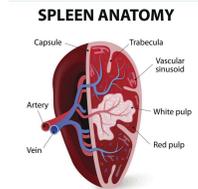


Cells and tissues of the Immune System: The Spleen

Learning Objective 1: Basic Anatomy of the Spleen

Spleen: Immune organ critical for response to blood borne infections

- Attached to the stomach
- ÷ into white and red pulp
- Surrounded by a capsule



- Network of trabeculae ÷ the organ into segments where veins + arteries branch and arterioles extend into the pulp
- Arterioles in the pulp are surrounded by a peri-arteriolar lymphoid sheath (PALS)
- Small arterioles terminate near the marginal zone between the white and red pulp

Red pulp - where RBC are

- Functions as a filtration organ for the removal of senescent RBC + platelets
- Iron recycling
- Removal of bacteria from the blood
- Blood storage
- Antibody production

White Pulp - where WBC are

- Similar to a lymph node but bathed in blood rather than lymph

Learning Objective 2: Filtration Function of the Spleen

- Blood is released into chords of fibroblasts and reticular fibers
- Aging erythrocytes have stiffer membranes and cannot exit the chords into the venous sinus
- Macrophages in these cords phagocytose aged RBC
- When erythrocytes are degraded, iron is released and stored within macrophages
- Anti-bacterial since many invasive pathogens are limited by the bioavailability of iron
- Some bacteria secrete siderophores to collect free iron
- During infection, red pulp macrophages secrete lipocalin-2 which binds siderophores

Learning Objective 3: Macrophage population in the Red Pulp + Marg. zone

Marginal Zone B Cells

↳ A specialized (non-circulating) B cell population

- Express cross-reactive B cell receptors
- Express high levels of toll-like receptors
- T-cell independent
- Can quickly produce low-affinity antibody specific for many bacteria
- Part of the innate immune system

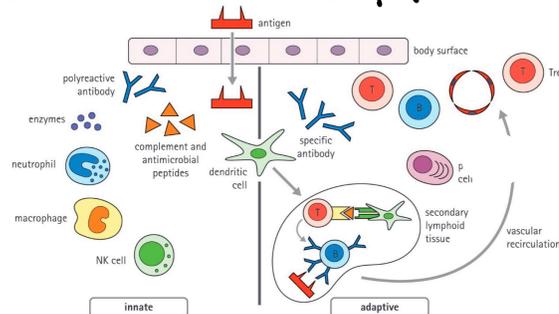
	FD B cell	MZ B cell	B-1 B cell
Primary localization	Secondary lymphoid organs; mainly in B cell follicles	Secondary lymphoid organs; mainly in the splenic marginal zone	Peritoneal and pleural cavities
Distinguishing surface markers	B220 ⁺ , CD19 ⁺ , CD1d ^{lo} , CD21 ⁺ , CD23 ^{hi} , CD43 ⁺ , IgM ^{hi} , IgD ^{hi}	B220 ^{hi} , CD19 ^{hi} , CD1d ^{hi} , CD21 ^{hi} , CD23 ^{lo} , CD43 ⁺ , IgM ^{hi} , IgD ^{lo}	B220 ^{lo} , CD19 ^{hi} , CD1d ⁺ , CD23 ⁺ , CD43 ⁺ , IgM ^{hi} , IgD ^{lo}
Principal function	Participation in T-dependent immune responses	Housekeeping function (natural IgM), first responders to blood-borne pathogens	Housekeeping function (natural IgM), first responders to mucosal pathogens

Learning Objective 4+5: Innate + adaptive immune response in the Spleen

Innate: Pathogens in the bloodstream get deposited into the marginal zone where macrophages + B cells can be activated via primitive receptors that recognize pathogen products like LPS

• Initiates a rapid inflammatory response that recruits more phagocytes and allows marginal

zone B cells to secrete antibodies



Adaptive: Dendritic cells in the Marginal zone become activated and move into the T cell area of the white pulp

- Naive T cells are activated to proliferate and develop effector functions
- Some of these T cells assist B cells to form a germinal center

Learning Objective 6: Iron recycling and Hematopoiesis

• Macrophages in the red pulp engulf RBC and recycle iron making sure that iron availability is low for blood borne pathogens

Extramedullary Hematopoiesis: formation of blood cells outside the bone marrow (typically spleen + liver)

• Occurs in fetal development, hypoxia, some immune responses, and in some disease states