

Vaccination

Induces active immunity +
immunological memory

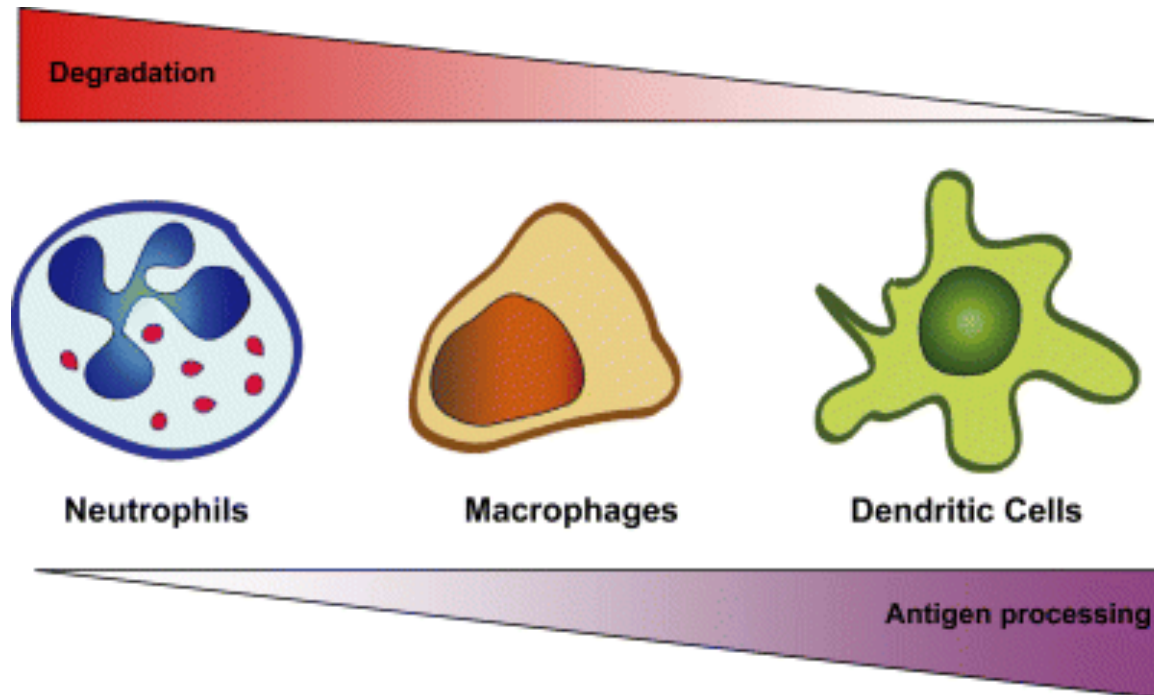
- ***Innate immunity*** refers to **nonspecific defense** mechanisms that come into play **immediately or within hours** of an antigen's appearance in the body.
- ***Adaptive immunity (also “acquired immunity”)*** refers to an **antigen-specific immune response**, which is tailored to the specific invader/antigen.

Parts of the innate immune system

Examples

- Skin and mucous membranes (Physical/Chemical barriers)
- Hair-like structures in the lung (cilia)
- Body fluids like tears, sweat, urine
- Proteins (Enzymes)
- Phagocytotic cells (Granulocytes, Macrophages, Dendritic cells)

Cells of the innate immune system



Neutrophils: high destructive capacity, conservation of peptides from microorganisms is compromised

Dendritic cells: degrade proteins inefficiently, thus preserving the antigenic information contained in peptides.

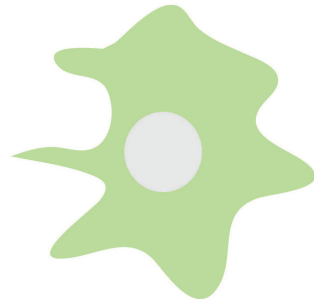
Macrophages eliminate pathogens efficiently but to a certain degree they can process antigens to stimulate T-cells

Savina and Amigorena (2007) *Immunological Reviews* **219**:143-156

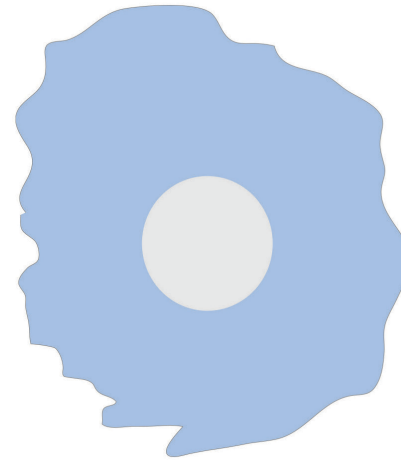
Innate immune response

- Cells of the innate immune system cells that mediate connection to the adaptive immune system.

Dendritic cell



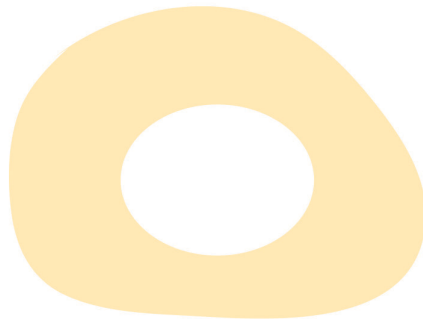
Macrophage



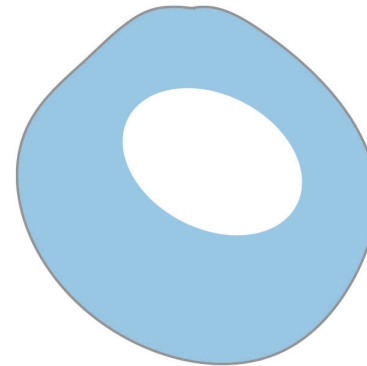
Adaptive immune response

- Functional important cell types

B cell



T cell

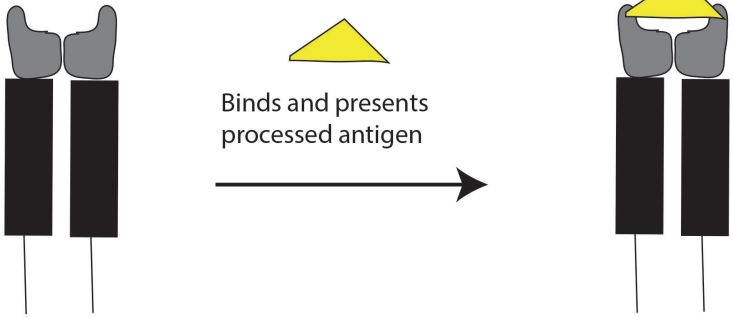
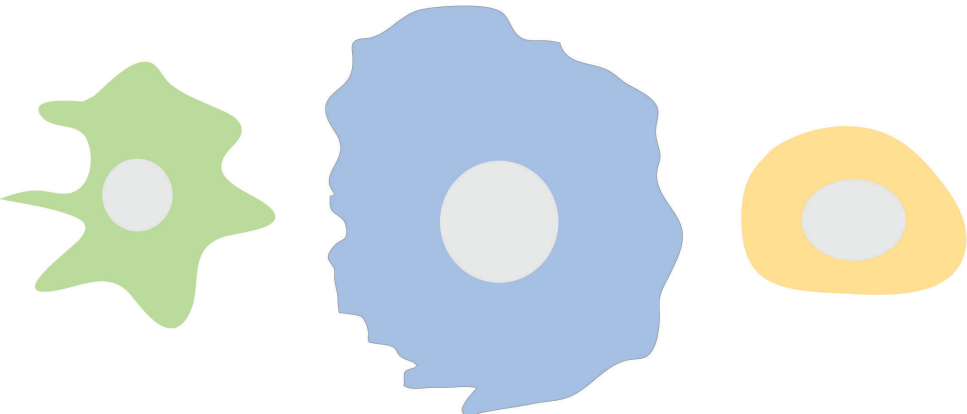


Antigen presenting cells

Dendritic cell

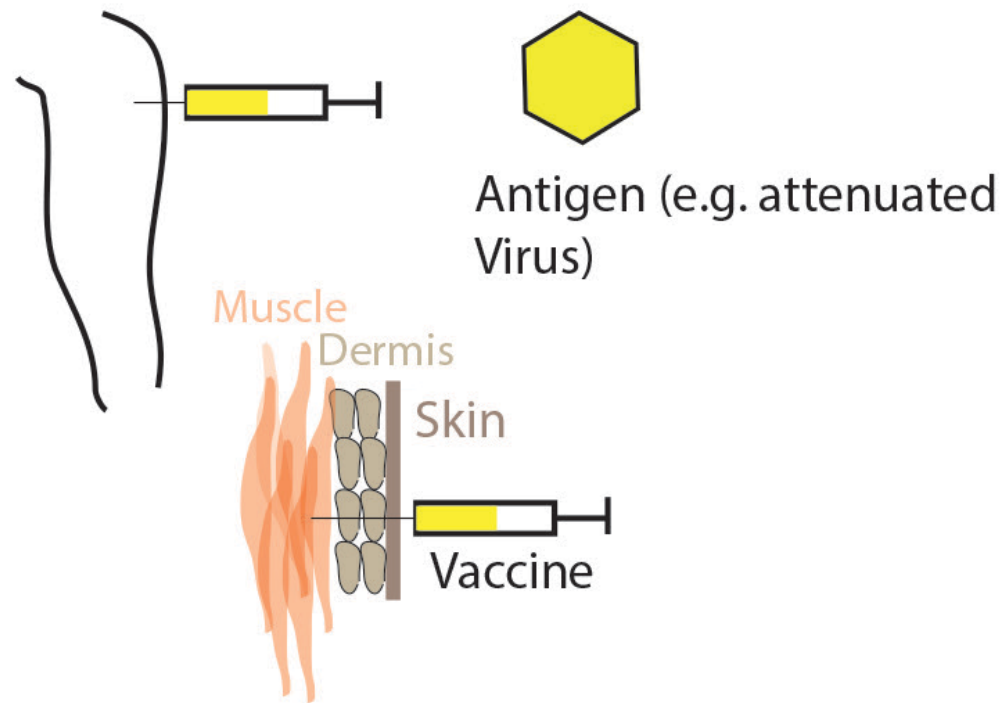
Macrophage

B cell



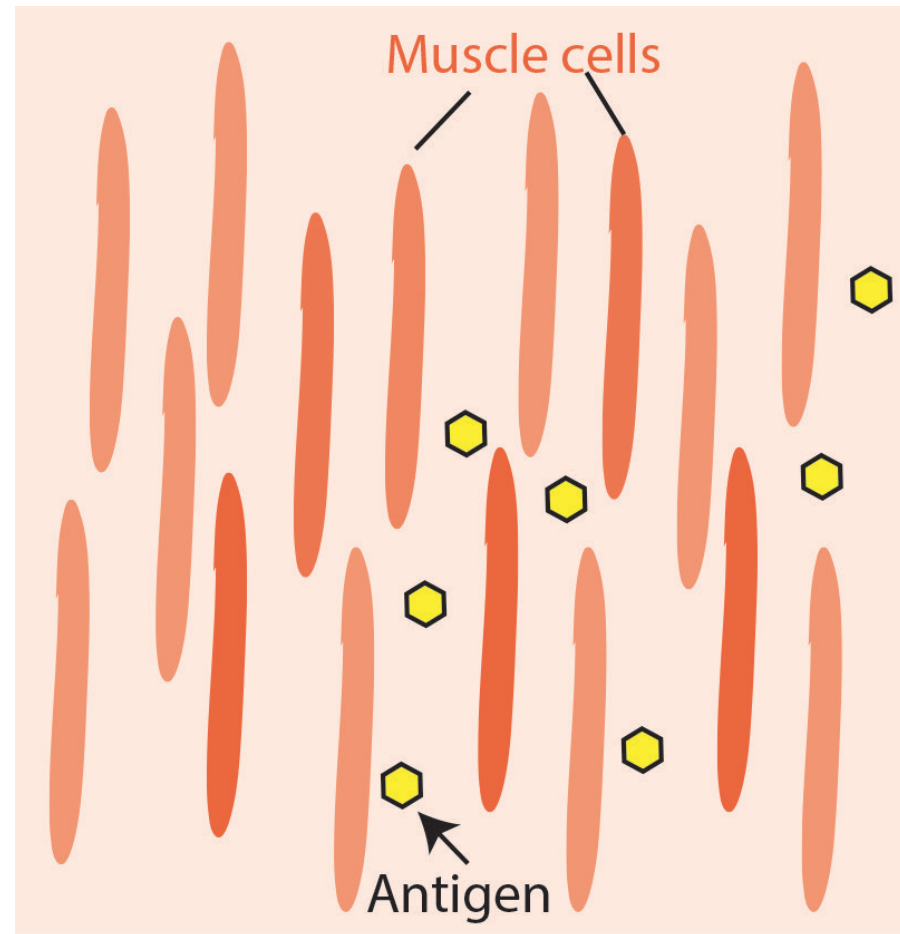
Major histocompatibility complex (MHC, class II)

Vaccination

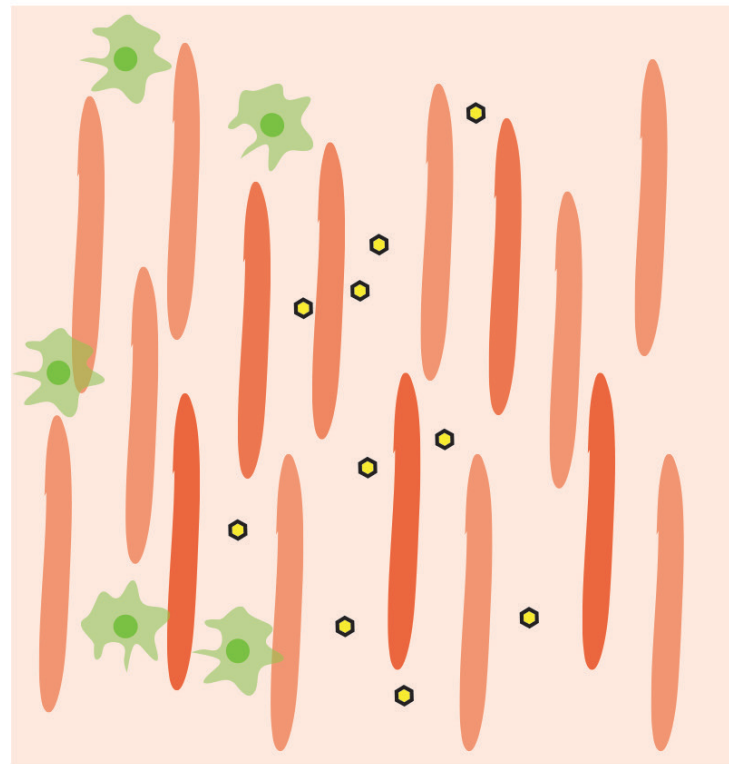


When vaccine enters the body it triggers an inflammatory reaction, initially mediated by the non-specific (innate) immune system

Vaccine injected into skeletal muscle tissue



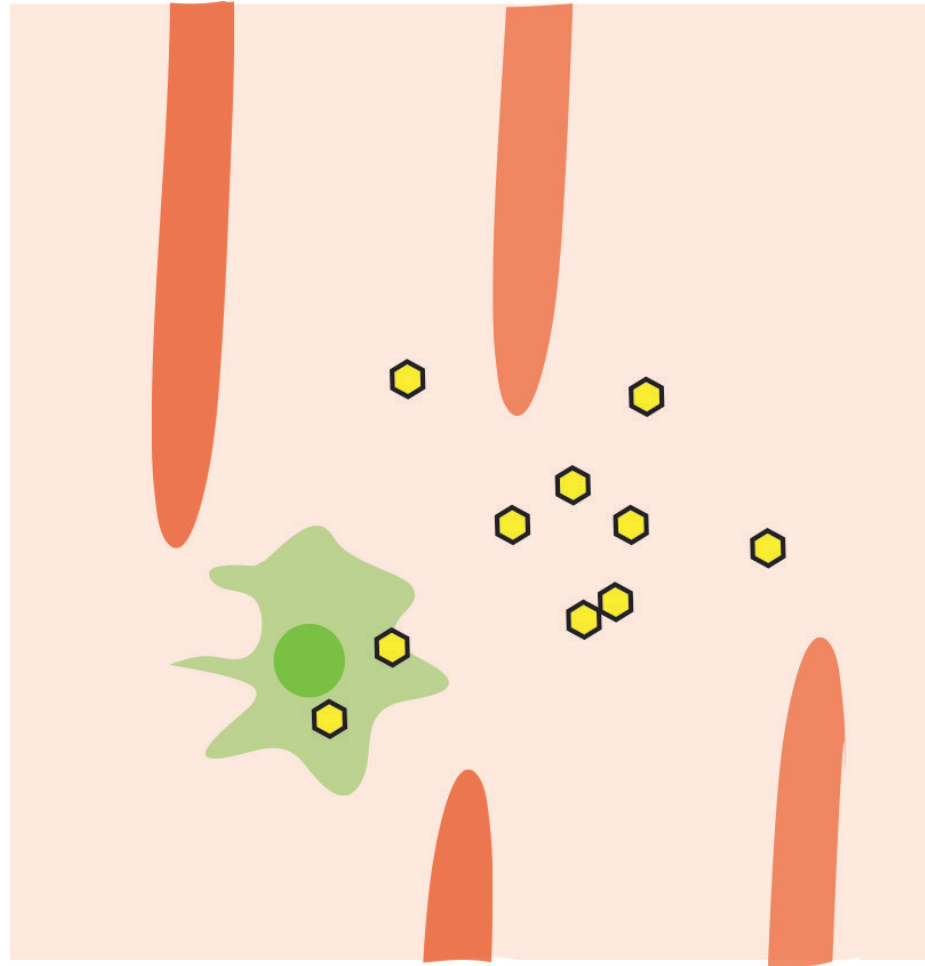
Dendritic cells are attracted to the antigen



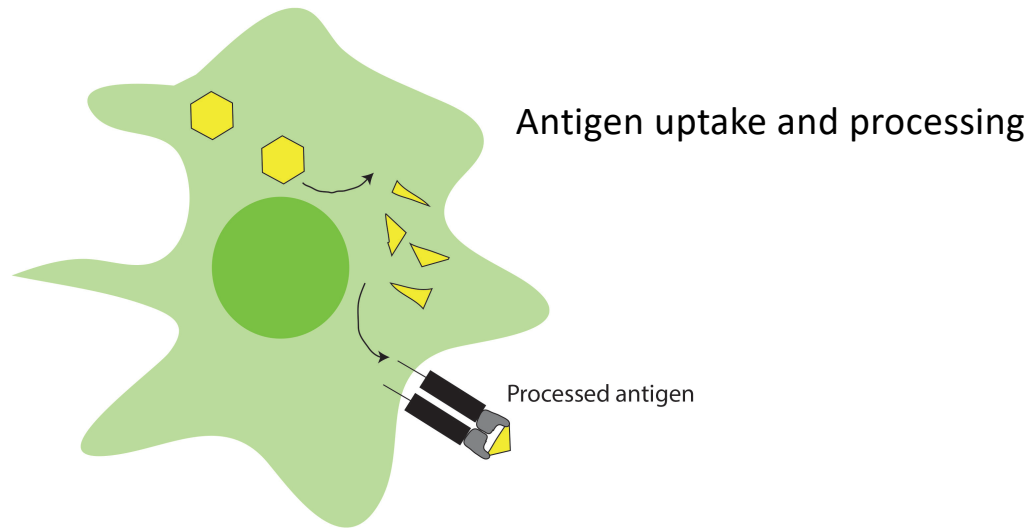
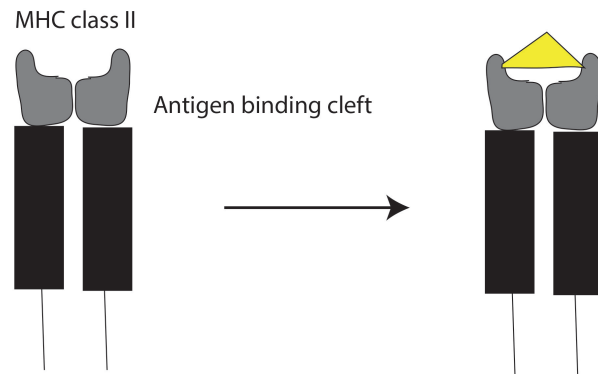
 Dendritic cell (Antigen presenting cell: APC)

 Antigen

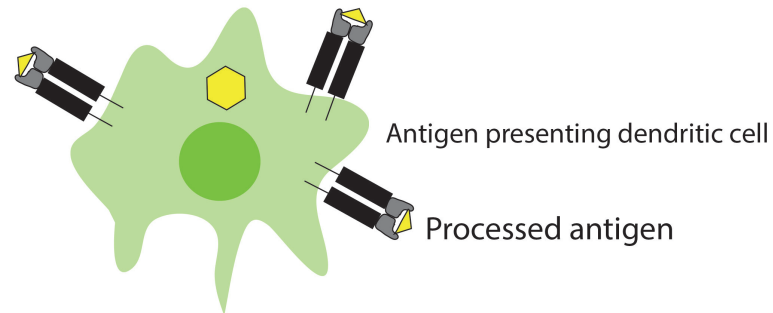
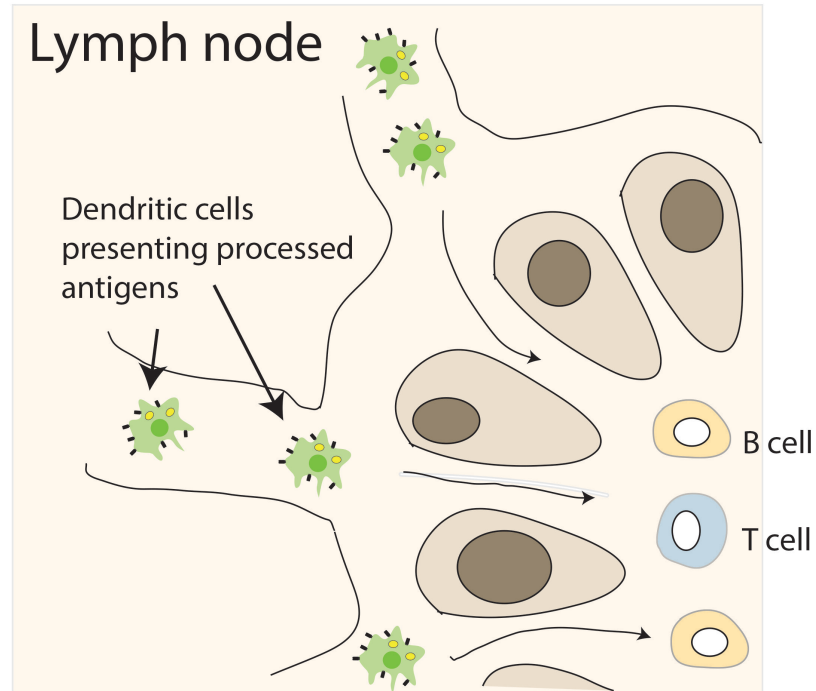
Antigens are taken up by the dendritic cells



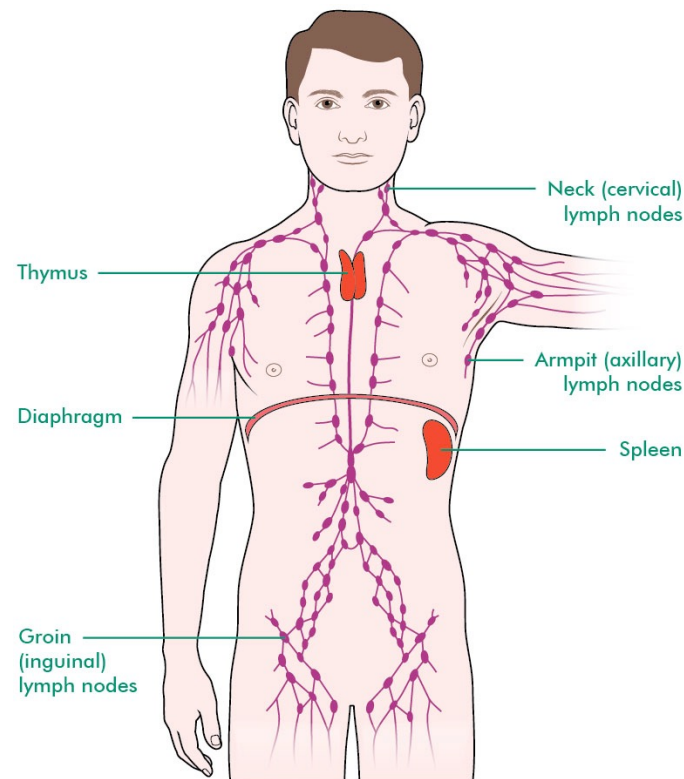
Dendritic cells present processed antigen on the surface and migrate to the lymph nodes



Dendritic cells migrate to lymph nodes to activate T-cells

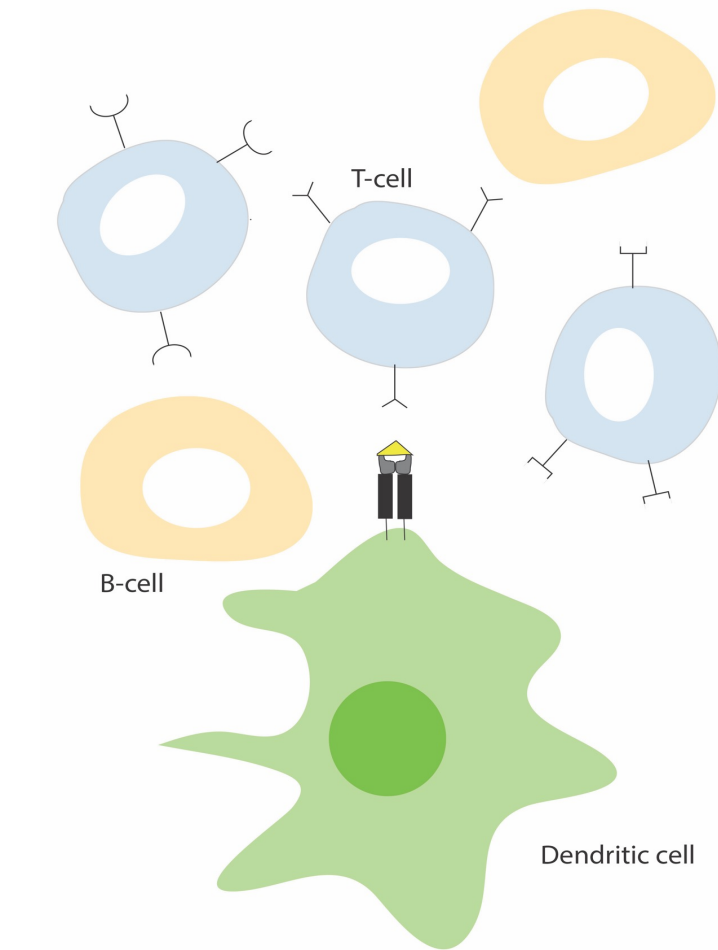


Human lymph nodes

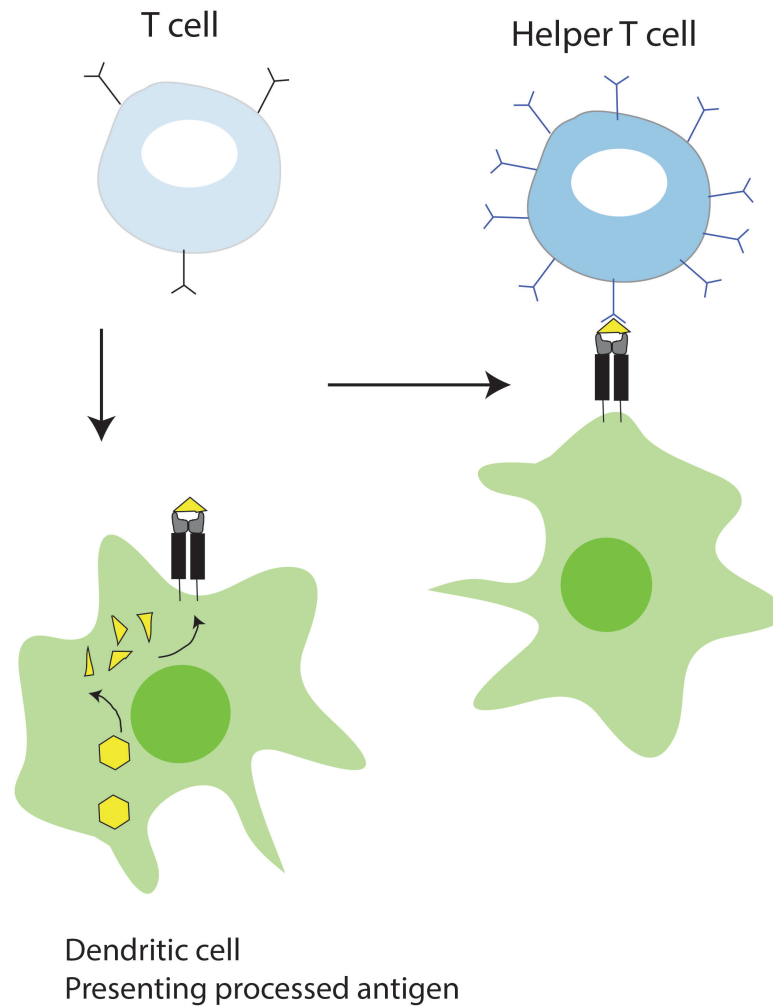


Lymph node: A small bean-shaped structure that is part of the body's immune system. They contain lymphocytes (white blood cells) that help the body fight infection and disease. There are hundreds of lymph nodes (500-600) found throughout the body. They are connected to one another by lymph vessels.

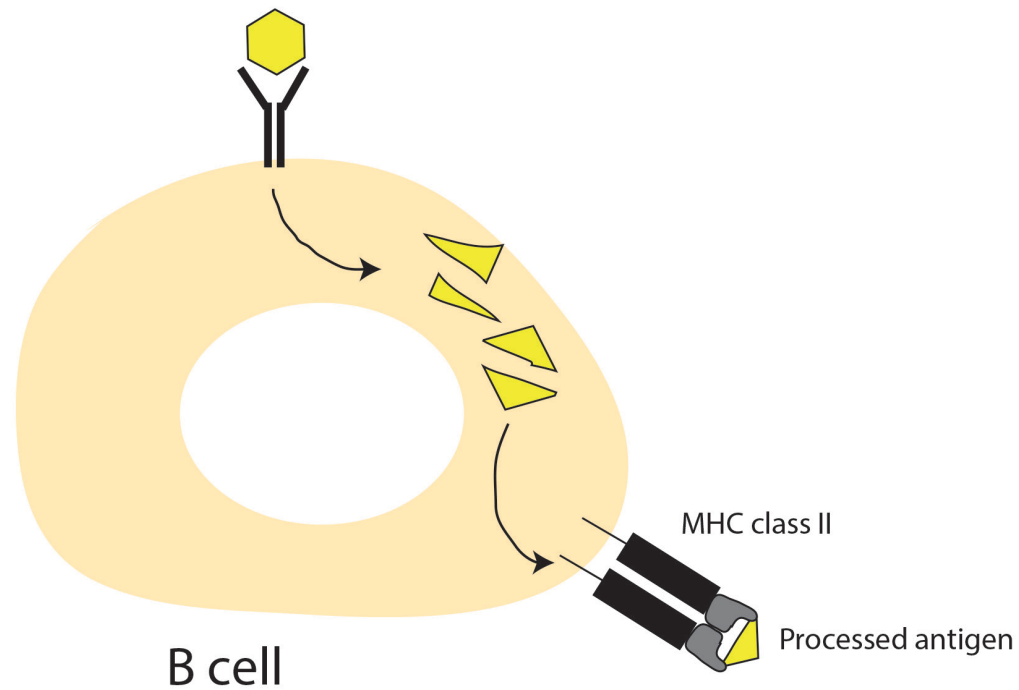
Selection of T cell with complementary T-cell receptor, recognizing the antigen fragment presented on dendritic cell surface



T cell activation in lymph node, to become a helper T cell

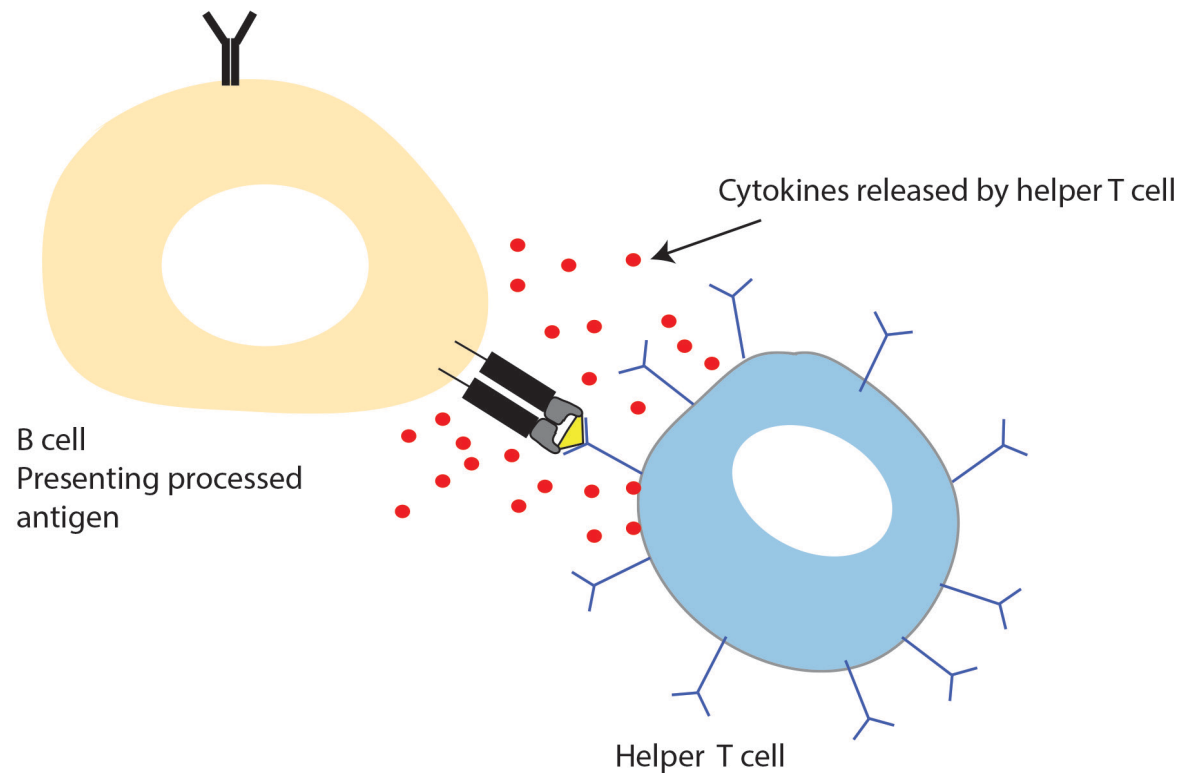


B cells pick up the antigen by their surface immunoglobulin, process it and present it on the cell surface



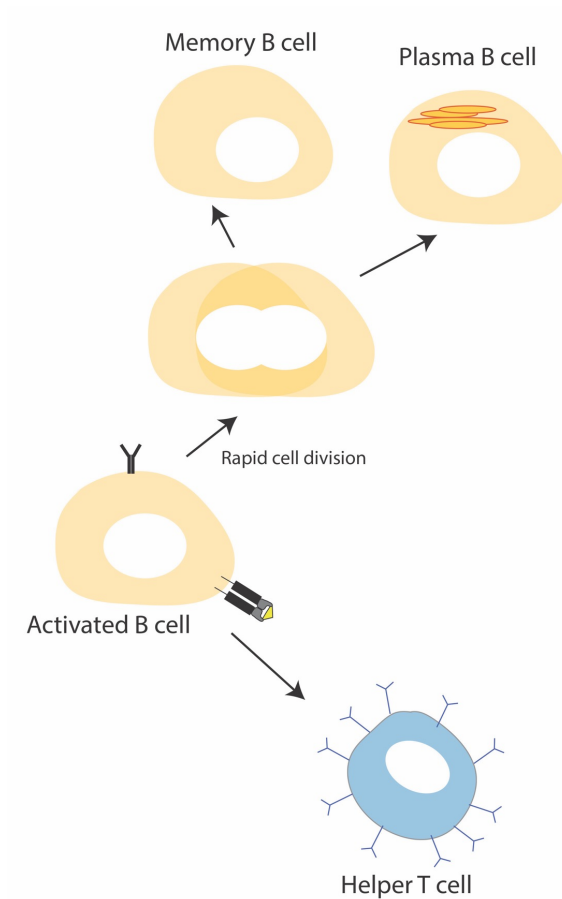
There are approximately 10 billion types of immature B cells, each carrying a unique immunoglobulin on its surface that can bind only one specific antigen

Helper T cell binds to the antigen on the B cell and then releases cytokines that stimulate the B cell (in lymph nodes)



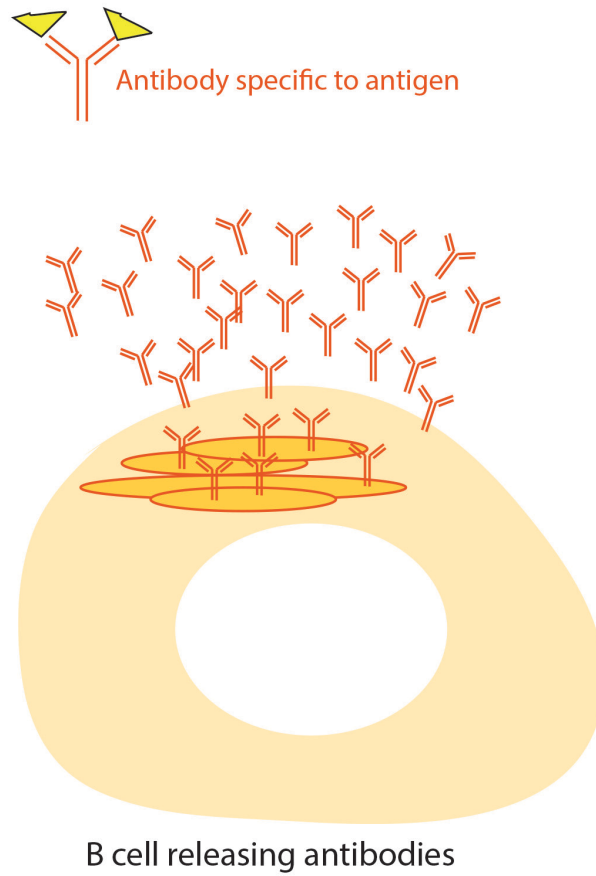
Cytokines are small signaling proteins (5-20 kDa), (e. g interleukins)

Activated B cells undergo rapid proliferation into plasma cells and memory B cells

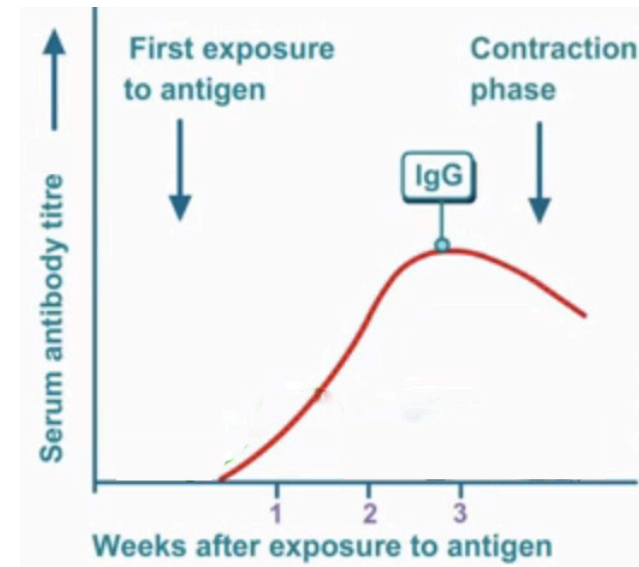
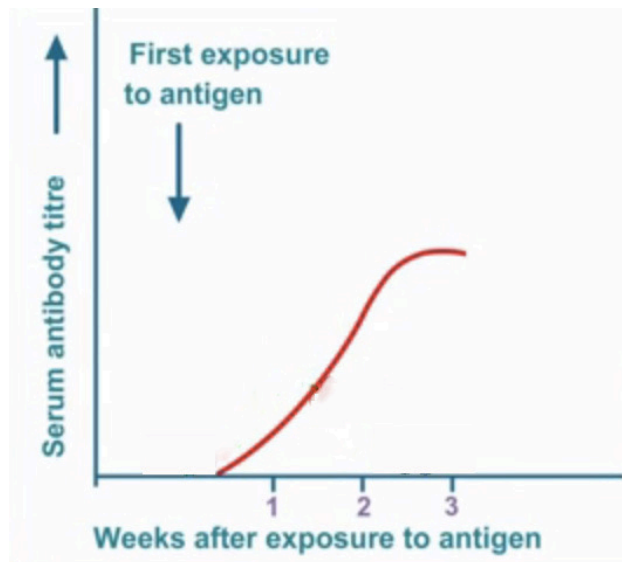


One B cell can produce thousands of daughter cells

Plasma B cells release antibodies against the antigen



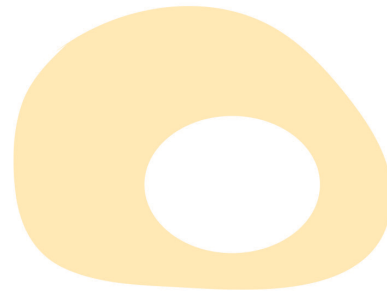
Primary immune response



Plasma cells die off and antibody concentration falls known as contraction phase

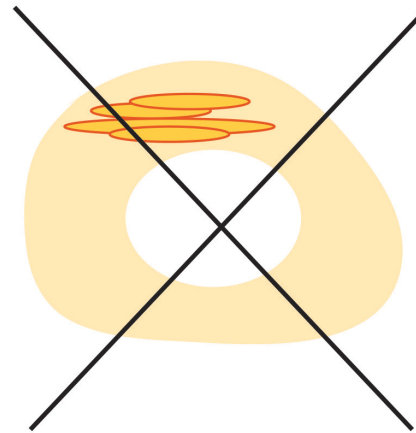
The specific adapted immune system retains memory of the antigen

Memory B cells



Retain memory of the antigen

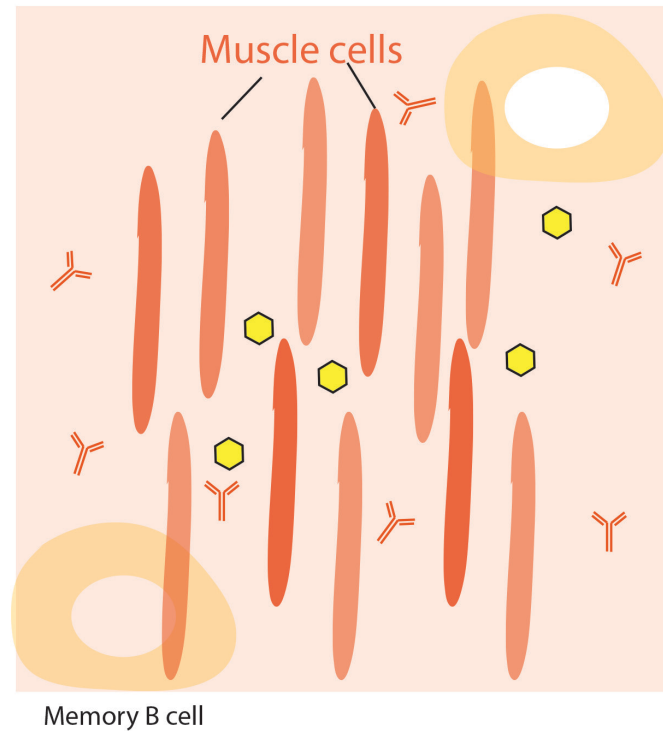
Plasma cells



Die after immune reaction

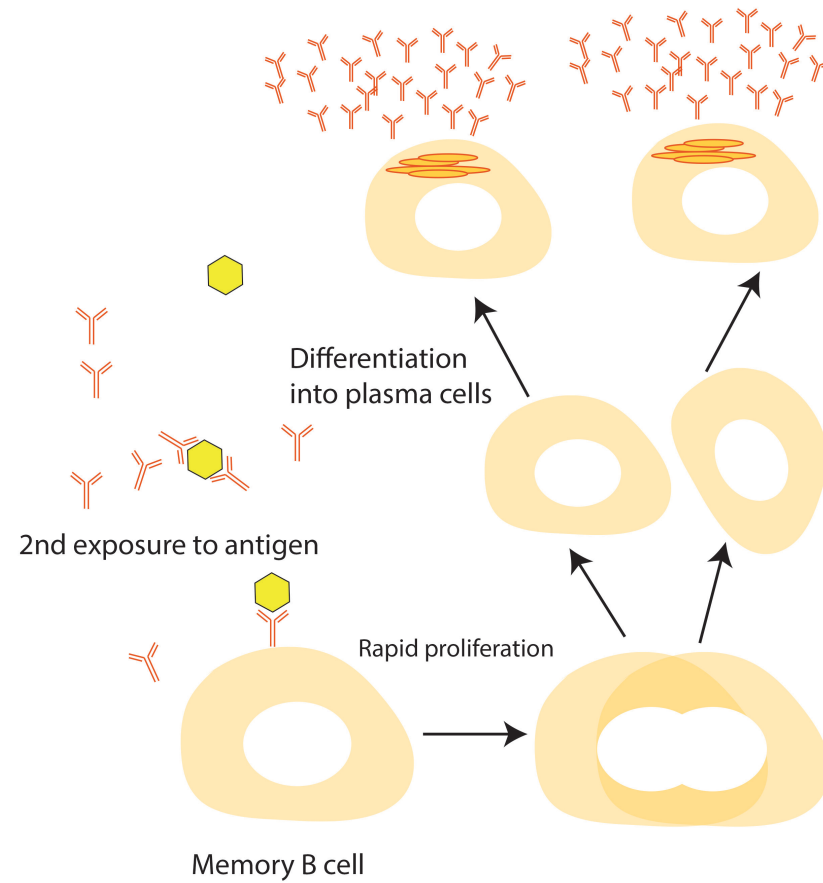
- Memory B cells remain in the bone marrow or circulate between lymph nodes to recognize the antigen again, when it presents itself. They continue to secrete a high affinity antibody against the specific antigen.

When the body is exposed to the same antigen again these high affinity antibodies in the blood bind to it



This signal stimulates other immune cells: secondary response begins

Secondary immune response



Secondary immune response

