

Immunology 434

Antibody-mediated Immunity

Forth lecture

Objectives:

1. 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

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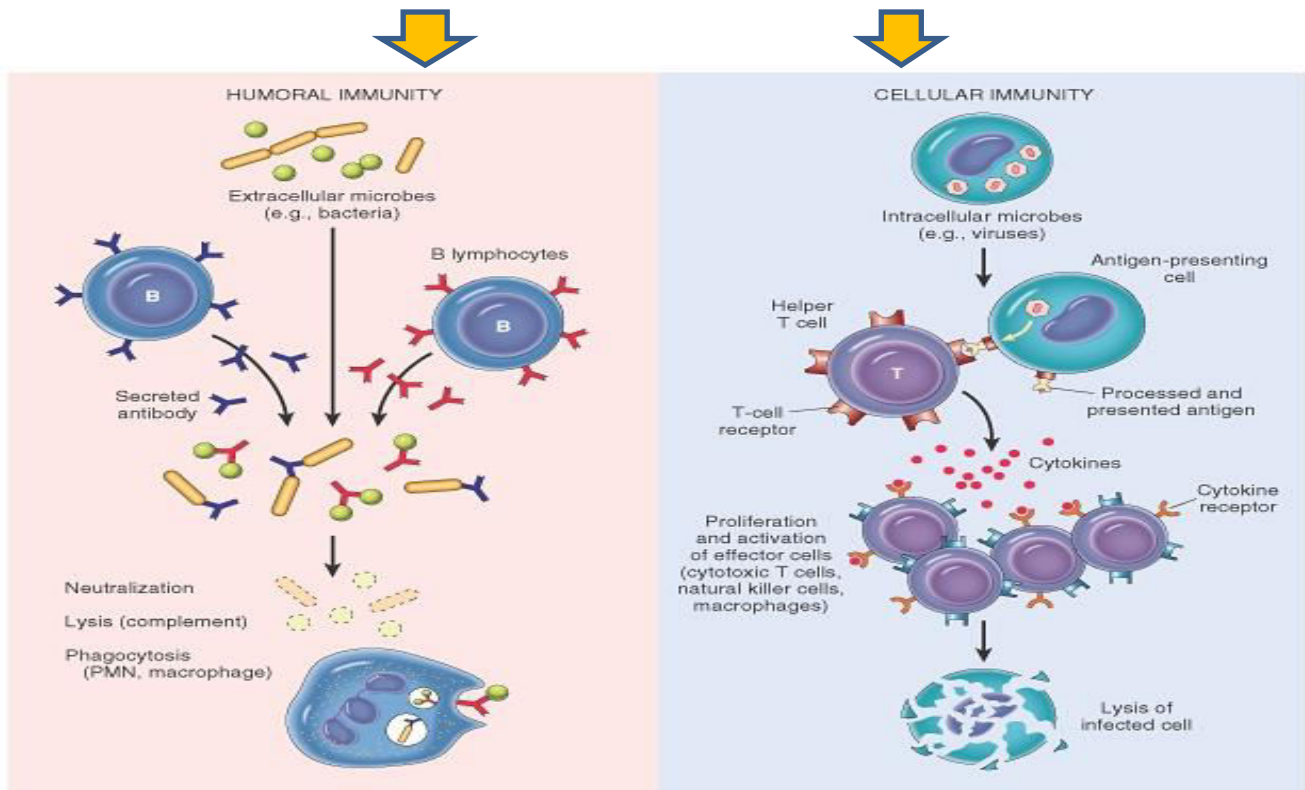
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 : Important

➤ Humoral immunity is so named because it involves substances found in the: **Humours or body fluids**

➤ The **Humoral Immune Response** (**antibody mediated immune**) is the aspect of immunity that is mediated by secreted **antibodies**

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



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❖ Activation of B cells by antigens

➤ Two types of antigens:

T-dependent

Antibody production by **B-cells** **requires T-helper cells.**

- **Macrophages** recognize antigen & present it to **T-helper cells** ((CD4 with class 2))

T-helper cells stimulate **B-cells** specific for that antigen to become **plasma cells** (Plasma cells could be produce antibody for antigen)(Plasma cells are "terminally differentiated").

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

Immune responses are **strong** compared to **T-independent** responses

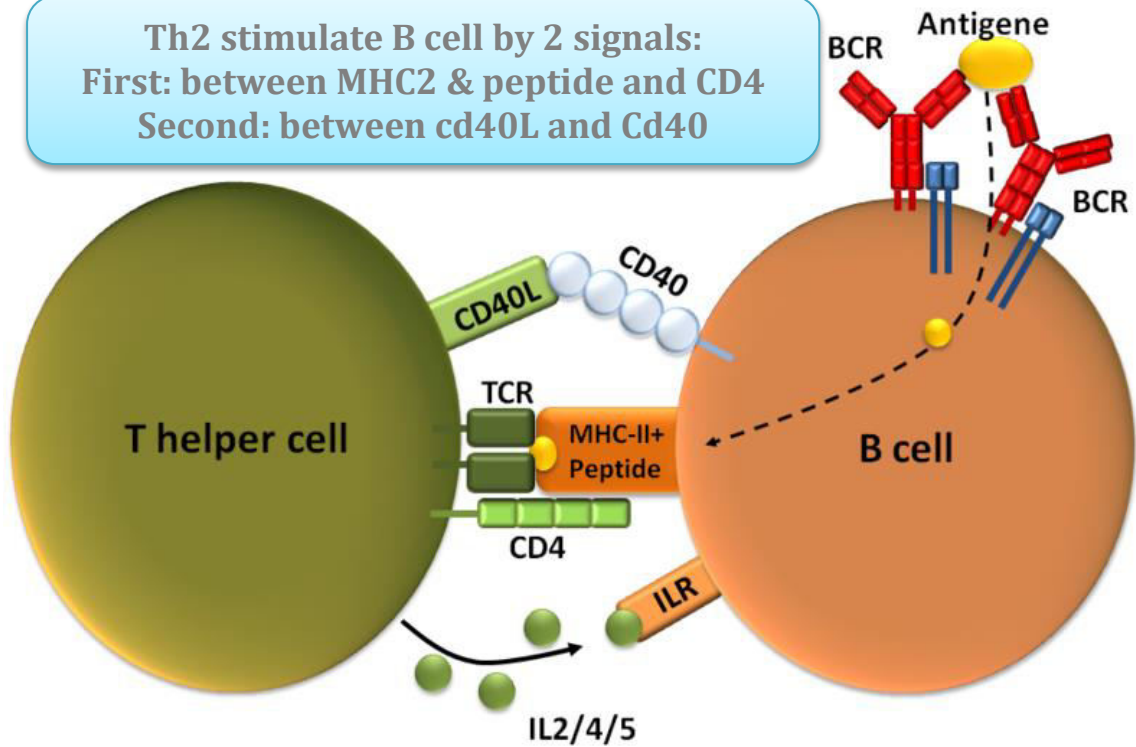
T- independent

B-cells **do not require T-helper** cells to produce antibody.

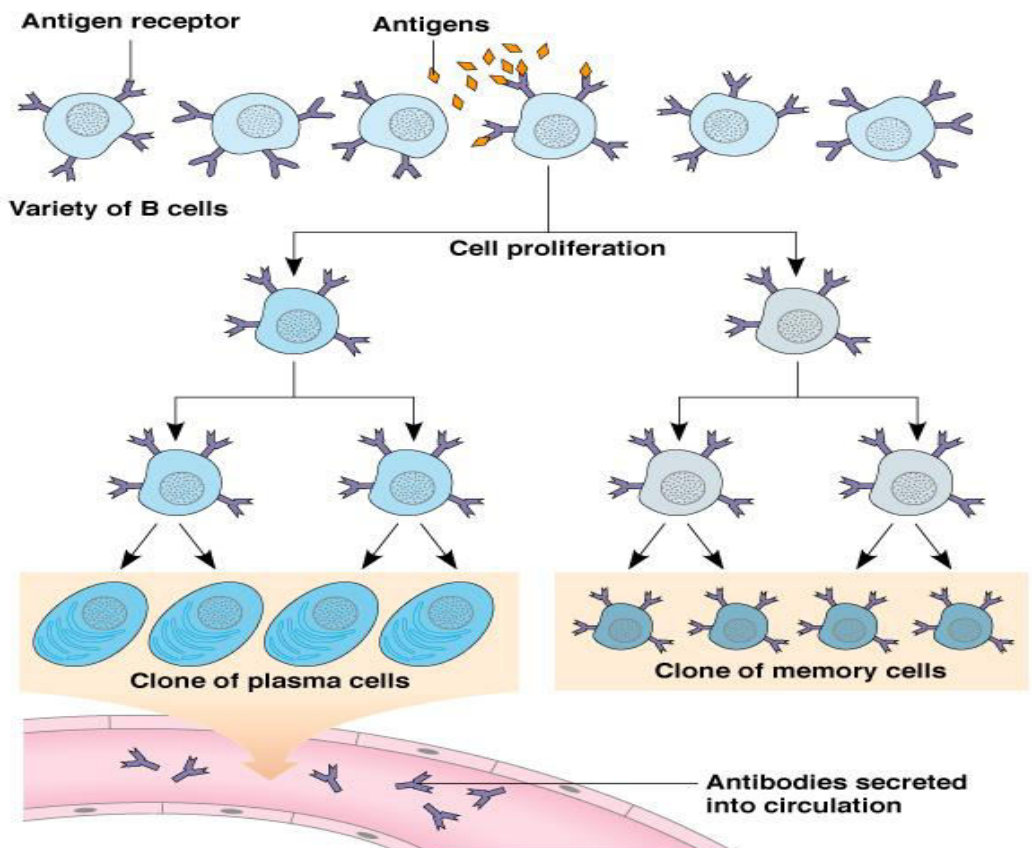
Antigens are mainly **polysaccharides** or **lipopolysacchrides** with repeating subunits (bacterial capsules).

Immune responses are **weak** compared to **T-dependent** responses

Th2 stimulate B cell by 2 signals:
 First: between MHC2 & peptide and CD4
 Second: between cd40L and Cd40



Clonal selection and clonal proliferation



Note:

B cells have clone selection and proliferation which means that each clone proliferate specifically to form plasma or memory cells and do a selected specific function and it's an important characteristic of B cells.

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❖ Antibodies

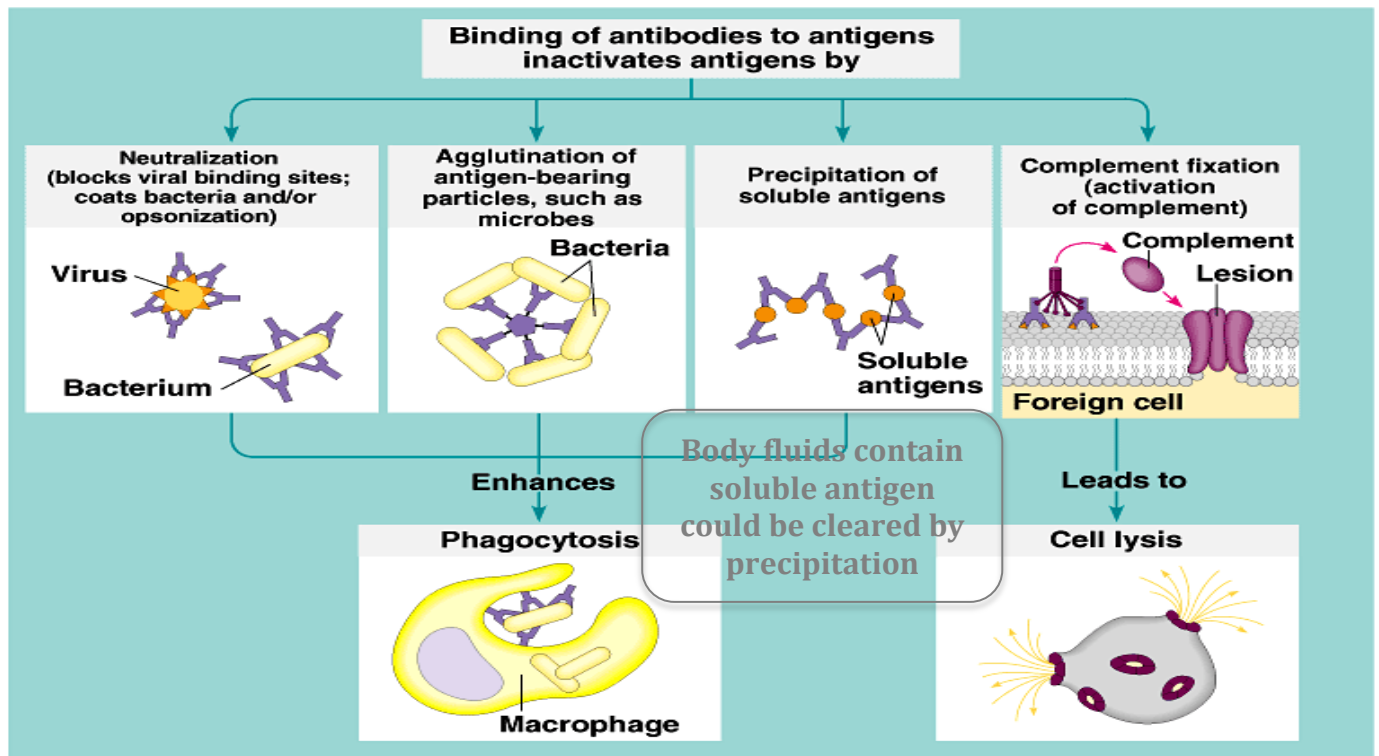
Note: the part of the antigen that interacts with the antibodies is called epitopes.

- Antibodies are immunoglobulins 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

Classical pathway requires antigen-antibody binding.

❖ Protective functions of antibodies

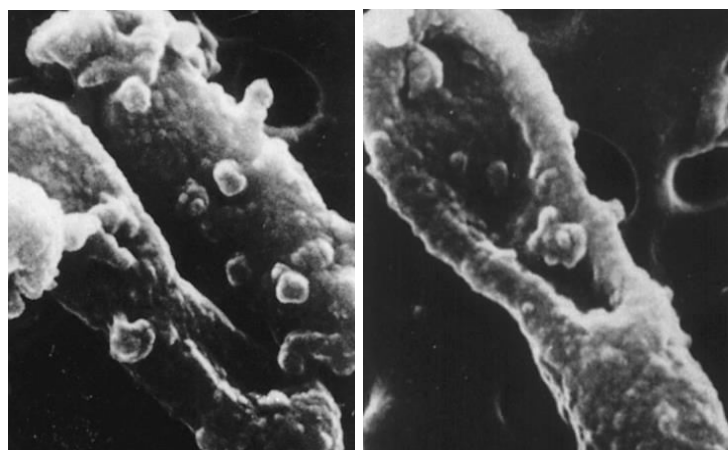


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❖ Electron micrographs of the effect of antibodies and complement upon bacteria



Healthy E. coli



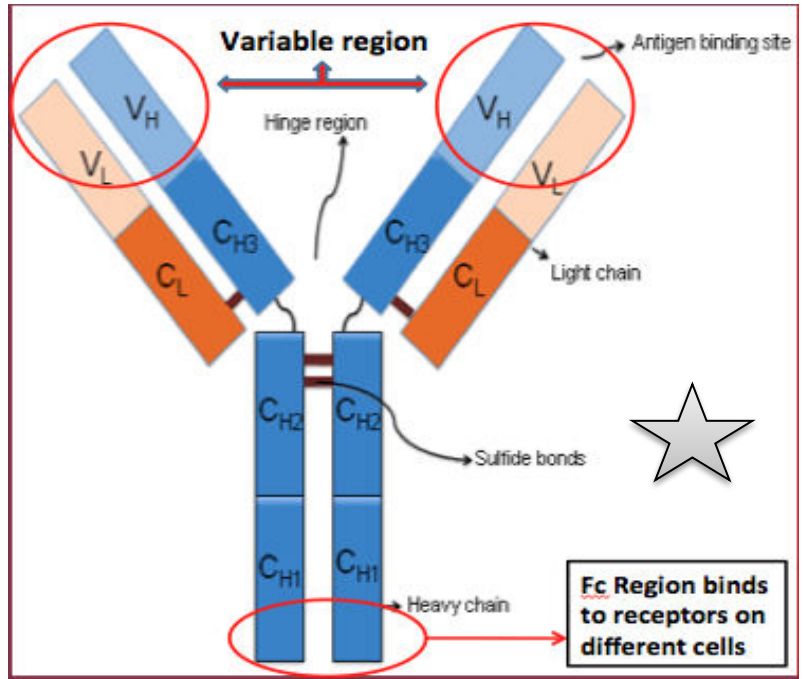
Antibody + complement-mediated damage to E. coli

❖ Antibody structure and functions

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 a letter "Y"



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

Note: the variable region consists of both parts of light and heavy chains. The same for the constant region.

Once a raw antibody is stimulated to fit to 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

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

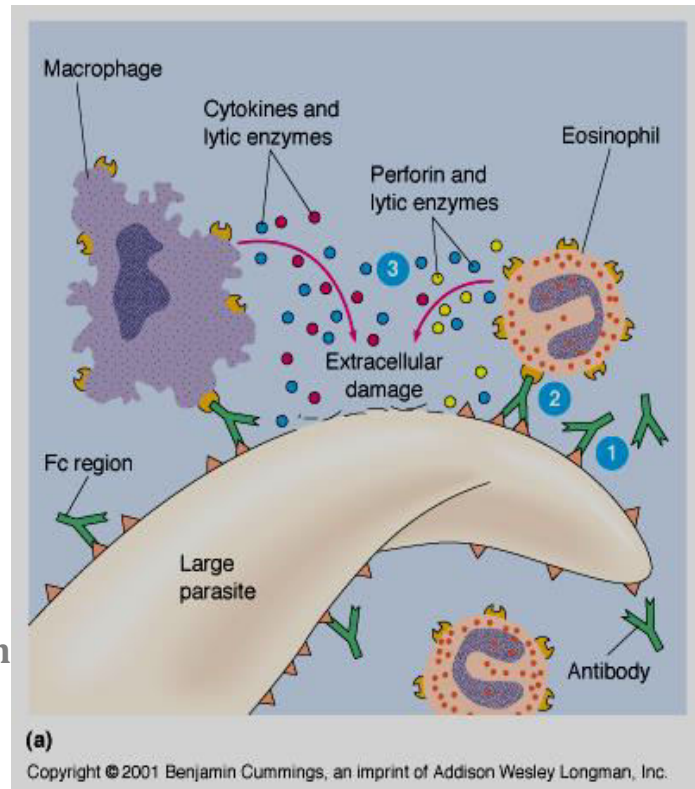
*Percentage in serum only; if mucous membranes and body secretions are included, percentage is much higher.

† May be yes via alternate pathway.

❖ Functions of Antibodies

➤ Antibody dependent cell-mediated cytotoxicity

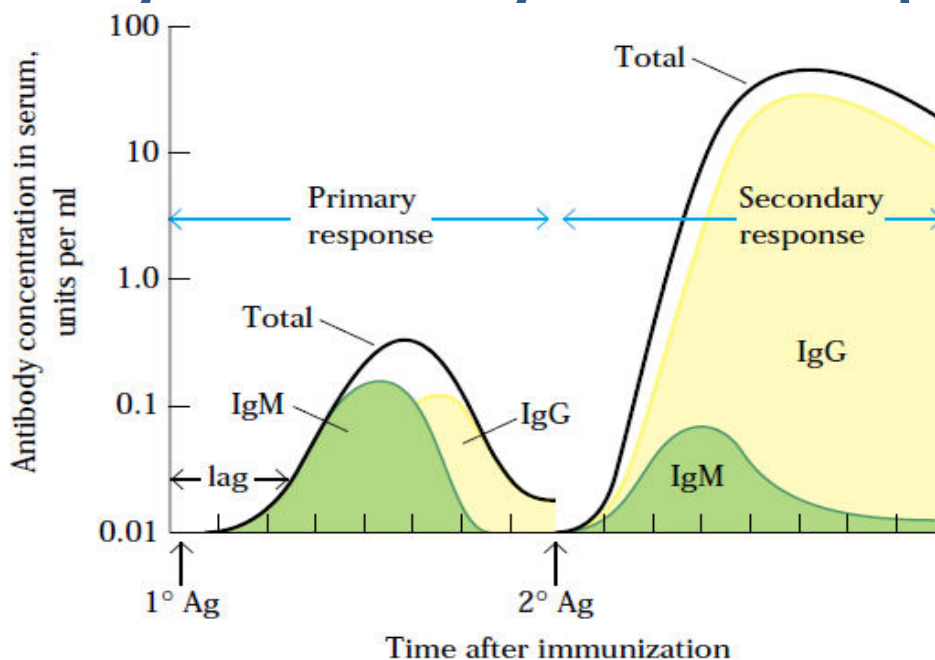
- Antibodies coat infecting cell (large parasite usually) - FC facing outwards
- NK (lysing ability), Macrophage, neutrophils, and eosinophils have receptors for FC region of antibody
- Secretion of lytic enzymes to destroy parasite (IgE function are destroy parasite by secretion perforin



❖ Primary & Secondary immune responses

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

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



❖ 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

Differences that there is development in memory cell they respond very quickly

--433 Notes--

The **largest** Immunoglobulin is **IgM** then **IgA**. The most **abundant** is **IgG**. If the **IgE** is high in concentration, which 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 injection: IgG is going sky high because of the memory cell is reacted to the antigen very 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



MCQs:

1. The class of immunoglobulins, which can cross the placenta, is

- A. IgM
- B. IgG
- C. IgA
- D. IgD

2. Simulation of which of the following will lead to appearance of first antibody to appear following stimulation by an antigen?

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

3. Which of the following immunoglobulins is present normally in plasma at the highest concentration?

- A. IgG
- B. IgM
- C. IgA
- D. IgD
- E. IgE

4. Opsonization refers to

- A) Adherence to mucosal epithelial cells.
- B) Antibody mediated viral inactivation.
- C) Coating of microorganisms or other particles by antibody and/or complement.
- D) Parasitic lysosomal degranulation.

5. which of the following are done by B-cells?

- A) Act as antigen-processing cells
- B) Respond to antigens by making antibodies
- C) Proliferate and differentiate into plasma cells
- D) All of the above

Answers: 1) B 2) A 3) A 4) C 5) D