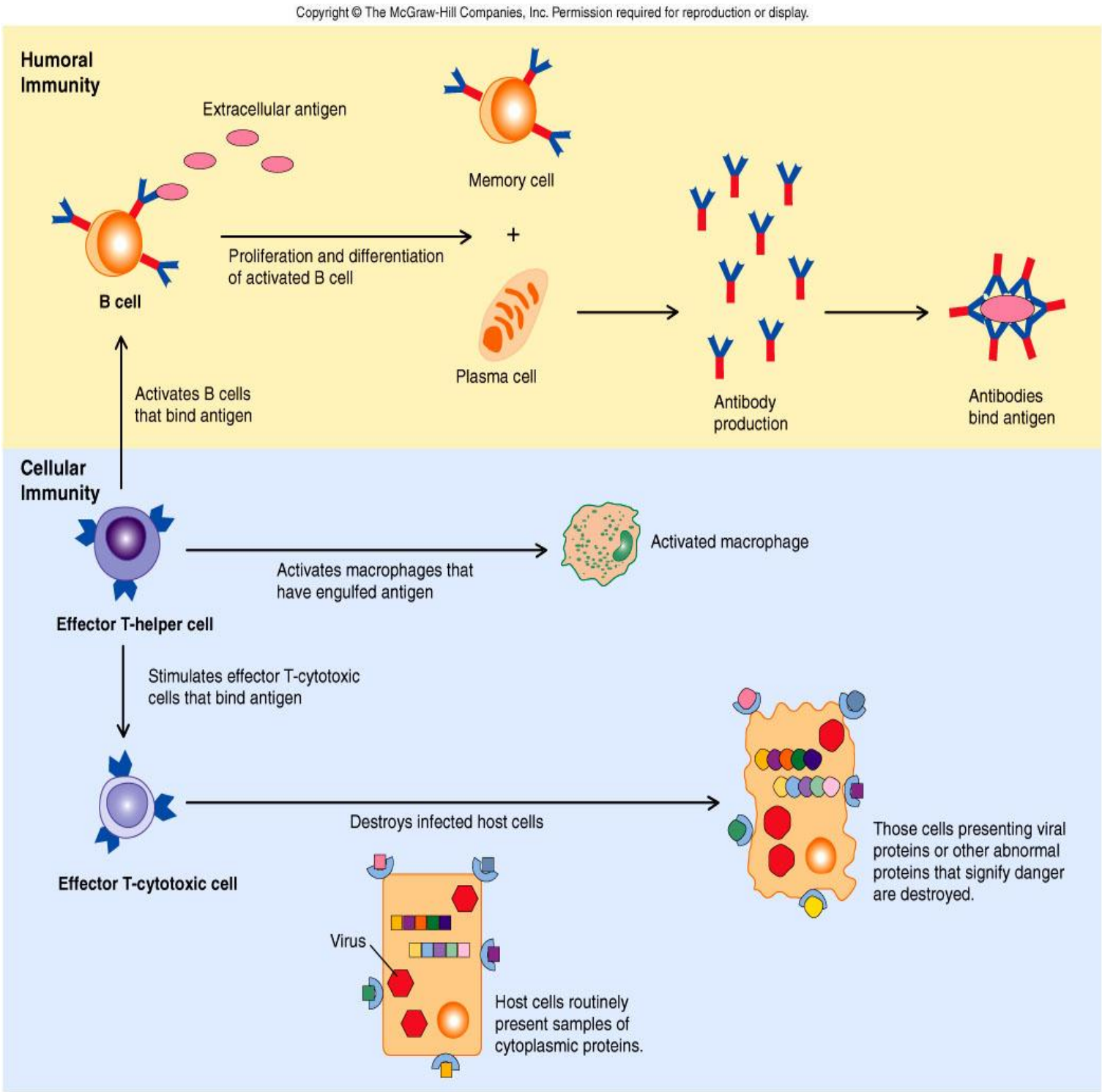
- **Primary & secondary immune responses:**
  1- Initial encounter with antigen produce primary immune response.
  2- Subsequent challenge with same antigen produce secondary immune response.



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

The differences that there is development in memory cell they respond very quickly

Summary


Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.
Humoral Immunity
Extracellular antigen
Memory cell
B cell
Proliferation and differentiation of activated B cell
+
Plasma cell
Antibody production
Antibodies bind antigen
Activates B cells that bind antigen
Cellular Immunity
Activated macrophage
Activates macrophages that have engulfed antigen
Effector T-helper cell
Stimulates effector T-cytotoxic cells that bind antigen
Destroys infected host cells
Those cells presenting viral proteins or other abnormal proteins that signify danger are destroyed.
Effector T-cytotoxic cell
Virus
Host cells routinely present samples of cytoplasmic proteins.