

Histology

*Blood, Bone marrow
Hematopoiesis*

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TUCOM

BLOOD

Objectives are to learn:

- **The composition and functions of blood** -
- How to identify blood cells the sizes, -
distributions, and features/functions of
different blood cells
- How blood cells are made via hematopoiesis -

Blood :-

Is a special type of connective tissue because the cellular elements in are separated by catamount of intercellular substance (plasma), and because some

blood cells have close affinities to cells in connective tissue . The volume of Blood in the healthy adult human is about 5 liters, and about 8 per cent of the body weight. Its composed of plasma and formed elements(erythrocytes, leukocytes and platelets).

Functions of Blood •

- Transports gases, nutrients, waste, cells and hormones throughout the body. •
- Transports O₂, CO₂, nutrients, hormones, heat and wastes. •
- Regulates pH, temperature, water content of cells. •
- Protects against blood loss through clotting. •
- Protects against disease through phagocytic white blood cells and antibodies. •

The process by which blood is made is called Haemopoiesis. •

Plasma

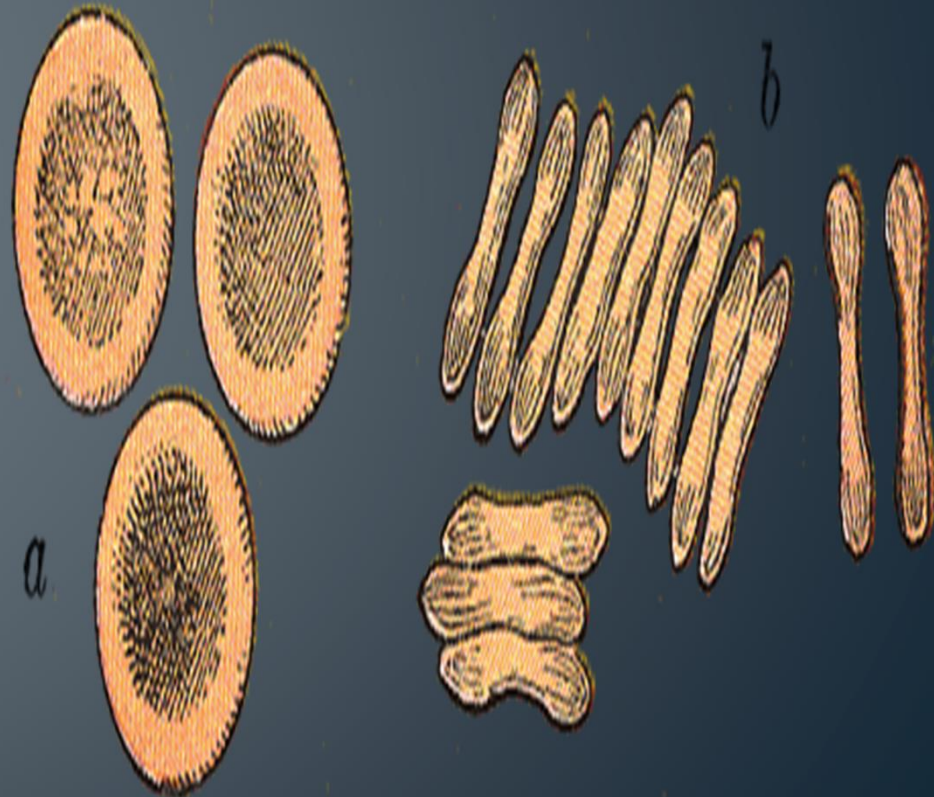
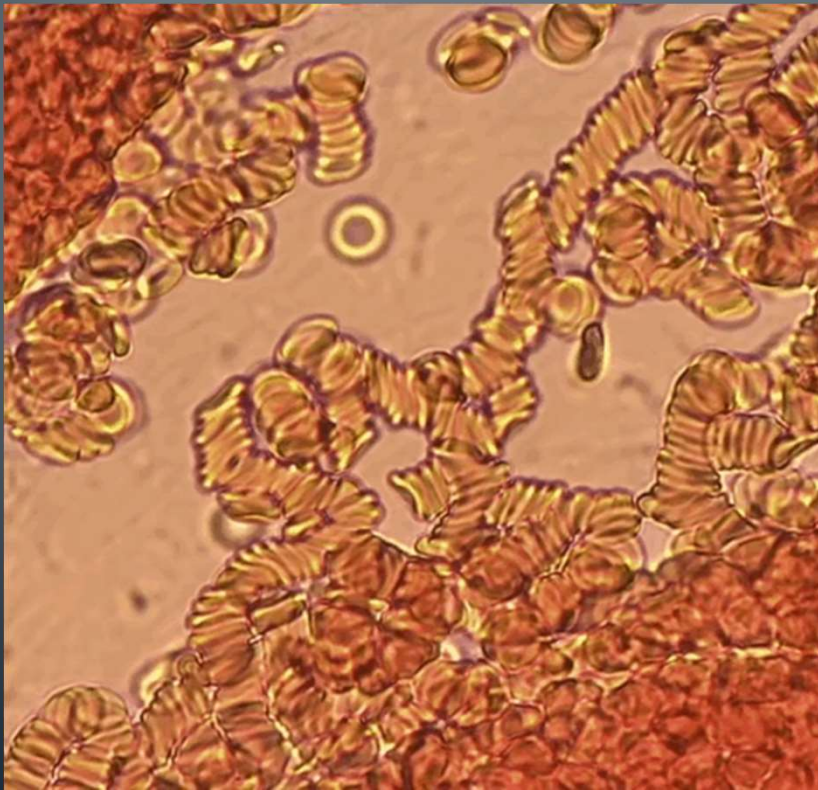
The intercellular substance of blood is a liquid called plasma, where the cellular elements of blood floats freely , its consist of water in which dissolved several types of protein and ions of sodium ,chloride, potassium etc, glucose and amino acid are also present. About 55% of total volume of blood is plasma. Plasma is a homogeneous, slightly alkaline fluid contains dissolved gases and inorganic salt . The contraction of clotted blood or plasma expresses a clear yellowish fluid, serum.

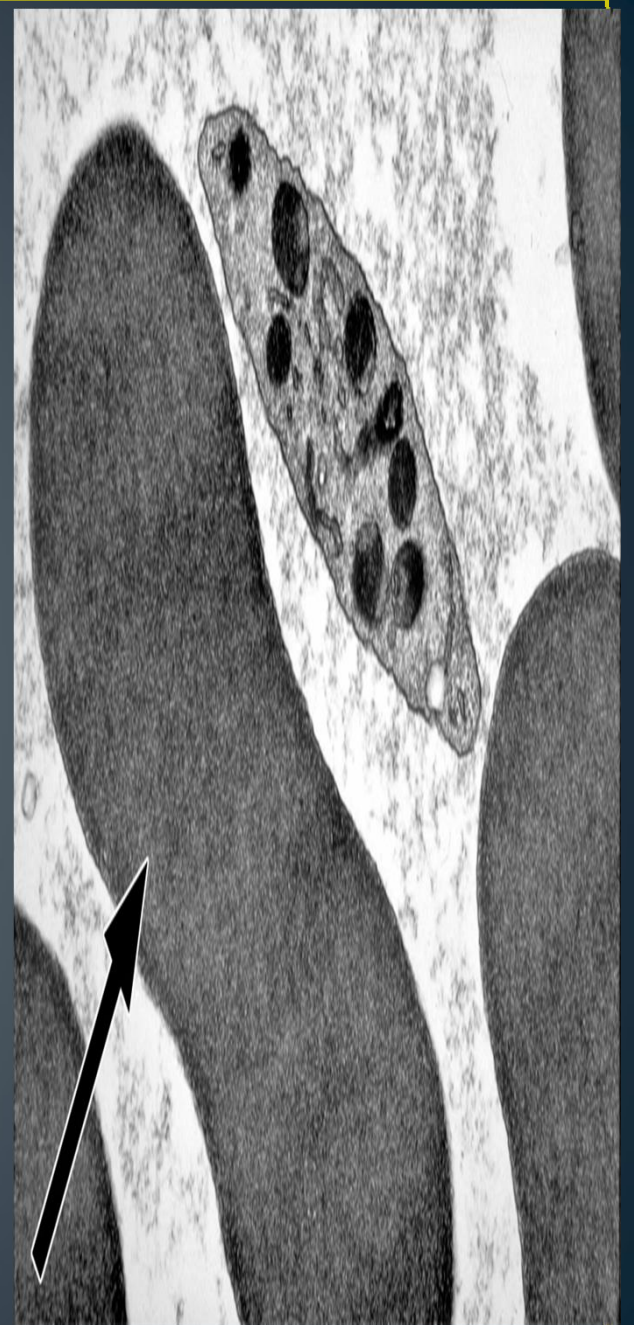
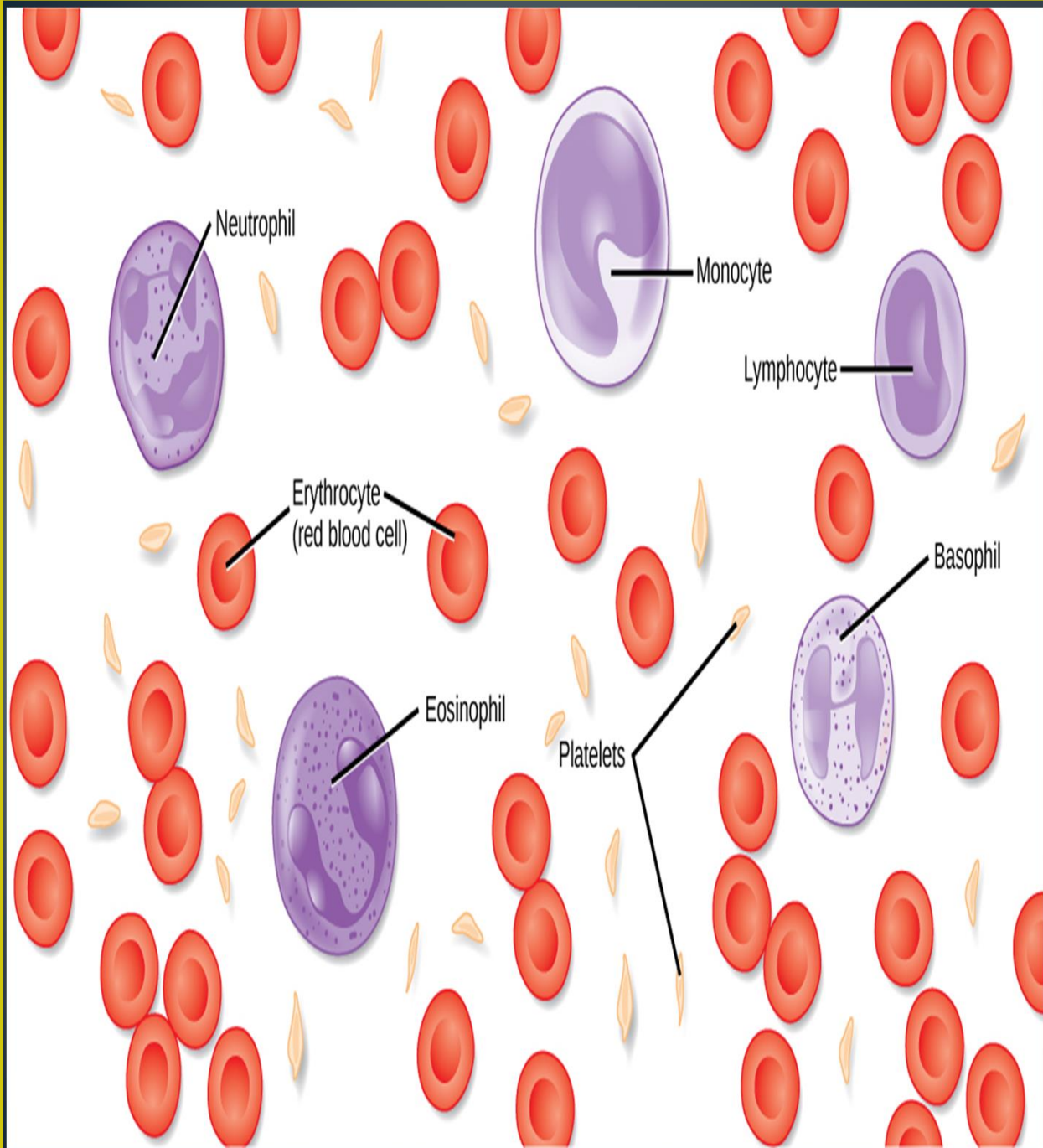
Cellular Elements

Erythrocytes

RBCs are the most abundant blood cells (about 700 erythrocytes for every 1 leukocyte), in human males there are (5-5.5 million erythrocytes per cubic millimeter) ; in females, (4.5-5 million). Erythrocytes are smaller than leukocytes. An erythrocyte has no nucleus (it is ejected as the cell develops) ,A single, fresh erythrocyte is pale greenish in color but in dense masses the color turns red . Erythrocytes in surface view are circular disc about 7 micron in diameter ,when viewed from side it is seen to be biconcave the maximum thickens about 2 micron . Erythrocytes are deliver O_2 to the cells , Hemoglobin molecules within erythrocytes bind O_2 when erythrocytes pass through the high O_2 environment of lung capillaries. Hemoglobin molecules release O_2 when erythrocytes pass through the low O_2 environment of capillaries in the rest of the body .Each erythrocyte is bounded by a delicate plasma membrane which is lipoprotein complex.

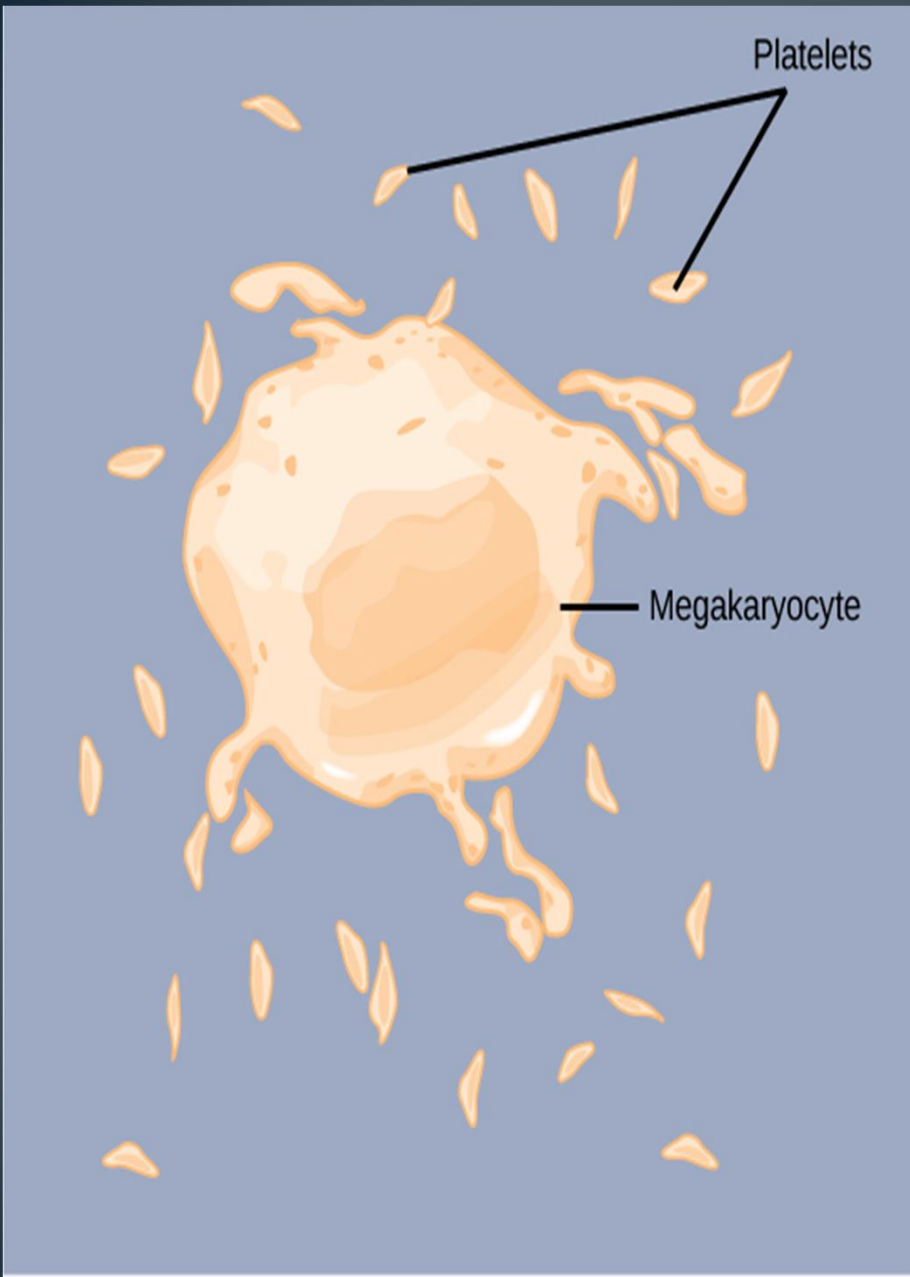
Erythrocytes have a tendency to adhere to each other along their concave surfaces, thus forming columns or rows, like piles of coin this phenomenon is termed rouleaux formation. Each erythrocyte has life of about 120 days and at the end of which it removed from plasma by cells of spleen and bone marrow.



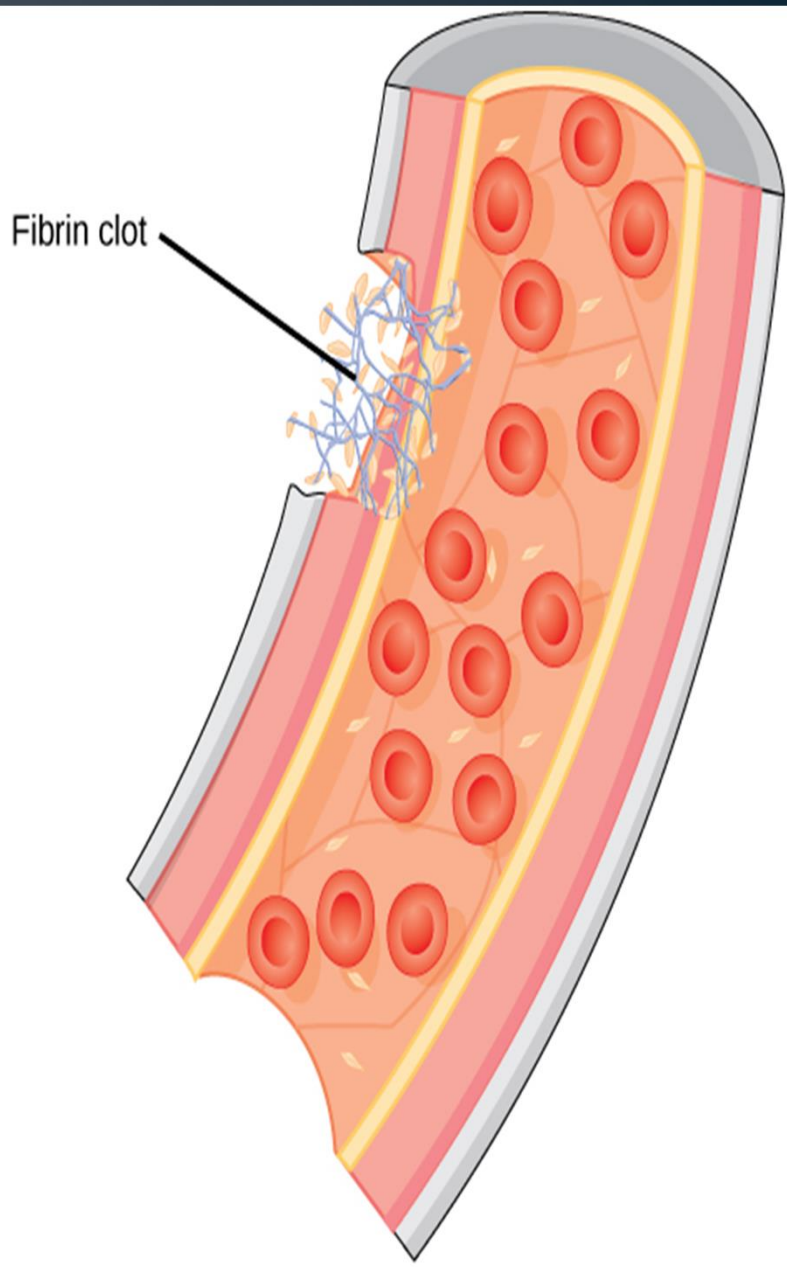


Platelets

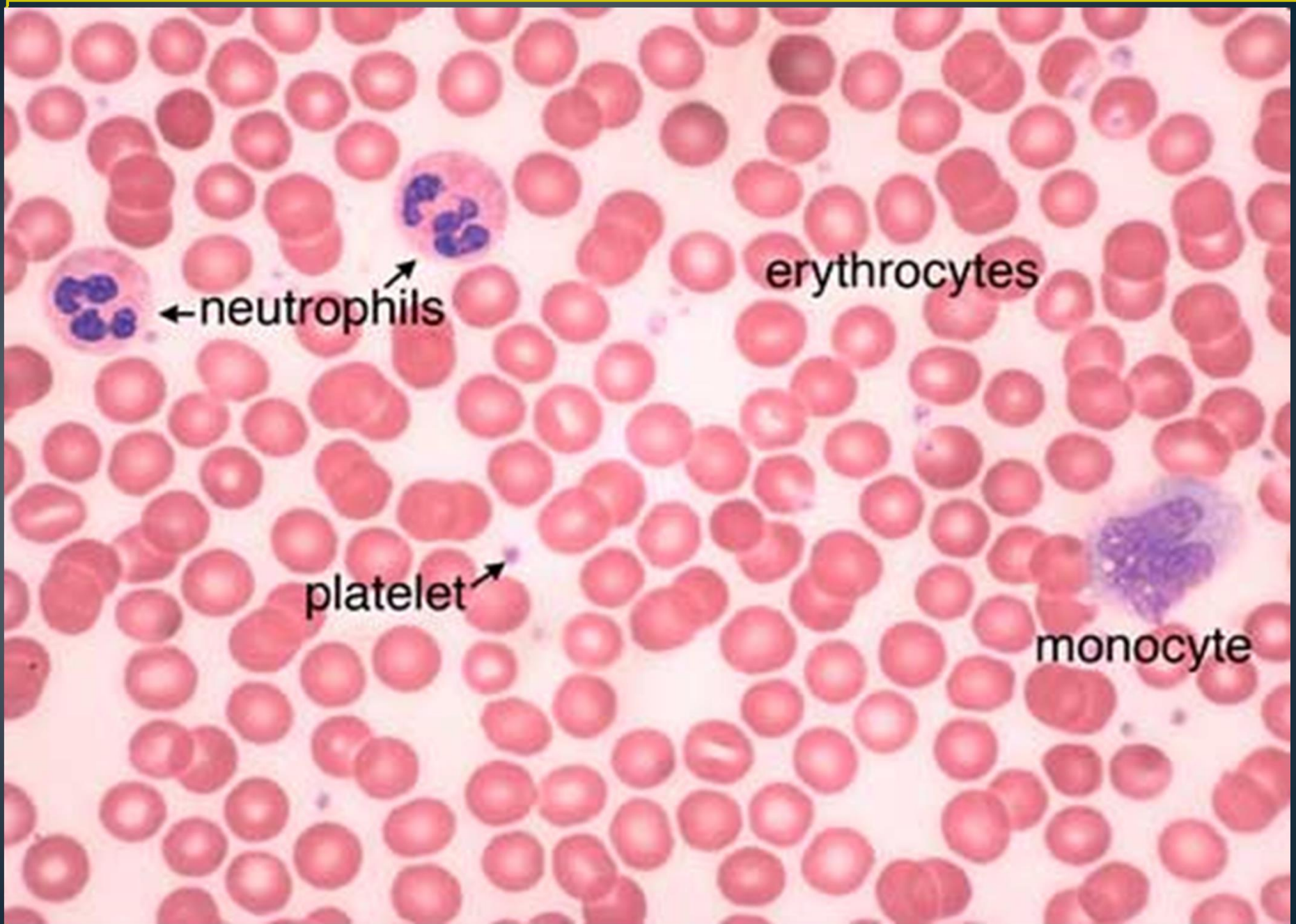
are pinched-off bits of cytoplasm (of a bone marrow cell called a megakaryocyte) enclosed in plasma membrane. Platelets devoid of nucleus and contain various substances that contribute to blood clotting ,These cells are round or oval discs about 3 micron in diameter . The discs are biconcave. Each disc is bounded by a plasma membrane with which there are mitochondria and membrane bound vehicles. There is no nucleus. In ordinary blood films the platelets appear to have a clear outer zone (hyalomere) appear pale and homogenous ,and a granular central part (granulomere) deeply basophil. The platelets are concerned with the clotting of blood. There are about 200,000 - 300,000 platelets per cubic millimeter of blood. The life of a platelet is about 10 days.



(a)



(b)



erythrocytes

← neutrophils

platelet →

monocyte

- Leucocytes(White blood cells)

The leukocytes have important roles in defending against infection, they are true cells, each leucocyte having a nucleus and organelles and they do not contain hemoglobin. Leucocytes can move actively and perform most of their functions after they leave the blood and enter tissues. In general leucocytes are of two types Granulated are further divided on the staining of their granules into (neutrophils, eosinophils, and basophils) and Agranulated leucocytes of two types (lymphocytes, monocytes) depending on the presence of special types of granules in their cytoplasm. So there are five types of leukocytes each with a different appearance and function.

Neutrophils

are the most abundant leukocyte (approximately 65% of the leukocytes). Neutrophils have a lobed nucleus (up to 6 lobes that's why these cells are also called polymorphonuclear leukocytes and their cytoplasm containing inconspicuous reddish-purple granules.

Lymphocytes

(about 25% of leukocytes) are the smallest of the leukocytes, just a bit larger than erythrocytes. A lymphocyte has a large spherical nucleus and a thin rim of blue-gray cytoplasm

Monocytes

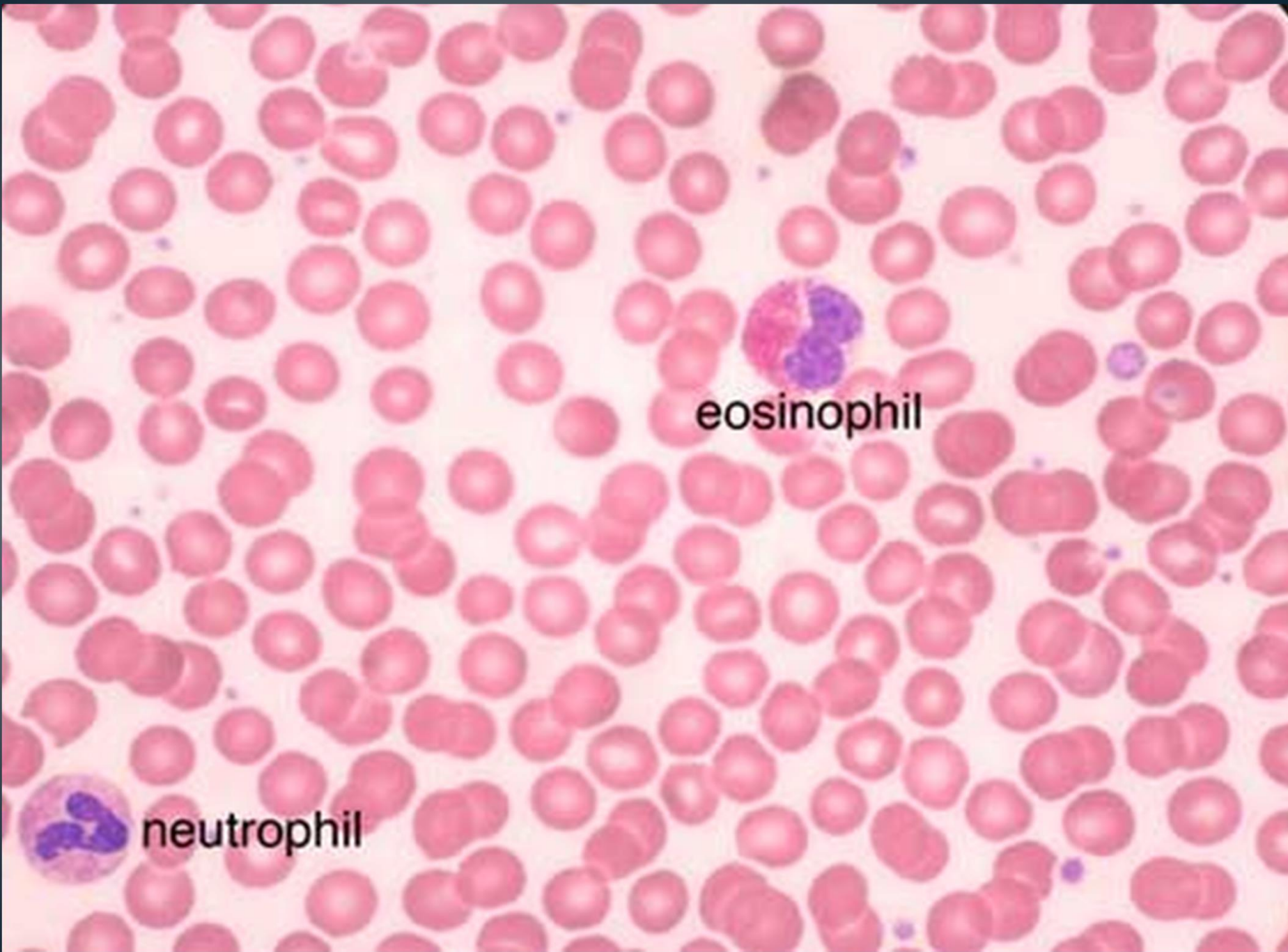
(about 6% of leukocytes) are the largest leukocytes and may show an irregular shape in blood smears. Monocytes typically have an indented nucleus and blue-gray cytoplasm.

Eosinophil's

(about 3% of leukocytes) have red granules in the cytoplasm and typically have a two-lobed nucleus.

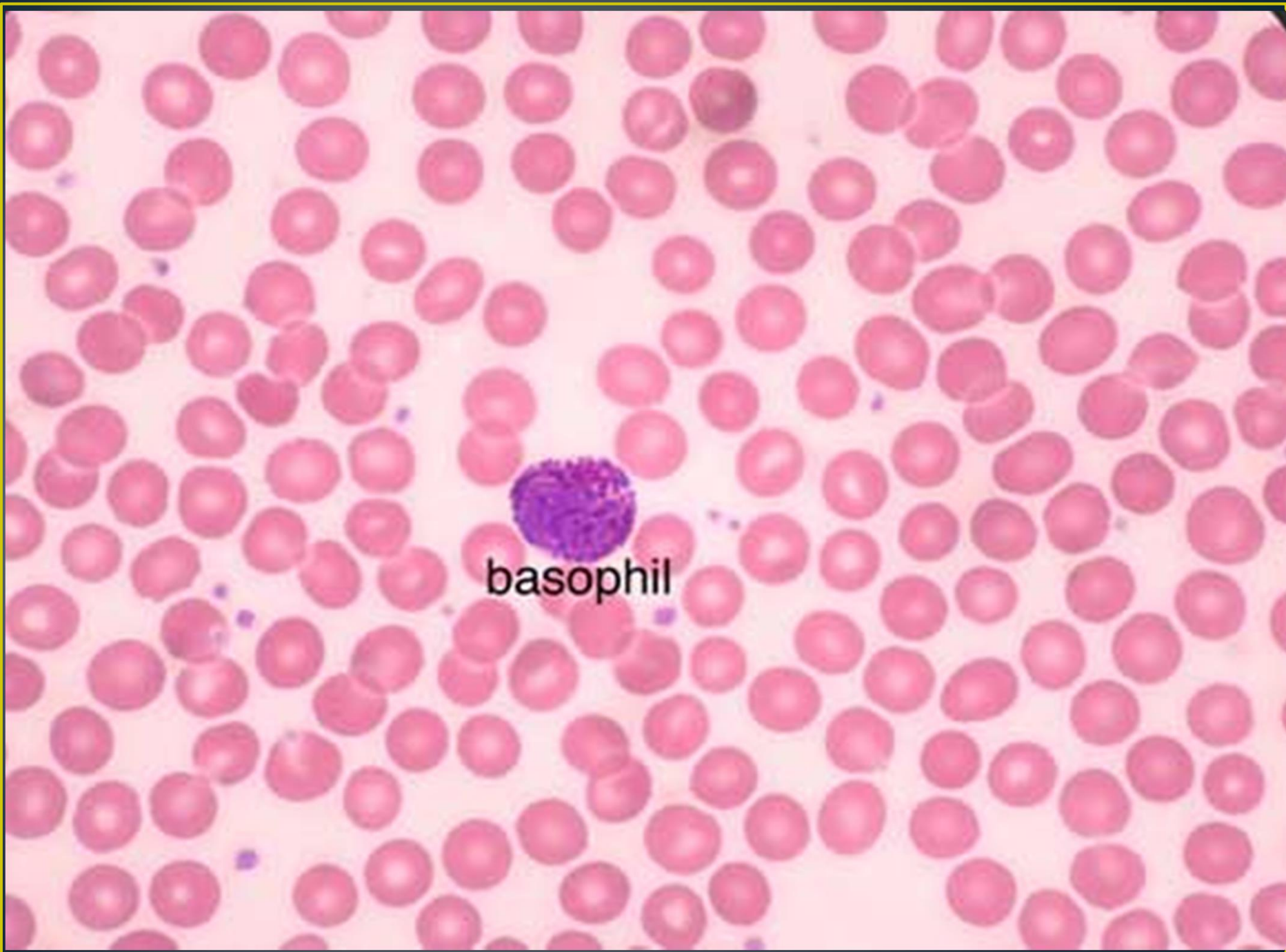
Basophils

(less than 1% of leukocytes) have prominent dark purple granules in the cytoplasm which partially obscure the lobed nucleus.

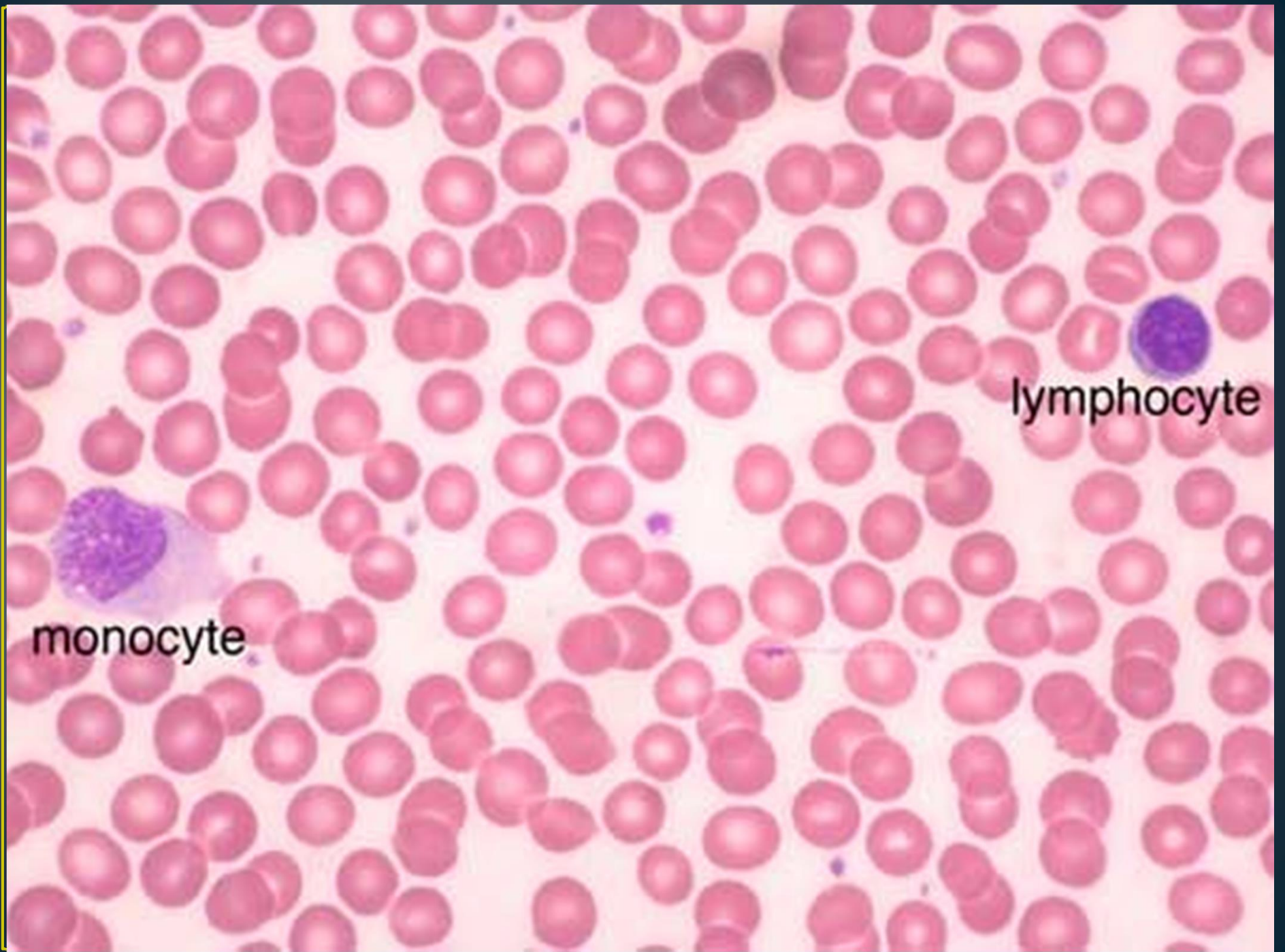


eosinophil

neutrophil



basophil



lymphocyte

monocyte

Hematopoiesis is the formation of new blood cells. In embryonic life blood cells are first form in relation to mesenchymal cells surrounding the yolk sac. After that in liver, later in spleen and still later in bone marrow. In postnatal life blood formation is confined to bone marrow and lymphoid tissue .There are embryonic stem cells that are pleuripotent. Arising from them 1- Haemopoietic stem cells, that are present only in bone marrow and give rise to all blood cells other than lymphocytes . 2- Lymphopoietic stem cells that are present in bone marrow and in lymphoid tissue and gives rise to lymphocytes. process, hematopoietic stem cells are processed, transformed, developed and differentiated into different type of cells to serve their specific purposes according to their location and structural build. All type of blood cells are derived from one immature cell which is the hematopoietic stem cells (HSCs). If we are to take a cross section of our bone, we can notice that there is a central cavity, and in this cavity we can find the bone marrow. Bone marrow is the major site for hematopoiesis. So obviously, there's a large amount of HSCs in this area. This is where the genetic structures of each HSCs are modified and differentiated by changing the protein components of our HSCs.

After that the production is transferred to our liver. And then when our bone matures it is then transitioned to our bone marrow and thymus gland..

Structure of the bone marrow

Stroma – network of reticular cells and reticular fibers
(reticular connective tissue)

Adipocytes, macrophages and fibroblasts are also seen

Sinusoids are wide, numerous, fenestrated blood
capillaries

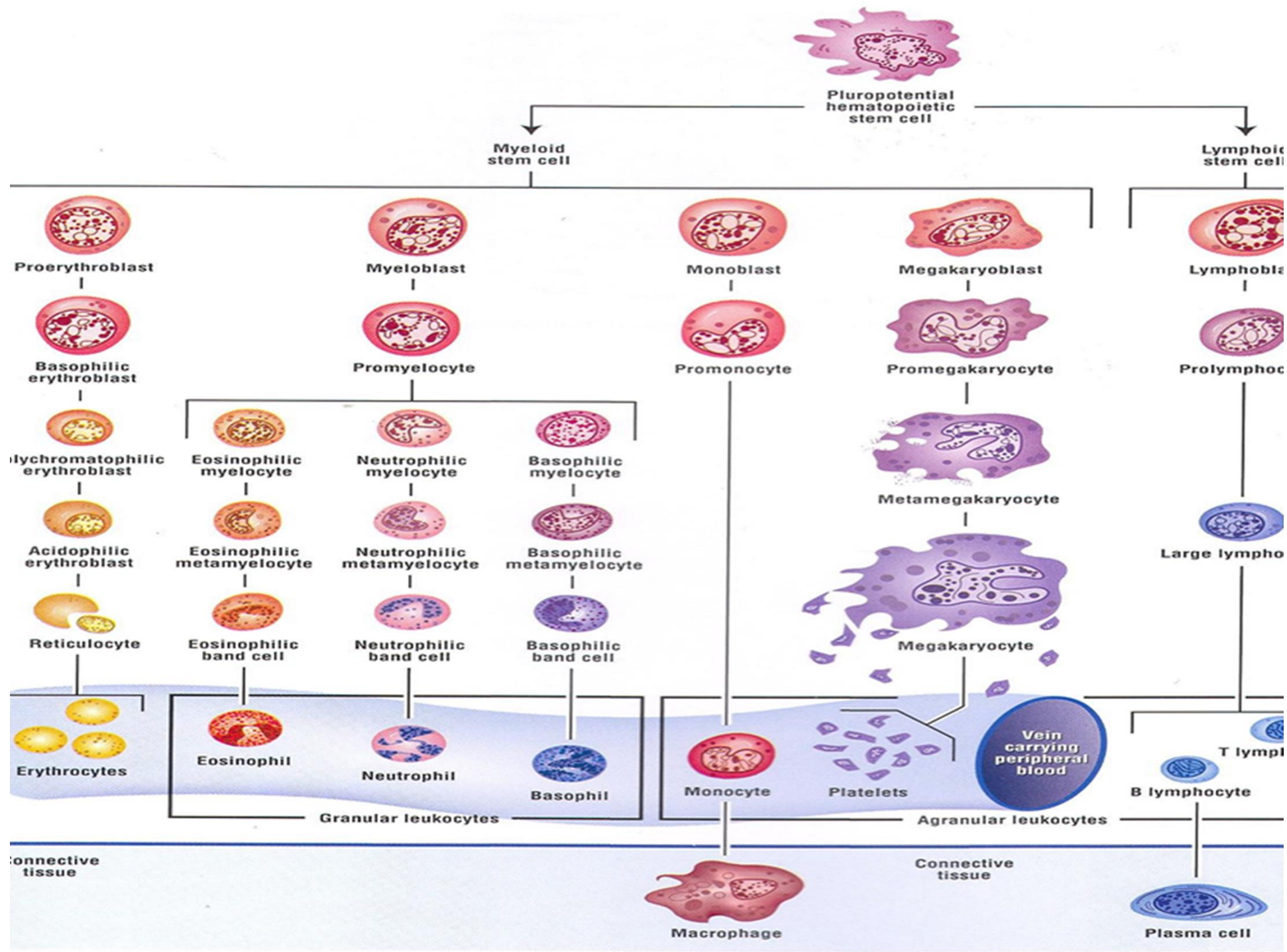
Haematopoietic stem cells and all stages in maturation
OF blood elements

Regulation of hematopoiesis

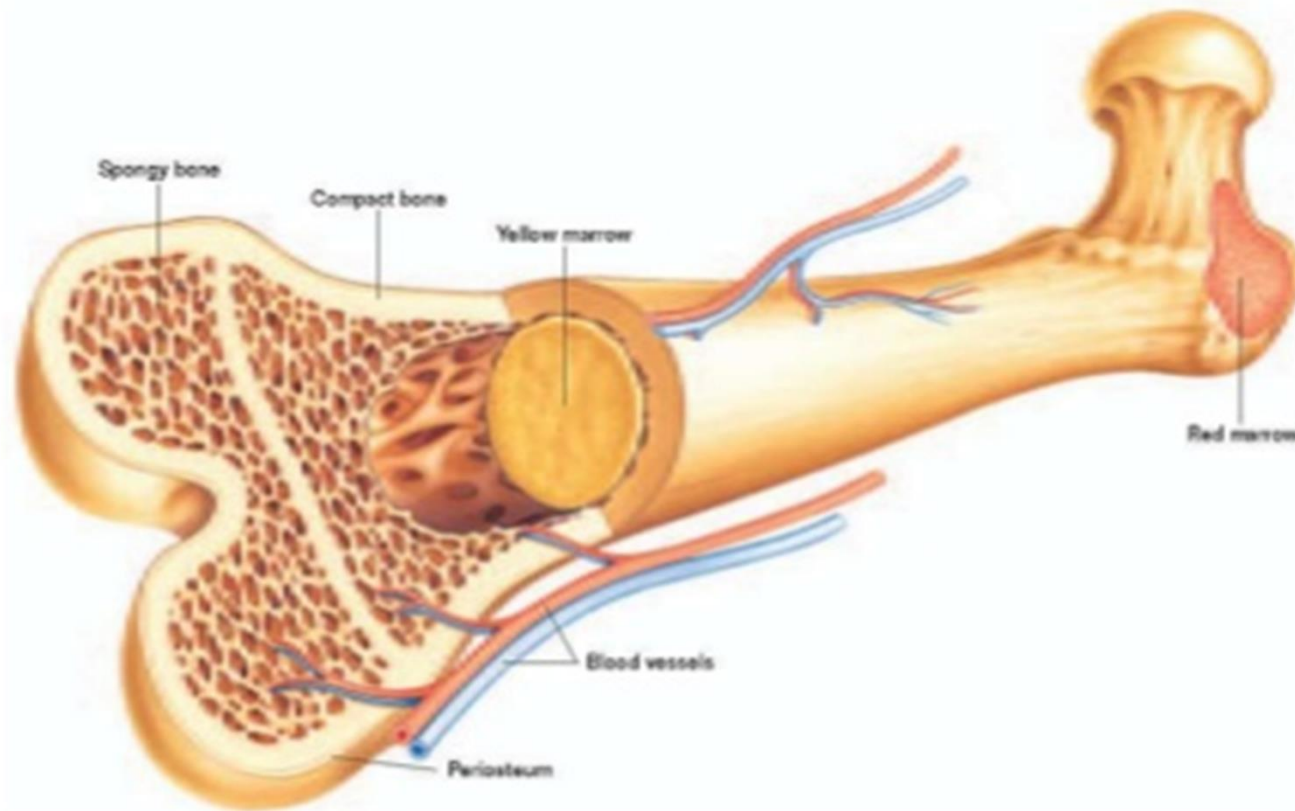
Erythropoietin – cortex of the kidney

Thrombopoietin (megakaryocyte growth and development
factor) – liver, kidney

Cytokines (protein signaling molecules) and growth factors –
stromal cells of bone marrow



Bone marrow



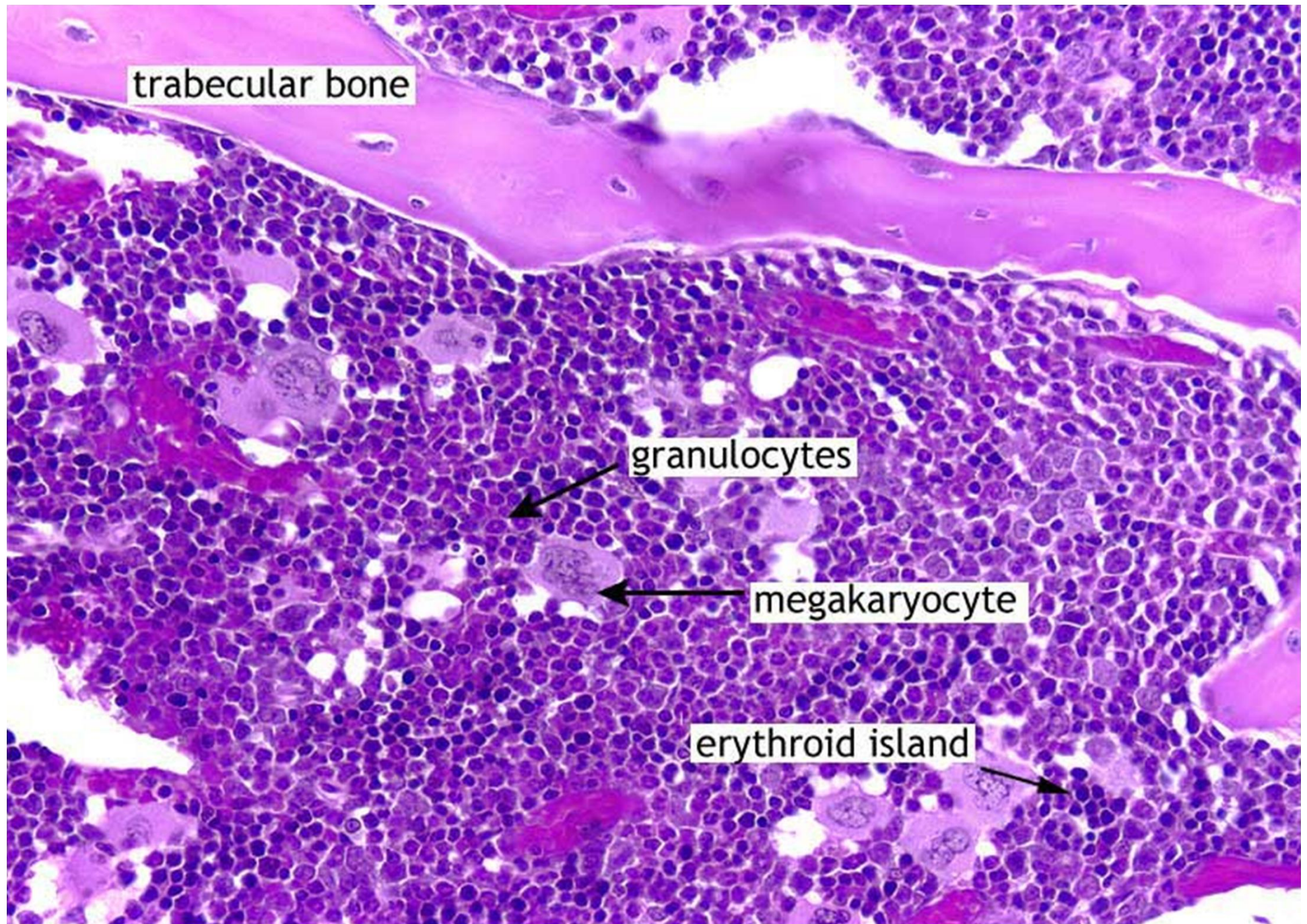
Yellow marrow is mostly fat.

Red marrow makes blood.

Bone marrow makes red blood cells.

red bone marrow - The type of marrow tissue found in spongy bone and marrow cavities where the various blood stem cells reside and where new red blood cells, white blood cells, and platelets are produced for release into the circulation.

yellow bone marrow - The type of marrow tissue found in spongy bone and marrow cavities where adipose tissue predominates a storage depot for fats.



trabecular bone

granulocytes

megakaryocyte

erythroid island

