

Immune System Summary (Ch. 6 - 7)

→ Types of Grafts

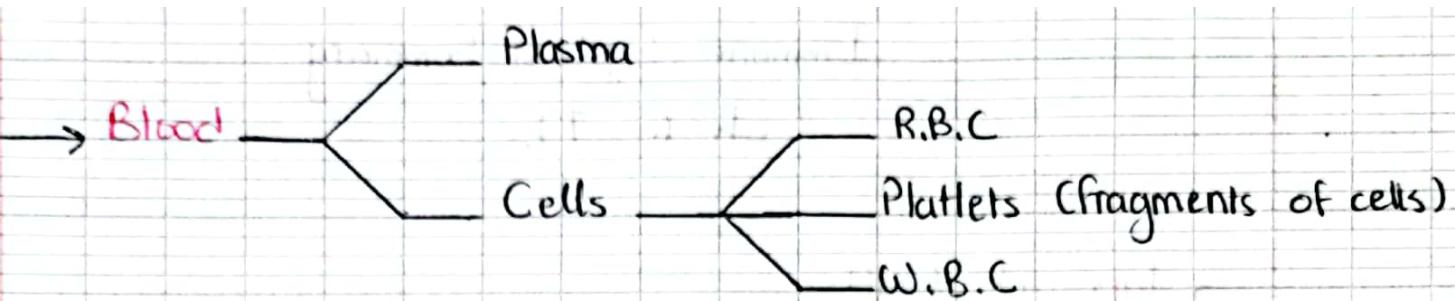
1. Autograft: is a graft of tissue from one spot to another of the same individual body.
2. Allograft: a tissue graft performed on 2 individuals of same species but ^{not} are genetically identical.
3. Isograft: graft concerning 2 genetically identical individuals (identical twins)
4. Xenograft: a graft transplanted between 2 individuals of different species.

→ HLA or MHC : identity marker for all nucleated cells

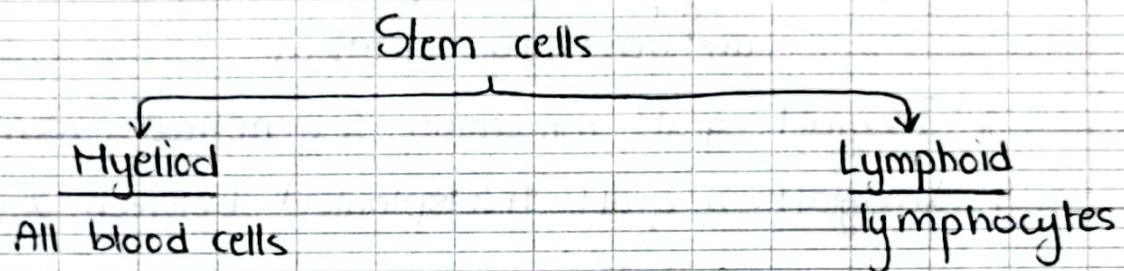
- HLA I: all nucleated body cells.
- HLA II: only immune cells (WBC)
- HLA is polymorphic (has many alleles) and is responsible for graft acceptance or rejection.
- It is present on chromosome 6 and has 6 loci.

→ Antigens involved in blood transfusions are:

- Agglutinogens: A and B (of the ABO system)
- Rh antigen (Rhesus system) : +ve or -ve



* Bone marrow contains stem cells for production of blood cells.



→ White Blood Cells : (Immune cells)

- Types:

 - Granulocytes
 - Phagocytes
 - Monocytes
 - Neutrophils
 - Macrophages
 - Mast Cells
 - Lymphocytes (B and T lymphocytes)

Myeloid cells

Lymphoid cells

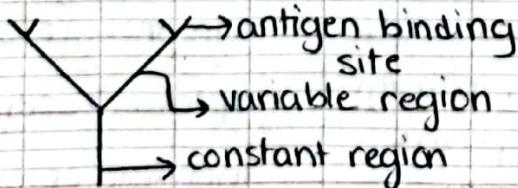
WBC :	Granulocytes	Monocytes	Plast Cells	BL	T_H	T_C
Origin	Myeliod Stem Cells			Lymphoid Stem Cells		
Size	12 Nm	10-18 Nm	10-18 Nm	7.8 Nm	7.8 Nm	7.8 Nm
Morphology	Granules in cytoplasm	horse shoe shaped	rounded nucleus	large nucleus	large nucleus	large nucleus
Receptors	X	X	antibodies for all allergic reactions	antibodies	CD_4	CD_8
Role	non-specific immune response	become macrophages	Allergy	secrete antibodies	Helper	Killer cells of infected self cells

lymphocytes

B lymphocytes

T lymphocytes

- produced and mature in the bone marrow
- mature into plasma cells to produce antibodies (role)



- * antibodies bind to the epitope of the antigen

- produced in the bone marrow
- mature in the thymus

Tc or T₈

T_H or T_4

- Killer T-lymphocytes
- receptors : CD_8
- attack infected self - cells

- Helper T-lymphocytes
- receptor : CD_4
- induce the specific immune response or regulate the activity of other cells of immunity.

- * T lymphocytes that recognizes non-self HLA or self antigens are eliminated. While those that recognize self HLA or non-self antigens are preserved.

- * TL has double recognition by its receptor TCR

HLA I non-self peptide

→ Lymphatic System

lymph + lymphatic vessels + W.B.C

- primary lymphoid organs: { Bone marrow
Thymus

site of production and maturation of W.B.C

- secondary lymphoid organs: { spleen
lymph nodes

site of accumulation and storage of immune cells

→ Immune Cells

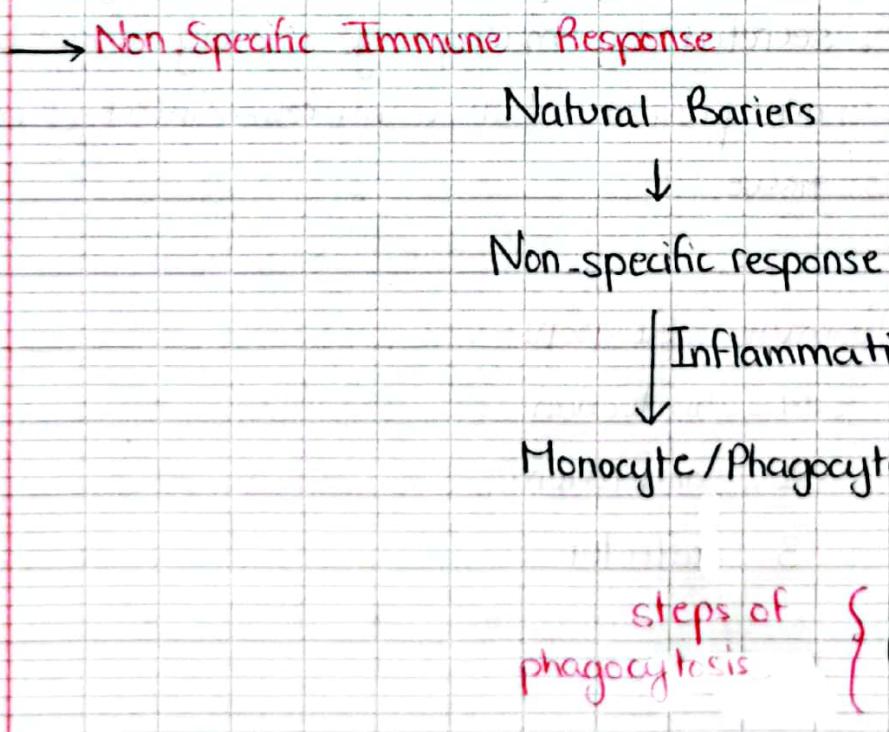
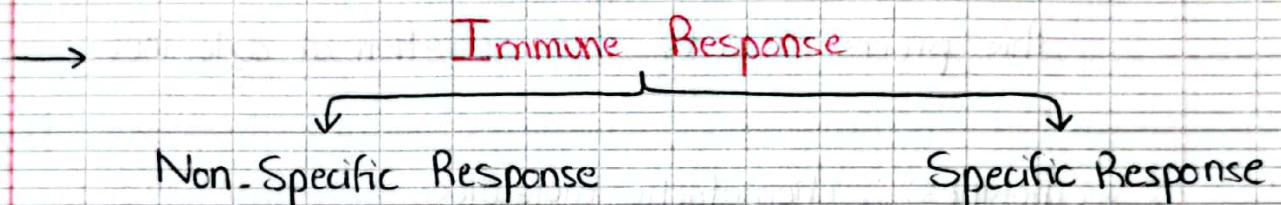
the myeloid lineage

like: macrophages, phagocytes } have phagocytic activity + incharge of non-specific immunity

the lymphoid lineage

lymphocytes: have antigen-specific receptors so they are incharge of specific immunity.

- Antibodies (produced by plasma cells which are mature BL) are specific for a single antigen.
- An antigen may have different antigenetic determinants, therefore causing the formation of more than one antibody.
- Antibody binding site for an antigen is formed by the variable region of both heavy and light chains.



result: either complete destruction or steady state or multiplication

- **Natural Barriers:**
- skin
 - saliva
 - HCl (pH=2)
 - ear wax
 - tears
 - mucosa
 - urinary
 - respiratory
 - external genitalia

- **Inflammation:**
- becomes red and swollen
 - feels hot
 - painful

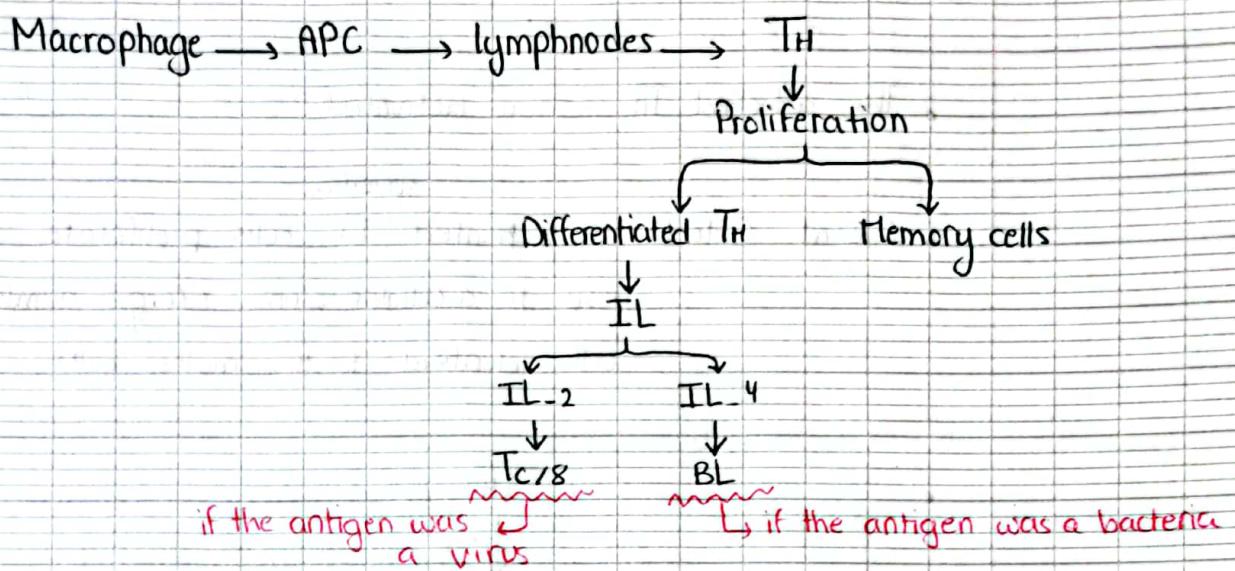
→ **Phagocytosis :**

this process starts by secretion of cytokines.

- * Cytokines:
- chemotactic molecules
 - attract phagocytes (that undergo phagocytosis)
 - secreted by macrophage (or any white blood cells) that are present when a microbe / infected cell enter a tissue.

→ **Specific Immune Response**

- * phases :
- 1 - induction
 - 2 - activation
 - 3 - effector

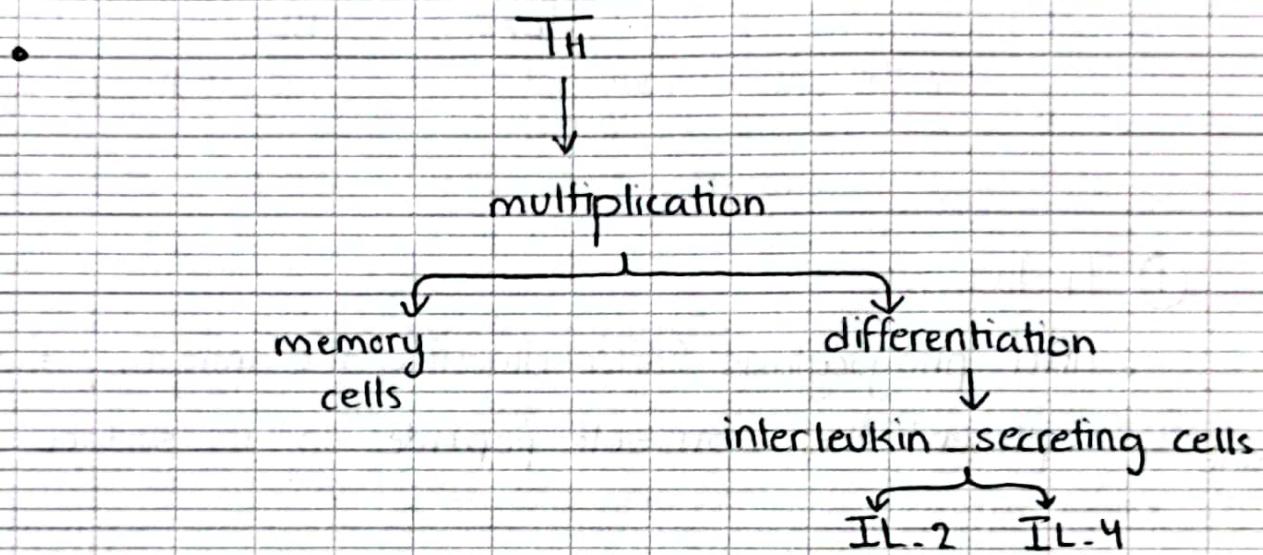


① Induction

- After phagocytosis (after digesting the antigen), the macrophage present the non-self peptide on its surface (on its HLA-II)
 - The macrophage presenting the antigen is called APC (Antigen-presenting cell)
 - This macrophage migrates to the nearest lymphnode (lymphnodes are site of storage of lymphocytes and Th keep circulating in them).
 - The circulating Th inspect the HLA-peptide complexes. (Th double recognizes HLA II and non-self peptide).
 - Th specific to the peptide presented on the APC remain attached to it.
- Then, activation phase starts.

② Activation Phase

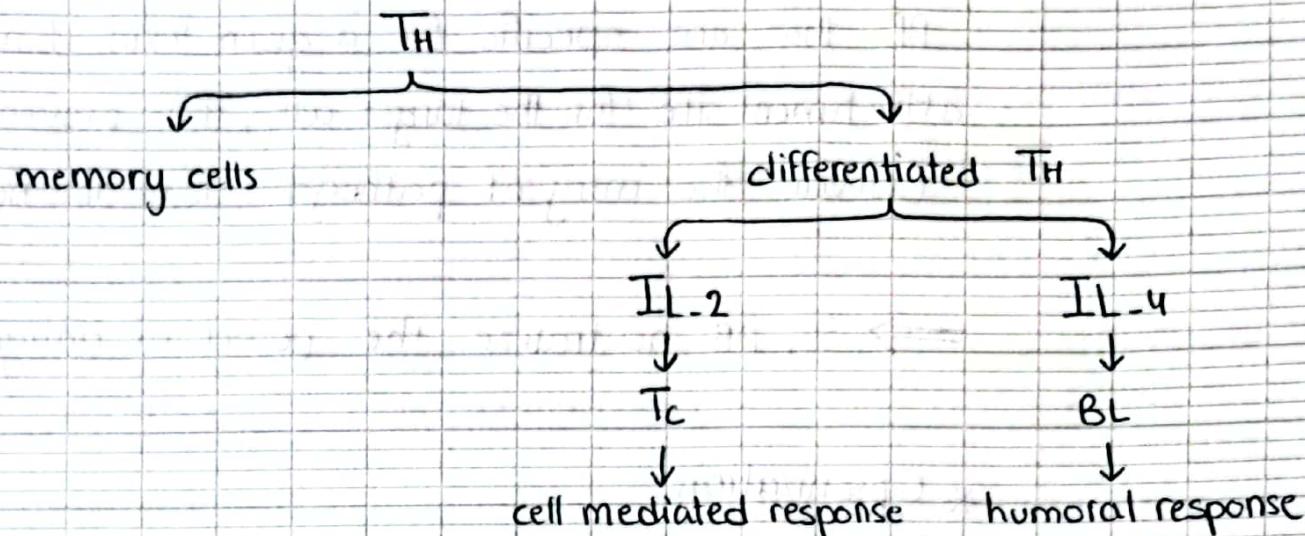
- The attached T_H is now activated.
- Clonal Selection : activated T_H cells proliferate and each give rise to a cellular clone (large number of daughter cells identical to the mother cell).
specific



(T_H mature to become interleukin secreting cells <IL> and secrete interleukin.)

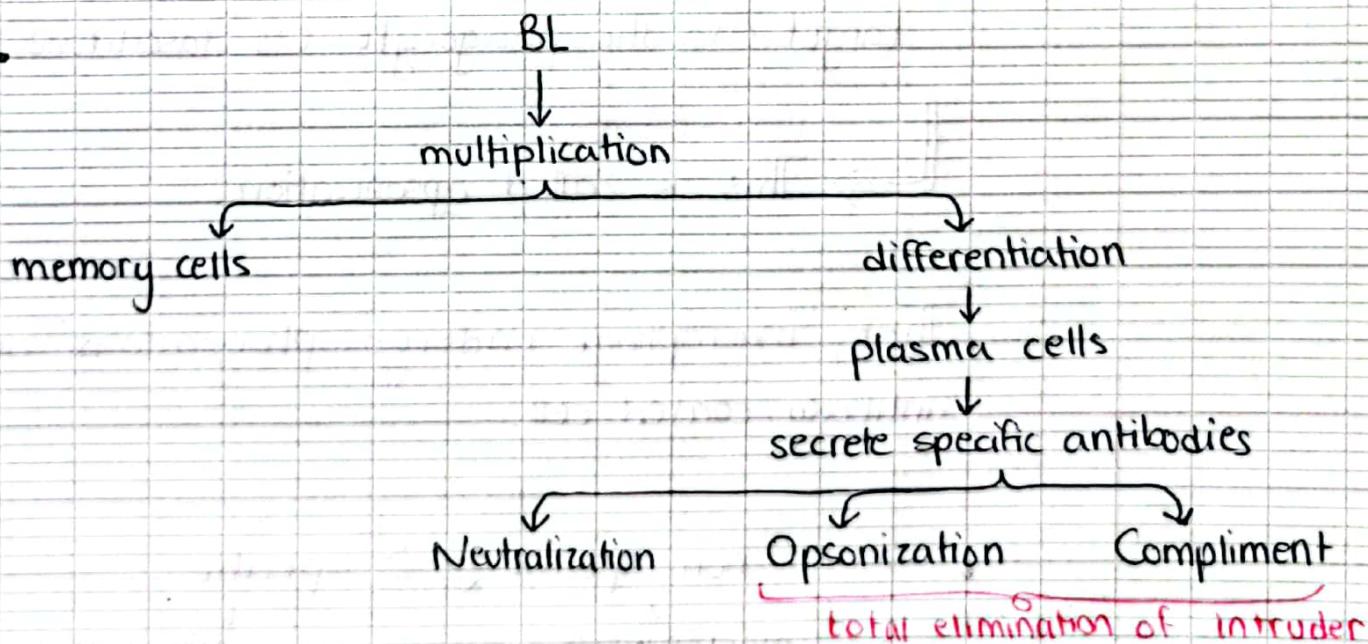
- IL2 activates Tc
- IL4 activates BL

③ Effector Phase



→ Specific Humoral Immune Response

- Clonal Selection: only specific BL that recognize the different epitopes of the antigen through their surface Ig are activated.
 - Selected cells proliferate in presence of IL4.



- antibodies are found in the serum and have the same antigenic specificity as the mother B cells.
 - antibodies specific to the antigen bind to it forming immune complex.

* Neutralization:

AB that are specific for a given toxin bind to it and cover the attachment site for the target cell, thus preventing its action.
(prevent the entry of pathogens into the host cell)

⇒ So, AB neutralize the power of antigen to infect.

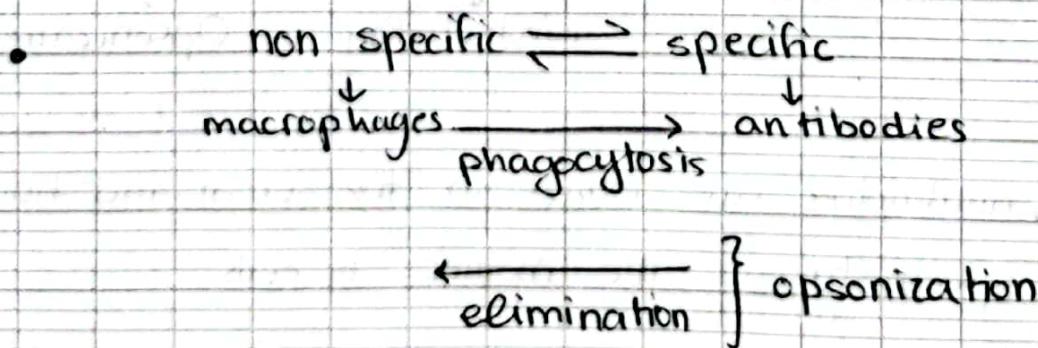
* Opsonization:

(AB binding cannot by itself kill a microbe, so it is eliminated either by opsonization or compliment proteins)

- Macrophages have receptors for the constant region of binded antibodies.
→ antibodies create a molecular bridge between the target and the phagocyte. (to facilitate the adherence).

↳ This is called opsonization.

- Then, macrophage undergo phagocytosis and digest the antibody coated cell.

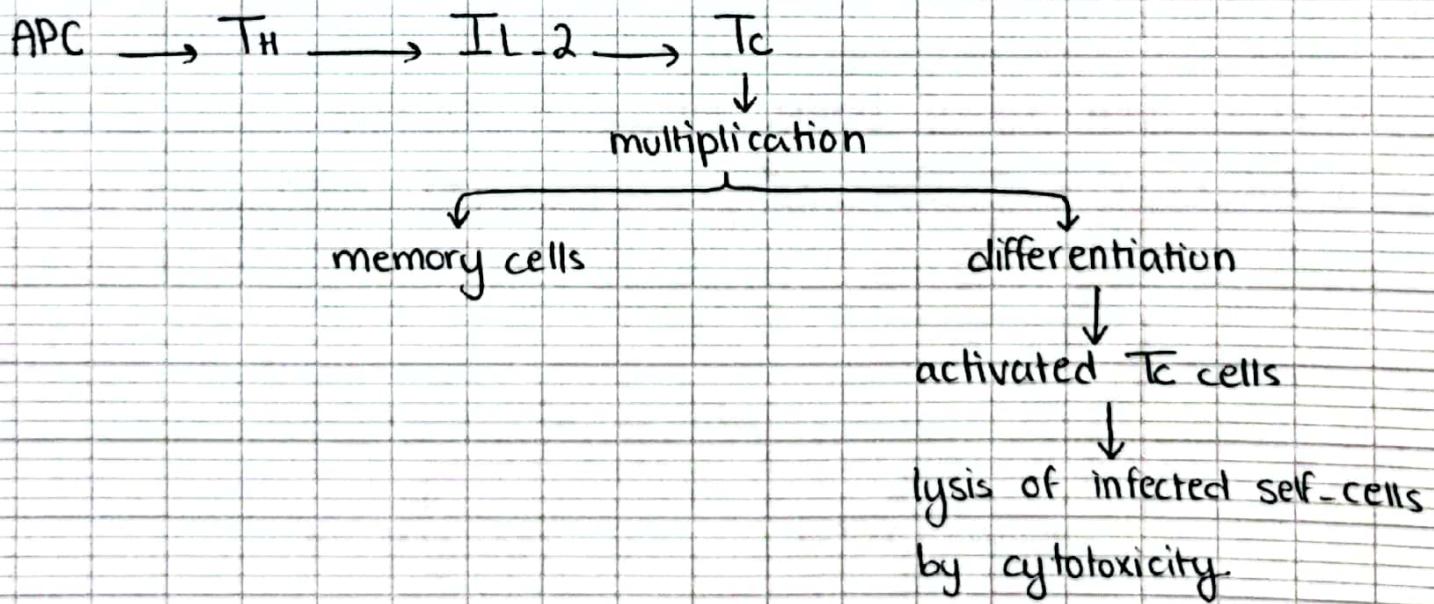


* Compliment Proteins:

- plasma proteins (named C₁ → C_n) bind to the constant region of antibodies binded to antigens (immune complex).
< C₁ binds first>
- C₁ activates the other components. → this is called ^{complement} cascade.
- The cascade leads to the formation of a complex of a membranal attack. → Complete destruction of the immune complex.

→ Specific cell mediated immune response

(selected Tc cells recognize IL-2 not the APC)

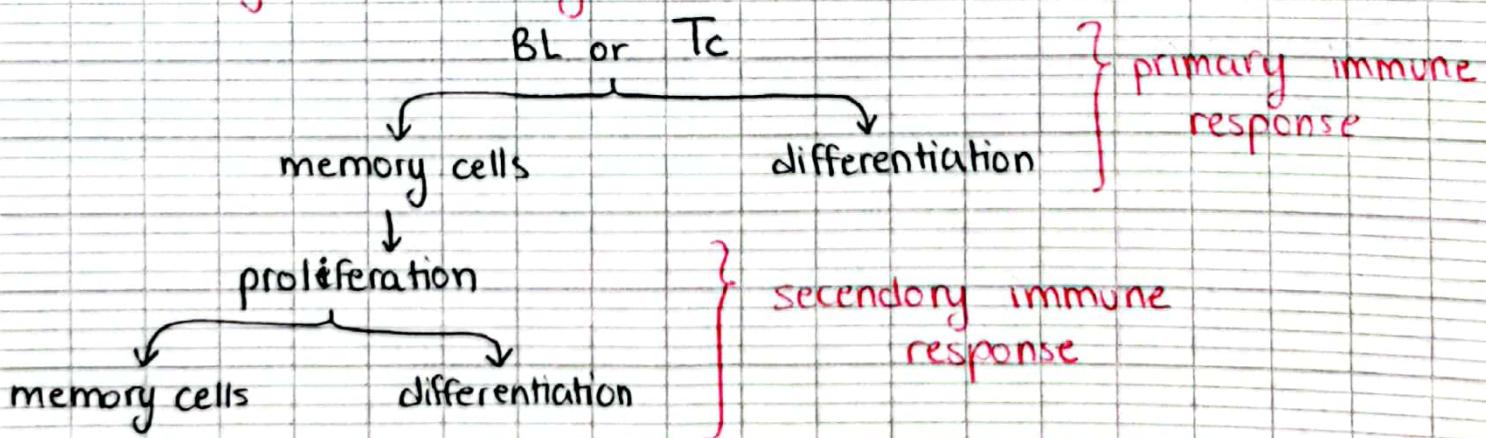


- Tc cells (expressing different TCR) that are specific to the antigen undergo clonal selection.

* Cytotoxicity:

- 1) Tc cells contain cytoplasmic granules
 - perforin
 - granzymes
- 2) Tc cell recognize infected self cell and bind to the HLA-I peptide on the cell membrane through TCR.
- 3) It release perforin which then assembles into polymers that form a hollow channel through the membrane of the target cell.
- 4) Then, Tc releases granzymes that penetrate into the target cell through the polyperforin channels.
- 5) Granzymes cause the degradation of DNA → leads to death of the cell
- 6) Tc cell detaches from the killed target and it is ready to kill other targets carrying the same HLA I-peptide complex.

→ Immunological memory



- The secondary response is comparatively faster, more amplified and more persistent.

- Immune memory provide long-term protection (importance)

→ Specific terms :

- toxoid = attenuated / killed toxin
 - . vaccine
- vigorous = healthy
- congenital = born with
- intracytoplasmic bacteria = bacteria that can invade the cell
- lysis = destruction
- sedimentation = ترسب (residue)
- isotonic solution = same concentration as the cell
- hypertonic = higher concentration
- hypotonic = lower concentration