

# Cells and Tissues of the Immune System



# Normal Blood Cell Counts

|                                | Mean Number<br>per Microliter | Normal Range |
|--------------------------------|-------------------------------|--------------|
| White blood cells (leukocytes) | 7400                          | 4500-11,000  |
| Neutrophils                    | 4400                          | 1800-7700    |
| Eosinophils                    | 200                           | 0-450        |
| Basophils                      | 40                            | 0-200        |
| Lymphocytes                    | 2500                          | 1000-4800    |
| Monocytes                      | 300                           | 0-800        |



# Hematopoiesis

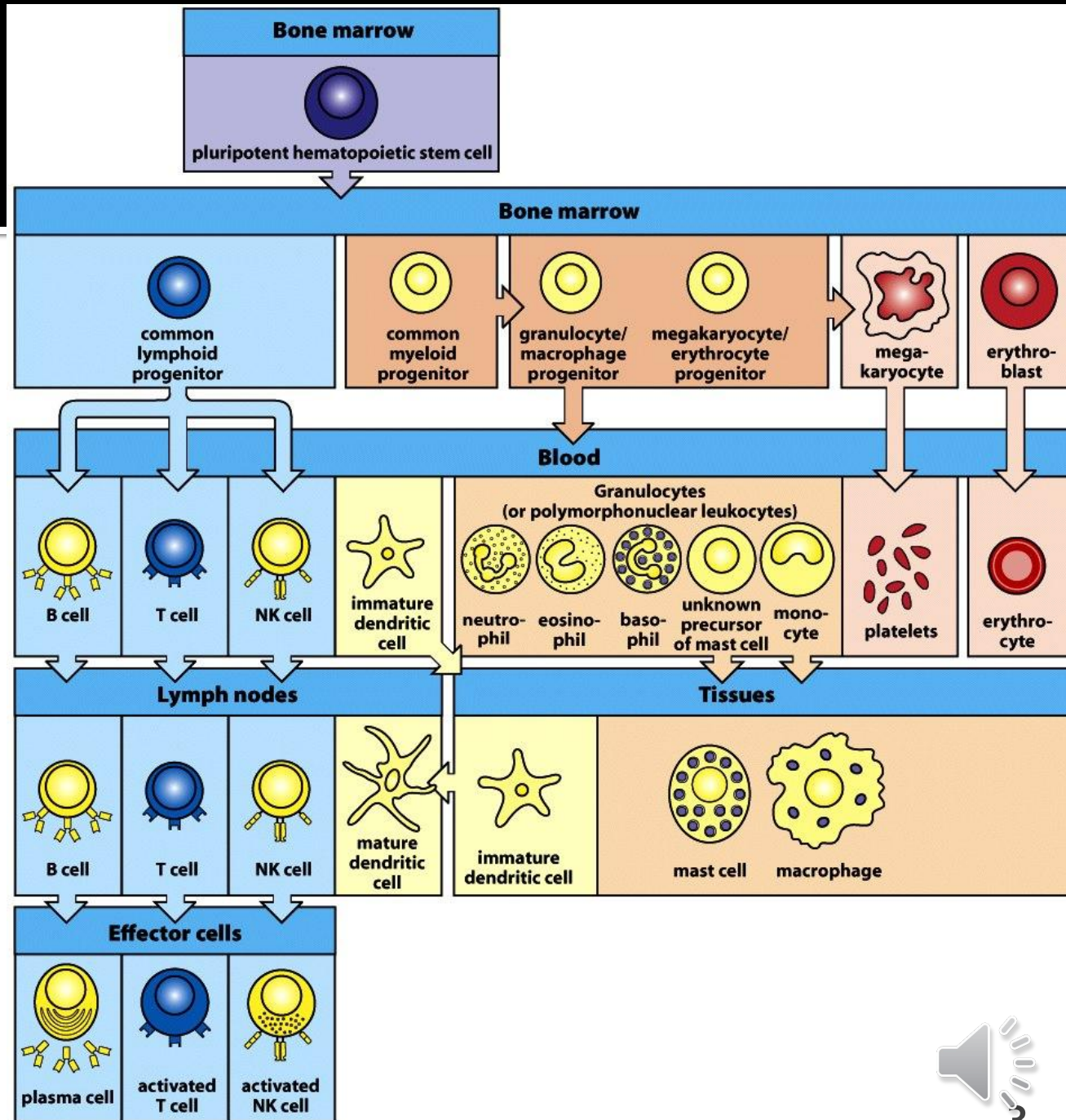


Figure 1-3 Immunobiology, 7ed. (© Garland Science 2008)



# Neutrophils

**Cell**

**Activated  
function**

**Neutrophil**



**Phagocytosis  
and activation  
of bactericidal  
mechanisms**

Figure 1-4 part 3 of 6 Immunobiology, 7ed. (© Garland Science 2008)

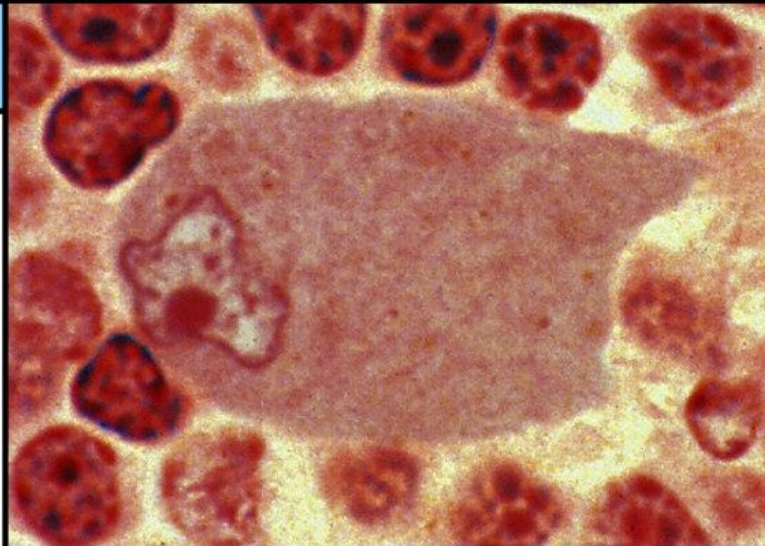
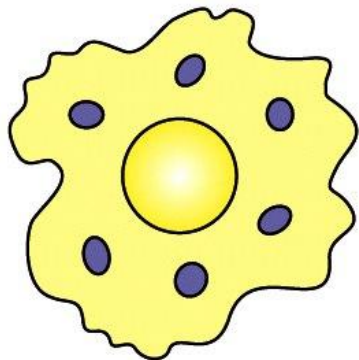


# Mononuclear Phagocytes

**Cell**

**Activated  
function**

**Macrophage**



**Phagocytosis  
and activation of  
bactericidal  
mechanisms**

**Antigen  
presentation**

Figure 1-4 part 1 of 6 Immunobiology, 7ed. (© Garland Science 2008)

# Dendritic Cells

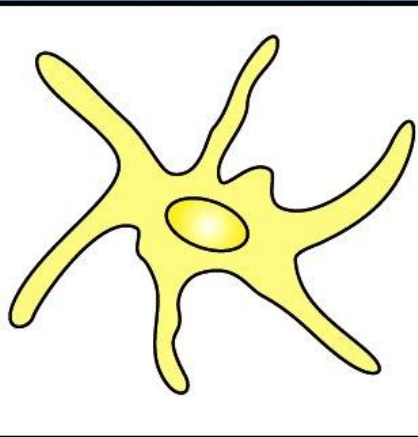

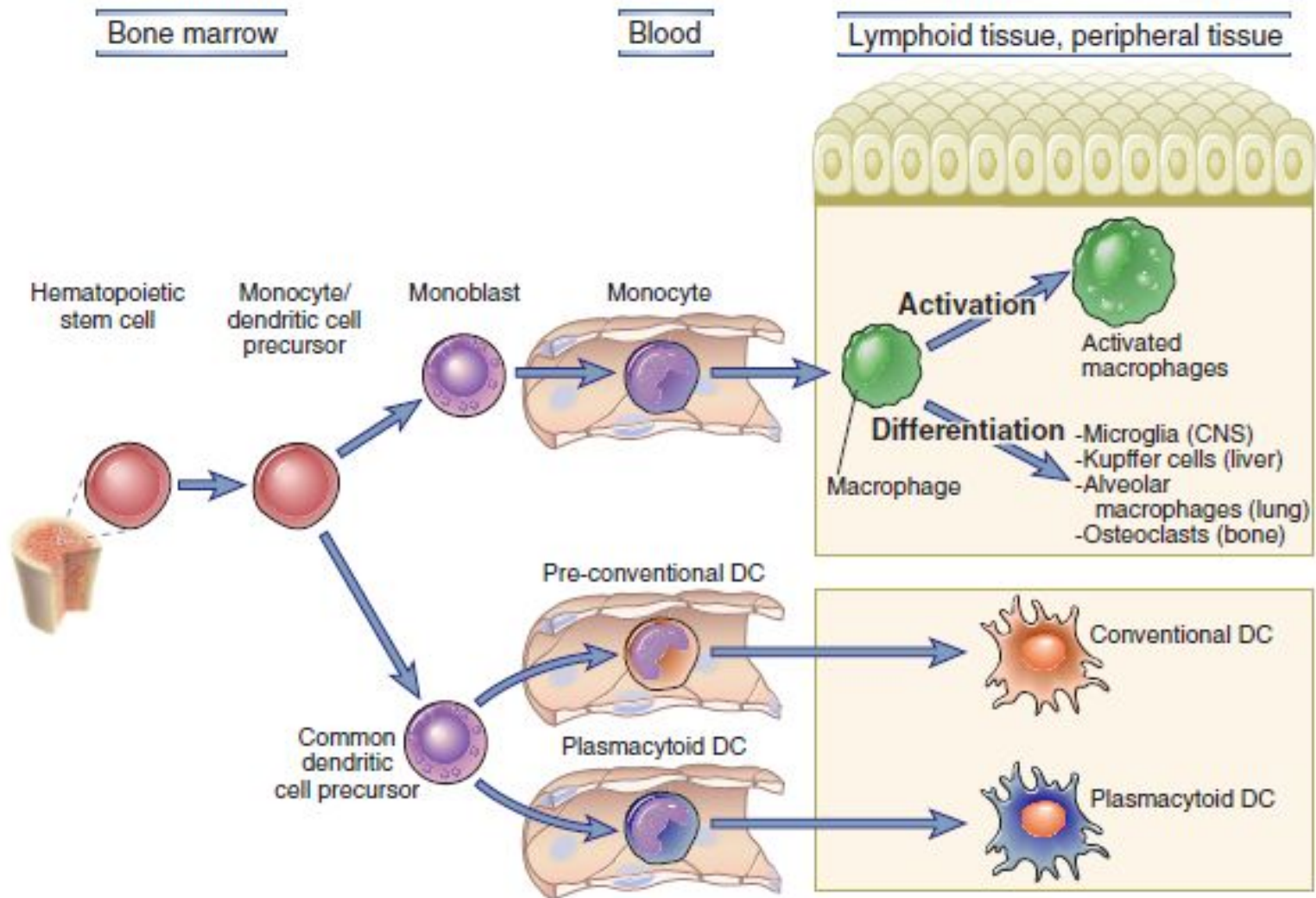
| Cell   | Activated function  |
|--|---|
| <p data-bbox="7 648 595 776"><b>Dendritic cell</b></p>  |  <p data-bbox="1406 776 1823 948"><b>Antigen uptake in peripheral sites</b></p> <p data-bbox="1406 1022 1746 1142"><b>Antigen presentation</b></p> |

Figure 1-4 part 2 of 6 Immunobiology, 7ed. (© Garland Science 2008)



# Maturation of mononuclear phagocytes and dendritic cells.





# Mast Cells

| Cell  | Activated function   |
|---|--|
| <p data-bbox="137 662 388 715"><b>Mast cell</b></p>  A diagram of a mast cell, showing a yellow oval cell with a central yellow nucleus and several smaller blue granules scattered throughout the cytoplasm. |  A micrograph showing a mast cell with a large, dark purple granule-filled cytoplasm and a central, lighter-colored nucleus. Other cells are visible in the background. |

Figure 1-4 part 6 of 6 Immunobiology, 7ed. (© Garland Science 2008)





# Basophils

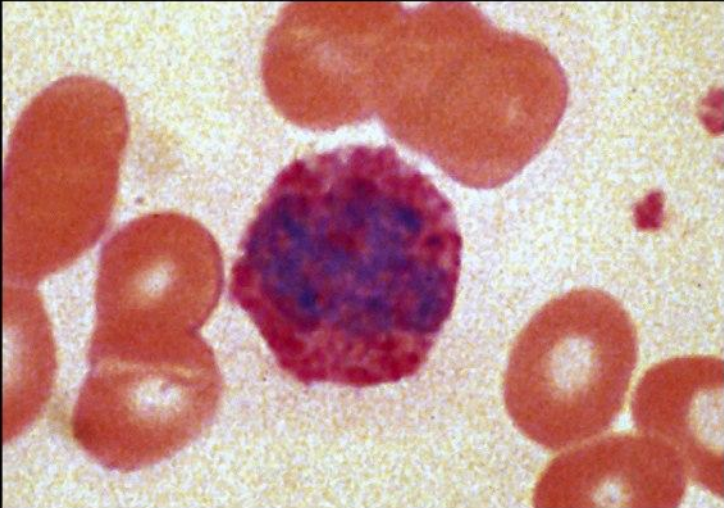
| Cell            |   | Activated function |
|-----------------|---|--------------------|
| <b>Basophil</b> |  A light micrograph showing a central basophil with a dark purple, granular nucleus and a pale, granular cytoplasm. It is surrounded by several red blood cells, which appear as reddish-orange discs. | <b>Unknown</b>     |

Figure 1-4 part 5 of 6 Immunobiology, 7ed. (© Garland Science 2008)



# Eosinophils

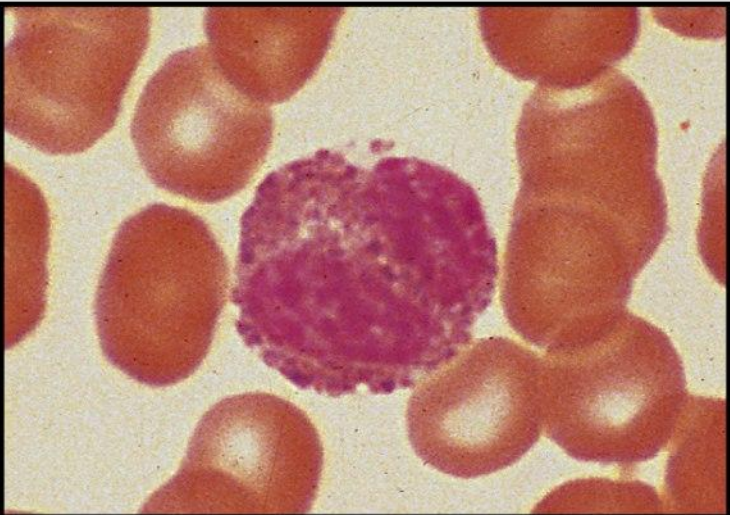
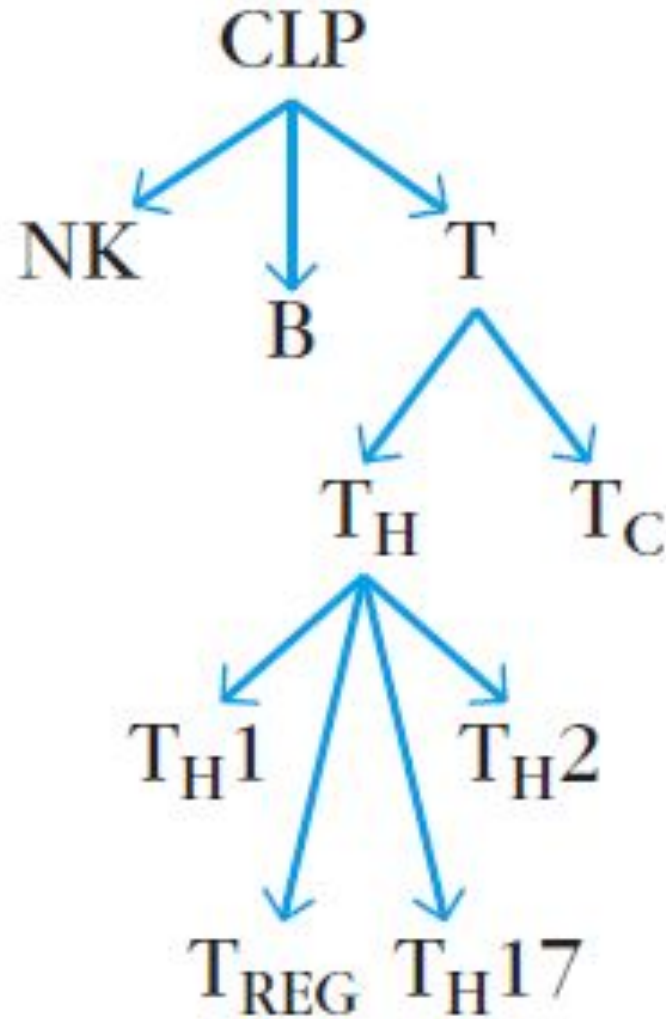
| Cell   | Activated function  |
|--|---|
| <p data-bbox="85 668 633 772"><b>Eosinophil</b></p>  |  <p data-bbox="1398 853 1812 1025"><b>Killing of antibody-coated parasites</b></p> |

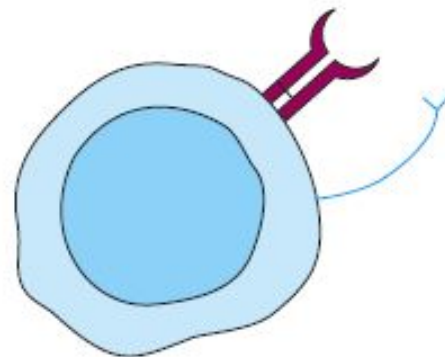
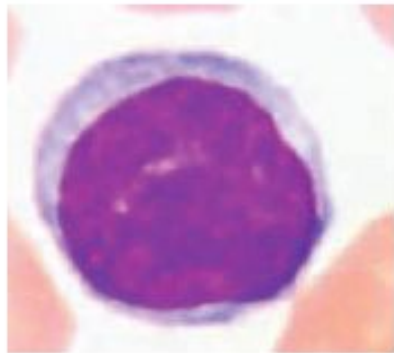
Figure 1-4 part 4 of 6 Immunobiology, 7ed. (© Garland Science 2008)

# *Lymphocytes*

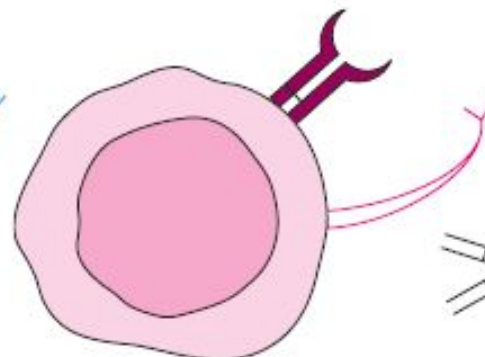


# T cells and B cells

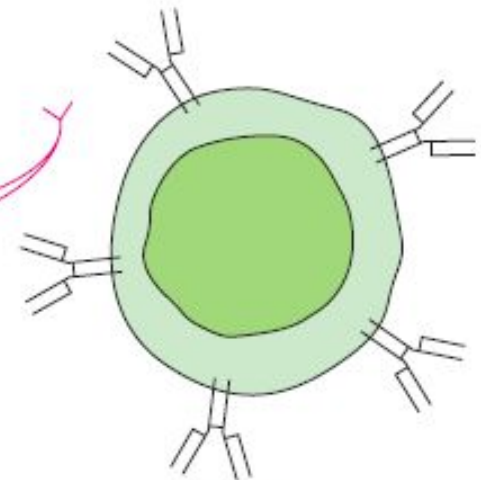
(a) Lymphocyte



T<sub>H</sub> helper cell



T<sub>C</sub> cytotoxic T cell

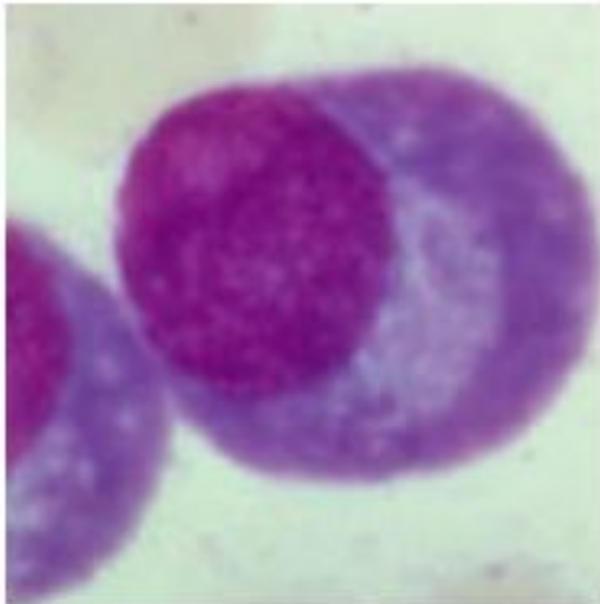


B cell

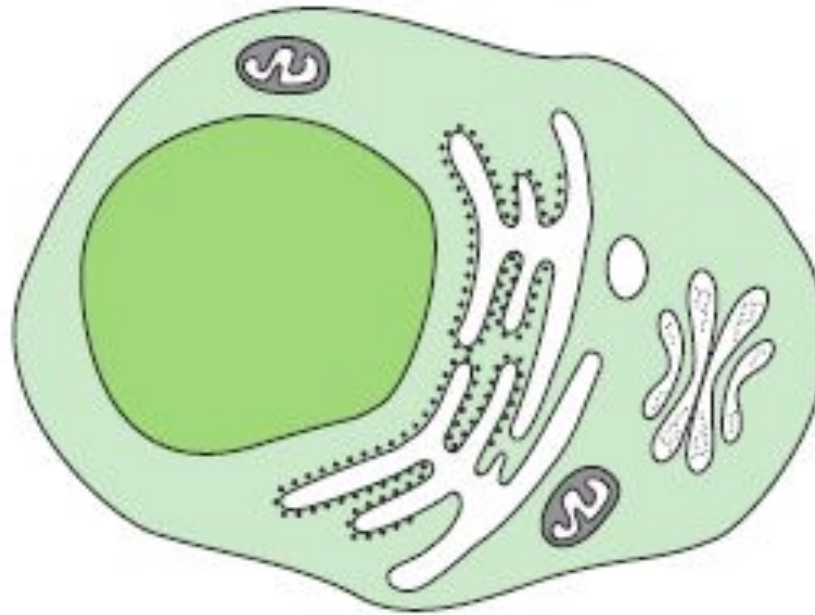


# Plasma cell

(c) Plasma cell

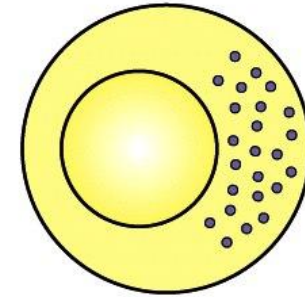


Plasma cell



# NK cell

## Natural killer (NK) cell



**Releases lytic granules that kill some virus-infected cells**

# CD marker

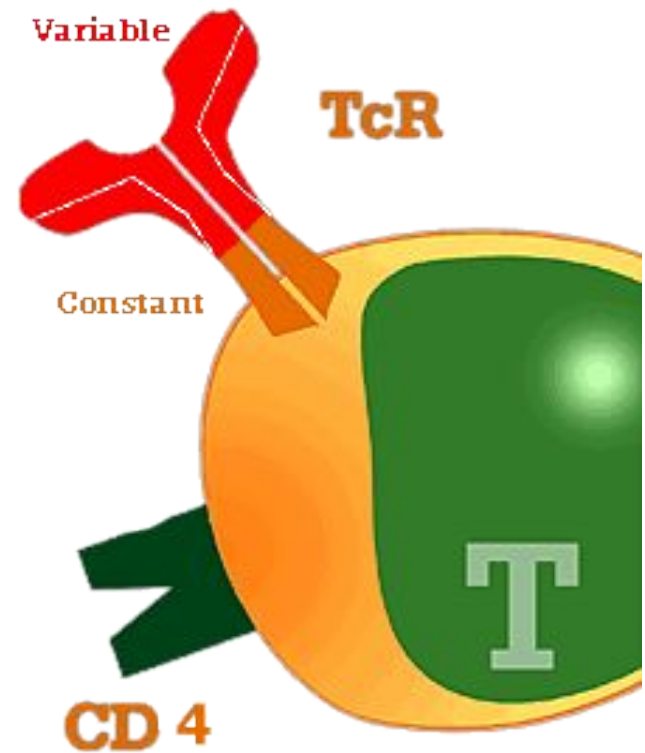


TABLE 2-3

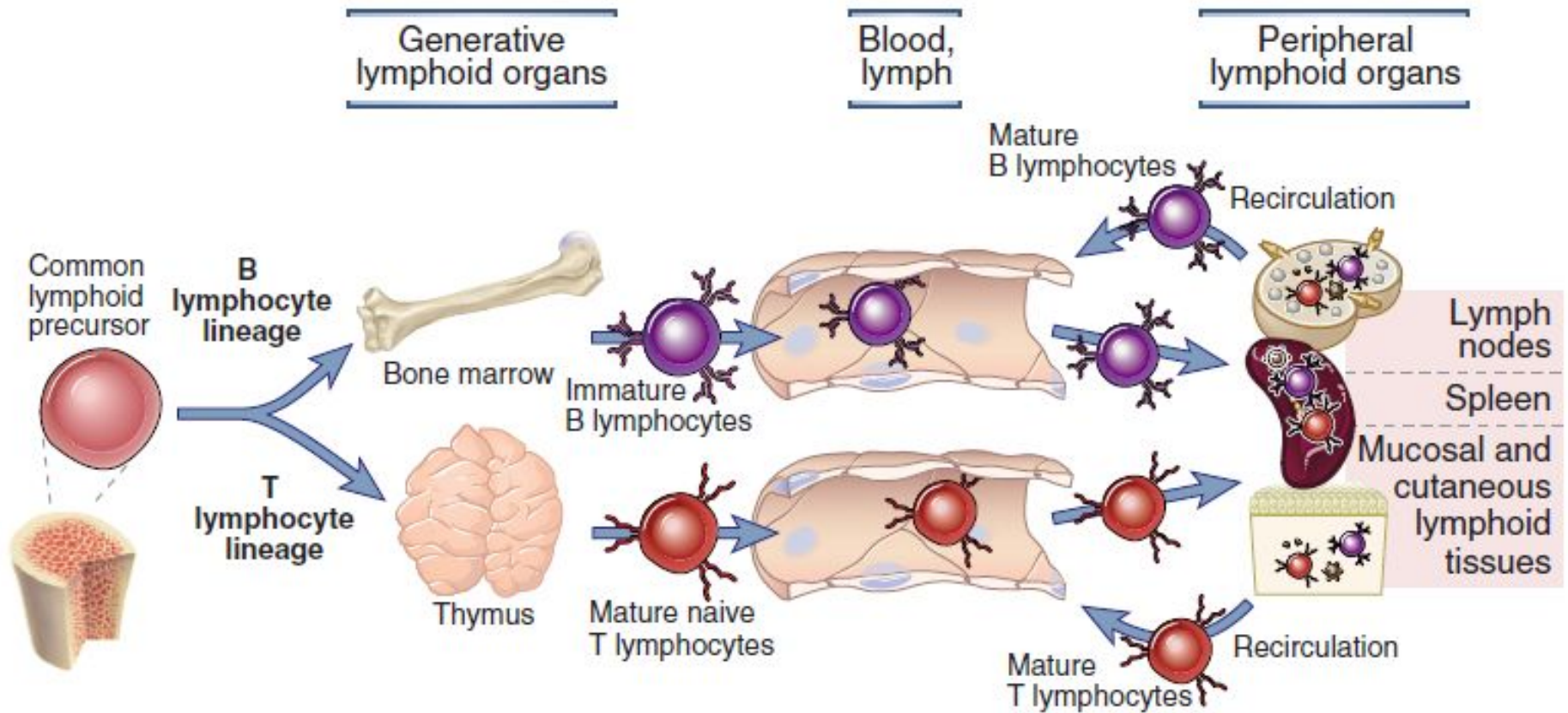
Common CD markers used to distinguish functional lymphocyte subpopulations

| CD designation          | Function  | B cell | T <sub>H</sub> | T <sub>C</sub> | NK cell    |
|-------------------------|---|--------|----------------|----------------|------------|
| CD2                     | Adhesion molecule;<br>signal transduction   | –      | +              | +              | +          |
| CD3                     | Signal transduction element<br>of T-cell receptor                                 | –      | +              | +              | –          |
| CD4                     | Adhesion molecule that binds<br>to class II MHC molecules;<br>signal transduction | –      | +              | –              | –          |
| CD5                     | Unknown   | +      | +              | +              | +          |
| CD8                     | Adhesion molecule that binds<br>to class I MHC molecules;<br>signal transduction  | –      | –              | +              | (variable) |
| CD16 (Fc $\gamma$ RIII) | Low-affinity receptor for Fc<br>region of IgG                                     | –      | –              | –              | +          |
| CD19                    | Signal transduction; CD21<br>co-receptor  | +      | –              | –              | –          |
| CD21 (CR2)              | Receptor for complement (C3d<br>and Epstein-Barr virus)                           | +      | –              | –              | –          |
| CD28                    | Receptor for costimulatory B7<br>molecule on antigen-presenting cells             | –      | +              | +              | –          |
| CD32 (Fc $\gamma$ RII)  | Receptor for Fc region of IgG   | +      | –              | –              | –          |
| CD35 (CR1)              | Receptor for complement (C3b)   | +      | –              | –              | –          |
| CD40                    | Signal transduction   | +      | –              | –              | –          |
| CD45                    | Signal transduction   | +      | +              | +              | +          |
| CD56                    | Adhesion molecule   | –      | –              | –              | +          |

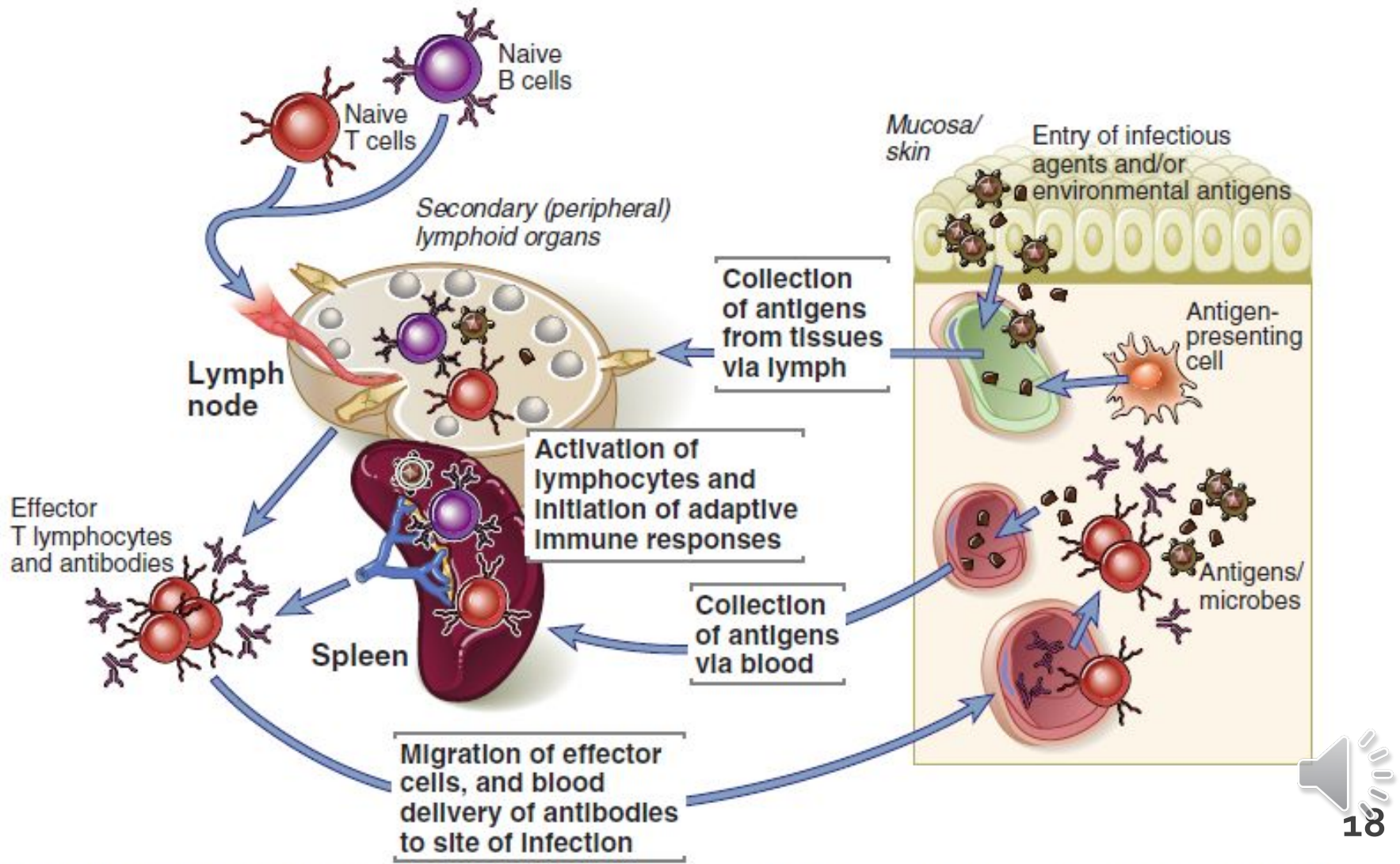




# Development of Lymphocytes



# The anatomy of lymphocyte activation



# Immune system

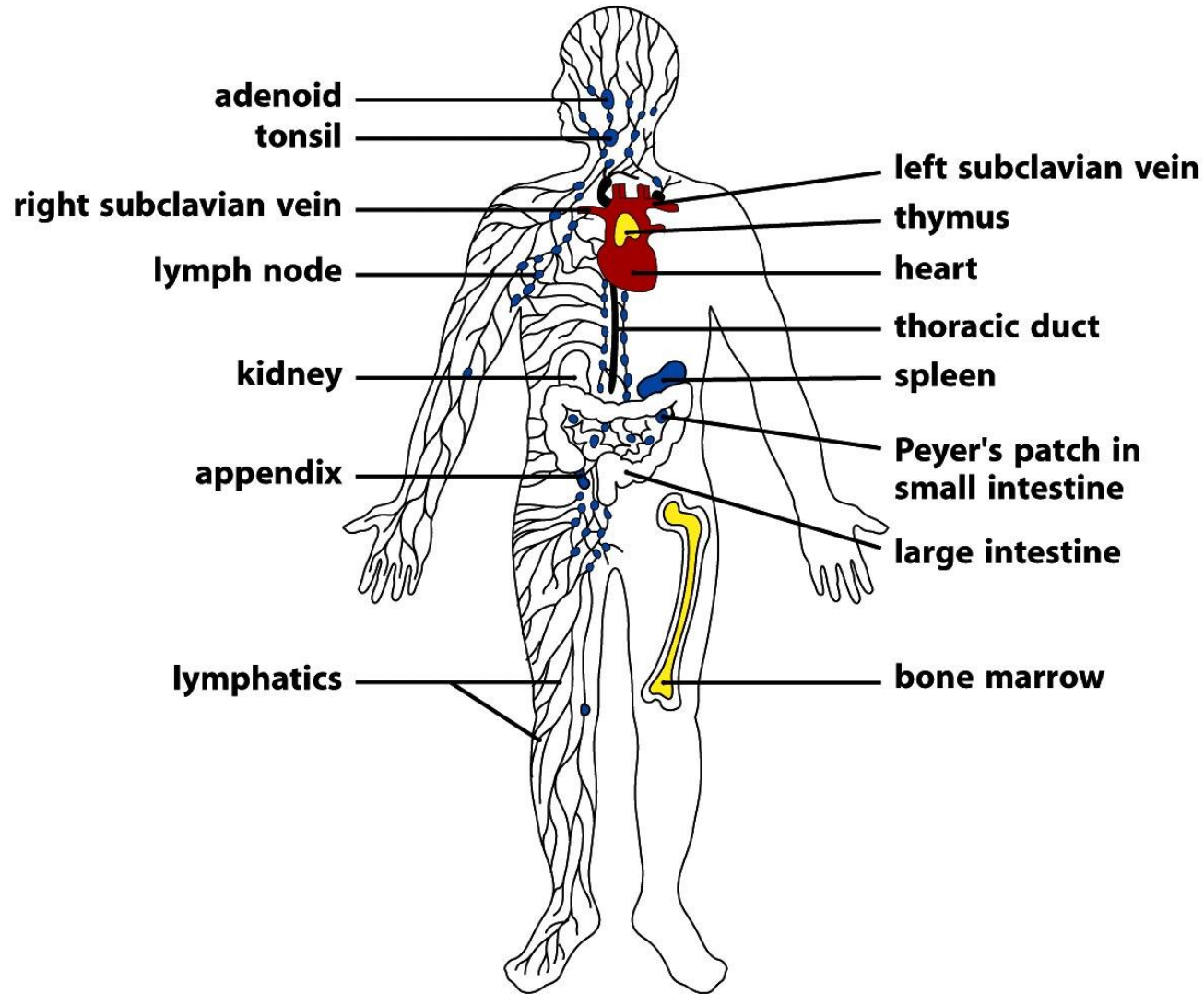
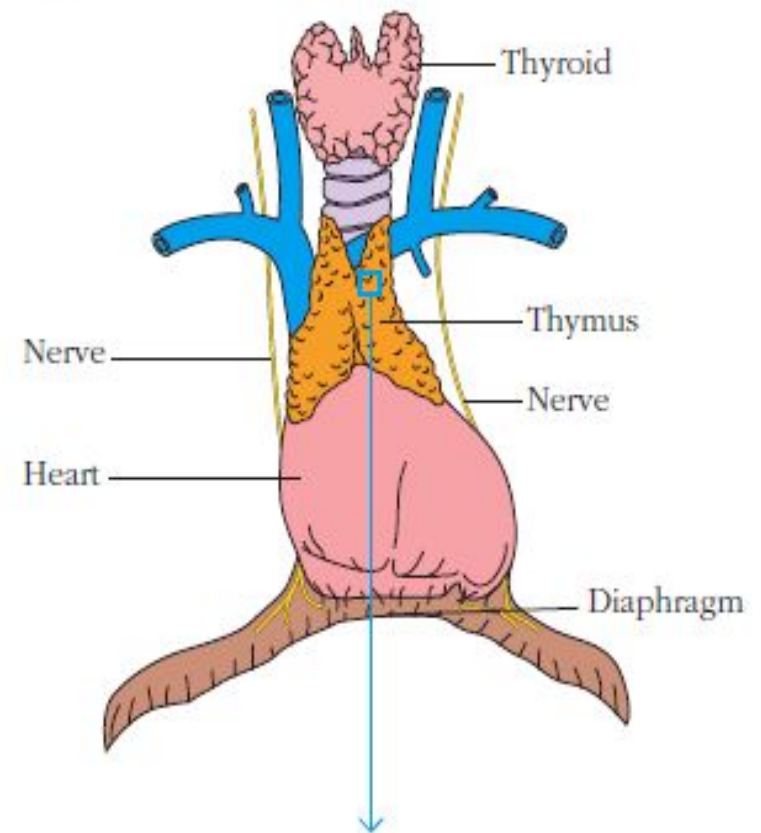
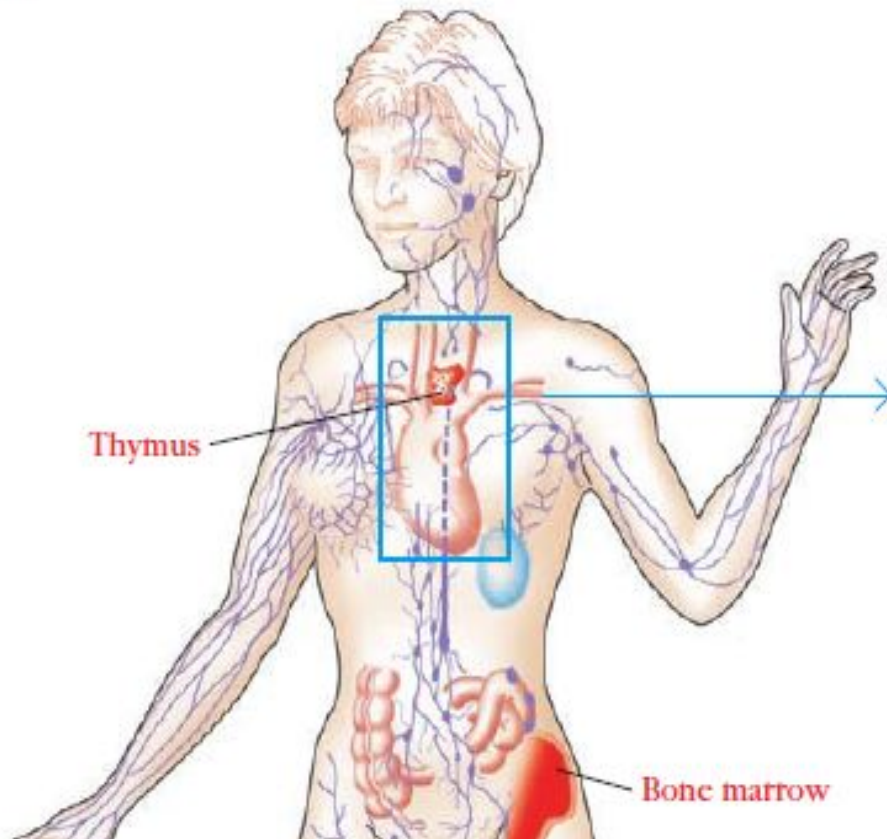


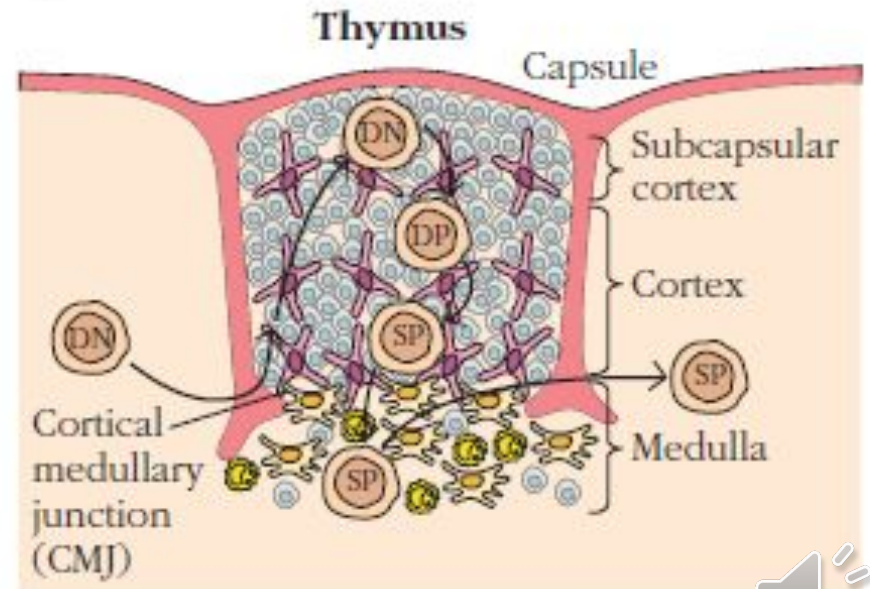
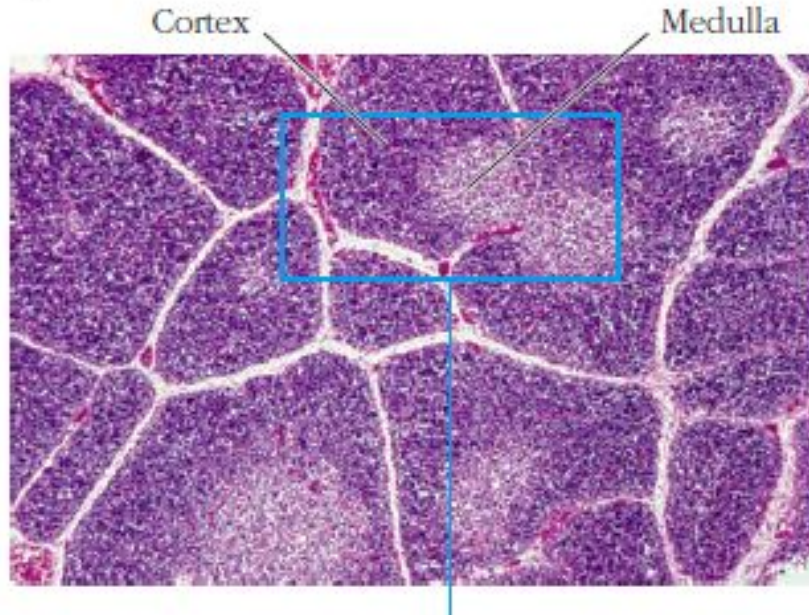
Figure 1-7 Immunobiology, 7ed. (© Garland Science 2008)

# Thymus: Gross anatomy

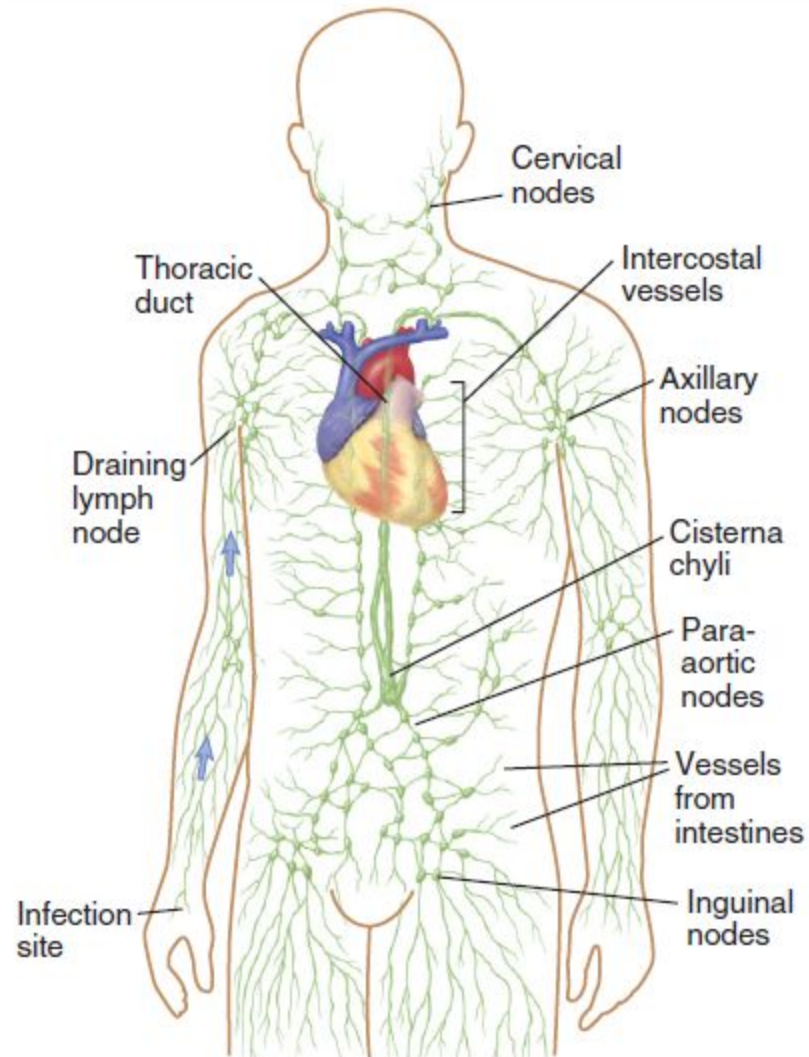




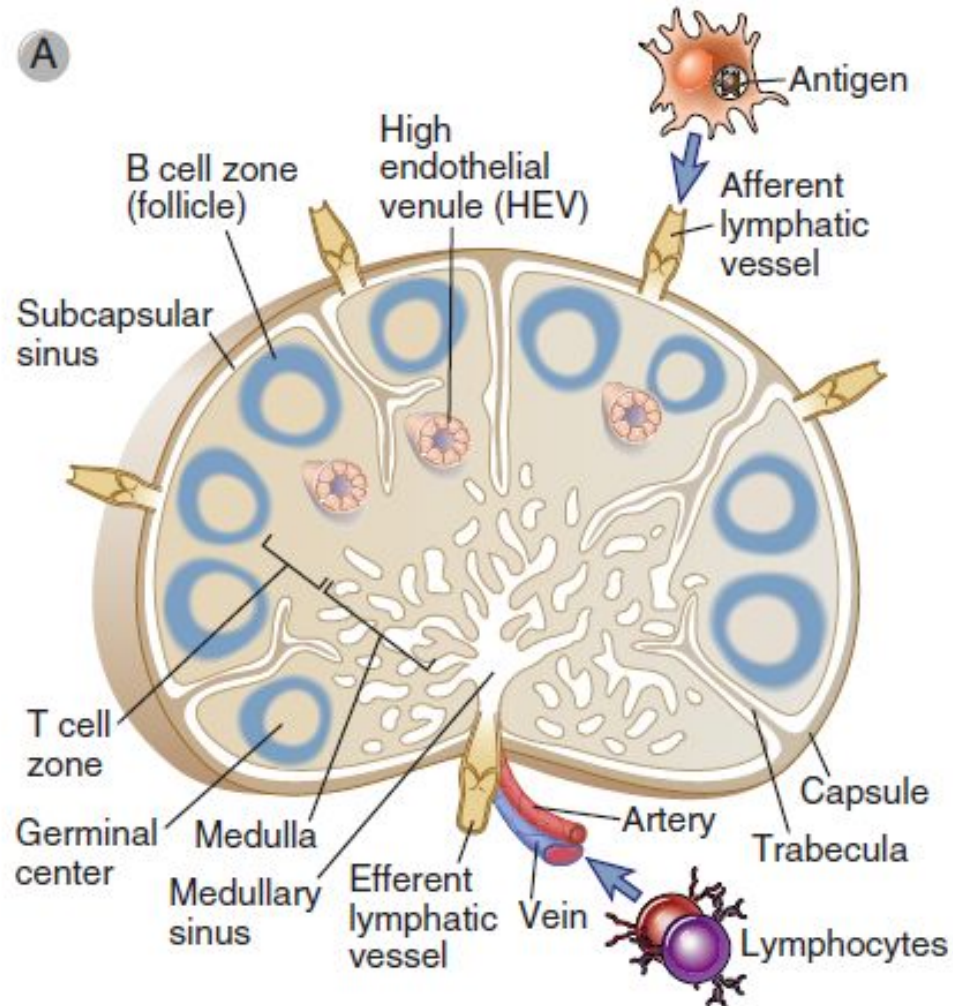
# Thymus : morphology



# The Lymphatic System

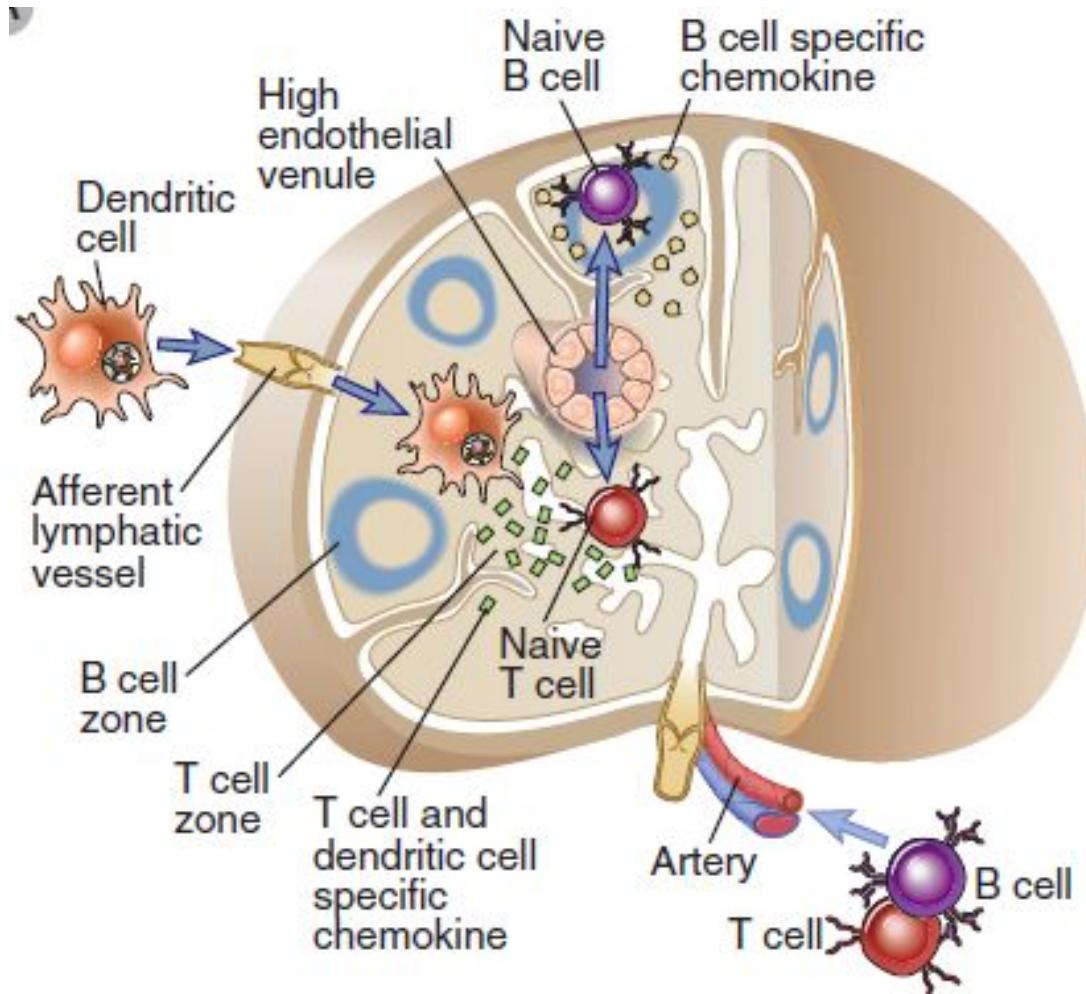


# Morphology of a lymph node



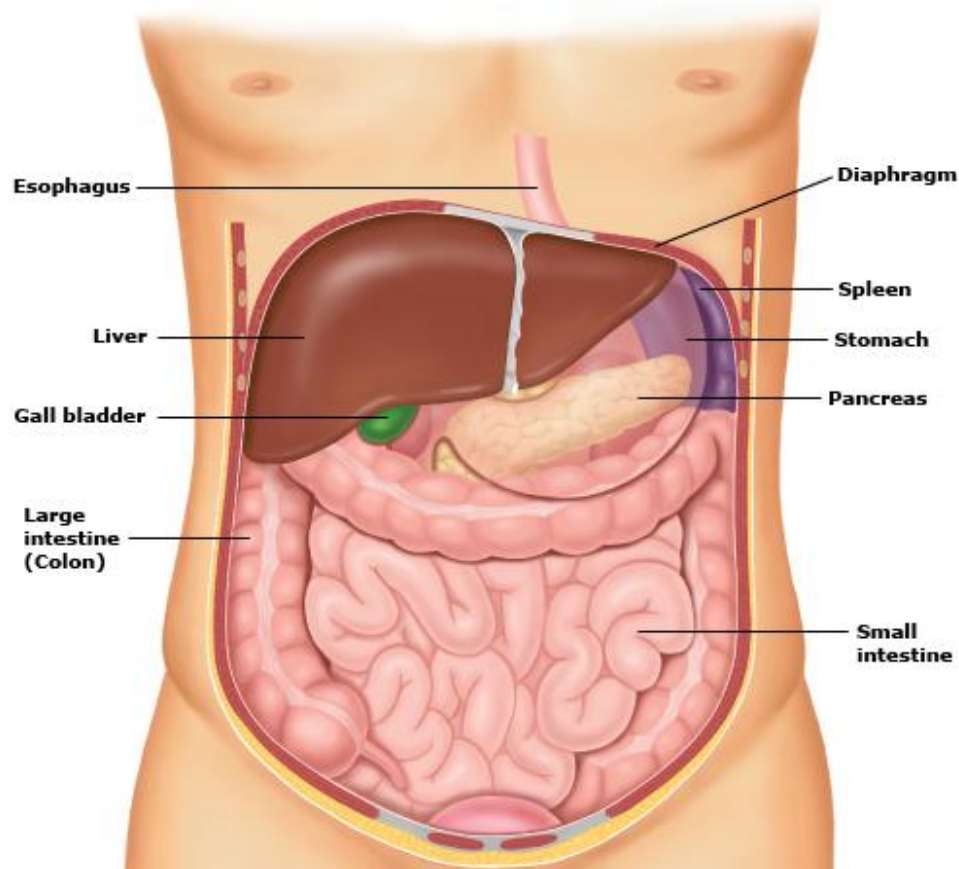


# Segregation of B cells and T cells in a lymph node

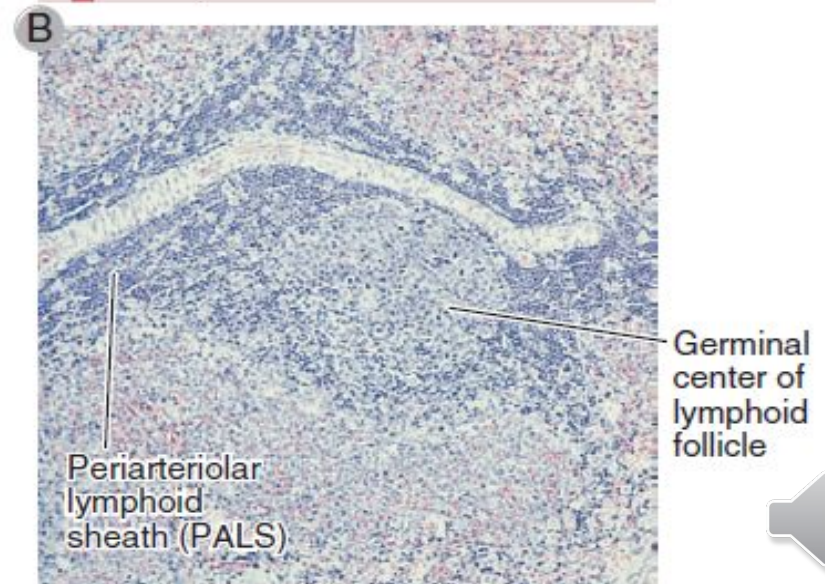
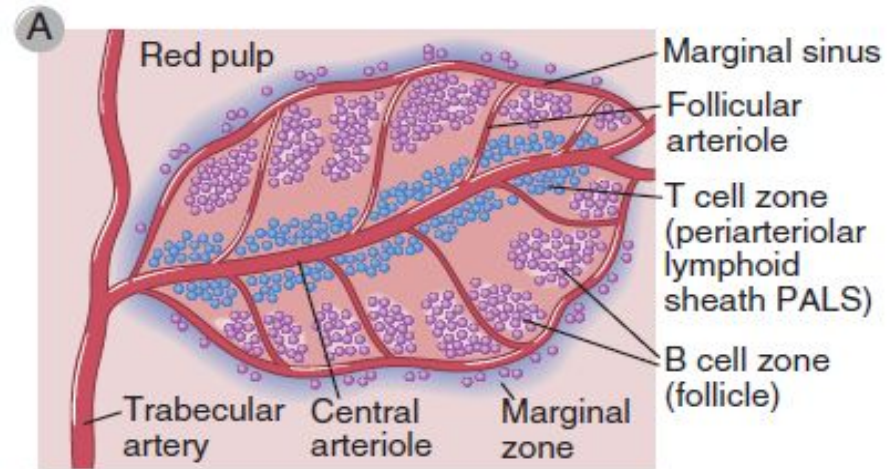
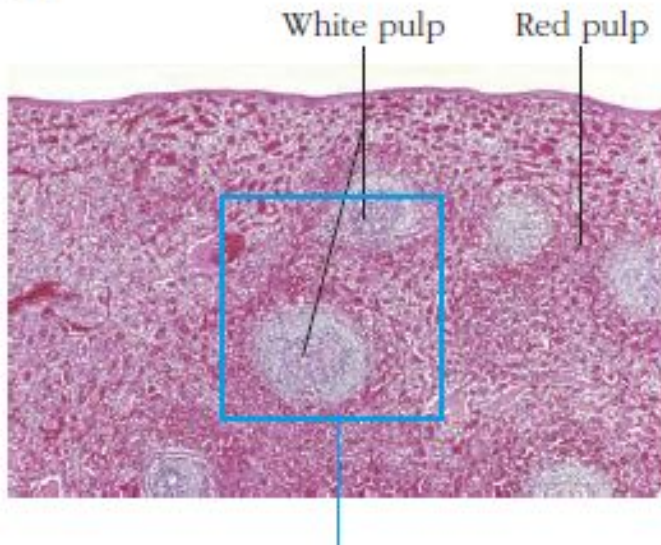




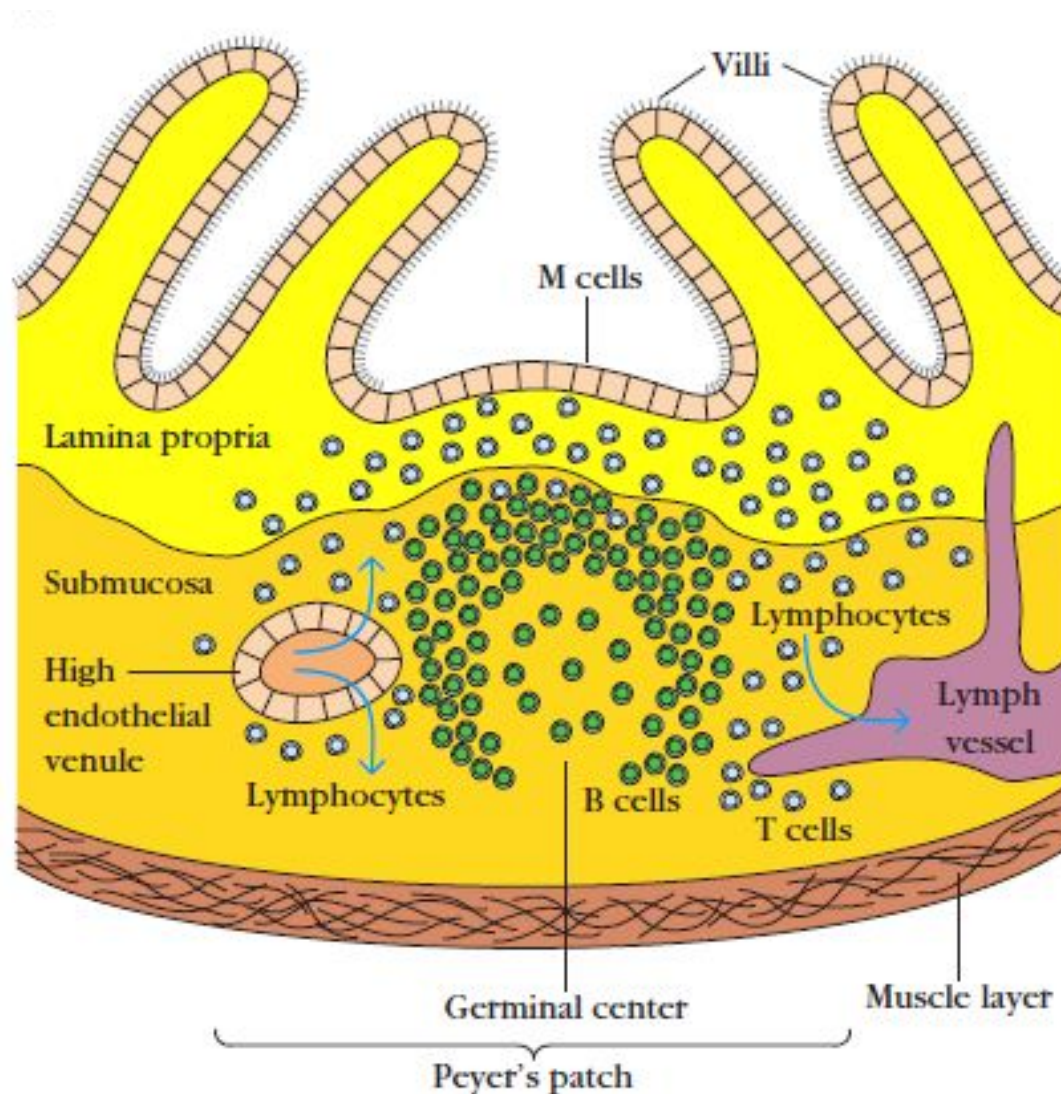
# Spleen : Gross anatomy



# Spleen : morphology



# Mucosa-associated lymphoid tissue (MALT)





پیروزی یعنی: توانایی رفتن از یک شکست به شکستی دیگر بدون از دست دادن اشتیاق!



**Victory is about moving from one failure to another  
without losing the enthusiasm!**

