

Lecture 1
BT304
31 July 2023

Introduction to Immunology

Instructor: Prof. Manish Kumar

BT 304 Syllabus

Instructor: Manish Kumar

Properties and Overview of Immune Responses, Cells and Tissue of the immune system, Leukocyte migration into tissues, Antibodies and antigen. Innate Immunity: Major histocompatibility complex. Antigen processing and presentation to T lymphocyte. Antigen receptors gene rearrangement and lymphocyte development, Immune receptors and signal transduction, Activation of T lymphocytes.

Adaptive Immunity: Effector mechanisms, B cell activation and antibody production, Regional Immunity, Immune memory response. Immunologic Tolerance: Autoimmunity, Immunity to Microbes, Transplantation immunology, Tumor Immunology. Hypersensitivity: IgE dependent Immune response, Allergic disease, Congenital and acquired immune deficiencies.

18 -to- 24 Sept: **Mid-Sem** and 19 -to- 25 Nov: **End-Sem**
17 Nov : Last date of instruction

Text Books

1. Cellular and Molecular Immunology: 7th Updated Edition by **Abul K. Abbas**
Andrew H. Lichtman & Shiv Pillai
2. **Kuby Immunology**. 4th Edition by W. H. Freeman & Co., 2000.

Definition

The word “**immunis**” (adjective) :
free or exempt from taxes or public service

and “**immunitas**” (Noun) means exemption from government taxes and this provided the English terminology **Immunity**.

- **Immunity** is a broad definition: This is a protective or defense mechanism of our body, which leads us to a healthy life.

Immunology

- **Immunology:**
 - Study of the **molecules, cells, organs**, and **systems** responsible for the recognition and disposal of foreign (non-self) material
 - Study of the **MECHANISMS** that protect an individual from injury due to:
 - Exogenous microorganisms – bacteria, fungi, viruses
 - Exogenous chemicals – pollen, poison ivy, etc.
 - Endogenous cells – malignant or senescent cells
 - **IMMUNE RESPONSE:** Broad range of defense mechanisms including inflammation, phagocytosis, antibody synthesis, etc.

Lecture 2
BT 304
2 Aug 2023

First some key definitions:

Pathogen: microbe that causes disease

Antigen: material (from a pathogen) that induces an immune response

Innate (natural) immunity: rapid, non-specific immune response

Adaptive (acquired) immunity: slower, specific immune response

Leukocytes: blood cells

Lymphocytes: specialized blood cells that mediate adaptive immunity (e.g. T and B cells)

Edward Jenner, “ the founder of modern immunology”

**1796- Introduction of protective vaccine against the small pox:
based on cow pox (in Latin - vaccinia)**



A Short History of Immunology

- ~ 430 B.C: Peloponesian War, **Thucydides** describes about plague disease – the ones who had recovered from the plague disease could nurse the sick one suffering from plague without getting the disease a second time
- 15th century: **Chinese and Turks** use dried crusts of smallpox as "vaccine"
- 1798: **Edward Jenner** – smallpox vaccine

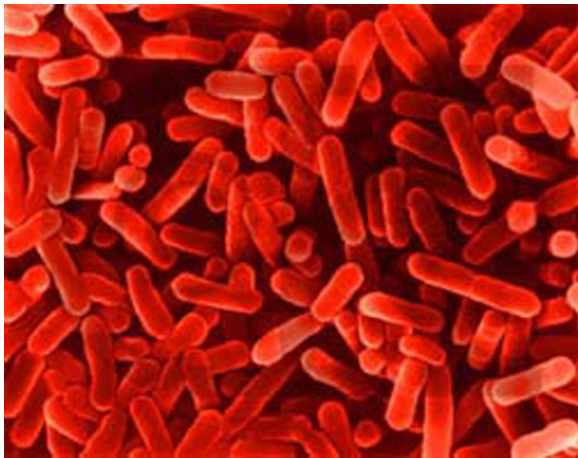
Jenner - Smallpox vaccine

- Noticed that milkmaidens that had contracted cowpox did NOT get smallpox
- Test on an 8 year old boy, injected cowpox into him (NOT very nice.....)
- Followed by exposure to smallpox
- Vaccine was invented (latin *vacca* means "cow")

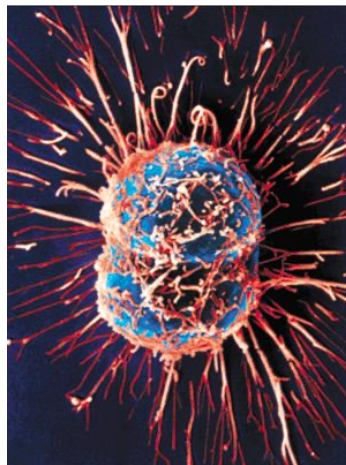


What is the immune system?

- The body's defense against disease causing organisms, malfunctioning cells, and foreign particles



Organisms



Malfunctioning cell

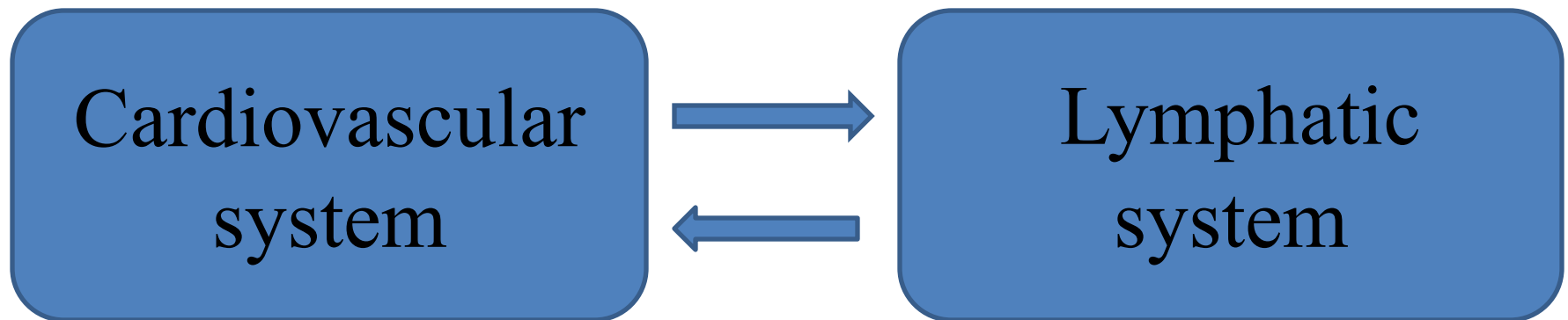


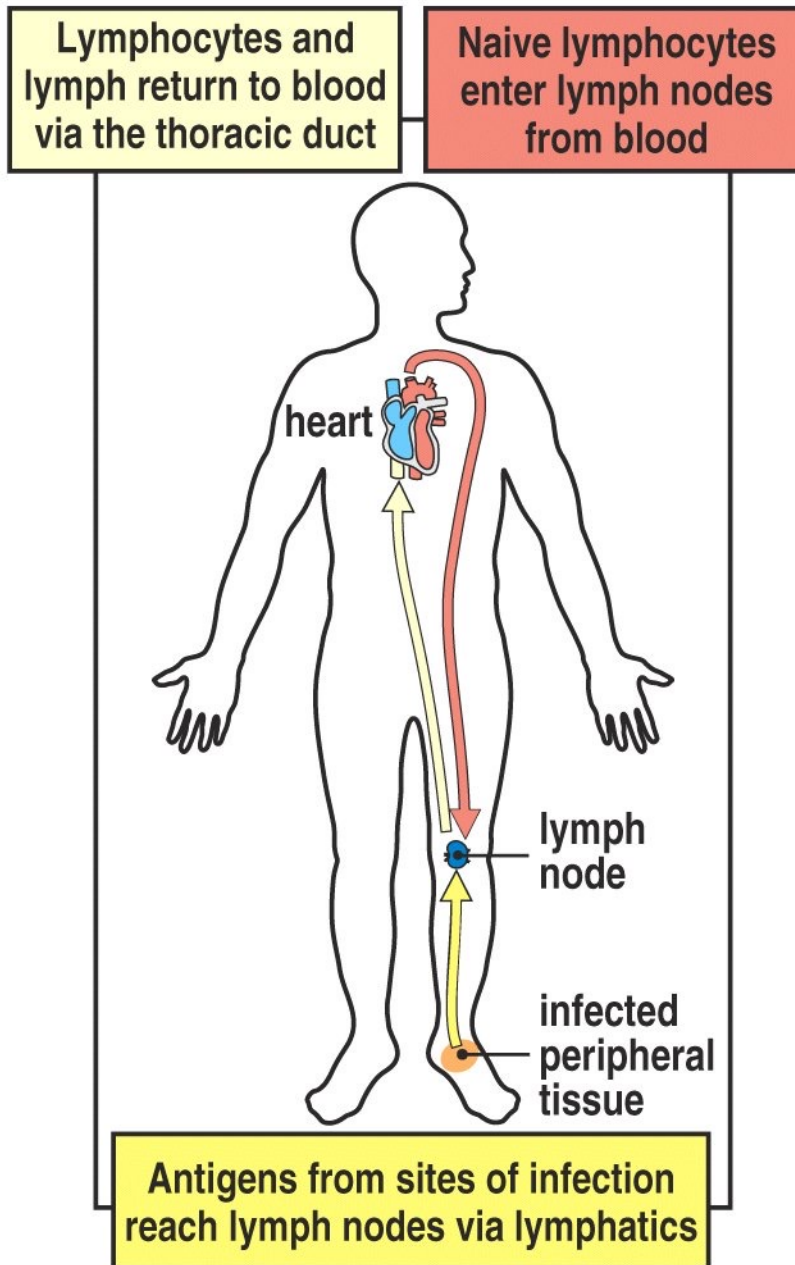
Foreign particles

Why study the immune system?

- Importance of the immune system in human health
- Provides model systems for studies of:
 - gene regulation
 - molecular recognition
 - signal transduction etc
- Provides powerful techniques for use in medicine and science

Circulatory system

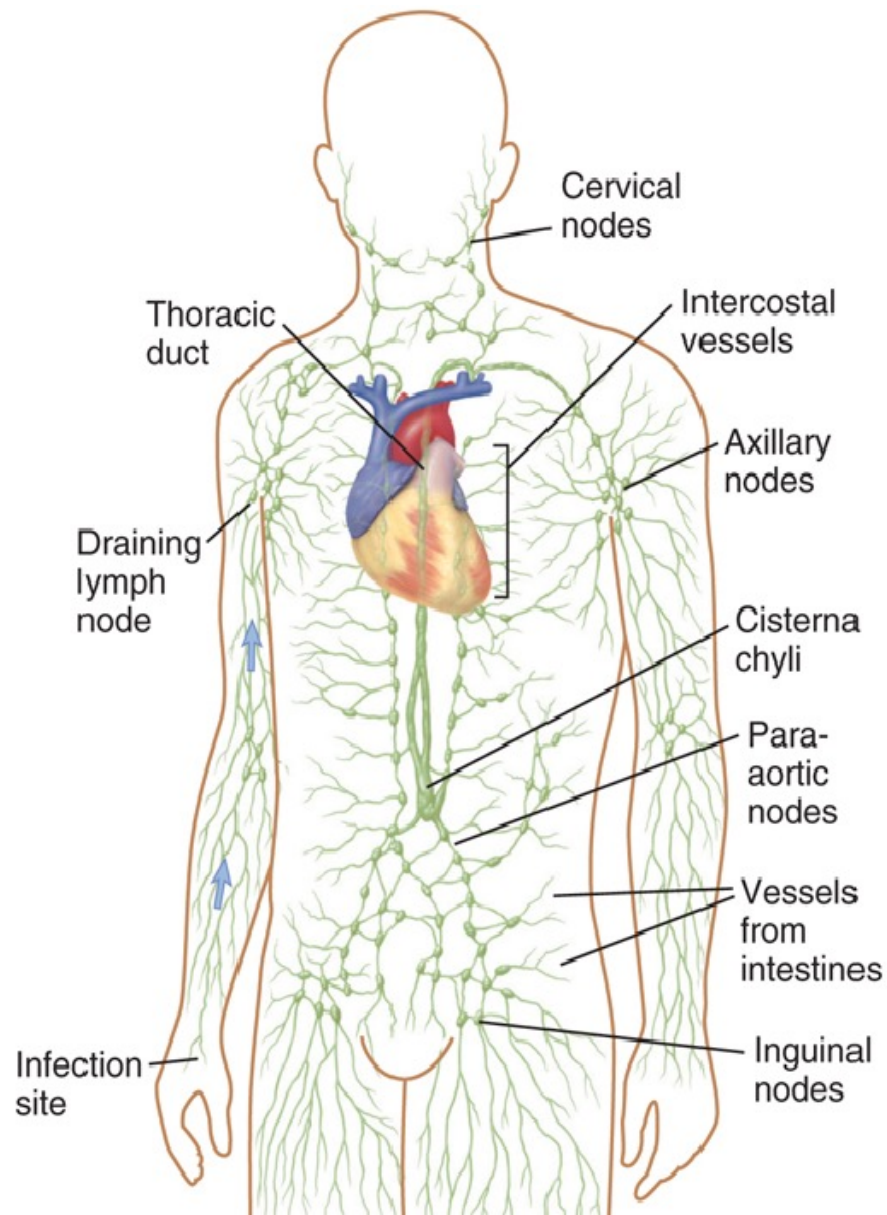




- The cells of the immune system circulate through the body via lymph and blood.
- Pathogens and their antigens are transported from tissues via lymphatic vessels to the lymph nodes where they encounter immune cells.

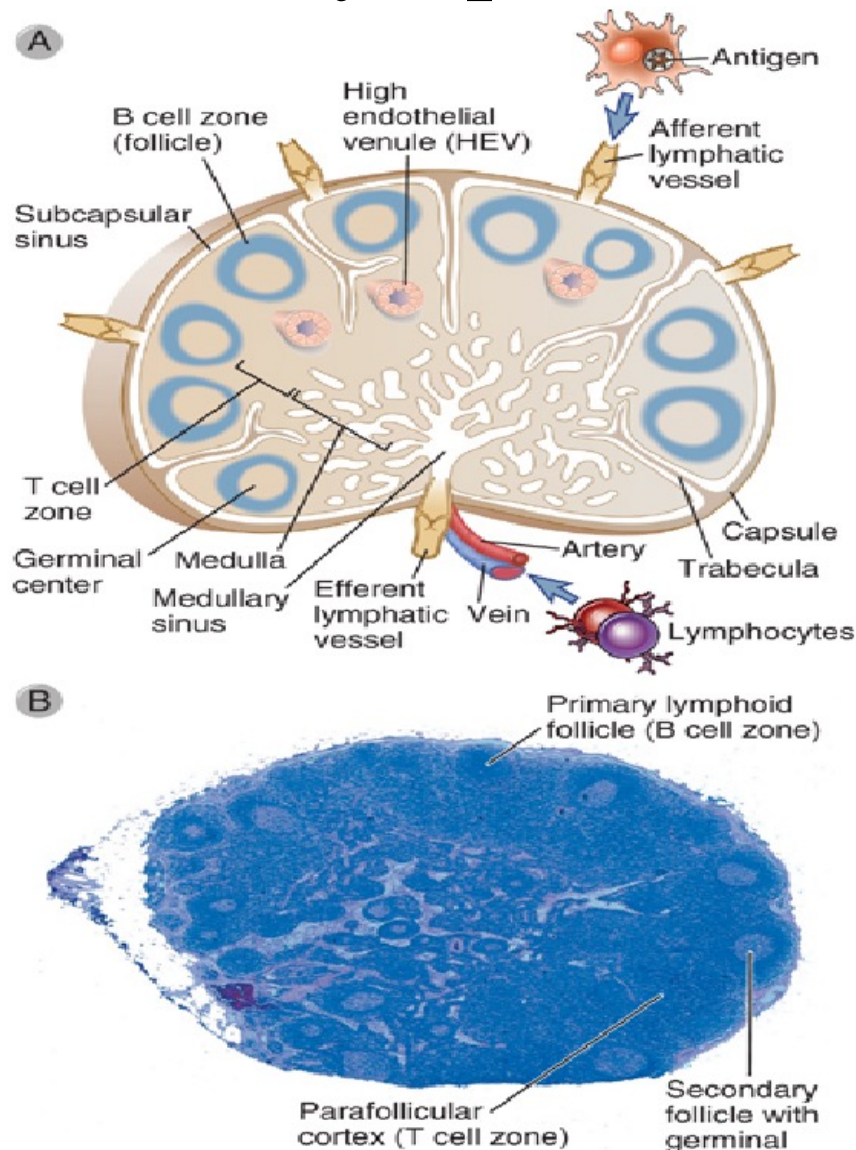
Figure 1-11 Immunobiology, 6/e. (© Garland Science 2005)

Lymph Node distribution in body



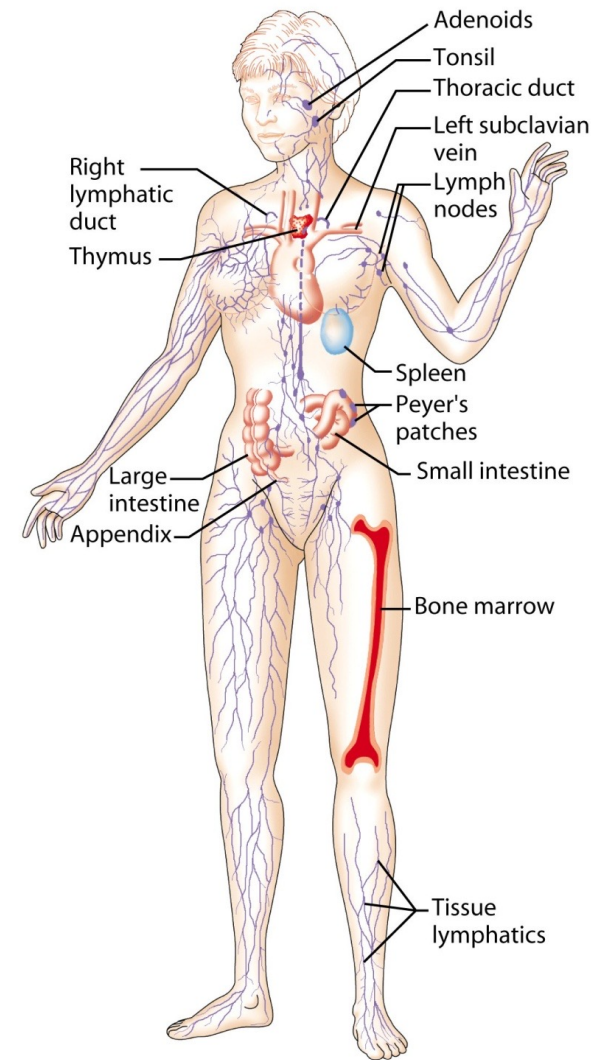
Lecture 3
BT304
3 Aug 2023

Lymph Node structure



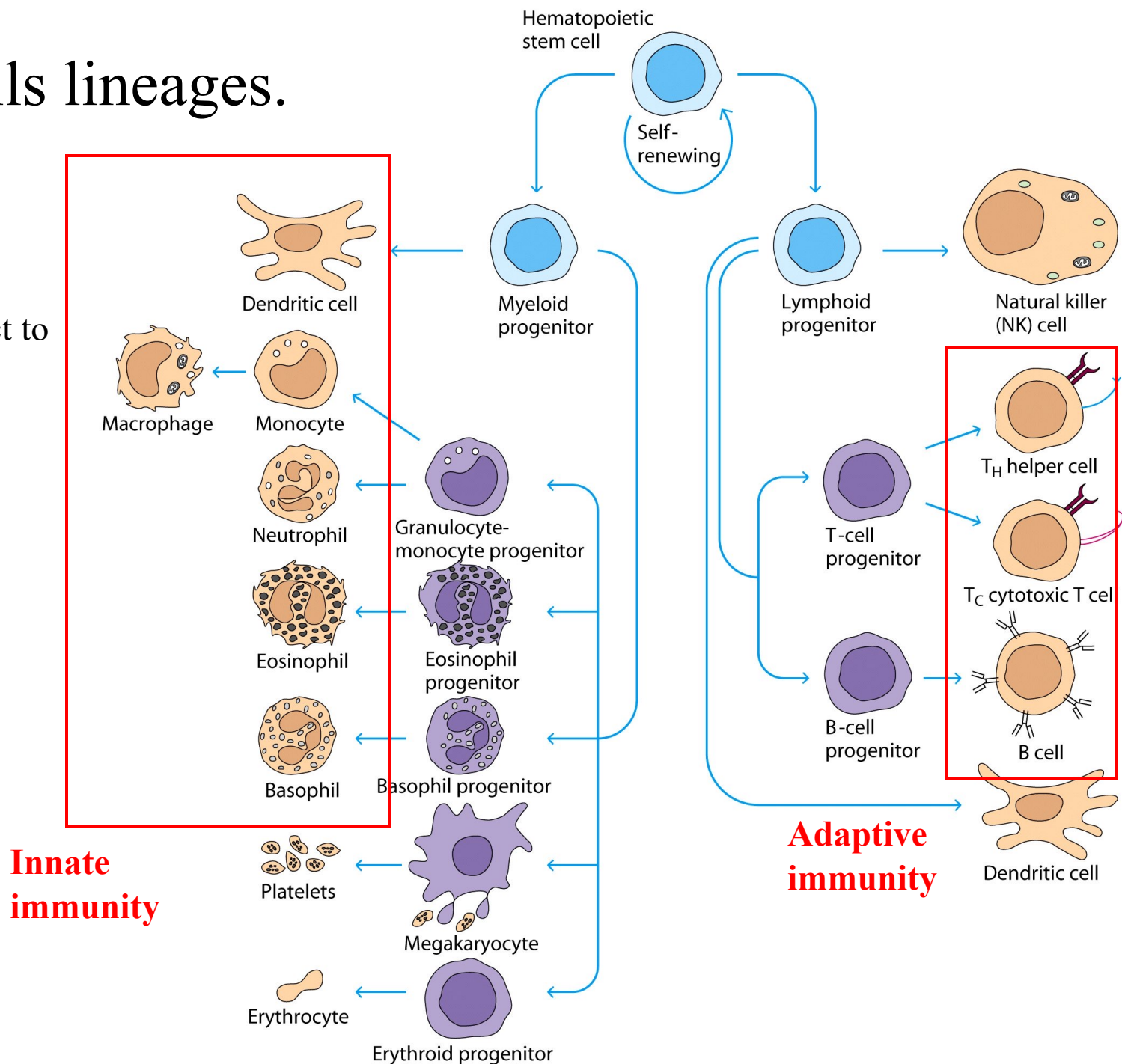
High endothelial venules (HEV) are specialized post-[capillary](#) venous swellings characterized by plump endothelial cells as opposed to the usual thinner [endothelial cells](#) found in regular [venules](#). HEVs enable [lymphocytes](#) circulating in the blood to directly enter a lymph node (by crossing through the HEV)

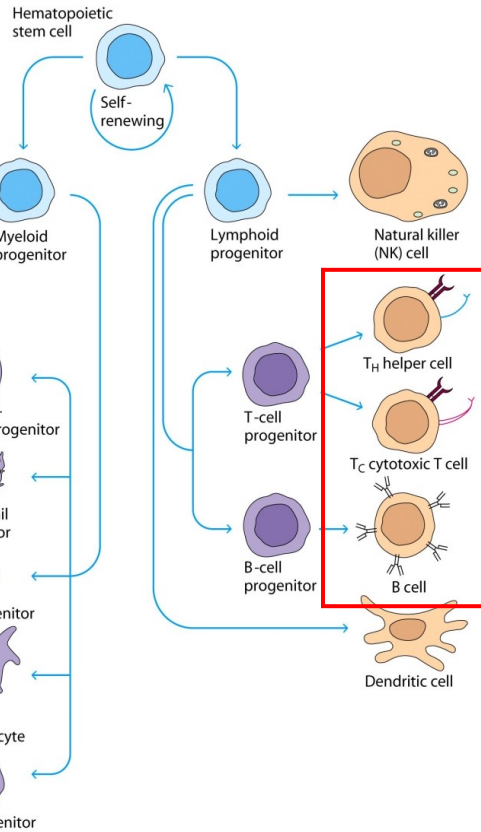
- The cells of the immune system spend much of their time in lymphoid organs.
- They develop (arise) in **primary lymphoid organs**, and they interact with antigens in **secondary lymphoid organs**.
- **Thymus**: primary lymphoid organ for T cell development
- **Bone marrow**: primary lymphoid organ for B cell development
- **Lymph nodes**: collect antigens from tissues
- **Spleen**: collects antigens from blood stream



Blood cells lineages.

Most blood cells act to fight infection.





Lymphocytes of the adaptive immune system

T helper cells: regulate other immune cells

T cytotoxic (killer) cells: kill infected cells

B cells: produce antibodies(immunoglobulin)

Dendritic cells and macrophage: directly kill microbes by phagocytosis and other mechanisms. They also help to activate T cells (connection between innate and adaptive immunity)

NK cells are lymphocytes that have characteristics of innate and adaptive immunity.