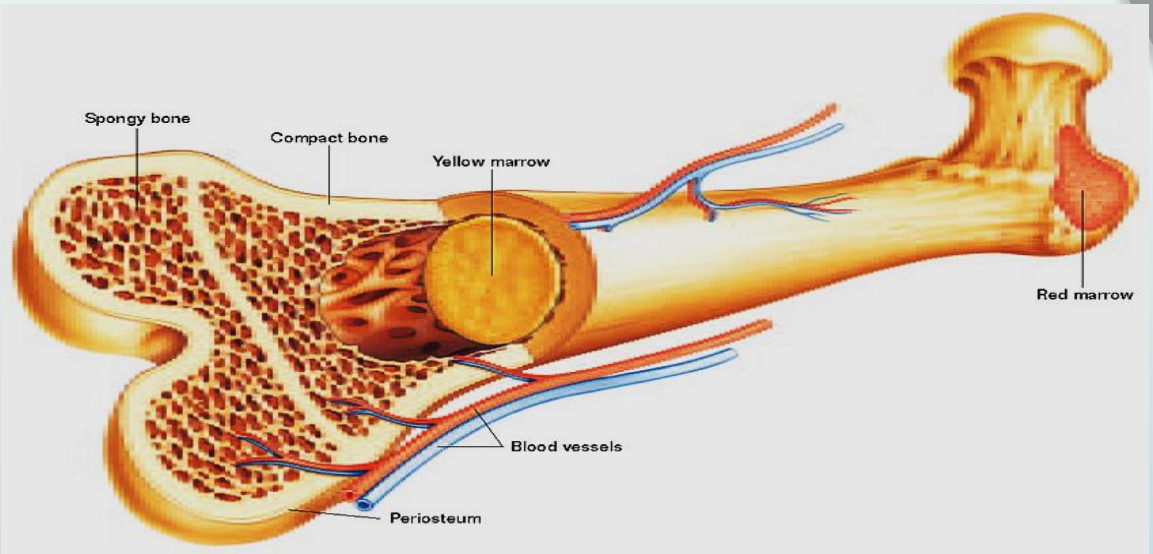
BONE MARROW



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Bone marrow

- **Bone marrow** is a spongy highly vascular and flexible connective tissue that fills the center of bones in your body.
- Serve as the primary site of new blood cell production or **hematopoiesis**.
- It is where **stem cells** produce red and white blood cells and platelets. Without bone marrow, you couldn't move oxygen through your body or fight infections, and blood wouldn't clot.

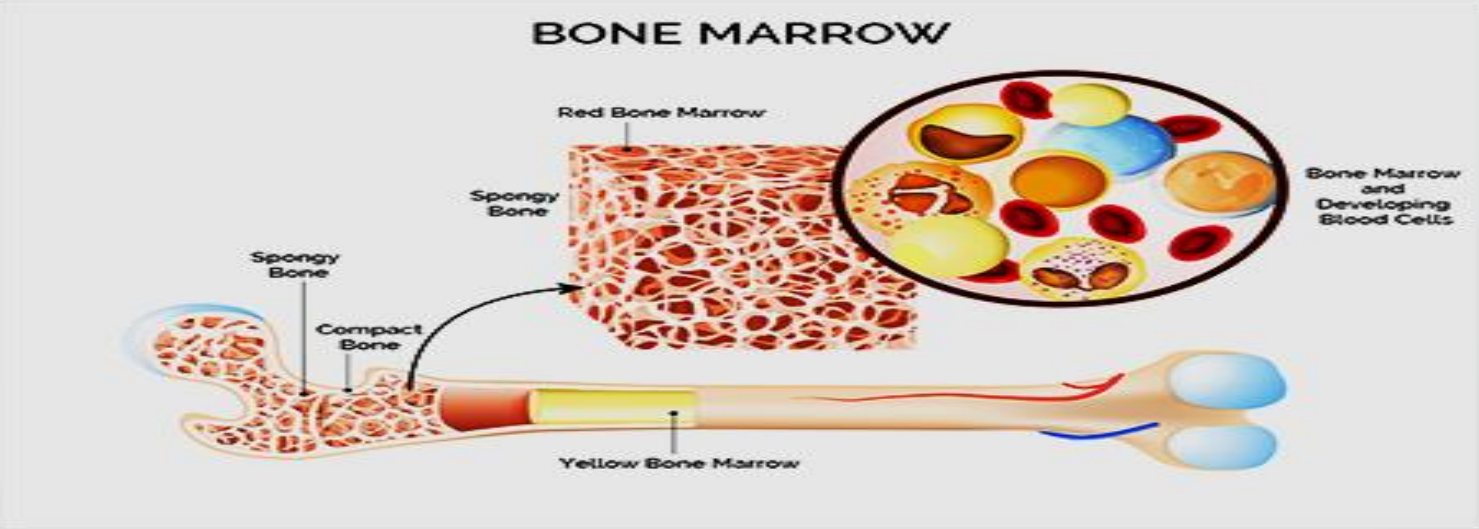
It is composed of :

1. Stem cells (hematopoietic).
2. Marrow adipose tissue.
3. Supportive stromal cells.

- In adult humans, bone marrow is primarily located in the axial bones **ribs, vertebrae, sternum, and bones of the pelvis.**
- Bone marrow comprises approximately **5%** of total body mass in healthy adult humans.

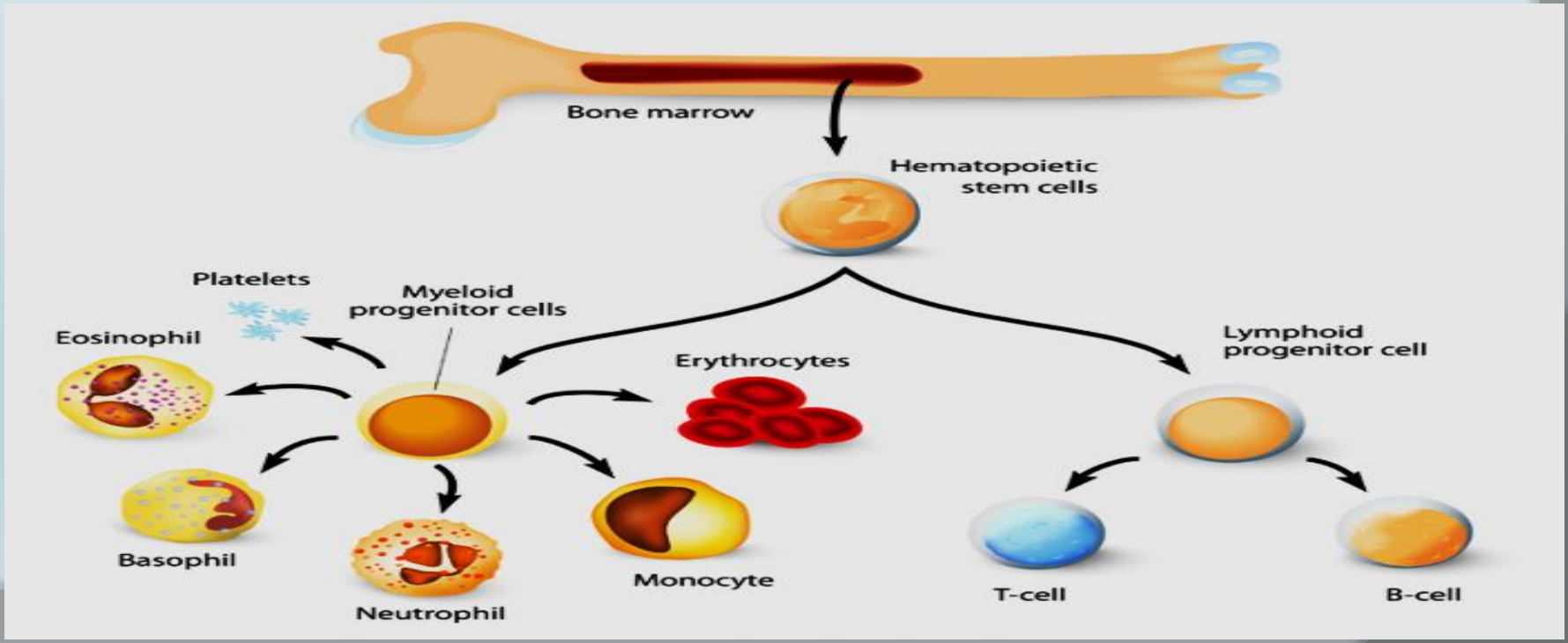
Structure

- In humans, marrow is characterized as **"red"** or **"yellow"** marrow, respectively depending on the prevalence of **hematopoietic (stem cells) vs fat cells.**
- A newborn baby's bones exclusively contain haematopoietically active "**red**" marrow, and there is a progressive conversion towards "**yellow**" marrow with age.
- **Yellow** bone marrow stores **fat and nutrients** for **red** bone marrow to use and to maintain body functions.
- In conditions of **chronic hypoxia**, the body can convert **yellow** marrow back to **red** marrow to **increase blood cell production**.



Hematopoietic components

- At the cellular level, the main functional component of bone marrow includes the **progenitor cells** which are destined to mature into **blood and lymphoid cells.**
- Marrow contains **hematopoietic stem cells** which give rise to the three classes of blood cells that are found in circulation: white blood cells **(leukocytes),** red blood cells **(erythrocytes),** and platelets (**thrombocytes**).



Stroma

- Stromal cells may be **indirectly** involved in hematopoiesis, providing suitable-environment that influences the function and differentiation of hematopoietic cells.

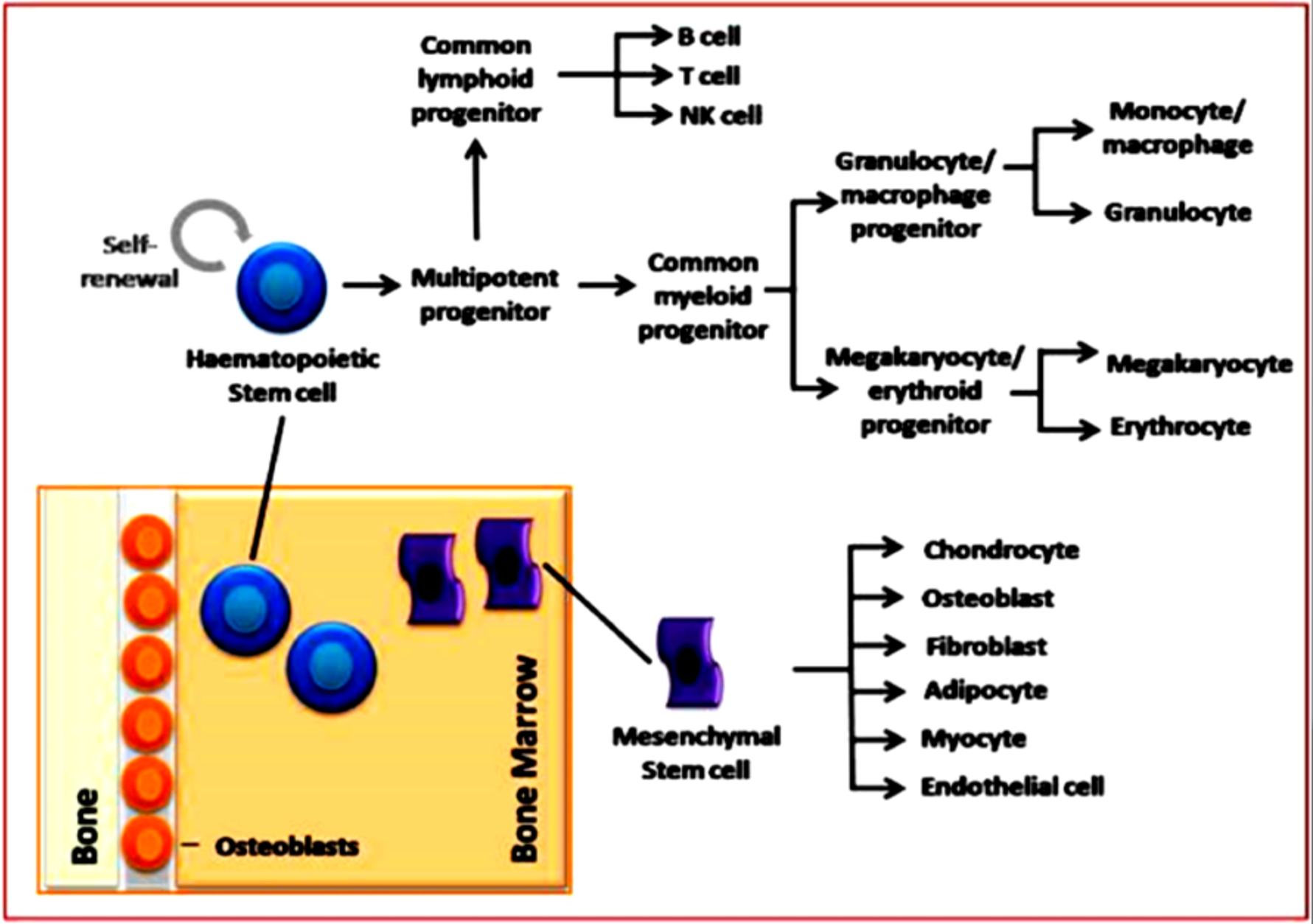
For example : They generate **colony stimulating factors**, which have a significant effect on hematopoiesis.

- Cell types that constitute the **bone marrow stroma**

Stroma

Mesenchymal stem cells

- The bone marrow stroma contains mesenchymal stem cells **(MSCs),** also known as marrow stromal cells.
- These are **multi-potent stem cells** that can differentiate into a variety of cell types.
- MSCs have been shown to differentiate, in vitro or in vivo, into chondrocytes, myocytes, beta-pancreatic islets cells , fibroblasts (formation of connective tissue), Adipocytes (fat cells) , Osteoblasts (synthesize bone), Osteoclasts (resorb bone) and Endothelial cells, which form the sinusoids.



Cellular constitution of the red bone marrow parenchyma

Bone marrow barrier

- The **blood vessels** of the bone marrow constitute a barrier, inhibiting immature blood cells from leaving the marrow.
- Only **mature blood cells** contain the membrane proteins, such as **aquaporin** and **glycophorin,** that are required to attach to and pass the blood vessel endothelium.

Lymphatic role

- The **red bone marrow** is a key element of the lymphatic system, being one of the **primary lymphoid organs** that generate lymphocytes from **hematopoietic stem cells**.
- The bone marrow and thymus constitute the primary lymphoid tissues involved in the **production** and **maturation** of lymphocytes.

Bone marrow diseases

1. Aplastic anemia

- This serious blood disorder arises when damage, such as from **autoimmune disorders** or **exposure to toxins**, sustained to the stem cells in bone marrow causes it to create fewer number of all types of blood cells.
- As a result, your blood supply won't meet your body's demands and you may be easily fatigued, shortness of breath, weakness, bleeding tendency and immunity suppression.

2. Leukemia

- Leukemia originates in the bone marrow. This blood cancer accelerates production of abnormal **white blood cells**, which replace healthy bone marrow cells, interfering with other blood cell production.

- The abnormal white blood cells also are **unable to fight infections**.
- There are two main types:

acute leukemia, which progresses rapidly, **chronic leukemia**, which develops more slowly.

Bone marrow tests

There is screen test that can determine if your bone marrow and blood cell counts are healthy.

One test is the **complete blood count** (**CBC**):

- It measures the number of red blood cells ,white blood cells and platelets in your blood.

- If blood cell counts generally fall within the normal ranges for age & gender, It means normally functioning bone marrow .

- If your **red** or **white blood cell** or **platelets** count is out of normal ranges, your doctor may want to test your bone marrow tissue directly for disease.
- There are **two main** methods of collecting bone marrow for further testing, often performed together:

1. **Bone marrow aspiration** : A needle is inserted into the bone and a small sample of liquid marrow is extracted for examination.
2. **Bone marrow biopsy** :A specialized bone marrow biopsy needle is inserted to remove a solid piece of bone marrow for examination.

Bone marrow transplantation

- Severely damaged bone marrow may require replacement via bone marrow transplant.
- Clinicians can place healthy stem cells in bone through a catheter.
- The body can take up to a month to accept transplanted stem cells and begin to use them to produce new blood cells (a process called **engraftment**).
- While your body replenishes its white blood cells, your immune system will be weakened and vulnerable to disease.

Keeping bone marrow healthy

- You can support the health of your bone marrow by eating a balanced diet that includes plenty of the following nutrients:
  - Iron
  - Protein
  - Phosphorus
  - Vitamin B
  - Unsaturated (healthy) fats
- Regular exercise such as swimming, hiking or cycling, also supports your bone marrow and a healthy cardiovascular system.

Thank You