Microbiology 1

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Medical Immunology

- **Common terms:**
  - *Immunity*: Resistance to disease, specifically infectious disease.
  - *Immune system*: collection of cells, tissue and molecules that mediate resistance to infection
  - *Immune response*: coordinated reaction of the cells and molecules to infectious microbes comprises an immune response.
  - *Immunology*: the study of the immune system, including its responses to microbial pathogens and damaged tissues and its role in disease.

- **General info's about immune system:**
  - *Functions of the immune system*
    - ✓ *Defense* against infections
    - ✓ *Defense* against tumors
    - ✓ *Induce* pathologic inflammation
    - ✓ *Recognizes* and responds to tissue grafts and newly induced proteins
  - *Components of the immune system*
    - ✓ Innate immunity
    - ✓ Adaptive immunity
      - The cells of the innate and adaptive immune system are normally present as circulating cells in the blood and lymph, as anatomically defined collections in lymphoid organs, and as scattered cells in virtually all tissues.

	Innate immunity	Adaptive Immunity
Components	 1. Physical and chemical barriers 2. Phagocytic leukocytes 3. Dendritic cells 4. Natural Killer cells 5. Plasma proteins (complement)	 1. Humoral immunity (B cells, which mature into antibody secreting plasma cells) 2. Cell-mediated immunity (T cells, which mature into effector helper and cytotoxic T cells)
Activity	Always present	Normally silent
Response and potency	Immediate response, but has a limited and lower potency	Slower response (over 1-2 weeks, but is much more potent
Specificity	General: can recognize general classes of pathogens (i.e. bacteria, viruses, fungi, parasites) but cannot make fine distinctions	Recognizes highly specific antigens
Course	Attempts to immediately destroy the pathogen, and if it can't, it contains the infection until the more powerful adaptive immune system acts.	Slower to respond; effector cells are generally produced in 1 week and the entire response occurs over 1-2 weeks. However, this course can vary somewhat during different responses in an individual.

  - *Antigen-antibody*
    - ✓ Epitope part of antigen recognized by immune system
      - *Self-antigen:* originate within the body should not be attacked by the immune system in normal situations
      - *Non self – antigen*: can be bacteria, viruses, or fungi that cause infection and disease
    - ✓ Stimulates immune system to produce antibodies
      - *Antibodies*: called immunoglobulins, Y-shaped molecules are proteins manufactured by the body that help fight against foreign substances called antigens.
      - *Antigens* are any substance that stimulates the immune system to produce antibodies.
        - Can be :bacteria, viruses, or fungi that cause infection and disease or from within the body ("self-antigen"), but should not be attacked by the immune system in normal situations.

➢ *Location of immune system*

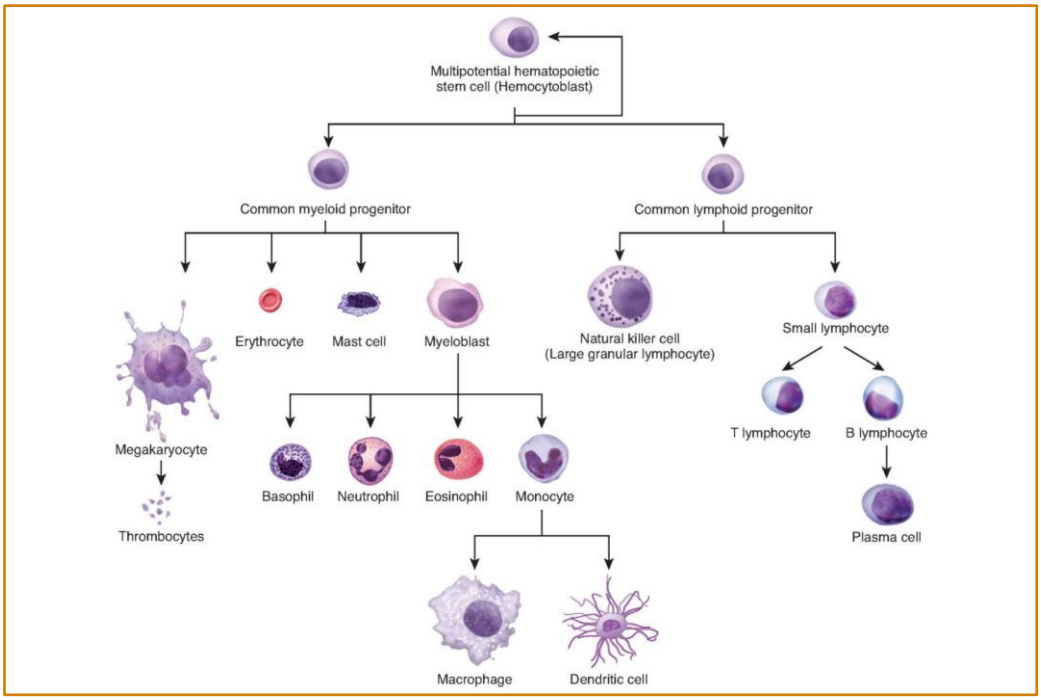
- ✓ Everywhere
- ✓ There are sites where immune cells are aggregated to fulfil their function (lymph nodes)
- ✓ The bone marrow is an important place for generation of immune and non-immune blood cells.

➢ *Mechanism of immune system*

- ✓ *Recognize*: What is self and non-self
- ✓ *Restore*: Homeostasis by eliminating the foreign object.
- ✓ *Remember*: The invading pathogen to respond better the next time it is encountered.
  - The immune system is not only active when danger arises, but is constantly sensing danger and is important for normal physiology and homeostasis similar to the heart and kidney.

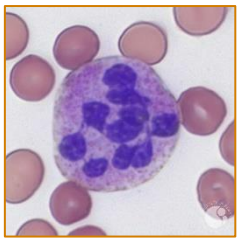
➢ *Origin of immune system*

- ✓ ***In:*** Bone marrow
- ✓ Stem cells → ***Myeloid + Lymphoid***
- ✓ ***Myeloid:***
  - Megakaryoblast (platetes)
  - Erythroblast (RBC)
  - Myeloblast (Neutrophils / Basophils/ Eosinophils) [granulocyte]
  - Putative mast cell precursor
  - Monoblast → Monocytes → Macrophage + Dendritic cell [APC]
- ✓ ***Lymphoid:***
  - Natural killer
  - Lymphoblasts [T cells + B cells]
- ✓ Macrophage, neutrophil → phagocyte
- ✓ White blood cells [lymphocyte]: T B cells , NK, granulocytes



➢ *Neutrophils*

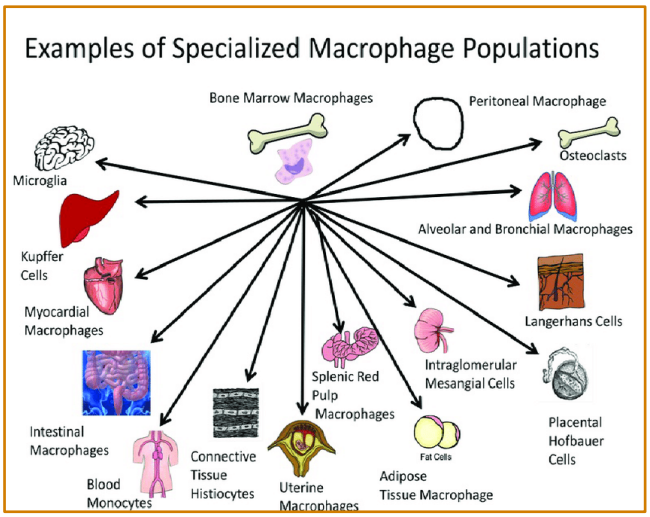
- ✓ Most abundant, 6 hours life span [Short lifespan], not stained
- ✓ Their production stimulated by G-CSF [granulocyte colony-stimulating factor]
- ✓ Nuclear → polymorphonucler [3-5 connected lobules]



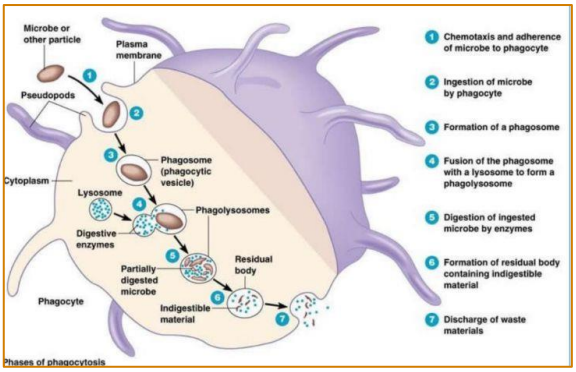
- ✓ ***Granules:***
  - *Specific:*
    - Lysozyme →Break NAM and nag in cell wall
    - Collagenase → breaks peptide bond In collagen
    - Elastase → breaks elastic fibers
  - *Azurophilic*
- ✓ ***Mechanism of fighting:***
  - Phagocytosis , neutrophil extracellular trap
  - NET → neutrophils may get their DNA out the cell and this DNA binds pathogens, and traps bacteria

➢ *Macrophages*

- ✓ *Originate* from monocytes, circulate in blood, tissue specific
- ✓ Once monocytes enter the tissue they mature and become macrophage → macrophage in different tissue have been given special names

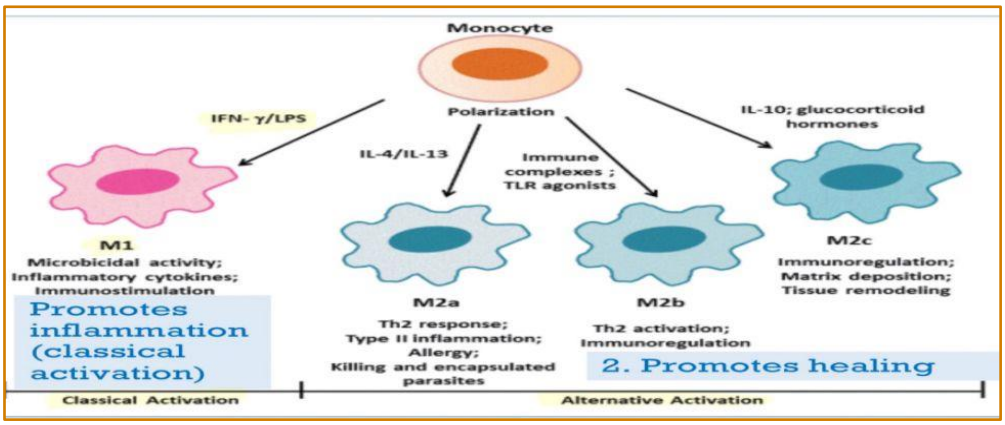


- ✓ ***Functions***
  - *Ingesting* microbe and dead cells
  - *Secrete* proteins called cytokines
  - Serve as APC to *activate* T cells
  - *Promote* repair of damaged tissue

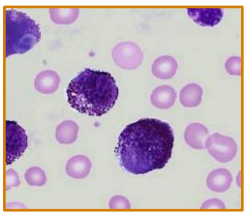


- ✓ ***Phagocytosis***
  - Eat → break → discharge, present
  - identify, ingest, and destroy microbes.
  - *Including* neutrophils and macrophages
  - Phagocytes also communicate with other cells in ways that promote or regulate immune responses.

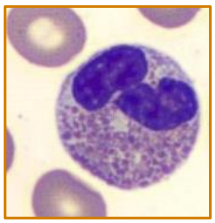
- *Monocytes response vary:*
  - ✓ IFN-Y , LPS → M1 → secret cytokines → *immunostimulation*
  - ✓ Inflammation already took place → M2 → *immunoregulation*



- *Mast cells:*
  - ✓ most important
  - ✓ From bone marrow. , present in the skin and Mucosal epithelium , mostly found in the Site of *allergy* → rich with granules filled with cytokines and histamine
  - ✓ *Receptors* for IgE & IgG antibodies



- *Basophils, Eosinophils*:
  - ✓ Don't have important role in the immune response
  - ✓ Basophils IgG & IgE receptors less than 1% of blood leukocytes
  - ✓ Eosinophils express cytoplasmic granules containing enzymes that are harmful to the cell walls
  - ✓ stained by acidophilic dyes.



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