

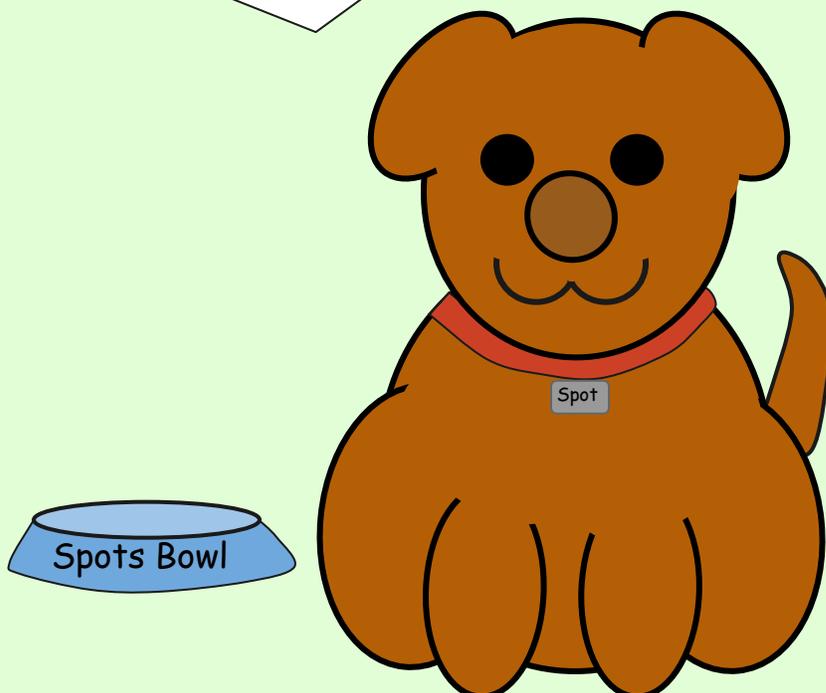
Sharing is Caring

Topics:

- ~ Immune System ~
- ~ White Blood Cells ~
- ~ Hygiene Hypothesis ~
- ~ Species Specific ~
- Illnesses-
- Viruses-
- Diseases-

Have you ever wondered why your pet does not get sick when you do?

Well, there is a lot that goes into that. Your pet can actually get sick from you, but it depends on what you are sick from. It is because there is something called “Species Specific”, meaning that not everything that affects human will affect other species, organisms, and vice versa.



By Iliamna O'Malley

Immune system is a functional system rather than organ system

- Innate and adaptive defenses work together to protect the body.
- They share, not all, but some of the same defensive molecules.
- For the innate defenses, there are specific pathways for certain substances and the innate responses release proteins that alert cells in the adaptive system to foreign molecules.

Barrier defenses is things like the skin and mucous membranes. They act instantaneously to prevent pathogenic invasion into the body tissues. The innate system has surface barriers and internal defenses The adaptive system has humoral and cellular immunity

Hematopoietic stem cells let blood cells change to replace any that are lost to age or function. There are

three different types of functional groups:

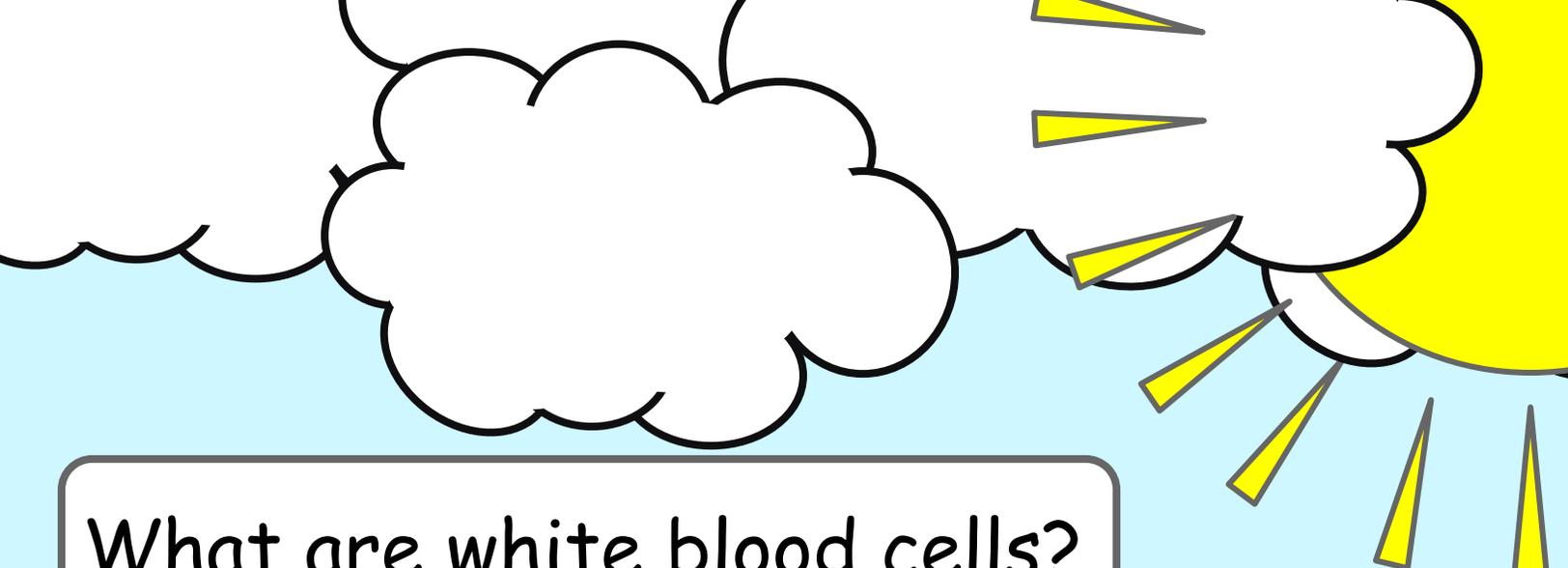
Phagocytic cells: Ingest pathogens to destroy them

Lymphocytes: Specifically coordinate the activities of adaptive immunity

Cells containing cytoplasmic granules: These help mediate immune responses against parasites and intracellular pathogens such as viruses

(Anatomy and Physiology pg 980)





What are white blood cells?

There are actually five different types of white blood cells, each look different, and each have a specific job to do inside the body. The five different white blood cells are:

- Neutrophils: Multilobed nucleus, pale red and blue cytoplasmic granules
- Lymphocytes: Large spherical nucleus, thin rim of pale blue cytoplasm
- Monocytes: Kidney-shaped nucleus, abundant pale blue cytoplasm
- Eosinophils: Bilobed nucleus, red cytoplasmic granules
- Basophils: Bilobed nucleus, purplish-black Cytoplasmic granules



White blood cells are also called Leukocytes and they are grouped into two major categories: Granulocytes and Agranulocytes

Granulocytes - Agranulocytes

Granulocytes:

Neutrophils, Eosinophils, Basophils

Agranulocytes:

Lymphocytes, Monocytes

Meow:
Meow, Meow, Meow
Meow:
Meow, Meow

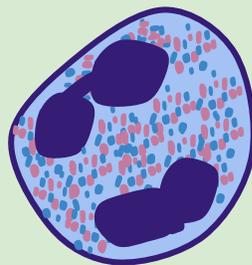


Granulocytes have visible cytoplasmic granules and Agranulocytes do not have any visible cytoplasmic granules.

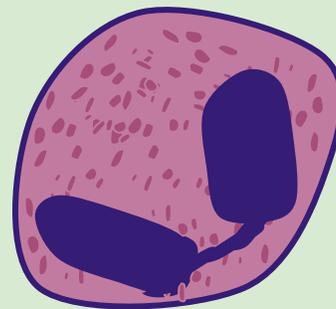
Most common WBC to least common WBC:

1. Neutrophils
2. Lymphocytes
3. Monocytes
4. Eosinophils
5. Basophils

Granulocytes



Neutrophils

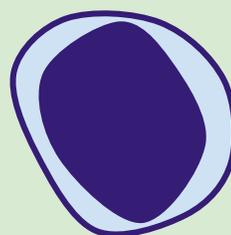


Eosinophil

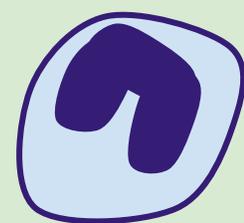


Basophil:

Agranulocytes



Lymphocyte



Monocyte

Immune system

The immune system provides resistance to disease and it is made up of two intrinsic systems:

-Innate Defense-

This has the first and second lines of defense

-Adaptive Defense-

This has the third line of defense

Species Specificity

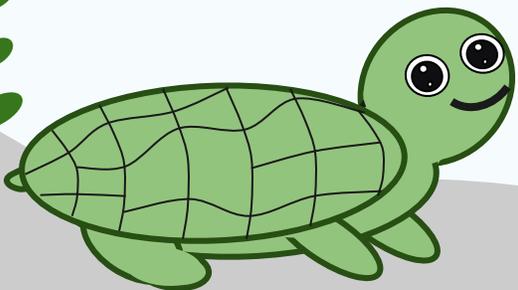
Not everything that affects humans affects other animals and organisms! The biology definition of species specificity is:

“The frequency with which a test shows a true negative result among individuals who do not have the disease or the genetic variant in question.”

(NIH Et al, 2020).

The three main functions of the immune system are to fight infections, to stop harmful substances, and to help fight against non-infectious diseases.

We are going to talk about humans first, because humans have their different ways to protect their bodies. It is a lot more complicated than this but we can put it simply as that there is a first, second, and a third line of defense!



First line of defense: external body membranes

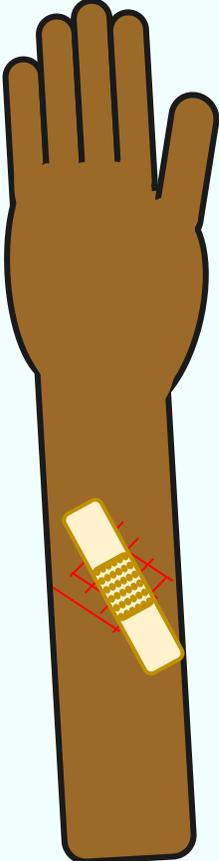
The first line of defense for humans is the outside of their bodies. The skin, mucus, and tears are just three examples of ways the body protects itself. It is a broad category but it can be broken down into three groups:

Physical Chemical Biological

Physical: This would be things like your skin and mucous membranes.

Chemical: This is more complicated but this is things that fall under PH and antimicrobial molecules. For example the human skin has a low pH to make it an inhospitable environment for pathogens.

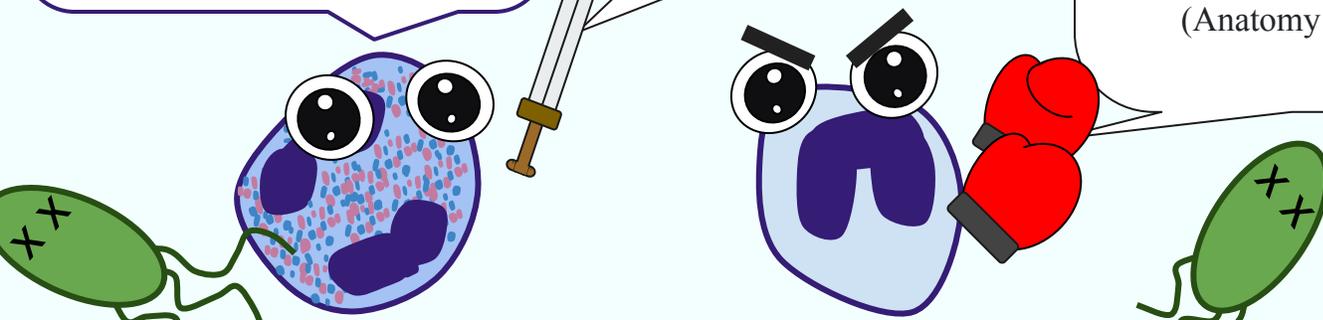
Biological: This would be the microbiome inside your body.



I am a Neutrophil! I am the main WBC that works during the first line of defense!

We are referred to as “bacteria slayers”!
We are able to encapsulate and kill dangerous bacteria!

I am a Monocyte, I differentiate into macrophages.
“When pathogens breach the body’s barrier defenses macrophages are the first line of defense!”
(Anatomy & Physiology, pg 991)



The Second Line of Defense: Antimicrobial proteins, phagocytes, and other cells

I am an Eosinophil! I have a digestive enzymes that I release on large parasitic worms! Those enzymes digest their surface!

Cells and Chemicals: The second line of defense is nonspecific immune cells and chemicals that work together to fight pathogens.

In the second line of defense there are many different types of specialized cells and soluble factors that destroy invaders in a generalized way without targeting specific individuals.

The goal of the second line of defense is to inhibit the spread of invaders, and inflammation is the most important mechanism here.

Phagocytes: These are white blood cells that eat foreign invaders

Natural killer (NK) cells: These are large granular lymphocytes that police blood and lymph.

Inflammatory response: This is macrophages, mast cells, WBCs, and inflammatory chemicals.

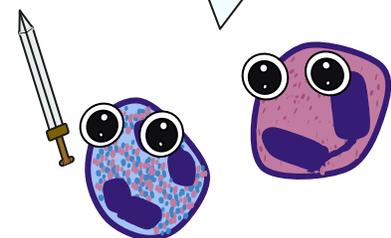
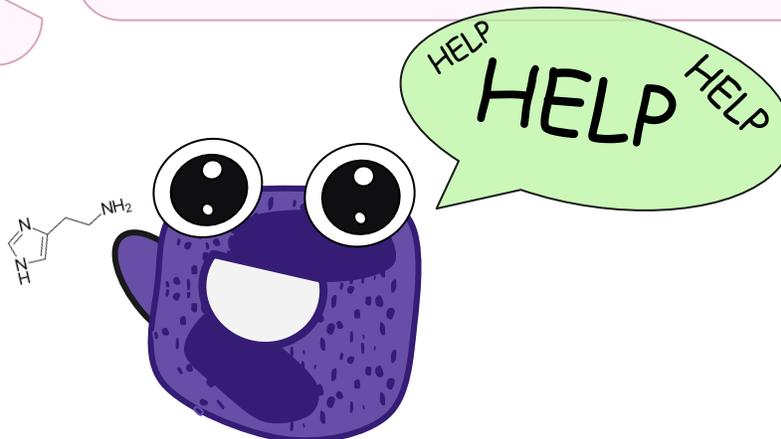
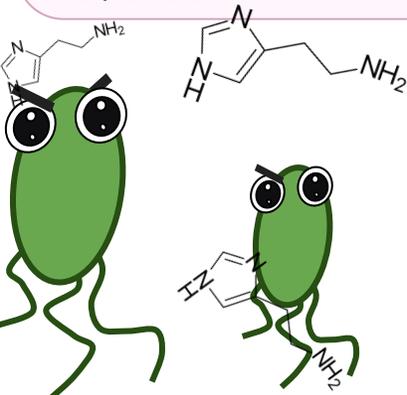
Antimicrobial proteins: These are interferons and complement proteins.

Fever: This is an abnormally high body temperature that is systemic response to invading microorganisms

I am a basophil and I am mostly found in the second line of defense!

When I find an allergen I release Histamine, which is an inflammatory chemical that acts as a vasodilator and attracts white blood cells to inflamed sites!

Where is the trouble!?



The Third Line of Defense: attacks particular foreign substances

The third line of defense is the only defense in the Adaptive (specific) defense system:

- It is specific so it recognizes and targets specific antigens.
- It is systemic so it is not restricted to an initial site
- It has memory which allows it to mount an even stronger attack to “known” antigens

Two main branches of adaptive system:
Humoral immunity and
Cellular immunity

I am a Lymphocyte! My job is to produce antibodies!

There are a few types of me but two types I use here are T and B cells!



Humoral immunity:
Antibodies are produced by lymphocytes and circulate freely in body fluids. They also bind temporarily to target cell and have extracellular targets

Cellular Immunity:
Lymphocytes act against target cells either directly or indirectly. Unlike humoral immunity, cellular immunity has cellular targets.

T Cells

T lymphocytes act against virus-infected cells and tumor cells. The T-Cells job is to help identify pathogenic cells and destroy target cells. These cells have cellular immunity . Some T cells directly kill cells while others release chemicals that regulate immune response.



I am a very complicated cell there are many types of cells, mainly T and B cells. There are helper, cytotoxic, and regulatory T cells too! There is a lot that goes into how important I am!

B Cells

B Cells produce antibodies by giving rise to plasma cells. Those plasma cells produce antibodies. These cells have humoral immunity. B Cells present antigens to helper T cells to assist their own activation.

The third line of defense is the last main line of defense in the immune system.

The B-Cells and T-Cells are white blood cells that work in the third line of defense. The B-Cells produce antibodies and the T-Cells help identify pathogenic cells and destroy target cells.

Human's immune systems and almost all vertebrates Immune Systems are pretty similar. The biggest differences lie in the difference in tough skin, mucous, friendly bacteria, and other things that help keep germs from entering the body.

Different organisms immune systems:

A salamander's immune system is why they are able to regrow limbs.

The number of immune cells present are different from human to dog immune systems.

Elephants have heterophils instead of neutrophils.

Adult American lobsters are susceptible to few naturally occurring pathogens and there is no viral pathogen that is known to exist.

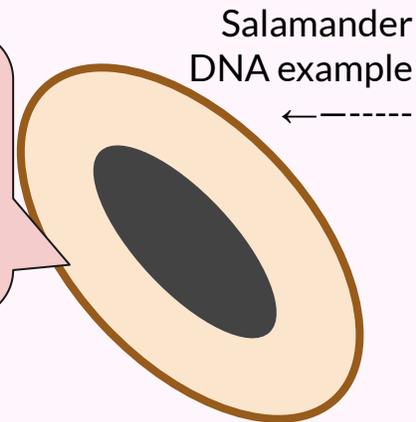
Lamprey's immune cells produce proteins that grab onto foreign substances.

Blood Cells

"There are three types of blood cells: red blood cells (erythrocytes), white blood cells (leukocytes), platelets (thrombocytes)." (Praveen, n.d.)

There is a lot of things that play a role in our, and almost all organisms, blood, but the main things are blood cells. Blood cells can differ in organisms, and when compared to humans it can be interesting.

Salamanders RBC tend to be more oval shaped and have a nucleus filled with DNA.



Amphibians have DNA-bearing nucleuses in their red blood cells, making them have some of the largest red blood cells! That includes salamanders!



Nonspecific and Specific immunity:

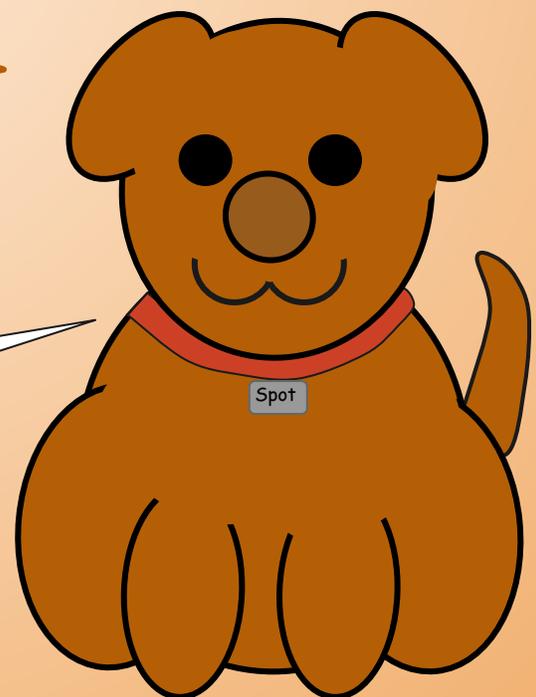
There are so many different immune systems out there, but we are going to shift now to the original question, "Have you ever wondered why your pet does not get sick when you do?"

Let's use me, a pet dog, just like humans dogs have active immunity and passive immunity.

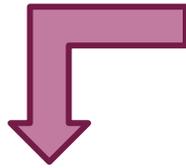
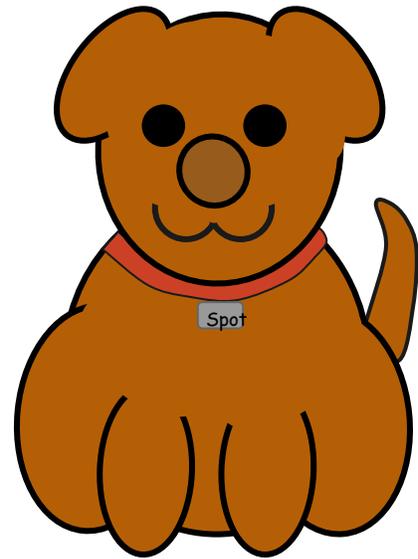
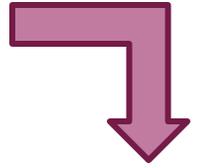
Active immunity is the immunity is when our own immune system is responsible while passive is immunity we gained from someone else.

So a dog has nonspecific immunity at birth and they can gain specific immunity through things like vaccines. This means your dog can get sick, but not everything that gets you sick will get them sick.

Let's use the common cold, the common cold virus that causes the cold in humans is species specific, so I cannot get that from you! I can get sick from the flu though!



The reason I cannot get the common cold is because viruses require a specific receptor, that is on the outside of the cell, in order to get in. Receptor can vary from species to species, and I do not have that receptor!



The Merriam Webster Dictionary defines species specificity as, “...the phenomenon involved in the interaction of an agent (such as a pathogen, drug, or antigen) and members of a given species that results in a reaction characteristic for that species...”

This means that just because a human has a receptor for a certain virus, does not mean that their pet does. This is also true for most organisms.

If we look at blood cells in general, most vertebrates have the same variation but different amounts and sizes.

Another difference is how elephants have heterophils instead of neutrophils.

Heterophils are a finely granular polymorphonuclear leukocyte. In some mammals they have granules that have variable sizes and staining characteristics.

Neutrophils VS Heterophils

They are functionally equivalent. Both play a role in acute inflammatory response but neutrophils create purulent discharge or pus while heterophils create cheesy or caseous debris.

There are many different organisms out there, with many differences in their immune systems. To keep your pets good and healthy, you need to take care of them like you would take care of you. All of these will help keep them healthy:

- Proper vaccinations -
- Healthy lifestyle -
- Regular vet checkups-

“One important part of the body’s immune system is white blood cells (WBC). The white blood cells protect the body against infectious diseases. There are five different types of white blood cells, named as lymphocytes, monocytes, eosinophils, basophils, and neutrophil. The number of white blood cells, as well as their structure, is important in the diagnosis of different infection diseases, such as HIV, rubeola, poliovirus, and chickenpox.” (Manthouri, 2022)

Although the white blood cells are important, especially when it comes to protecting the body, there are other important blood cells or parts that work with blood cells.

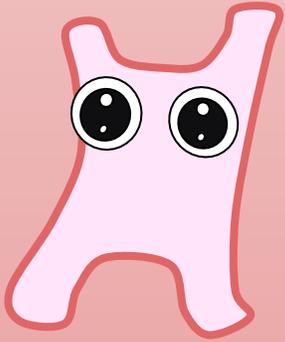
Red blood cells carry oxygen from our lungs to the rest of our bodies and then they take carbon dioxide back to our lungs to be exhaled.

Platelets, also called thrombocytes, are small and colorless cell fragments in our blood that form clots to stop or prevent bleeding.

Plasma is the liquid part of your blood that contributes to 55% of your blood's total volume. It helps your body recover from injuries, helps to distribute nutrients, it remove wastes, and it helps prevent infection. It does all this while moving throughout the circulatory system.

Differences in blood cells:

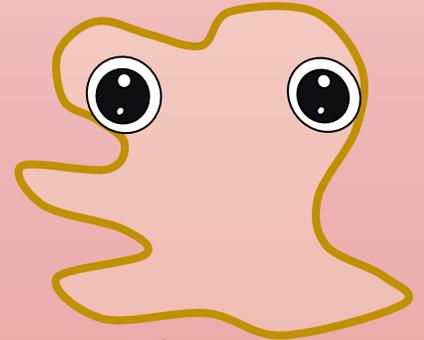
Animals with higher energy needs have smaller red blood cells so that they can exchange gas and travel through blood vessels more efficiently. A nucleus in a red blood cell makes them oval-shaped, and without nuclei red blood cells are able to have unique shapes.



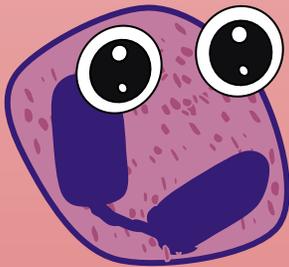
Platelet



Red Blood Cell



Plasma



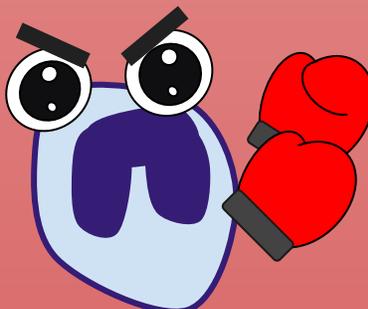
Eosinophil



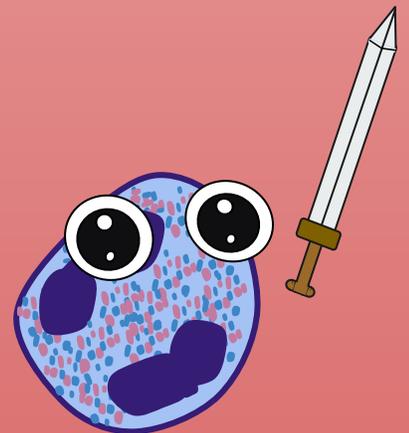
Basophil



Lymphocyte



Monocyte



Neutrophil

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UCSB Science Line, C. E. al. (2016, August 31). *Why animals have such strong immune systems compared to us (humans)?* UCSB Science Line. Retrieved July 29, 2022, from <http://scienceline.ucsb.edu/getkey.php?key=5505>

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Manthouri, M., Aghajari, Z., & Safary, S. (2022, January 12). *Computational intelligence method for detection of white blood cells using hybrid of convolutional deep learning and Sift*. *Computational and Mathematical Methods in Medicine*. Retrieved July 29, 2022, from <https://www.hindawi.com/journals/cmmm/2022/9934144/>

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Thank you for reading my book!
The Immune System is a lot more complicated than it is described in this book, I encourage you to research it more because it is fascinating!

