بسم الله الرحمن الرحيم

Erythropoiesis (from Greek 'erythro' meaning "red" and 'poiesis' meaning "to make"(is the process which produces erythrocytes). It is stimulated by decreased O_2 in circulation, which is detected by the kidneys, which then secrete the hormone erythropoietin. This hormone stimulates proliferation of red cell. In the early fetus, erythropoiesis takes place in the yolk sac. By the third or fourth month, erythropoiesis moves to the liver. After seven months, erythropoiesis occurs in the bone marrow. The bone marrow produces red blood cells until a person is around five years old. The tibia and femur cease to be important sites of hematopoiesis by about age 25; in the vertebrate pelvis and ribs, and cranial bones continue to produce red blood cells throughout life.

RBC's circulate for 120 days, many die in the spleen due to narrow channels. When hemolysis occurs, hemoglobin is released and plasma membranes are digested by macrophages in the liver and spleen.

Homeostasis: is the ability to maintain a relatively stable internal state despite changes in the world outside. For example, if the blood pressure get high or body temperature plummets, the organ systems may struggle to do their jobs. Each of these variables is controlled by one or more regulators, which together maintain life. Examples of homeostasis in humans include the regulation of blood sugar via insulin, the regulation of body temperature by the hypothalamus, regulation of blood pressure via sensors in the walls of arteries, the pH balance maintained by the lungs and kidneys.

The human body is an amazingly complex machine, but many of its parts and processes exist simply to maintain homeostasis, for example,

- Humans' internal body temperature is a great example of homeostasis. When someone is healthy, their body maintains a temperature close to 37 degrees Celsius.
- When glucose levels get too high, the pancreas releases a hormone known as insulin. However, if blood glucose levels drop too low, pancreas signals to liver and muscle cells to change glycogen back to glucose, and raising the levels.

White Blood Cells (**WBC**s) or **leukocytes:**

It is called **leucocytes** and abbreviated as WBCs. They are the cells of the immune system that are involved in protecting the body against both infectious disease and foreign invaders. All white blood cells are produced from cells in the bone marrow known as stem cells. Leukocytes are found throughout the body, including the blood and lymphatic system. All white blood cells have nuclei, which distinguishes them from the other blood cells.

Classification of white blood cells:

White blood cells (WBC) play a significant role in the immune system by protecting the body from infectious disease and foreign invaders. Therefore, an automatic identification of WBC from microscopic images is an importance to help the haematologist in diagnosing diseases, such as leukemia, AIDS, and certain types of blood cancer.

There are five different types of white blood cells, they are put into two different groups based on appearance in the microscope:

1- Granulocytes have visual grains in their cells that help with their specific functions; they are:

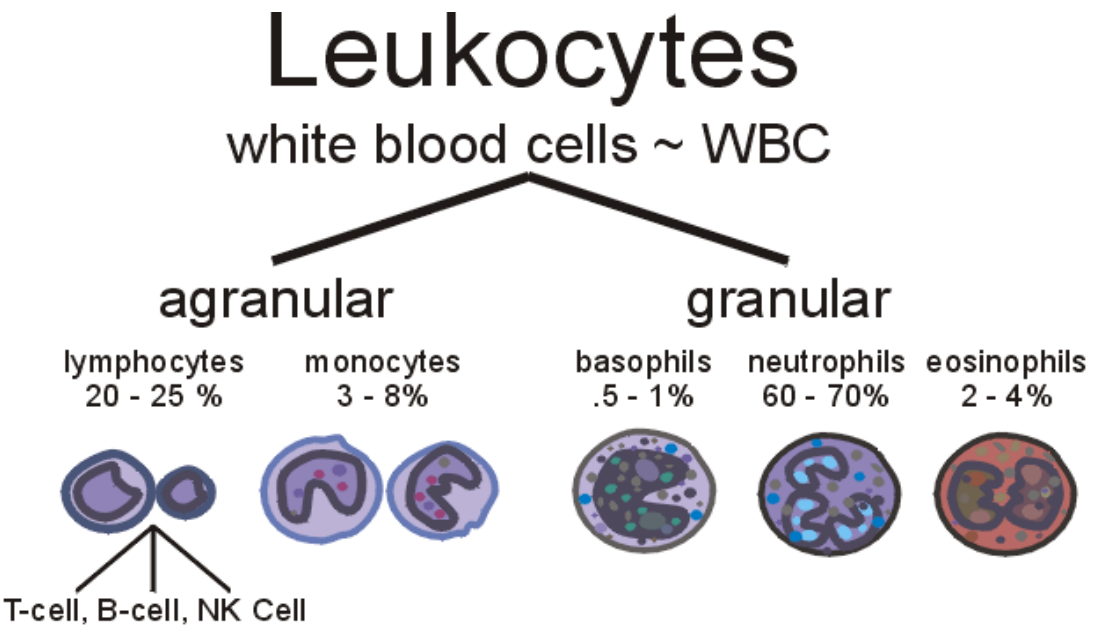
Neutrophils, the most numerous of the white blood cells.

Eosinophils, are usually involved in infections of **parasitic worms.**

Basophils, the granules seen in basophils contain histamine and heparin.

2- Agranulocytes have not any type of visual grains in their cells, there are:

Monocytes, *the* largest white blood cell. When they leave the blood they're called macrophages.



Lymphocytes, are a special type of white blood cell that are capable to division in lymphatic organs and tissues, such as the tonsils, lymph nodes and spleen. Lymphocytes come in three main types.

B lymphocytes differentiate in the bone marrow and produce antibodies and do antibody-mediated resistance.

T lymphocytes differentiate in the thymus and perform cell-mediate resistance, and

NK cells or natural killer are a part of the innate immune system and play a major role in defending the body against tumors and virally infected cells.

Number of leukocytes

The number of leukocytes in the blood is often an indicator of disease. Normally approximately 7000 white blood cells per microliter of blood. They make up approximately 1% of the total blood volume in a healthy adult. Basophils, make up between 0.01 to 0.03 percent of white blood cells. Whereas **neutrophils** are the most common cell type seen in the early stages of acute inflammation, they make up 60-70% of total leukocyte count in human blood. An increase in the number of leukocytes over the upper limits is called **leukocytosis**, and a decrease below the lower limit is called **leukopenia.** Most of Leukocytes are produced in bone marrow from the same kind of stem cells that produce red blood cells. Others are produced in the thymus gland, which is at the base of the neck

Specific Function of leukocytes:

Leukocytes, or white blood cells (WBCs), are essential immune system components that defend the body against foreign materials and infectious diseases. Leukocytes are present in the lymphatic system and the blood, traveling to infected tissues and/or organs to attack the cause of the infection.

Neutrophilis:

1- Killing foreign bacteria in the body.
2- Release a super oxide burst to kill many bacteria at once.
3- Most active in addressing phagocytosing bacteria.

4- Protect against many diseases include tuberculosis, leprosy, cholera, syphilis, typhoid fever and tetanus.

Eosinophils:

1- *Release toxins* to kill the parasites.
2- Provide protection to the body in case of allergic reactions (hay fever and asthma).
3- Provide defense against parasitic infections. include babesiosis, malaria, sleeping sickness.

Basophils:

Main function is help with the inflammatory response when tissue is damaged, secretion of both histamine and heparin. Histamine draws blood into the damaged area, while heparin slows clotting so that more blood can enter the damaged area.

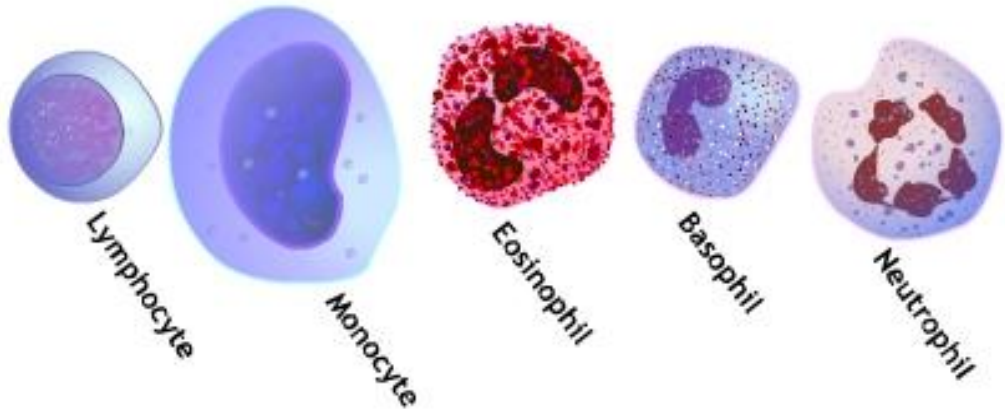
Monocytes

Monocytes are only found in the blood. But when enter tissues, they are called macrophages. These cells crawl and phagocytize all sorts of things big or small. Monocytes or macrophages do phagocytosis of foreign particles in the body, such as **bacteria**, **dead neutrophils** and **dead body cells.**

Lymphocytes:

1- T cells are involved in cell-mediated immunity.
2- T cells release cytokines and growth factors that regulate other immune cells.
3- B cells are primarily responsible for humoral immunity.
4- B cells Secretion of antibodies.
5- NK cells play a major role in defending the host from both tumors and virally infected cells.

6- NK cells distinguish infected cells and tumors from normal and uninfected cells by recognizing changes of a surface molecule.



Normal Value:

How many white blood cells (WBCs) someone has varies, but the normal range in adult males and females are usually between 4,000 and 11,000 per microliter of blood.

Granulocytes (or polymorphonucl)

Neutrophils (or segs): 50 - 70% relative value (2500-7000 absolute value)

Eosinophils: 1 - 3% relative value (100-300 absolute valu

Basophils: 0.4% - 1% relative value (40-100 absolute value)

Agranulocytes (or mononuclears) e)

Lymphocytes: 25 - 35% relative value (1700-3500 absolute value)

Moncytes: 4 - 6% relative value (200-600 absolute value)