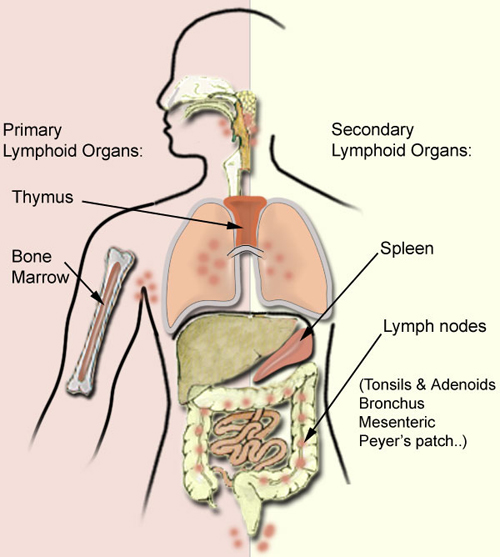
# Immune system:

The **immune system** is a system of biological structures and [processes](http://en.wikipedia.org/wiki/Biological_process) within an [organism](http://en.wikipedia.org/wiki/Organism) that protects against [disease](http://en.wikipedia.org/wiki/Disease). To function properly, an immune system must detect a wide variety of agents, known as [pathogens](http://en.wikipedia.org/wiki/Pathogens), from [viruses](http://en.wikipedia.org/wiki/Virus) to [parasitic worms](http://en.wikipedia.org/wiki/Parasitic_worm), and distinguish them from the organism's own healthy [tissue](http://en.wikipedia.org/wiki/Biological_tissue). In many species, the immune system can be classified into subsystems, such as the [innate immune system](http://en.wikipedia.org/wiki/Innate_immune_system) versus the [adaptive immune system](http://en.wikipedia.org/wiki/Adaptive_immune_system), or [humoral immunity](http://en.wikipedia.org/wiki/Humoral_immunity) versus [cell-mediated immunity](http://en.wikipedia.org/wiki/Cell-mediated_immunity).

Pathogens can rapidly [evolve](http://en.wikipedia.org/wiki/Evolution) and adapt, and thereby avoid detection and neutralization by the immune system; however, multiple defense mechanisms have also evolved to recognize and neutralize pathogens. Even simple [unicellular](http://en.wikipedia.org/wiki/Microorganism) organisms such as [bacteria](http://en.wikipedia.org/wiki/Bacteria)possess a rudimentary immune system, in the form of [enzymes](http://en.wikipedia.org/wiki/Enzyme) that protect against [bacteriophage](http://en.wikipedia.org/wiki/Bacteriophage) infections.

**Lymph organs :**



**Innate immune system:**

The **innate immune system**, also known as the **nonspecific immune system** and the first line of defense, is a subsystem of the overall [immune system](http://en.wikipedia.org/wiki/Immune_system) that comprises the cells and mechanisms that defend the host from infection by other organisms. This means that the cells of the innate system recognize and respond to [pathogens](http://en.wikipedia.org/wiki/Pathogens) in a generic way, but, unlike the [adaptive immune system](http://en.wikipedia.org/wiki/Adaptive_immune_system) (which is found only in [vertebrates](http://en.wikipedia.org/wiki/Vertebrate)), it does not confer long-lasting or protective immunity to the host.[[2]](http://en.wikipedia.org/wiki/Innate_immune_system#cite_note-Alberts-2) Innate immune systems provide immediate defense against infection, and are found in all classes of [plant](http://en.wikipedia.org/wiki/Plant) and [animal](http://en.wikipedia.org/wiki/Animal) life. They include both [humoral immunity](http://en.wikipedia.org/wiki/Humoral_immunity) components and [cell-mediated immunity](http://en.wikipedia.org/wiki/Cell-mediated_immunity) components.

**Anatomical barriers:**

Anatomical barriers include **physical, chemical** and **biological barriers**.

**1**-The epithelial surfaces form a physical barrier that is impermeable to most infectious agents, acting as the first line of defense against invading organisms. The skin and respiratory tract secrete [antimicrobial peptides](http://en.wikipedia.org/wiki/Antimicrobial_peptides) such as the β-[defensins](http://en.wikipedia.org/wiki/Defensin) **2**-[Desquamation](http://en.wikipedia.org/wiki/Desquamation) of skin epithelium also helps remove bacteria and other infectious agents that have adhered to the epithelial surfaces. Lack of blood vessels and inability of the epidermis to retain moisture

**3**- presence of sebaceous glands in the dermis provides an environment unsuitable for the survival of microbes.

**4**- In the gastrointestinal and [respiratory tract](http://en.wikipedia.org/wiki/Respiratory_tract), movement due to peristalsis or cilia, respectively, helps remove infectious agents. Also, [mucus](http://en.wikipedia.org/wiki/Mucus) traps infectious agents.[[4]](http://en.wikipedia.org/wiki/Innate_immune_system#cite_note-Mayer-4) The [gut flora](http://en.wikipedia.org/wiki/Gut_flora) can prevent the colonization of pathogenic bacteria by secreting toxic substances or by competing with pathogenic bacteria for nutrients or attachment to cell surfaces or by changing the conditions in their environment, such as [pH](http://en.wikipedia.org/wiki/PH) or available iron. **5**-The flushing action of tears and saliva helps prevent infection of the eyes and mouth.  [Enzymes](http://en.wikipedia.org/wiki/Enzyme) such as [lysozyme](http://en.wikipedia.org/wiki/Lysozyme)  and [phospholipase](http://en.wikipedia.org/wiki/Phospholipase_A2) in [saliva](http://en.wikipedia.org/wiki/Saliva), tears, and [breast milk](http://en.wikipedia.org/wiki/Breast_milk) are also [antibacterials](http://en.wikipedia.org/wiki/Antiseptic).

**Anatomical barrier** **with** **defense mechanisms**:

|  |  |
| --- | --- |
| **Anatomical barrier** | **Additional defense mechanisms** |
| [Skin](http://en.wikipedia.org/wiki/Skin) | Sweat, desquamation, flushing, organic acids |
| [Gastrointestinal tract](http://en.wikipedia.org/wiki/Gastrointestinal_tract) | [Peristalsis](http://en.wikipedia.org/wiki/Peristalsis), [gastric acid](http://en.wikipedia.org/wiki/Gastric_acid), [bile acids](http://en.wikipedia.org/wiki/Bile_acid), [digestive enzyme](http://en.wikipedia.org/wiki/Digestive_enzyme),flushing, [thiocyanate](http://en.wikipedia.org/wiki/Thiocyanate), [defensins](http://en.wikipedia.org/wiki/Defensin), [gut flora](http://en.wikipedia.org/wiki/Gut_flora) |
| [Respiratory airways](http://en.wikipedia.org/wiki/Respiratory_airways) and [lungs](http://en.wikipedia.org/wiki/Lungs) | Mucociliary elevator, [surfactant](http://en.wikipedia.org/wiki/Pulmonary_surfactant), [defensins](http://en.wikipedia.org/wiki/Defensins) |
| [Nasopharynx](http://en.wikipedia.org/wiki/Nasopharynx) | Mucus, saliva, [lysozyme](http://en.wikipedia.org/wiki/Lysozyme) |
| [Eyes](http://en.wikipedia.org/wiki/Human_eye) | Tears |

**Cellular barriers:**

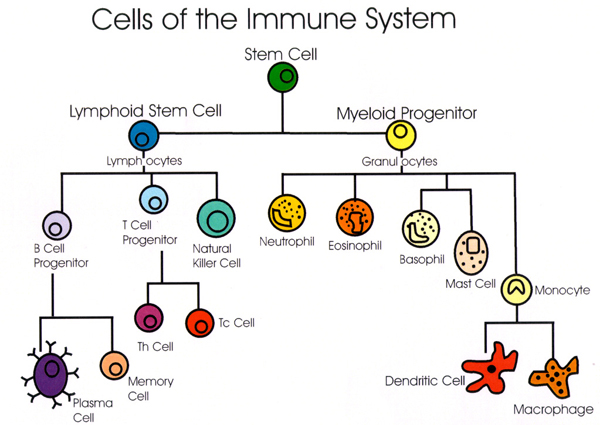
**Leukocytes (**[**white blood cells**](http://en.wikipedia.org/wiki/White_blood_cell)) are the second arm of the innate immune system.[[14]](http://en.wikipedia.org/wiki/Immune_system#cite_note-Alberts-14) The innate leukocytes include the [**phagocytes**](http://en.wikipedia.org/wiki/Phagocyte)**(**[**macrophages**](http://en.wikipedia.org/wiki/Macrophage)**,**[**neutrophils**](http://en.wikipedia.org/wiki/Neutrophil_granulocyte)**, and**[**dendritic cells**](http://en.wikipedia.org/wiki/Dendritic_cell)**),**[**mast cells**](http://en.wikipedia.org/wiki/Mast_cell)**,**[**eosinophils**](http://en.wikipedia.org/wiki/Eosinophil_granulocyte)**,**[**basophils**](http://en.wikipedia.org/wiki/Basophil_granulocyte)**, and**[**natural killer cells**](http://en.wikipedia.org/wiki/Natural_killer_cell). These cells identify and eliminate pathogens, either by attacking larger pathogens through contact or by engulfing and then killing microorganisms.[[35]](http://en.wikipedia.org/wiki/Immune_system#cite_note-Janeway6-35) Innate cells are also important mediators in the activation of the [adaptive immune system](http://en.wikipedia.org/wiki/Adaptive_immune_system).[[12]](http://en.wikipedia.org/wiki/Immune_system#cite_note-USC-12)

[**Phagocytosis**](http://en.wikipedia.org/wiki/Phagocytosis) is an important feature of cellular innate immunity performed by cells called '[**phagocytes**](http://en.wikipedia.org/wiki/Phagocyte)' that engulf, or eat, pathogens or particles. Phagocytes generally patrol the body searching for pathogens, but can be called to specific locations by [**cytokines**](http://en.wikipedia.org/wiki/Cytokine).[[14]](http://en.wikipedia.org/wiki/Immune_system#cite_note-Alberts-14) Once a pathogen has been engulfed by a phagocyte, it becomes trapped in an intracellular [vesicle](http://en.wikipedia.org/wiki/Vesicle_(biology)) called a [**phagosome**](http://en.wikipedia.org/wiki/Phagosome), which subsequently fuses with another vesicle called **a**[**lysosome**](http://en.wikipedia.org/wiki/Lysosome) to form **a**[**phagolysosome**](http://en.wikipedia.org/wiki/Phagolysosome). The pathogen is killed by the activity of digestive [enzymes](http://en.wikipedia.org/wiki/Enzyme) or following a[respiratory burst](http://en.wikipedia.org/wiki/Respiratory_burst) that releases [free radicals](http://en.wikipedia.org/wiki/Radical_(chemistry)) into the phagolysosome. **Phagocytosis** evolved as a means of acquiring [nutrients](http://en.wikipedia.org/wiki/Nutrient), but this role was extended in phagocytes to include engulfment of pathogens as a defense mechanism. Phagocytosis probably represents the oldest form of host defense, as phagocytes have been identified in both vertebrate and invertebrate animals.

**Neutrophils** and macrophages are phagocytes that travel throughout the body in pursuit of invading pathogens.[[](http://en.wikipedia.org/wiki/Immune_system#cite_note-42)  Neutrophils are normally found in the [**bloodstream**](http://en.wikipedia.org/wiki/Circulatory_system) and are the most abundant type of phagocyte, normally representing **50% to 60%** of the total circulating leukocytes. During the acute phase of inflammation, particularly as a result of bacterial infection, neutrophils migrate toward the site of inflammation in a process called **chemotaxis**, and are usually the first cells to arrive at the scene of infection. **Macrophages** are versatile cells that reside within tissues and produce a wide array of chemicals including **enzymes**, [**complement proteins**](http://en.wikipedia.org/wiki/Complement_system), and regulatory factors such as [**interleukin 1**](http://en.wikipedia.org/wiki/Interleukin_1). Macrophages also act as **scavengers**, ridding the body of worn-out cells and other debris, and as [**antigen-presenting cells**](http://en.wikipedia.org/wiki/Antigen-presenting_cell) that activate the adaptive immune system.[[12]](http://en.wikipedia.org/wiki/Immune_system#cite_note-USC-12)

**Dendritic cells (DC)** are phagocytes in tissues that are in contact with the external environment; therefore, they are located mainly in the[skin](http://en.wikipedia.org/wiki/Human_skin), [nose](http://en.wikipedia.org/wiki/Human_nose), [lungs](http://en.wikipedia.org/wiki/Lung), [stomach](http://en.wikipedia.org/wiki/Stomach), and [intestines](http://en.wikipedia.org/wiki/Intestine). They are named for their resemblance to [**neuronal**](http://en.wikipedia.org/wiki/Neuron)[**dendrites**](http://en.wikipedia.org/wiki/Dendrite), as both have many spine-like projections, but dendritic cells are in no way connected to the [nervous system](http://en.wikipedia.org/wiki/Nervous_system). Dendritic cells serve as a link between the bodily tissues and the innate and adaptive immune systems, as they [present antigen](http://en.wikipedia.org/wiki/Antigen_presentation) to [T cells](http://en.wikipedia.org/wiki/T_cell), one of the key cell types of the adaptive immune system.

Mast cells reside in [connective tissues](http://en.wikipedia.org/wiki/Connective_tissue) and [mucous membranes](http://en.wikipedia.org/wiki/Mucous_membrane), and regulate the inflammatory response.[[46]](http://en.wikipedia.org/wiki/Immune_system#cite_note-46) They are most often associated with [allergy](http://en.wikipedia.org/wiki/Allergy) and [anaphylaxis](http://en.wikipedia.org/wiki/Anaphylaxis).[[43]](http://en.wikipedia.org/wiki/Immune_system#cite_note-IandF-43)Basophils and eosinophils are related to neutrophils. They secrete chemical mediators that are involved in defending against [parasites](http://en.wikipedia.org/wiki/Parasitism) and play a role in allergic reactions, such as [asthma](http://en.wikipedia.org/wiki/Asthma).[[47]](http://en.wikipedia.org/wiki/Immune_system#cite_note-47) Natural killer ([NK cells](http://en.wikipedia.org/wiki/NK_cells)) cells are leukocytes that attack and destroy [tumor](http://en.wikipedia.org/wiki/Tumor) cells, or cells that have been infected by viruses.



### Inflammation

Inflammation is one of the first responses of the immune system to infection.[[28]](http://en.wikipedia.org/wiki/Immune_system#cite_note-28) The symptoms of inflammation are redness, swelling, heat, and pain, which are caused by increased [blood](http://en.wikipedia.org/wiki/Blood) flow into tissue. Inflammation is produced by [eicosanoids](http://en.wikipedia.org/wiki/Eicosanoid) and [cytokines](http://en.wikipedia.org/wiki/Cytokine), which are released by injured or infected cells. Eicosanoids include [prostaglandins](http://en.wikipedia.org/wiki/Prostaglandin) that produce [fever](http://en.wikipedia.org/wiki/Fever) and the [dilation](http://en.wikipedia.org/wiki/Vasodilator) of [blood vessels](http://en.wikipedia.org/wiki/Blood_vessel) associated with inflammation, and [leukotrienes](http://en.wikipedia.org/wiki/Leukotriene) that attract certain [white blood cells](http://en.wikipedia.org/wiki/White_blood_cell) (leukocytes). Common cytokines include[interleukins](http://en.wikipedia.org/wiki/Interleukin) that are responsible for communication between white blood cells; [chemokines](http://en.wikipedia.org/wiki/Chemokine) that promote [chemotaxis](http://en.wikipedia.org/wiki/Chemotaxis); and [interferons](http://en.wikipedia.org/wiki/Interferon) that have [anti-viral](http://en.wikipedia.org/wiki/Antiviral_drug) effects, such as shutting down [protein synthesis](http://en.wikipedia.org/wiki/Protein_biosynthesis) in the host cell. [Growth factors](http://en.wikipedia.org/wiki/Growth_factor) and cytotoxic factors may also be released. These cytokines and other chemicals recruit immune cells to the site of infection and promote healing of any damaged tissue following the removal of pathogens. The process of acute inflammation is initiated by cells already present in all tissues, mainly resident [**macrophages**](http://en.wikipedia.org/wiki/Macrophages)**,**[**dendritic cells**](http://en.wikipedia.org/wiki/Dendritic_cells)**, histiocytes, Kupffer cells, and**[**mastocytes**](http://en.wikipedia.org/wiki/Mastocytes). These cells present receptors, contained on the surface or within the cell, named [***pattern recognition receptors***](http://en.wikipedia.org/wiki/Pattern_recognition_receptor)**(PRRs)**, which recognise molecules that are broadly shared by [pathogens](http://en.wikipedia.org/wiki/Pathogen) but distinguishable from host molecules, collectively referred to as [**pathogen-associated molecular patterns**](http://en.wikipedia.org/wiki/Pathogen-associated_molecular_pattern)**(PAMPs)**. At the onset of an infection, burn, or other injuries, these cells undergo activation (one of their **PRR recognize a PAMP**) and release [inflammatory mediators](http://en.wikipedia.org/wiki/Inflammatory_mediators) responsible for the clinical signs of inflammation.

The inflammatory response is characterized by the following symptoms:

* redness
* heat
* swelling
* pain
* possible dysfunction of the organs or tissues involved.

### Complement system

The complement system is a [biochemical cascade](http://en.wikipedia.org/wiki/Biochemical_cascade) that attacks the surfaces of foreign cells. It contains over 20 different proteins and is named for its ability to "complement" the killing of pathogens by [antibodies](http://en.wikipedia.org/wiki/Antibody). Complement is the major [humoral](http://en.wikipedia.org/wiki/Humoral_immunity) component of the innate immune response.[[33]](http://en.wikipedia.org/wiki/Immune_system#cite_note-Rus-33)[[34]](http://en.wikipedia.org/wiki/Immune_system#cite_note-USCcomp-34) Many species have complement systems, including non-[mammals](http://en.wikipedia.org/wiki/Mammal) like plants, fish, and some [invertebrates](http://en.wikipedia.org/wiki/Invertebrate).[[35]](http://en.wikipedia.org/wiki/Immune_system#cite_note-Janeway6-35)

In humans, this response is activated by complement binding to antibodies that have attached to these microbes or the binding of complement proteins to [carbohydrates](http://en.wikipedia.org/wiki/Carbohydrate) on the surfaces of [microbes](http://en.wikipedia.org/wiki/Microbe). This recognition [signal](http://en.wikipedia.org/wiki/Cell_signaling) triggers a rapid killing response.[[36]](http://en.wikipedia.org/wiki/Immune_system#cite_note-36) The speed of the response is a result of signal amplification that occurs following sequential[proteolytic](http://en.wikipedia.org/wiki/Proteolysis) activation of complement molecules, which are also [proteases](http://en.wikipedia.org/wiki/Protease). After complement proteins initially bind to the microbe, they activate their protease activity, which in turn activates other complement proteases, and so on. This produces a [catalytic](http://en.wikipedia.org/wiki/Catalysis) cascade that amplifies the initial signal by controlled [positive feedback](http://en.wikipedia.org/wiki/Positive_feedback).[[37]](http://en.wikipedia.org/wiki/Immune_system#cite_note-37) The cascade results in the production of peptides that attract immune cells, increase [vascular permeability](http://en.wikipedia.org/wiki/Vascular_permeability), and [opsonize](http://en.wikipedia.org/wiki/Opsonin) (coat) the surface of a pathogen, marking it for destruction. This deposition of complement can also kill cells directly by disrupting their [plasma membran](http://en.wikipedia.org/wiki/Cell_membrane)

## Adaptive immune system:*.*

The **adaptive immune system**, also known as the **acquired immunity** or, more rarely, as the **specific immune system**, is a subsystem of the overall [immune system](http://en.wikipedia.org/wiki/Immune_system) that is composed of highly specialized, systemic cells and processes that eliminate or prevent [pathogen](http://en.wikipedia.org/wiki/Pathogen) growth. One of the two main [immunity](http://en.wikipedia.org/wiki/Immunity_(medical)) strategies found in [vertebrates](http://en.wikipedia.org/wiki/Vertebrate) (the other being the [innate immune system](http://en.wikipedia.org/wiki/Innate_immune_system)), acquired immunity creates [immunological memory](http://en.wikipedia.org/wiki/Immunological_memory) after an initial response to a specific pathogen, leading to an enhanced response to subsequent encounters with that same pathogen. This process of acquired immunity is the basis of [**vaccination**](http://en.wikipedia.org/wiki/Vaccination). Like the innate system, the adaptive system includes both [**humoral immunity**](http://en.wikipedia.org/wiki/Humoral_immunity)**components** and [**cell-mediated immunity**](http://en.wikipedia.org/wiki/Cell-mediated_immunity)**components.**

Unlike the innate immune system, the adaptive immune system is highly specific to a specific pathogen. Adaptive immunity can also provide long-lasting protection: for example; someone who recovers from measles is now protected against measles for their lifetime but in other cases it does not provide lifetime protection: for example; chickenpox. The adaptive system response destroys invading pathogens and any toxic molecules they produce. Sometimes the adaptive system is unable to distinguish foreign molecules, the effects of this may be hay fever, asthma or any other allergies. [Antigens](http://en.wikipedia.org/wiki/Antigens) are any substances that elicit the adaptive immune response. The cells that carry out the adaptive immune response are white blood cells known as **lymphocytes**.

**There are two main broad classes:-**

1-**Antibody responses** ([**humoral immunity**](http://en.wikipedia.org/wiki/Humoral_immunity))

2-**Cell mediated immune response** which are also carried by two different lymphocytes (B cells and T cells).

**In antibody responses**, B cells are activated to secrete [antibodies](http://en.wikipedia.org/wiki/Antibodies), which are proteins also known as **immunoglobulins.** Antibodies travel through the bloodstream and bind to the foreign antigen causing it to inactivate, which does not allow the antigen to bind to the host.

**In acquired immunity**, pathogen-specific [receptors](http://en.wikipedia.org/wiki/Immune_receptor) are "acquired" during the lifetime of the organism (whereas in innate immunity pathogen-specific receptors are already encoded in the [germline](http://en.wikipedia.org/wiki/Germline)). The acquired response is said to be "adaptive" because it prepares the body's immune system for future challenges (though it can actually also be [maladaptive](http://en.wikipedia.org/wiki/Maladaptation) when it results in [autoimmunity](http://en.wikipedia.org/wiki/Autoimmunity)).

## Functions:

Acquired immunity is triggered in vertebrates when a pathogen evades the innate immune system and generates a threshold level of antigen and generates "stranger" or "danger" signals activating dendritic cells.

**The major functions of the acquired immune system include:**

* Recognition of specific "non-self" antigens in the presence of "self", during the process of [antigen presentation](http://en.wikipedia.org/wiki/Antigen_presentation).
* Generation of responses that are tailored to maximally eliminate specific pathogens or pathogen-infected cells.
* Development of [immunological memory](http://en.wikipedia.org/wiki/Adaptive_immune_system#Immunological_memory), in which pathogens are "remembered" through memory cells.

## Lymphocytes:

The cells of the acquired immune system are **T** and **B** [lymphocytes](http://en.wikipedia.org/wiki/Lymphocytes); lymphocytes are a subset of [leukocyte](http://en.wikipedia.org/wiki/Leukocyte). [**B cells**](http://en.wikipedia.org/wiki/B_cell) and [**T cells**](http://en.wikipedia.org/wiki/T_cell) are the major types of lymphocytes. The human body has about 2 trillion lymphocytes, constituting 20–40% of white blood cells **(WBCs)**; their total mass is about the same as the [brain](http://en.wikipedia.org/wiki/Brain) or liver. The peripheral blood contains 2% of circulating lymphocytes; the rest move within the tissues and [lymphatic system](http://en.wikipedia.org/wiki/Lymphatic_system).

B cells and T cells are derived from the  [**stem cells**](http://en.wikipedia.org/wiki/Multipotent_hematopoietic_stem_cell) **in the bone marrow,** B cells play a large role in the [**humoral immune response**](http://en.wikipedia.org/wiki/Humoral_immune_response), whereas T cells are intimately involved in [c**ell-mediated immune responses**](http://en.wikipedia.org/wiki/Cell-mediated_immune_response).

**T** **cells** progenitors migrate from the **bone marrow** to the [**thymus**](http://en.wikipedia.org/wiki/Thymus) where they are called **thymocytes** and where they develop into T cells. In humans, approximately 1–2% of the lymphocyte pool recirculates each hour to optimize the opportunities for antigen-specific lymphocytes to find their specific antigen within the secondary lymphoid tissues.

In an adult animal, the peripheral lymphoid organs contain a mixture of B and T cells in at least three stages of differentiation:

* [**naive cells**](http://en.wikipedia.org/w/index.php?title=Naive_cell&action=edit&redlink=1) that have not matured, left the bone marrow or thymus, have entered the lymphatic system, but that have yet to encounter their cognate antigen,
* [**effector cells**](http://en.wikipedia.org/wiki/Effector_cell) that have been activated by their cognate antigen, and are actively involved in eliminating a pathogen.
* **memory cells** – the long-lived survivors of past infections.

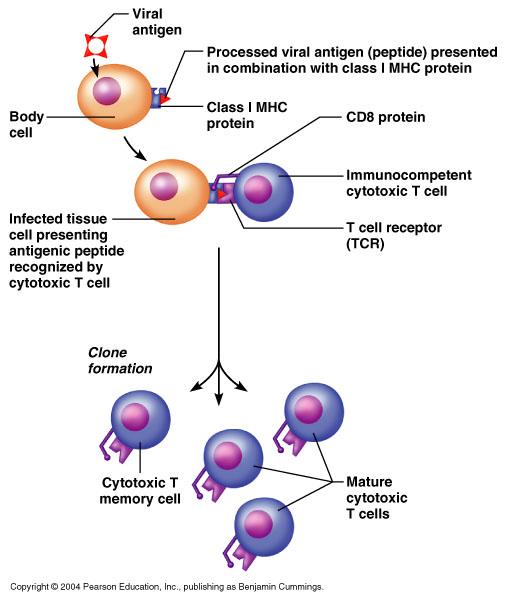
## 

**Both B cells and T cells** carry receptor molecules that recognize specific targets. T cells recognize a "**non-self**" target, such as a pathogen, only after antigens (small fragments of the pathogen) have been processed and presented in combination with a "**self**" receptor called **a**[**major histocompatibility complex**](http://en.wikipedia.org/wiki/Major_histocompatibility_complex)**(MHC) molecule**. There are two major subtypes of T cells: the [**killer T cell**](http://en.wikipedia.org/wiki/Cytotoxic_T_cell) and the [**helper T cell**](http://en.wikipedia.org/wiki/T_helper_cell). In addition there are [**suppressor T cells**](http://en.wikipedia.org/wiki/Regulatory_T_cell) which have a role in modulating immune response. Killer T cells only recognize antigens coupled to [**Class I MHC**](http://en.wikipedia.org/wiki/Major_histocompatibility_complex#MHC_class_I)**molecules**, while helper T cells only recognize antigens coupled to [**Class II MHC**](http://en.wikipedia.org/wiki/Major_histocompatibility_complex#MHC_class_II) molecules. These two mechanisms of antigen presentation reflect the different roles of the two types of T cell. A third, minor subtype are the **Gamma delta** [**γδ T cells**](http://en.wikipedia.org/wiki/Gamma/delta_T_cells) that recognize intact antigens that are not bound to MHC receptors.[[](http://en.wikipedia.org/wiki/Immune_system#cite_note-Holtmeier_W.2C_Kabelitz_D_2005_151.E2.80.9383-51)

In contrast, the **B cell** antigen-specific receptor is an [**antibody**](http://en.wikipedia.org/wiki/Antibody) molecule on the B cell surface, and recognizes whole pathogens without any need for [**antigen processing**](http://en.wikipedia.org/wiki/Antigen_processing).

#### http://www.sbs.utexas.edu/sanders/Bio347/Lectures/2006/Review_files/image002.jpgKiller or Cytotoxic T cells (Cellular immunity) :

[Killer T cells](http://en.wikipedia.org/wiki/Cytotoxic_T_cell) are a sub-group of T cells that kill cells that are infected with viruses (and other pathogens), or are otherwise damaged or dysfunctional. As with B cells, each type of T cell recognizes a different antigen. Killer T cells are activated when their [**T cell receptor**](http://en.wikipedia.org/wiki/T_cell_receptor)**(TCR)** binds to this specific antigen in a complex with the **MHC Class I receptor** of another cell. Recognition of this MHC: antigen complex is aided by **a**[**co-receptor**](http://en.wikipedia.org/wiki/Co-receptor) on the T cell, called [**CD8**](http://en.wikipedia.org/wiki/CD8). The T cell then travels throughout the body in search of cells where the MHC I receptors bear this antigen. When an activated T cell contacts such cells, it releases [**cytotoxins**](http://en.wikipedia.org/wiki/Cytotoxicity), such as [**perforin**](http://en.wikipedia.org/wiki/Perforin), which form pores in the target cell's [**plasma membrane**](http://en.wikipedia.org/wiki/Cell_membrane), allowing [ions](http://en.wikipedia.org/wiki/Ion), water and toxins to enter. The entry of another toxin called [granulysin](http://en.wikipedia.org/wiki/Granulysin) (**a protease**) induces the target cell to undergo [**apoptosis**](http://en.wikipedia.org/wiki/Apoptosis). T cell killing of host cells is particularly important in preventing the replication of viruses. T cell activation is tightly controlled and generally requires a very strong MHC/antigen activation signal, or additional activation signals provided by "helper" T cells .



#### Helper T cells (Humeral immunity):

[**Helper T cells**](http://en.wikipedia.org/wiki/T_helper_cell) regulate both the **innate and adaptive immune responses** and help determine which immune responses the body makes to a particular pathogen. These cells have **no cytotoxic activity and do not kill infected cells or clear pathogens directly**. They instead control the immune response by directing other cells to perform these tasks.

Helper T cells express T cell receptors (TCR) that recognize antigen bound to **Class II MHC molecules**. The MHC:antigen complex is also recognized by the helper cell's [**CD4**](http://en.wikipedia.org/wiki/CD4)**co-receptor**,. The activation of a resting helper T cell causes it to release **cytokines** that influence the activity of many cell types. This combination of MHC and antigen attracts a matching helper T cell, which releases [lymphokines](http://en.wikipedia.org/wiki/Lymphokine) and activates the B cell. As the activated B cell then begins to [divide](http://en.wikipedia.org/wiki/Cell_division), its offspring ([**plasma cells**](http://en.wikipedia.org/wiki/Plasma_cells)) [secrete](http://en.wikipedia.org/wiki/Secretion) millions of copies of the **antibody** that recognizes this antigen. These antibodies circulate in blood plasma and [lymph](http://en.wikipedia.org/wiki/Lymphatic_system), bind to pathogens expressing the antigen and mark them for destruction by [**complement activation**](http://en.wikipedia.org/wiki/Immune_system#Complement_system) or for uptake and destruction by **phagocytes**.

