


The Immune System

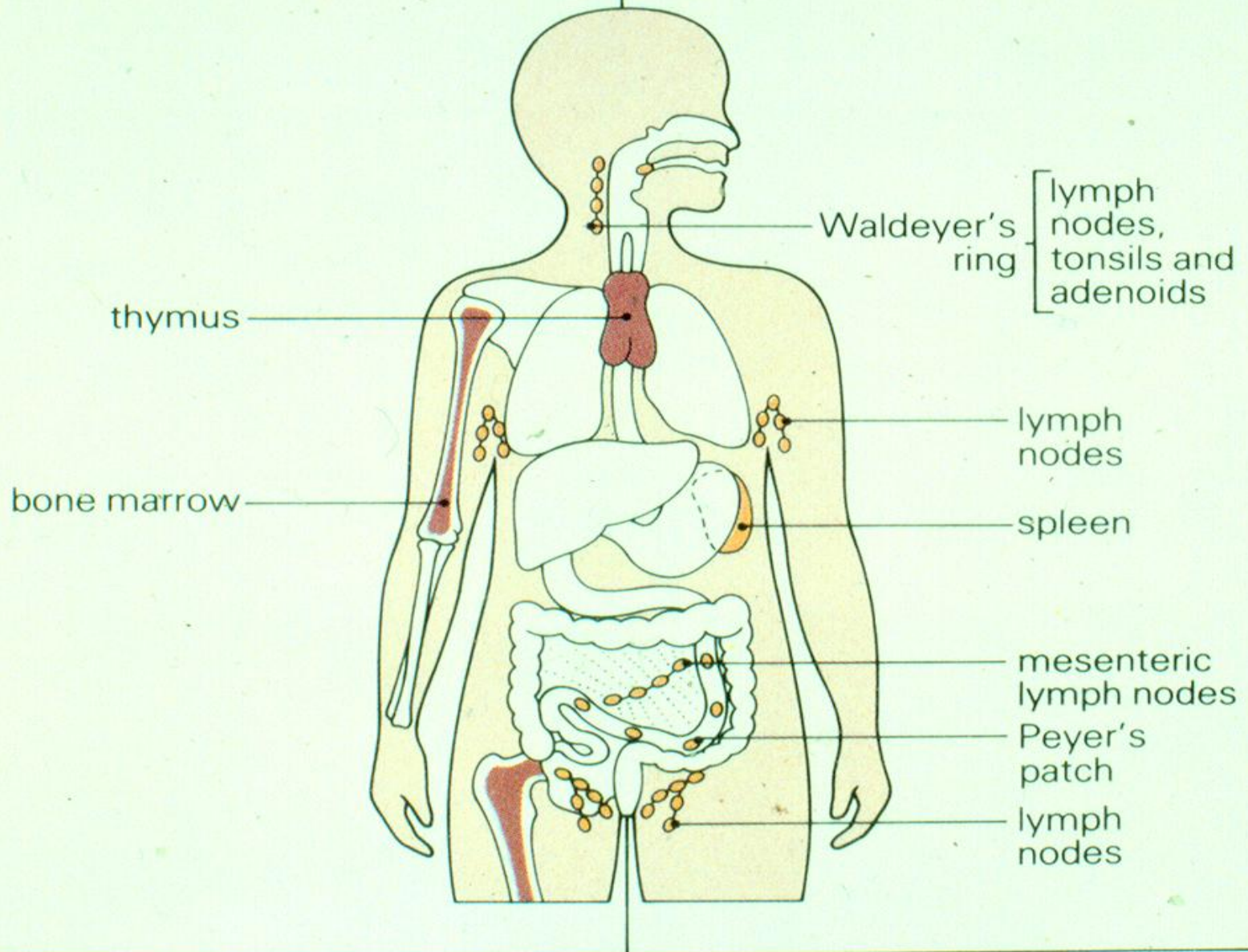
- in brief

Klaus Müller
Rigshospitalet

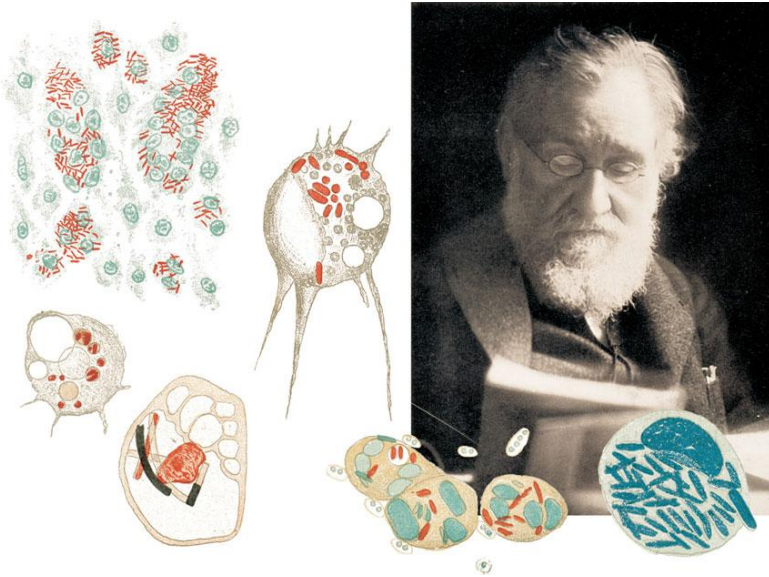
- Innate responses to infection
- Interaction between innate responders and adaptive immune system
 - Interactions between antigen presenting cells and T cells
- Regulation of immune responses
- Effector mechanisms
 - Cell mediated, Cytotoxic, Antibody mediated
- Inborn errors of the immune system 

• primary lymphoid organs

secondary lymphoid organs

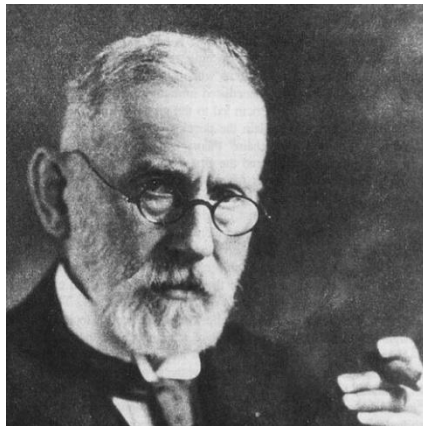
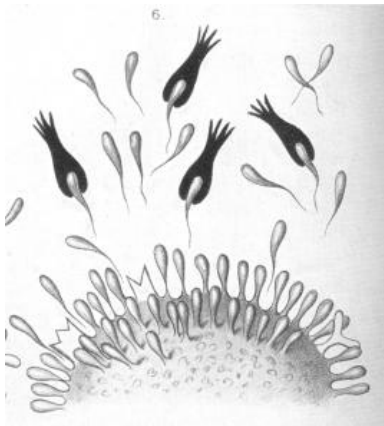


Nobel Prize winners 1908



Elie Metchnikoff 1845-1916

Discoverer of phagocytosis
Founder of Innate Cellular
Immunology



Paul Ehrlich 1854-1915

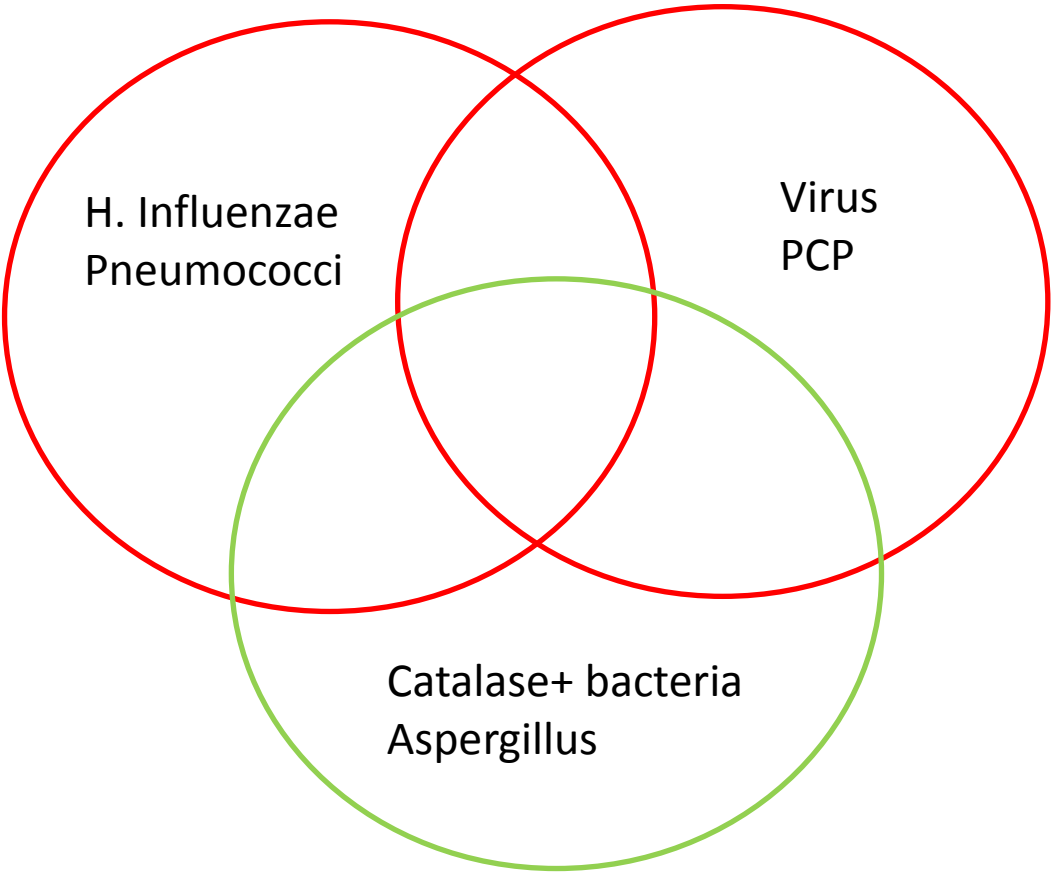
Discovered antibody formation
One of the fathers of humoral
adaptive immunology

Immundefense

Innate immune system  Adaptive immune system

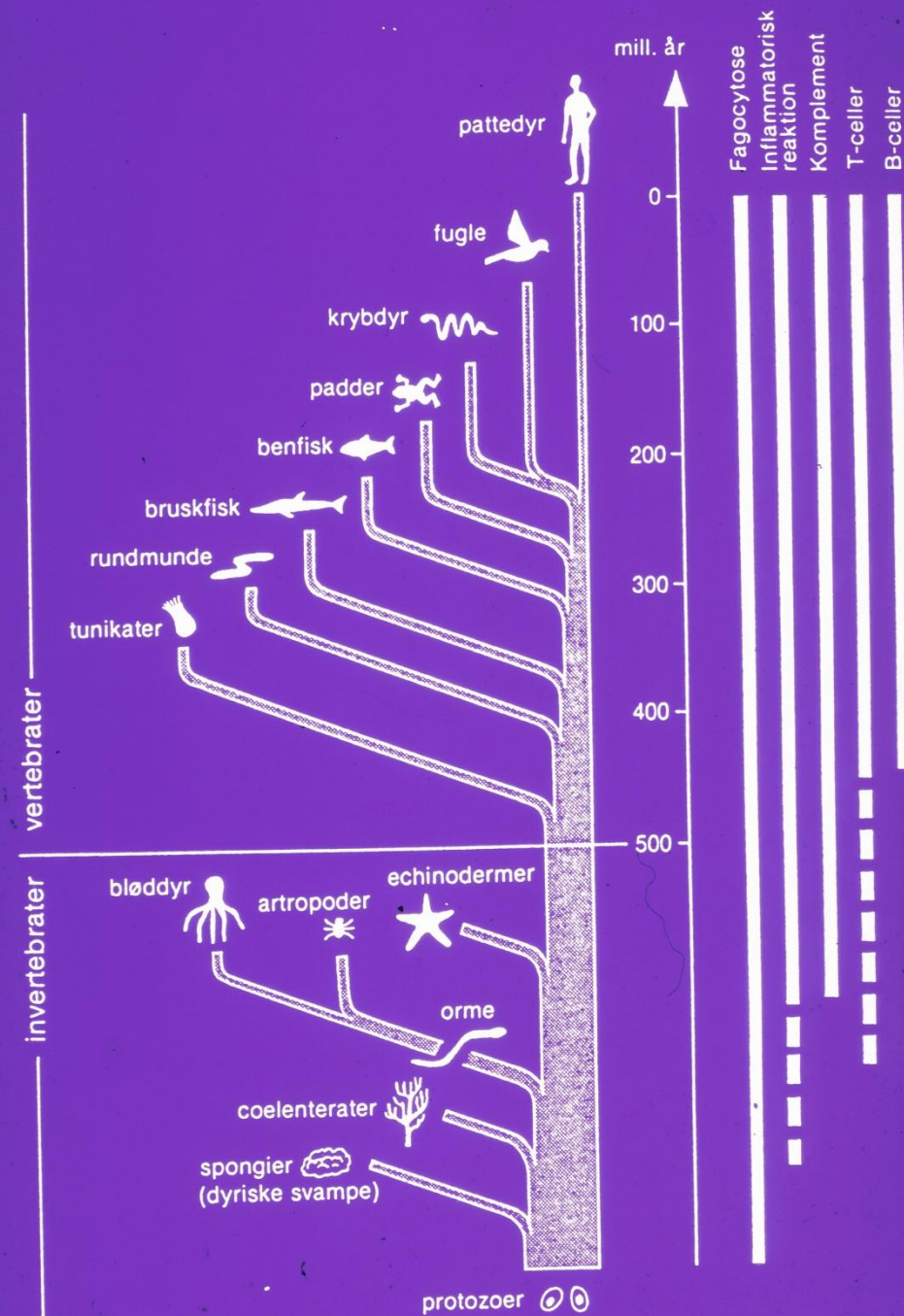
B-cell defects

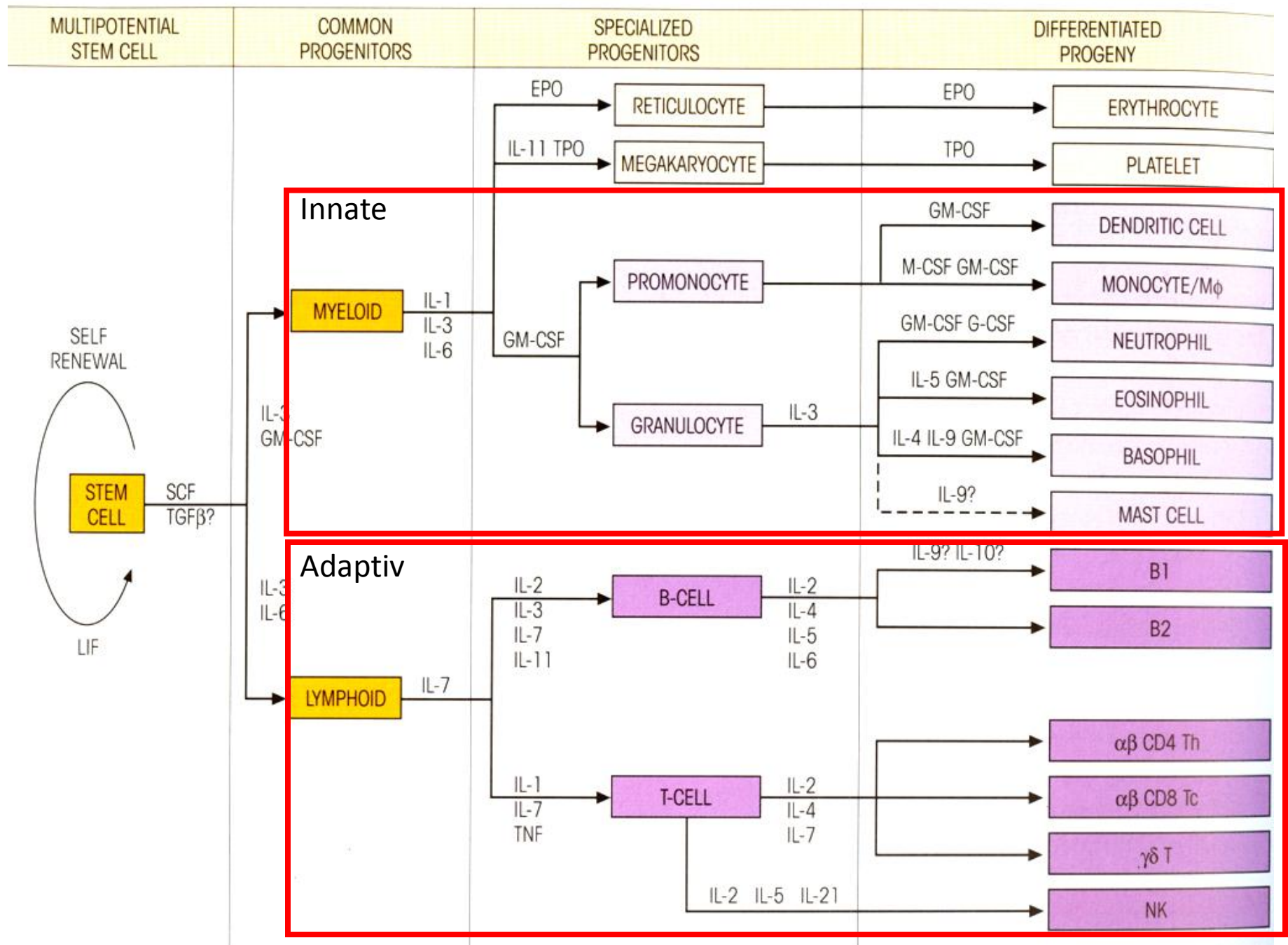
T cell defects



Phagocyte defects

Phylogenesis of the Immunsystem








Innate Immunsystem

No adaptation, No memory


Leucocytes:

- Granulocytes 
- Macrophages

Soluble Factors:

- Prostaglandin, leucotriens
- Complement 
- Properdin
- CRP
- Mannan-binding lectin 

Surfaces:

- Goblet cells
- Cilia 
- Lysozyme
- Acid

Kostmann's syndrome

Cyclic neutropenia

Chronic granulomatous disease

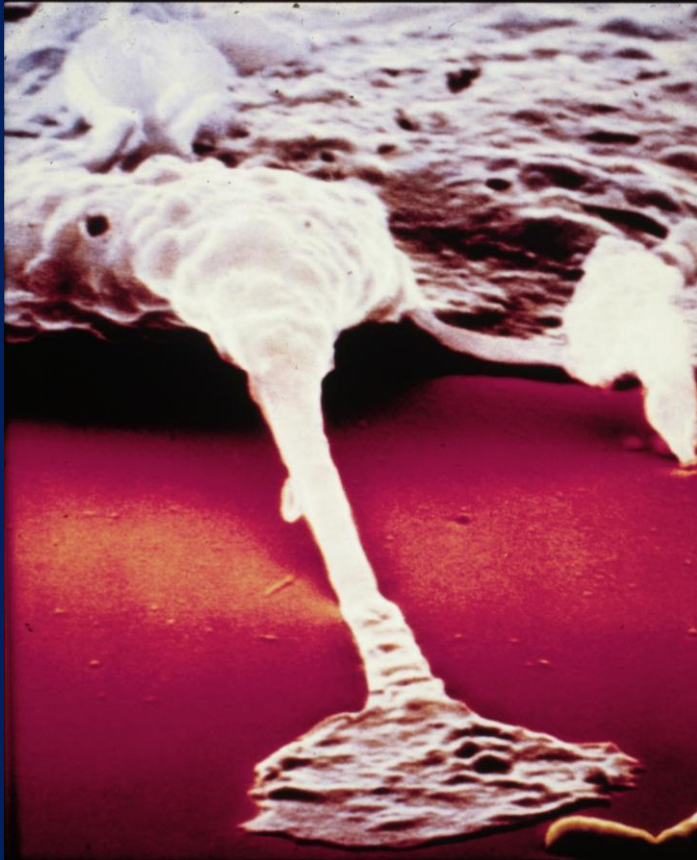
Complement deficiency

MBL deficiency

Primay ciliary dyskinesia

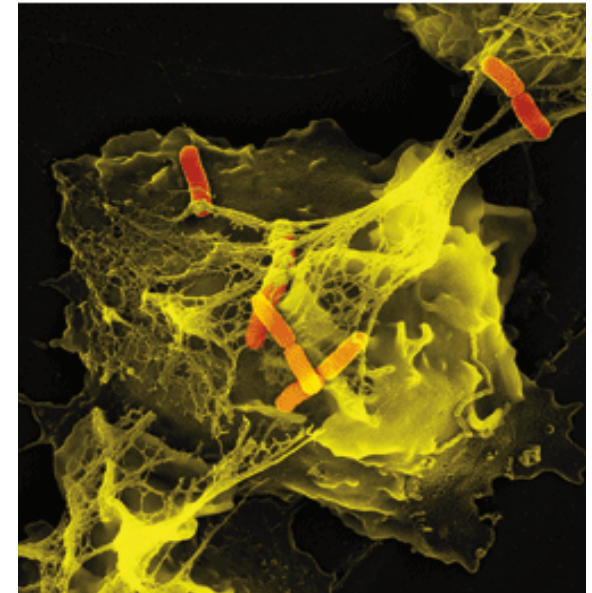
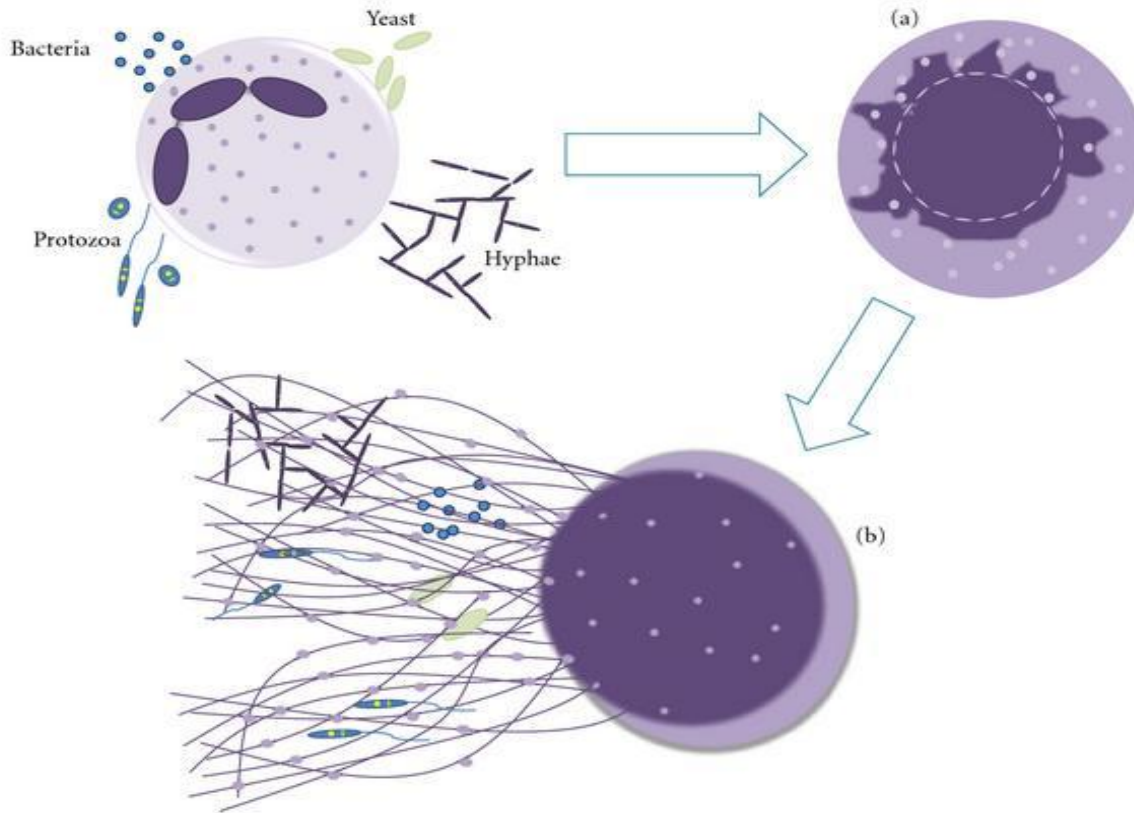
Phagocytosis

– intracellular killing

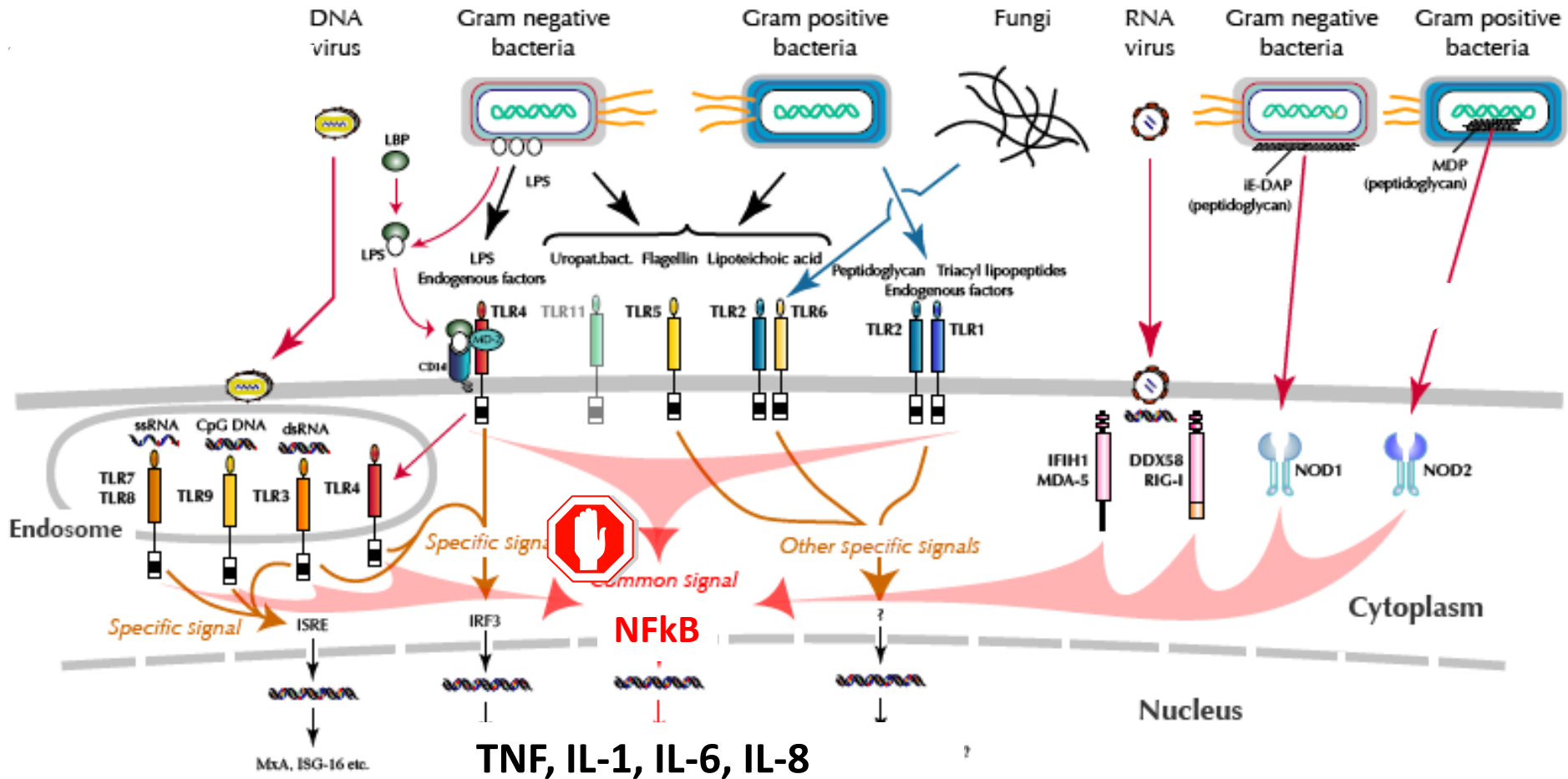


Neutrophil extracellular trap (NET)

- Extracellular killing



Pattern Recognition Receptors (PRR)

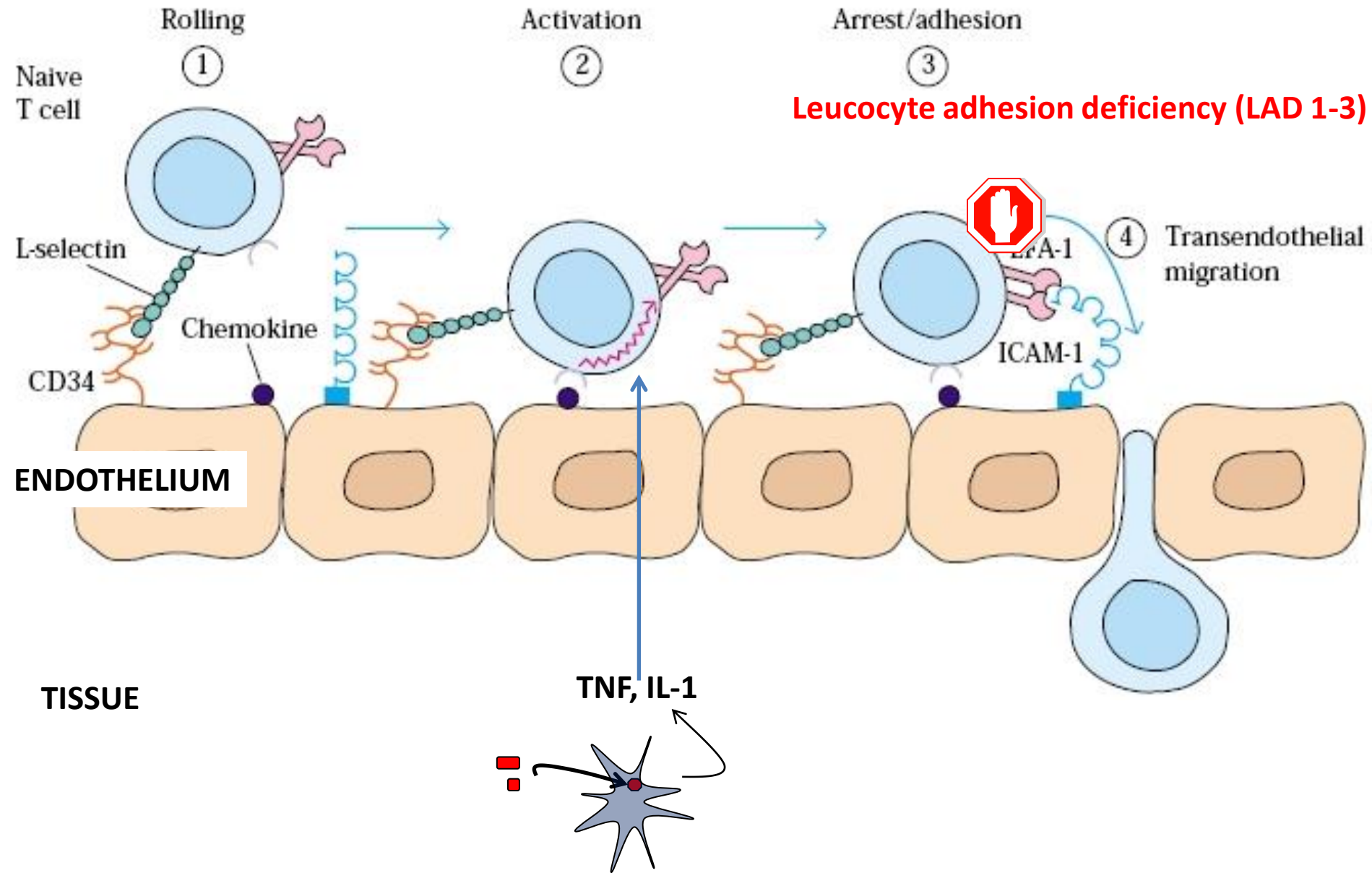


Recruitment and activation of leukocytes

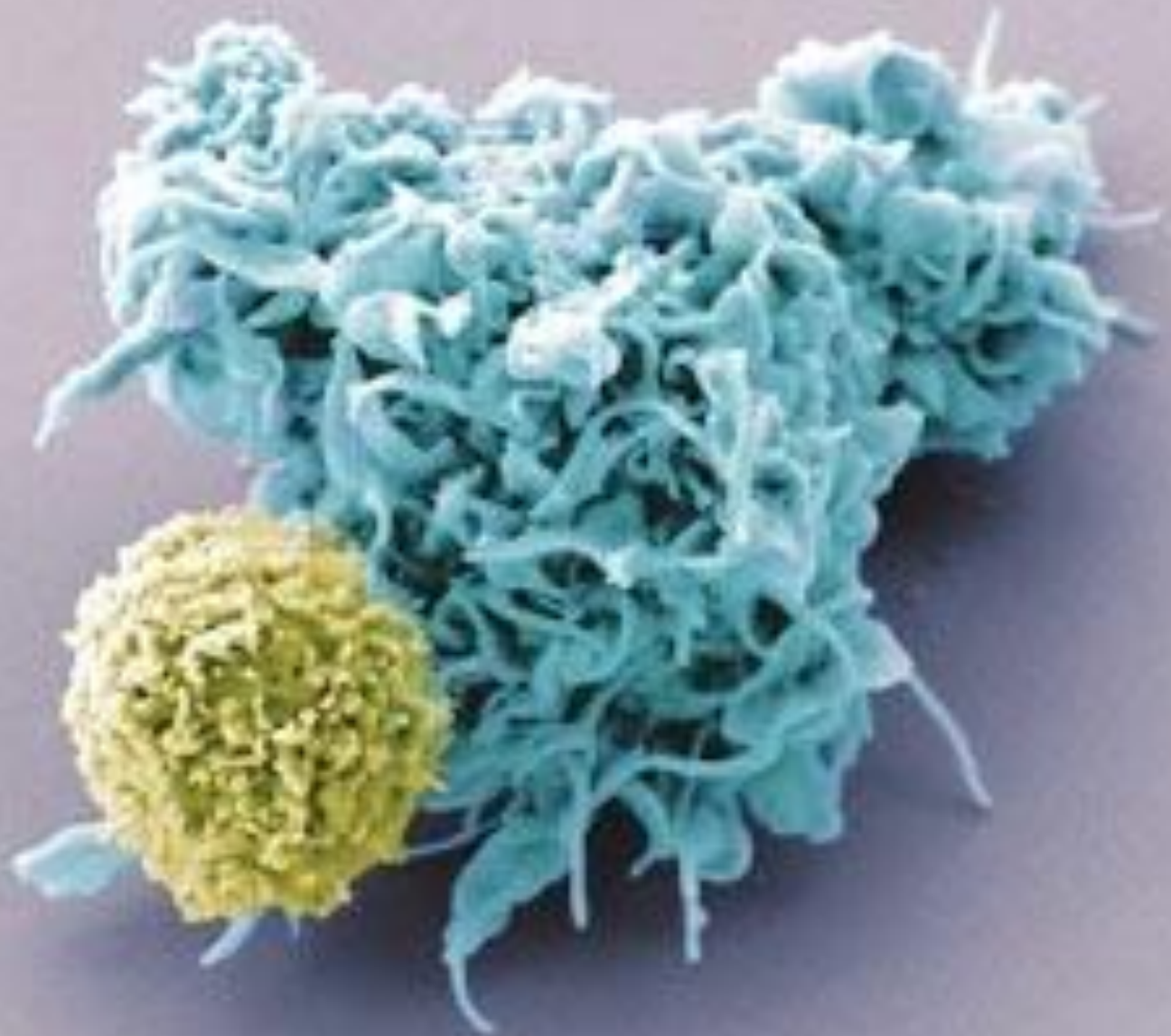
Acute phase response: fever, CRP, loss of appetite, general malaise

Leucocyte recruitment

LUMEN

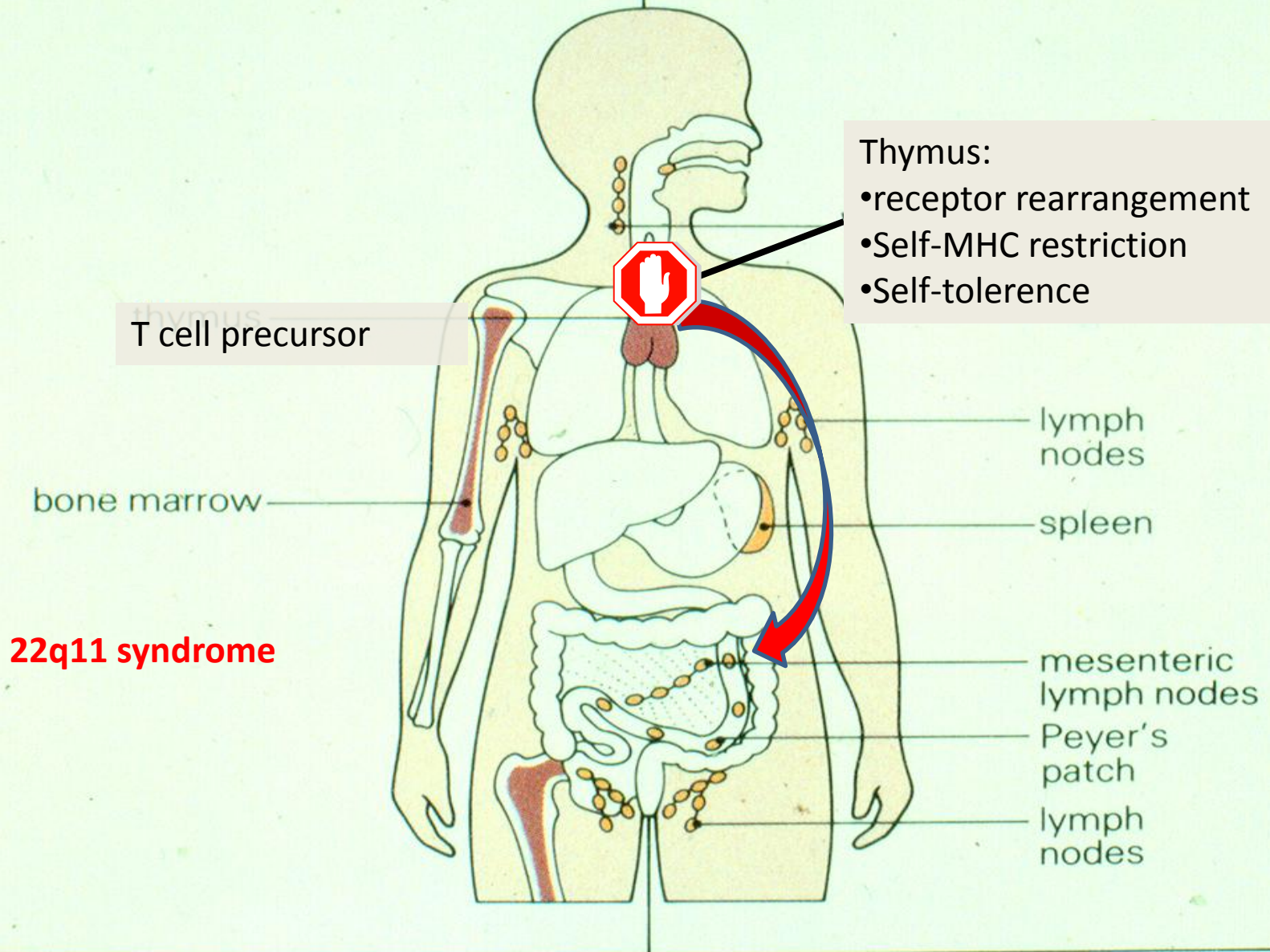


The smart lymphocyte provides help to the phagocyte



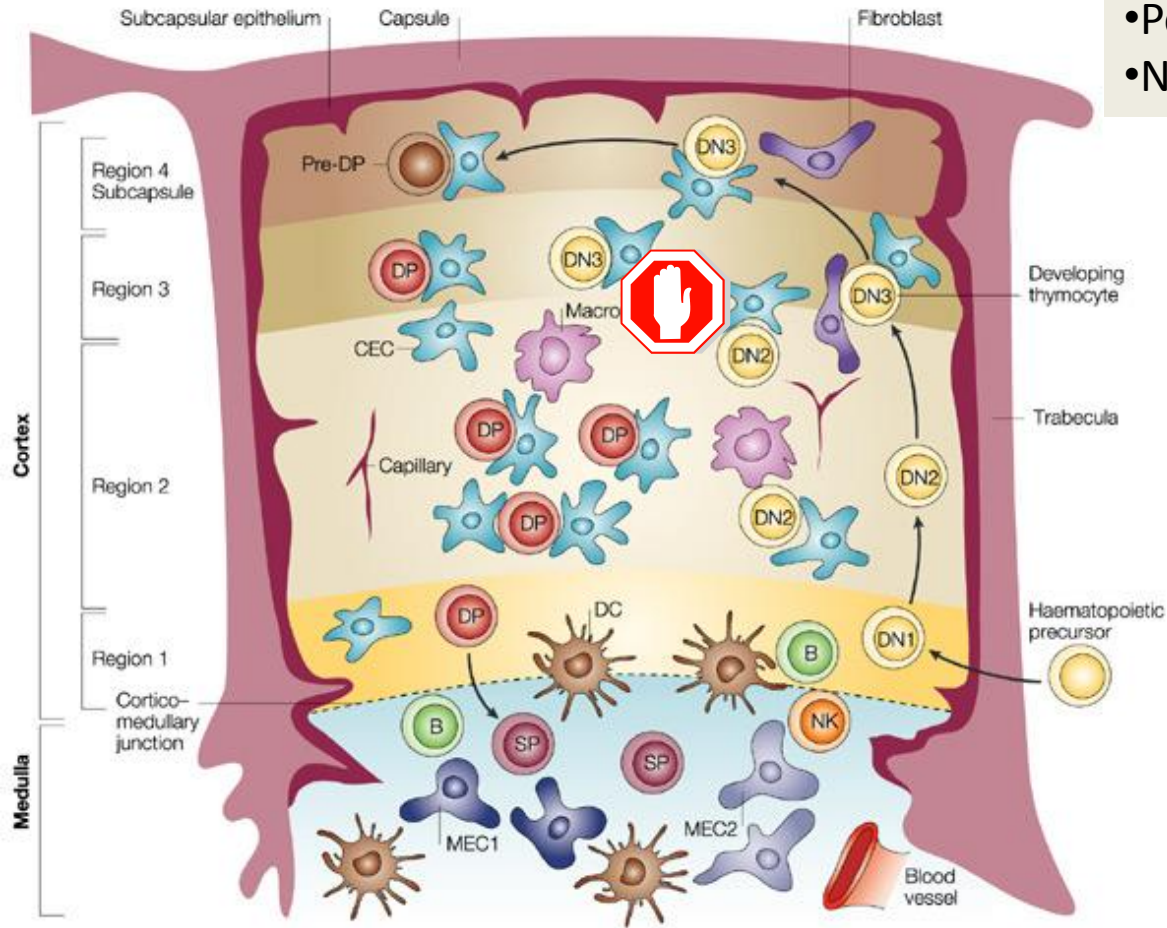
• primary lymphoid organs

secondary lymphoid organs



Thymus

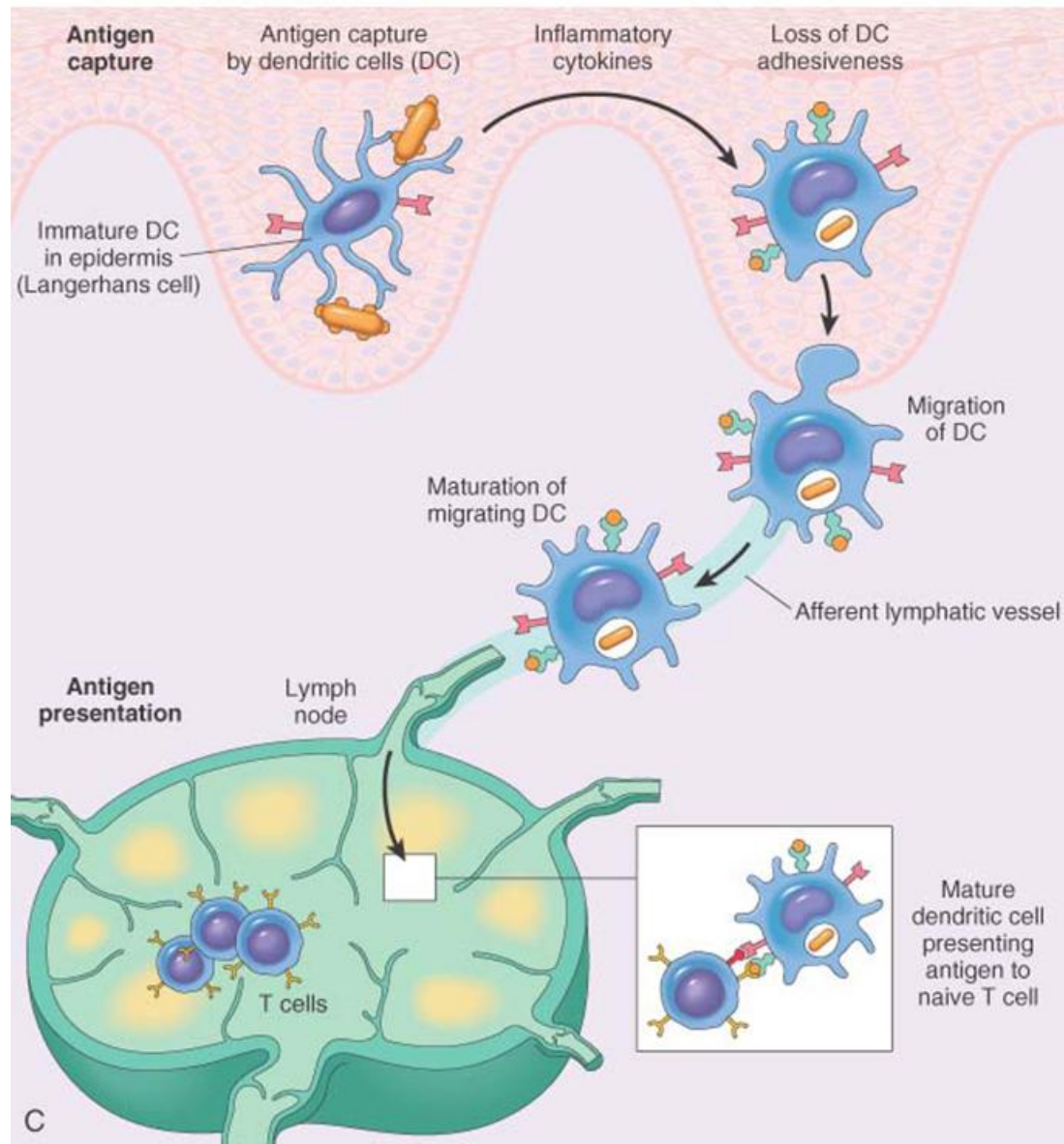
- Antigen receptor rearrangement
- Pos. Selection: Self-MHC restriction
- Neg. selection: Self-tolerance



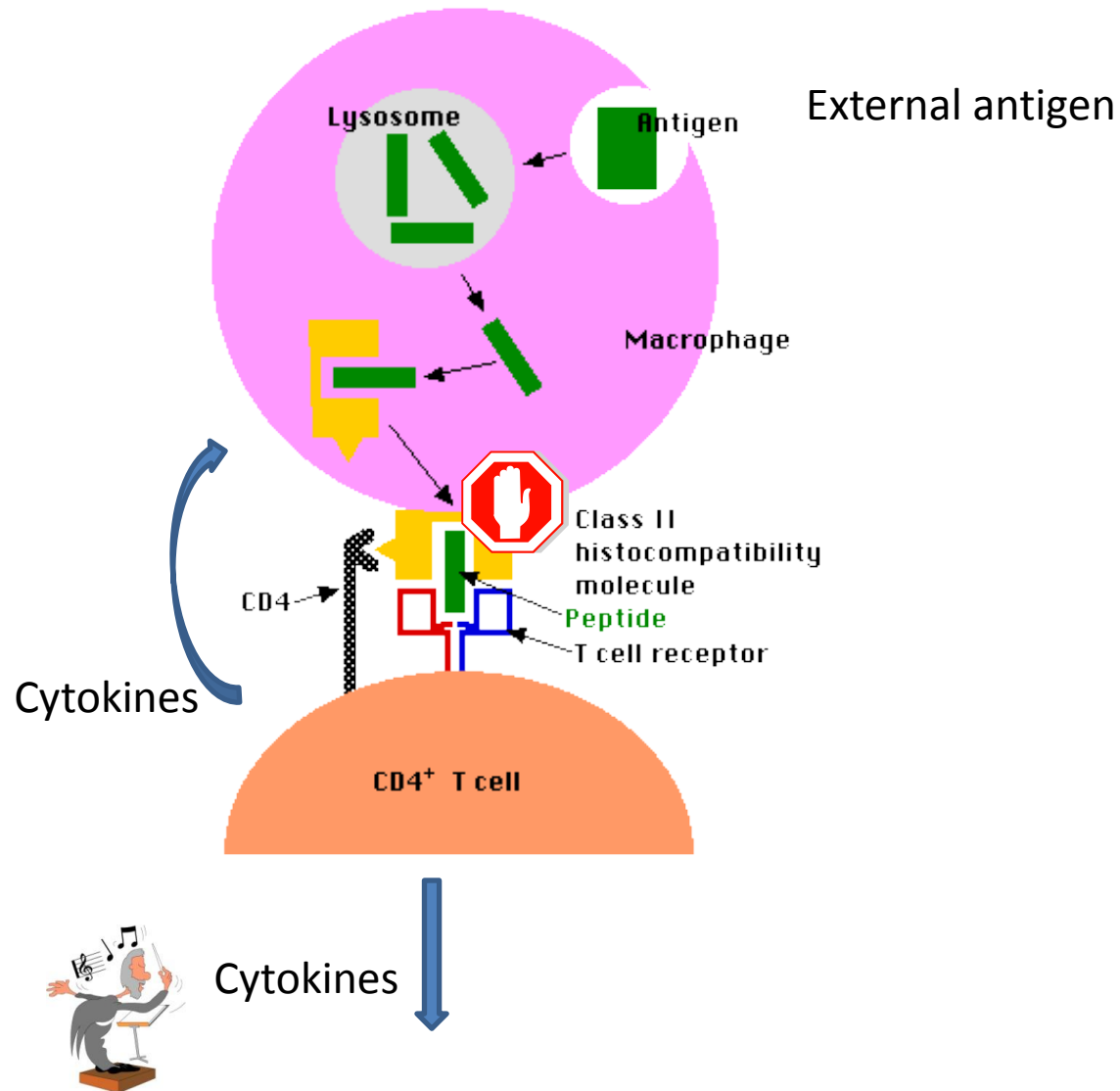
SCID:
RAG defect
IL-7R defect

CD4-/CD8-
→ CD4+/CD8+
→ CD4+/CD8- or CD4-/CD8+

From the site of invasion to the lymphnode

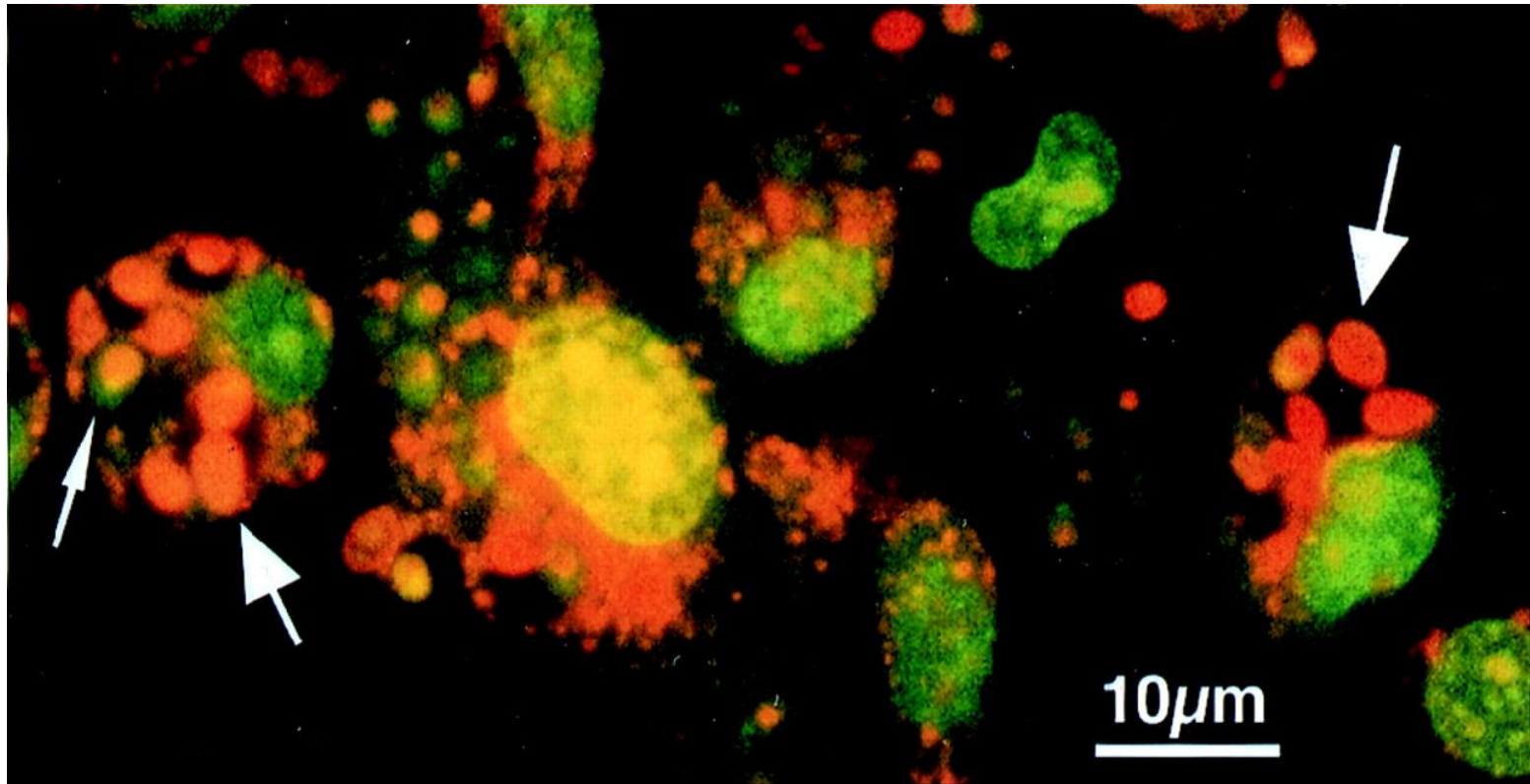


Antigen presentation by dendritic cells

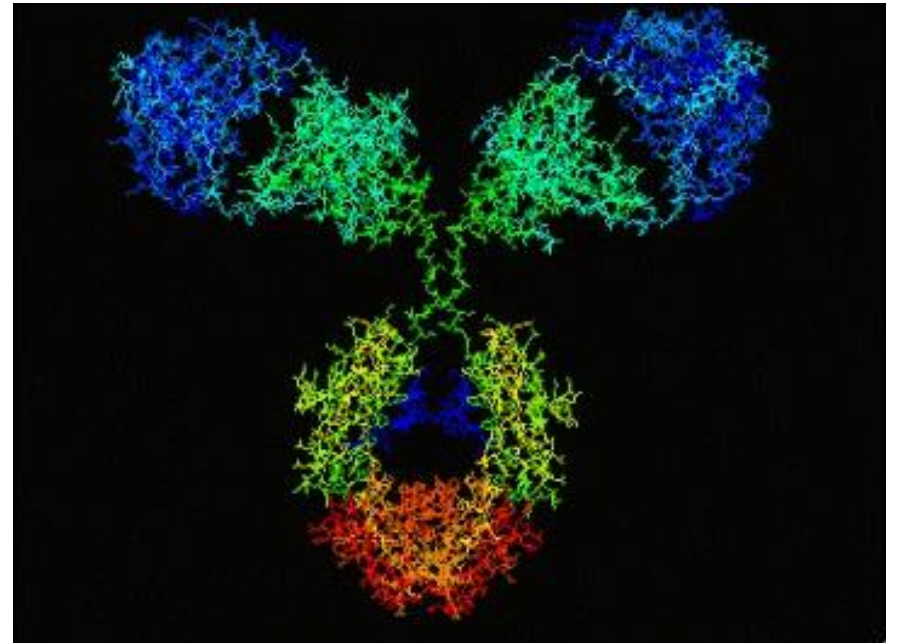
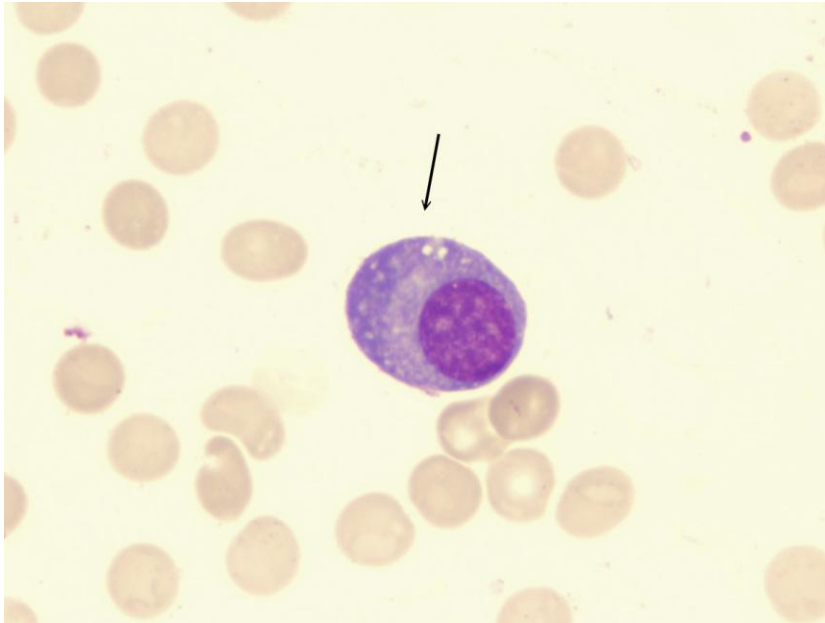


MHC defects: Bare lymphocyte syndromes

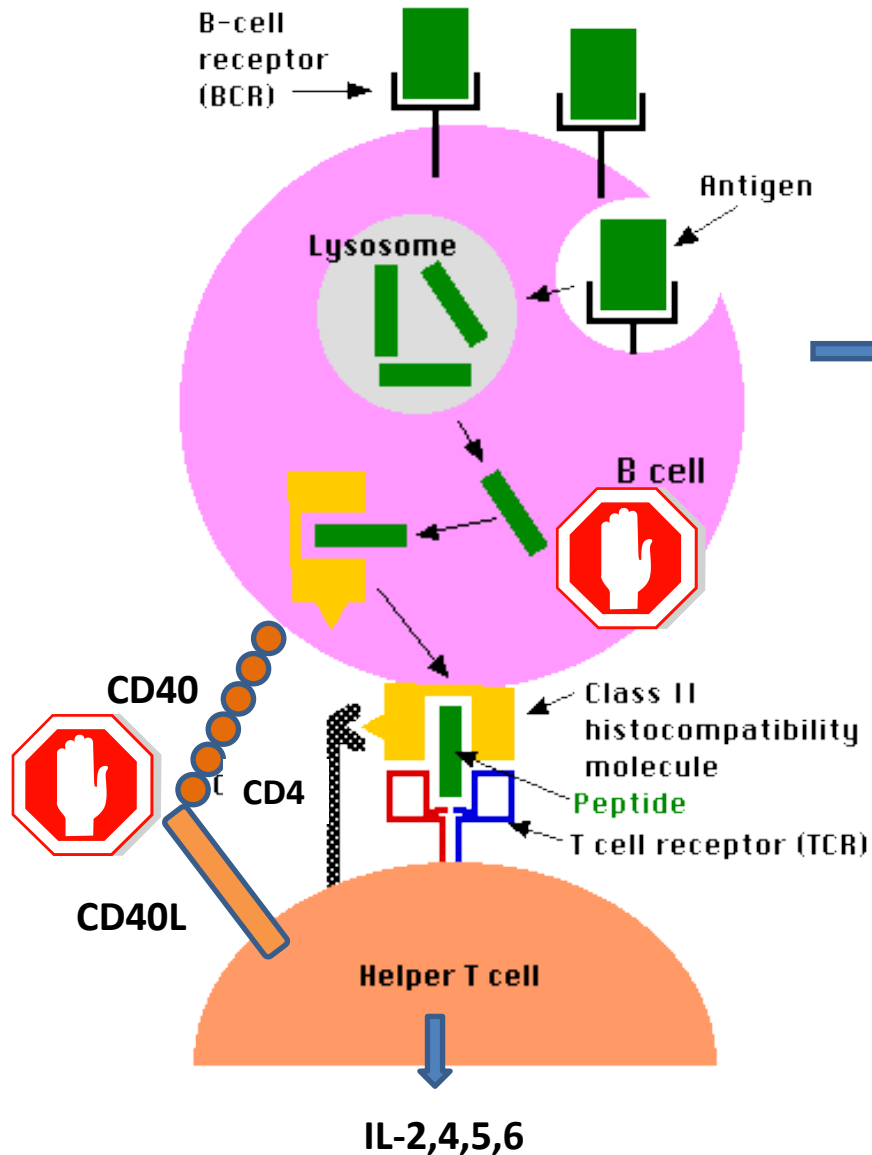
Effector mechanisms: Cell mediator immunity
Intracellular killing of yeast



Effector mechanisms: antibodies



Antigen presentation by B cells



IgM → IgG₁₋₄
IgA
IgE

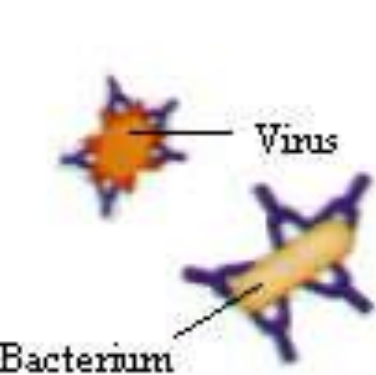
$K_A : 10^6/M \rightarrow 10^8/M$

Bruton agammaglobulinaemia

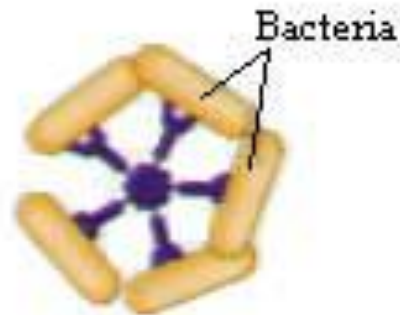
Hyper IgM syndrome

Effector mechanisms: effects of antibodies

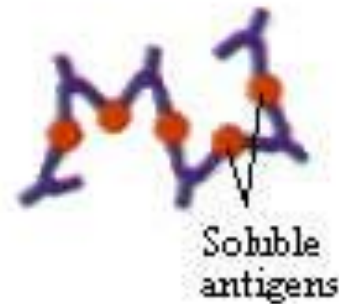
Blocking of viral binding sites or bacterial antigens



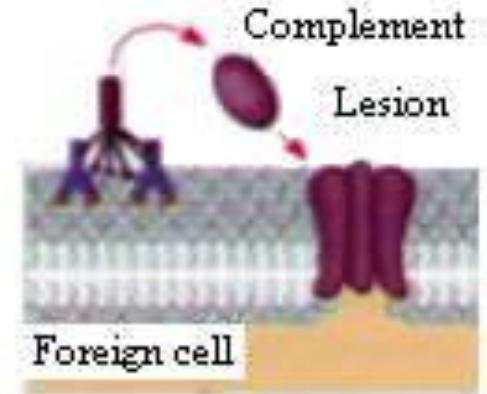
Agglutination of particulate antigens



Precipitation of soluble antigens

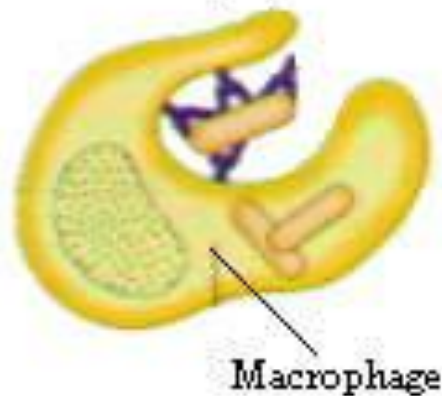


Activation of complement



Enhances

Phagocytosis

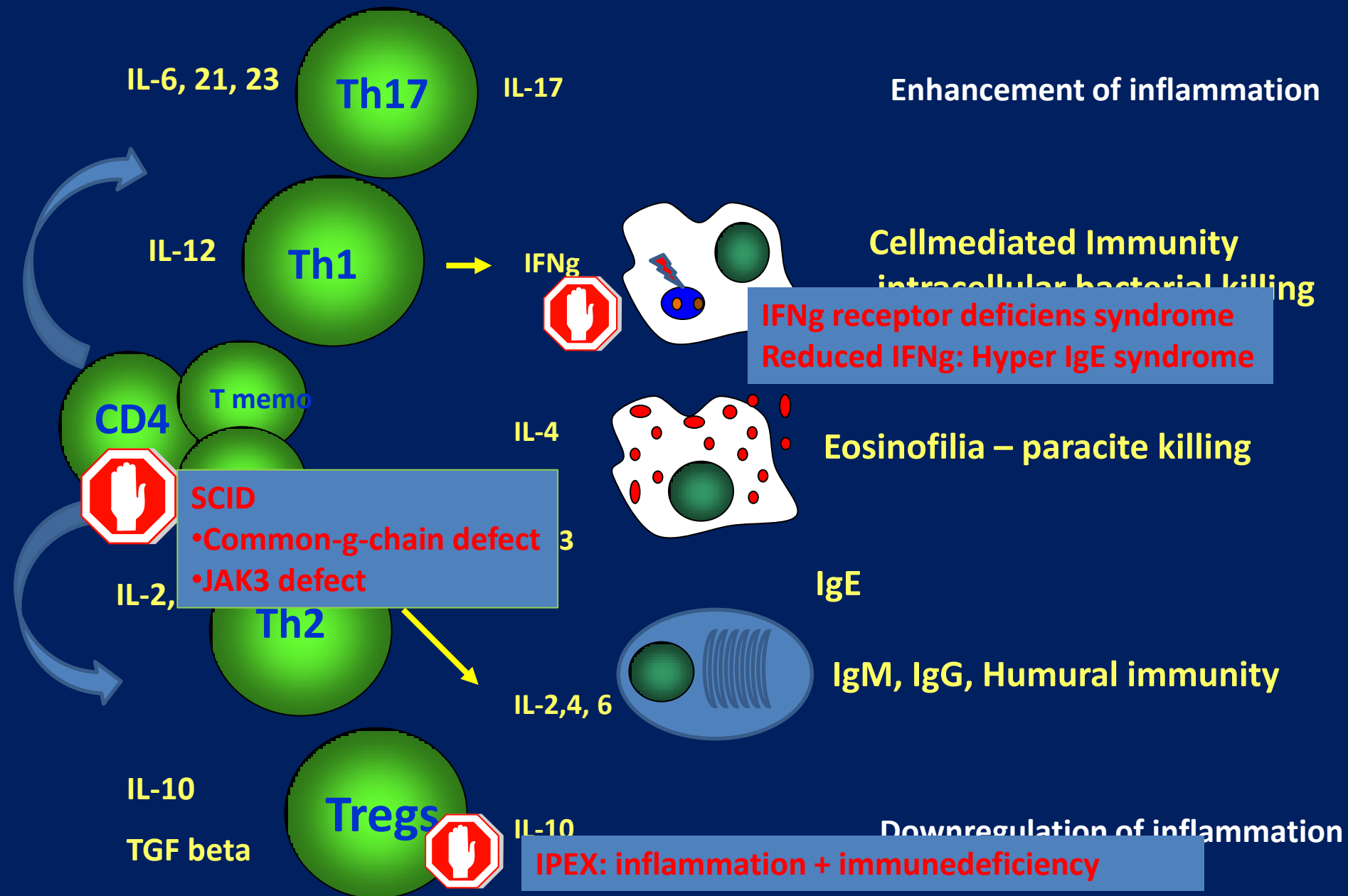


Leads to

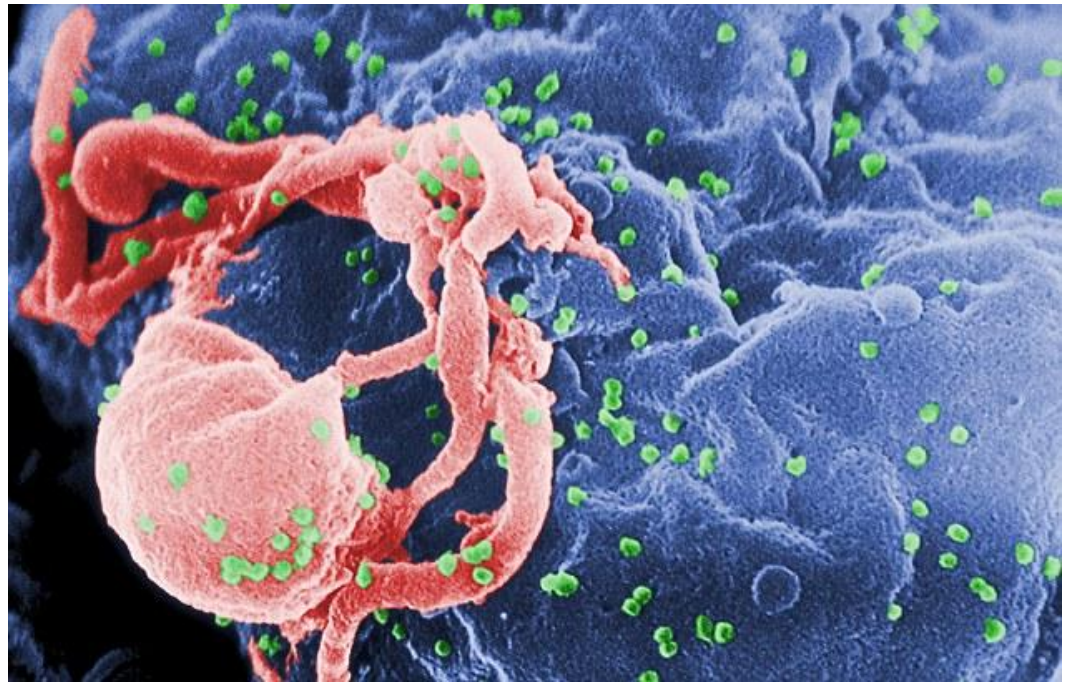
Cell lysis



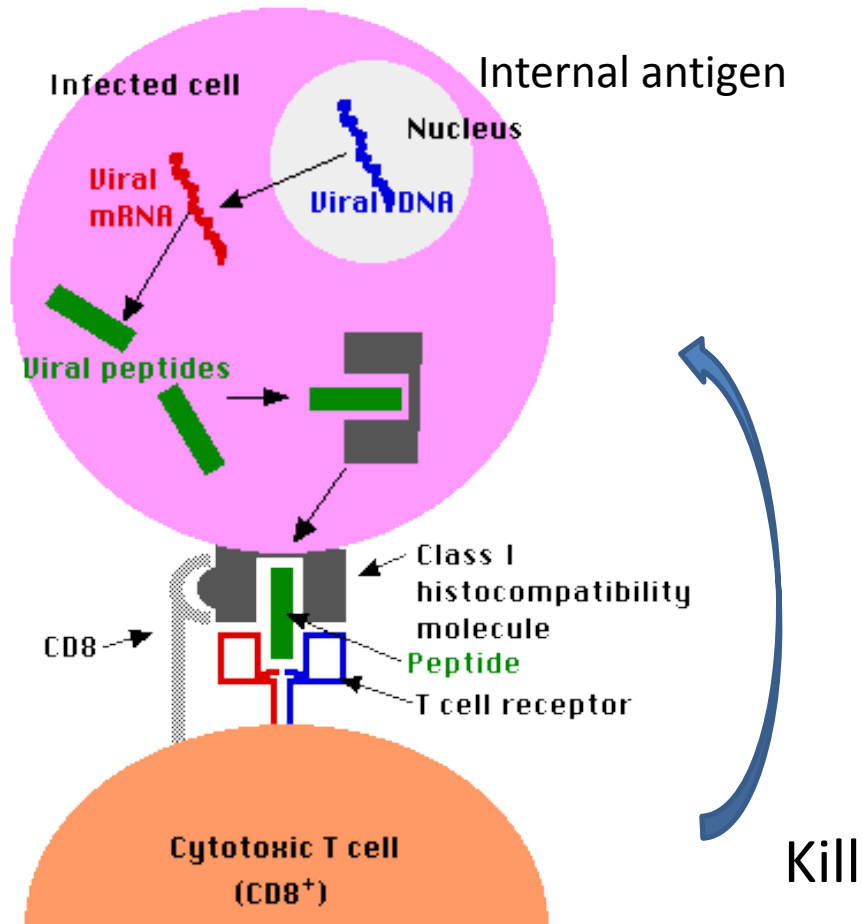
Immune regulation



Effector mechanisms: Killing of cancer cells and virally infected cells

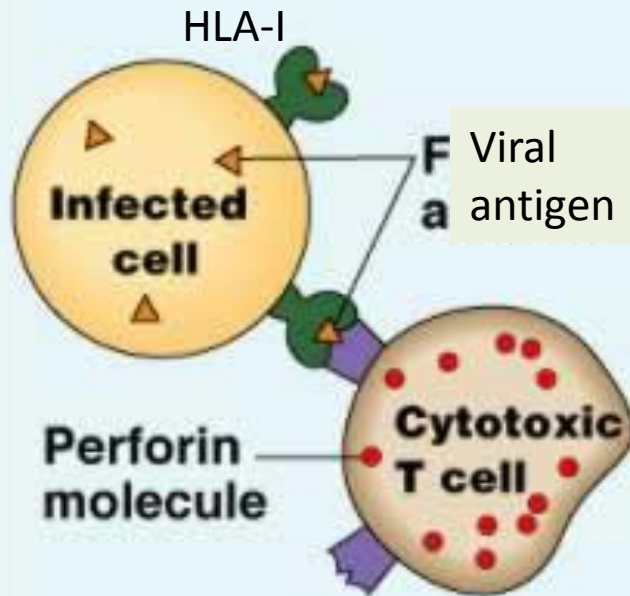


Antigen presentation by virally infected cell

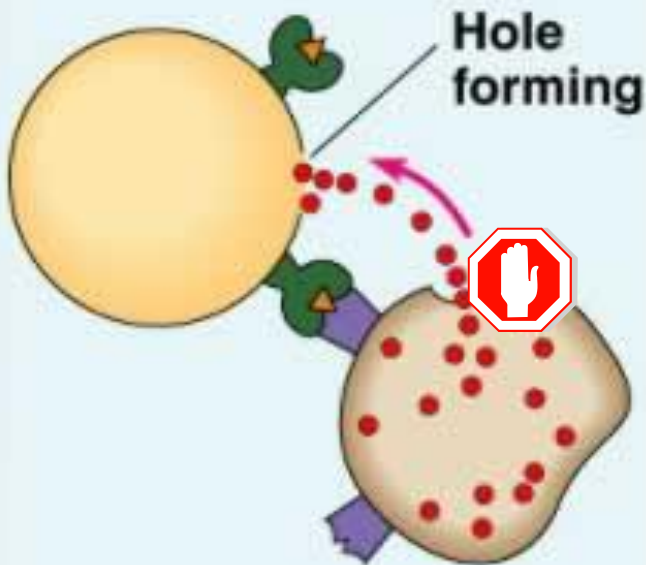


Effector mechanisms: killing of virally infected cells

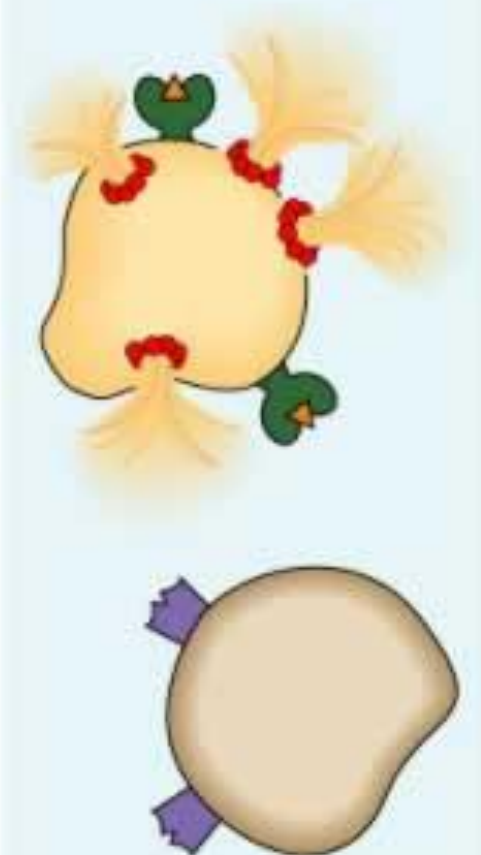
1 Cytotoxic T cell binds to infected cell



2 Perforin makes holes in infected cell's membrane



3 Infected cell lyses



Hemophagocytic lymphohistiocytosis
Chediak-Higashi syndrome
Gricelli syndrome

