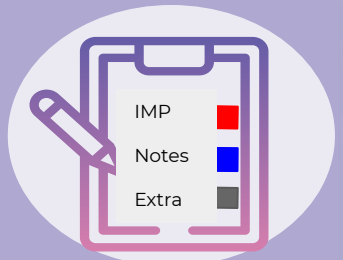
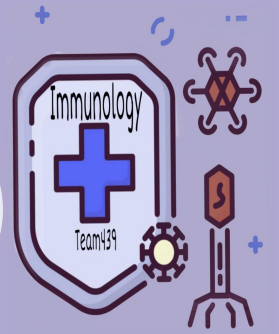
Introduction to Immunology





Objectives

01

To know the historical perspective of immunology

02

To be familiar with the basic terminology and definitions of immunology

03

To recognize immune response cells

04

To understand types of immune responses

05

To know about the lymphoid system

06

To understand T and B cell functions

What is Immunology?

Word Origin:

- **Immune** (Latin - 'immunus')
- To be free, exempt.

Immunity: The state of protection from infectious disease.

Definition of immunology:

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

such as bacteria, viruses, parasites and toxins.

Here is a helpful video which explains the basic of immunology (the video Explains all 6 lectures):

Definitions

Vaccination (inoculating)

deliberate induction of protective immunity to a pathogen.
*pathogen: a disease causing organism

Allergen

noninfectious antigens that induce hypersensitivity reactions, most commonly IgE-mediated type I reactions.

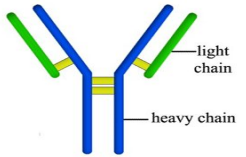
Antigen (Ag)

any substance (usually foreign) that binds specifically to a component of the adaptive immunity.

Examples of **antigens**:
-Microorganisms (bacteria, viruses, parasites) and their related products (proteins, polysaccharides, lipids).
-Environmental substances (pollens, soil component).
-Drugs (allergic reactions against certain drugs).
-Organs (kidney transplant), tissues, cells.

Immunoglobulin (Ig) or Antibodies

- 2 heavy and 2 light polypeptide chains linked to each other via disulfide bonds.
-Secreted from plasma cell (B cell)



Innate immunity

Nonspecific host defenses

adaptive immunity

Specific host defenses

438

There's a difference between antigens and immunogens. Not all antigens induces an immune response. Antigens that induce an immune response are called immunogens. So all immunogens are antigens but not all antigens are immunogens.

History Behind Immunology

1789 Edward Jenner

Observation:

Milkmaids (girls who milked cow) who contracted cowpox (mild disease) were subsequently immune to smallpox (deadly disease).
. [Extra: cowpox is transferable from animals to humans]

Profound results:

- Jenner's technique of inoculating with cowpox to protect against smallpox.
- He began the science of immunology.

What are the symptoms for smallpox?
1-Scarring bumps
2-blindness
3-limb deformities

1849 Louis Pasteur

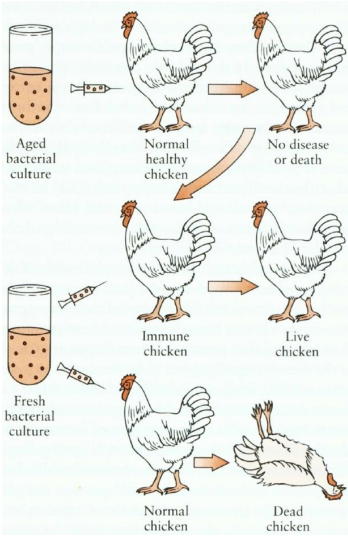
~Terminology~
-Virulence(n): ability to cause disease.
-Virulent(adj) disease: deadly disease.
-Attenuated(adj):weakened,non-virulent.
-Strain(n): سلالة
-Anthrax(n): الجمرة الخبيثة

Cholera in Chickens

He discovered that the virulence of a pathogen weakens with age (Example: chickens inoculated with old strains not only survive but become resistant).

Anthrax in Sheeps

a classical experiment on the same concept. He attenuated anthrax bacillus with heat and inoculated it on sheeps.

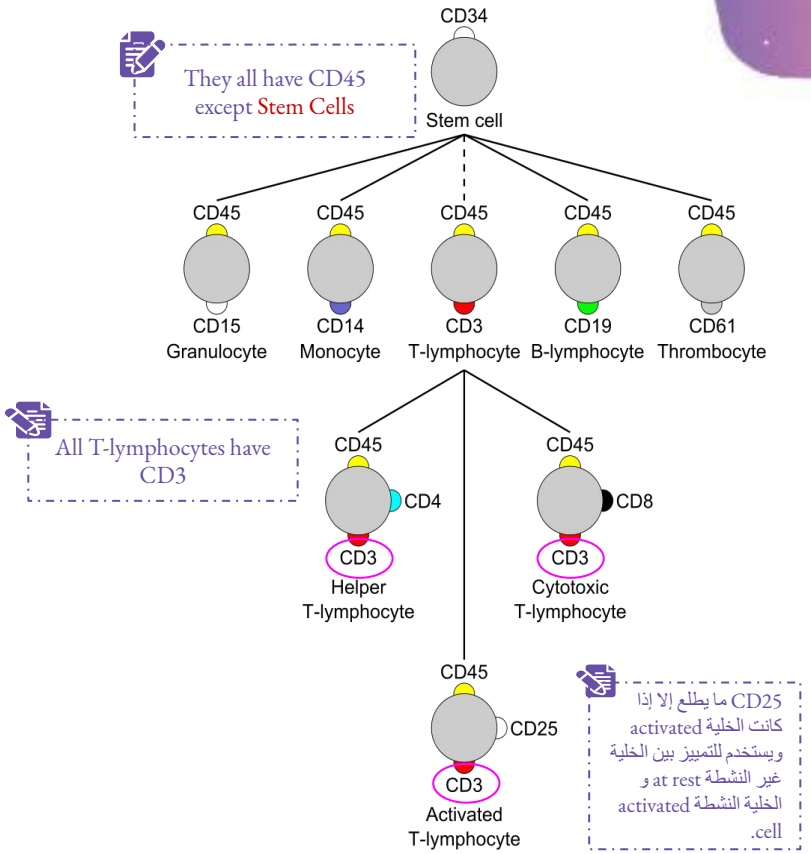


Cluster of differentiation (CD)

What is cluster of differentiation ?

molecule with a CD designation has a characteristic cell surface protein are often associated with the cell's function.

Under microscope we cannot distinguish between B and T lymphocytes, so we study the proteins on the surface to identify them.



Types of Immunity

Innate Immunity
First Line

they work mutually **not** separately

Adaptive Immunity
Second Line

Nonspecific host defenses that exist prior to exposure to antigen.

- Shorter duration.
- No memory.
- Immediate

Specific host defenses that are mediated by T & B cells following exposure to antigen.

- Response of a specific B and T lymphocytes to an antigen.
- develop immunological memory.
- specificity.
- self/non-self recognition.

Recognize whether the body (antigen) is from inside or outside the body. Example: autoimmune disease.

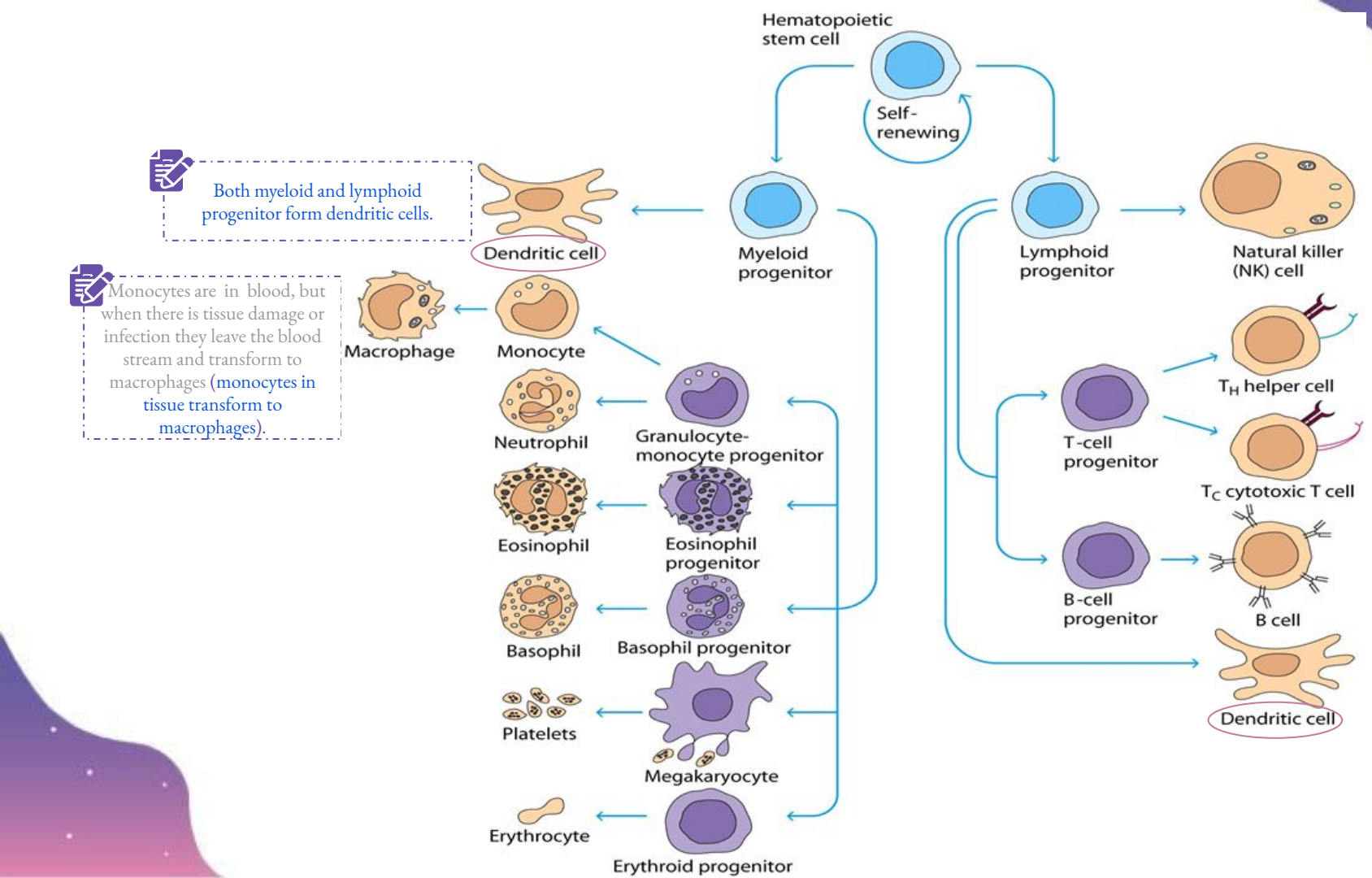
Humoral Immunity

Immunity that is mediated by antibodies, (B cells). response takes place in blood and lymph

Explanation:
1-Antibodies produce by (B-lymphocytes)
2-antibodies are found in body fluid (blood and lymph) > humeral means fluid (latin)

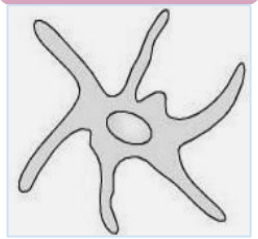
Cell Mediated Immunity

Response in which antigen specific T cells dominate. response takes place inside the cell

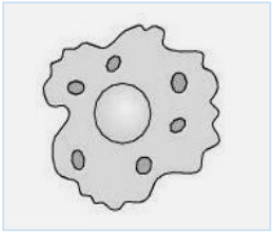

Hematopoietic stem cell
Self-renewing
Both myeloid and lymphoid progenitor form dendritic cells.
Dendritic cell
Myeloid progenitor
Lymphoid progenitor
Natural killer (NK) cell
Monocytes are in blood, but when there is tissue damage or infection they leave the blood stream and transform to macrophages (monocytes in tissue transform to macrophages).
Macrophage
Monocyte
Neutrophil
Granulocyte-monocyte progenitor
Eosinophil
Eosinophil progenitor
Basophil
Basophil progenitor
Platelets
Megakaryocyte
Erythrocyte
Erythroid progenitor
T-cell progenitor
T_H helper cell
T_C cytotoxic T cell
B-cell progenitor
B cell
Dendritic cell

Antigen Presenting Cells (APC)

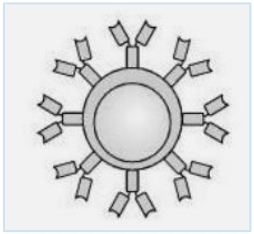
- Dendritic Cell



- Macrophage



- B Lymphocyte



T-lymphocytes can recognize other cells after antigen presenting cells process it

Antigen Responding Cells

The receptor of T-lymphocyte recognizes the antigens then differentiate

- CD3 Positive T Lymphocyte
  - T Cytotoxic Lymphocytes (CD8)
  - T Helper Lymphocytes (CD4)
    - Th1 (CD4) — T Helper 1
    - Th2 (CD4) — T Helper 2
- Natural Killer (NA)
- B Lymphocyte

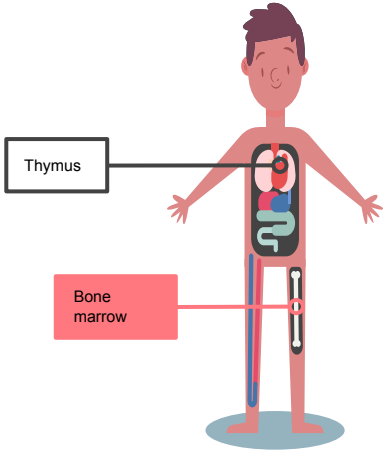
Lymphoid System

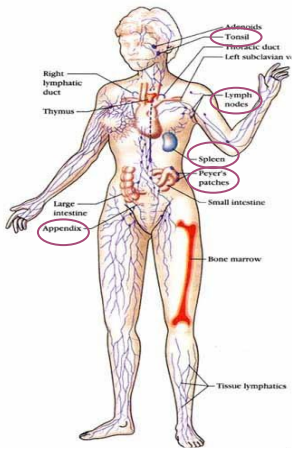
Lymphatic vessels

Lymphoid organs

- **Primary lymphoid organs:**
  (Responsible for Development & Differentiations of immune cells)
  Bone marrow and Thymus

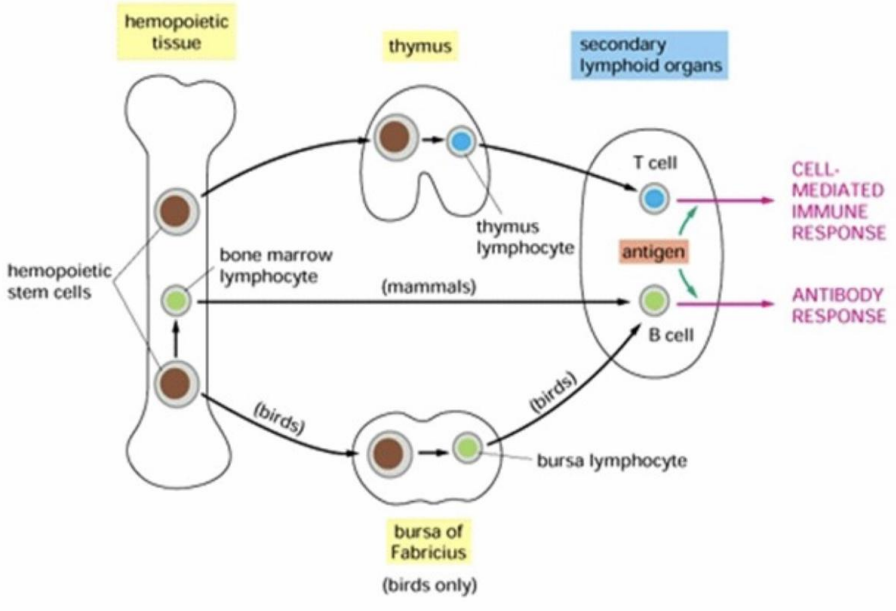
- **Secondary Lymphoid organs :**
  (where the immune response occurs)
  Spleen - Lymph nodes - Tonsils - MALT (Mucosa Associated Lymphoid Tissue) - Peyer's patches - Appendix .





T-Lymphocyte Differentiation

- T cells 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)



Note: B cells -> bone marrow (mature)
T cells -> bone marrow (immature) -> Thymus (maturation)

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 Lymphocytes :

(CD4 Lymphocytes (T helper 1 and 2: Th1 and Th2)

- T helper 1 (Th1) :
  - Help CD8 cells to become activated cytotoxic T cells
  - Help macrophages in cell mediated immunity (Th1) during inflammatory response.

- T helper 2 (Th2) :
  - Help B cells to develop into antibody producing plasma cells

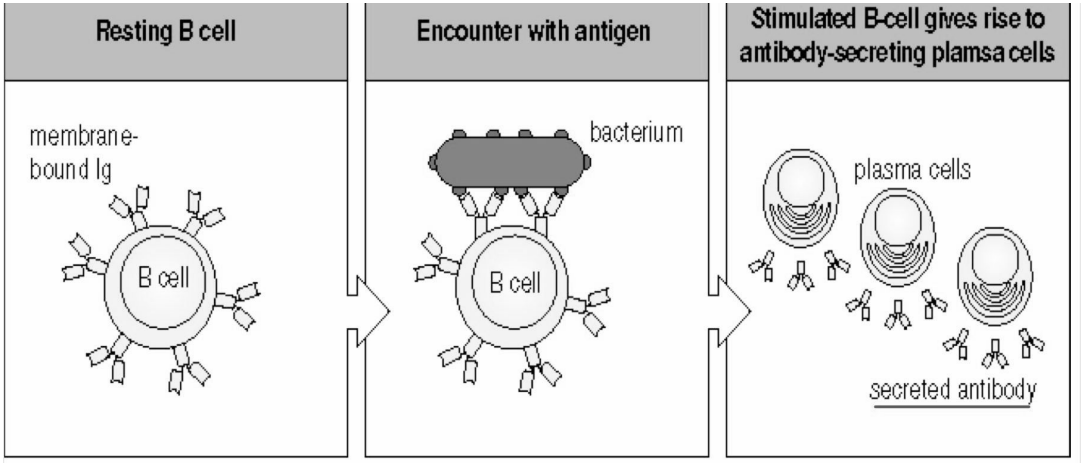
CD8 positive cells Cytotoxic T Cells:

- About 35% of peripheral blood T cells
- Perform cytotoxic functions
- They mediate the killing of:
  - Virus-infected cells
  - Tumors
  - Allograft cells (transplant)

B cells :

Origin	During embryogenesis – fetal liver (before birth) Migrate to bone marrow – final destination (after birth) * They do not require thymus for maturation
Display	They display Surface: IgM IgD They both serve as an antigen receptor
B cell progenitors :	- like Pro-B cells, Pre-B cells and immature B cells are normally found in bone marrow - Mature B cells are found circulating through body fluids (blood, lymphatic fluid) and lymphoid organs

The Antibodies



Antibodies are also called Immunoglobulins

- Immunoglobulins (Ig) are grouped into 5 classes:

IgG (gamma)
IgM (miu)
IgA (alpha)
IgD (delta)
IgE (epsilon)

Med436;
Remember:
GAMED

- Ig are glycoproteins
- They differ in size, amount of CHO and biologic functions after binding to specific antigens

Take home message :

- Normal healthy state is maintained by intact immune response either innate (natural immunity) and/or adaptive (acquired immunity after exposure to antigens) .
- Cell mediated immunity and humoral immunity is mediated by T and B lymphocytes respectively .
- Lymphoid system provides suitable environment for development, maturation and proper functioning of cells of immune system .

Quiz

Question 1:What do both myeloid and lymphoid progenitors form?
A - T Cells B- Erythrocytes C- Macrophages D- Dendritic cells
Question 2: How are the polypeptide chains connected linked in immunoglobulins?
A - Hydrogen bonds B- Disulfide bonds C- Glycosidic bonds D- Phosphodiester bonds
Question 3: Which of the following Help CD8 cells to become activated cytotoxic T cells?
A - T helper 1 B- T helper 2 C- B cells D- Antibodies
Question 4: Antibodies are :
A - Glycerol B- Lipoglycans C- Glycoproteins D- Polysaccharide

C :4
A :3
B :2
D :1

team leaders

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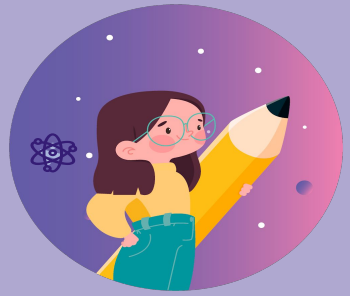
Faisal alotaibi



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