

Immunology 434

Introduction to Immunology & Lymphoid System

First lecture

Objectives:

- To know the historical perspective of immunology.
- To be familiar with the basic terminology and definitions of immunology.
- Cells of immune response.
- To understand types of immune responses.
- To know about the lymphoid system.
- To understand T and B cell functions.

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<-This is very good video to begin the work with



Check this video it's a great overview of the lecrure

Colors of text:

Extra explanation: grey

❖ Historical perspective of immunology:

- In 1798 Edward Jenner began the science of Immunology. After noticed that Milkmaids who contracted cowpox (a mild disease) were subsequently immune to small pox.
- Louis Pasteur Introduced Weakened Virulence (attenuated: weakened, non-virulent strain whose exposure can confer resistance to disease.)

❖ Basic terminology and definitions of immunology:

Immunology: The study of mechanisms which humans and other animals use to defend their bodies from invading organisms.

Immunity: The state of protection from infectious disease.

Cluster of Differentiation (CD): Molecule with a CD designation has a characteristic cell surface protein are often associated with the cell's function (used for identification).

Antigen (Ag): Any substance (usually foreign) that binds specifically to a component of adaptive immunity.

Allergen: Non-infectious Antigens (that induce hypersensitivity reactions, most commonly IgE mediated type I reactions).

Immunoglobulin (Ig) or Antibodies: Consists of heavy and light polypeptide chain, it's secreted from plasma cells.

Adaptive Immunity: **Specific** host defenses that are mediated by T & B cells following exposure to Ag.

Innate Immunity: **Nonspecific** host defenses that exist prior to exposure to Ag.

Pathogen: A disease-causing organism.

Vaccination: deliberate induction of protective immunity to a pathogen.



Where & what are antigens?

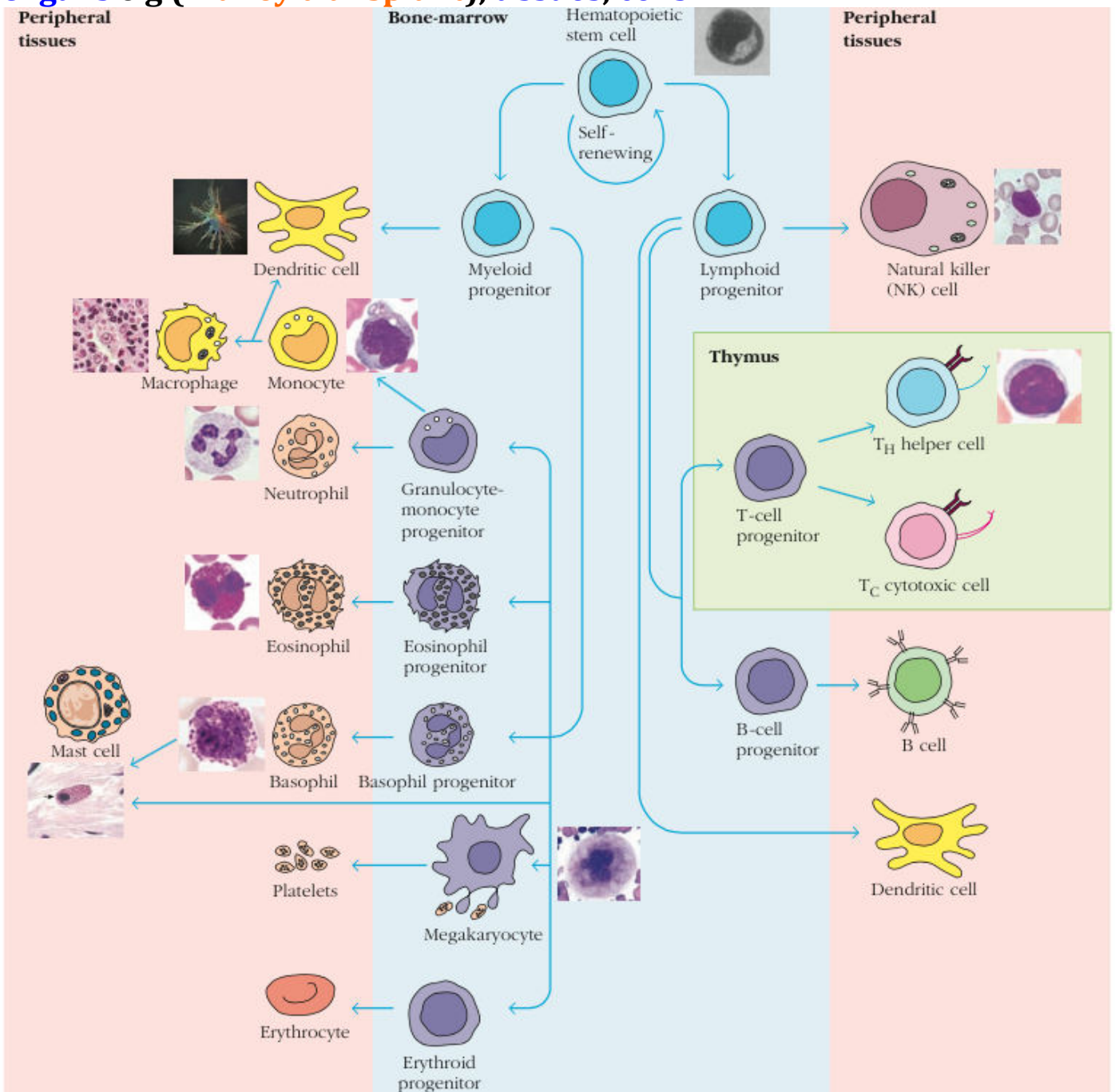
Microorganisms: Viruses, Bacteria, fungi and parasites.

Their related products: proteins, polysaccharides, and lipids.

Environmental substances

Drugs

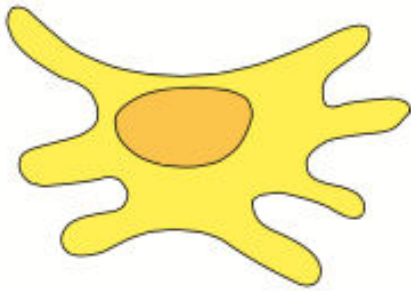
Organs e.g. (kidney transplant), tissues, cells





Antigen Presenting Cells:

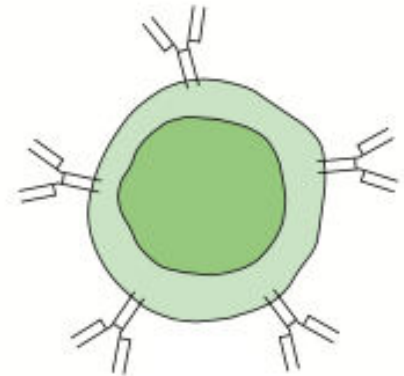
Dendritic cell



Macrophage



B lymphocyte



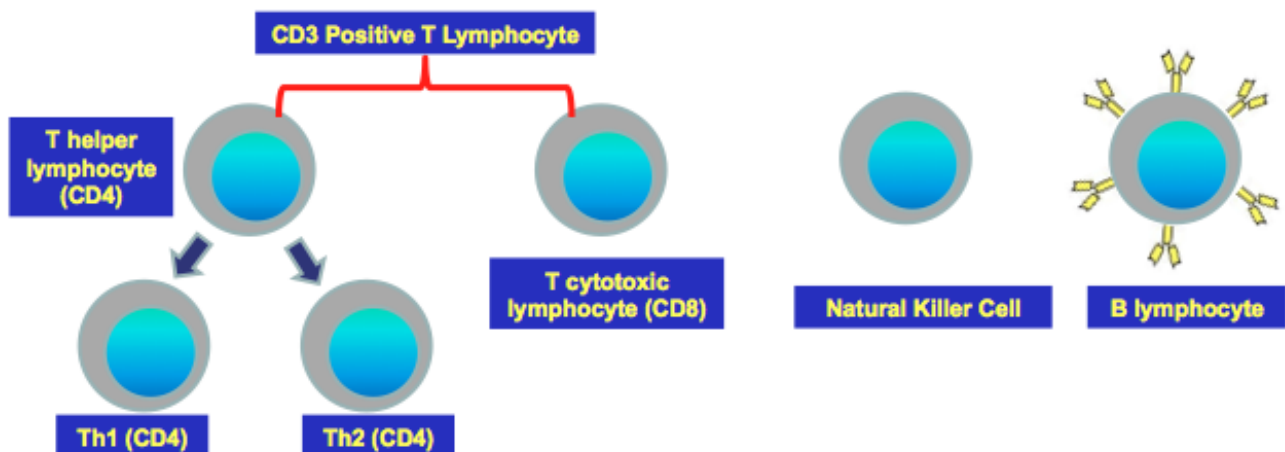
Fun facts:

- In Macrophages, macro means big and phage to eat
- There also garbage collectors' because they eat any foreign or dead molecules

* T and B cells cannot recognize the antigens directly in the adaptive immunity, it has to be presented and processed via **dendritic cells**, **macrophages** and **B-lymphocytes**.



Responding Cells:





Types of Immunity:



Innate Immunity	Adaptive Immunity
Nonspecific	Specific
Shorter duration	Response of an antigen specific B and T lymphocytes to an antigen
No memory	Exhibit immunological memory, specificity and self/nonself recognition

* Memory: programming the cells to recognize the pathogen quickly and strongly in the second exposure.

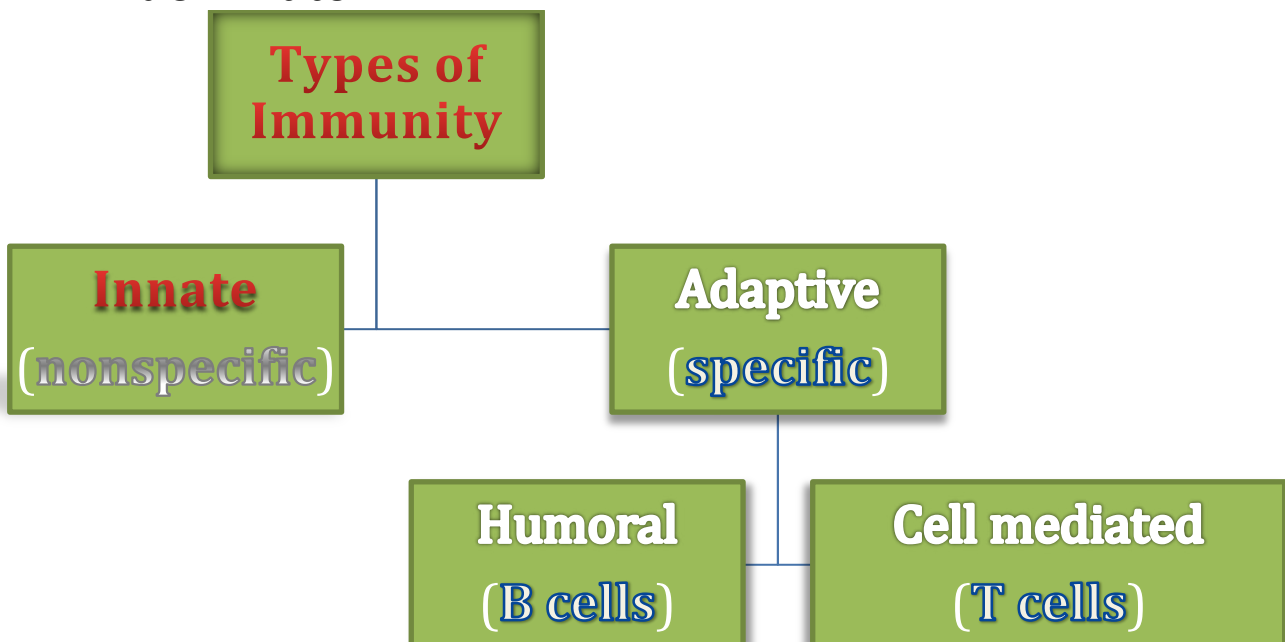
✓ Adaptive Immunity:

❖ Humoral Immunity

➤ Immunity that is mediated by antibodies (**B cells**)

❖ Cell Mediated Immunity

➤ Immunity response in which antigen specific **T cells** dominate.



❖ Lymphoid System:

Lymphatic System

Lymphoid Organs

Lymphatic Vessels

PRIMARY

SECONDARY

Thymus

Spleen

Bursa Of Fabricius (Birds Only)

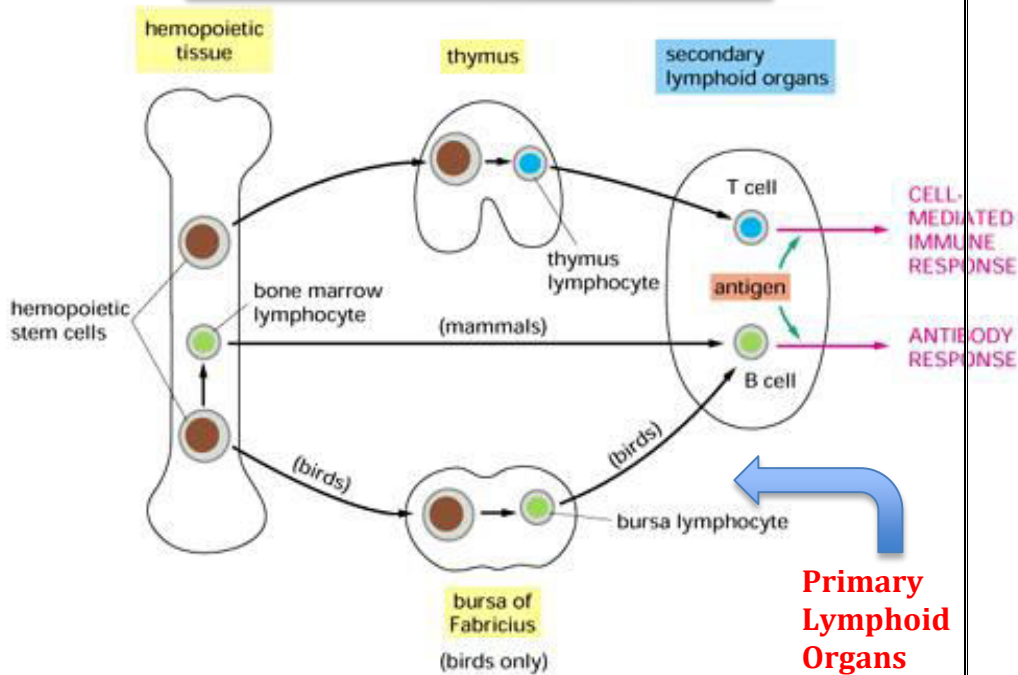
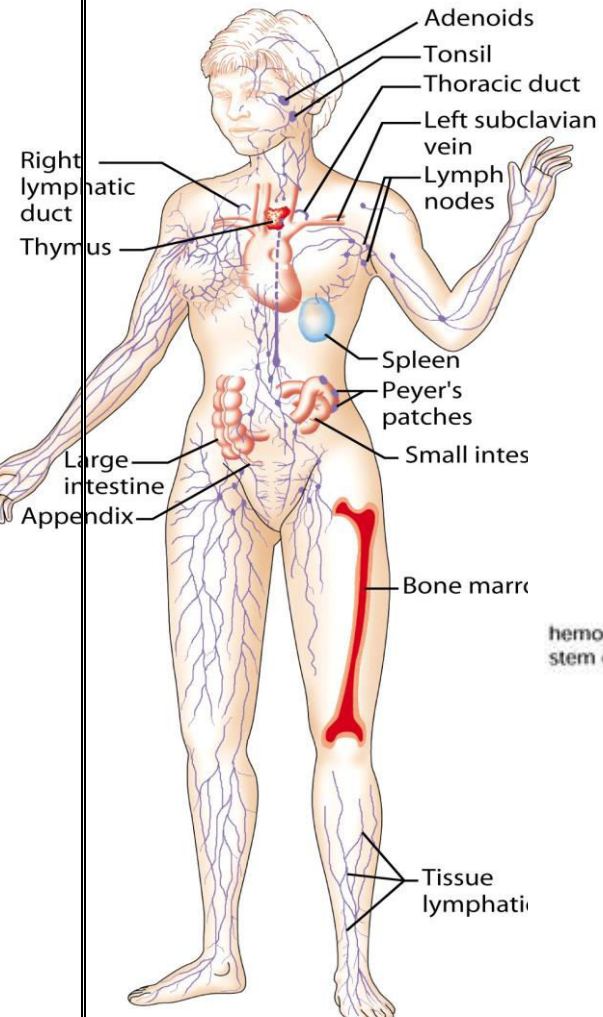
Lymph Nodes

Hemopoietic Cells (Bone Marrow)

Tonsils

MALT (Mucosa Associated Lymphoid Tissue) - Peyer's Patch

Appendix



Primary lymphoid organs (bone marrow & thymus): where the T lymphocyte will develop and mature.

*It is very important to know that T lymphocyte originate only in the bone marrow then it goes to the thymus to complete the maturation and development.

*B-lymphocytes mature and develop in bone marrow **without** going to the thymus.

Secondary lymphoid organs: where the antigen is going to meet either B or T lymphocytes.

- ❖ **Lymphoid series comprise of two main lymphocyte populations:**
 - **T cells** and **B cells**

❖ T cells:

T-Lymphocyte Differentiation:

- Originate in Bone Marrow then migrate to Thymus for development.
- T cell precursors differentiate into mature T cells in thymus
- Stem cells lack antigen receptors and CD3, CD4, CD8 surface markers
- During their passage through thymus they differentiate into T cells expressing either markers (CD4 or CD8)

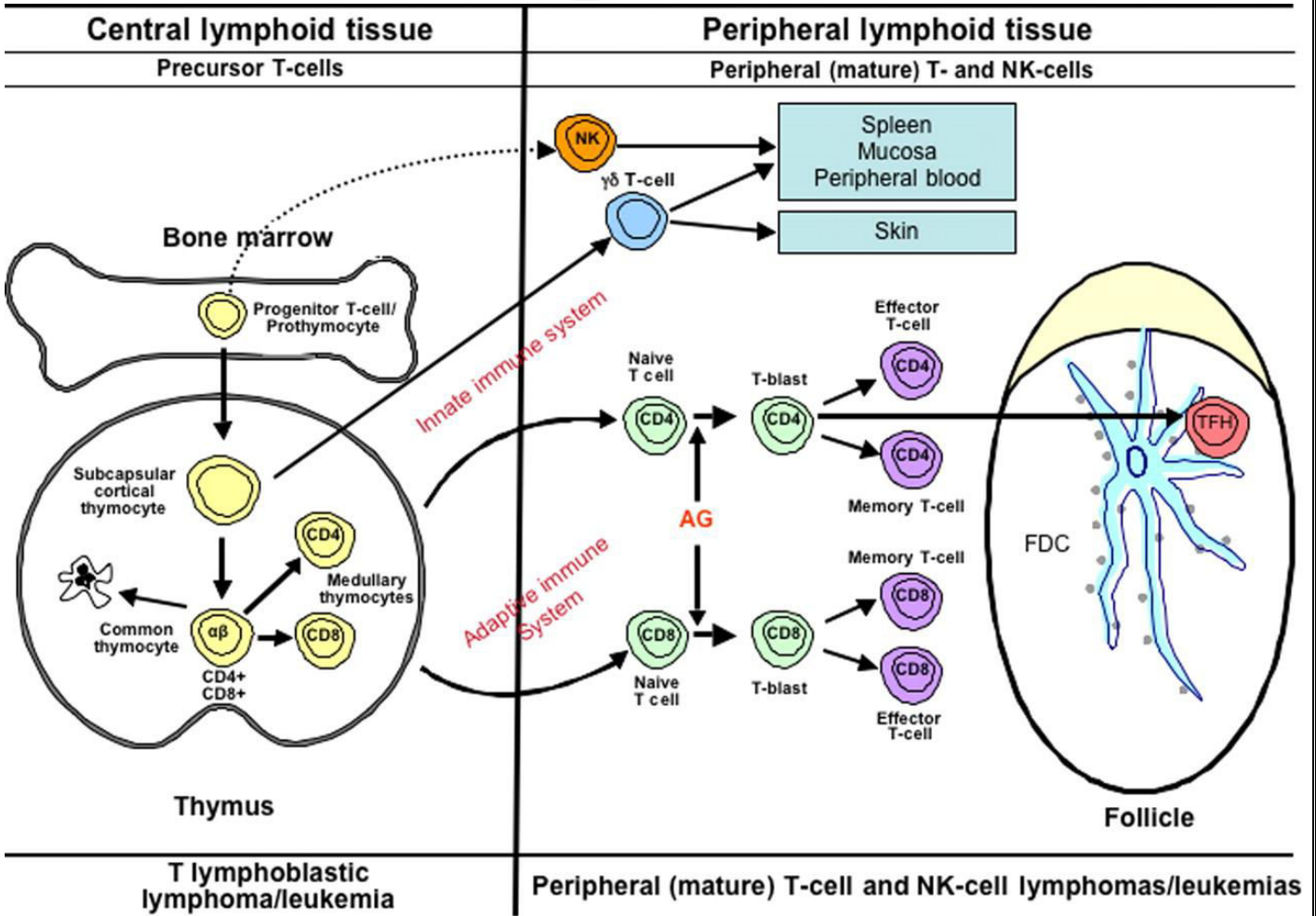
❖ T-Lymphocytes

- All T cells have CD3 proteins on their cell surface
- Mature T cells have either CD4 or CD8 proteins but **not both**.

❖ Functions of T helper CD4 Lymphocytes:

T helper 1 (TH1)	T helper 2 (TH2)
Help <u>CD8</u> cells to become activated <u>cytotoxic T cells</u> . Help <u>macrophages</u> in cell <u>mediated immunity</u> during <u>inflammatory response</u> .	Help <u>B cells</u> to develop into antibody producing <u>plasma cells</u> .

Extra explanation*:



❖ CD8 positive cells:

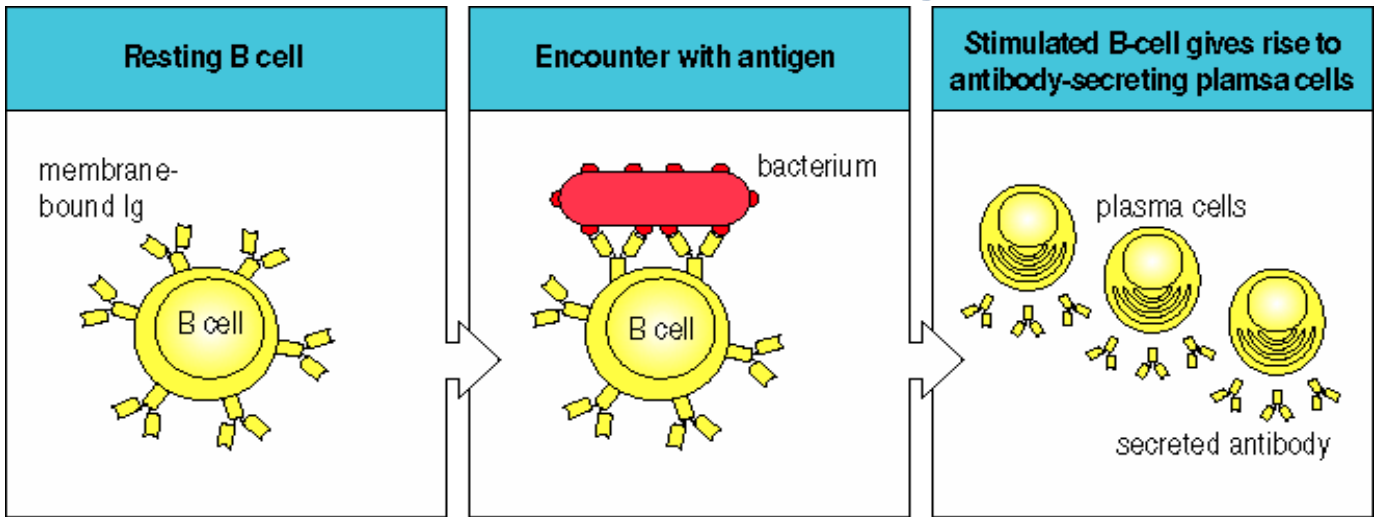
- About **35%** of **peripheral blood T cells**
- Perform **cytotoxic** functions
- They **kill virus-infected cells, tumor** and **allograft cells** (**transplant**)

❖ B cells:

➤ Origin

1. During embryogenesis – **fetal liver**.
 2. Migrate to **bone marrow** – final destination.
- They **do not** require **thymus** for maturation.
 - **B cells** display surface **IgM** which serves as **antigen receptor**
 - Surface **IgD** on some **B cells** also serves as an **antigen receptor**
 - **Pre B cells** are found in **bone marrow** and **mature B cells** are found circulating in **bloodstream**.

❖ The Antibodies (Immunoglobulins):



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Immunoglobulins (Ig)



Ig are glycoproteins

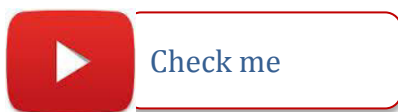
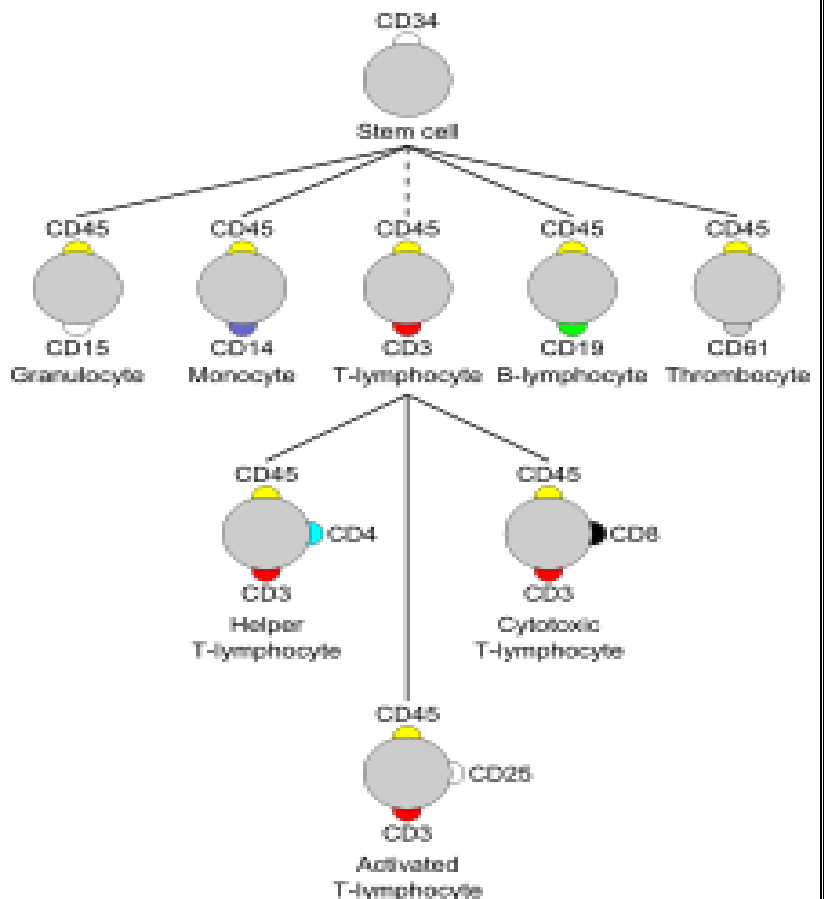
They differ in size, amount of CHO and biologic functions after binding to specific antigens.

❖ Summary:

433 Immunology team*

CD: is used for identification

- **Stem cells** lack **antigen receptors**
- **CD3** in **T lymphocyte**
- **CD4** in **helper T lymphocyte**
- **CD8** in **cytotoxic T lymphocyte**



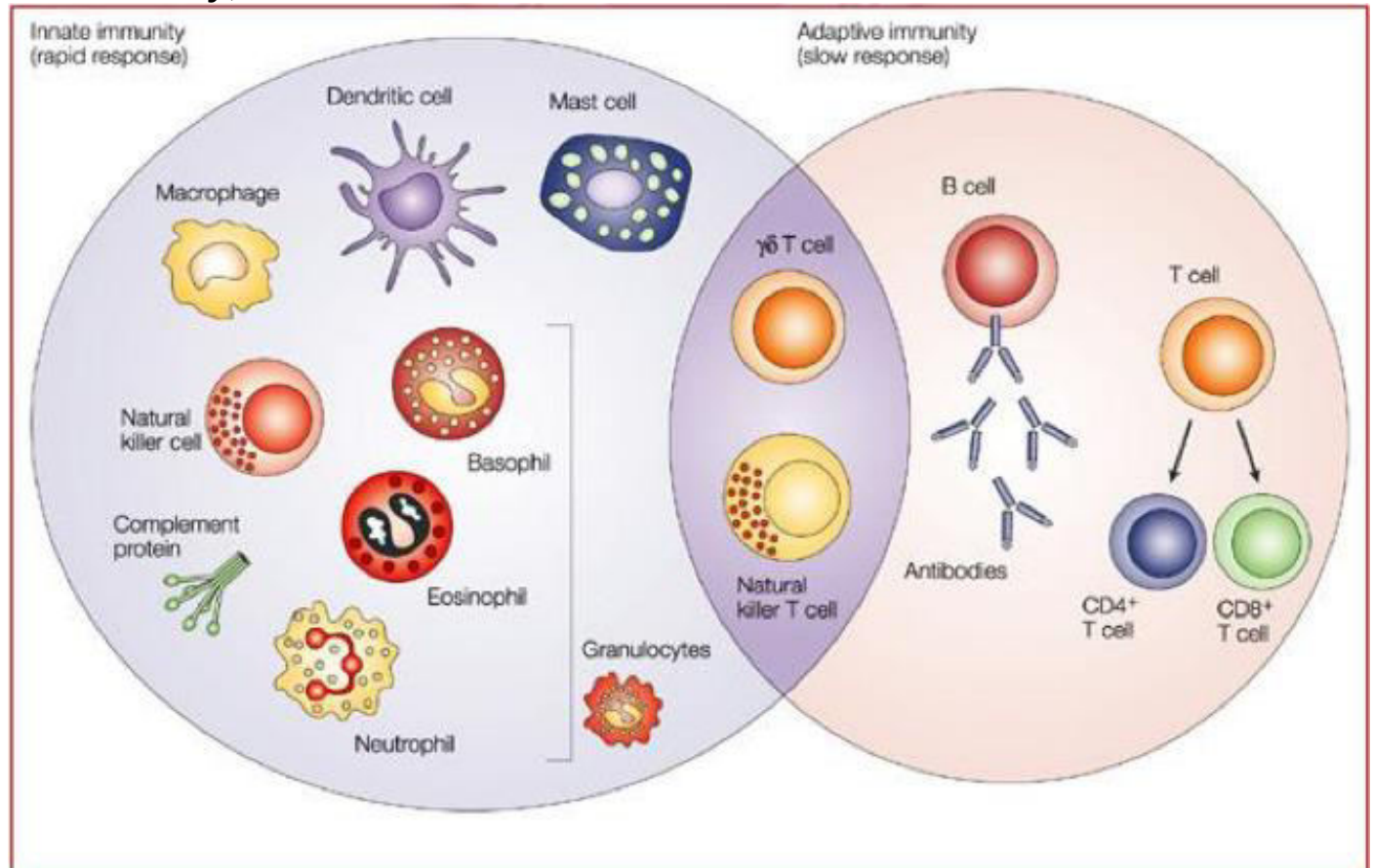
Types of Immunity:

1. Adaptive (Specific) Immunity

- Humoral Immunity (B-cells)
- Cell Mediated (T-cells)

2. Innate (Nonspecific) Immunity

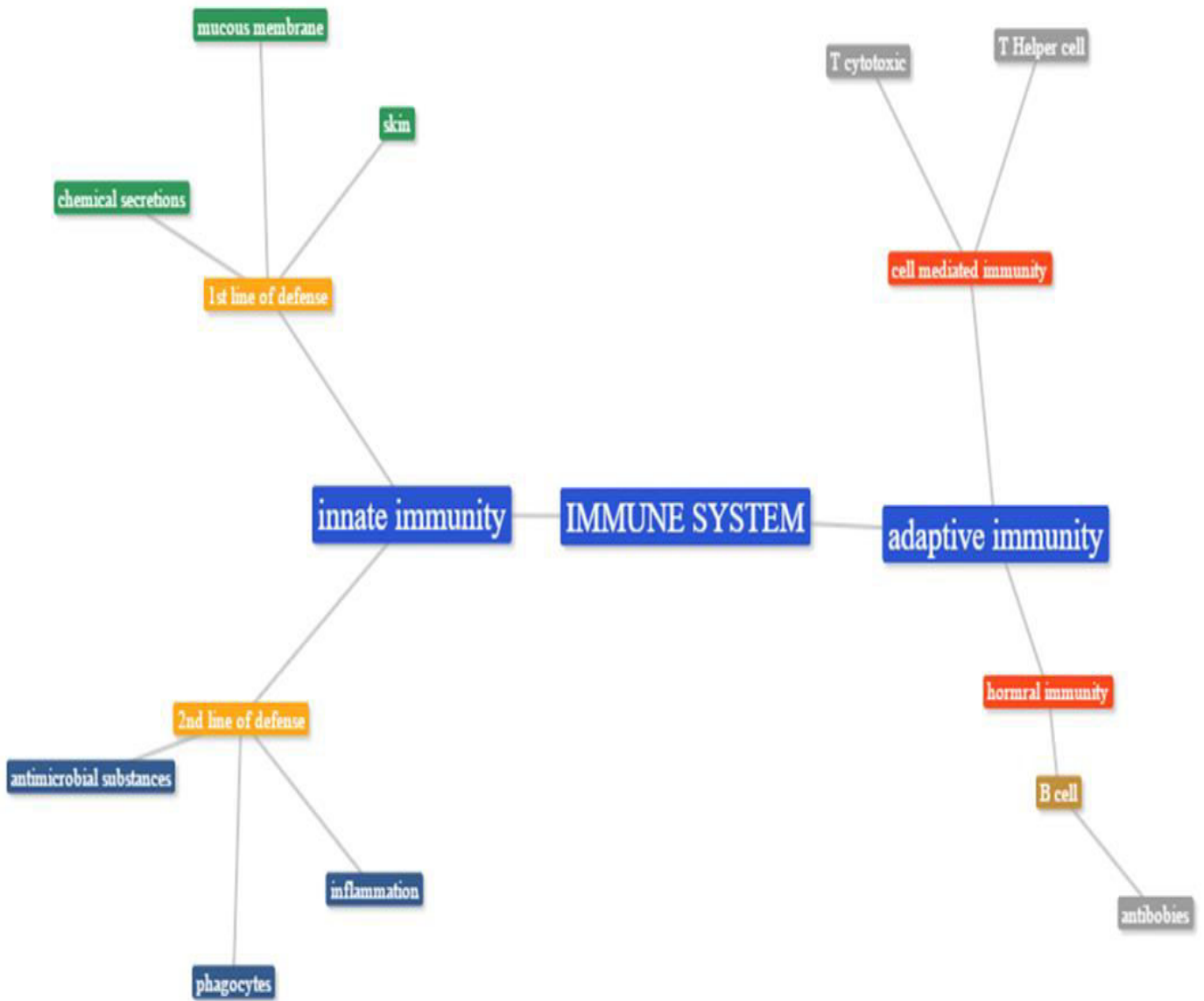
No memory, Natural



T & B cells:

	T cells	B cells
Origin	Originate in the Bone Marrow	1. During Embryogenesis (fetal liver) 2. Pre B cells (bone marrow) 3. Mature (bloodstream)
Maturation	Maturate in the Thymus	Don't need Thymus for maturation
Antigen Receptors	Lack Antigen Receptors. <u>Mature T Cells have CD4 protein</u> (T helper lymphocytes) <u>or CD8 protein</u> (T cytotoxic lymphocytes) but not both.	They display IgD and \ or IgM (serve as antigen receptors)

Mind Map





MCQs:

1) Innate immunity is all of following except:

- a. Has no memory
- b. Natural immunity
- c. Acquired immunity
- d. Prior to antigen

2) Immunoglobulin (Ig) is secreted from:

- a. Stem cells
- b. Plasma cells
- c. Monocytes
- d. Dendrite cells

3) One of the following is NOT a secondary lymphoid organ:

- a. Thymus
- b. Spleen
- c. Tonsils
- d. Appendix

4) Which of the following helps B cells to develop into antibody producing plasma cells?

- a. CD4
- b. CD8
- c. CD3
- d. CD4 and CD8

5) What is the final destination of B cells?

- a. Thymus
- b. Bone marrow
- c. Fetal liver

d. Tonsils

6) Began the science of Immunology

- A) Edward Jenner
- B) Louis Pasteur
- C) Gregor Mendel

7) Attenuated (weakened) bacteria cause a disease

- A) True
- B) False

8) The state of protection from infectious disease:

- A) immune
- B) Immunity
- C) Immunology

9) Antigen presenting cell (APC):

- A) T cells
- B) Natural killer (NK)
- C) Dendritic cell

10) Humoral immunity mediated by:

- A) T cells
- B) B cells
- C) Macrophages

11) Non-specific, and second line of defense:

- A) Adaptive immunity, antibodies
- B) Skin
- C) Phagocytes WBCs

Answers: 1- C 2- B 3- A 4- A 5- B
6- A 7- B 8- B 9- C 10- B 11- C