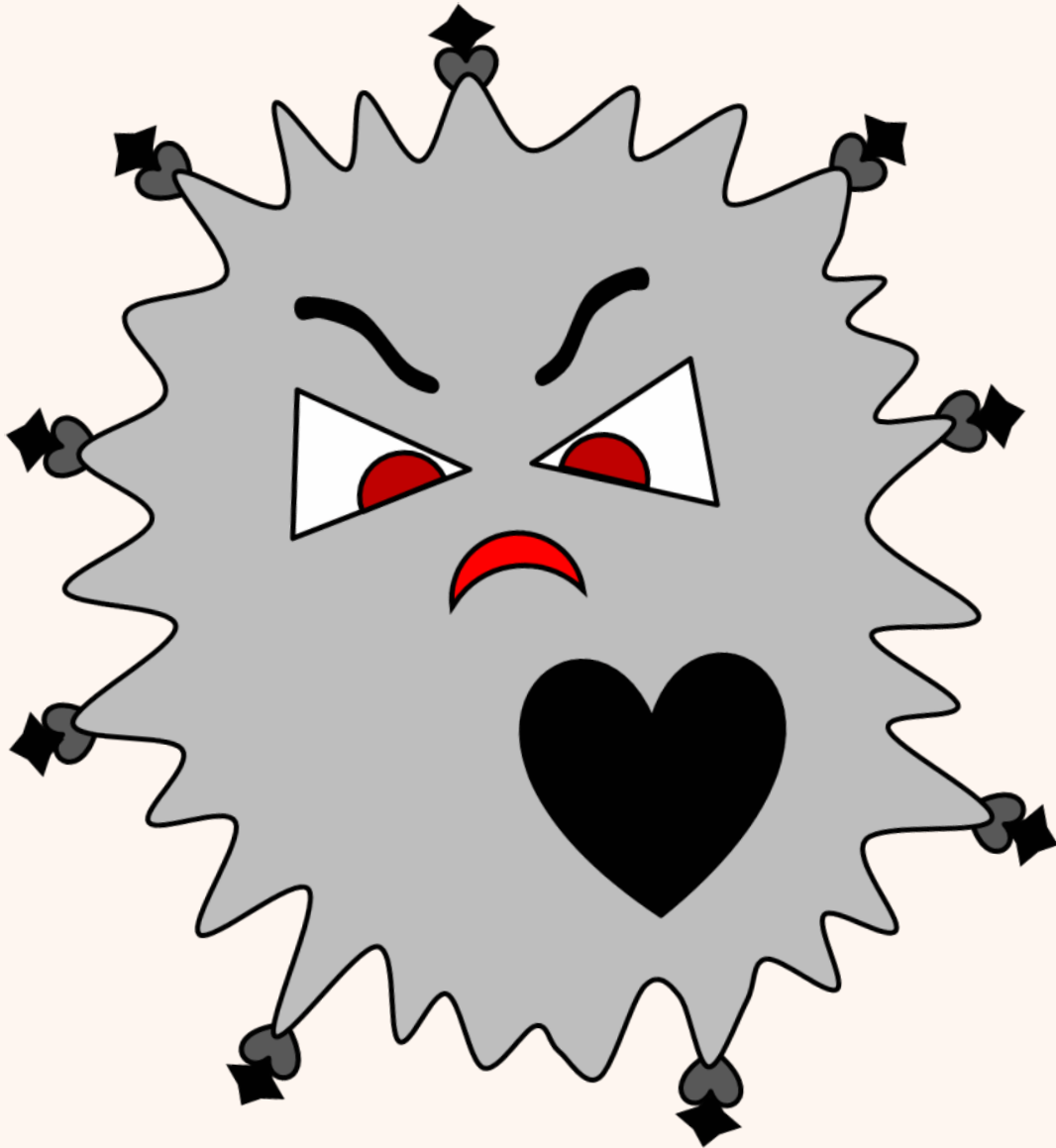


# **The Immunocytes against cancer**



**Juan Carlos Aldave, MD**  
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Around us, in the environment, there are many microbes that can cause illness or death. Even our own cells, when they become malignant (Cancerous), can destroy us.

From birth we are exposed to the attack of microbes and to the risk of developing cancer. Therefore, we need many cells and molecules capable of defending ourselves.

We will call “immune system” to our body defenses, and “immunocytes” to the immune cells that protect us.

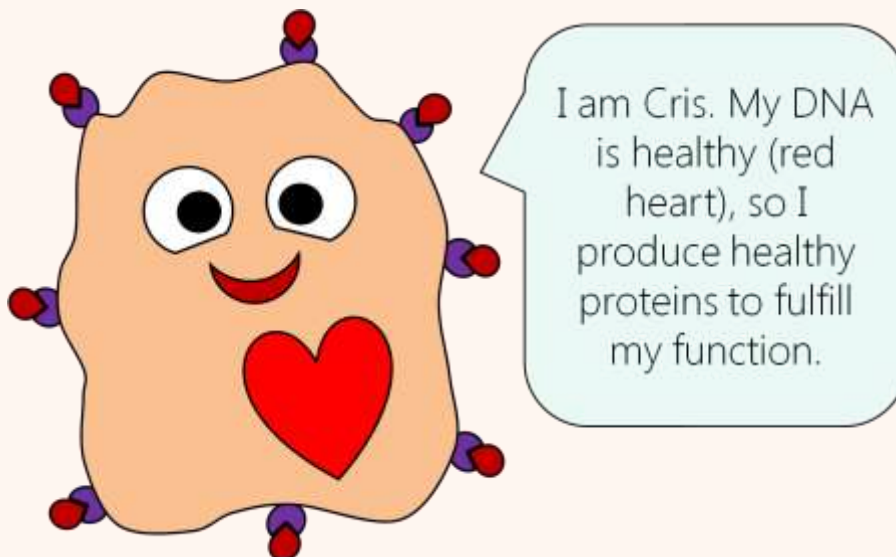
In this little book I will show you how our immunocytes fight and defend us from the malignant cells that cause cancer.

# Chapter 1: The malignant cells

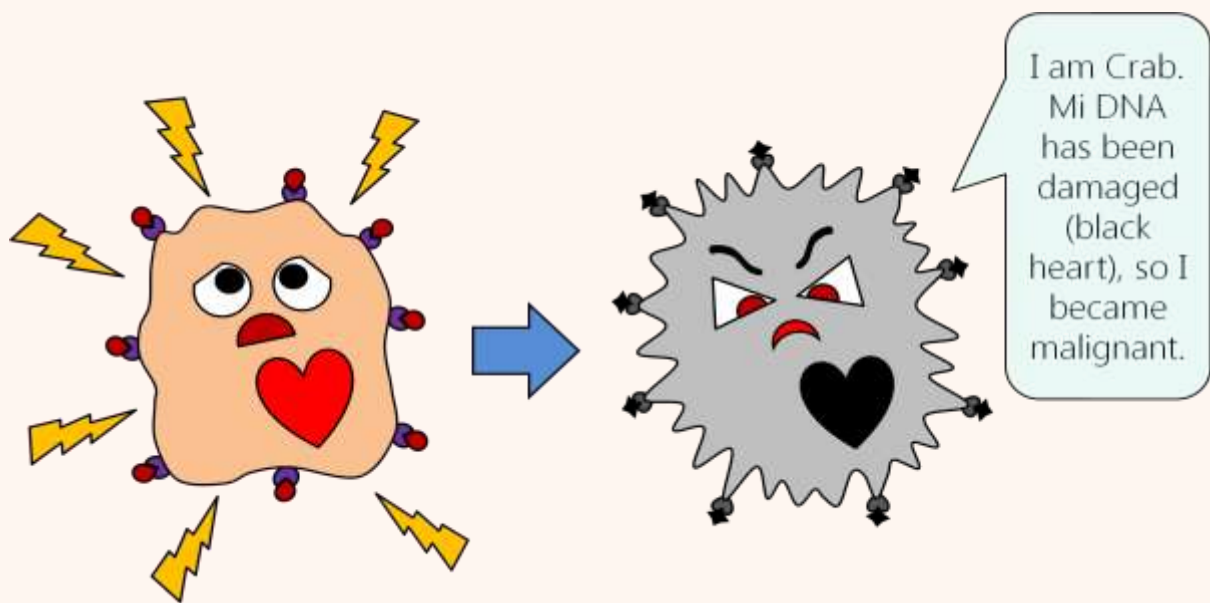


Our body is made up of millions of cells. Old or damaged cells die and are replaced by new cells. Thus a balance is maintained in our tissues.

Each human cell produces many proteins essential for cellular function. Some proteins control cell reproduction. The DNA of the cell contains the information necessary to produce each protein. Our healthy cell will be named Cris.



When the DNA of Cris is damaged and mutations occur, the control of cell proliferation can be lost. To prevent this, Cris has mechanisms that repair the DNA. Sometimes these mechanisms fail and the cell accumulates mutations, becoming a cell that loses the control of reproduction. This cell will be named Crab, the malignant cell.



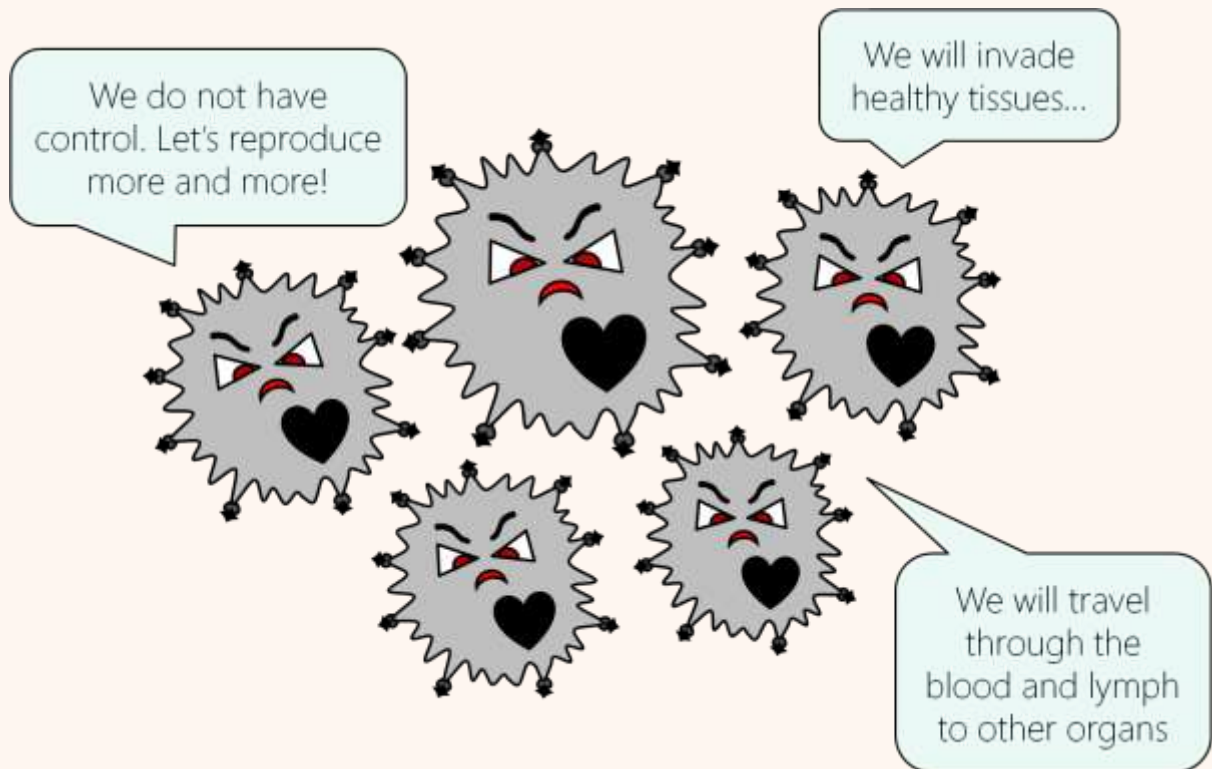
Malignant cells are extremely dangerous. They can reproduce uncontrollably and become resistant to death. They can invade and destroy neighboring cells and tissues. They can enter the bloodstream and lymph to spread in the body ("metastasis").

Malignant cells originate malignant tumors ("cancer"). Cancer causes millions of deaths worldwide. It can develop in any organ including the lungs, stomach, pancreas, brain, skin, etc.

Place true or false about Crab, the malignant cell:

1. It can invade and destroy neighboring cells \_\_\_\_\_
2. It can spread through our body \_\_\_\_\_
3. It is very easy to destroy \_\_\_\_\_

## Chapter 2: Why cancer occurs?



Cancer occurs when mutations in the cellular DNA accumulate and the control of cell proliferation is lost. Crab and her malignant friends reproduce uncontrollably and generate a malignant tumor.

There are many factors that increase the risk of accumulating DNA mutations and cancer development. For example:

- Cigarette smoking increases the risk of cancer in many organs (lung, tongue, larynx, stomach, pancreas, urinary bladder, etc.).
- Ultraviolet radiation in sunlight increases the possibility of developing skin cancer.

- Human papillomavirus infection increases the risk of cervical cancer.
- Hepatitis B and hepatitis C viruses can cause cirrhosis and liver cancer.
- Junk food and constipation increase the risk of developing colon cancer.
- Wood dust is a risk factor for cancer of the nasal cavity and paranasal sinuses.
- Human immunodeficiency virus (HIV) increases the risk of developing many types of cancer, such as Kaposi's sarcoma.
- Toxic chemicals promote the development of many types of cancer.

Malignant cells can appear in any person at any time. In the next chapter we will see how our immune cells fight against them.

Please answer the following questions:

1. When cancer occurs?

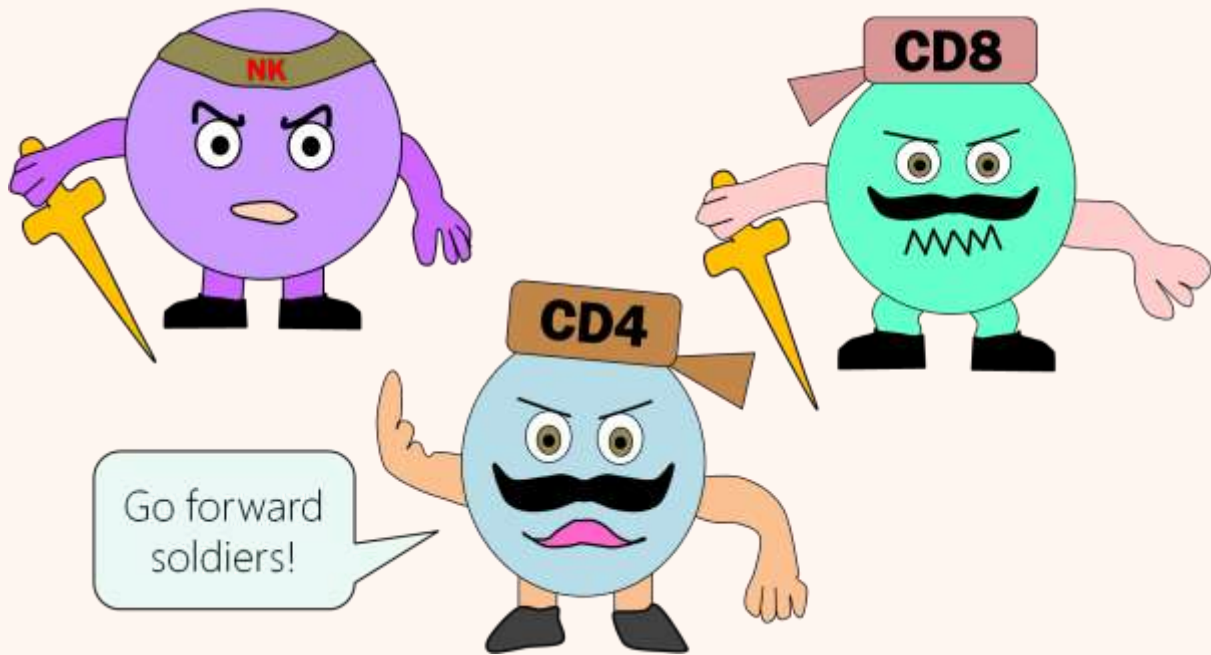
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2. Match the correct options with arrows:

Cigarette smoke	skin cancer
Hepatitis B virus	liver cancer
Junk food	lung cancer
Ultraviolet radiation	colon cancer
Human papillomavirus	cervical cancer
Wood dust	Kaposi sarcoma
Human immunodeficiency virus	paranasal sinuses cancer

# Chapter 3:

## Our anti-cancer army



Malignant cells can appear in any part of our body and at any time of our life. To protect against them we have our immune system ("defense system").

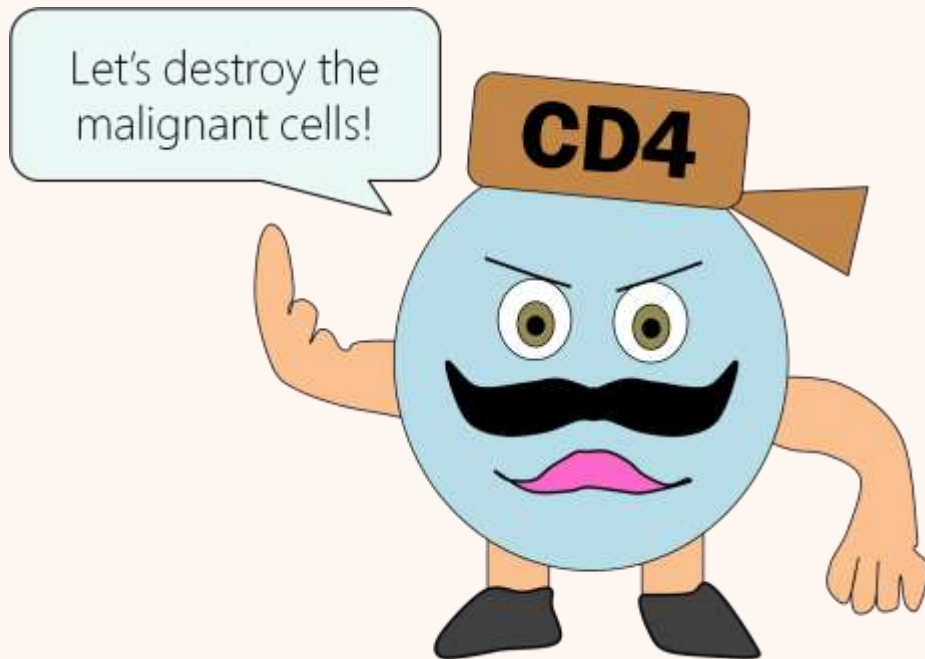
Our immunocytes are always watching for malignant cells. When they recognize a bad cell, their mission is to destroy it.

Our anti-cancer army has 2 lethal soldiers which are led and strengthened by a commander.

The two brave soldiers are:

- The T CD8 lymphocyte, also known as cytotoxic T lymphocyte.
- The NK (natural killer) lymphocyte.

Both soldiers are led by the commander Felix, our T CD4 lymphocyte, also called T-helper cell.



In the next chapter we will understand how our T CD8 cell recognizes and attacks the malignant cells. Please solve these questions:

1. In which part of our body the malignant cells can be generated?

\_\_\_\_\_

2. When can the malignant cells be generated?

\_\_\_\_\_

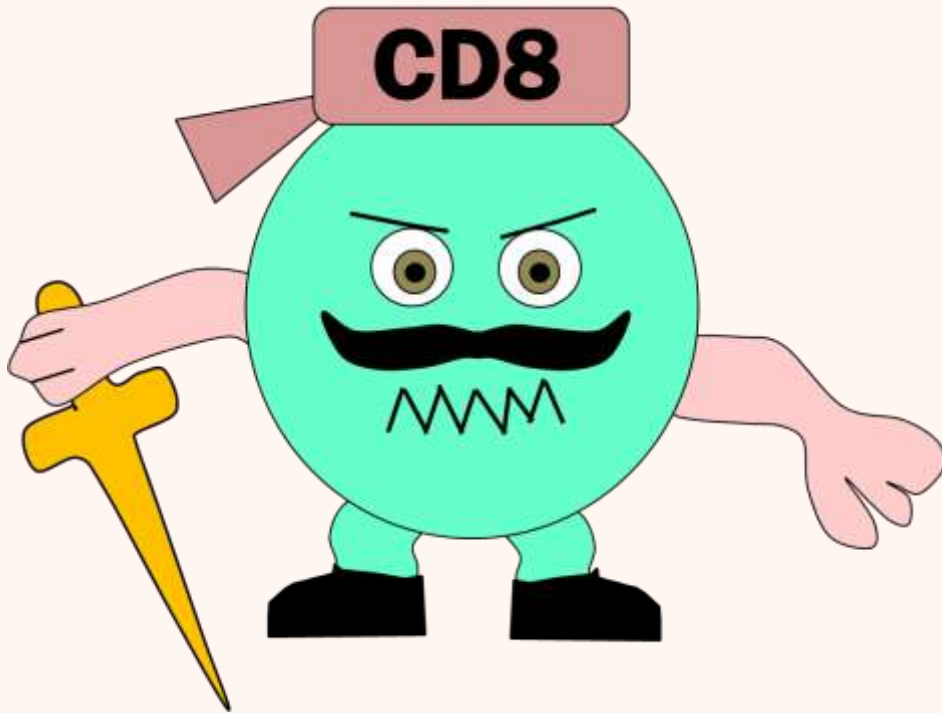
3. How is shaped our anti-cancer army?

Two soldiers: \_\_\_\_\_

One commander: \_\_\_\_\_



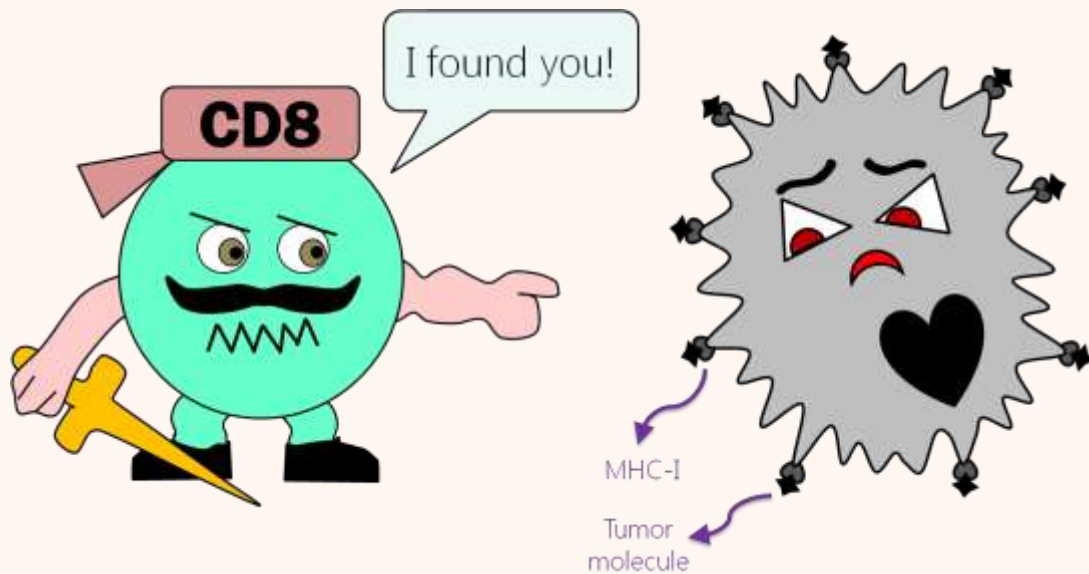
## Chapter 4: The powerful Pacco, our T CD8 lymphocyte



In the first book of the collection ("The Immunocytes") we met Pacco, our T CD8 lymphocyte. He is also known as cytotoxic T lymphocyte because of his ability to kill cells directly.

Pacco is very important to remove malignant cells and defend us against cancer. How does he act?

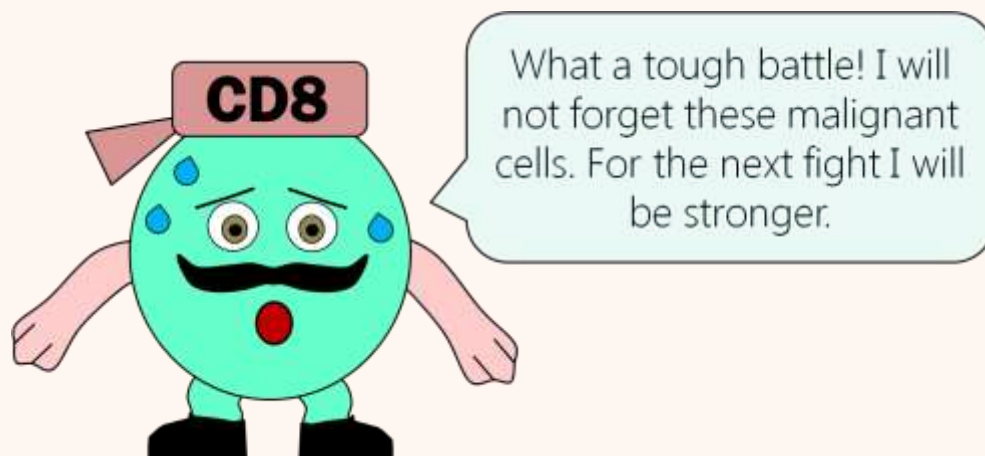
Crab expresses in her membrane abnormal proteins (tumor proteins) through molecules called MHC-I (major histocompatibility complex type I). Pacco recognizes these tumor proteins and attacks Crab throwing toxic molecules such as perforin or granzyme.



To boost his attack Pacco can "clone" himself and form a battalion of identical lymphocytes (phenomenon of "clonal proliferation").



At the end of the battle Pacco remembers the threat so that he can fight faster and stronger after a new encounter ("memory").

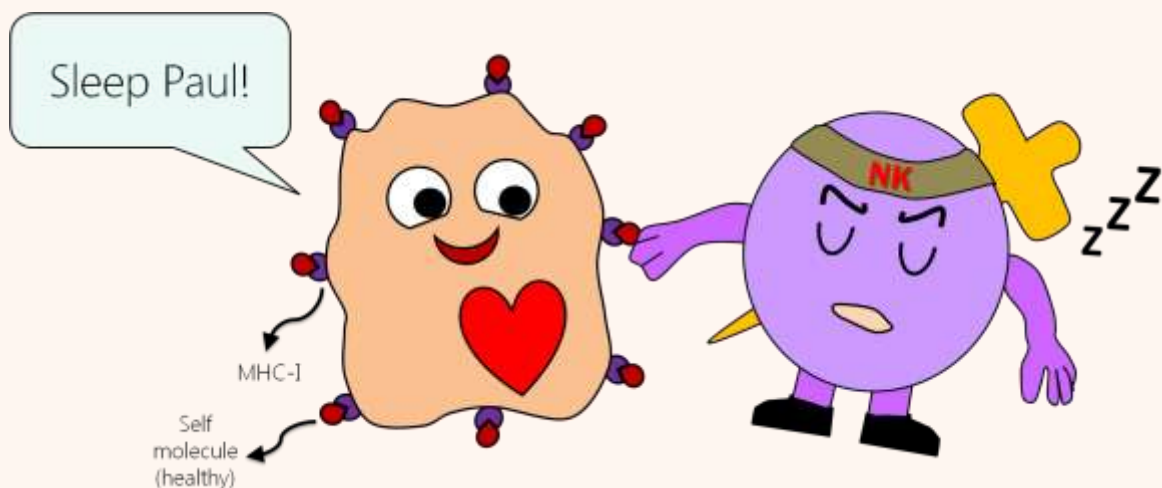


## Chapter 5: The attack of Paul, our NK lymphocyte

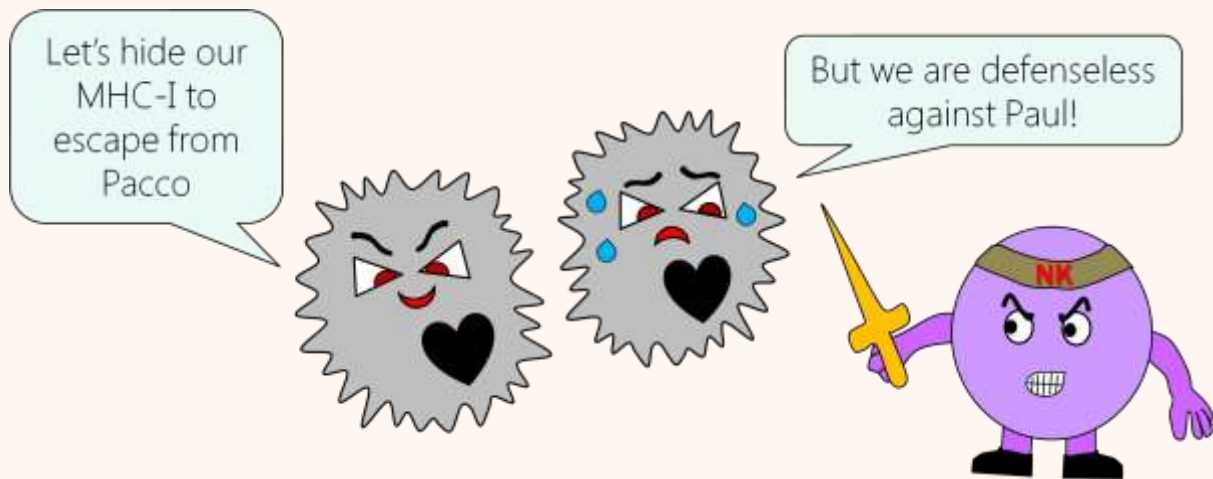


The second soldier of our anti-cancer army is the NK cell. NK means "natural killer".

Paul is our NK lymphocyte. He is always ready to kill other cells. Healthy cells, like Cris, switch-off Paul using MHC-I molecules to protect from his attack.



Some malignant cells stop expressing MHC-I molecules to escape from Pacco, the T CD8 cell. When this occurs, the malignant cell becomes vulnerable to Paul. As soon as Paul finds a cancerous cell, he wakes up and starts his deadly attack with toxic proteins such as perforin or granzyme. Thus, the malignant cell is destroyed.



Unlike Pacco, Paul generally does not develop "memory" neither "clonal proliferation" after facing a threat.

Paul and Pacco complement their mechanisms of attack to recognize and destroy the malignant cells that cause cancer. Both soldiers are powered by Felix, the T CD4 lymphocyte.

Let's help Paul to answer the following questions:

1. How do healthy cells protect from the attack of Paul?

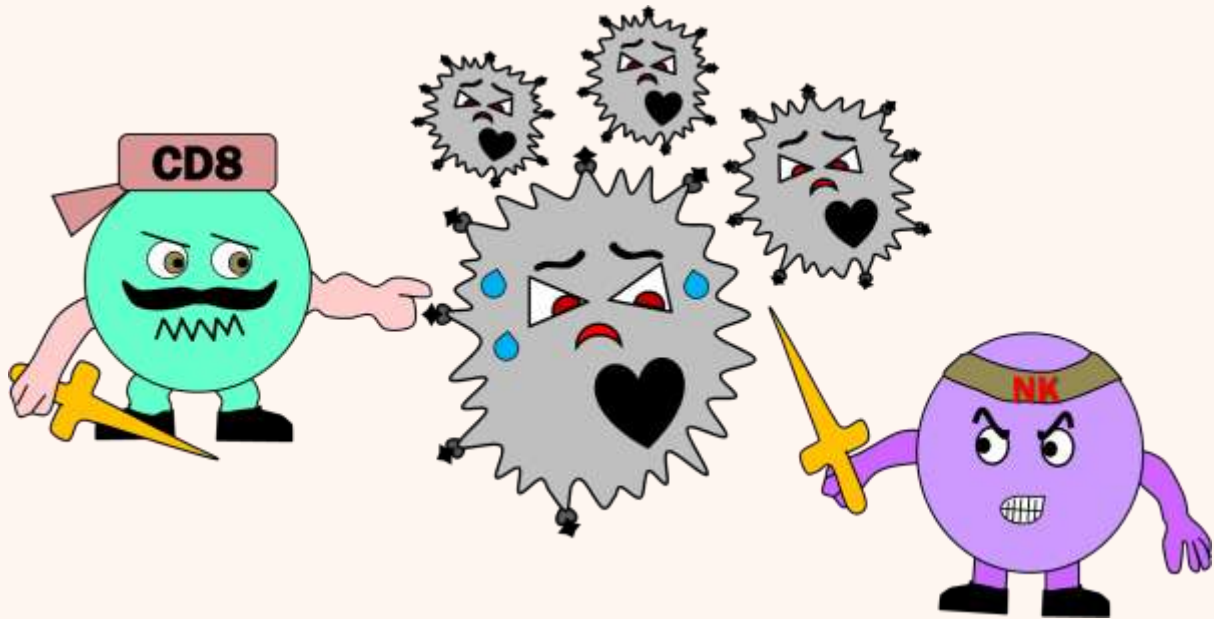
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2. Place true or false:

Pacco attacks a malignant cell after recognizing tumor proteins in its membrane \_\_\_\_\_

Paul attacks a malignant cell when it stops expressing MHC-I molecules \_\_\_\_\_

## Chapter 6: Fighting against cancer



Our anti-cancer army has the mission to destroy Crab and her malignant friends.

The soldiers Paul and Pacco patrol permanently inside our body to monitor the appearance of cancerous cells. This process is called "immune surveillance". Once our immunocytes recognize a malignant cell, they attack and destroy it.

The recognition and elimination of malignant cells by our immune system often succeeds. However, sometimes malignant cells escape the process of "immune surveillance", grow, reproduce and generate a malignant tumor.

Patients with defects of the immune system (immunodeficiencies) are more likely to develop malignant tumors because the process of "immune surveillance" is deteriorated.

On the other hand, cancer is more common in people exposed to factors that favor the appearance of mutations in cellular DNA (for example, ultraviolet radiation or cigarette smoke).

Thus, in some patients the malignant cells win the battle over the immunocytes putting our life at risk. Cancer is a deadly disease. Therefore, scientists have developed several therapies to destroy cancerous cells.

For the reasons mentioned above, it is very important to:

- Practice behaviors for cancer prevention.
- Be aware about cancer symptoms.
- Diagnose and treat cancer promptly.

Please solve the following questions:

1. What is the "immune surveillance"?

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2. Place true or false:

Our immune cells always eliminate malignant cells and prevent the development of cancer \_\_\_\_\_

Scientists have developed several therapies to destroy cancerous cells \_\_\_\_\_

It is very important to practice behaviors that promote cancer prevention \_\_\_\_\_

## Chapter 7:

# Can we prevent or treat cancer?



There are several treatment modalities for cancer. Sometimes they work, sometimes not. For example:

- Removing the tumor by surgery.
- Killing malignant cells using highly toxic drugs (chemotherapy) or radiation (radiotherapy).
- Boosting the immune system to kill malignant cells (immunotherapy). Anti-cancer immunotherapy has improved markedly in the last years, for example, the use of monoclonal antibodies against malignant tumors.

Cancer is difficult to cure. It is better to prevent it. Then, we should:

- Avoid cigarette smoke. As a result we reduce the risk of many types of cancer (lung, larynx, stomach, pancreas, etc.).

- Use sunscreen to reduce the risk of skin cancer.
- Receive the hepatitis B vaccine to reduce the risk of cirrhosis and liver cancer.
- Receive the human papillomavirus vaccine to reduce the risk of cervical cancer.
- Eat healthy foods (fruits, vegetables, water, low amount of salt and sugar) and avoid exposure to toxic chemicals. Thus we reduce the risk of various types of cancer.

It is also very important to detect cancer at an early stage. For example, it is recommended that:

- Adult women should have mammograms regularly to detect breast cancer.
- From certain age, women should have a Pap smear to detect cervical cancer.
- Men from a certain age should have a test called PSA for early detection of prostate cancer.

We should do everything necessary to help our immunocytes in the battle against cancer!





In this little book we have learned how our immunocytes defend us from the malignant cells to prevent and fight against cancer.

Do not miss the following book, where I will show you how our immunocytes learn to tolerate substances that, although being strange to our bodies, give benefit to us, such as food.

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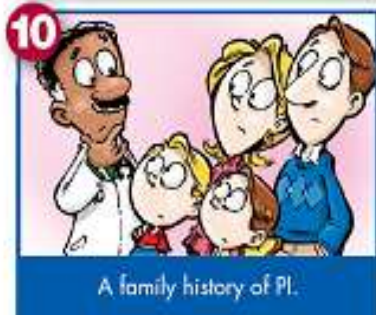
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"For God so loved the world that he gave his one and only Son, that whoever believes in him shall not perish but have eternal life". **John 3:16**

# 10 Warning Signs of Primary Immunodeficiency

Primary Immunodeficiency (PI) causes children and adults to have infections that come back frequently or are unusually hard to cure. 1:500 persons are affected by one of the known Primary Immunodeficiencies. **If you or someone you know is affected by two or more of the following Warning Signs, speak to a physician about the possible presence of an underlying Primary Immunodeficiency.**



"These warning signs were developed by the Jeffrey Modell Foundation Medical Advisory Board. Consultation with Primary Immunodeficiency experts is strongly suggested. ©2013 Jeffrey Modell Foundation"

[www.INFO4PI.org](http://www.INFO4PI.org)



**Series:** Funny Immunology to Save Lives

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- Book 3: The TH1 army against Mycobacteria
- Book 4: The TH2 army against worms
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- Book 6: The immunocytes against cancer
- Book 7: T regs: controlling the immune army
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- Book 9: When the Immunocytes go crazy...
- Book 10: The Immunocytes and the transplantation...
- Book 11: The armor of Felix the Immunocyte

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