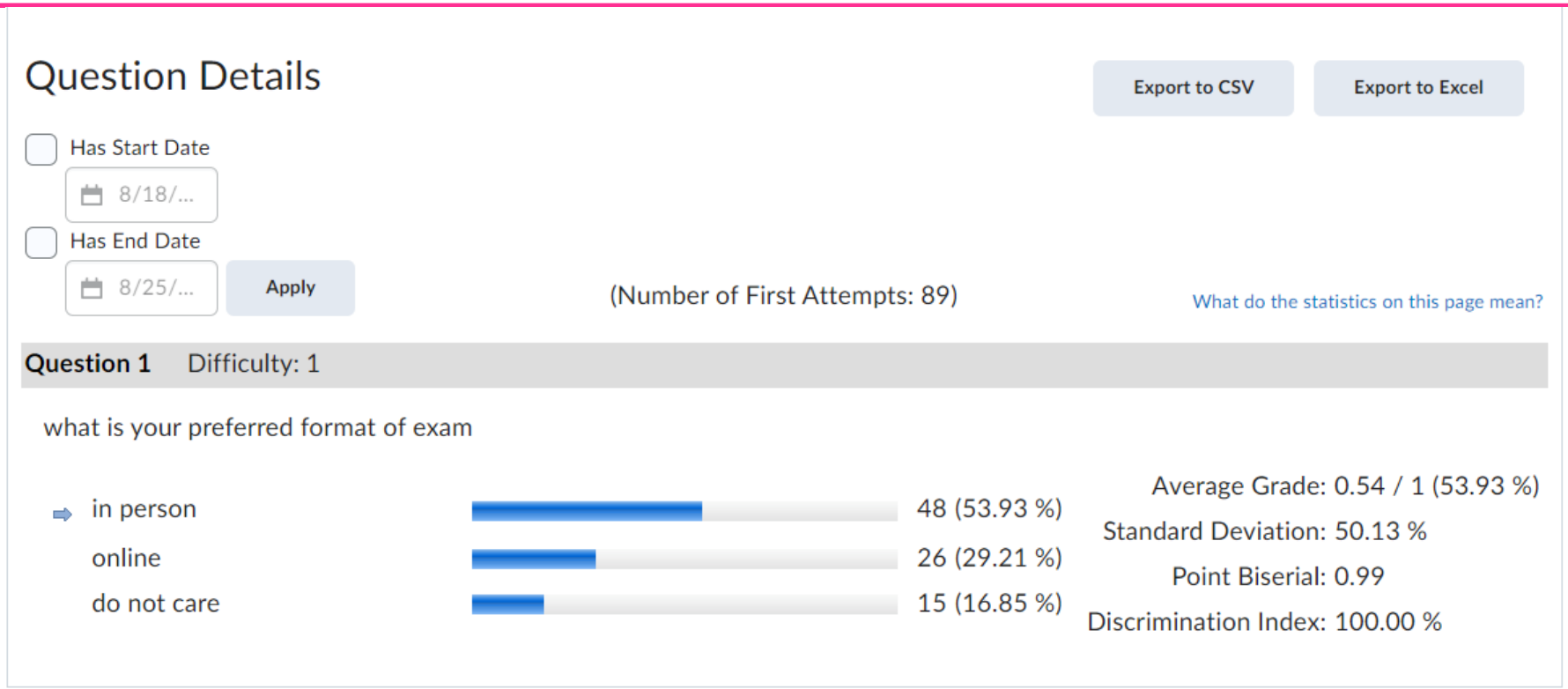
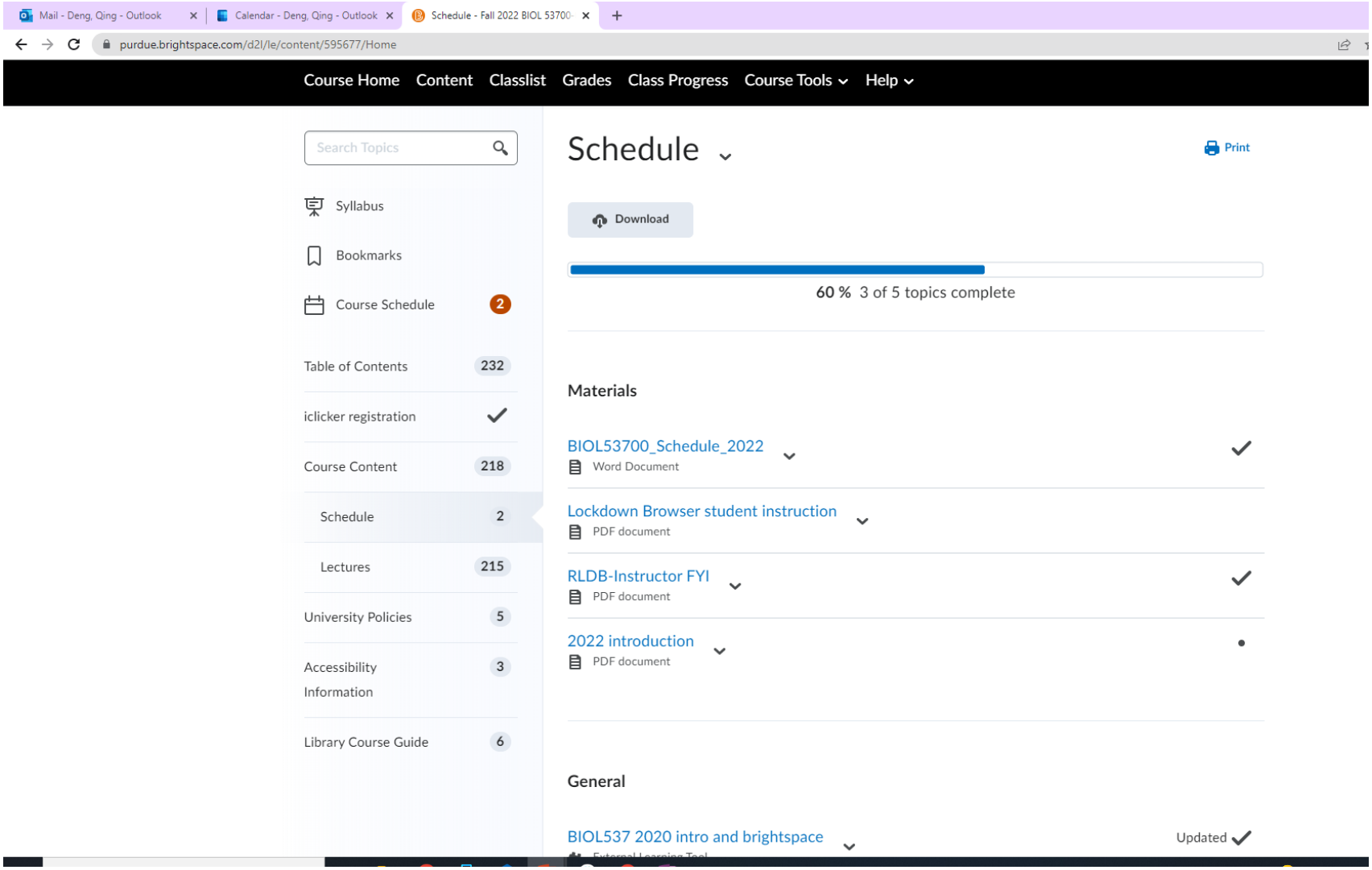
Exams will be in person

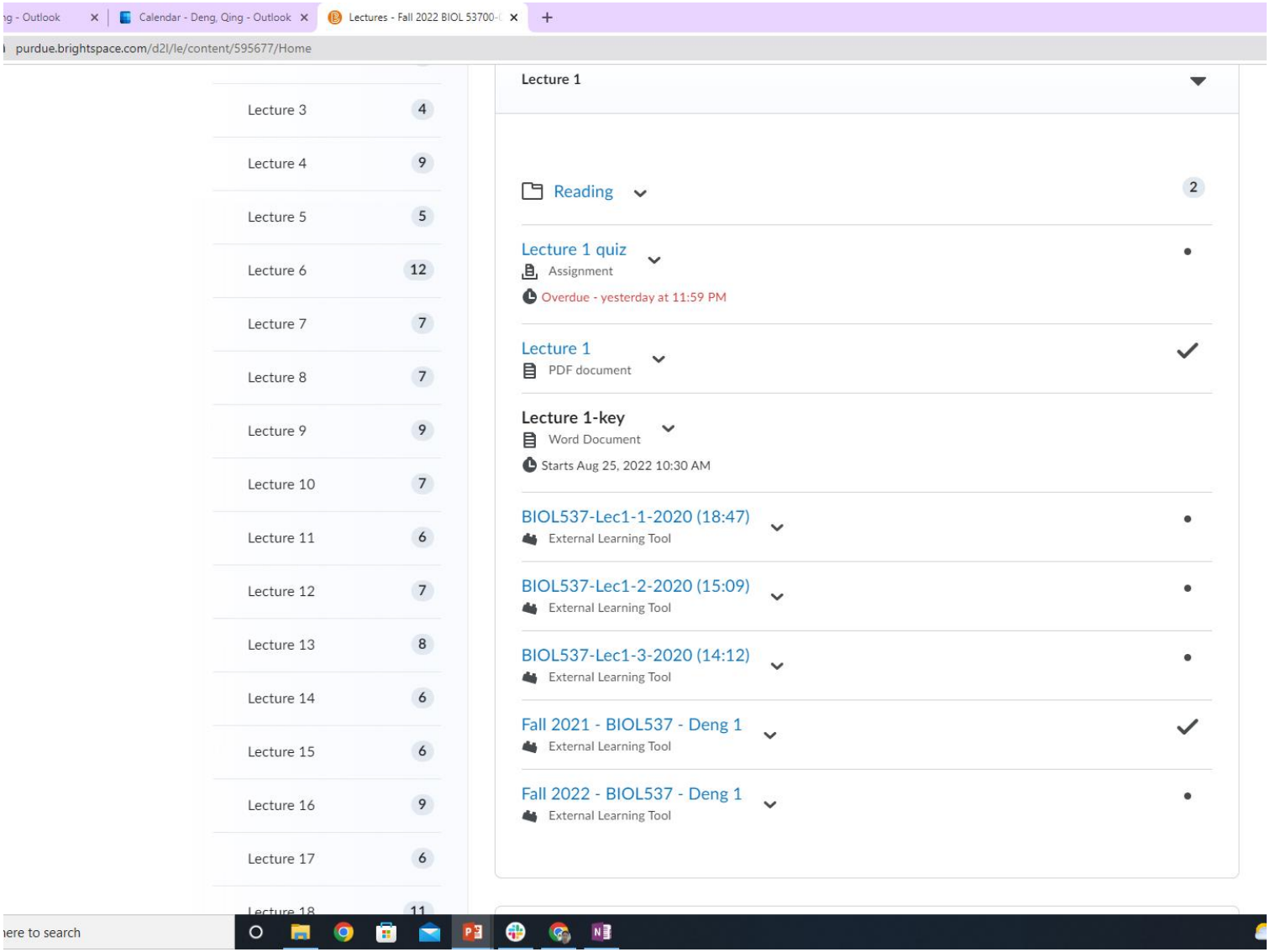


UC 114 8 pm-9:30 pm
Please bring pencils - scantron
Please email me with DRC accommodations one week ahead of scheduled time
One week ahead also for foreseen conflicts.
Make up will be within one week due to illness.

BrightSpace Introduction



BrightSpace Introduction



Major Concepts

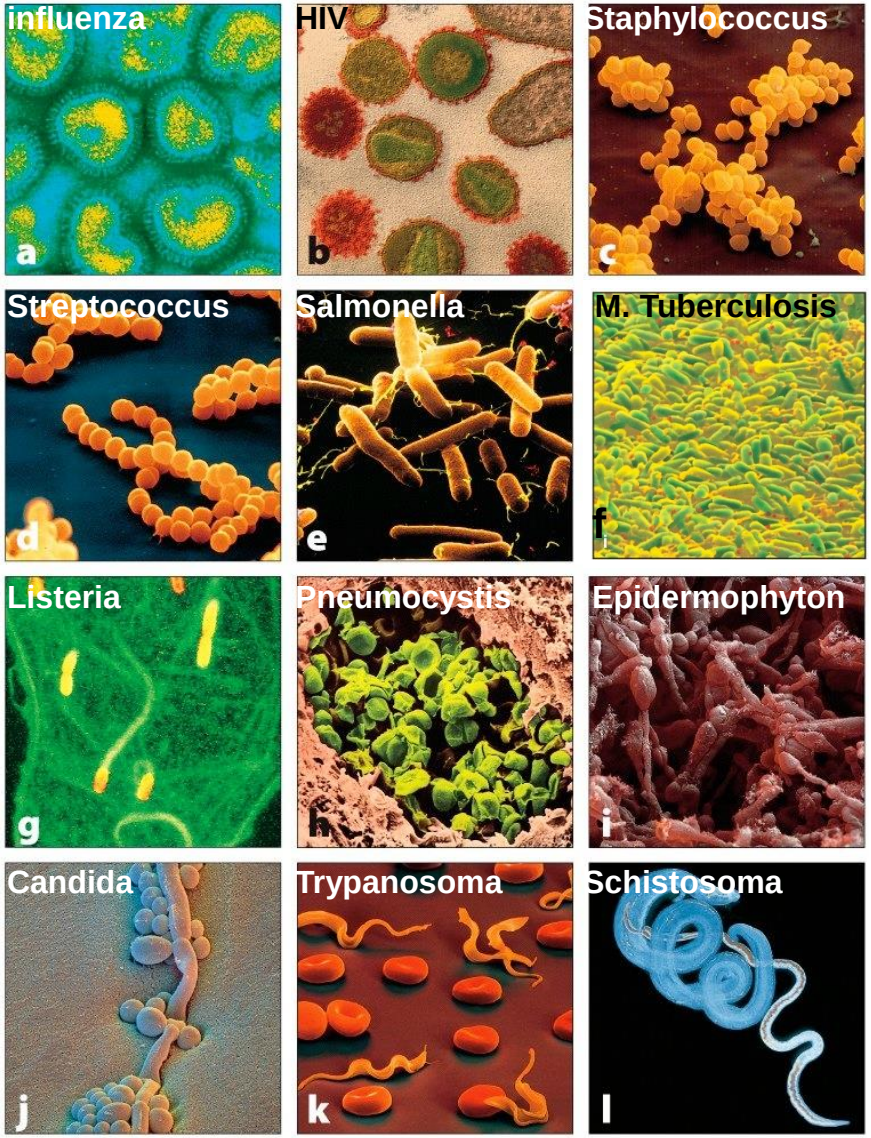


Figure 1.3 The Immune System, 3ed. (© Garland Science 2009)

Pathogen: An infectious agent

Extracellular: pathogen that can replicate outside the cell

- bacteria (c, d), parasites (k, l), fungus (h, i, j)

Intracellular: pathogen that requires cellular environment to replicate

- bacteria (e, f, g), viruses (a, b)

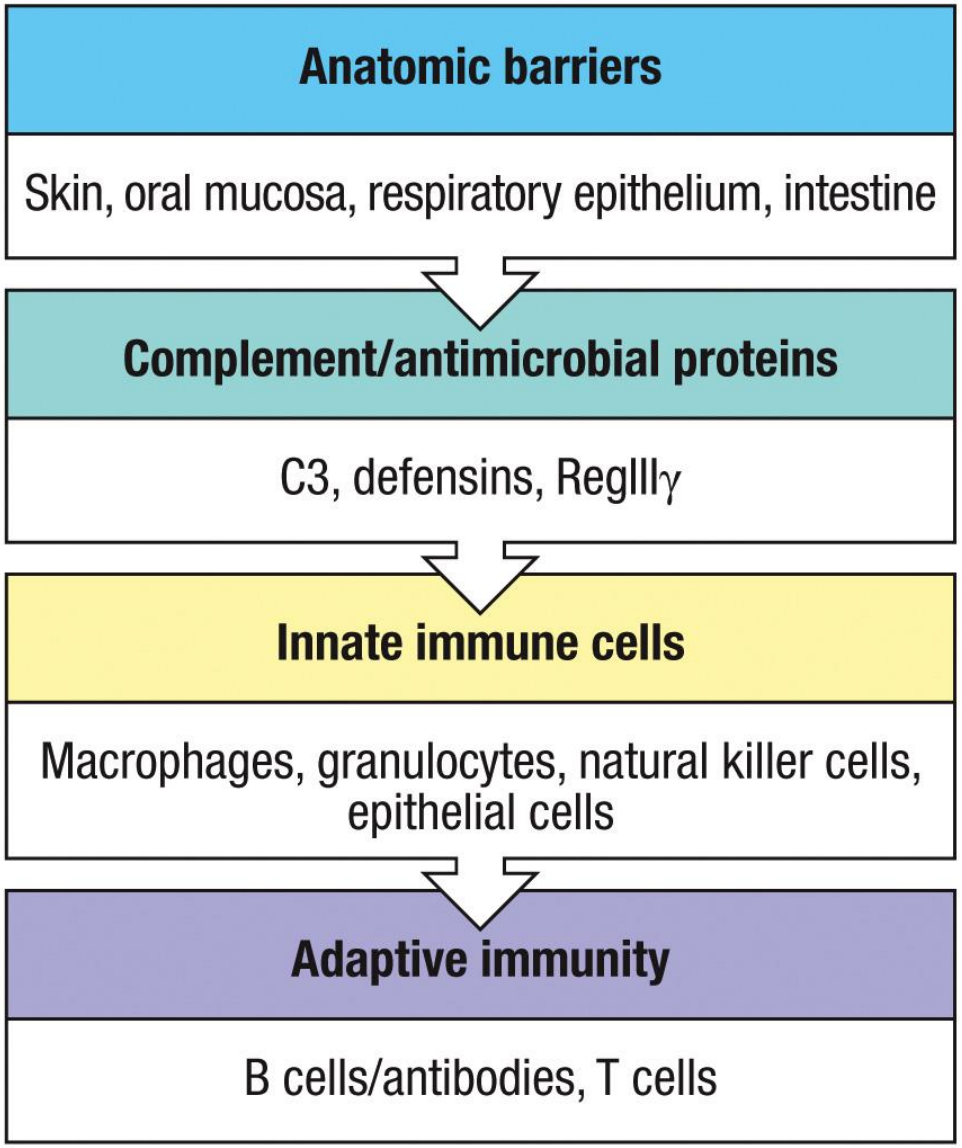
Mucosal immunity: response mounted at the mucosal surface

Innate immunity: early phase of host response to pathogen

Adaptive immunity: response of an antigen-specific lymphocyte to an infection

Antigen: a molecule which can stimulate an adaptive immune response

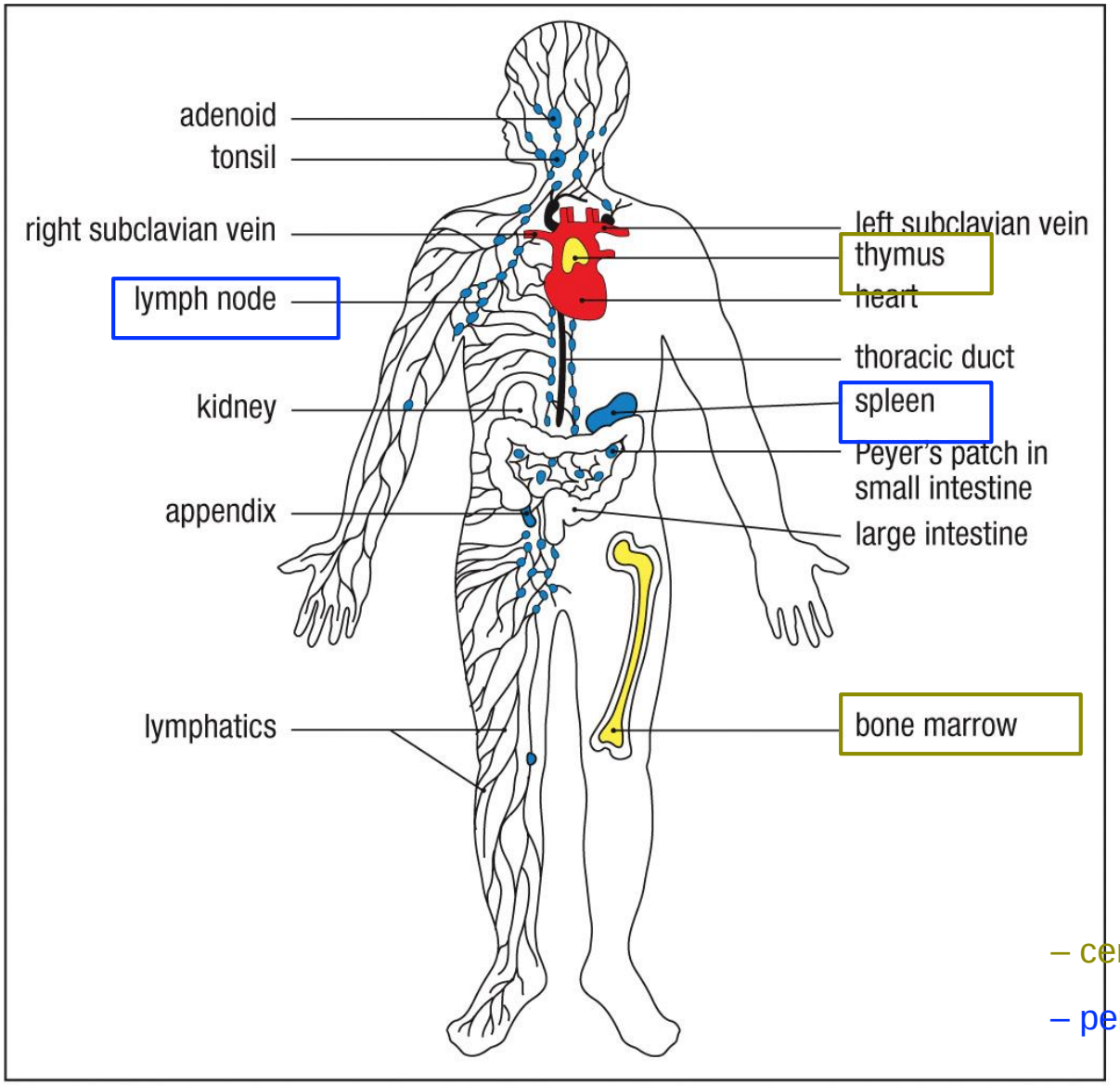
Barriers, Cells and Cytokines



Outline

- Cells and tissues of the immune system
- Case study: Congenital Asplenia

Lymphoid Tissue



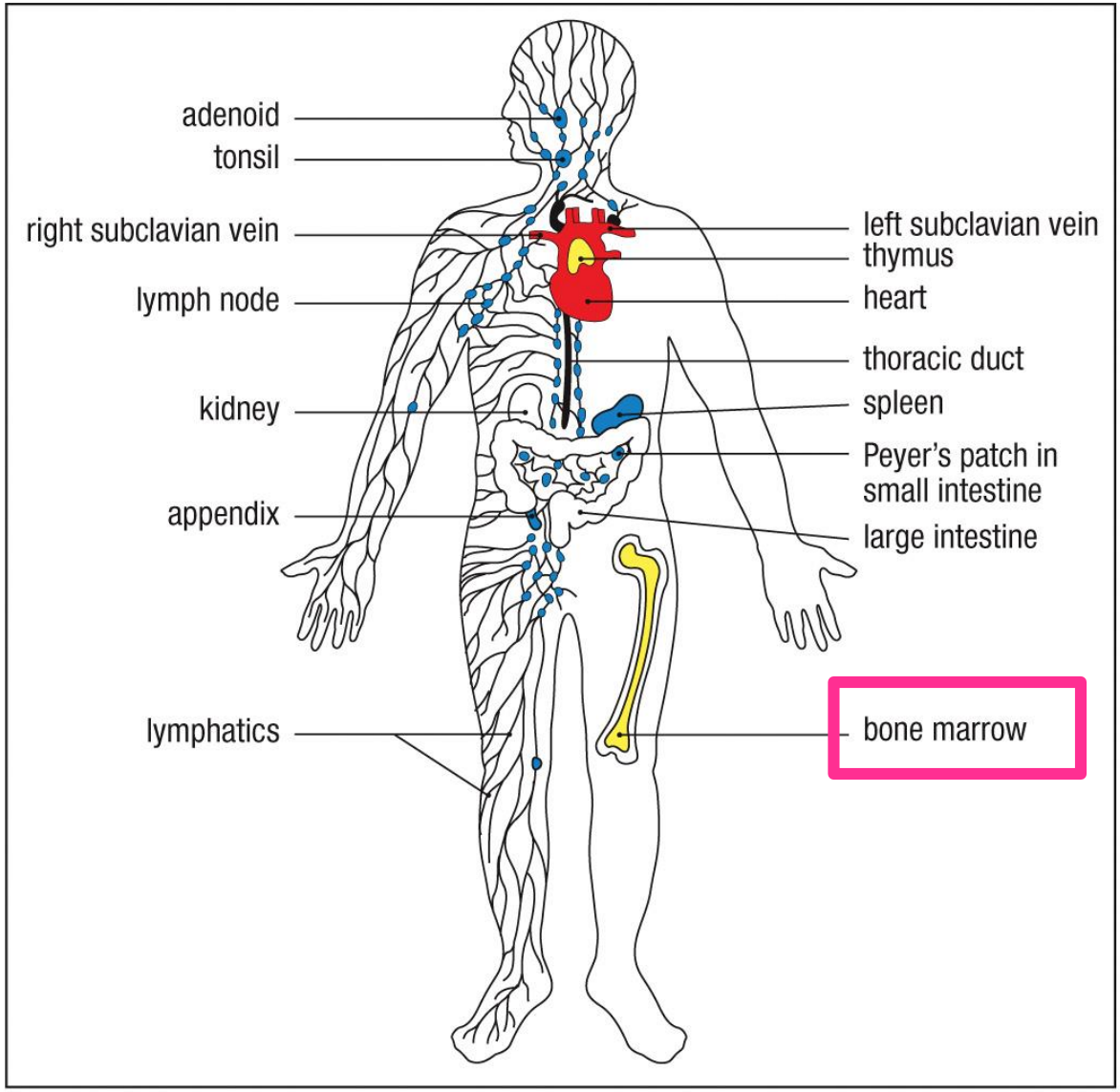
– central lymphoid organ

– peripheral lymphoid organ

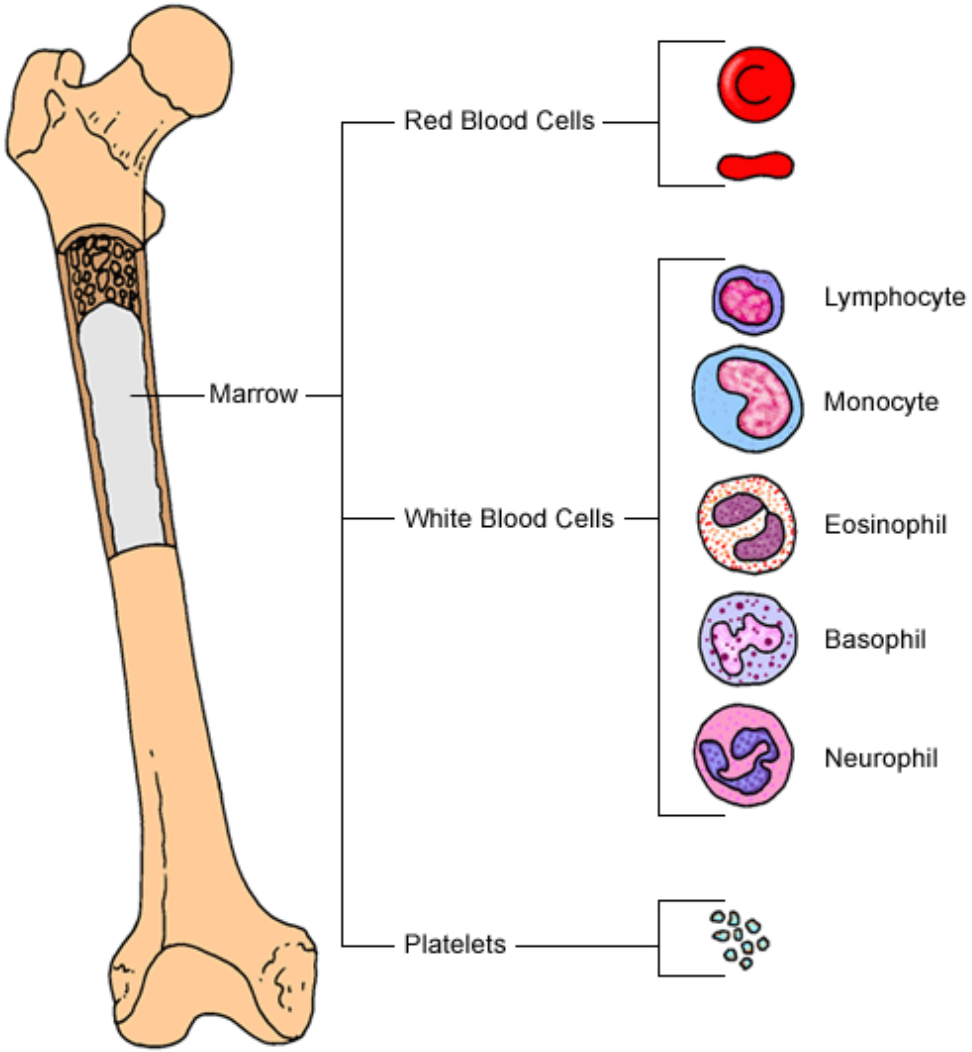
Lymphoid Tissue

- central lymphoid organ: where lymphocytes form and mature
- peripheral lymphoid organ: the sites of lymphocyte activation by antigens

Bone Marrow Is the Site of Adult Hematopoiesis

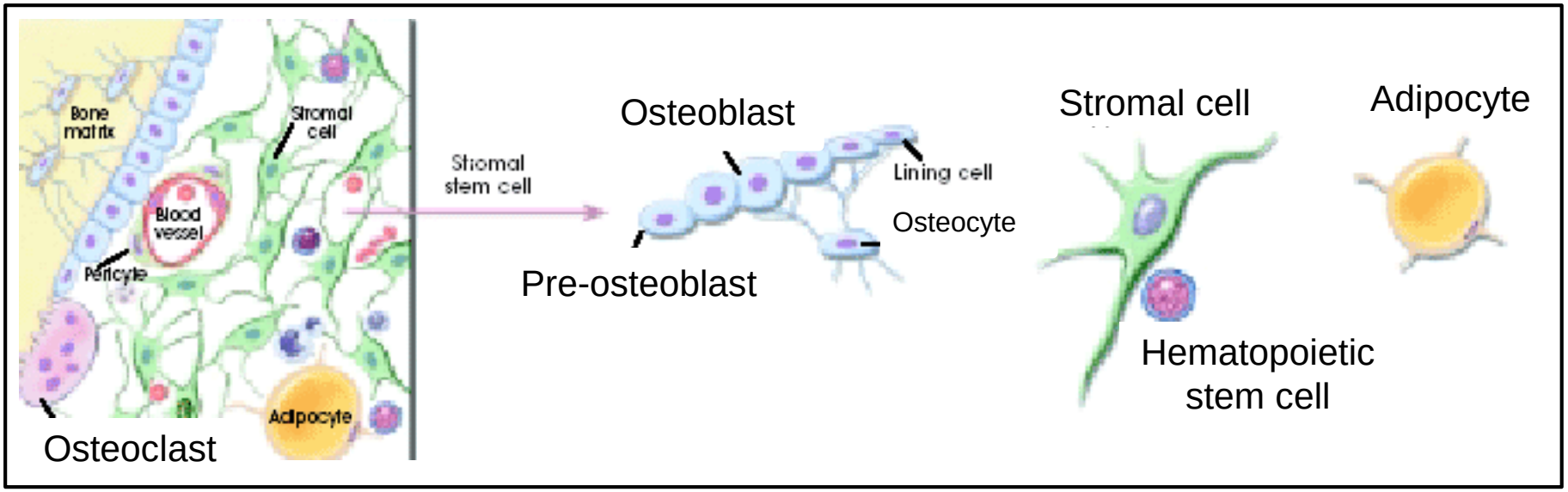


Hematopoietic Cells Develop in the Bone Marrow

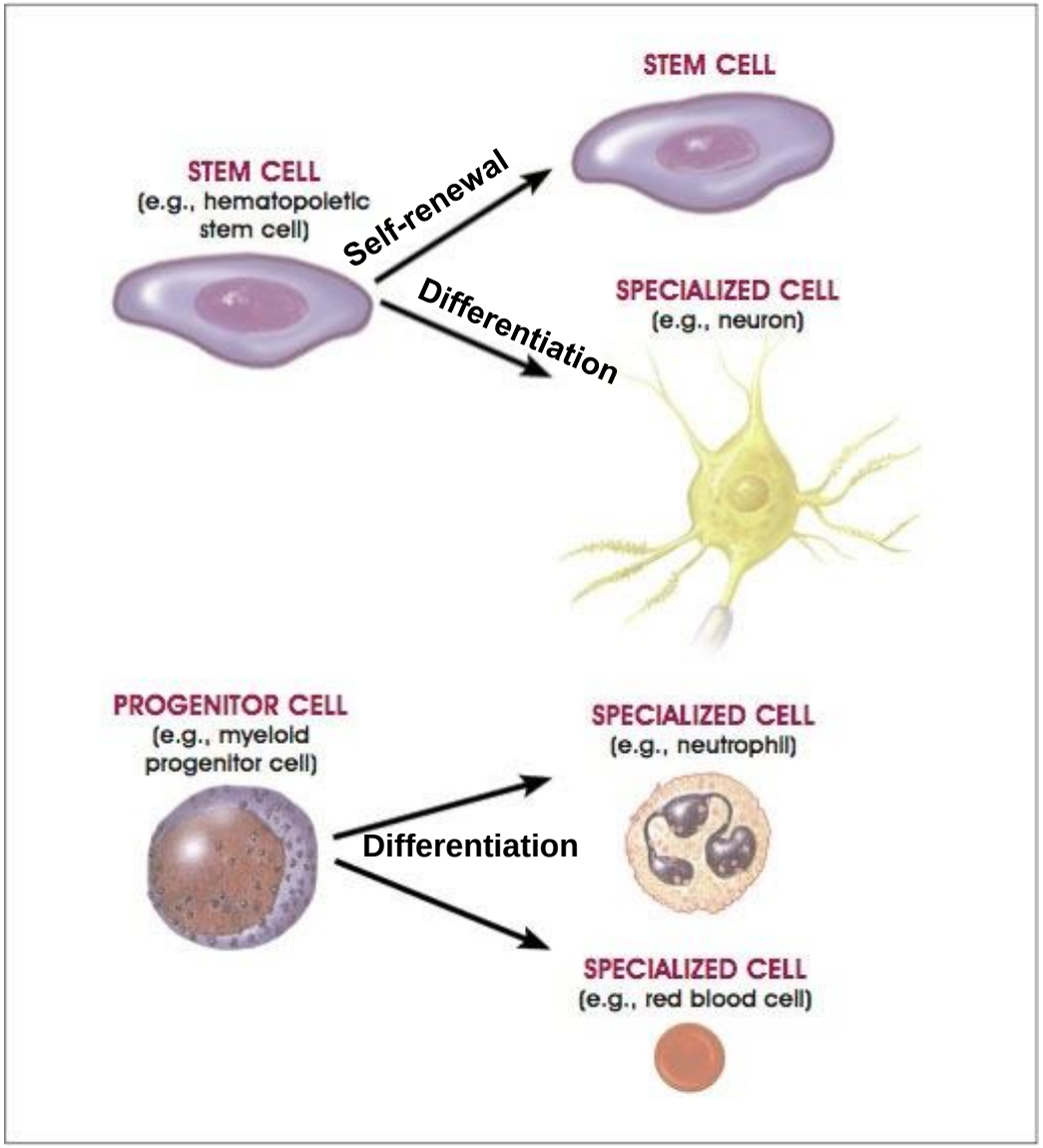


http://www.schneiderchildrenshospital.org/peds_html_fixed/images/ei_0062.gif

Bone Marrow Stromal Cells Support Hematopoiesis

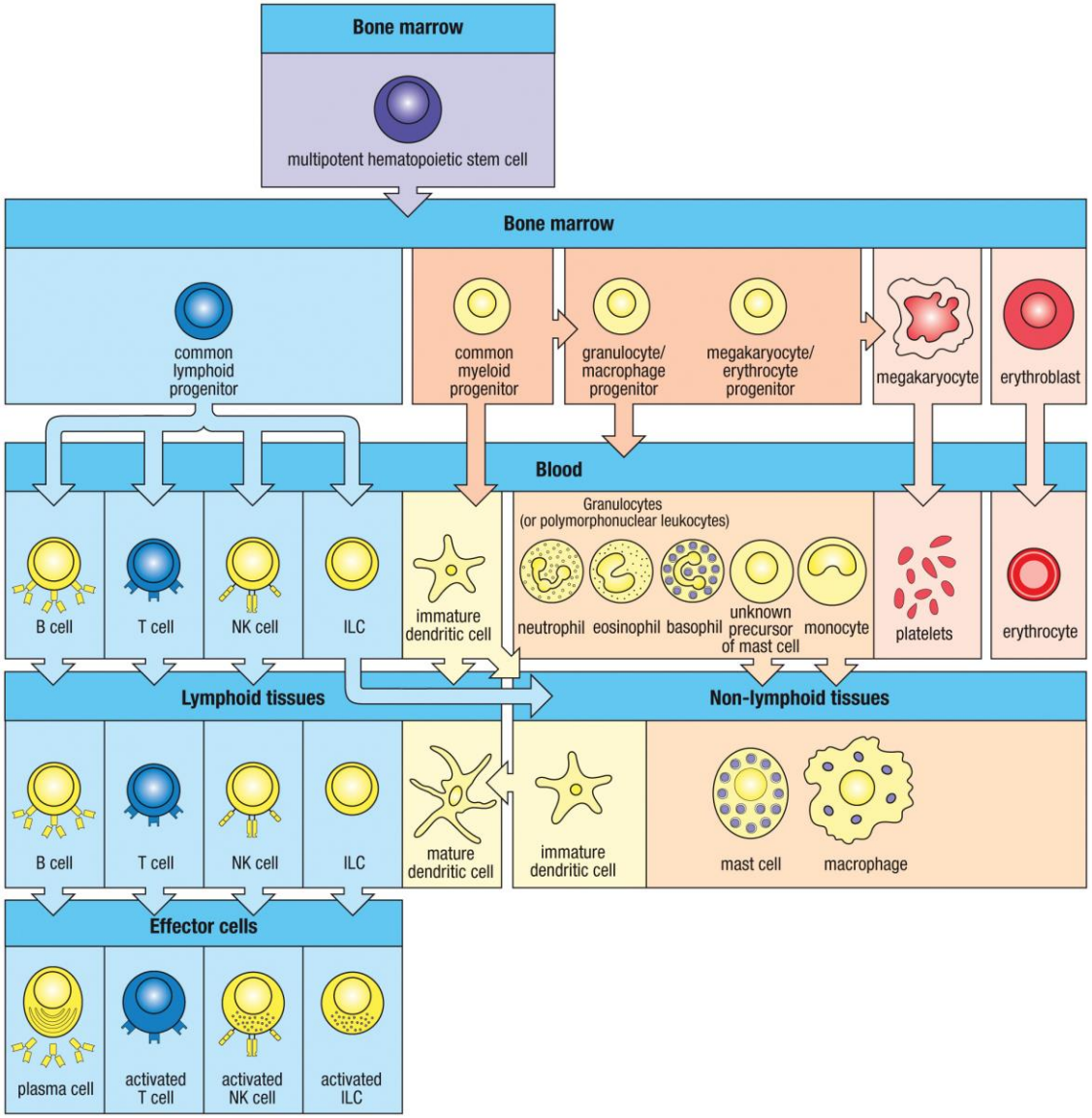


Distinguishing Features of Progenitor and Stem Cells

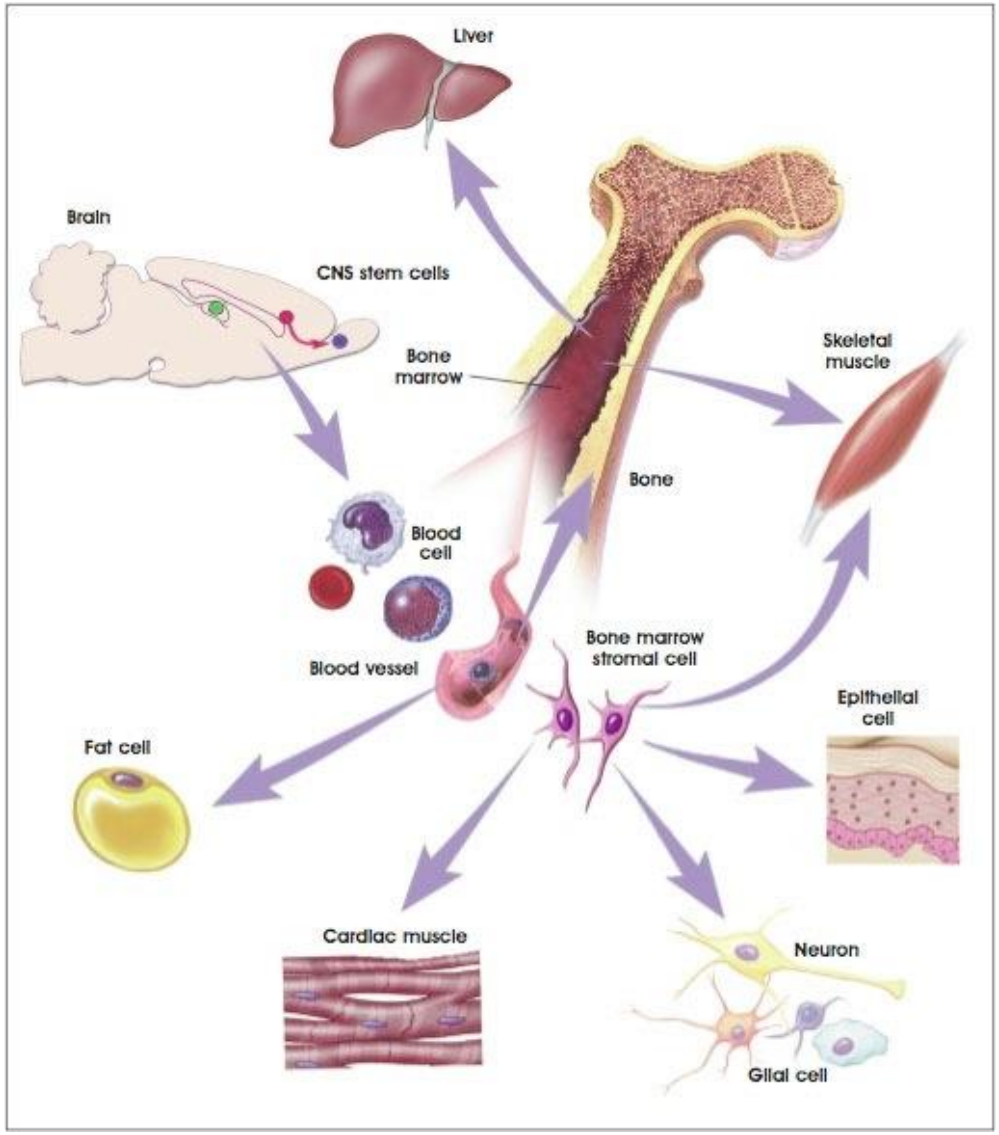


http://stemcells.nih.gov/StaticResources/info/scireport/images/figure41.jpg

Hematopoiesis

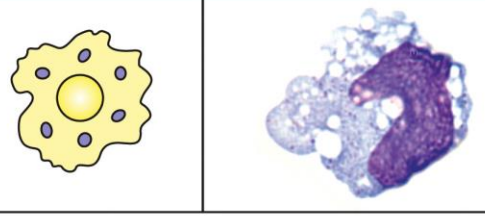


Plasticity of Bone Marrow Stem Cells



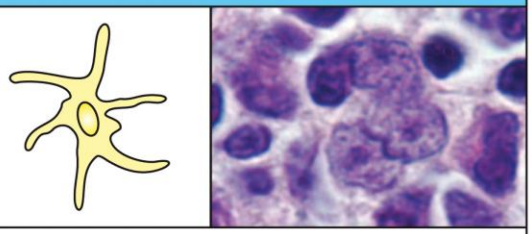
Myeloid Cells

Macrophage



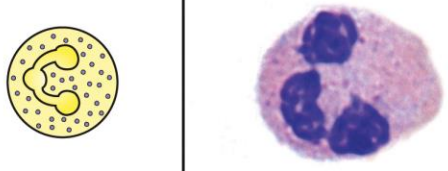
Phagocytosis and activation of bactericidal mechanisms
Antigen presentation and cytokine production

Dendritic cell



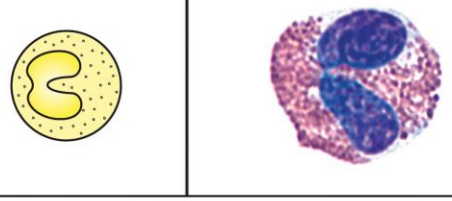
Antigen uptake in peripheral sites
Antigen presentation and cytokine production

Neutrophil



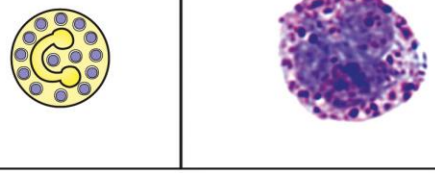
Phagocytosis and activation of bactericidal mechanisms

Eosinophil



Killing of antibody-coated parasites

Basophil



Promotion of allergic responses and augmentation of anti-parasitic immunity

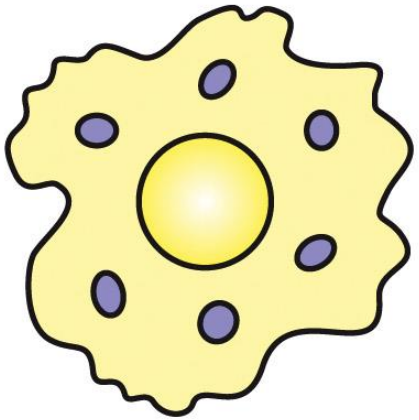
Mast cell

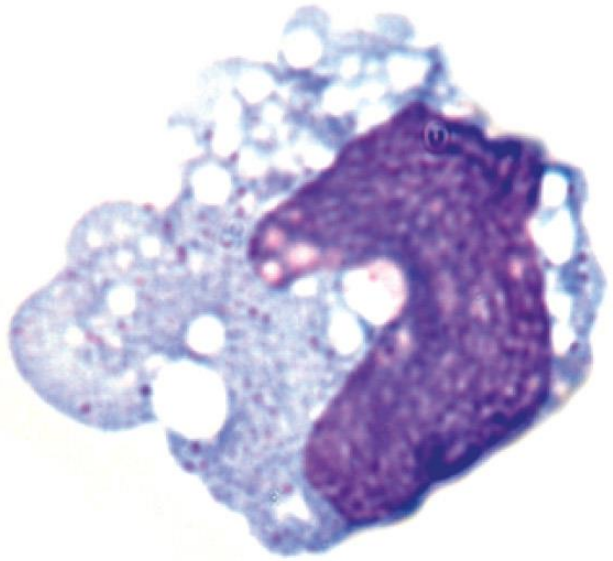
Release of granules containing histamine and active agents

(all): Yasodha Natkunam

Macrophage

Macrophage

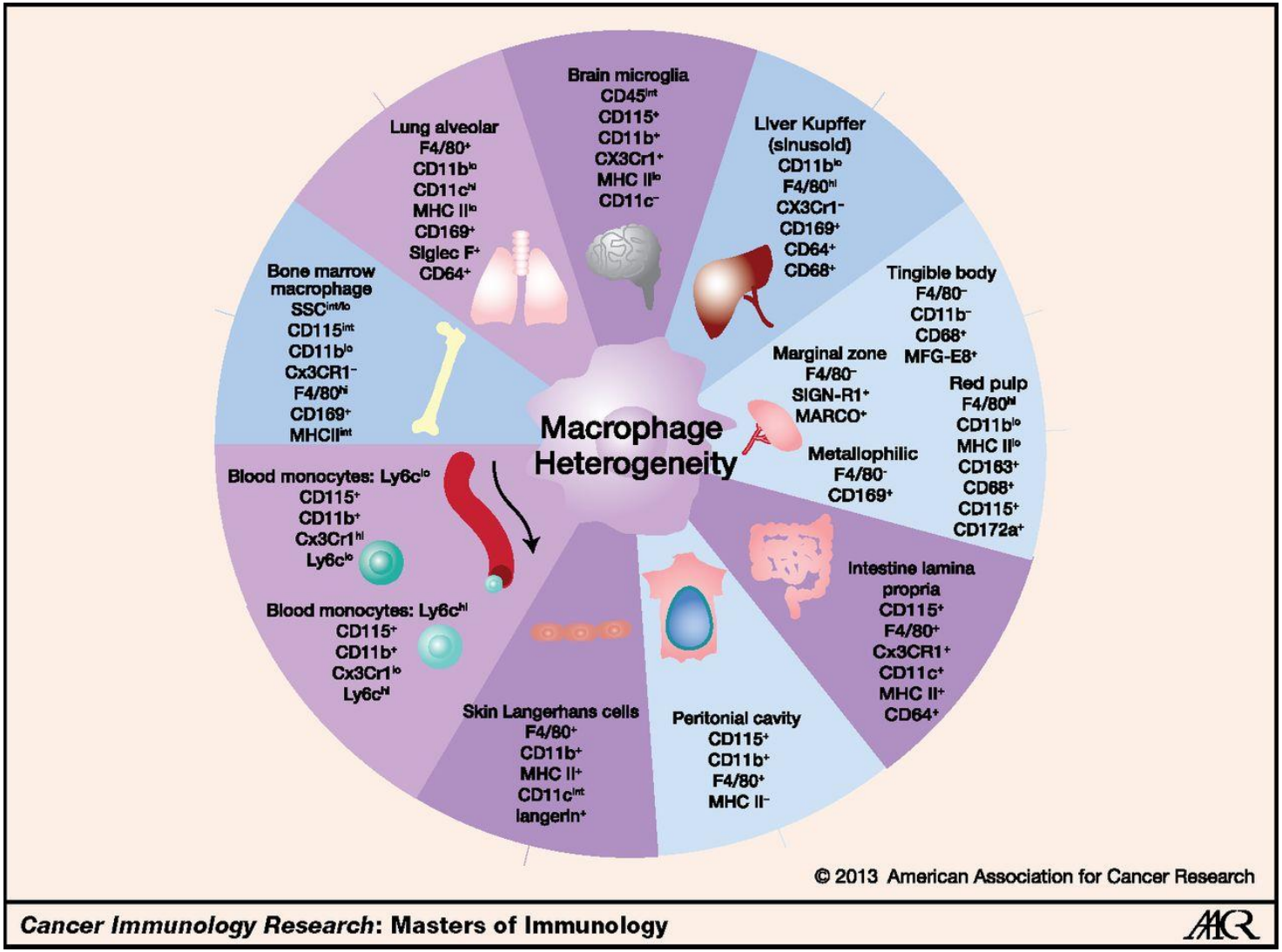




Phagocytosis and activation of bactericidal mechanisms
Antigen presentation and cytokine production

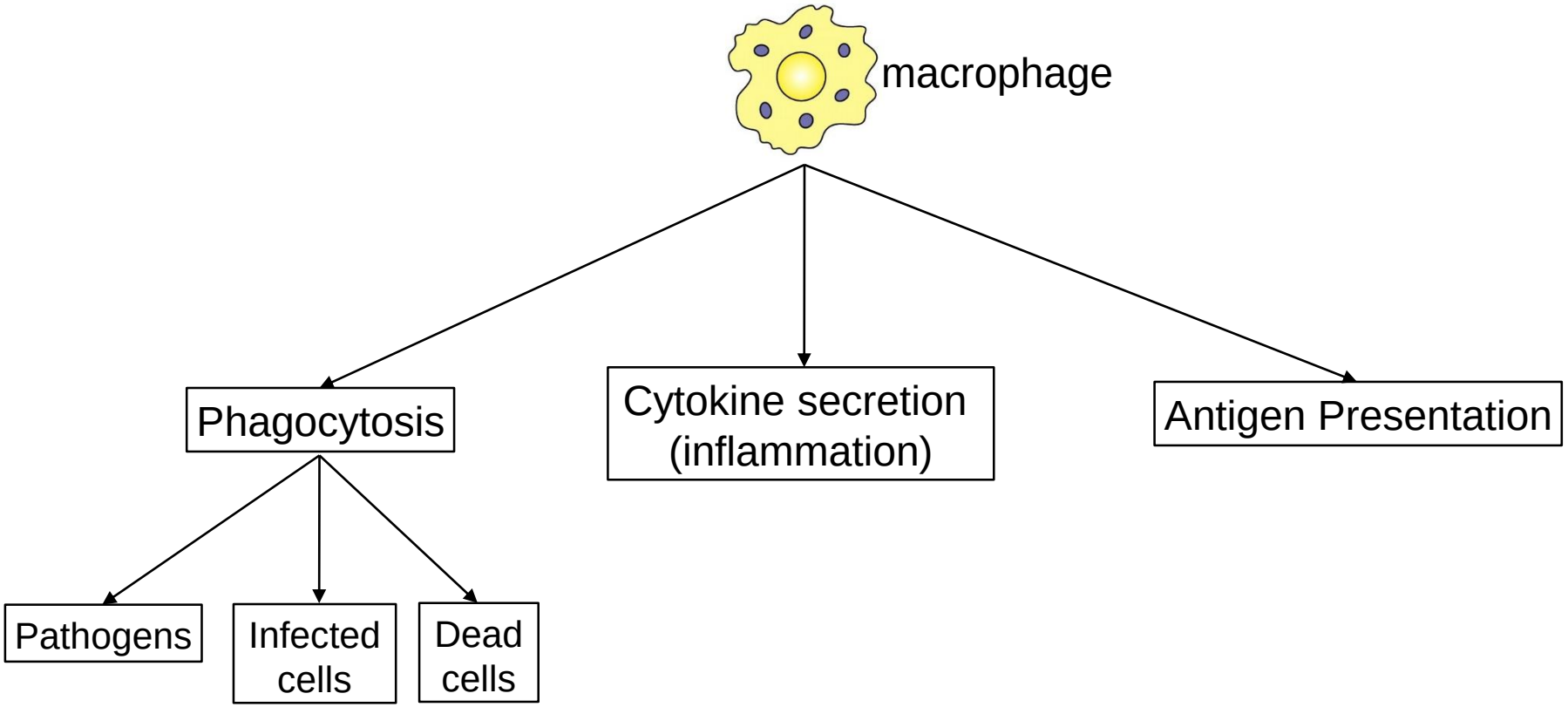
Yasodha Natkunam

Tissue resident macrophages

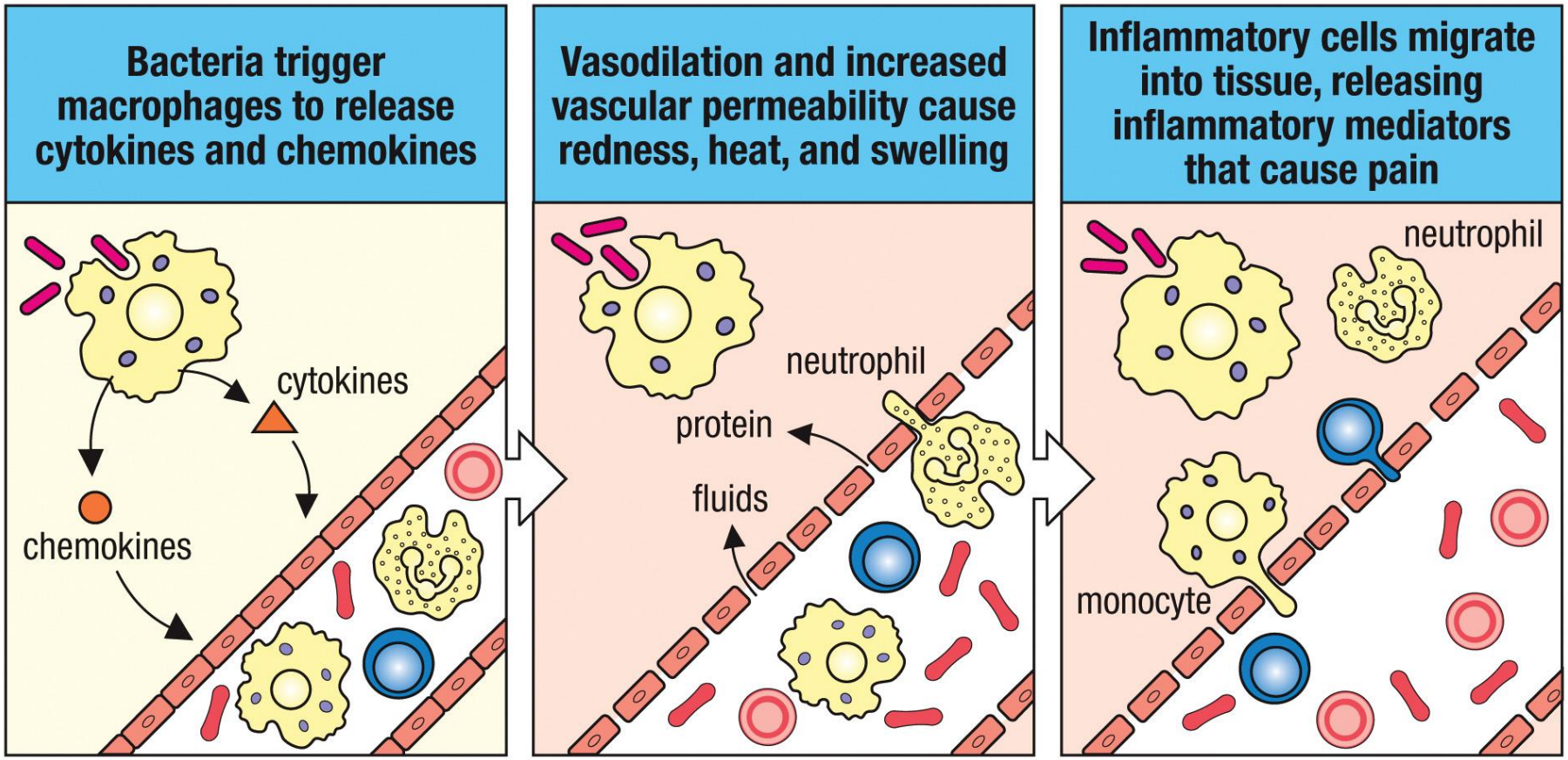


http://cancerimmunolres.aacrjournals.org/content/1/4/201/F1.expansion.html

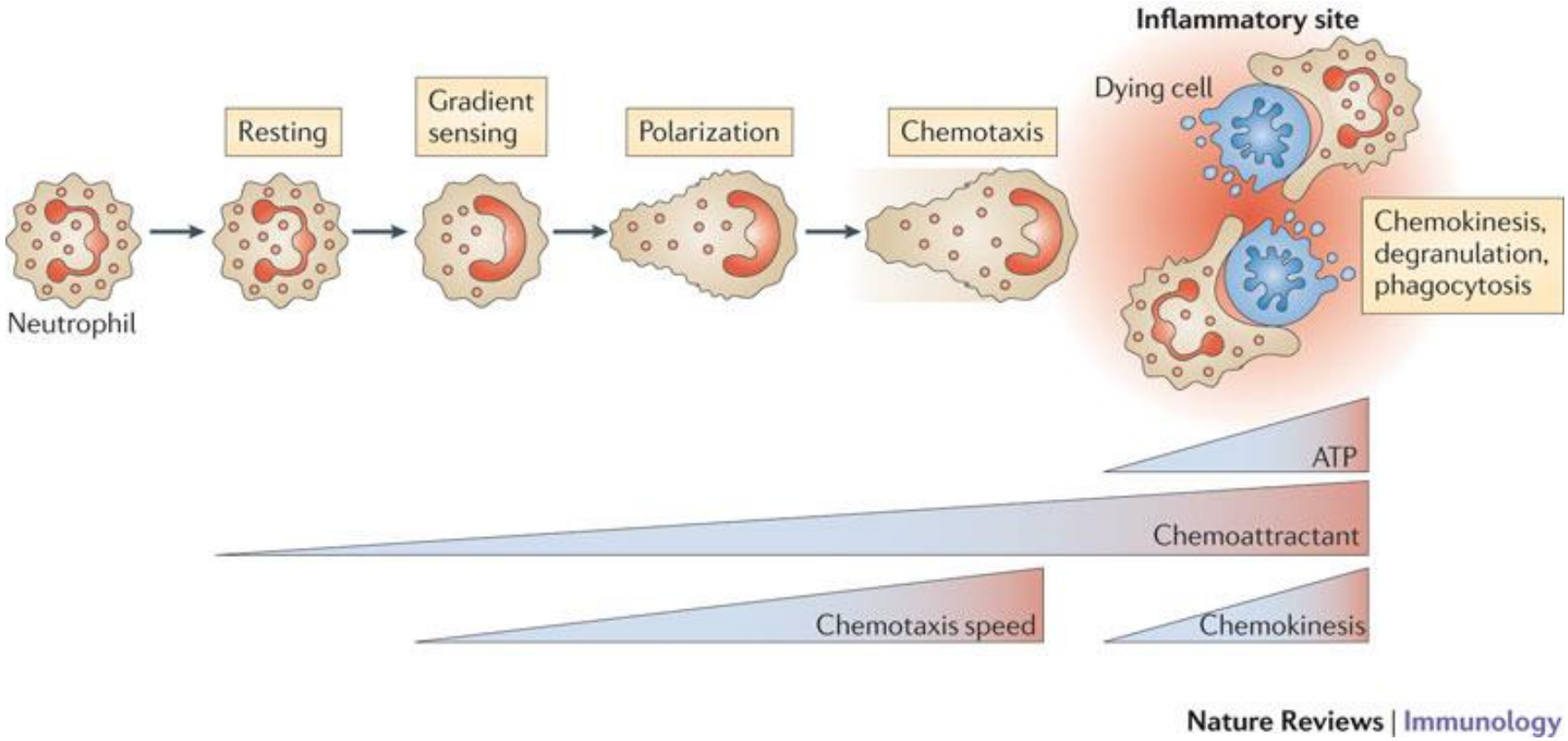
Macrophage Function



Macrophages Initiate an Immune Response And Recruit Other Immune Cells to Sites of Infection

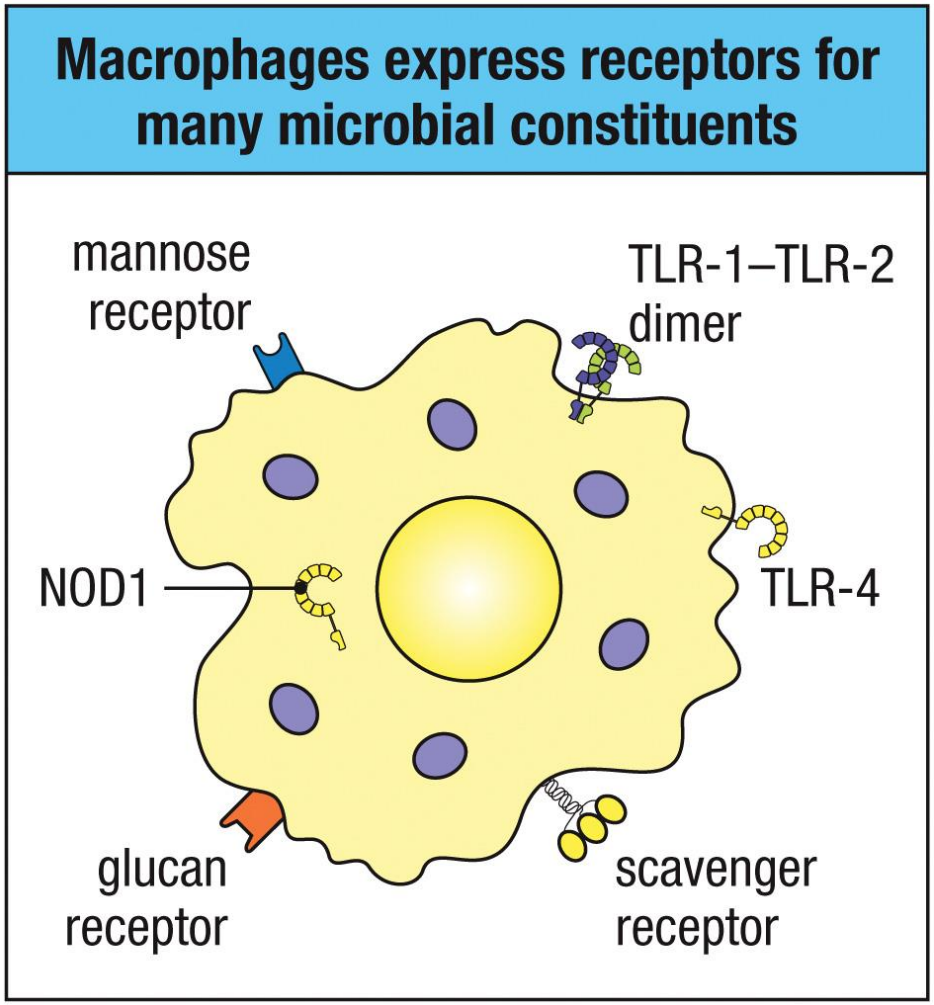


Homing of Leukocytes is Mediated By Chemokines



http://www.nature.com/nri/journal/v11/n3/fig_tab/nri2938_F3.html

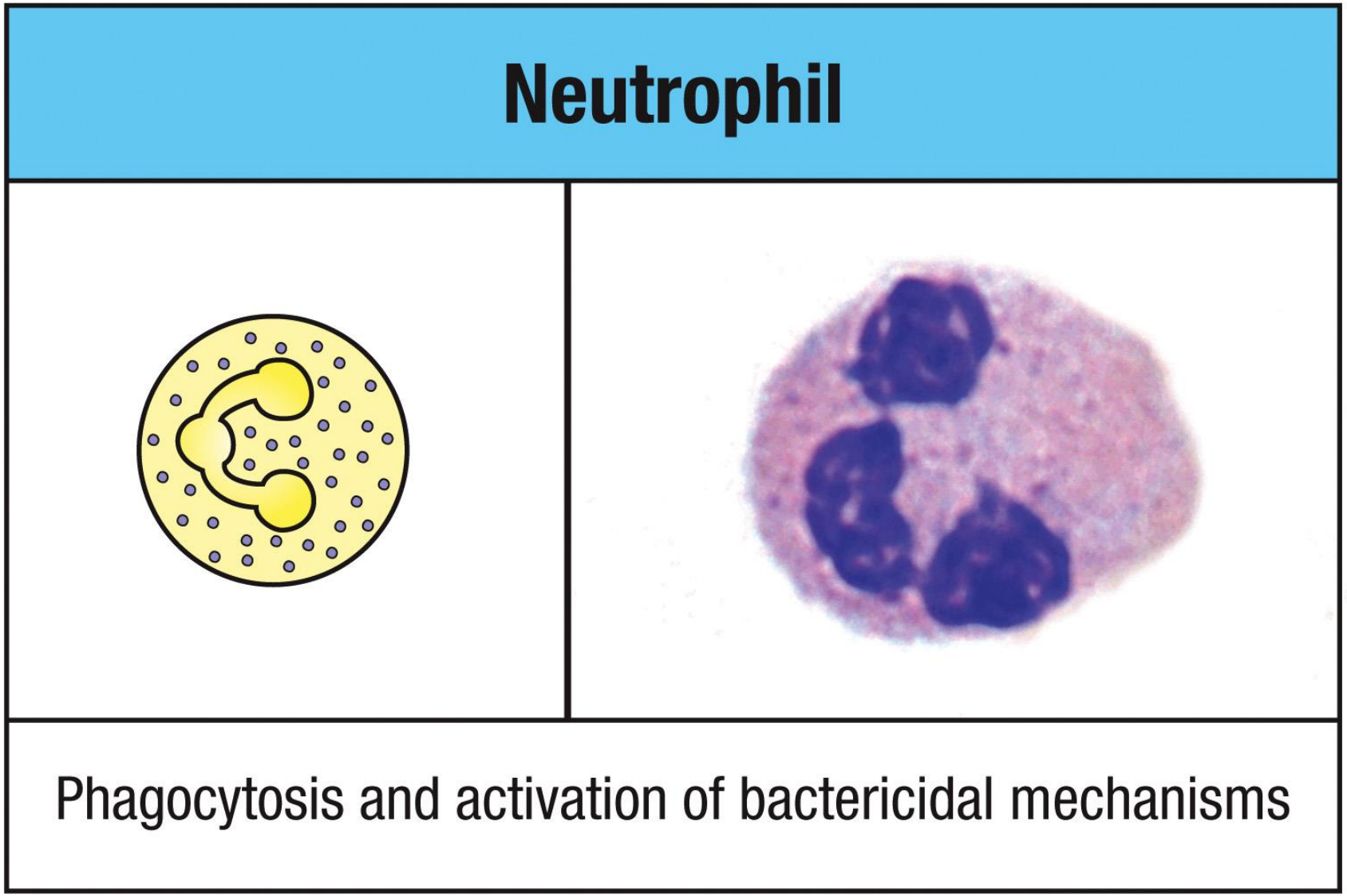
Pathogen Receptors On Macrophages



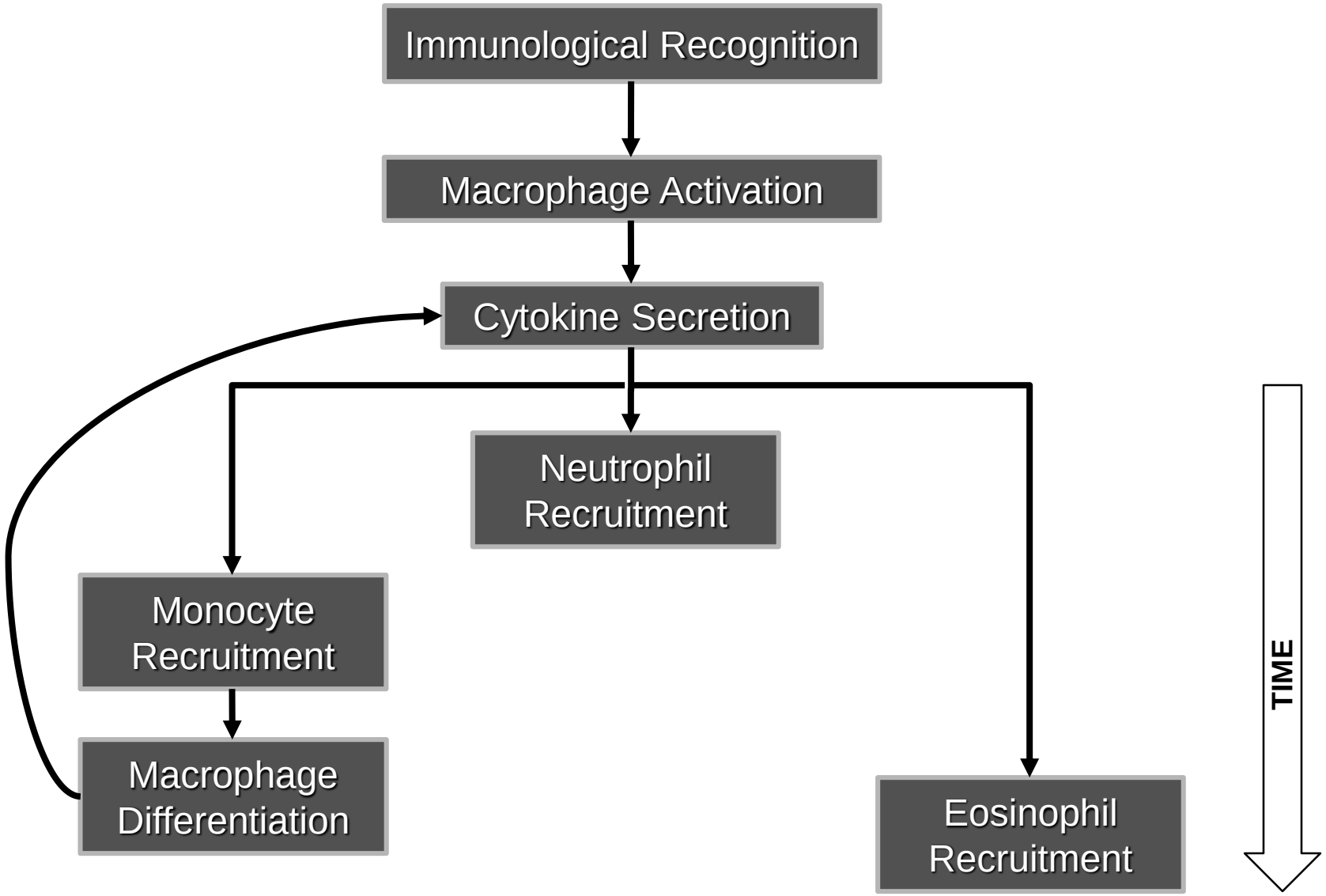
Receptor expression is constant, is not adapted based on the nature of the pathogen (unlike the receptors of the adaptive immune response).

- No problems with self-recognition

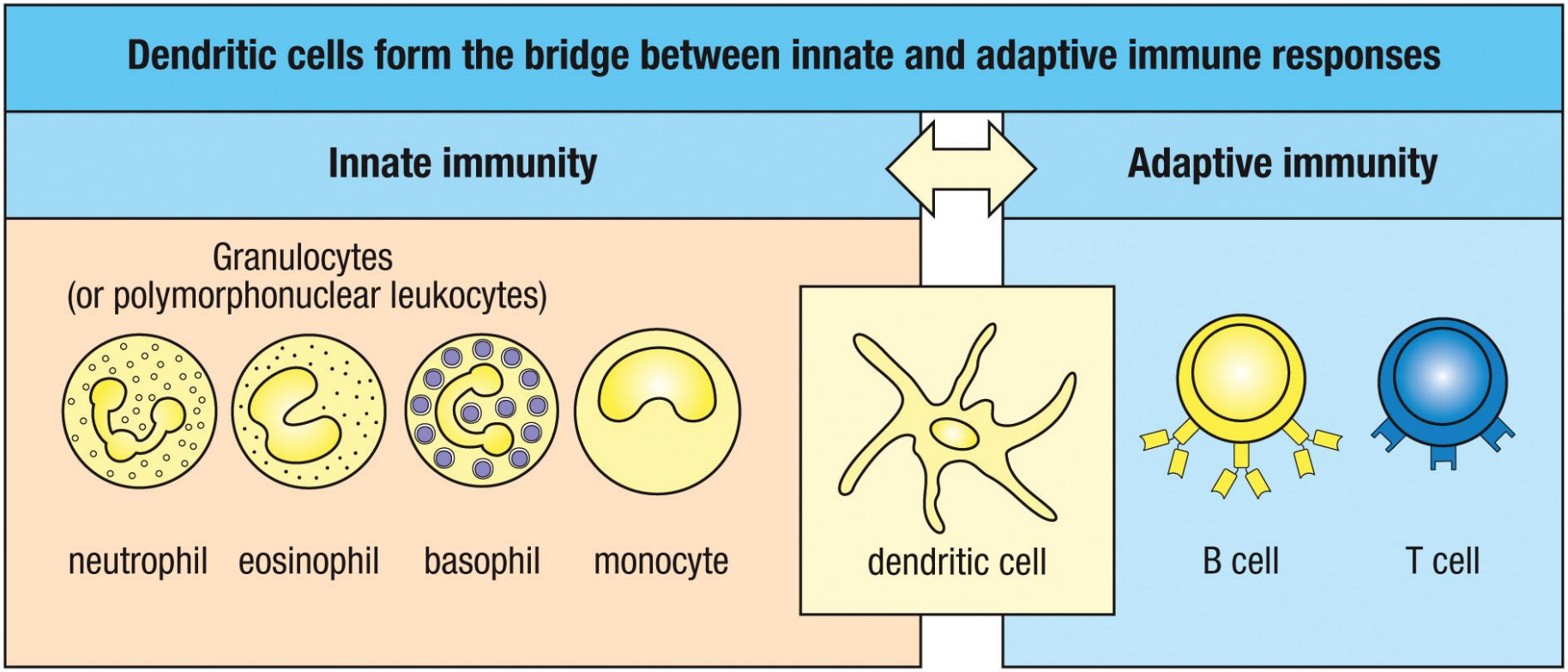
Neutrophils Phagocytose Pathogens



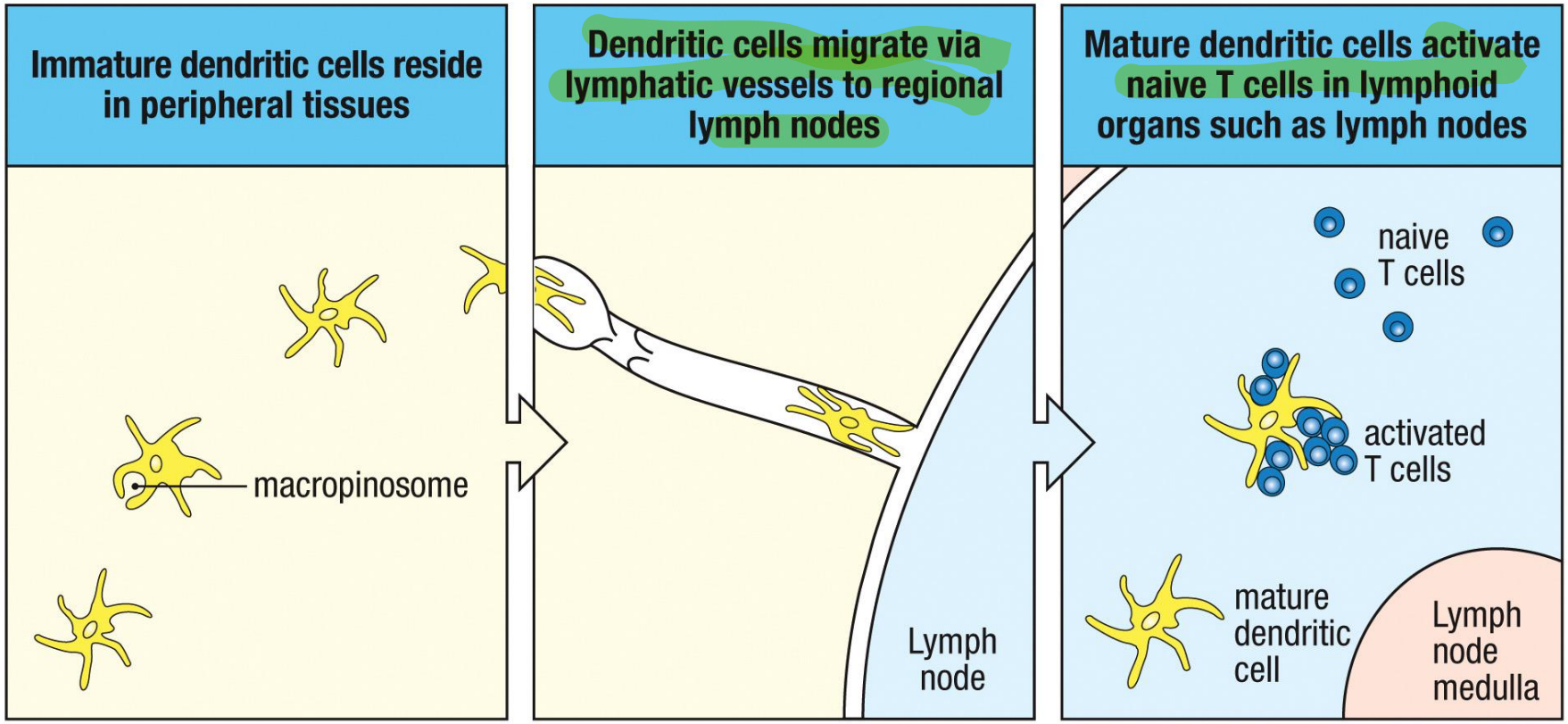
Timecourse of Innate Immune Response



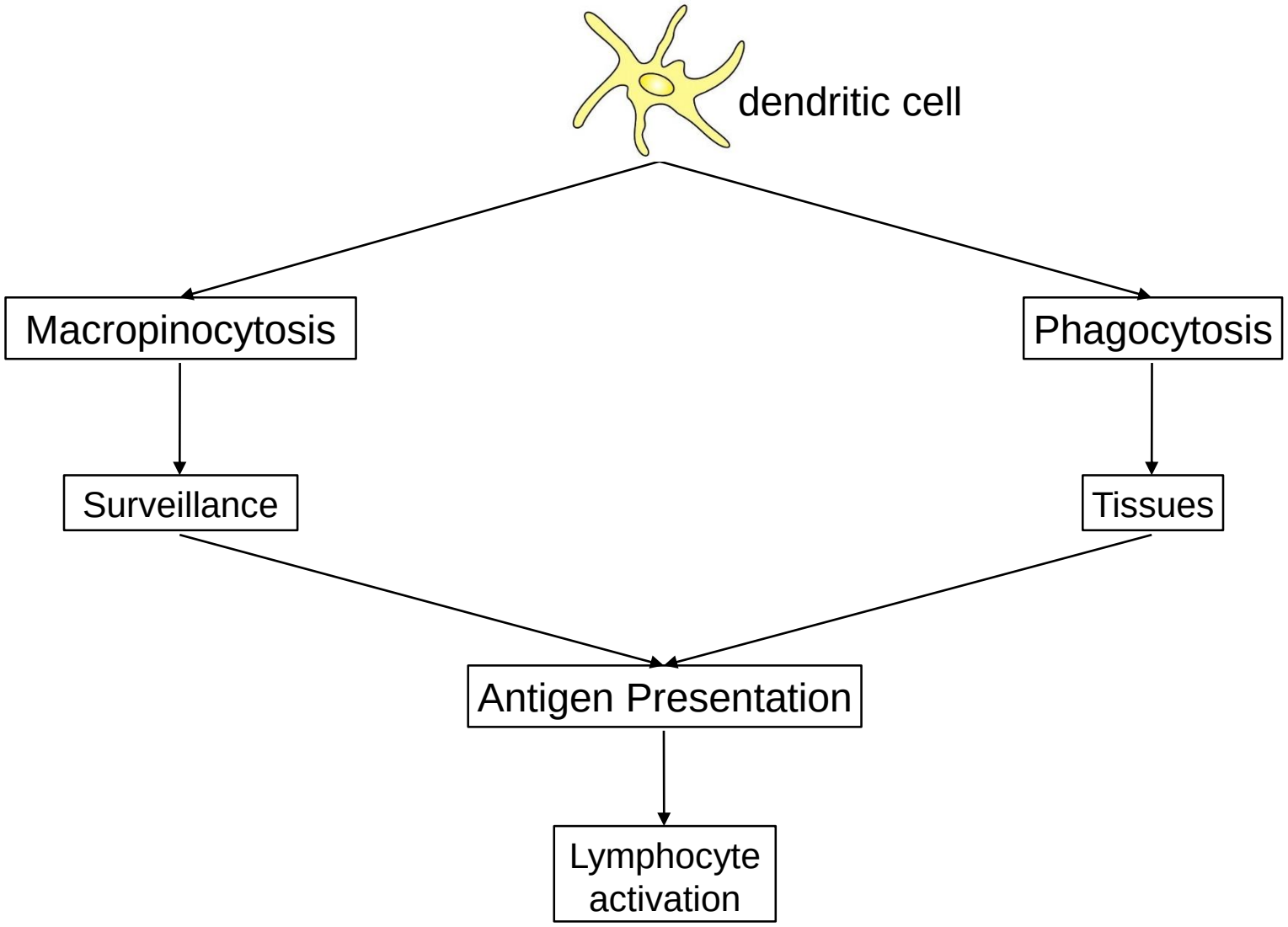
Dendritic Cell



Dendritic Cells Initiate Adaptive Immune Responses



Dendritic Cell Function

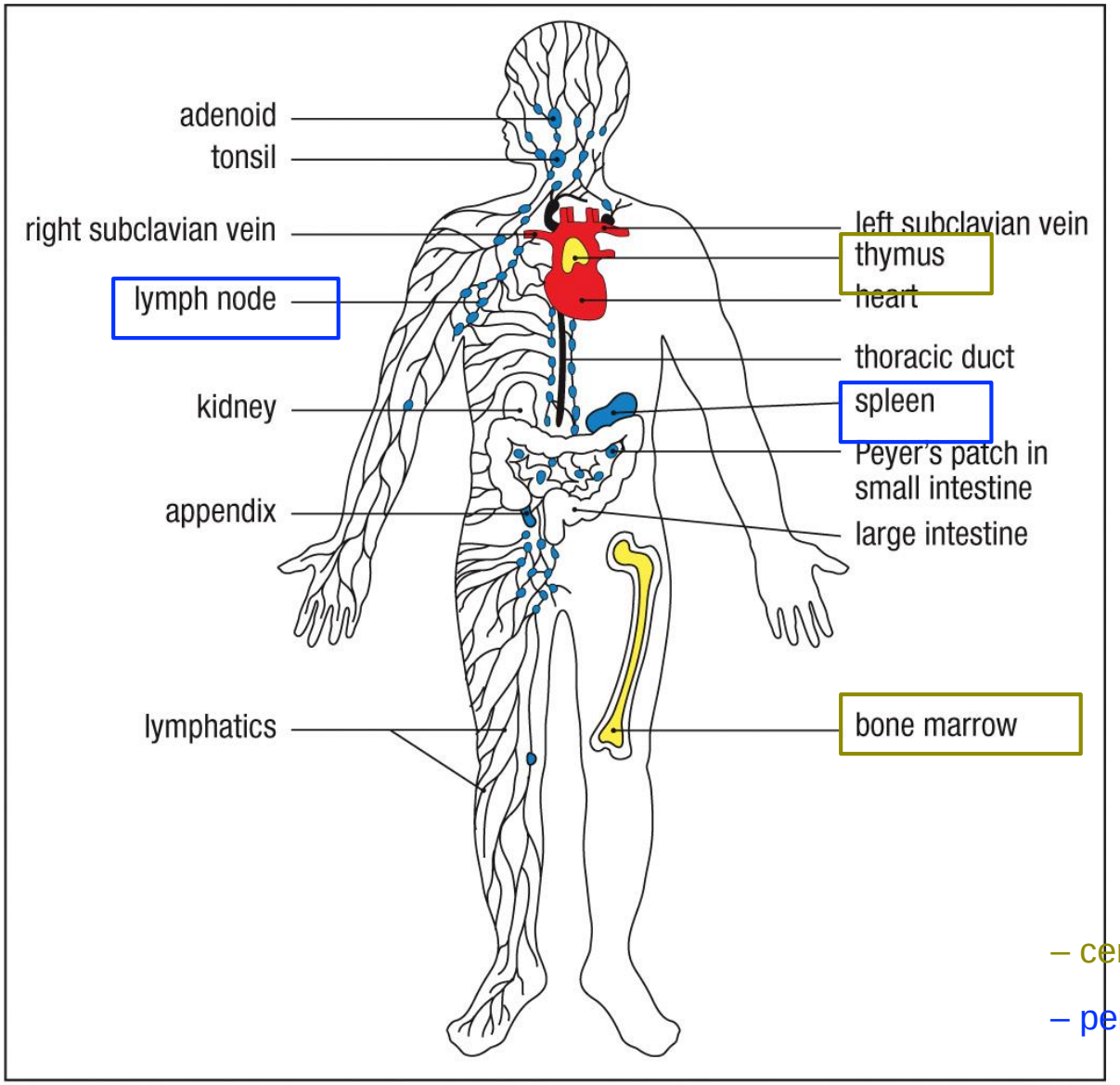


Question

What are the functions of macrophages?

What are the functions of dendritic cells?

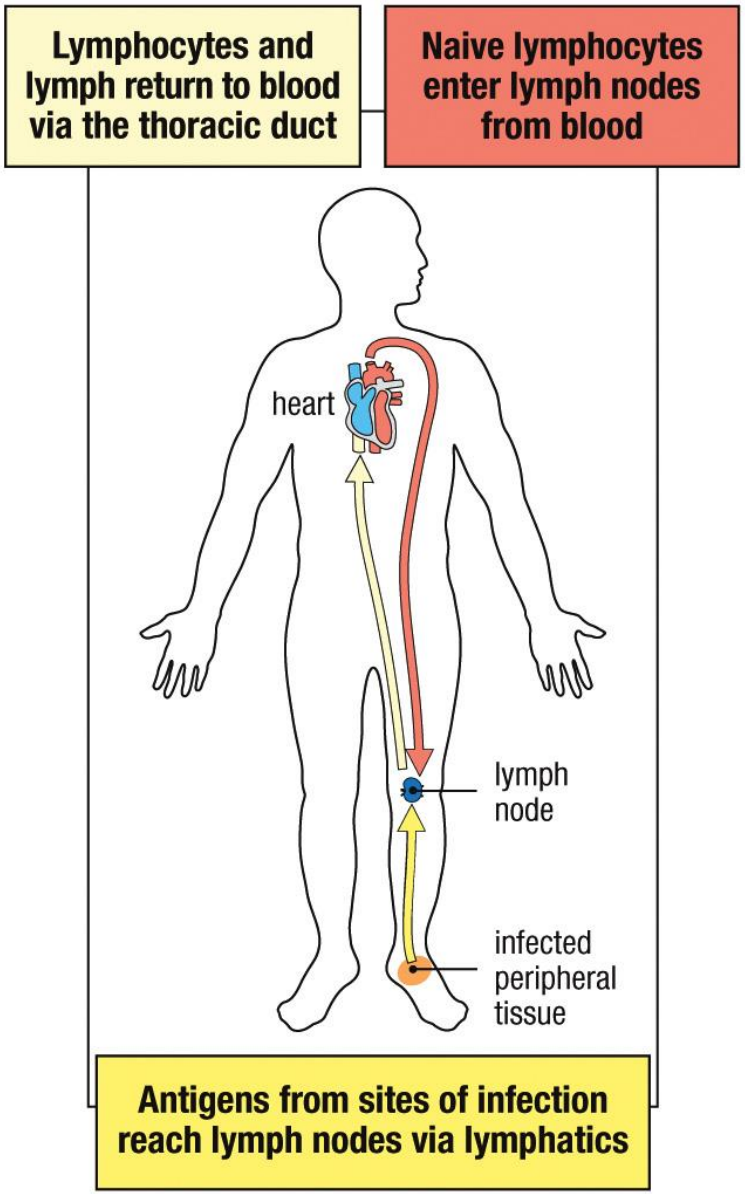
Lymphoid Tissue



– central lymphoid organ

– peripheral lymphoid organ

Lymphoid Organs: Sites of Antigen Encounter



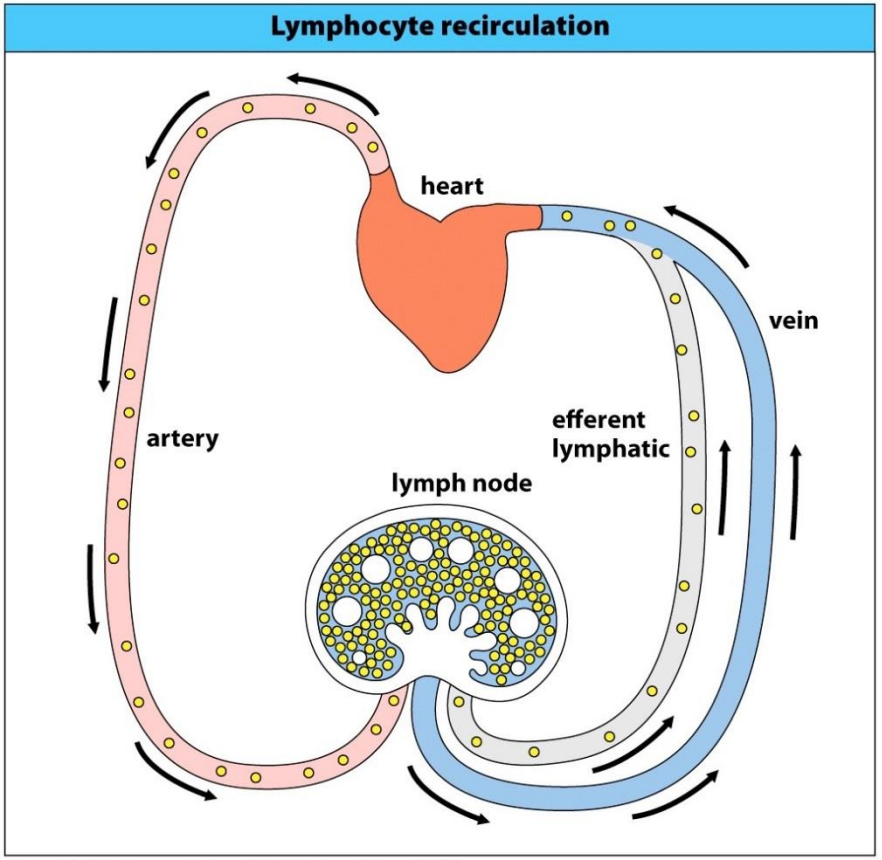
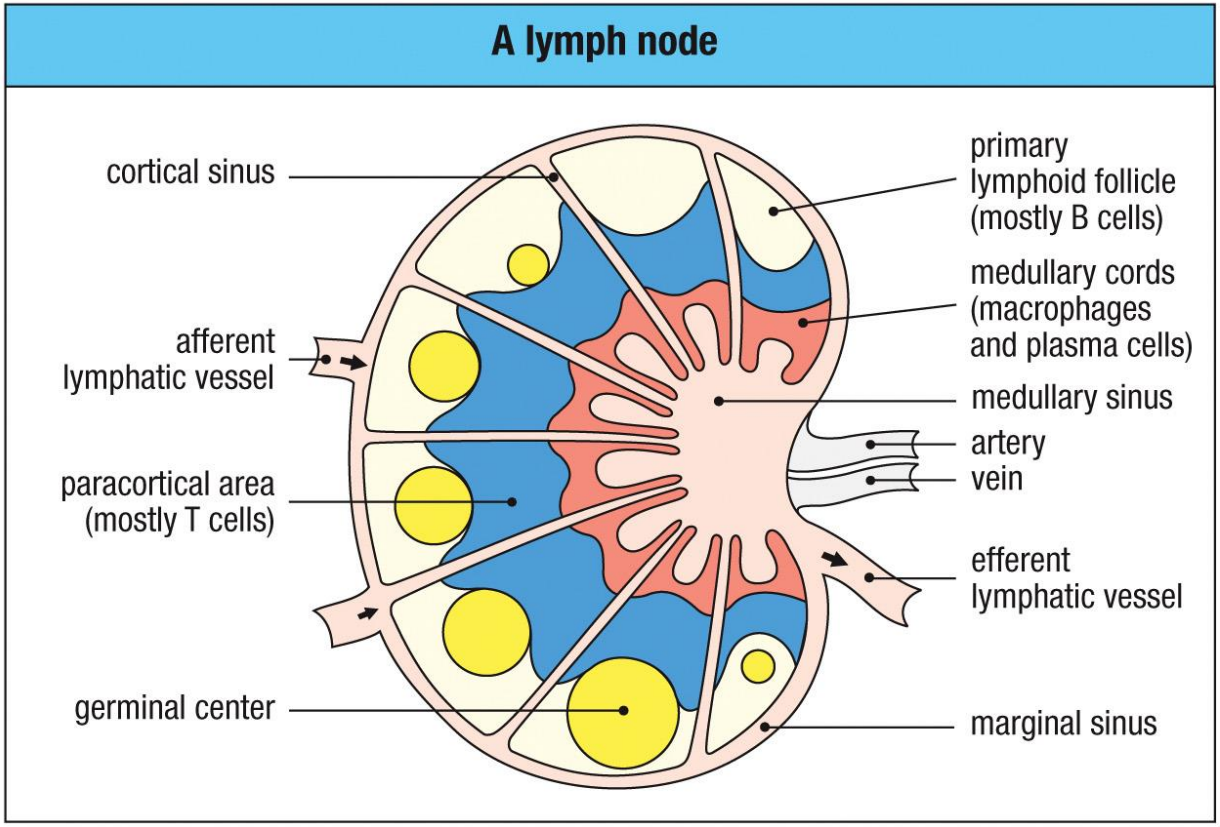
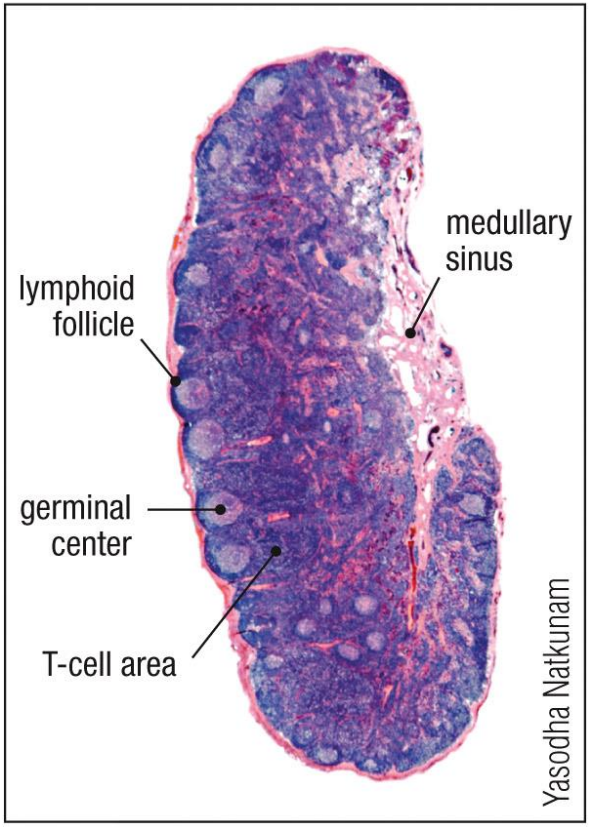


Figure 1.19 The Immune System, 3ed. (© Garland Science 2009)

Organization of a Lymph Node





Cellular Traffic to the Lymph Node

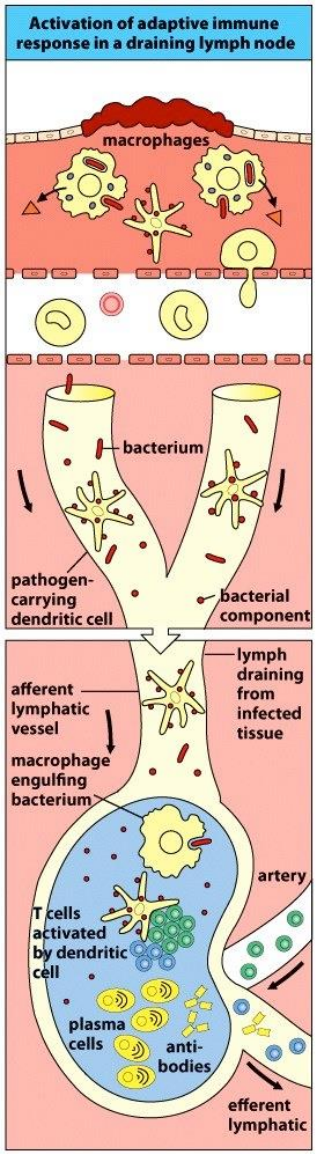


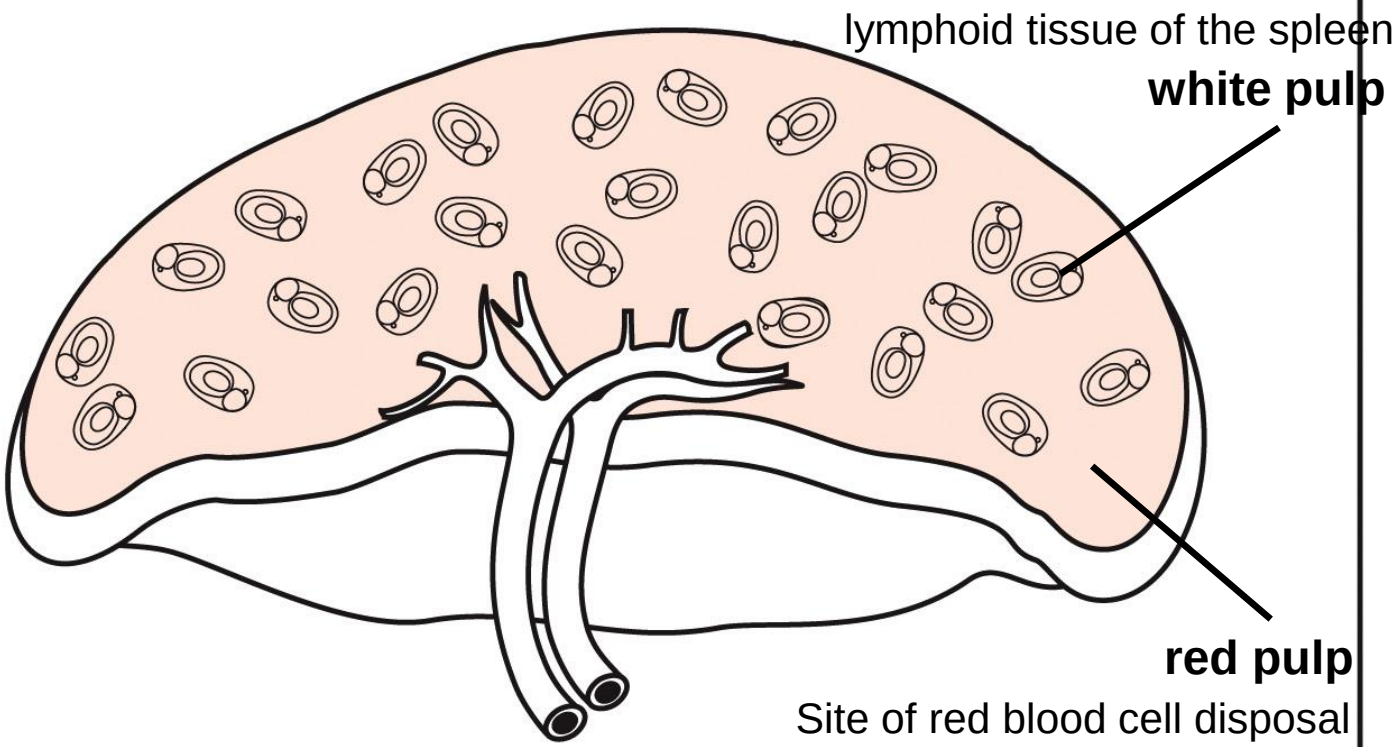
Figure 1.22 The Immune System, 3ed. (© Garland Science 2009)

Macrophages in the lymph node

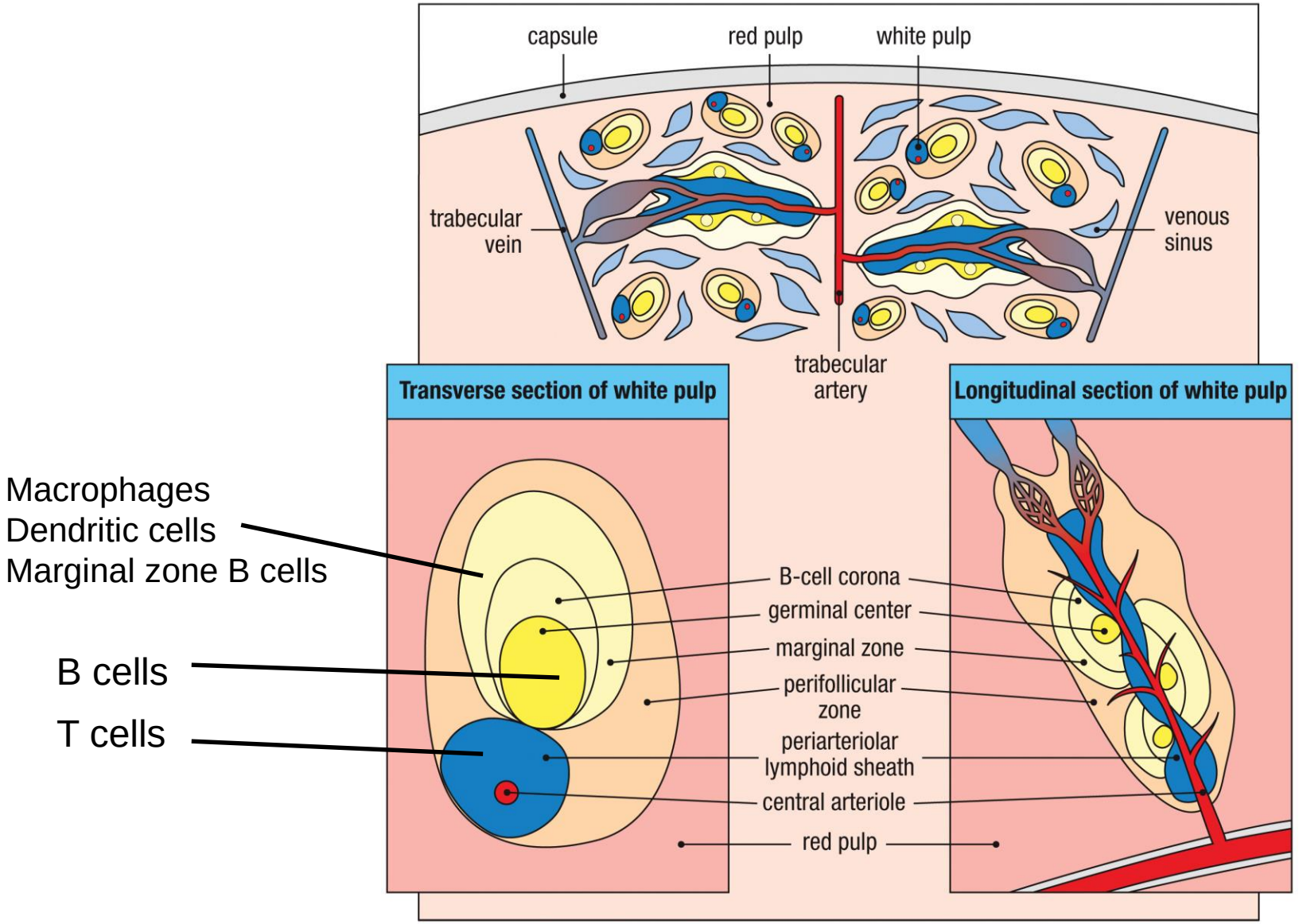
- Engulf free pathogen
- Antigen presentation
- Prevent the spread of the infection from the lymphatic system

Spleen

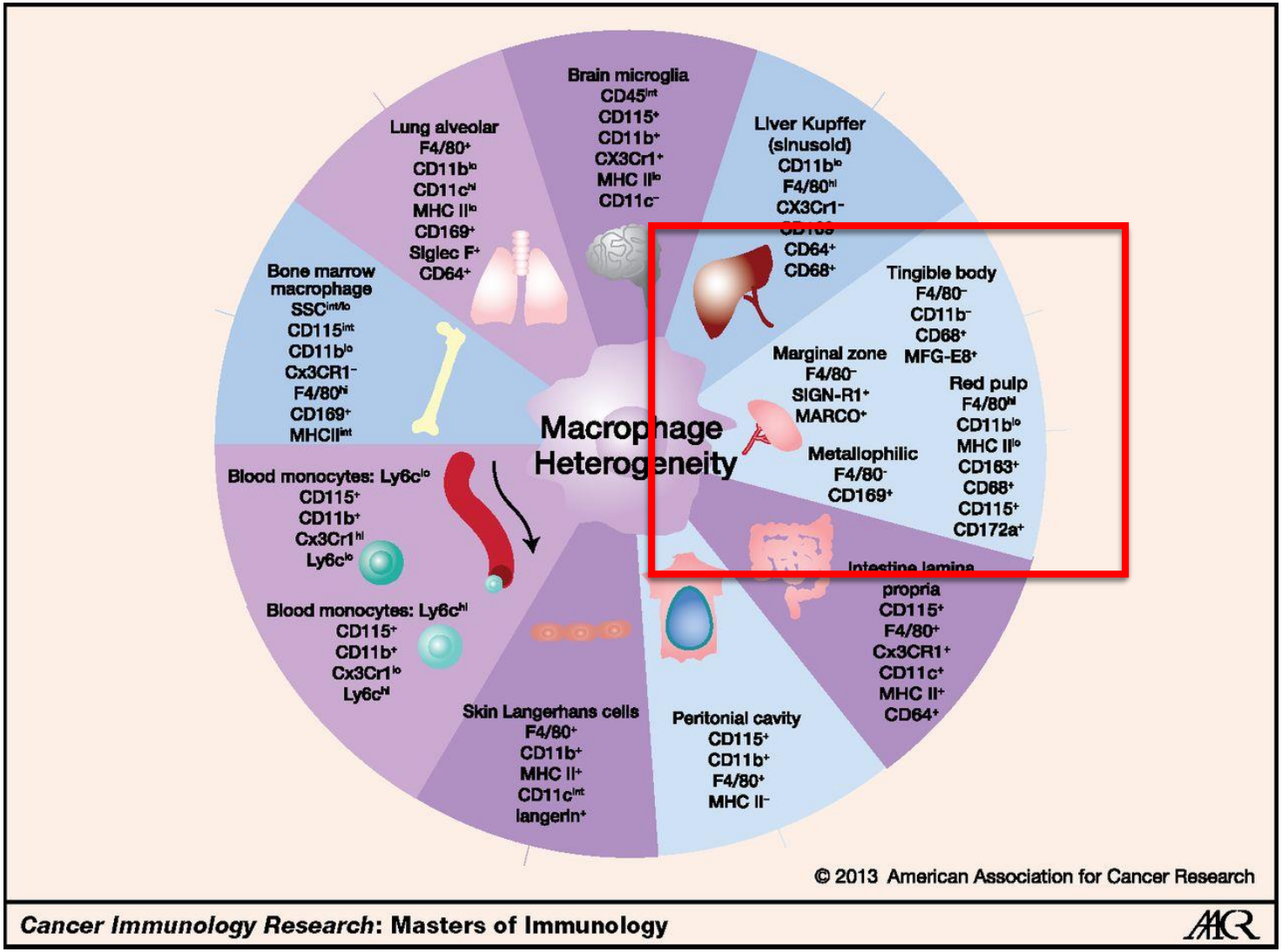
Immune responses to blood-borne pathogens



Lymphoid Tissues of the Spleen

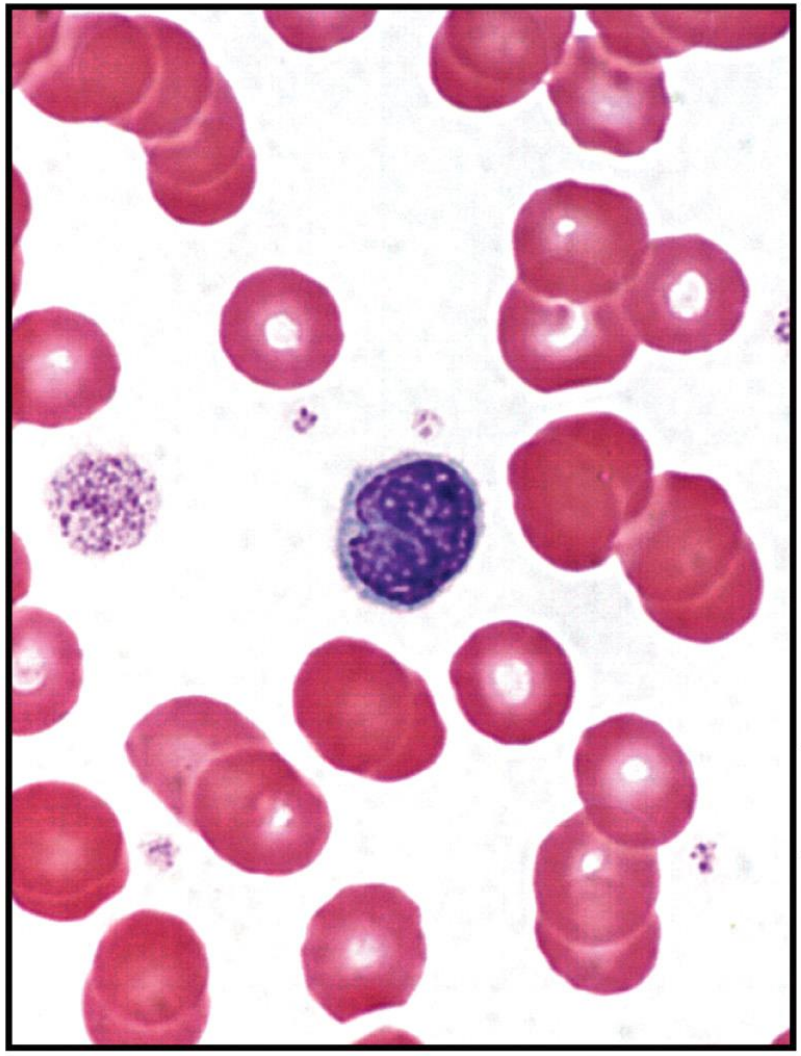


Tissue resident macrophages

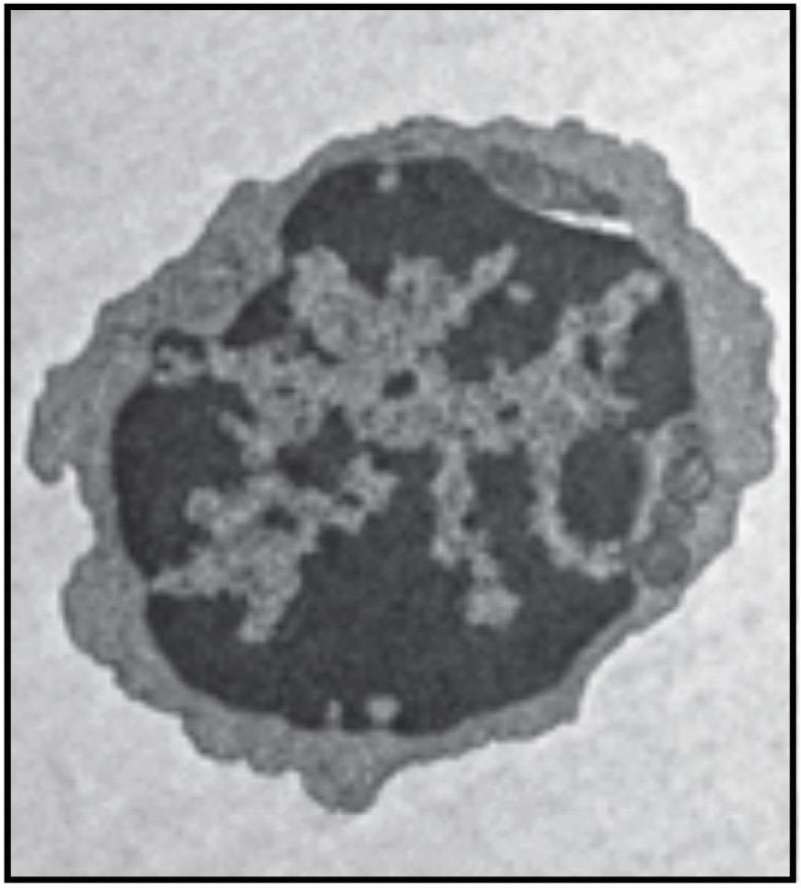


http://cancerimmunolres.aacrjournals.org/content/1/4/201/F1.expansion.html

Lymphocyte



Michael Ross/Science Source



Rawlings et al. (2011) *EMBO J* (2011) 30: 263–276. Reprinted with permission © Wiley

Stages of Lymphocyte Development

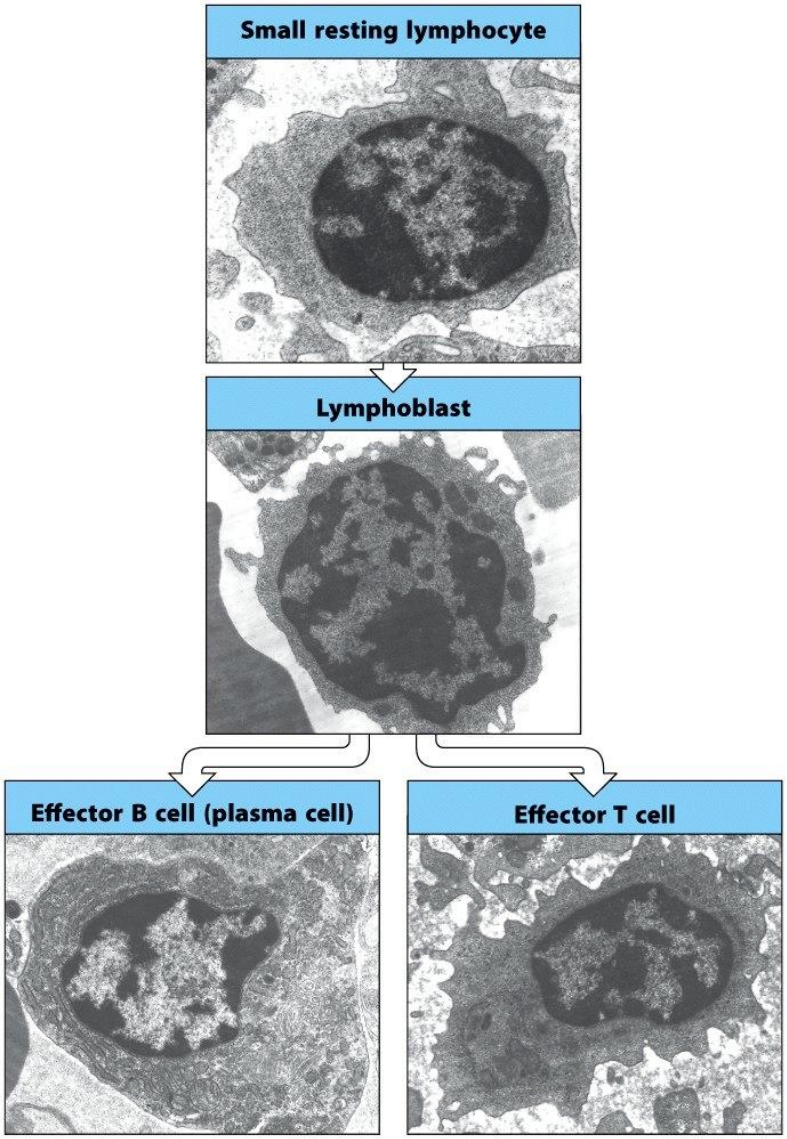
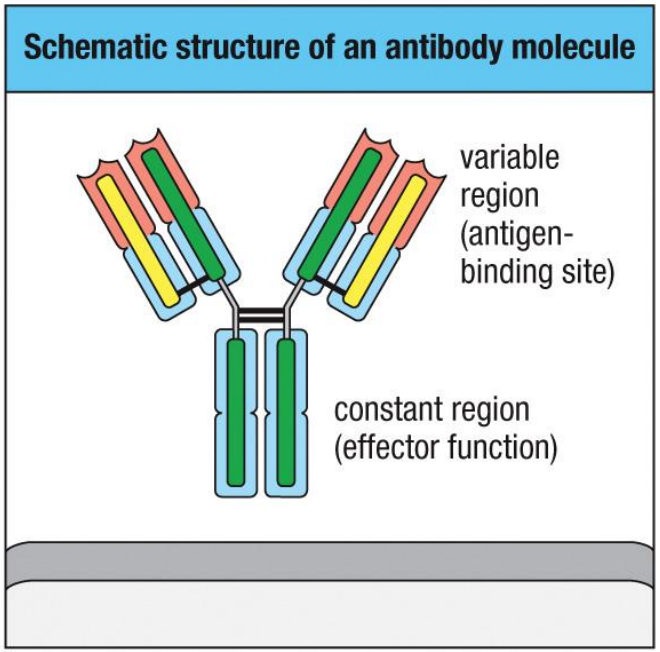
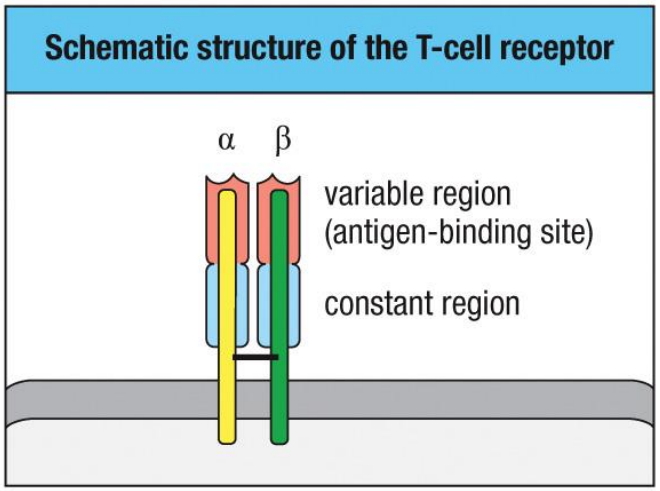


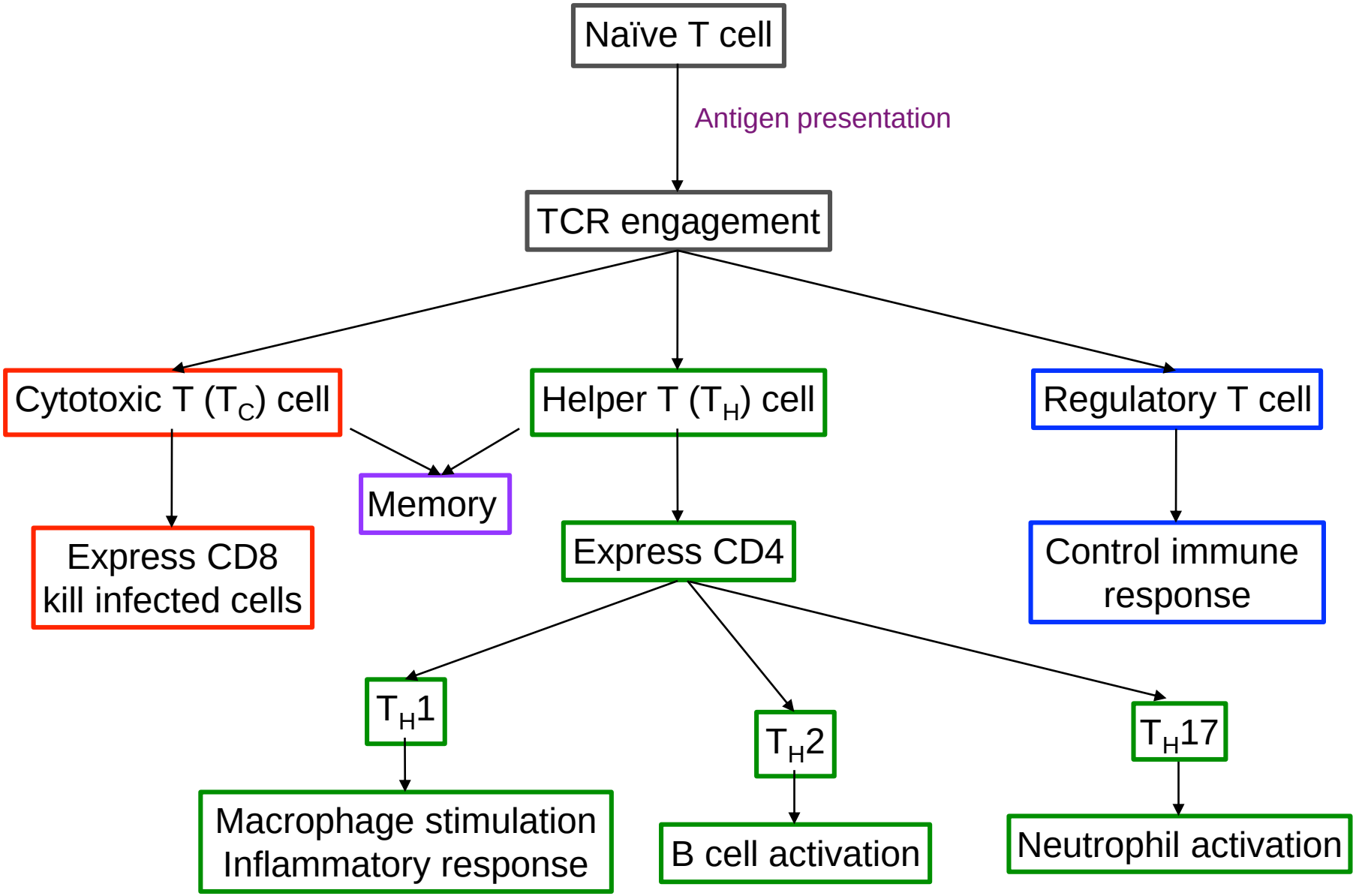
Figure 1-23 Immunobiology, 7ed. (© Garland Science 2008)

Antigen Receptors

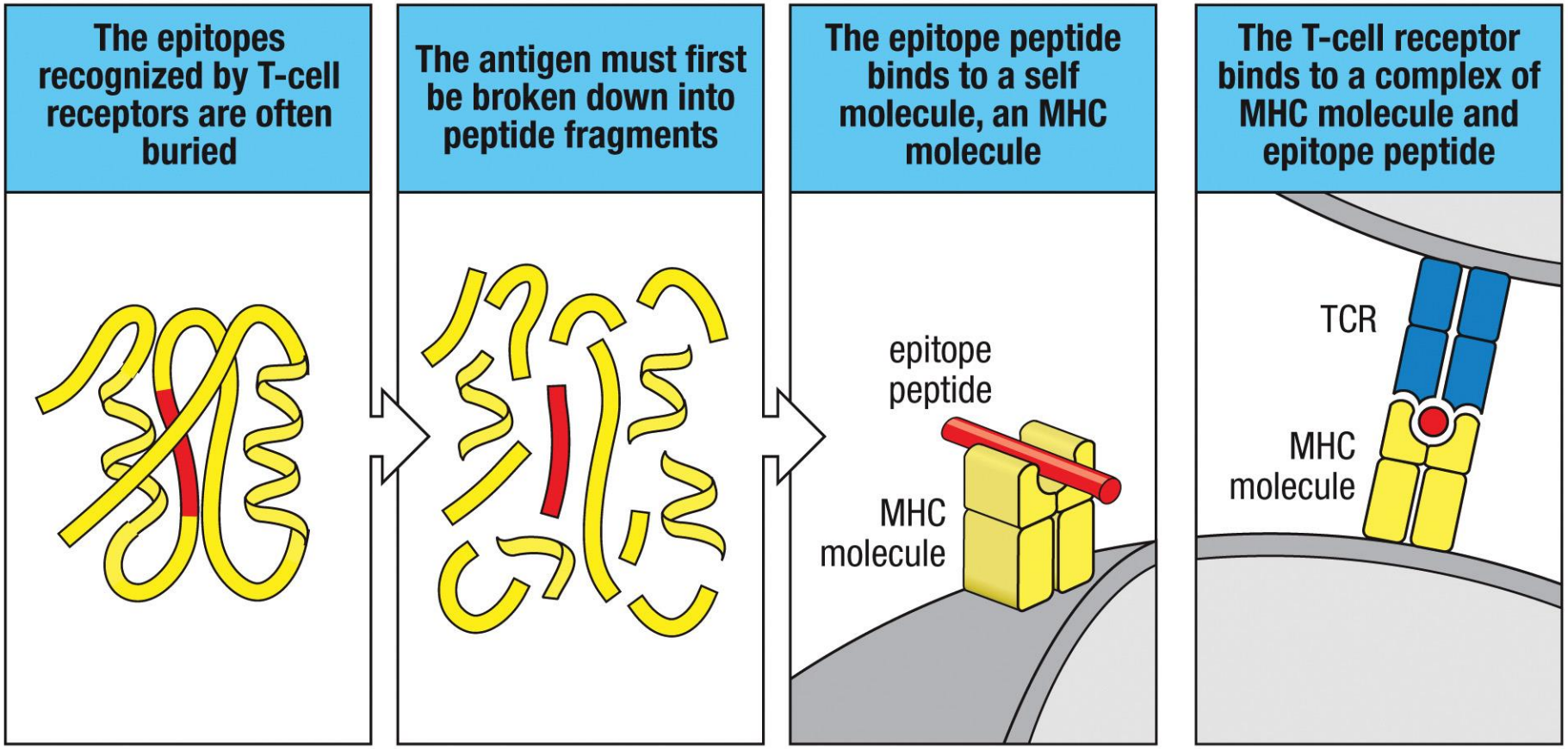




T Lymphocyte Differentiation



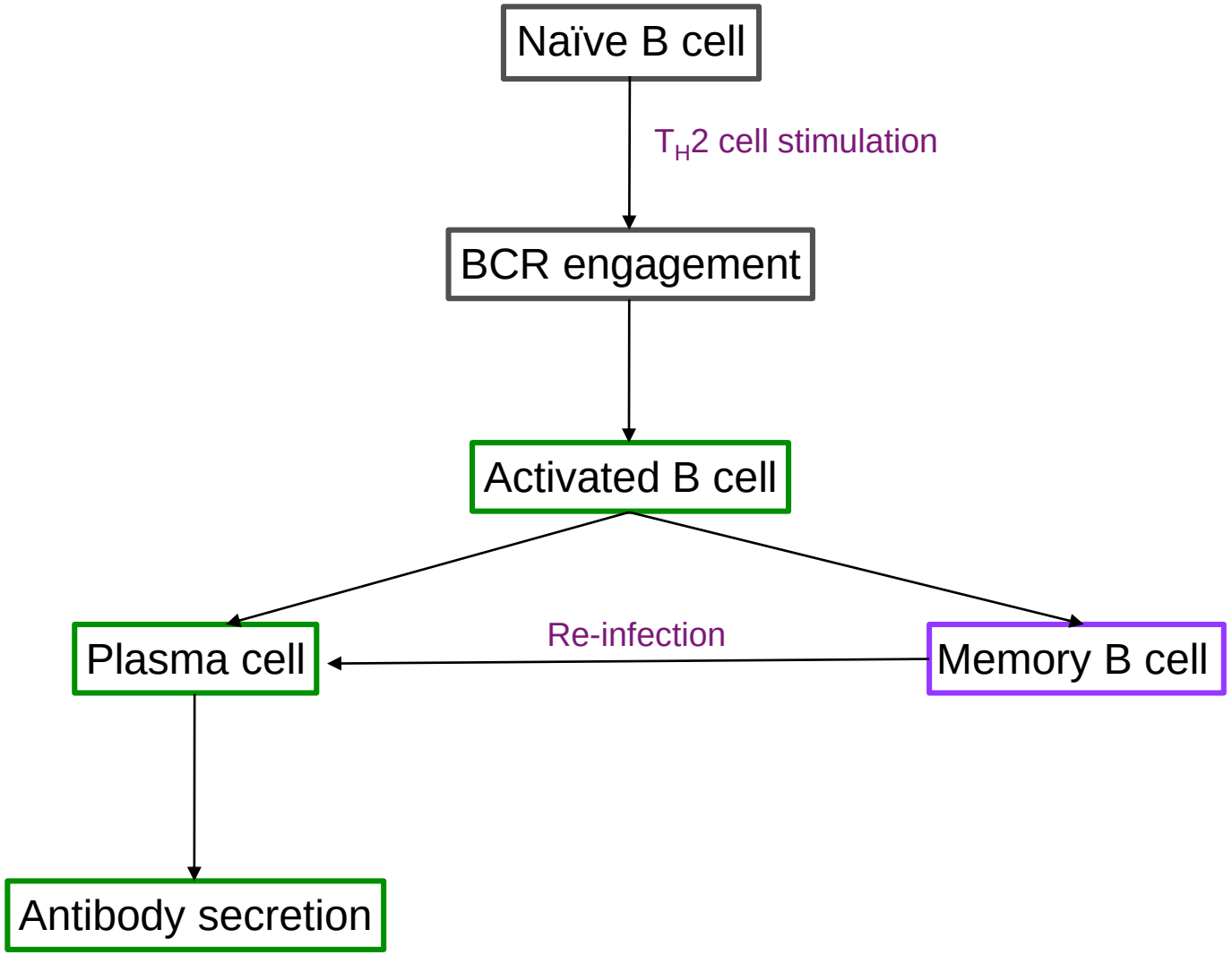
T Cell Receptors



T Lymphocyte Function

Effector module	Cell types, functions, and mechanisms
Cytotoxicity	NK cells, CD8 T cells
	Elimination of virally infected and metabolically stressed cells
Intracellular immunity (Type 1)	ILC1, T_H1 cells
	Elimination of intracellular pathogens; activation of macrophages
Mucosal and barrier immunity (Type 2)	ILC2, T_H2 cells
	Elimination and expulsion of parasites; recruitment of eosinophils, basophils, and mast cells
Extracellular immunity (Type 3)	ILC3, T_H17 cells
	Elimination of extracellular bacteria and fungi; recruitment and activation of neutrophils

B Lymphocyte Differentiation



Question

- What is the central lymphatic organ? What is its function?
- What are the two major peripheral lymphatic organs? What are their functions?

Outline

- Cells and tissues of the immune system
- Case study: Congenital Asplenia

Congenital Asplenia: Case Study

Patient:

- 10 month old female
- dead on arrival in emergency room
- prior illness, 2 weeks
- cultures positive for *H. influenzae* (bacterial)

Family history:

- Ancestors: Consanguineous marriages
- Sister, 3 years old, severe *H. influenzae* infection, recovered
- Brother, 5 years old, bacterial pneumonia at 21 & 27 months, and 3.5 years, recovered

Tests:

- Both siblings have normal responses to typhoid vaccine & tetanus toxoid
- Both siblings have impaired response to vaccination with sheep red blood cells (RBCs)
- Abnormal colloidal gold (^{198}Au) scan

Congenital Asplenia: Case Study

Why did the infant die?

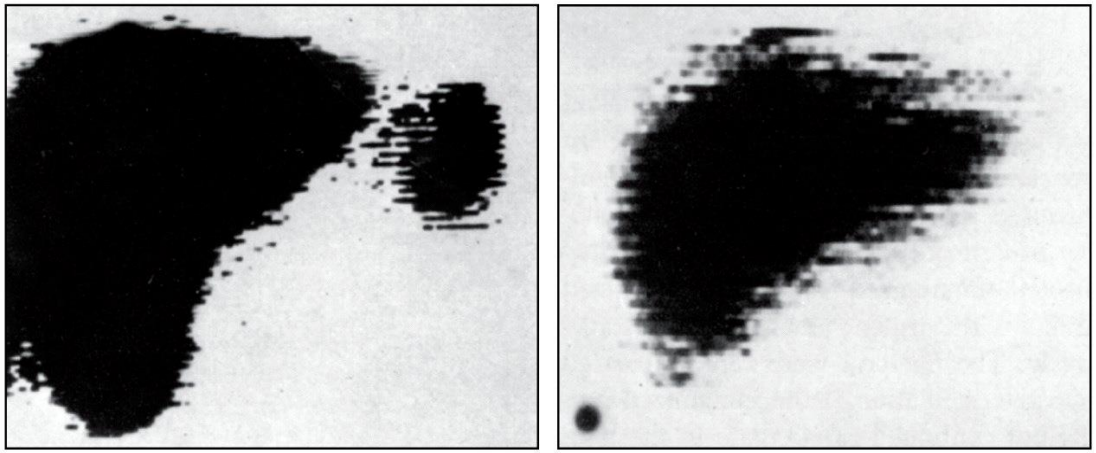
NORMAL RESPONSES	IMPAIRED RESPONSES
Typhoid vaccine	**Sheep RBCs**
Subcutaneous vaccine (under the skin)	Intravenous vaccine
Response in lymph node	Response in spleen

Congenital Asplenia: Case Study

Colloidal gold (^{198}Au) scan

Mother

Children



Liver

Spleen

Congenital Asplenia: Case Study

Baby S.V. died of bacteremia

Due to her inability to mount an adaptive response against a pathogen in her blood stream.

Absent of spleen

Congenital Asplenia: Case Study

Absent or non-functional spleen

Susceptible to bloodstream infections by microorganisms against which they have no antibodies
-Streptococcus pneumonia
-Haemophilus influenzae

Treatment

Prophylactic antibiotics
Immunization