

# 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.

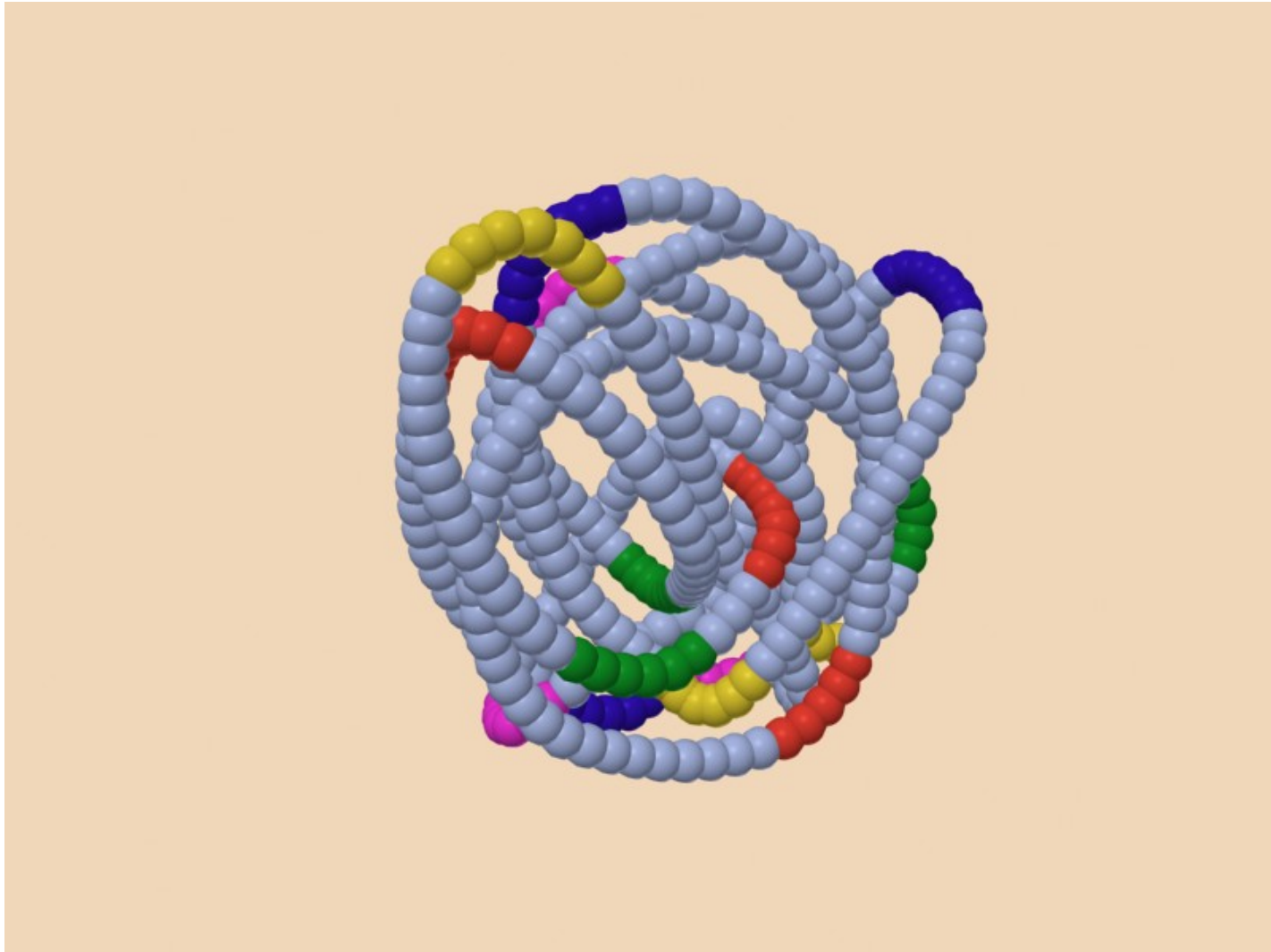
# Requirements of immunogenicity

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

# Antigen – functional components

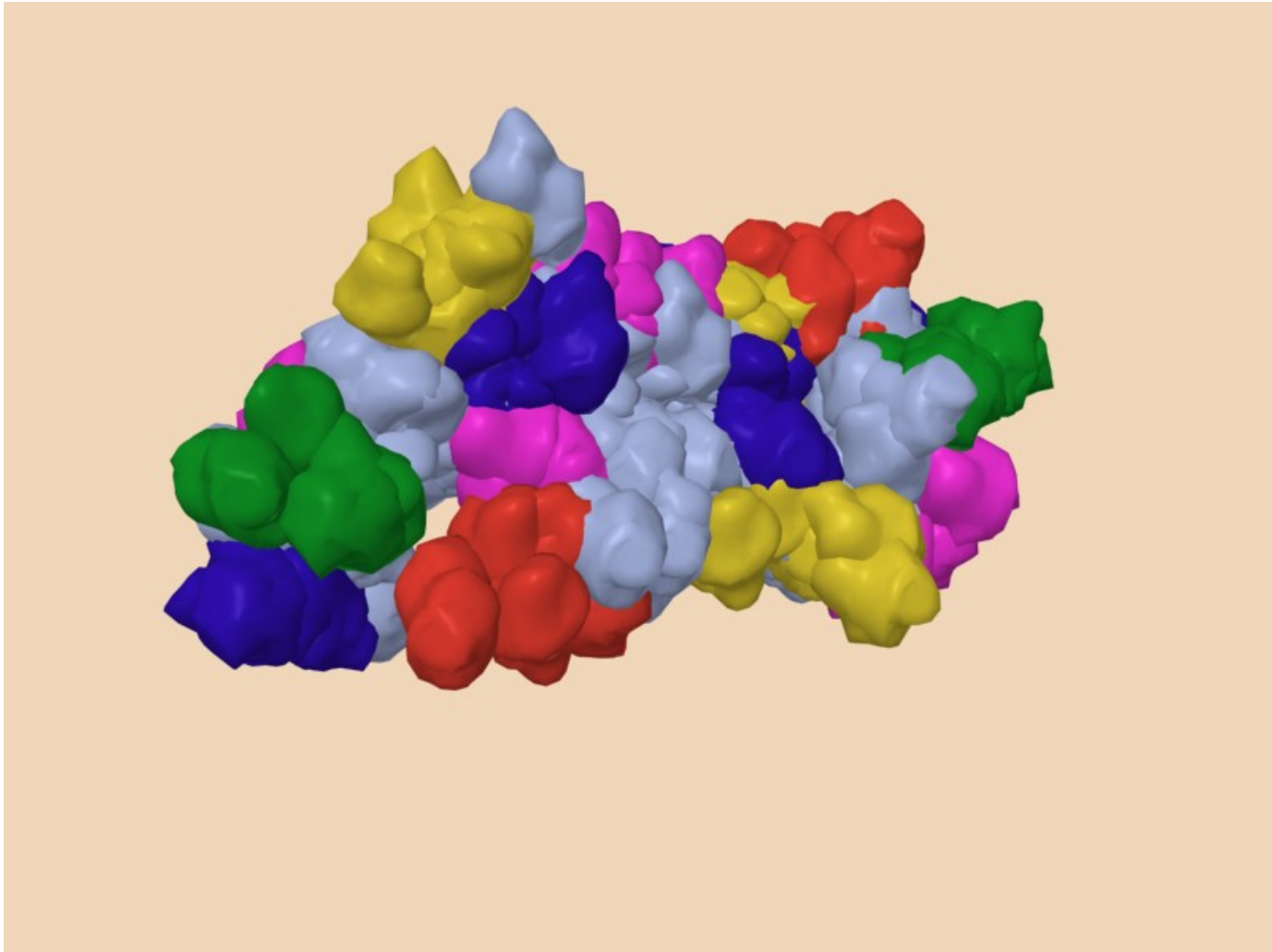
- Carrier part of the molecule
- Antigenic determinant- epitope (cca 5-7 aminoacids)

# Antigen - epitopes, carrier part

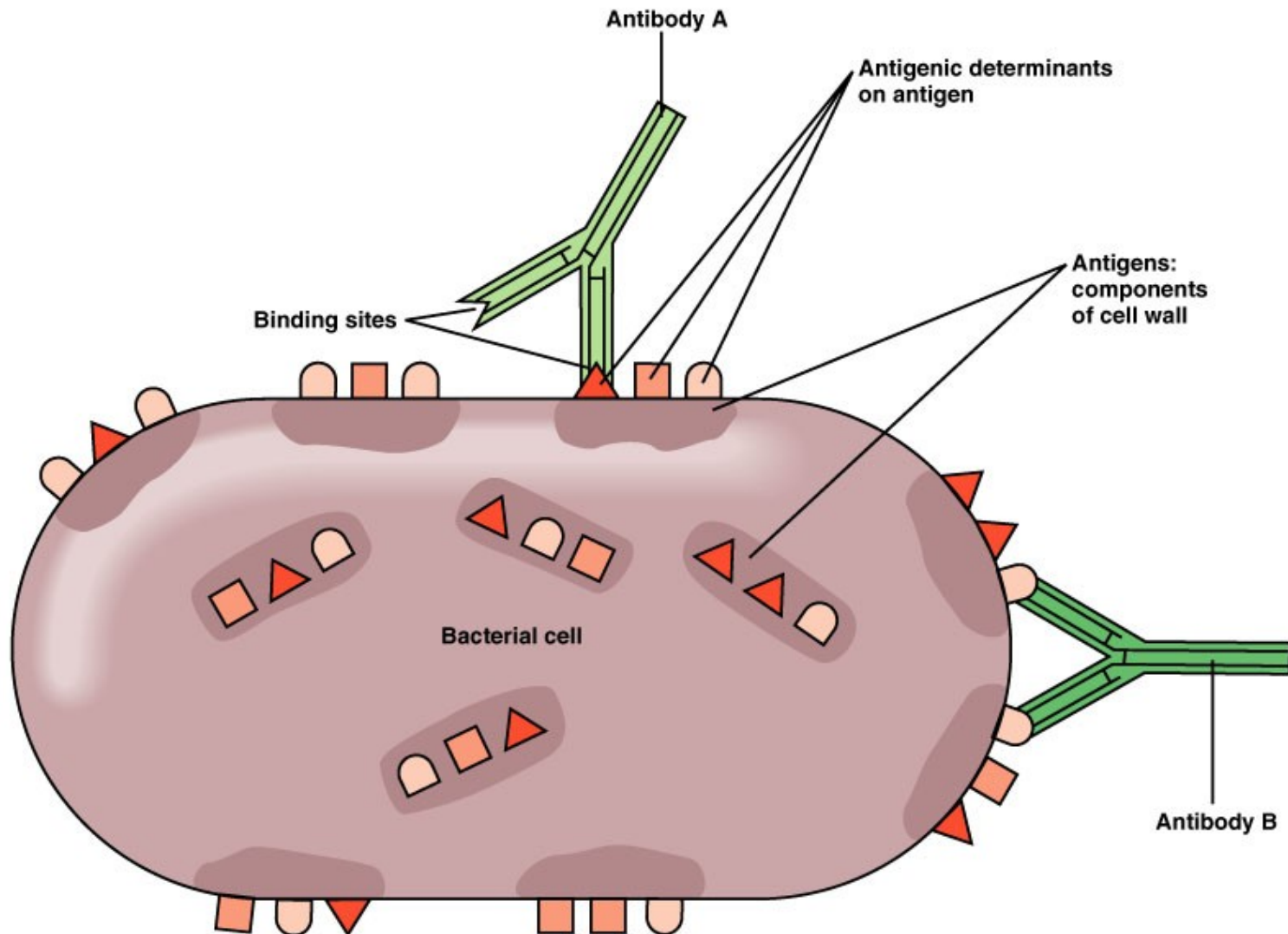




# Antigen - epitopes, carrier part



# Antigen and epitope



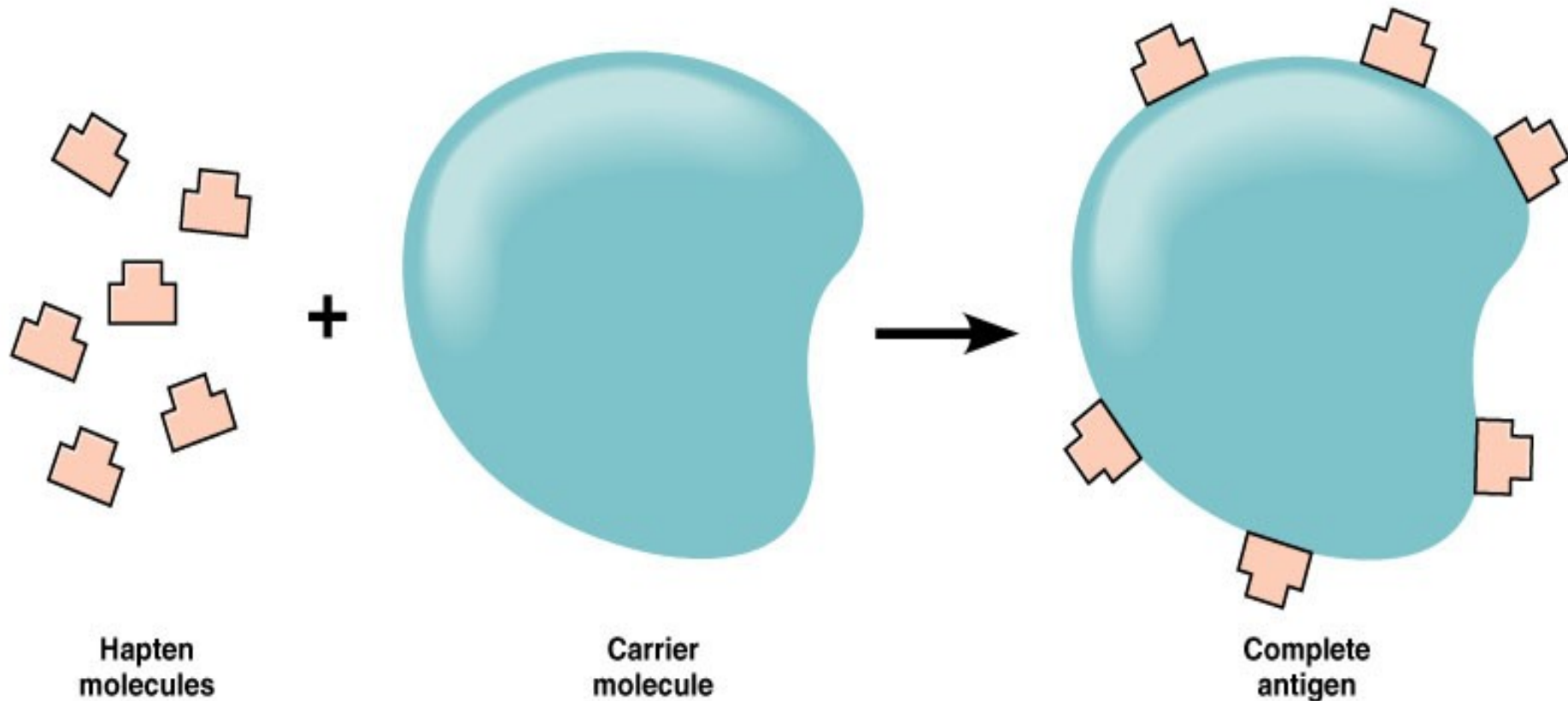
# Chemical composition of antigens

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

# 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.

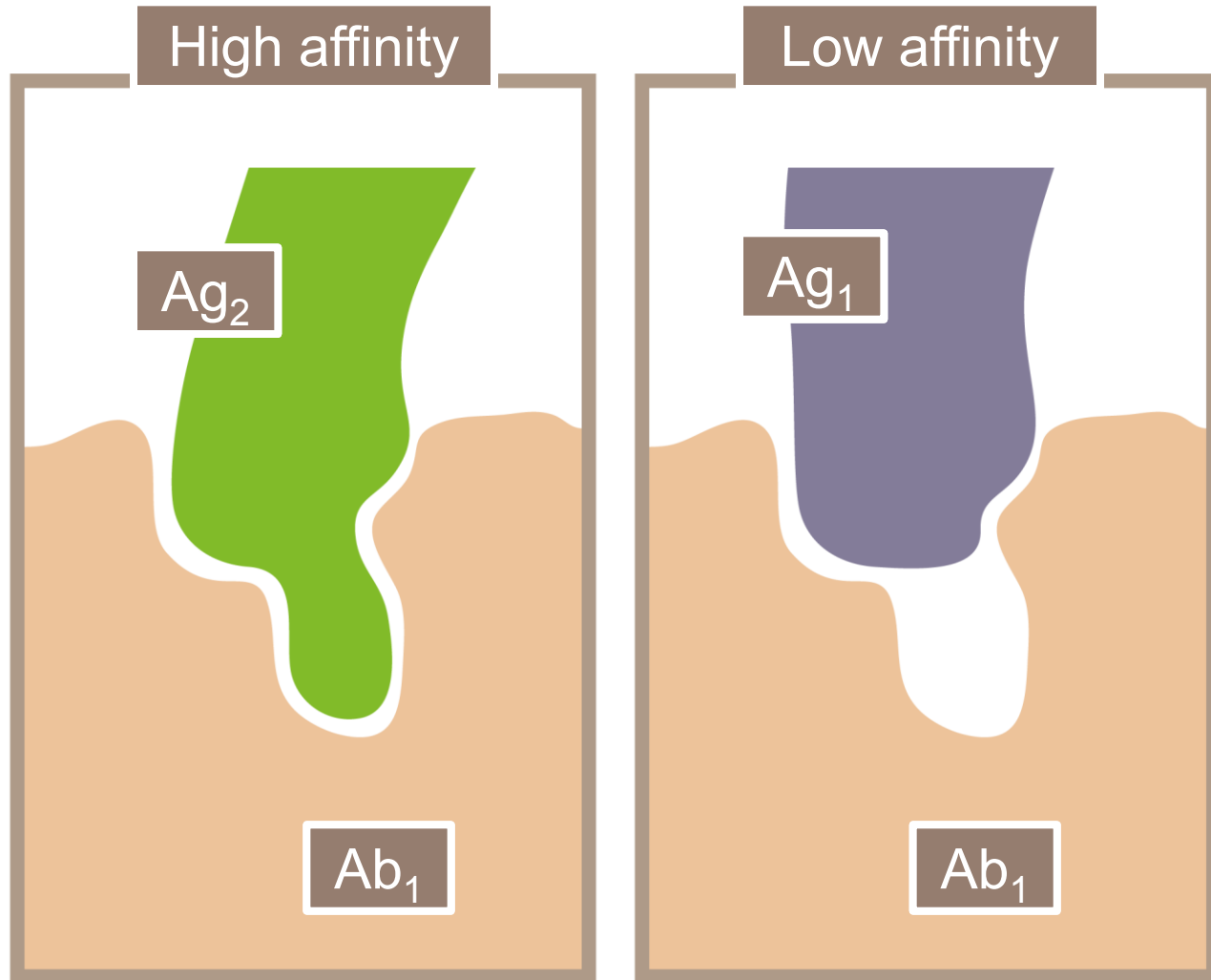
# Immunogenicity of hapten



# 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



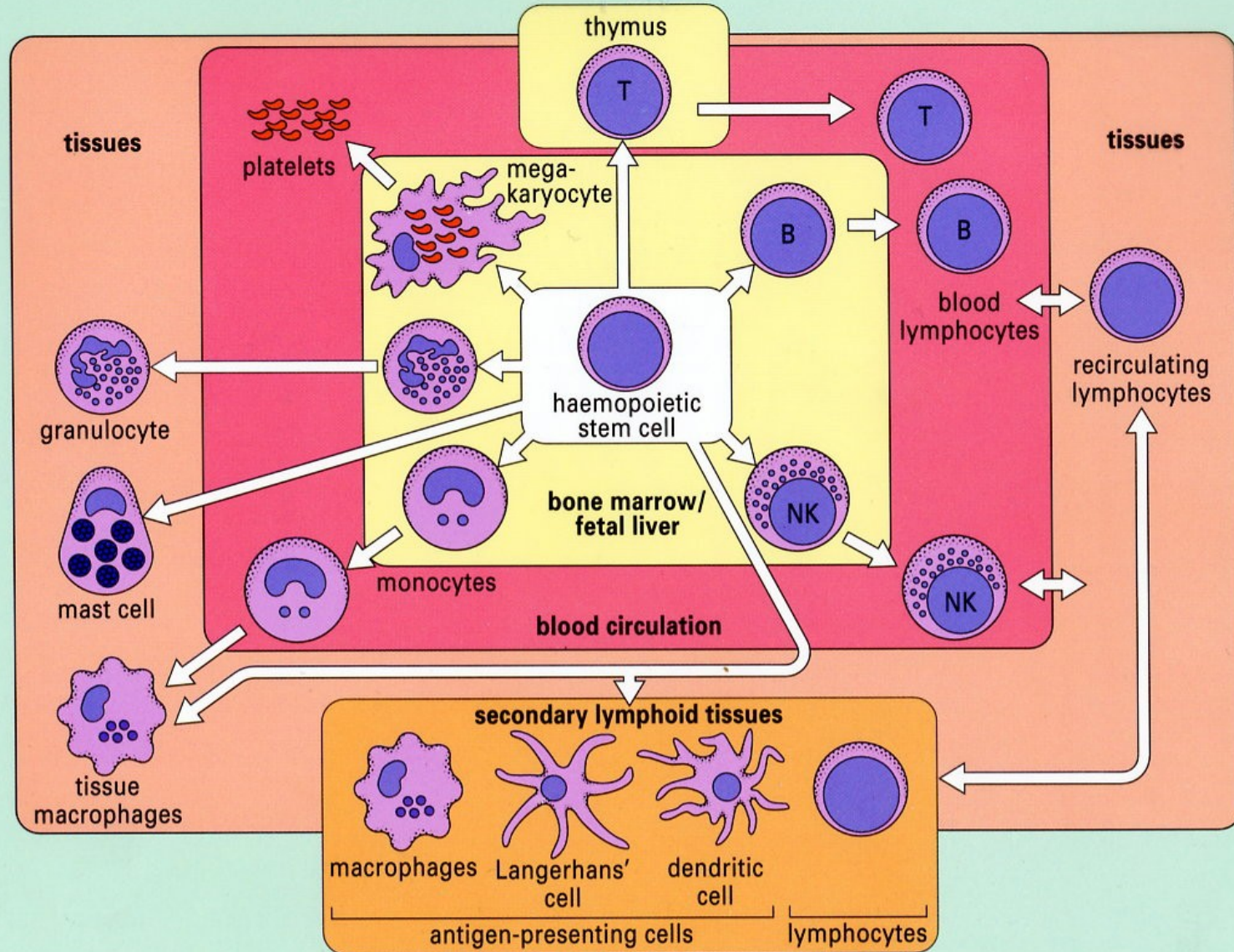
# Two branches of the immune response

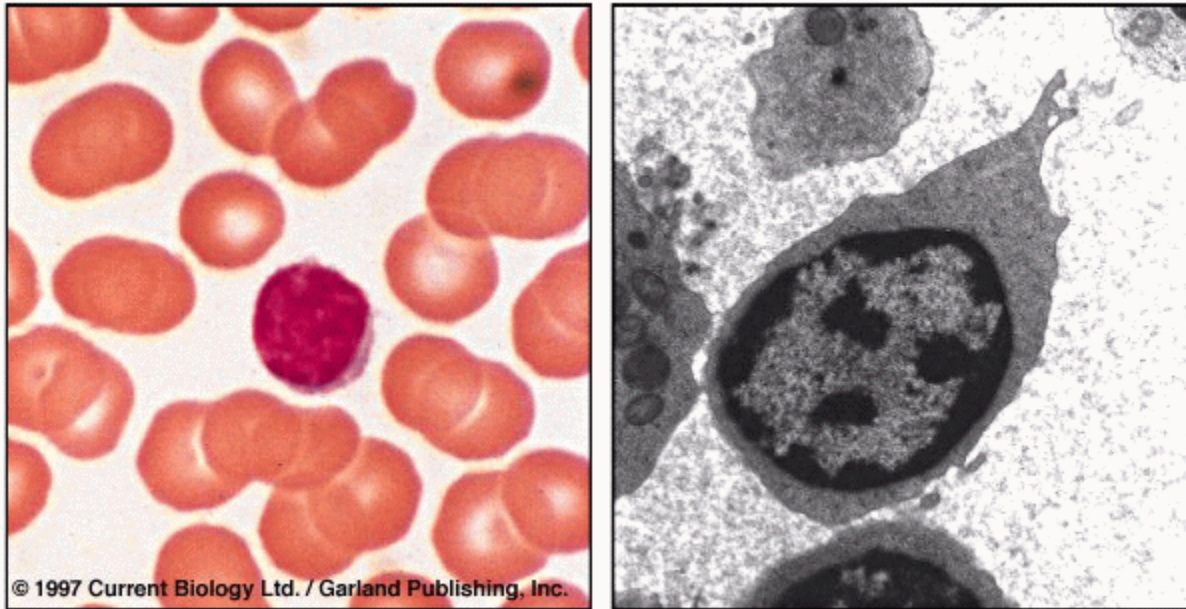
- Innate, nonspecific – very quickly recognizes most foreign substances and eliminates them. There is no memory.
- Adaptive, specific – high degree of specificity in distinction between self and non-self. The reaction requires several days to be effectively triggered. There is immune memory.

# 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

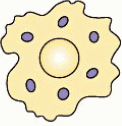


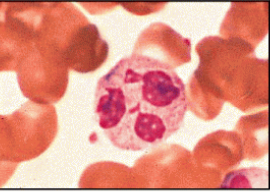

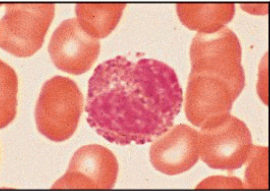

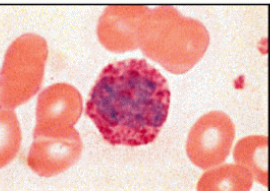

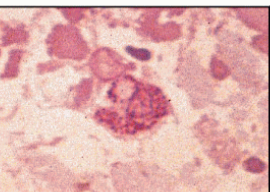

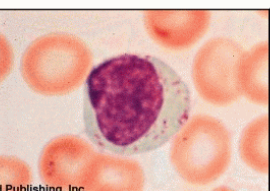
# Majority of immune system cells originate in bone marrow



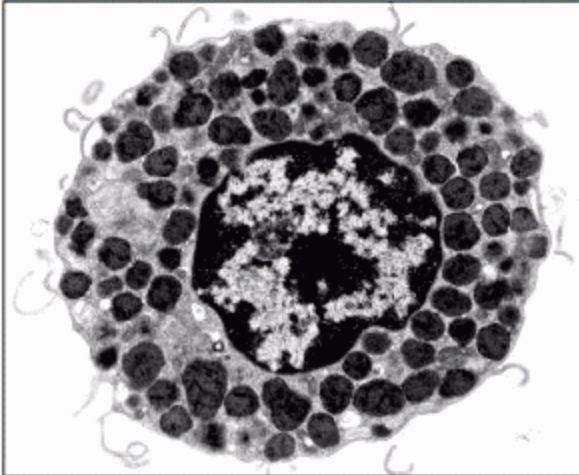


Lymphocyte – central cell of the immune system

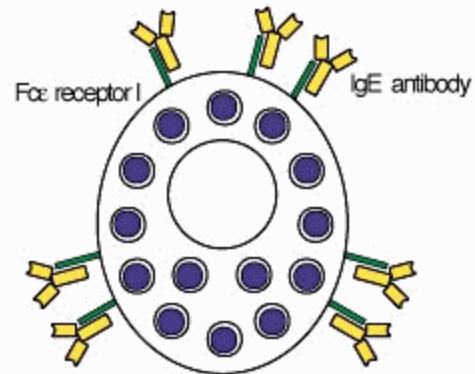
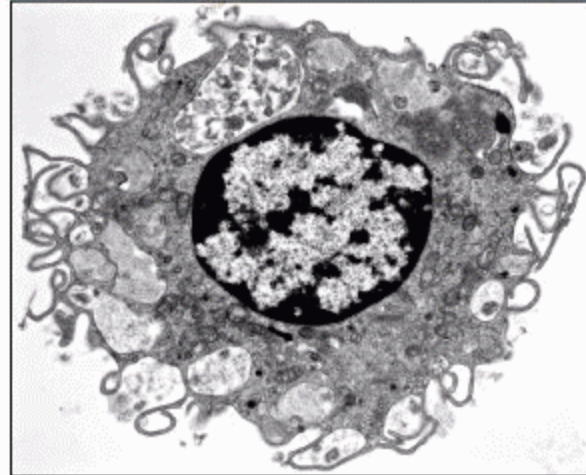
# Auxiliary cells of the immune system

Cell		Activated function
<p data-bbox="664 258 745 272">Macrophage</p> 		<p data-bbox="1128 334 1205 348">Phagocytosis</p>
<p data-bbox="664 454 736 468">Neutrophil</p> 		<p data-bbox="1128 508 1205 572">Phagocytosis and activation of bactericidal mechanisms</p>
<p data-bbox="664 649 736 664">Eosinophil</p> 		<p data-bbox="1128 711 1205 761">Killing of antibody-coated parasites</p>
<p data-bbox="664 845 726 859">Basophil</p> 		<p data-bbox="1128 925 1186 939">Unknown</p>
<p data-bbox="664 1041 726 1055">Mast cell</p> 		<p data-bbox="1128 1083 1205 1176">Release of granules containing histamine and other active agents</p>
<p data-bbox="664 1236 803 1250">Natural killer (NK) cell</p> 		<p data-bbox="1128 1293 1205 1372">Release of lytic granules that kill some virus-infected cells</p>

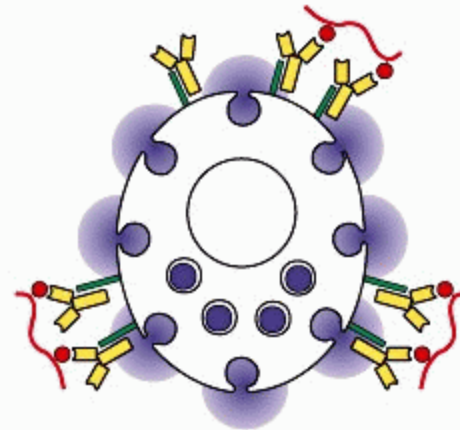
Resting mast cell



Activated mast cell

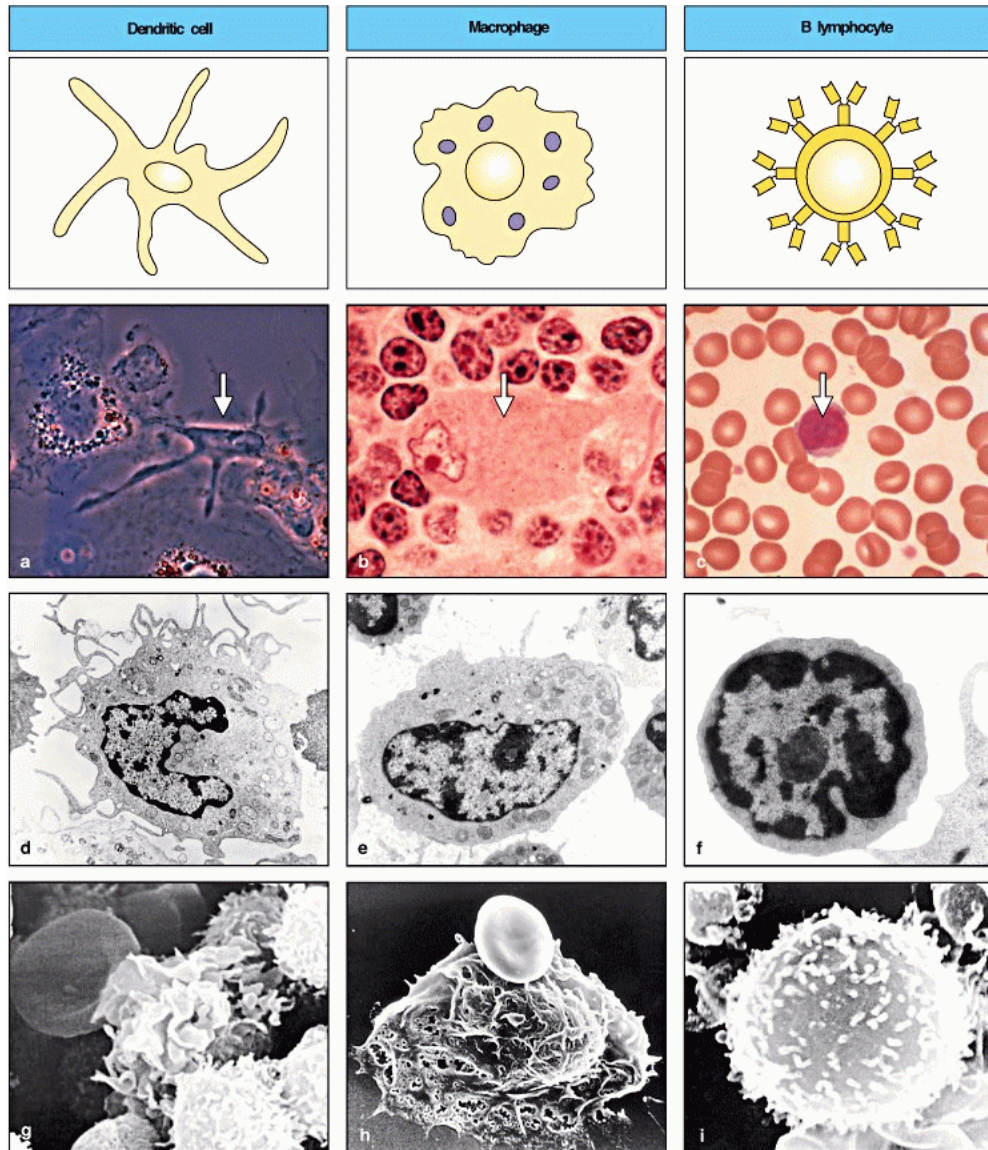


Resting mast cell contains granules containing histamine and other inflammatory mediators



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

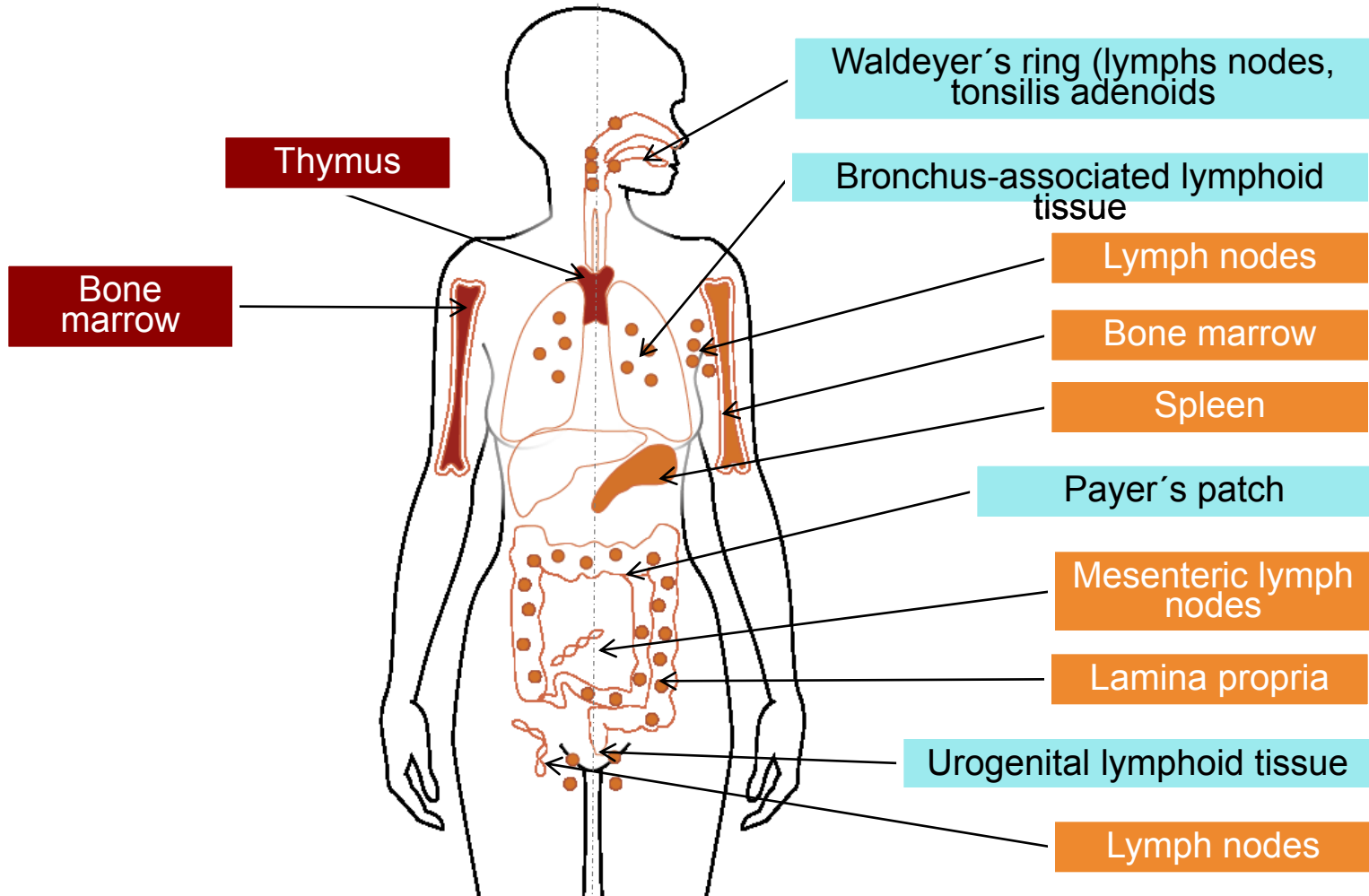
# Antigen- presenting cells



# Organs of the immune system

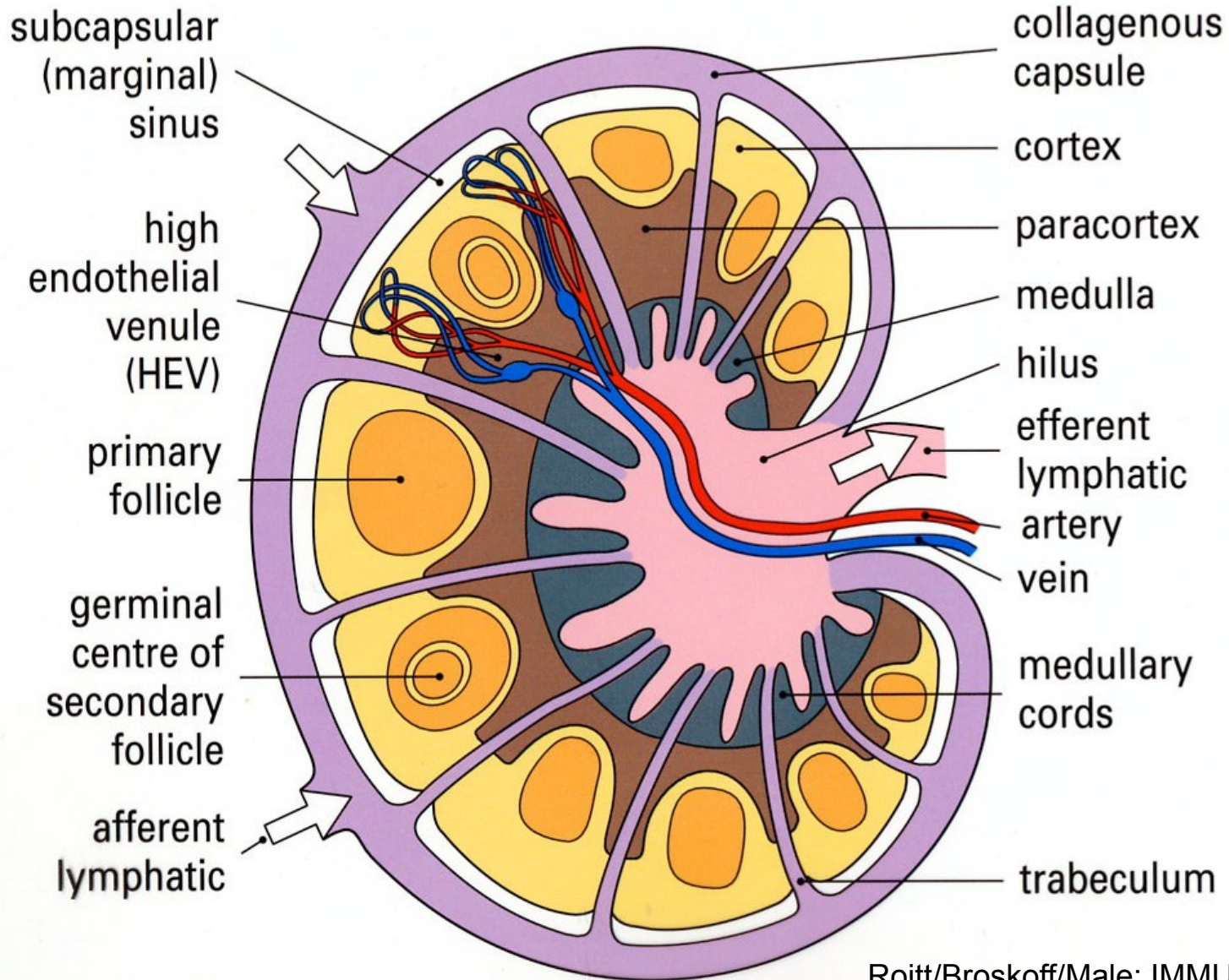
## Primary lymphoid organs

## Secondary lymphoid organs

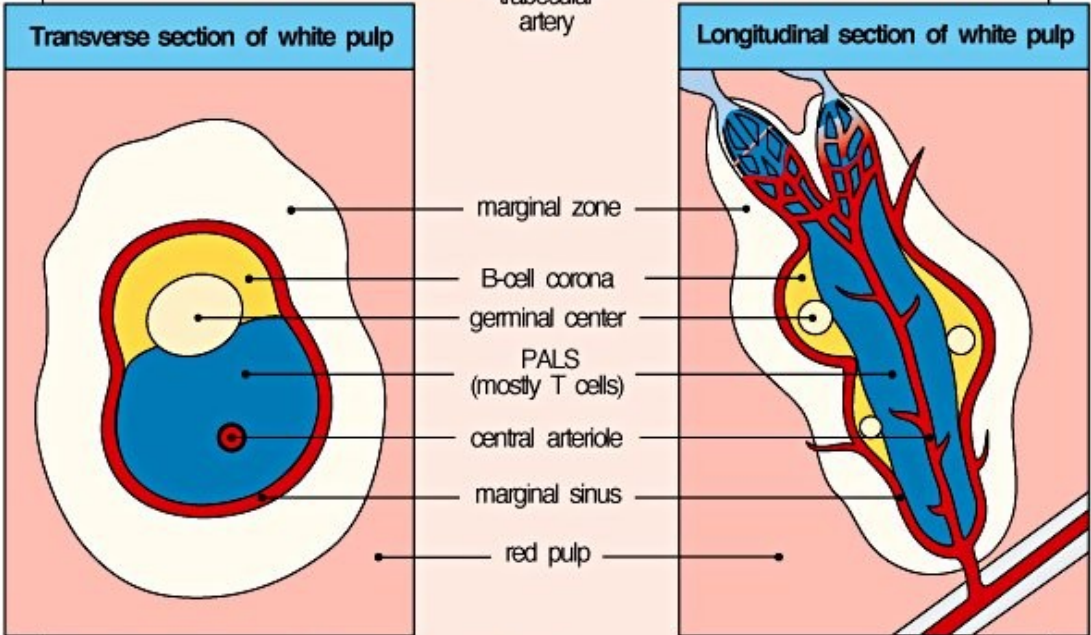
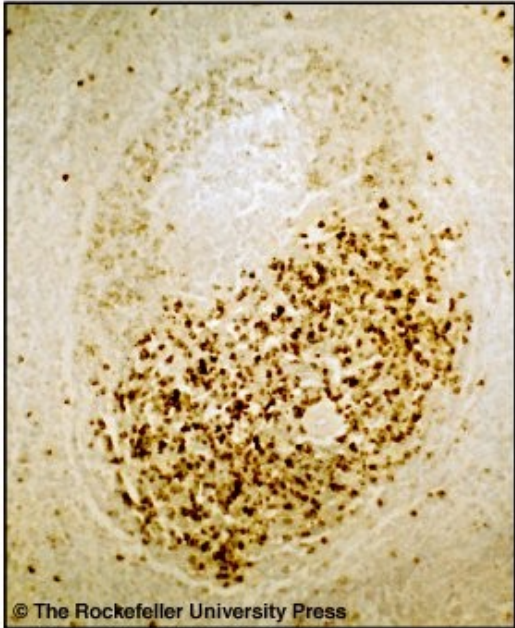
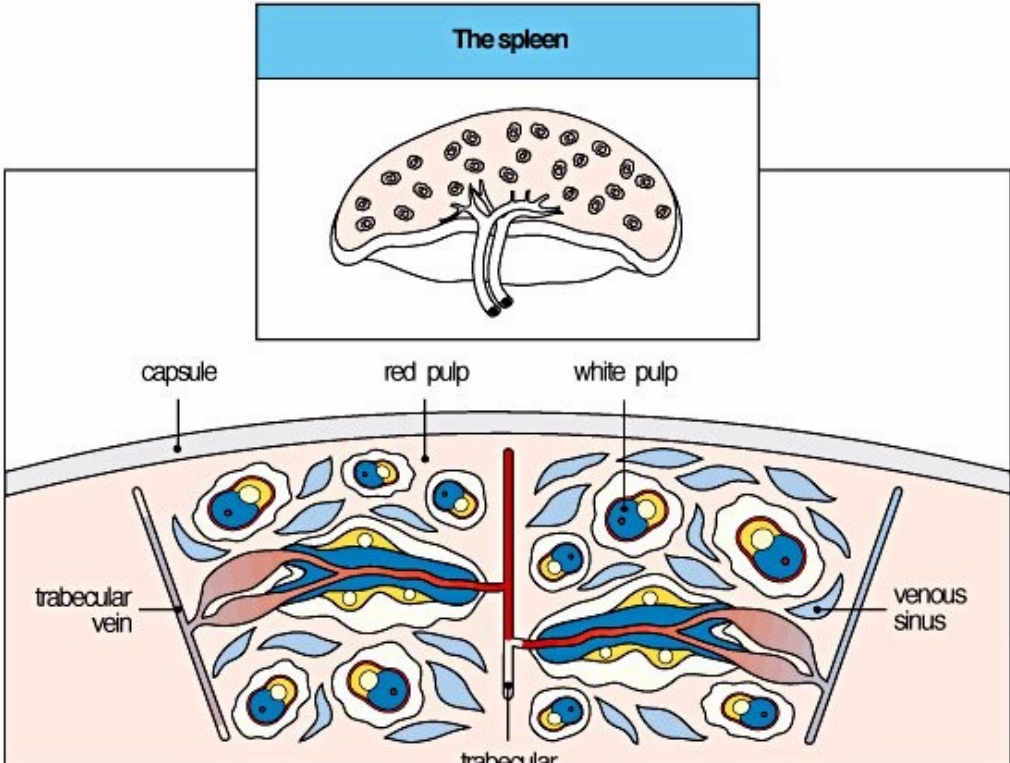




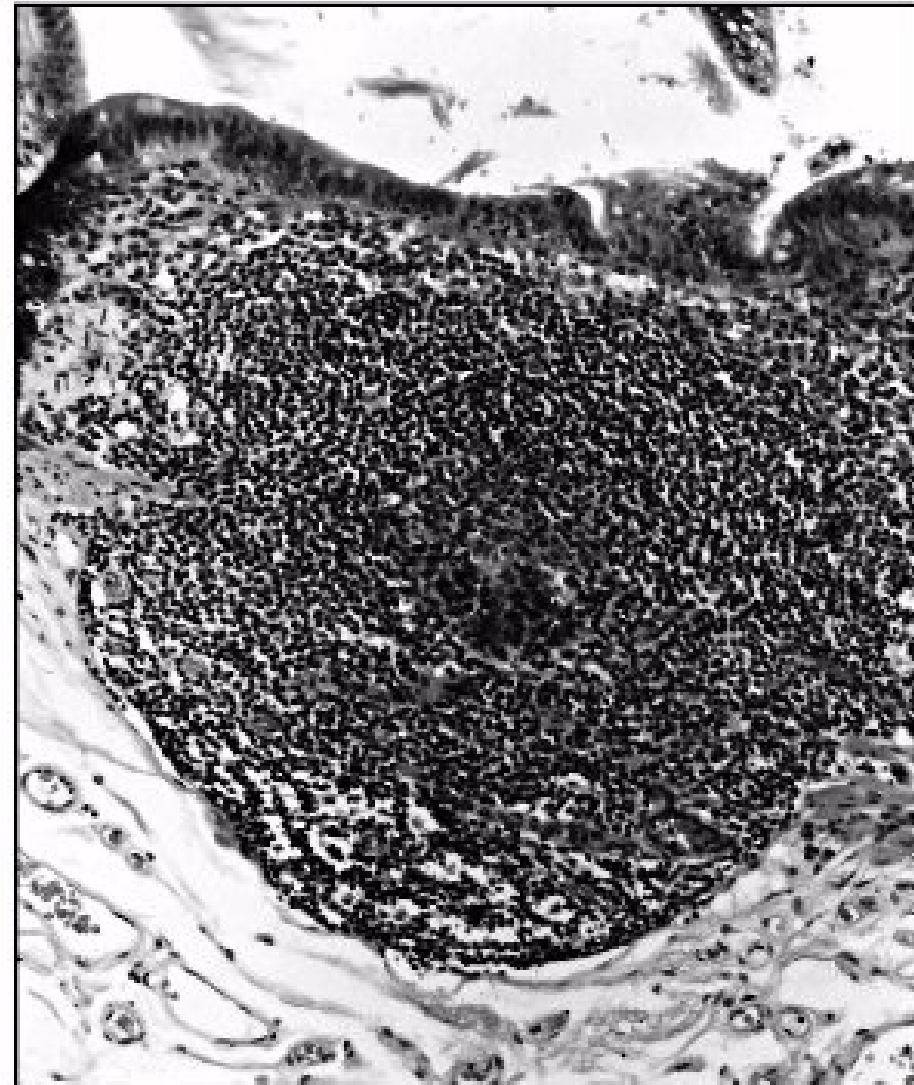
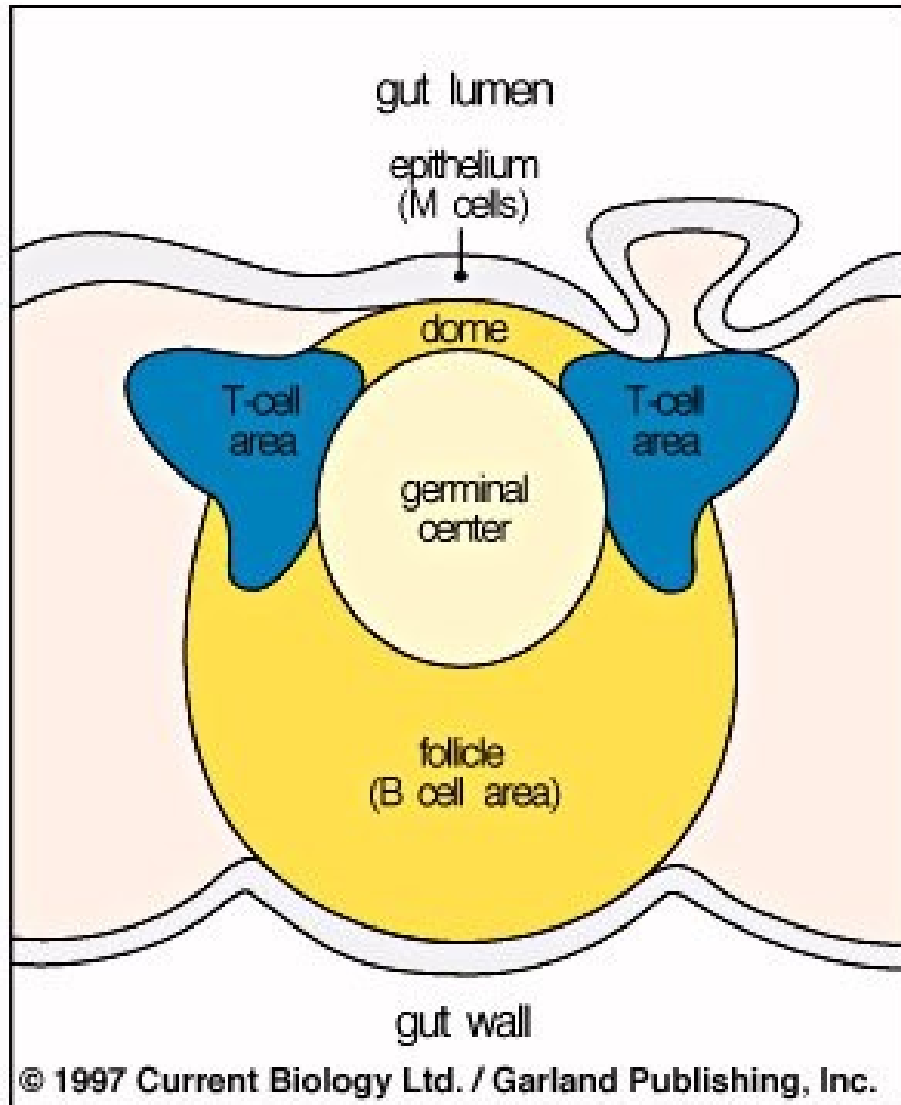
# Lymph node



# The Spleen



# Payer 's Patches

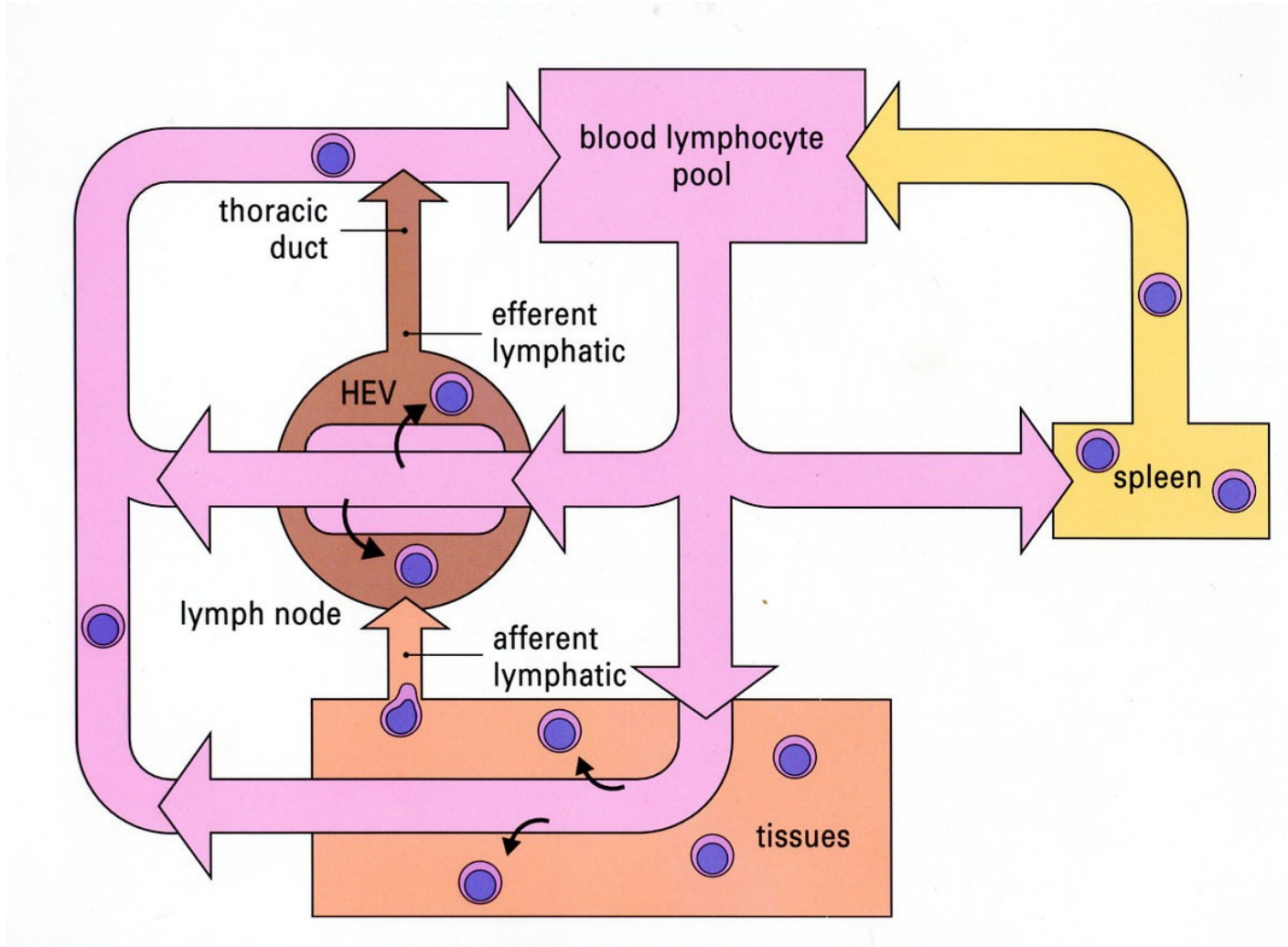


# High endothelial venules

- 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 Endotelial Venules



# Circulation of lymphocytes

