

Immunology-introduction

Immune system

- One of basic homeostatic mechanisms of the body.
- Its function is the recognition of foreign/dangerous substances.
- The dangerous substances trigger complex reactions which result in elimination of those substances.

Immune system

- Recognizes foreign/dangerous substances from the environment (mainly microbes)
- Is involved in elimination of old and damaged cells of the body.
- Attacks tumor and virus-infected cells.

Functions of the immune system

- Defence
- Autotolerance
- Immune surveillance

Antigen

- Substance, that is recognised by the immune system as a foreign and triggers immune reaction (immunogenicity).
- Products of the immune reaction (antibodies, T-lymphocytes) react with the antigen.

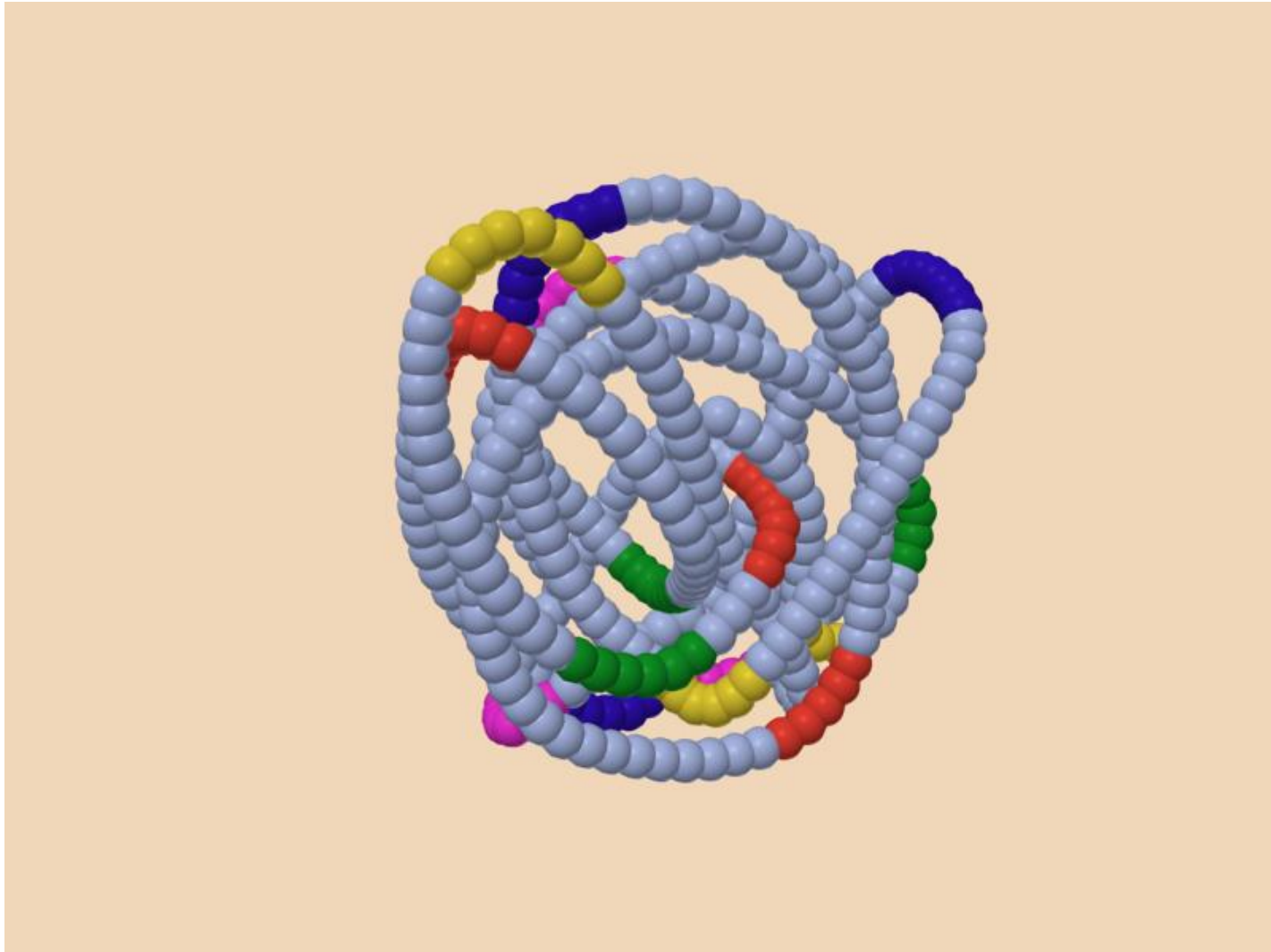
Requirements of immunogenicity

- Foreign (unknown) for the immune system
- High molecular weight (> 6 kDa)
- Chemical complexity

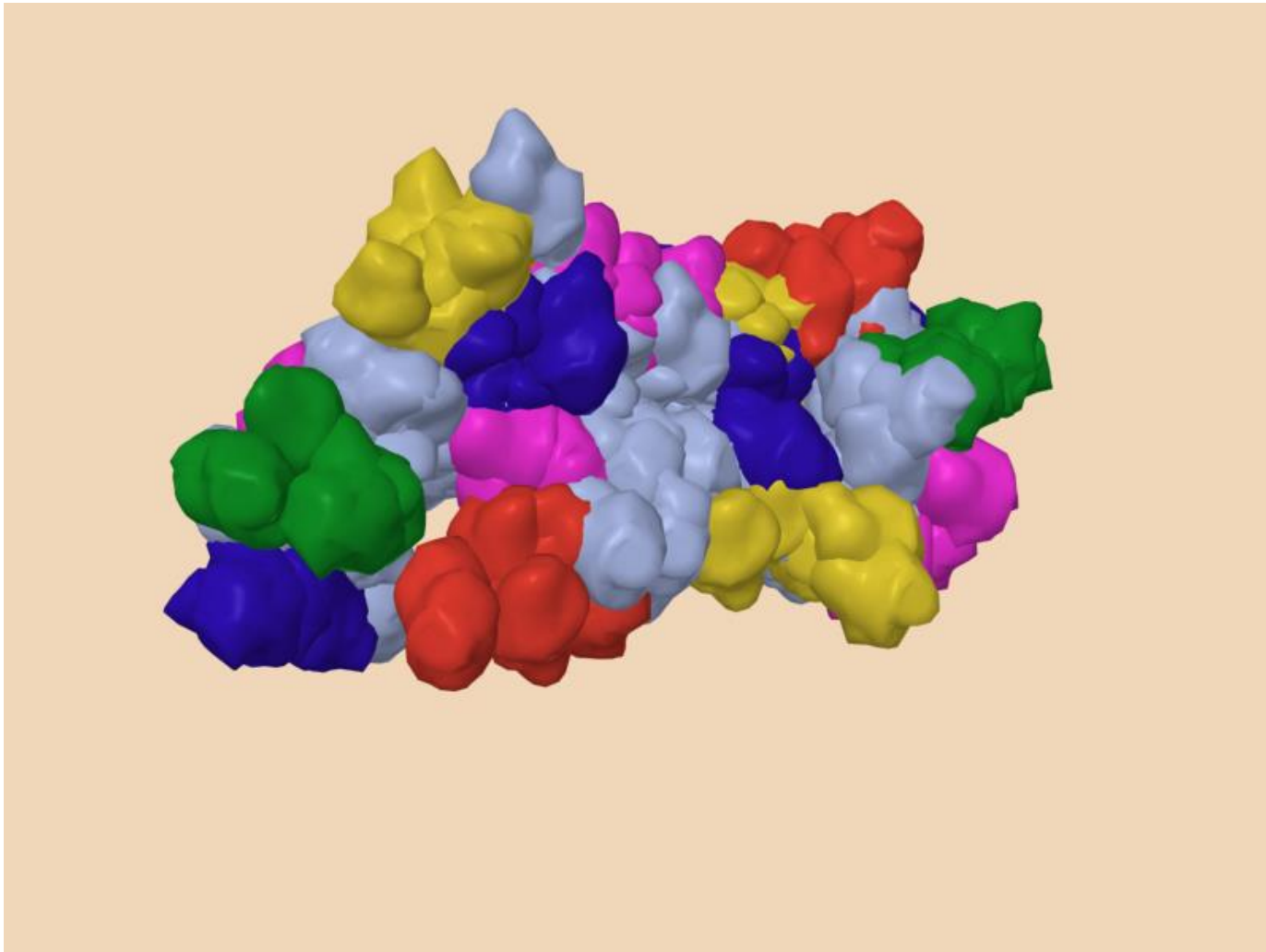
Antigen – functional components

- Carrier part of the molecule
- Antigenic determinant- epitope (cca 5-7 aminoacids)

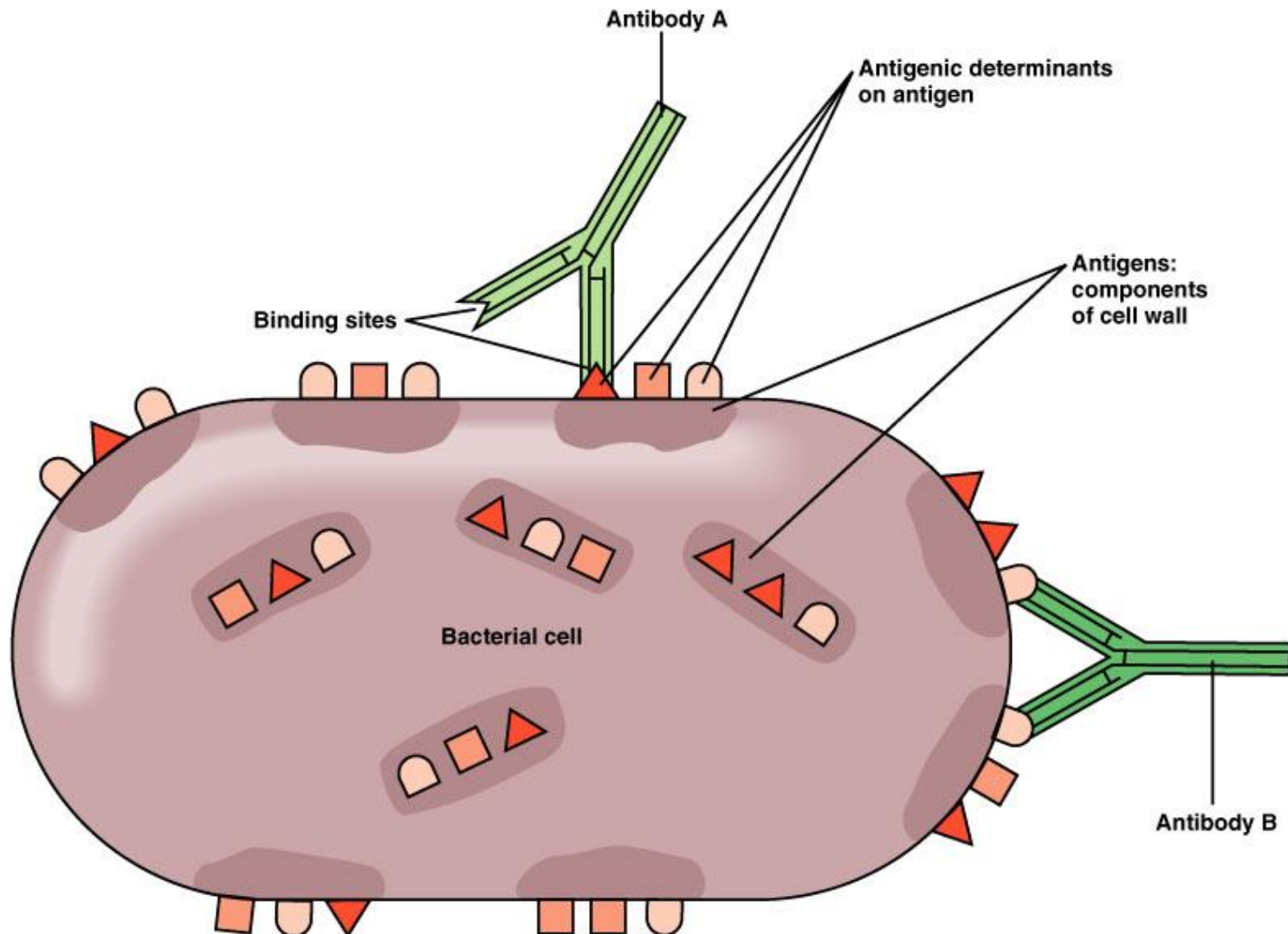
Antigen - epitopes, carrier part



Antigen - epitopes, carrier part



Antigen and epitope



Chemical composition of antigens

- Proteins – usually very good antigens.
- Polysaccharides- usually only as a part of glycoproteins.
- Nucleic acids- poor antigenicity, limited to complexes with proteins
- Lipids – only exceptionally, best known are sfingolipids.

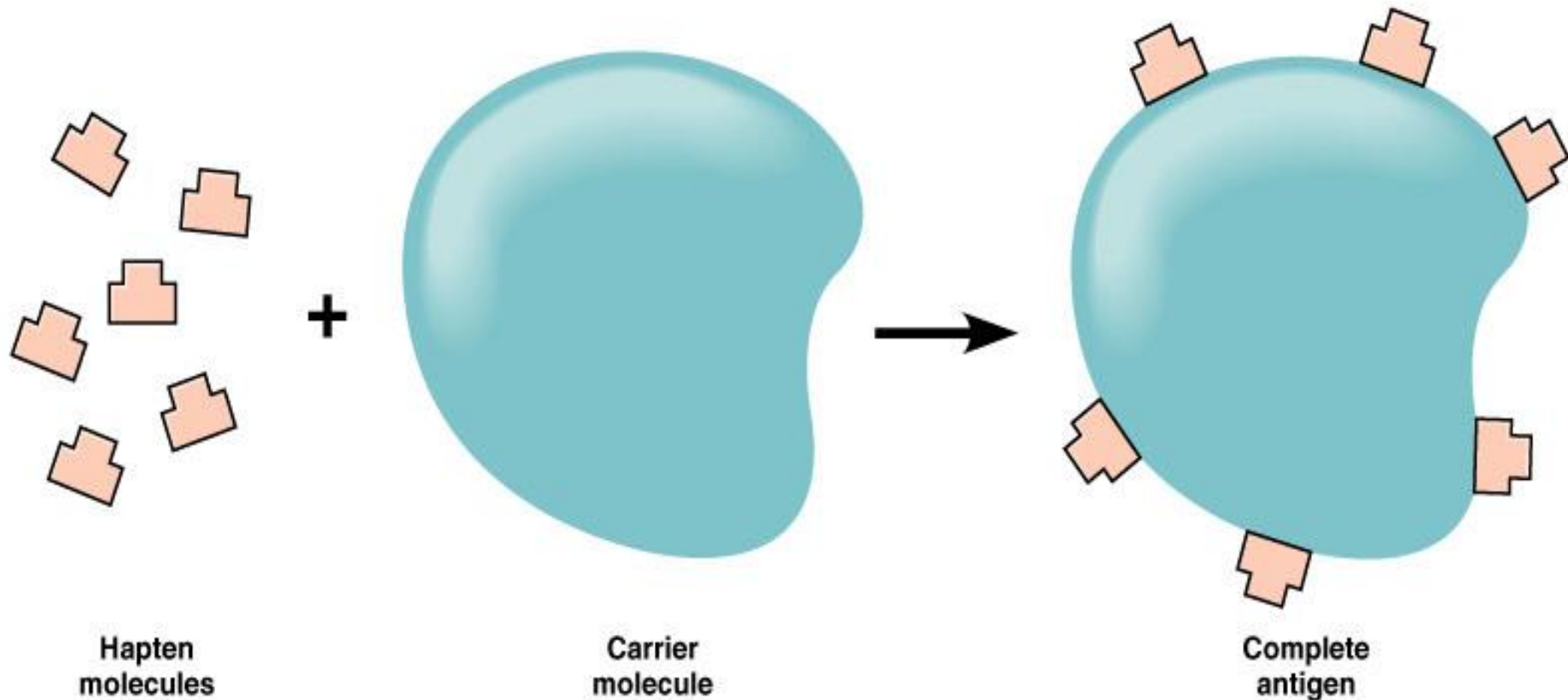
Protective and nonprotective antigens

- Protective antigens – elicit protective immune response that leads to elimination of the microbe.
- Non-protective antigens – elicit non-protective immune response, but it does not lead to elimination of the microbe (e.g. antibodies against HIV).

Hapten

- Low-molecular weight substances that trigger immune reaction after binding to various proteins of the body.
- They react with products of the immune reaction.
- Typical examples are metals (Cr, Ni) that trigger type IV immunopathological reactions. Drugs (antibiotics, local anesthetics) cause type I immunopathological reaction.

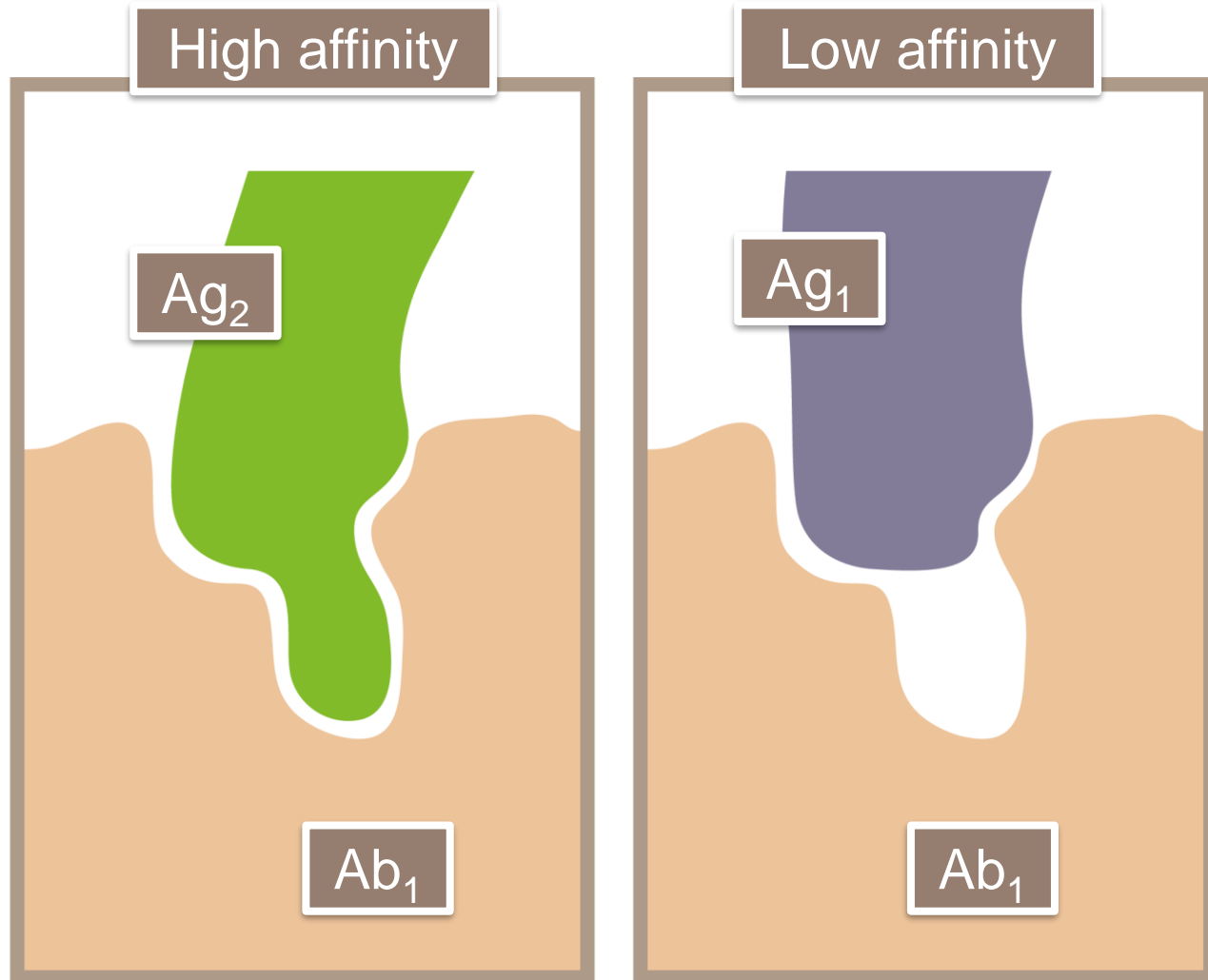
Immunogenicity of hapten



Cross reactivity of antigens

- Products of the immune reaction may, in some conditions, react with substances that are very different from the initial immunogen.
- Immunological cross-reactivity not necessary mean similar chemical composition.
- The degree of cross reactivity may be different.
- Cross reactivity is important in pathogenesis of several autoimmune diseases.

Cross reactivity of anntigens



Adjuvants

- Substances, that when mixed with antigen, non-specifically enhance immune reaction against the antigen.
- Freud's adjuvant: killed Mycobacterium tuberculosis + water-in-oil emulsion. Used in veterinary medicine.
- Alum precipitate - $Al(OH)_3$ - used in human medicine.
- Mechanisms: improved presentation of the antigen, fixation of the antigen in the place of application..

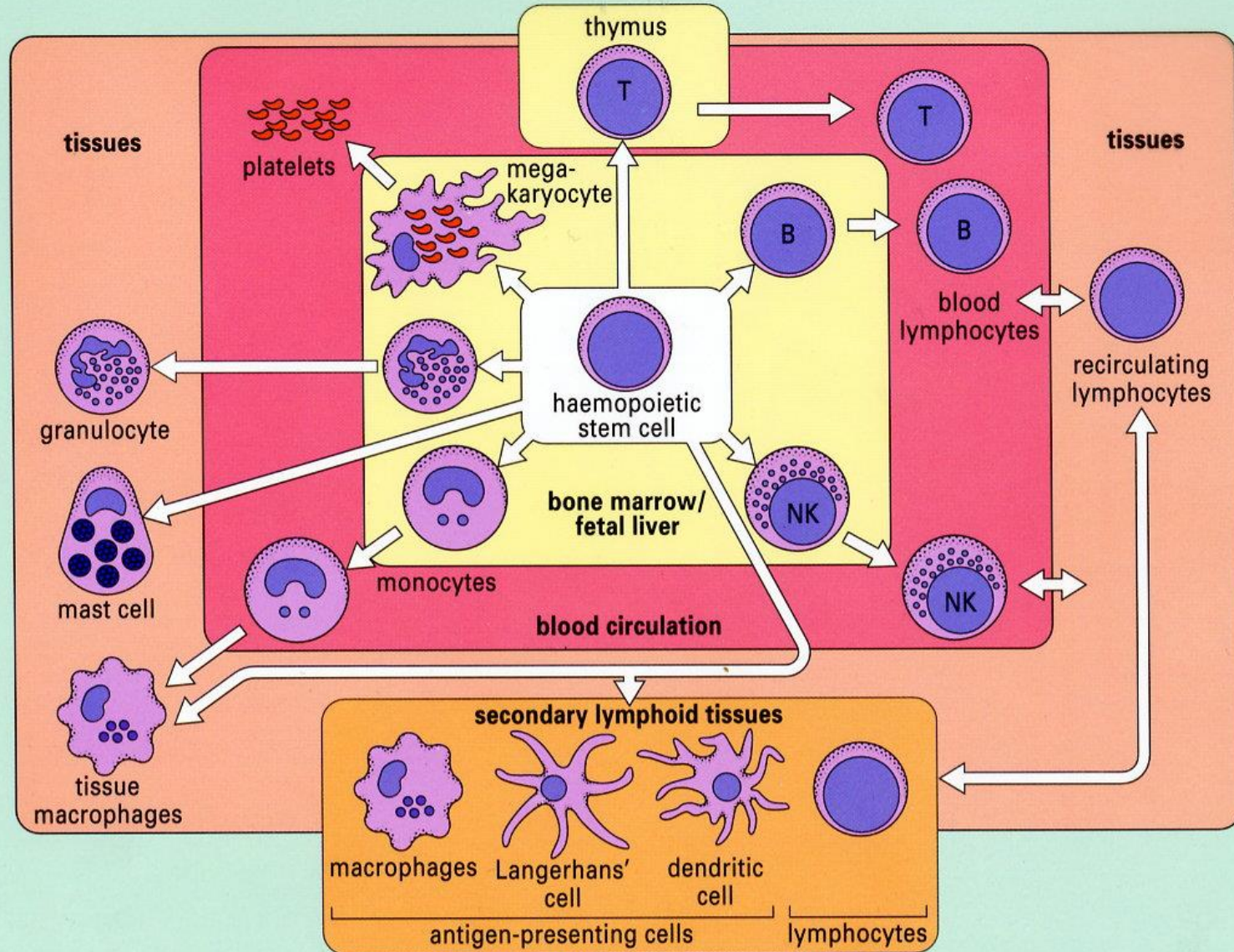
Two branches of the immune response

- Innate, nonspecific – very quickly recognizes most foreign substances and eliminates them. There is no memory.
- Adaptive, specific – high degree of specificity in distinction between self and non-self. The reaction requires several days to be effectively triggered. There is immune memory.

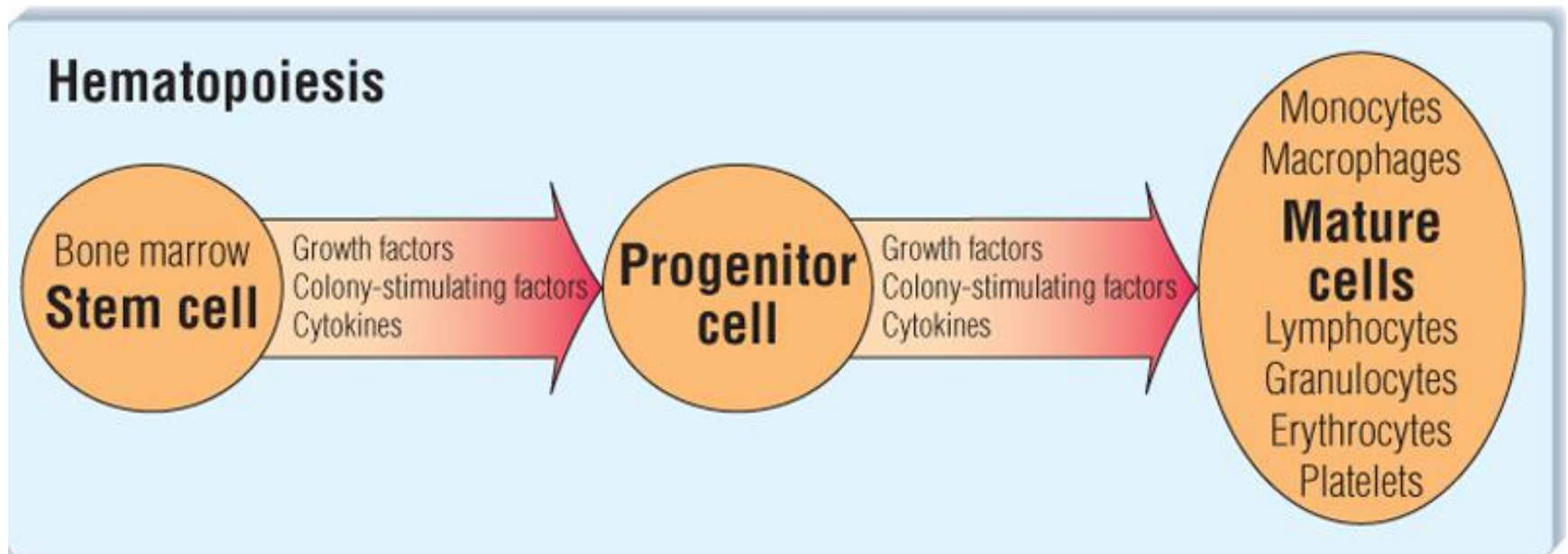
Cells of the immune system

- Main cells of the immune system
 - Lymphocytes (T a B)
- Accessory cells of the immune system
 - Granulocytes
 - Monocytes
 - Tissue macrophages
 - Mast cells
 - Dendritic cells
 - NK cells
 - Endotelial cells
 - Thrombocytes, erythrocytes, fibroblasts, epithelial cells

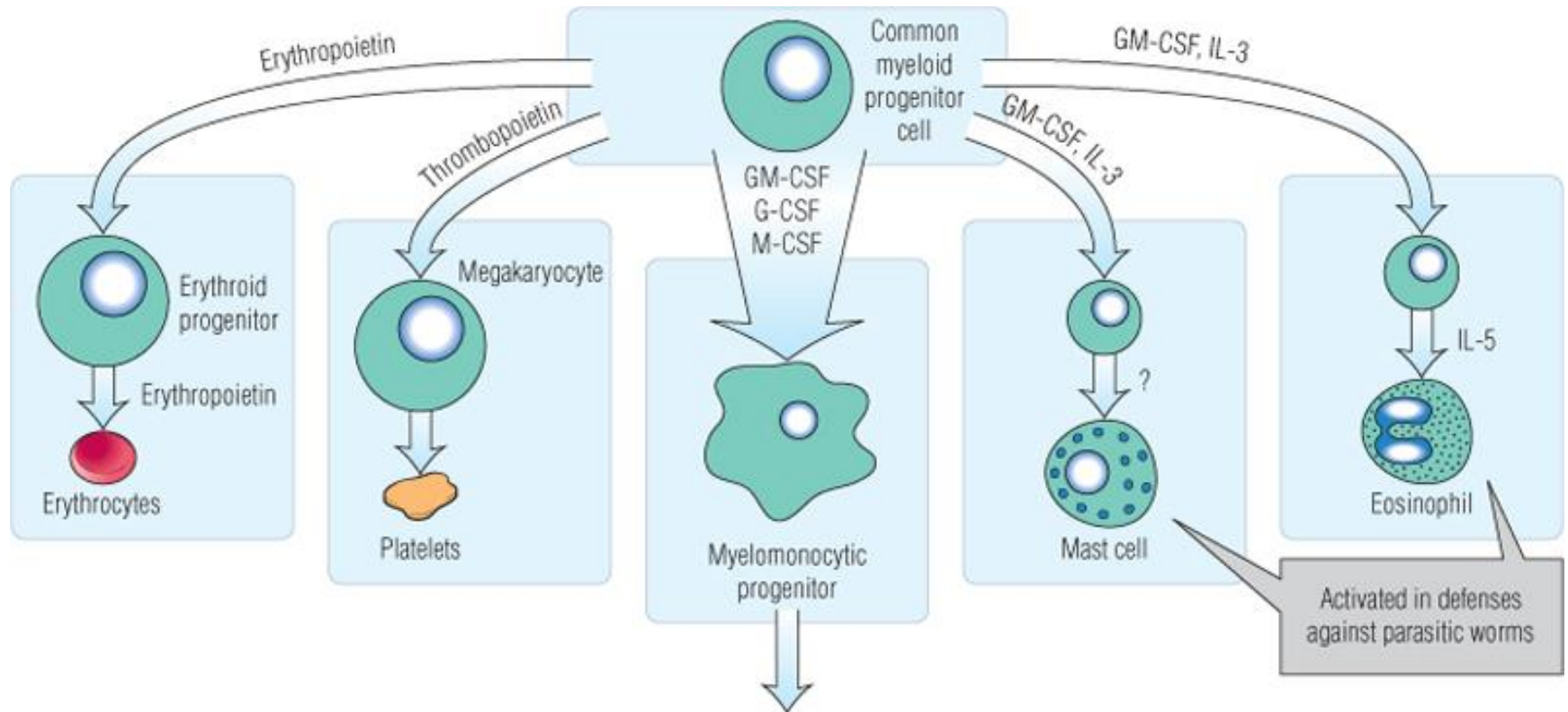
Majority of immune system cells originate in bone marrow

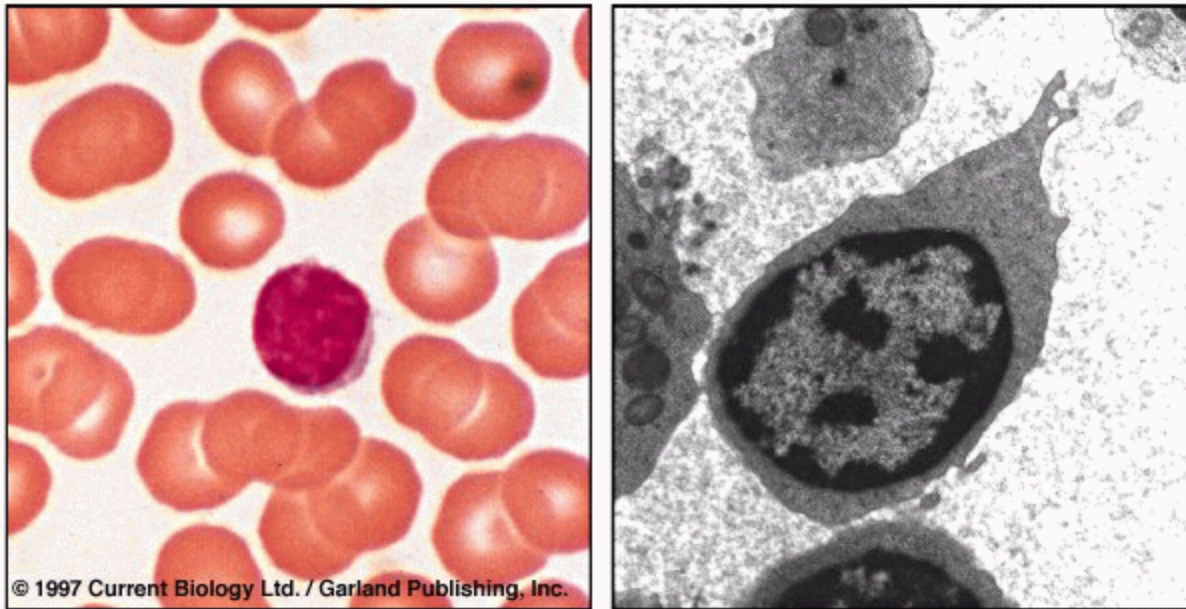


Differentiation of cells during hematopoiesis



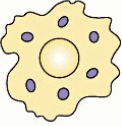
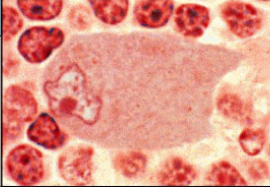

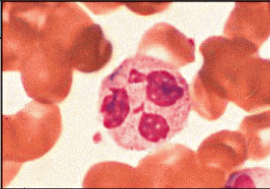

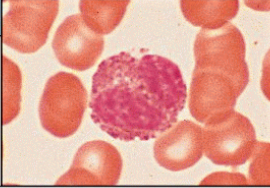

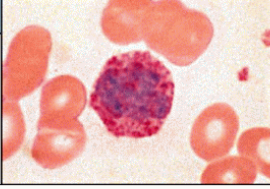
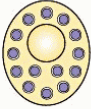
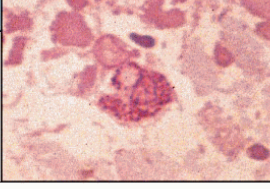

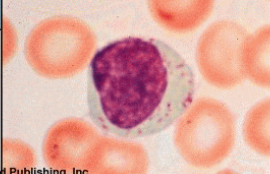
Differentiation of haematopoietic stem cell is influenced by the local environment



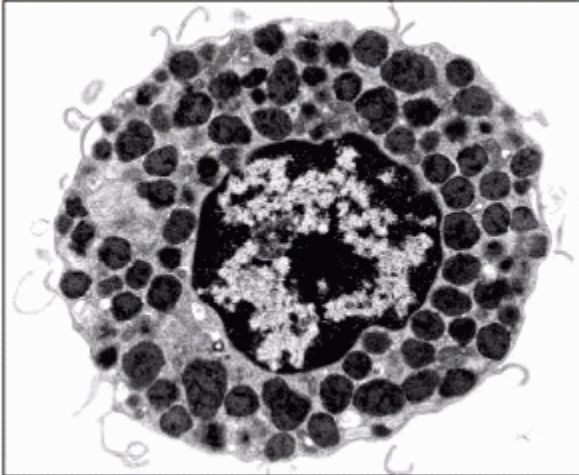


Lymphocyte – central cell of the immune system

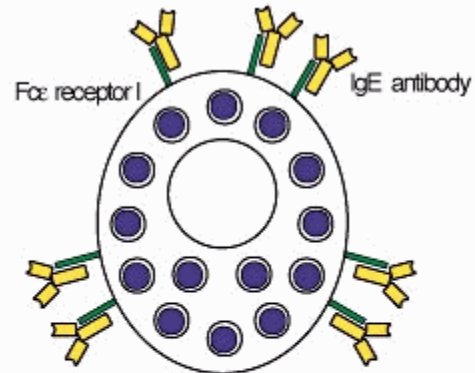
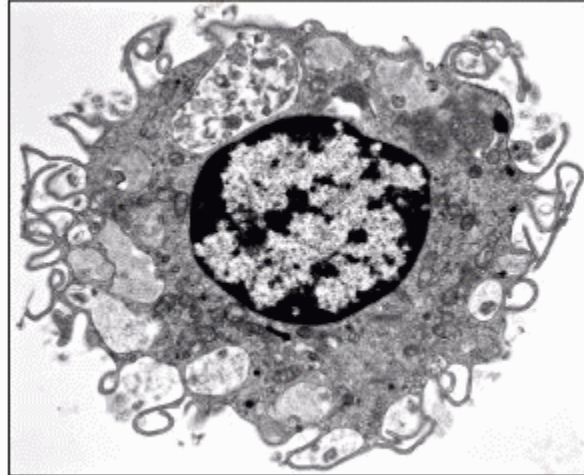
Auxiliary cells of the immune system

Cell		Activated function
Macrophage 		Phagocytosis
Neutrophil 		Phagocytosis and activation of bactericidal mechanisms
Eosinophil 		Killing of antibody-coated parasites
Basophil 		Unknown
Mast cell 		Release of granules containing histamine and other active agents
Natural killer (NK) cell 		Release of lytic granules that kill some virus-infected cells

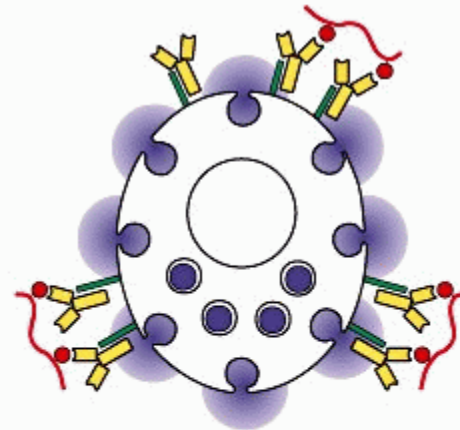
Resting mast cell



Activated mast cell

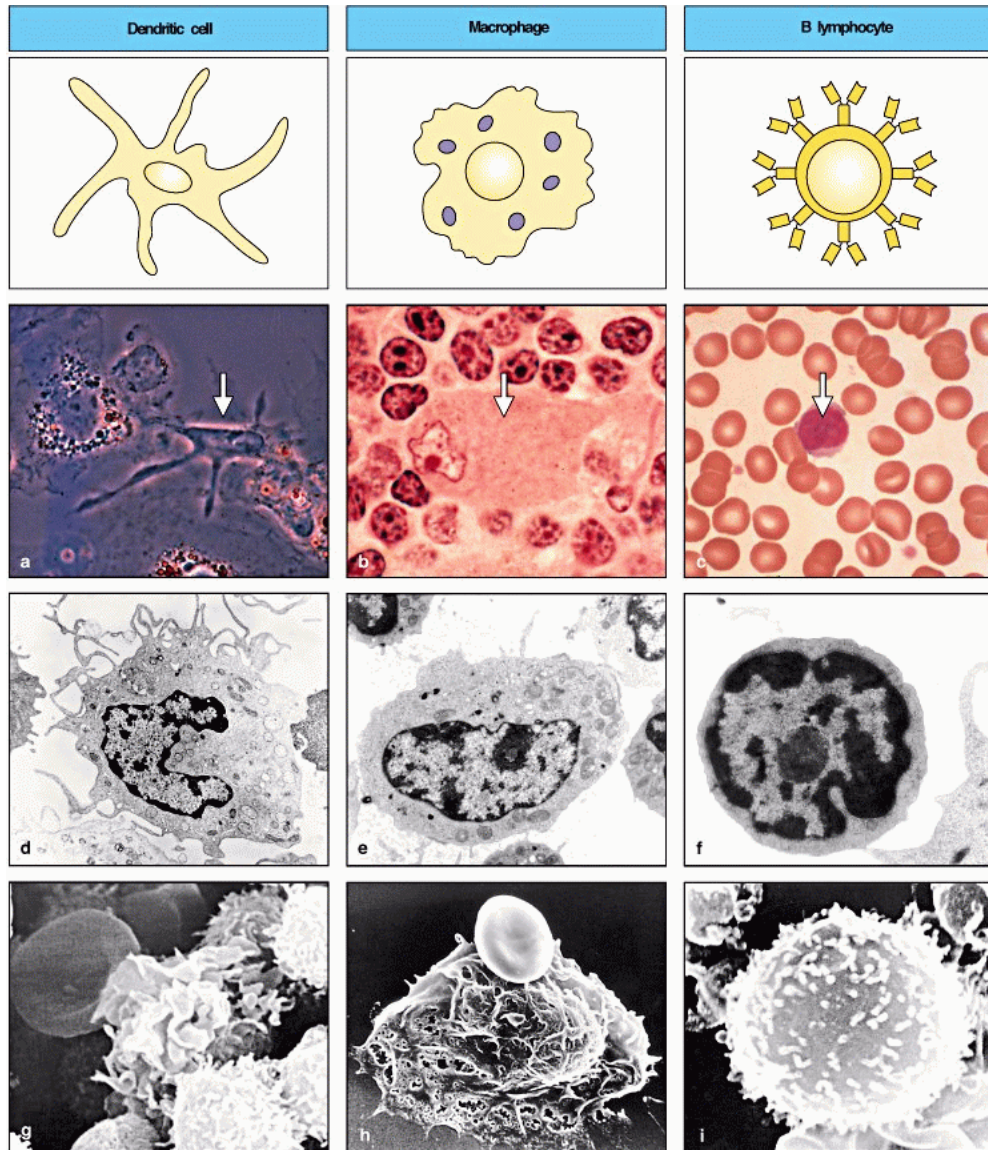


Resting mast cell contains granules containing histamine and other inflammatory mediators



Multivalent antigen crosslinks bound IgE antibody, causing release of granule contents

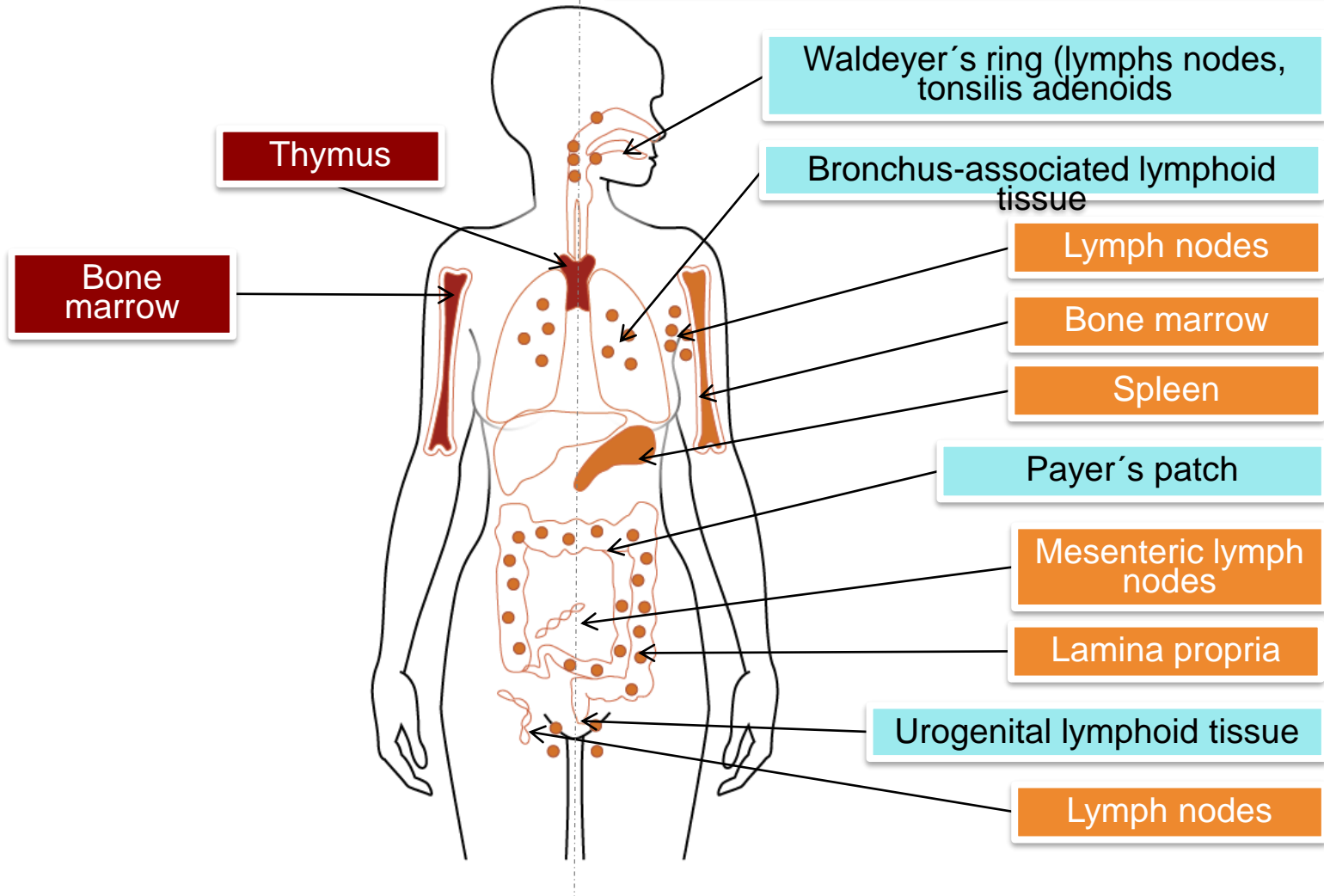
Antigen- presenting cells



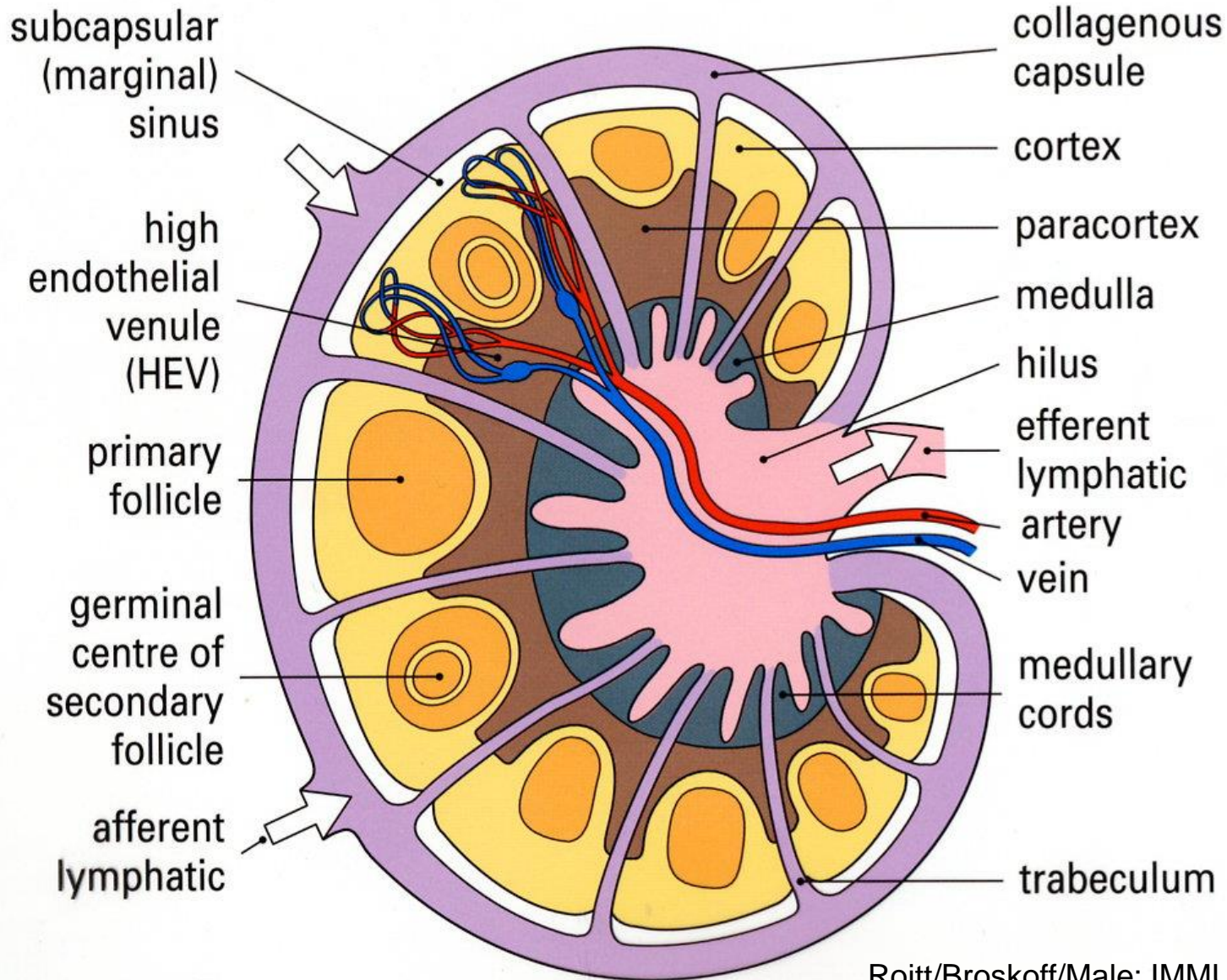
Organs of the immune system

Primary lymphoid organs

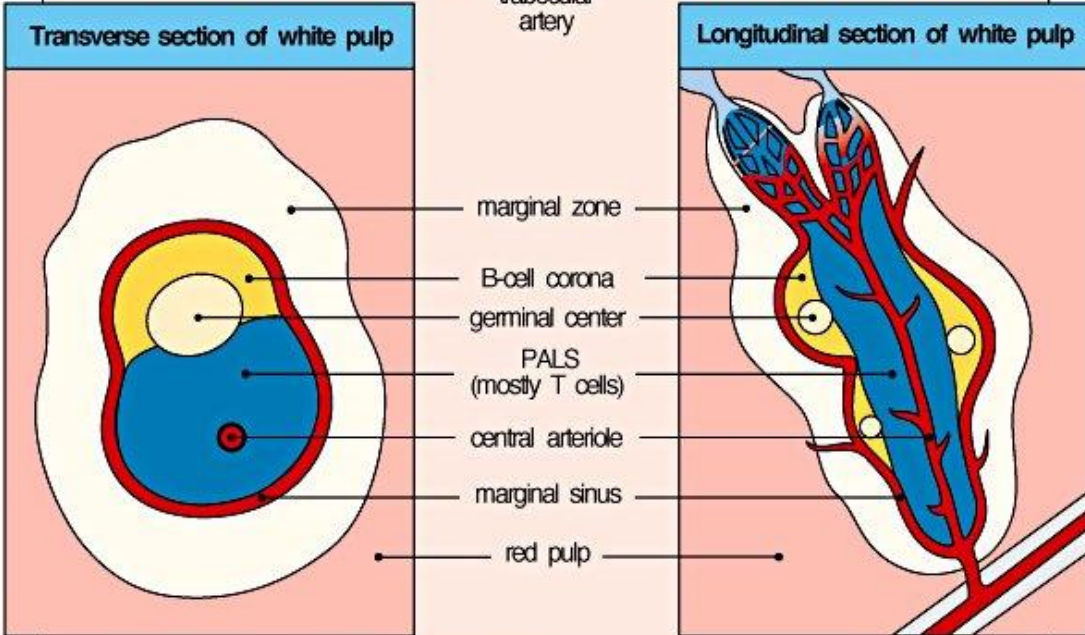
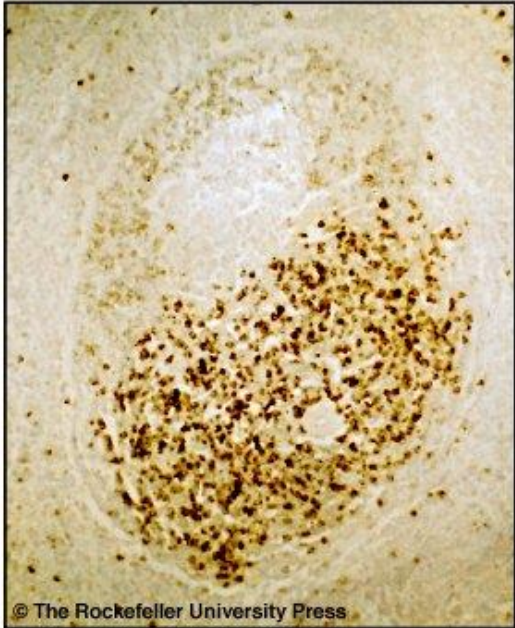
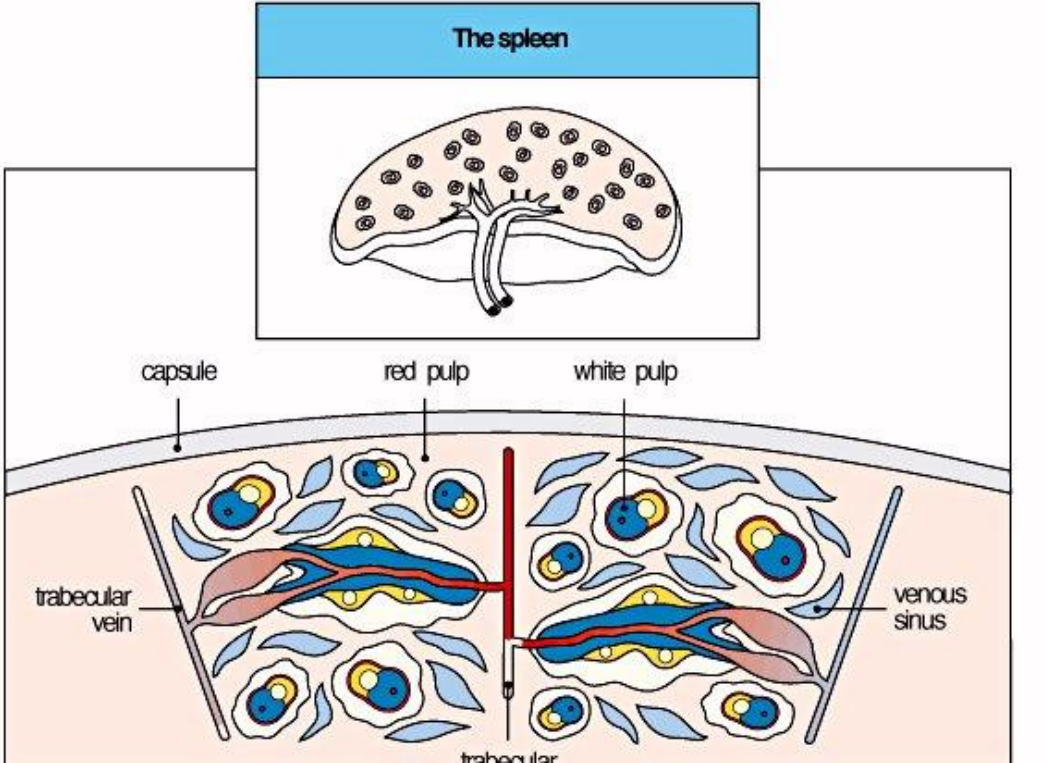
Secondary lymphoid organs



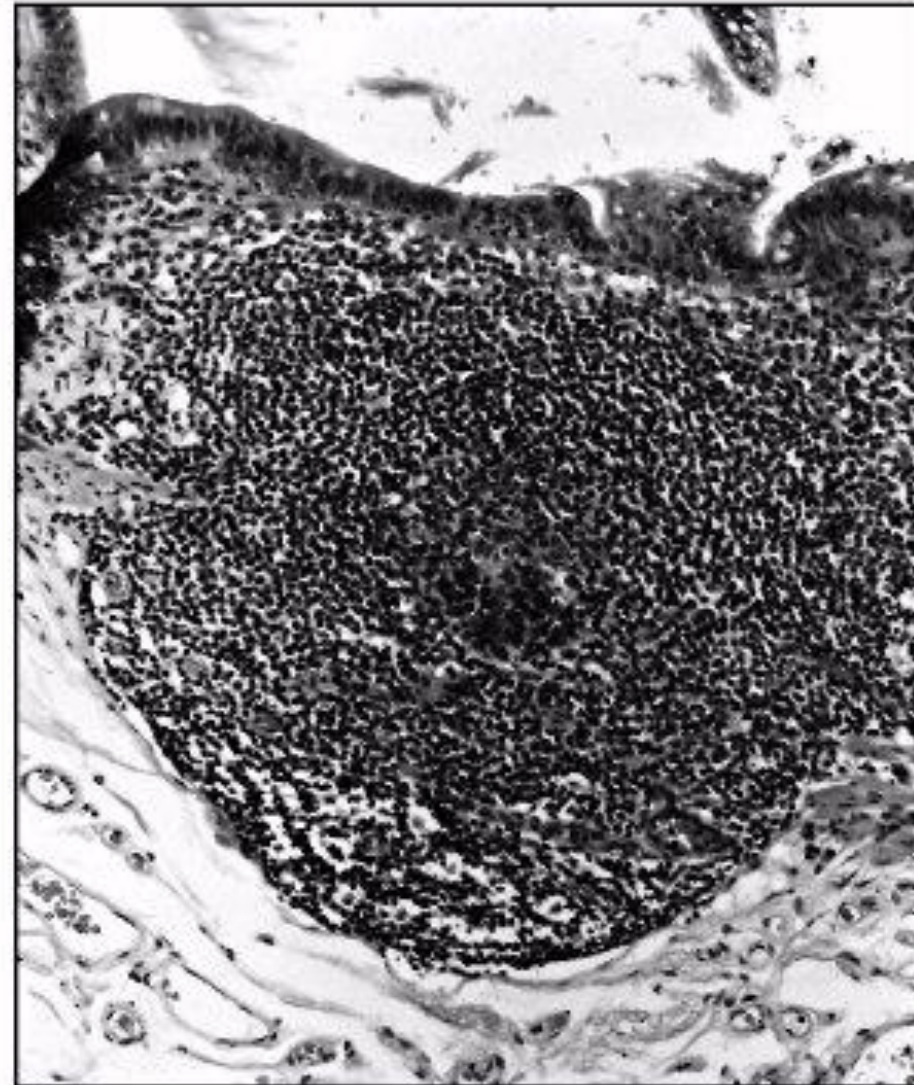
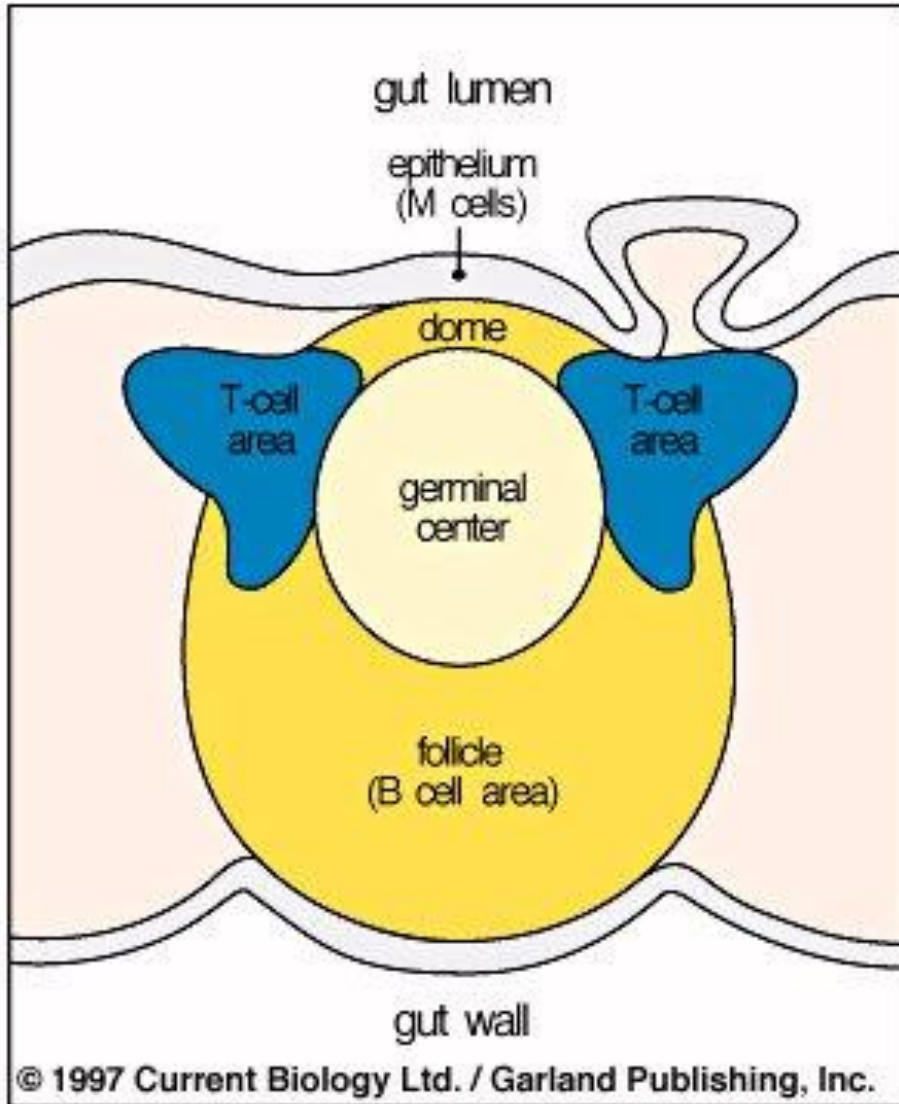
Lymph node



The Spleen



Payer 's Patches



High endothelial venules

- Specialized venules. The site where lymphocytes leave the blood stream and migrate into lymph nodes, spleen, organs of MALT.
- Adhesion molecules enable selective attachment of various types of lymphocytes.

Circulation of Lymphocytes in the body

The role of High Endothelial Venules

