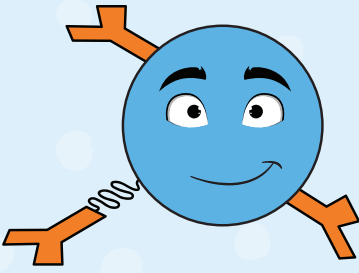
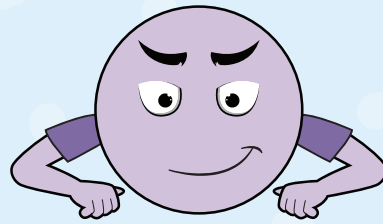


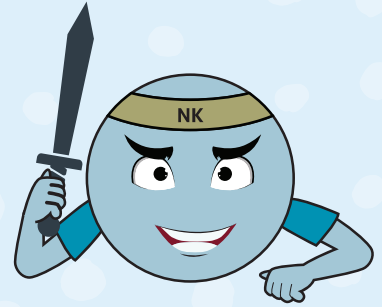
The Immunocytes



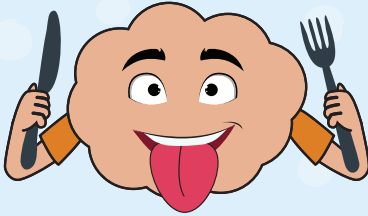
MOLI



ROBERT



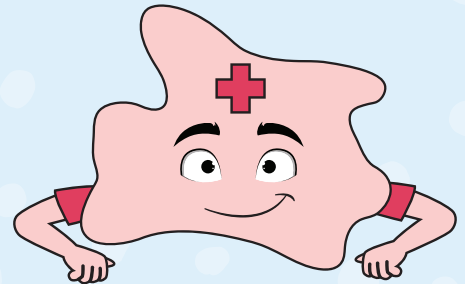
PAUL



FEFON



FELIX



BERTHA



PACCO

Written by: Juan Carlos Aldave Becerra, MD
Allergy and Clinical Immunology

Arranged by: Mehdi Adeli, MD, FAAAAI, FAP
Senior Consultant, Allergy and Immunology

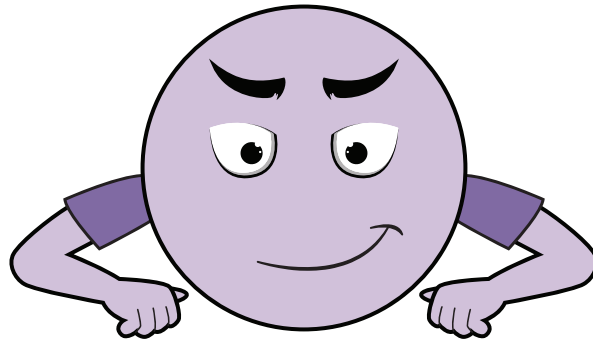
Around us, in the environment, many microbes can harm us, causing illness, or even death.

There are four (4) major groups of microbes: viruses, bacteria, fungi, and parasites. We are exposed to these threats since birth, so we need to have many cells and molecules to defend our bodies.

We will call our 'immune system' our body's defense, and 'immunocytes' the immune cells that protect us.

In this little book, you will learn about the life and function of seven of our most important immunocytes.

Robert, the Neutrophil



The first immune cells that we will meet are neutrophils, which represent the most abundant immunocytes in our blood. Similar to the other immunocytes, neutrophils are born in bone marrow with a size of 10 micrometers, that is, one hundredth of a pinhead.

Neutrophils have a very short life, from between six (6) hours to four (4) days, so they need to be renewed permanently from bone marrow. Once in the blood, neutrophils circulate through our body patrolling for warning signals. We will call these warning signals 'inflammation'.

Many microbes can generate inflammation and damage in our body tissues. Neutrophils rapidly detect inflammation and go out of the blood into the injured tissue to fight. They fight by eating microbes or releasing toxic substances. Neutrophils usually die during the battle, so we can consider them 'war heroes'.

Our neutrophils are very important in defending us against bacteria and fungi. We will name one of our neutrophils; we will call him Robert.

The following questions will help you understand the importance of our neutrophils:

1. Which are the most abundant immune cells in our blood?

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2. How long do neutrophils live?

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3. Against what microbes is the neutrophil Robert very important?

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4. How do neutrophils kill microbes?

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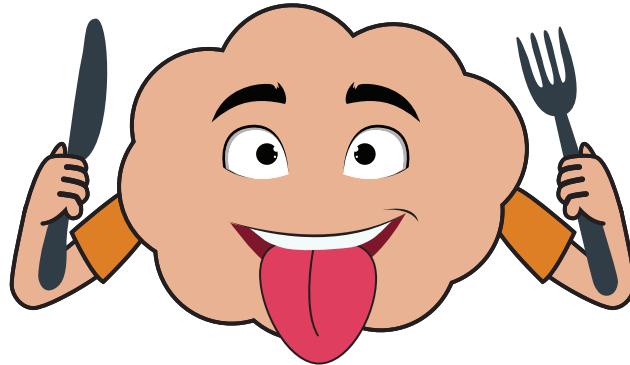
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5. Why are neutrophils called 'war heroes'?

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Fefon, the Macrophage



The second group of immunocytes we will study are the macrophages. Macrophages originate in the bone marrow and live in several tissues of our bodies. When circulating in the blood, they are called monocytes.

Macrophages live several months, depending on the tissues in which they reside and on the microbes that they find.

The main function of macrophages is to eat microbes and destroy them; therefore they are also called phagocytes ('eating cells'). Macrophages are the 'big phagocytes', with a size of 20 micrometers, twice the size of neutrophils. Neutrophils are the 'small phagocytes'.

Following the detection of a dangerous microorganism, the macrophage traps, eats, and destroys it. Furthermore, the big phagocyte sends warning signals to other cells, which are recruited to the infection site to help in the battle. That is, macrophages are capable of generating inflammation.

Our macrophages are very important to defend us against the bacteria and fungi living inside or outside our cells. We will call our hungry macrophage, Fefon.

The following questions will help you understand the importance of our macrophages:

1. Where are macrophages born?

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2. What do we call macrophages when they are circulating in the blood?

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3. What is the size of the macrophage Fefon?

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4. What is the main function of macrophages?

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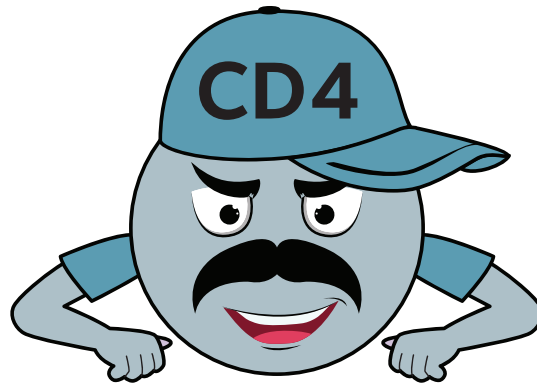
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5. What microbes are macrophages important against?

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Felix, the T CD4 Lymphocyte



The T CD4 lymphocytes, also called T helper cells, are the commanders of the immunocyte army. Their role is to collaborate with the other immune cells for optimal function. For example, if a macrophage requires collaboration to destroy an ingested microbe, the T helper cell appears to help the phagocyte. If a B lymphocyte wants to produce better antibodies, the T CD4 lymphocyte collaborates with him to achieve the goal.

T CD4 lymphocytes originate in the bone marrow and complete their development in the thymus, a lymphoid organ located in the thorax, near the heart and lungs. T helper cells can live many months or years, even throughout our life.

When a T CD4 lymphocyte encounters a microbe, he can 'clone' himself to form a battalion of identical cells. This phenomenon is called 'clonal expansion'.

After a battle between immunocytes and microbes, T helper cells are capable of remembering the germ forever, so that our immune system can respond faster and stronger against repeated infection. This process is known as 'memory'.

Our T CD4 lymphocytes are essential in the defense against all types of microbes (viruses, bacteria, parasites, and fungi). Let me introduce you to Felix, the T CD4 lymphocyte.

The following questions will help you understand the importance of our T CD4 lymphocytes:

1. What is another name for T CD4 lymphocytes?

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2. What is the main function of CD4 T lymphocytes?

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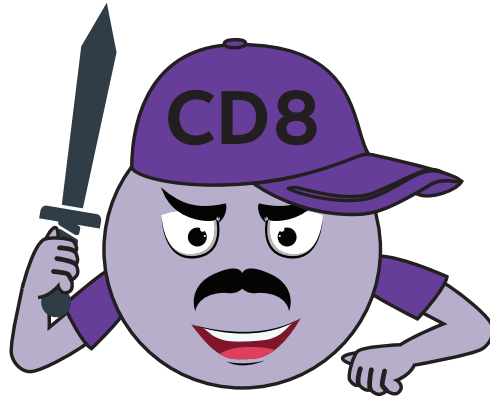
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3. What type of microbes do T helper cells protect against?

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Pacco, the T CD8 Lymphocyte



T CD8 lymphocytes are also called cytotoxic T cells because they are capable of killing other cells directly. When a T CD8 lymphocyte finds a cell infected by a virus or a malignant tumor cell, the T lymphocyte destroys it. T CD8 lymphocytes, similar to their T CD4 relatives, are born in the bone marrow and complete their development in the thymus. They are generally around eight (8) micrometers in size. Cytotoxic T cells have a prolonged lifespan, lasting between months to years.

When a T CD8 lymphocyte finds a microbe, it can 'clone' itself to form a brigade of identical cells. This process is called 'clonal expansion'. After a battle between immunocytes and microbes, T cytotoxic cells are capable of remembering the germ forever, so that they can fight faster and stronger against a repeated infection. This phenomenon is known as 'memory'.

Our T CD8 lymphocytes are very important to defend us against viral infections and cancers. We will call the powerful cytotoxic T cell Pacco.

The following questions will help you understand the importance of our T CD8 lymphocytes:

1. How do T CD8 lymphocytes get their name?

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2. What is the main function of CD8 T lymphocytes?

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3. What kind of dangers do T cytotoxic cells protect against?

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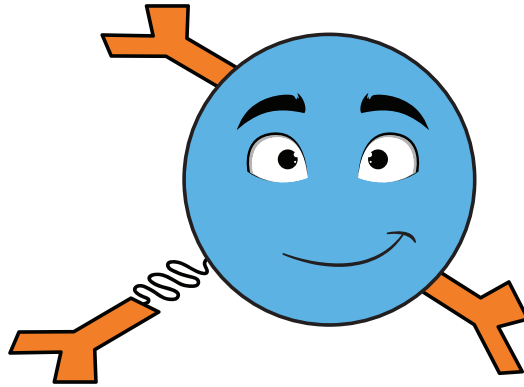
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3. What is the average lifespan of our T CD8 cells?

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Moli, the B Lymphocyte



The fifth group of immunocytes that we will meet are B lymphocytes. Our B cells are born in the bone marrow, as well as the other immunocytes. They measure around 8 micrometers in size, similar to the size of T lymphocytes, and can live several months to years. B lymphocytes can evolve into bigger cells, named plasma cells, which measure fourteen (14) micrometers. The principal function of our B lymphocytes and plasma cells is to produce antibodies, also called immunoglobulins (Ig). There are five (5) different classes of immunoglobulins: IgG, IgA, IgM, IgD, and IgE. Antibodies are molecules that protect us from many types of bacteria, viruses, and parasites, representing essential support to our immunocytes.

When B lymphocytes need to improve their antibody production, they request help from the T CD4 lymphocyte.

Similar to T cells, our B lymphocytes can 'clone' and form an army of identical cells. They can also develop 'memory' after fighting against microbes.

Let me introduce you to Moli, our brave B lymphocyte.

The following questions will help you understand the importance of Moli:

1. Where are B lymphocytes born?

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2. What is the principal function of Moli?

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3. What kind of microbes are we protected against by B lymphocytes?

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4. How many classes of immunoglobulins do we have?

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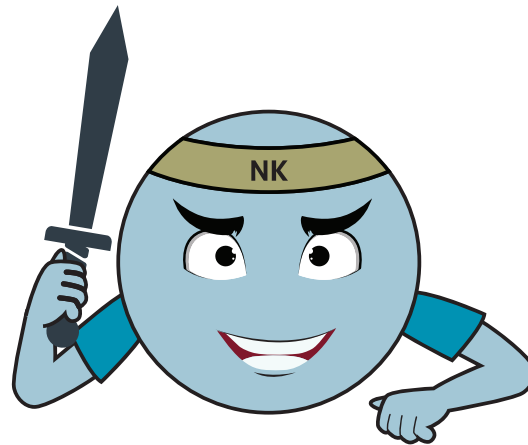
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5. Why do we say that B lymphocytes have 'memory'?

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Paul, the NK Lymphocyte



Do you remember T CD8 lymphocytes, our immunocytes which can destroy cells infected by viruses and malignant tumor cells? Well, we have another group of immunocytes that complement the actions of T CD8 cells. These are our 'natural killer' (NK) lymphocytes. NK cells are always ready to kill other cells.

When NK lymphocytes encounter healthy cells, they are 'switched off' by an inhibitor. However, as soon as they find a cancer cell or a virus-infected cell, they wake up and extend their deadly attack, destroying the sick cell. NK lymphocytes, like our other immunocytes, originate in the bone marrow. They measure around eight (8) micrometers and can live several months to years. Unlike T and B cells, NK lymphocytes are not able to develop 'memory' or 'clonal expansion' after fighting against microbes.

Our NK cells defend us against viral infections and cancer. We will name one of our NK lymphocytes, Paul.

The following questions will help you understand the importance of our NK lymphocytes:

1. Where are NK lymphocytes born?

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2. What is the main function of Paul, our NK cell?

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3. What are the similarities between NK lymphocytes and T CD8 lymphocytes?

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4. What are the differences between NK lymphocytes and T cells?

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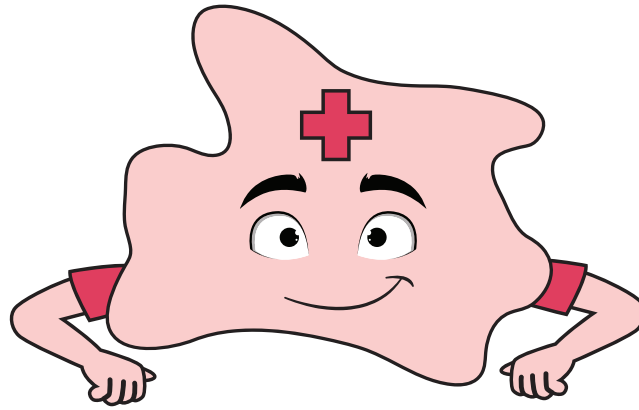
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5. From what dangers do NK lymphocytes protect us?

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Bertha, the Dendritic Cell



To achieve optimal function, T lymphocytes need to be activated by other cells. The main cells can then turn on T lymphocytes as dendritic cells. Dendritic cells are named because they have extensions (dendrites) that allow them to trap molecules more easily.

Dendritic cells form a network under our skin and mucous membranes. They detect and capture invading microbes, and process them into small fragments that are then presented to T lymphocytes. Some dendritic cells can also assist in the development and activation of B lymphocytes.

Like the rest of our immunocytes, dendritic cells are born in the bone marrow and are approximately 15 micrometers in size. They can live up to several years.

Bertha is our beautiful dendritic cell.

The following questions will help you understand the importance of dendritic cells:

1. Where are dendritic cells born?

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2. What are 'dendritic' cells named?

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3. What is the principal function of Bertha, our dendritic cell?

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4. Which lymphocytes are activated by dendritic cells?

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Note:

- This translation was created by the Jeffrey Modell Foundation and LUKE Society. We would like to thank them for giving us permission to include their education book in our products.

www.thejmfbook.org

Allergy and Immunology Awareness Program:
AIAP@hamad.qa
<http://aiap.hamad.qa>

