

Basic Immunology

(Dentistry)

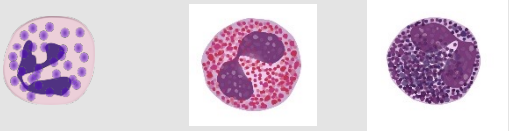

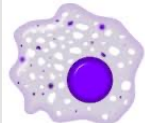

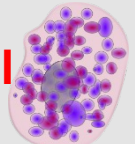
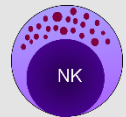
Lecture 3.-4.

Development and characteristics of the cells of the immune system.

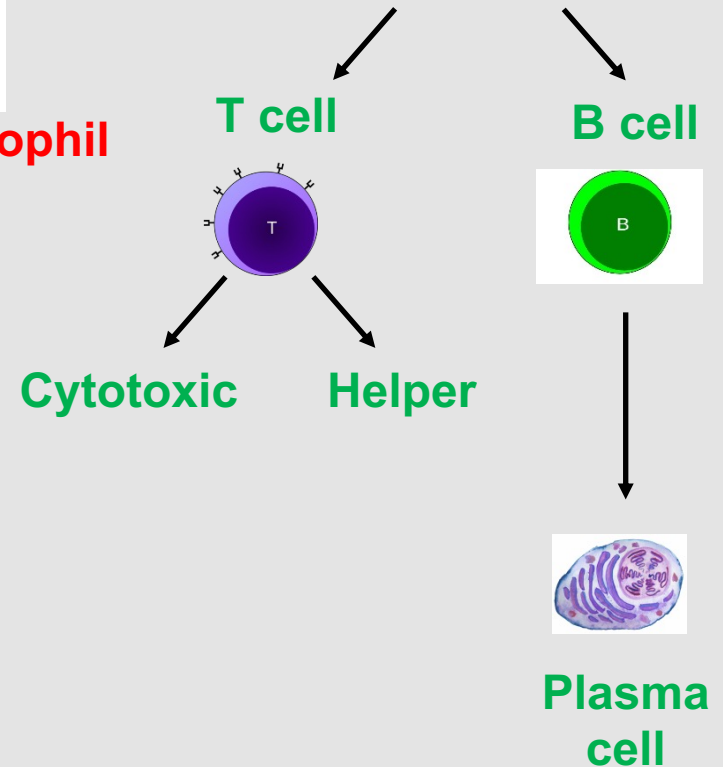
Ferenc Boldizsar MD, PhD

Cells of the innate and adaptive immune system

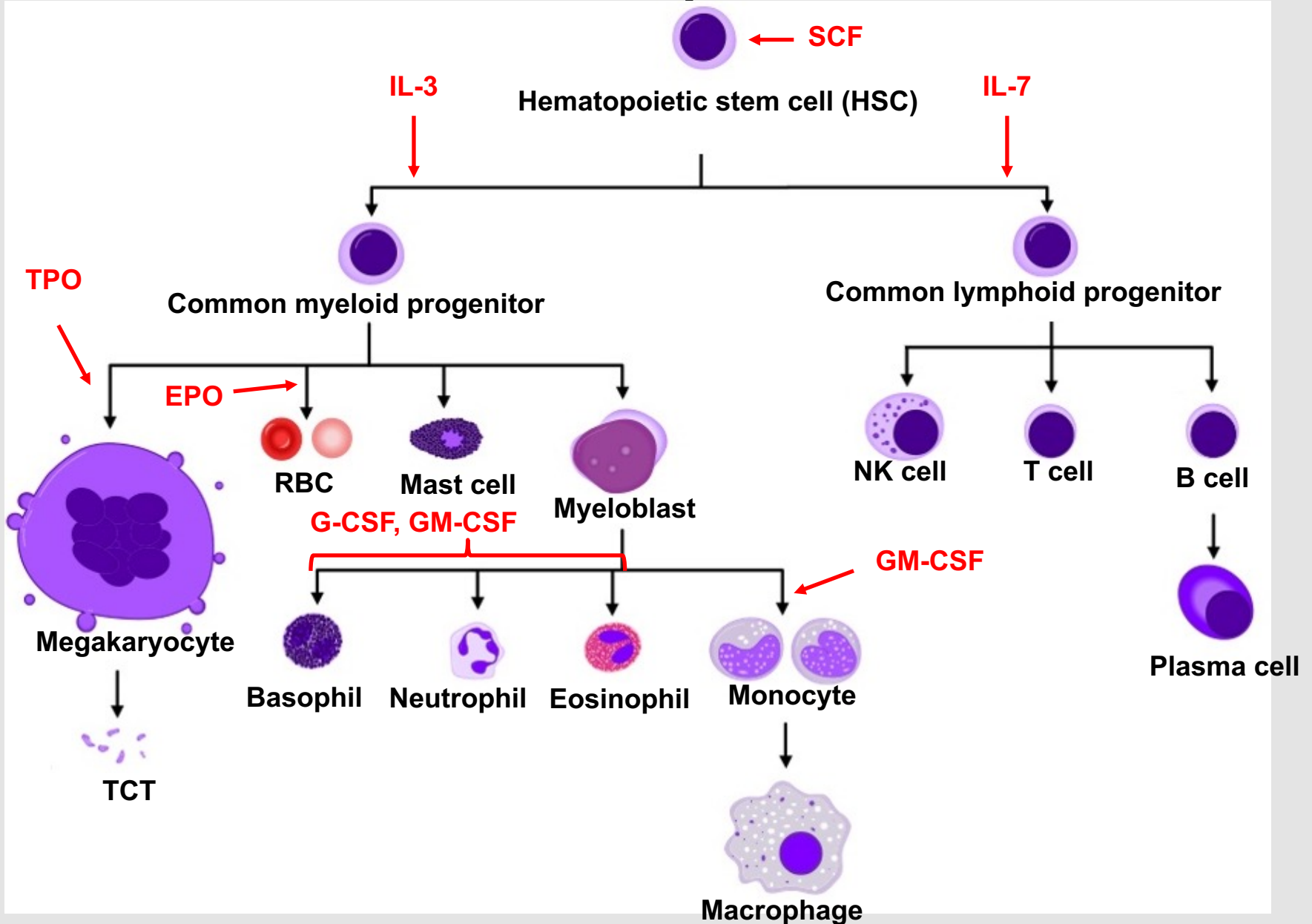
Innate:

- 1. Granulocytes:** 
neutrophil, eosinophil, basophil
- 2. Monocyte (blood), macrophage (tissues)**
 → 
- 3. Dendritic cell (DC), follicular dendritic cell (FDC)**

- 4. Mast cell**

- 5. NK cell (natural killer)**


Adaptive:



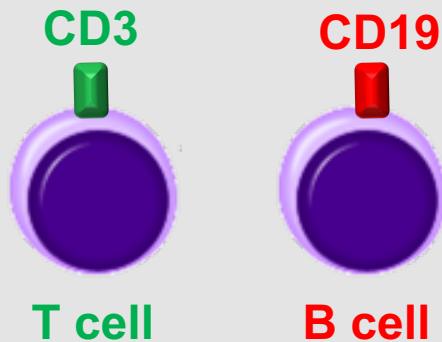
Hematopoiesis



CD markers

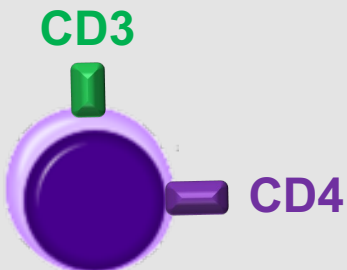


Certain cells (e.g. lymphocytes) cannot always be distinguished based on their morphology.



Different cells can be identified and distinguished by the molecules they express on the cell surface or in the cytoplasm.

IMMUNOPHENOTYPE: The characteristic molecular pattern of a cell type determined with the use of antibodies.



Such SURFACE MOLECULES were given a standardized nomenclature:

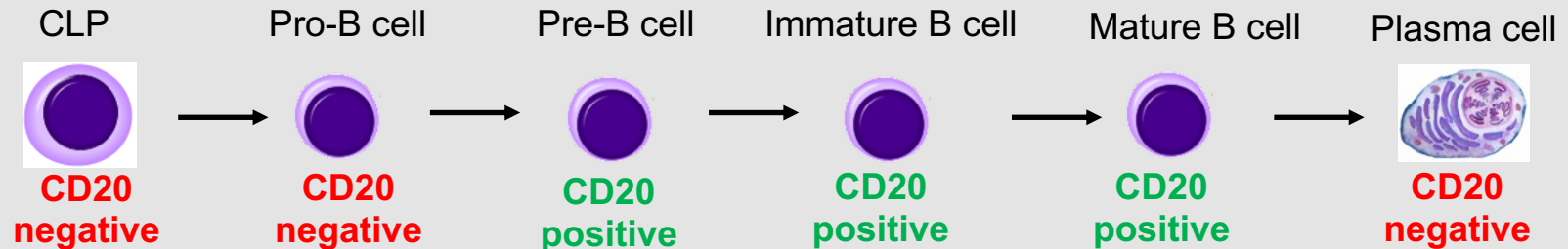
CD = Cluster of differentiation, usage: CD+number, e.g.: CD1, CD2, CD3, CD4, etc...

The structure and function of CD marker **varies!**

Example for immunophenotype:
CD3+/CD4+/CD8- → Helper T cell

Types of CD markers

- **Lineage markers:** Molecules expressed exclusively on certain cell lineages.
 - E.g.: CD3 → found on all T cells CD19 → found on all B cells
- **Maturation markers:** The immunophenotype might differ in the phases of cell maturation, certain molecules are only expressed on immature cells, others on mature, fully functioning cells, etc.
 - E.g.: CD20 (It is also a lineage marker of B cells, cannot be found on any other cells)

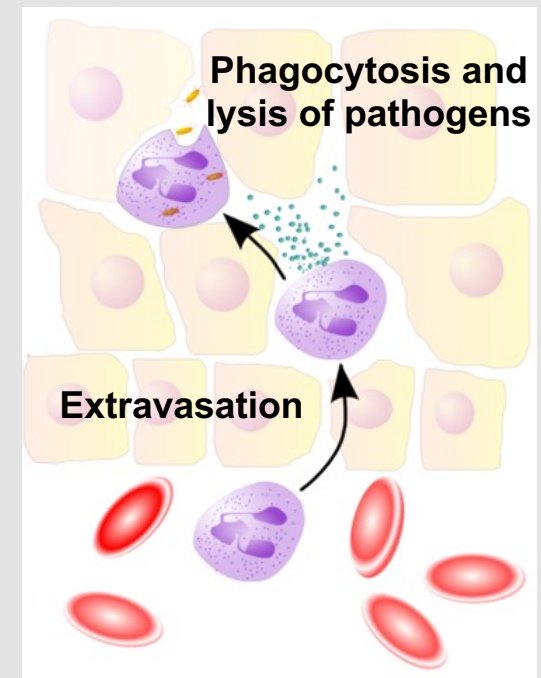
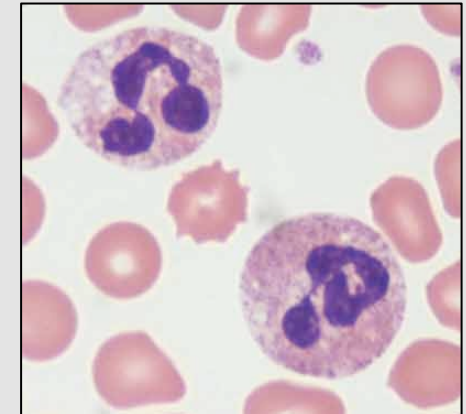


- **Activation markers:** Molecules expressed by activated cells, whereas resting cells either lack them completely or express them at low levels, e.g.:
 - CD25 (The alpha chain of the interleukin-2 receptor, IL-2R α , see later)
 - CD80 and CD86 (B7-1 and B7-2, so-called costimulatory molecules expressed by activated antigen presenting cells, see later)

Neutrophil granulocyte

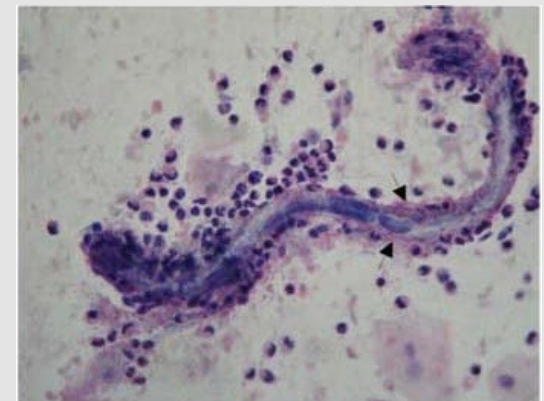
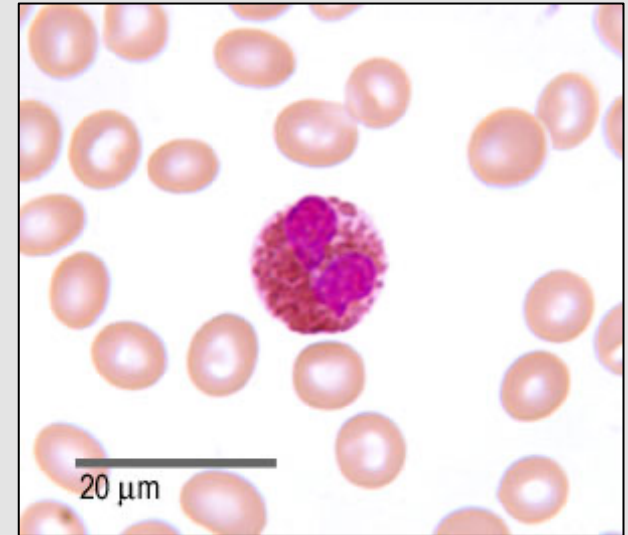
Leukocyte %	55-70
Main function:	Elimination of pathogens, removal of tissue debris
Recognition:	PRR, Fc receptor , Complement receptor
Content of granules:	Digesting enzymes
Elimination of pathogens:	Phagocytosis, respiratory burst, degranulation
Produced mediators:	Inflammatory cytokines
Fc receptor:	FcγR (binds IgG)
Role in diseases:	Inflammatory reactions

Red: Only possible after the activation of the adaptive immunity



Eosinophil granulocyte

Leukocyte %	2-4
Main function:	Defense against multicellular parasites
Recognition:	PRR, Fc receptor
Content of granules:	Toxic proteins, enzymes
Elimination of pathogens:	Degranulation
Produced mediators:	Prostaglandins, Leukotrienes, Inflammatory cytokines
Fc receptor:	FcεR (binds IgE)
Role in diseases:	Allergic reactions

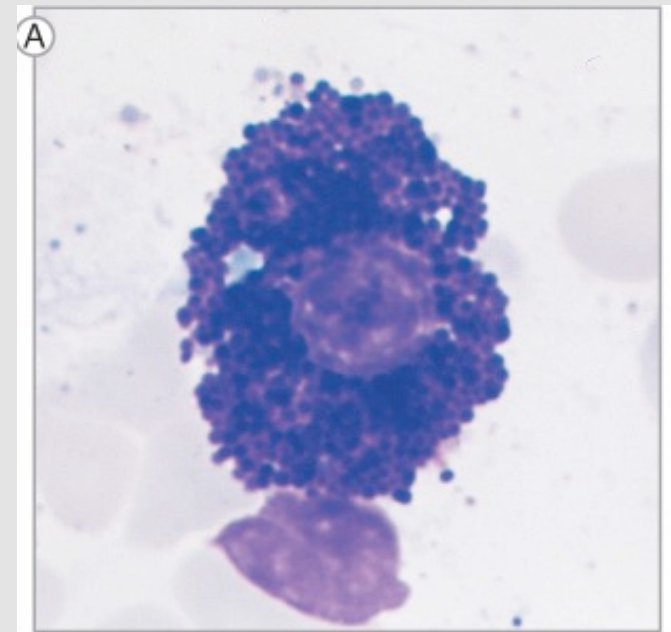
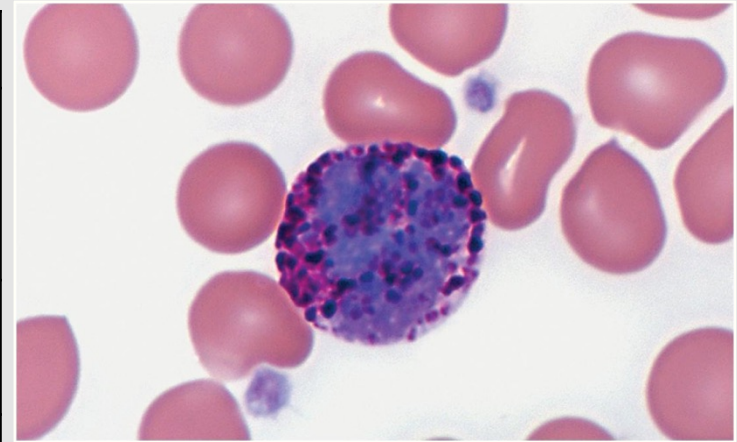


Red: Only possible after the activation of the adaptive immunity

Eosinophils surrounding a *Strongyloides stercoralis* larva. (sputum from a parasitic pneumonia case)

Basophil granulocyte

Leukocyte %	0-1
Main function:	Defense against multicellular parasites
Recognition:	PRR, Fc receptor
Content of granules:	Histamine, heparin
Elimination of pathogens:	Degranulation
Produced mediators:	Cytokines (e.g. IL-4), Leukotrienes
Fc receptor:	Fc ϵ R (binds IgE)
Role in diseases:	Allergic reactions

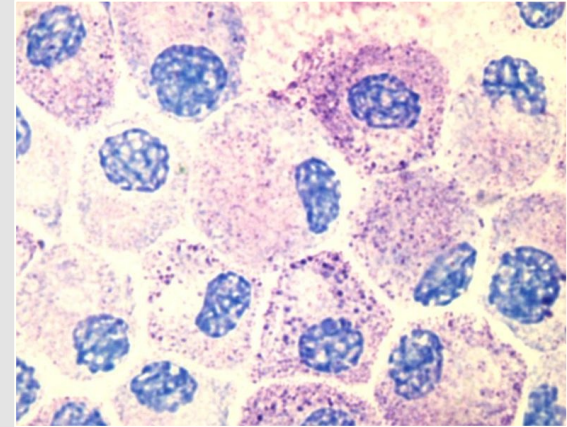


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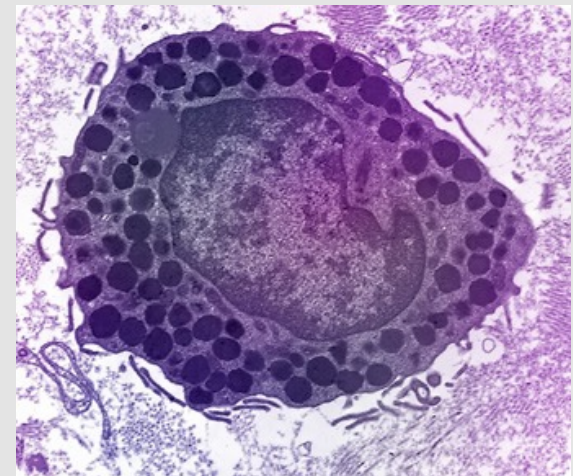
Mast cell (mastocyte)

Found in:	Tissues
Main function:	Defense against multicellular parasites
Recognition:	PRR, Fc receptor
Content of granules:	Histamine, heparin, enzymes
Elimination of pathogens:	Degranulation
Produced mediators:	Cytokines, Leukotrienes
Fc receptor:	FcεR (binds IgE)
Role in diseases:	Allergic reactions

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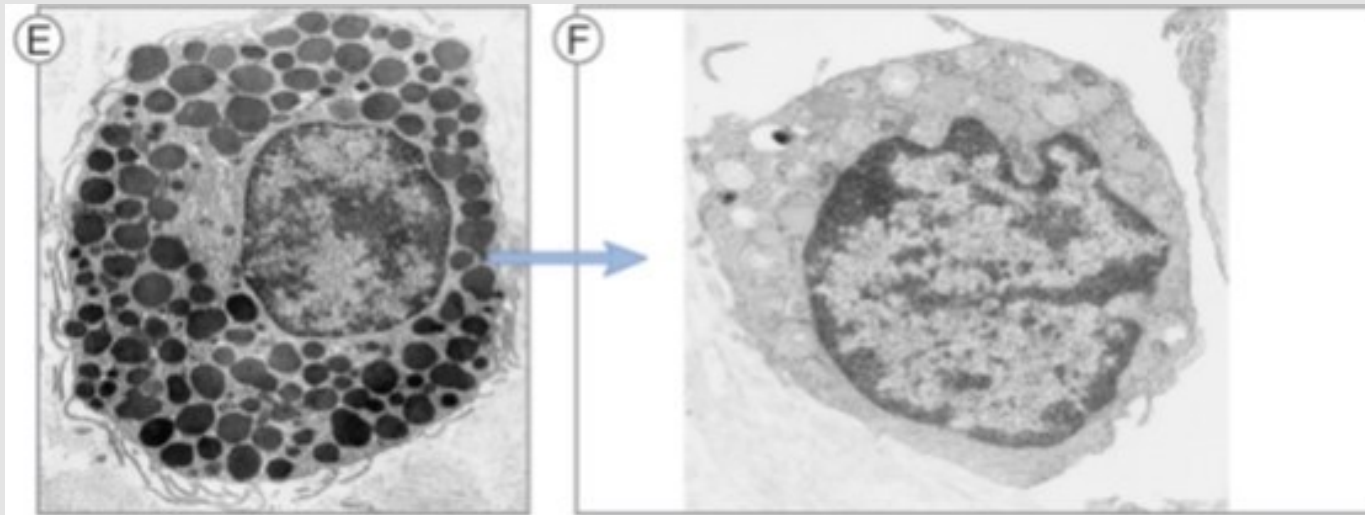
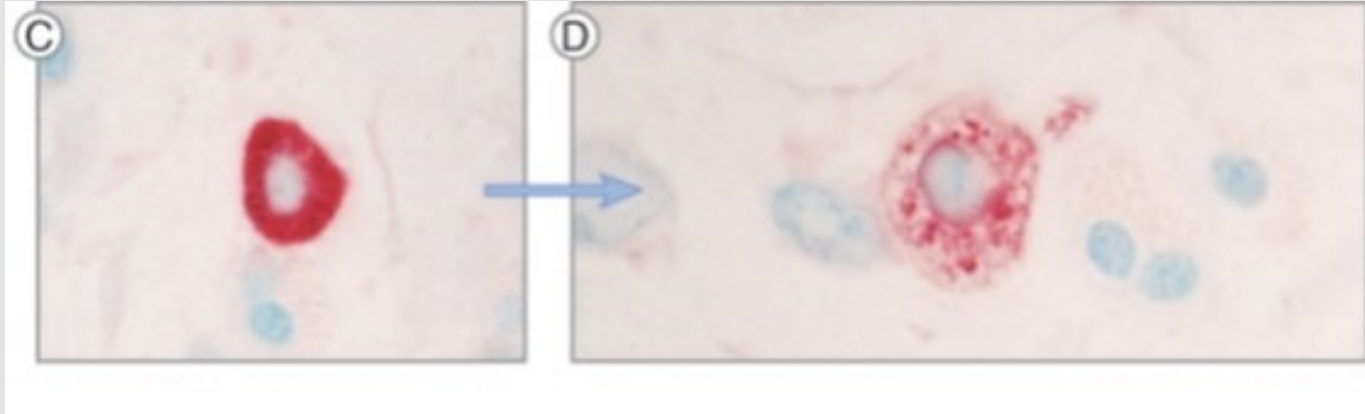


Cultured mast cells
(Toluidine blue staining)



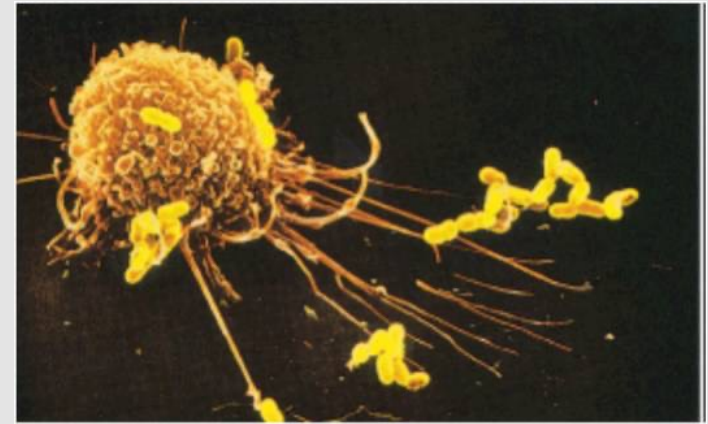
Mast cell (electron microscopy image)

Quick degranulation of a mast cell



Monocyte, macrophage

Leukocyte %:	2-8
Main function:	Phagocytosis, Antigen presentation, Cytokine production,
Site of antigen presentation:	Locally, in the tissues
Recognition:	PRR, Fc receptor , Complement receptor
Elimination of pathogens:	Phagocytosis, Respiratory burst
Produced mediators:	Cytokines
Fc receptor:	FcγR (binds IgG)
Role in diseases:	Type IV. hypersensitivity



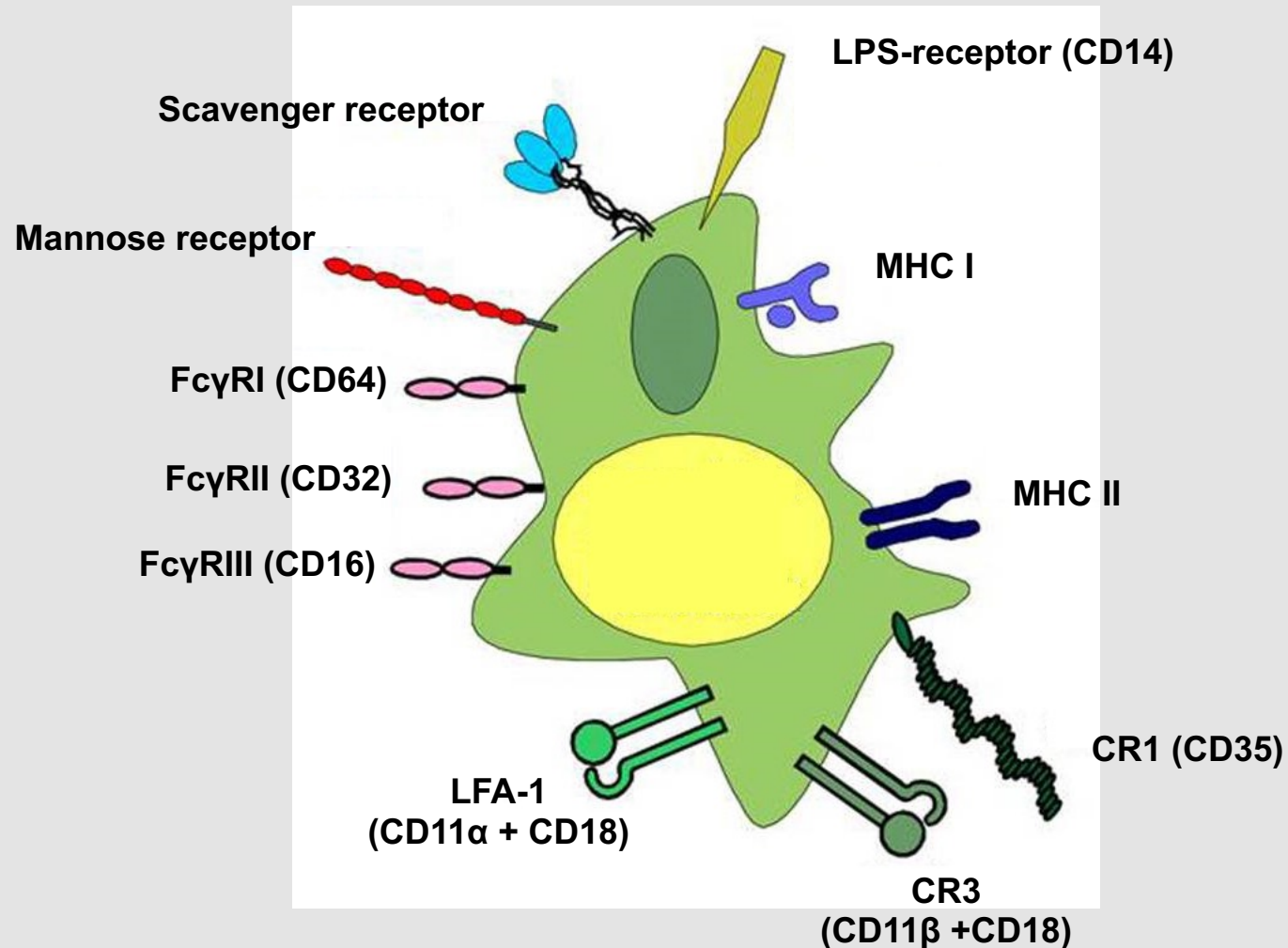
A macrophage ingesting (phagocytosing) bacteria (SEM image)



A monocyte in a blood smear

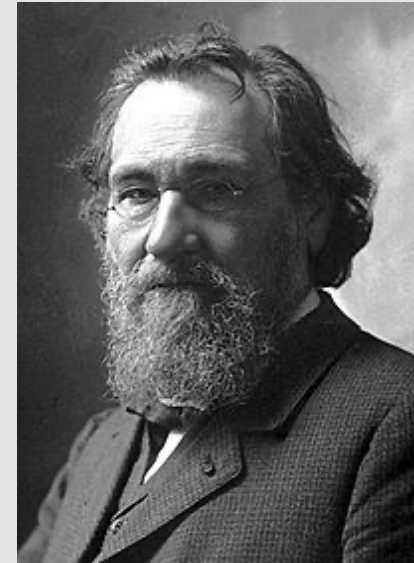
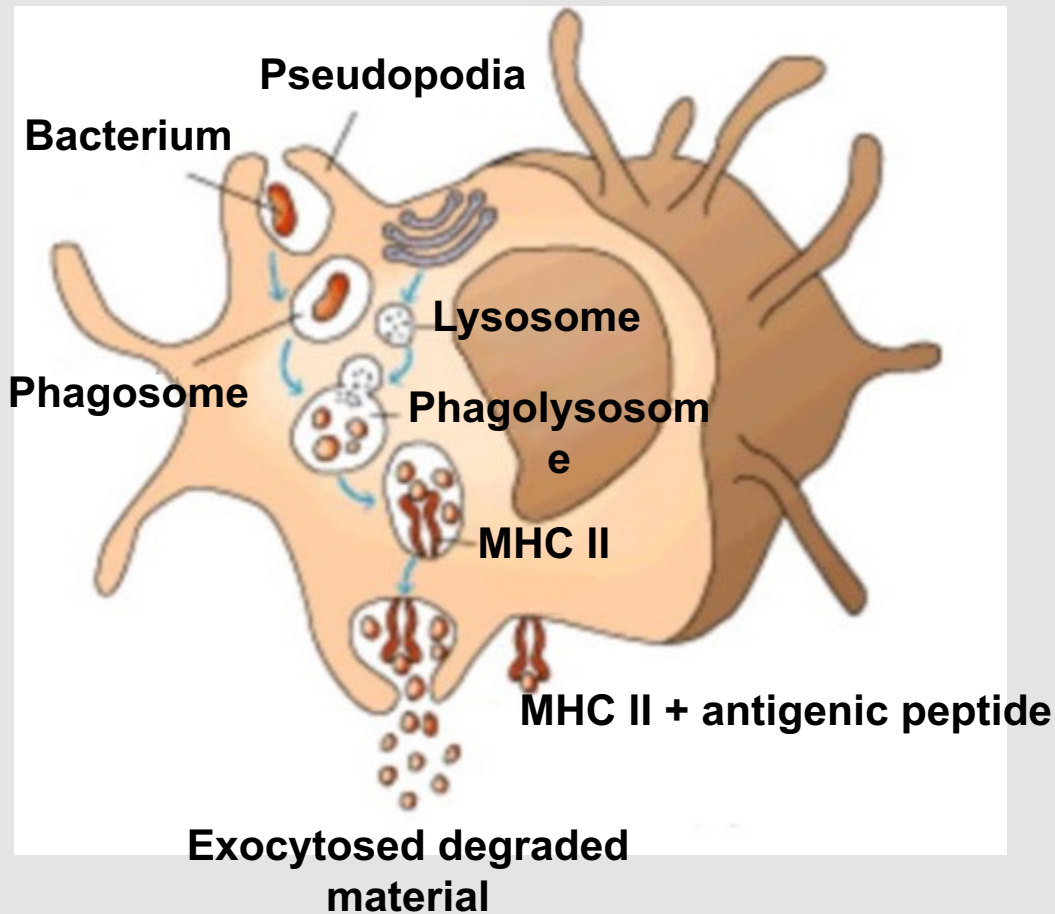
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Surface molecules of macrophages



Phagocytosis

Phagocytosis and antigen presentation of macrophages:



Ilya Ilyich Mechnikov who discovered macrophages and the phenomenon of phagocytosis.

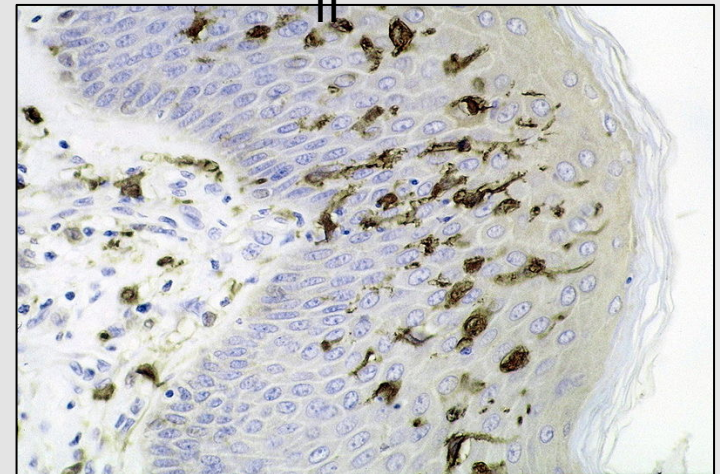
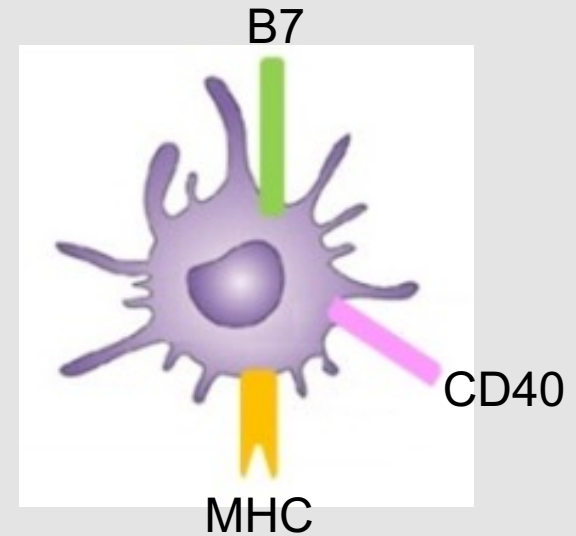


Was awarded the 1908 Nobel Prize in Physiology or Medicine jointly with Paul Ehrlich „in recognition of their work on immunity”.

Dendritic cell (DC)

Found in:	Tissues
Main function:	Antigen presentation
Site of antigen presentation:	In the secondary lymphoid organs
Recognition:	PRR, Fc receptor
Produced mediators:	Cytokines
Fc receptor:	FcγR (binds IgG)
Role in diseases:	Autoimmunity, HIV infection

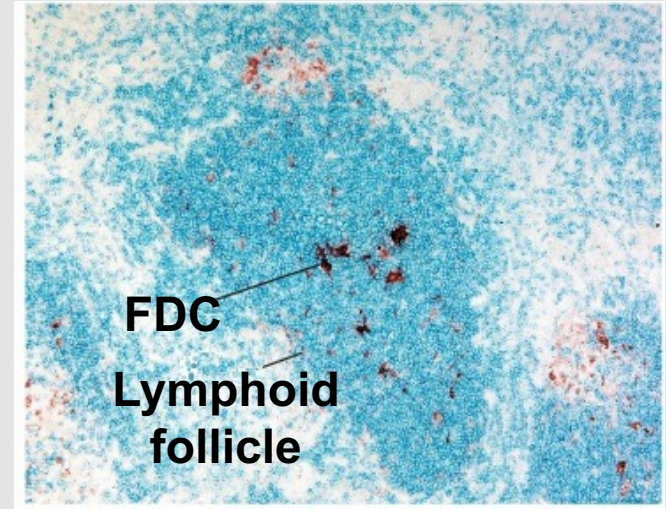
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Dendritic cells (Langerhans cells) in the skin of a *Mycobacterium ulcerans* infected patient. (immunohistochemistry)

Follicular dendritic cell (FDC)

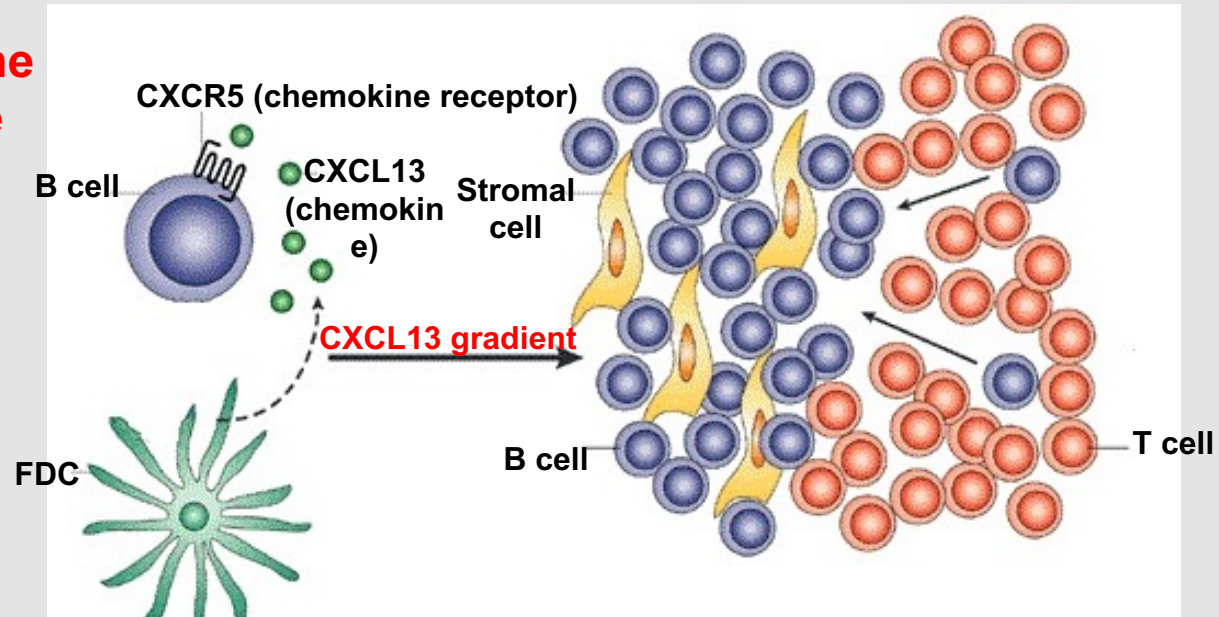
Found in:	Lymphoid follicles
Main function:	Formation of follicles, Keeping the antigen in the follicle for B cells
Recognition:	Fc receptor, Complement receptor
Produced mediators:	Cytokines
Fc receptor:	FcγR (binds IgG)



Red: Only possible after the activation of the adaptive immunity

Iccosome:

- Antigen
- Antibody + Fc receptor
- Complement + Complement receptor



Thank you for your attention!

