***Lecture four: Erythropoiesis*** :

***Its refers to the formation of erythrocytes*.**

The **bone marrow** produces all of the **different types of blood cells**. **Erythropoiesis is an extremely active process.**

**It is estimated that about 2.5 million erythrocytes (2.5 million/ sec) are produced every second in order to replace those that are continuously destroyed by the spleen and liver.**

***Regulation of Erythropoiesis (*Homeostasis** ) :

1. The primary regulator of erythropoiesis is: ***Erythropoietin:***

***A hormone produced by the kidneys in response to tissue hypoxia when the blood oxygen levels are decreased****.*

1. One of the possible causes of decreased blood oxygen levels is a decreased red blood cell count.
2. Because of erythropoietin stimulation, the daily production of new red blood cells compensates for the daily destruction of old red blood cells, **preventing a decrease in the blood oxygen content**.

An increased secretion of erythropoietin and production of new red blood cells **occurs when a person is at a high altitude** or has **lung disease**, which is conditions that reduce the oxygen content of the blood.



***The Life spane of red blood cells:***

When RBCs are delivered from the bone marrow into the circulatory system, they normally circulate an average of **120 days** before being destroyed.

Even though mature RBCs do not have:

**A**- A nucleus.

B- Mitochondria.

C- Endoplasmic reticulum.

They do have cytoplasmic enzymes:

That is capable of metabolizing glucose and forming small amounts of adenosine triphosphate.

**Death and Disposal رمي :**

1. The metabolic systems of old RBCs become progressively **less active** and the

**cells become more and more fragile.**

1. **Presumably,** because their life processes wear out اضعف Once the RBC membrane becomes fragile.
2. The **cell ruptures** during passage through some tight spot of the circulation.
3. Many **of the RBCs self-destruct in the spleen** where they **squeeze through the red pulp of the spleen** there.

the spaces between the structural trabecular of the red pulp, through which most of the cells must pass, is only **3 micrometers wide**, in comparison with diameter of the RBC. –

 When the spleen is removed, the number of old abnormal RBCs circulating in the blood increases considerably.

***Destruction of Hemoglobin*:**

 When RBCs burstتنفجر and release their hemoglobin, the hemoglobin is phagocytized almost immediately by **macrophages** in any parts of the body, but especially by the:

* 1. **Kupffer cells of the liver**.
	2. **Macrophages of the spleen**.
	3. **Bone marrow**.

 During the next few hours to days, the macro-phages release iron from the hemoglobin and pass it back into the blood, to be carried by **transferrin** either to the **bone marrow** for the **production of new RBCs** or to the **liver and other tissues for storage** in the form of **ferritin** .

The porphyrin portion of the hemoglobin molecule is converted by the macrophages, through a series of stages ,into the bile pigment bilirubin, which is released into the blood and later removed from the body by secretion through the liver into the bile.

***Leucocytes (White blood cells):***

**The leukocytes, also called white blood cells:**

**Are the mobile units of the body’s protective system**. They are formed **partially** in the

1. **Bone marrow** (granulocytes and monocytes and a few lymphocytes).
2. **Partially in the lymph** tissue (lymphocytes and plasma cells).

After formation, they are transported in the blood to different parts of the body where they are needed.

***The number of leukocytes*** in the blood***:***

Is oftean indicator of [disease](https://en.wikipedia.org/wiki/Disease), and thus the ***white blood cell coun****t* is an important subset of the [complete blood count](https://en.wikipedia.org/wiki/Complete_blood_count).

The normal white cell count [is usually](https://en.wikipedia.org/wiki/Reference_ranges_for_blood_tests) between **4 × 109/L and 11 × 109/L**. Usually expressed **as:**

***4,000 to 11,000 white blood cells per microliter of blood****.*

**A**- White blood cells make up approximately **1%** of the total blood volume in a healthy adult, making them substantially less numerous than the [red blood cells](https://en.wikipedia.org/wiki/Hematocrit)

[at 40% to 45%](https://en.wikipedia.org/wiki/Hematocrit).

**B**- However, this 1% of the blood makes a large difference to health, because [immunity](https://en.wikipedia.org/wiki/Immunity_%28medical%29) depends on it.

**C-** An increase in the number of leukocytes over the [upper limits](https://en.wikipedia.org/wiki/Reference_ranges_for_blood_tests#White_blood_cells_2) is called [leukocytosis](https://en.wikipedia.org/wiki/Leukocytosis).

**D-** It is normal when it is part of healthy immune responses, which happen frequently.

**E-** It is occasionallyمن حين الى اخر abnormal, when it is [neoplastic](https://en.wikipedia.org/wiki/Neoplasm)(the uncontrolled, abnormal growth of cells or tissues in the body )or [autoimmune](https://en.wikipedia.org/wiki/Autoimmunity) in origin.

**F-** A decrease below the lower limit is called [leukopenia](https://en.wikipedia.org/wiki/Leukopenia). This indicates a weakened immune system.

***The main features of white Blood Cells:***

1. White blood cells are spherical cells that lack hemoglobin.
2. White blood cells are **large**r than red blood cells.
3. Each has nucleus.
4. White blood cells can leave the blood and travel by amoeboid. Movement through the tissues.

***Functions of white blood cells :***

1. -Protect the body against invading microorganisms and other pathogens.

- Remove dead cells and debris from the tissues by phagocytosis