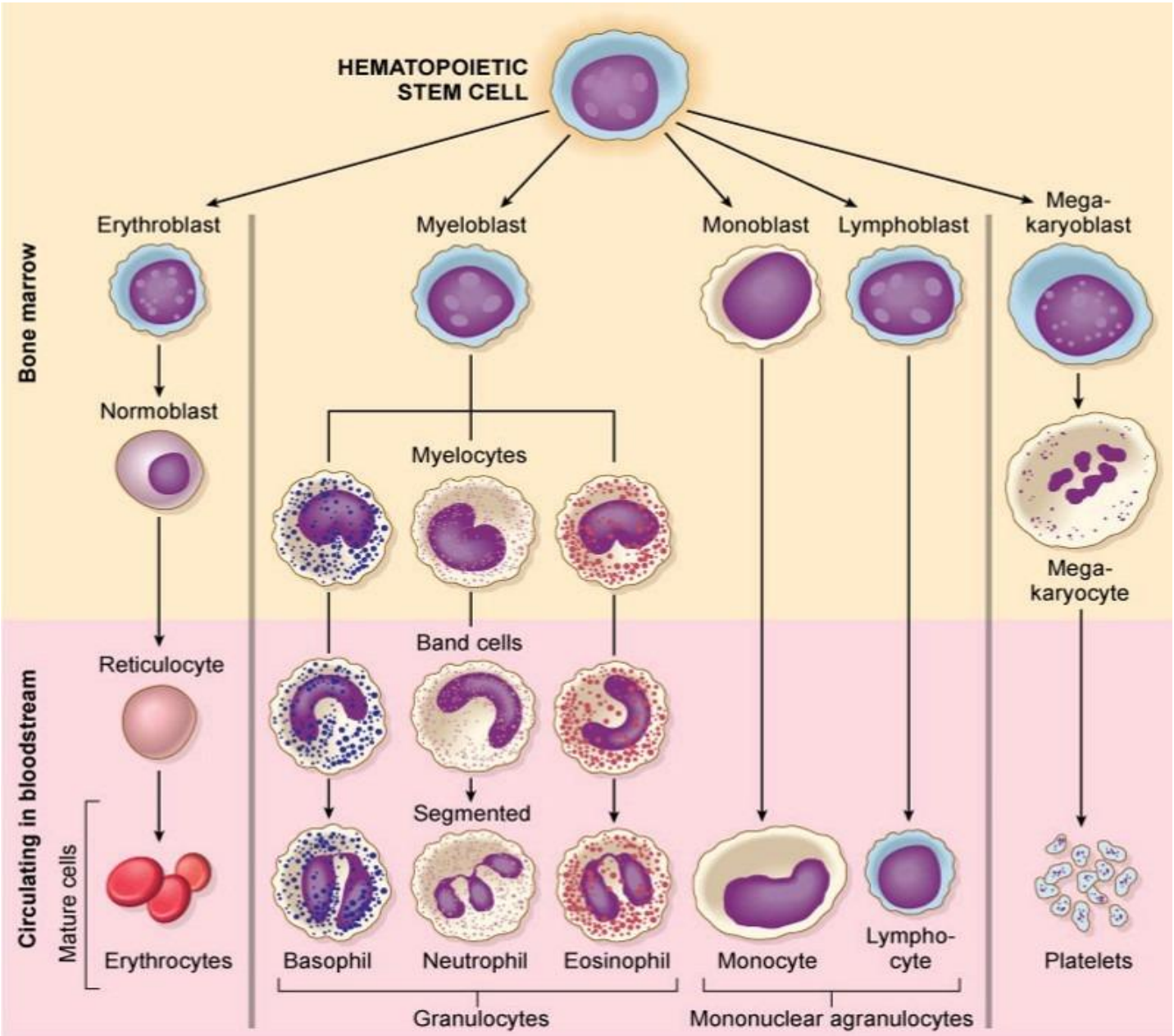
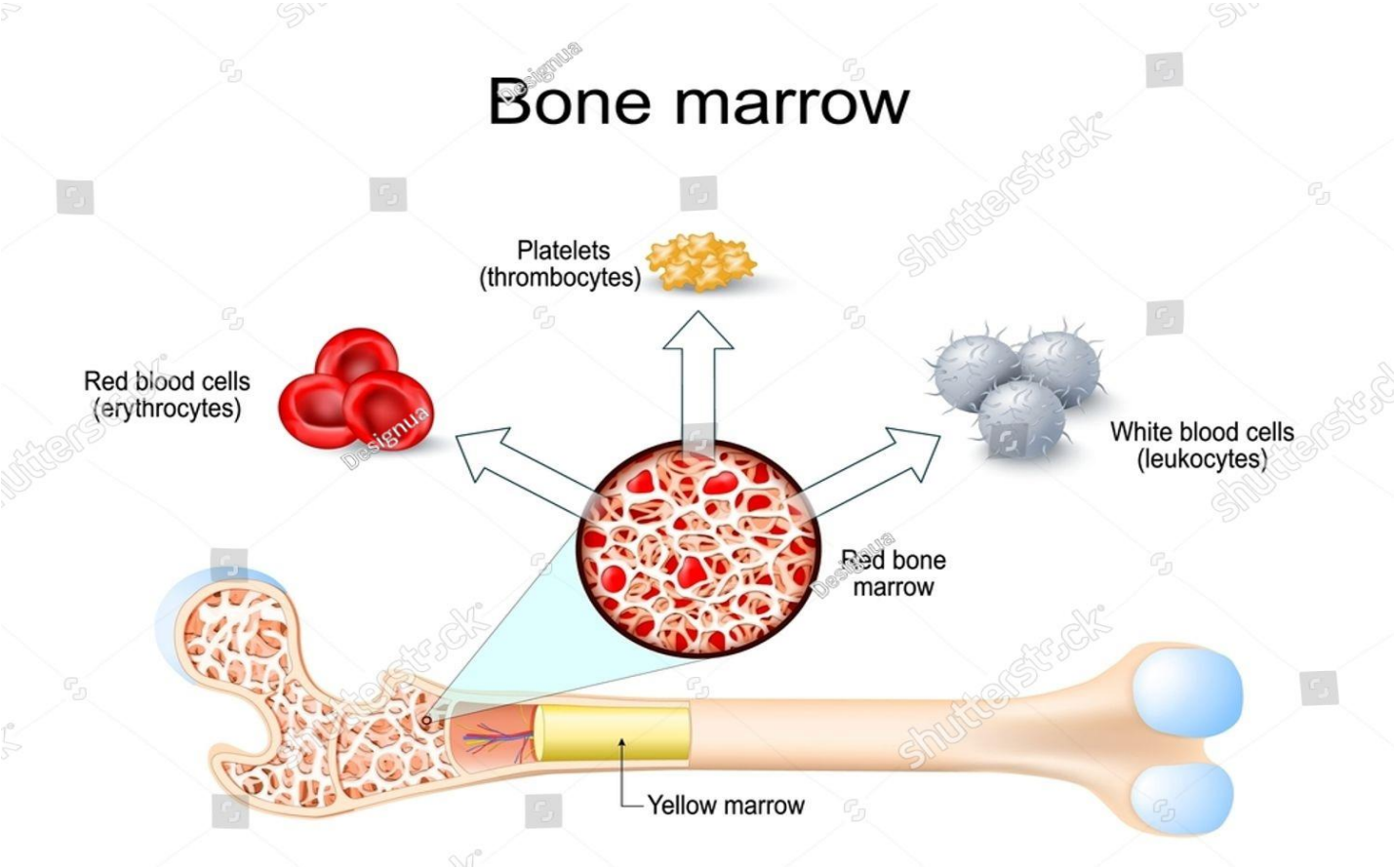
Hematology

Hematology is the study of the **physiology** and **pathology** of blood's cellular elements. Blood is a connective tissue. Like all connective tissues, it is made up of **cellular elements** and an **extracellular matrix**. The **cellular elements**—referred to as the formed elements include red blood cells (**erythrocytes**), white blood cells (**leukocytes**), and platelets (**thrombocytes**). The **extracellular matrix**, called (**plasma)**, makes blood unique among connective tissues because it is fluid. This fluid, mostly water, perpetually suspends the formed elements and enables them to circulate throughout the body within the cardiovascular system.





1. **Erythrocytes**, red blood cells (RBC), usually comprise about 45% of whole blood. The normal values:

   (Male): 4.7-6.1 million RBCs.

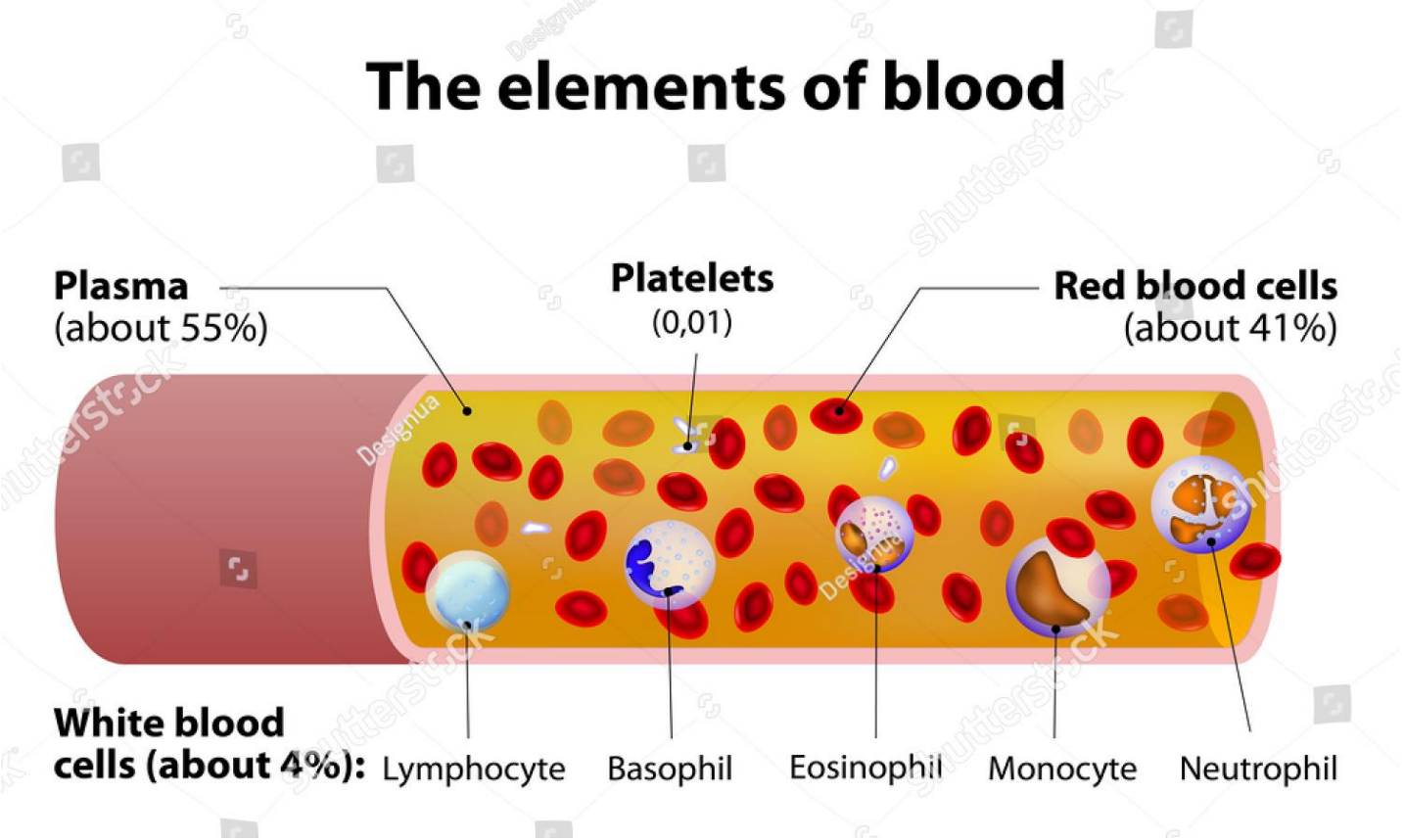
   (Female): 4.2-5.4 million RBCs.

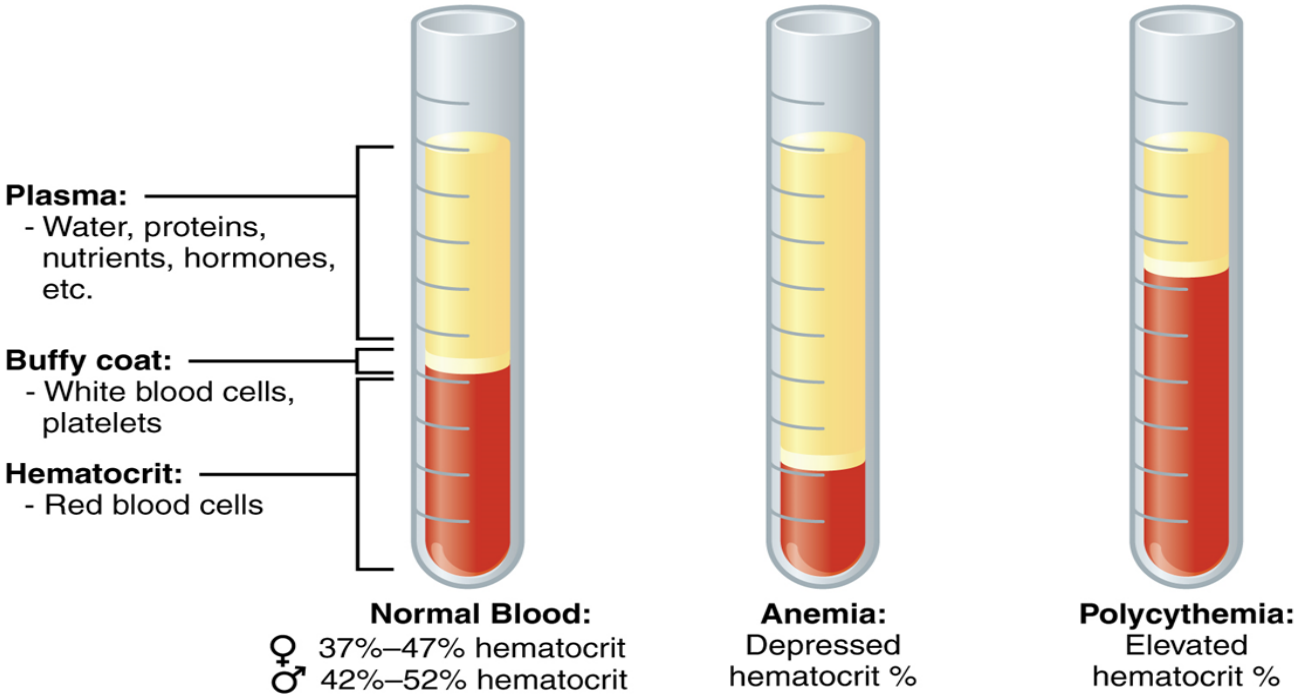
2. **Leukocyte**, white blood cells WBCs is about 0.7%. the normal values:

   (Male) (Female) = 4,000-11,000

3. **Trombocyte**, platelets. The normal values:

   (Male) (Female) = 200,000-500,000


The elements of blood
Plasma
(about 55%)
Platelets
(0,01)
Red blood cells
(about 41%)
White blood
cells (about 4%):
Lymphocyte
Basophil
Eosinophil
Monocyte
Neutrophil


Plasma:
- Water, proteins, nutrients, hormones, etc.
Buffy coat:
- White blood cells, platelets
Hematocrit:
- Red blood cells
Normal Blood:
♀ 37%–47% hematocrit
♂ 42%–52% hematocrit
Anemia:
Depressed hematocrit %
Polycythemia:
Elevated hematocrit %

➢ Plasma Proteins

About 7 % of the plasma volume—nearly all that is not water—is made of proteins. These include several proteins (proteins unique to the plasma) plus a much smaller number of regulatory proteins, including enzymes and some hormones.

○ **The three major groups of plasma proteins are as follows:**

- **Albumin** is the most abundant of the plasma proteins. The liver manufactures albumin molecules as binding proteins—transport vehicles for fatty acids and steroid hormones.

(Albumin typically accounts for approximately 54 % of the total plasma protein content).

- The second most common plasma protein is **globulins**. This heterogeneous group has three main subgroups: alpha, beta, and gamma globulins. The alpha and beta globulins transport iron, lipids, and the fat-soluble vitamins A, D, E, and K to the cells; like albumin, they also contribute to osmotic pressure. The gamma globulins are proteins involved in immunity and are better known as **antibodies** or **immunoglobulins**.

(Globulins comprise approximately 38 % of the total plasma protein volume).

- The least abundant plasma protein is **fibrinogen**. Like albumin and the alpha and beta globulins, fibrinogen is produced by the liver. It is essential for blood clotting;

(Fibrinogen accounts for about 7 % of the total plasma protein volume).

Hematology tests

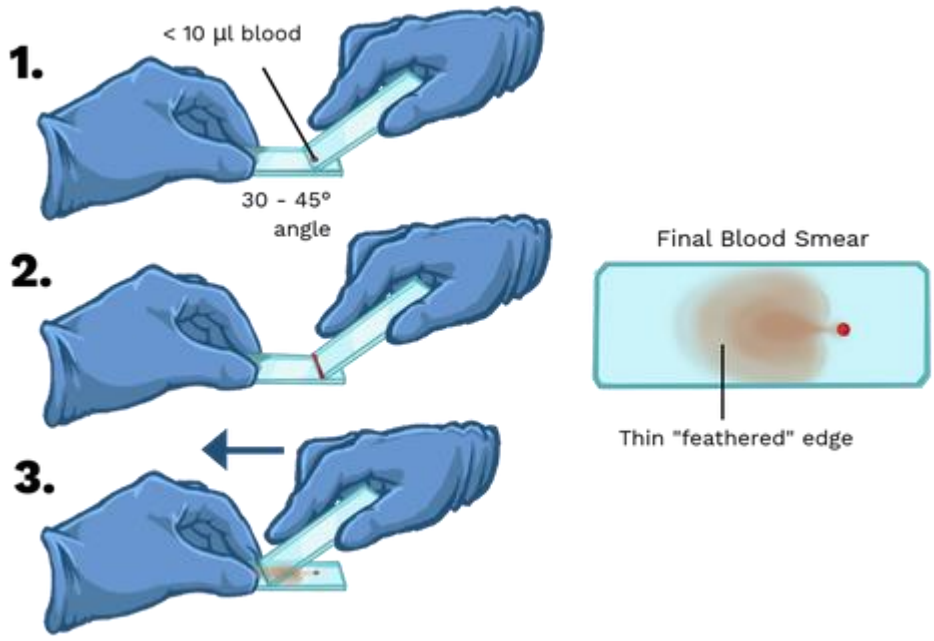
One of the most common hematology tests is the **complete blood count** (**CBC**). This test is often conducted during a routine exam and can detect anemia, clotting problems, blood cancers, immune system disorders, and infections.

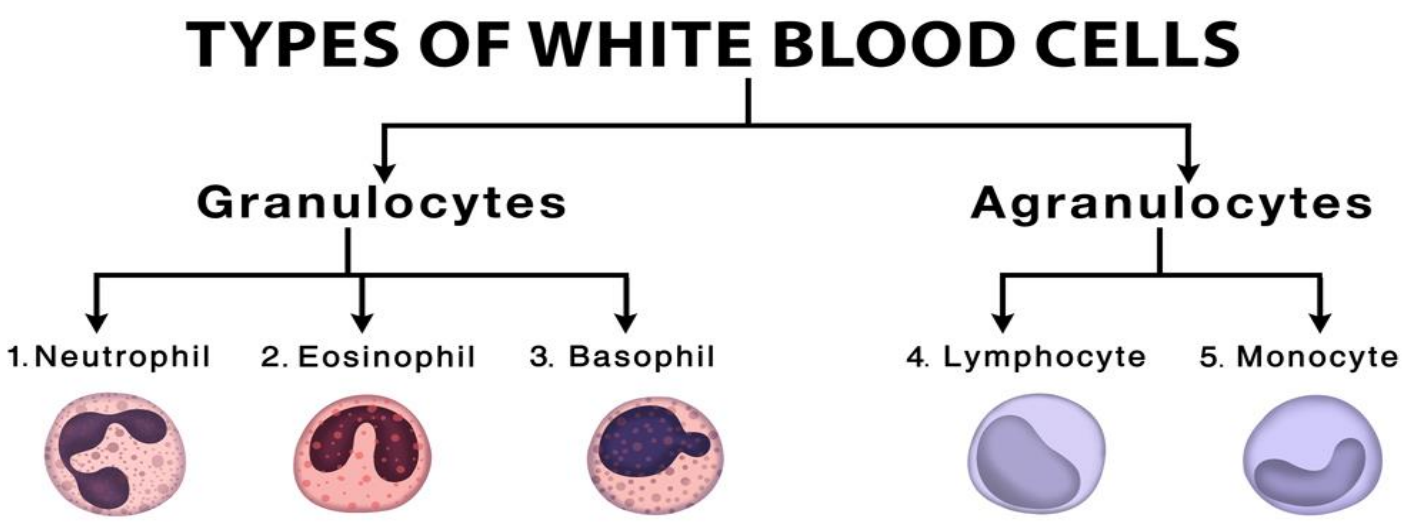
Other hematology tests include:

- **Blood chemistry test;**
- **Blood enzyme test and**
- **Blood tests to assess heart disease risk.**

Blood Smear

The optimal blood smear is a single layer of dispersed cells that accurately represents the distribution of cells in whole blood. The most common method of blood smear preparation is the wedge technique, in which a drop of blood is placed near the end of one glass slide. A second slide is held at a 30–45° angle, backed into the drop, and quickly pushed forward to the end of the first slide. The best area for cell counting is the monolayer of cells (counting area) between the thick region and the feathered edge.



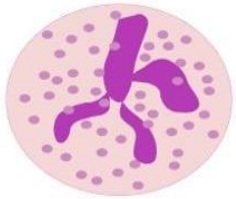


- **White blood cell count (WBC)** is a count of your total white blood cells (of all types):
- **Neutrophils.** These are the first responders of white blood cells. They fight **bacterial** and **fungal infections**.
- **Eosinophil.** These white blood cells fight **parasitic infections** and cause allergic reactions.
- **Basophils.** Basophils are a type of white blood cell that releases **histamine** and heparin during allergic reactions, which prevents blood from clotting.
- **Lymphocytes.** Lymphocytes are a type of white blood cell that fights **viral infections** and helps your immune system remember previous infections. This prepares your body so it can better fight off the same kind of infection in the future.
- **Monocytes.** Monocytes are white blood cells that clean up cell debris during an infection. They also help alert other white blood cells to harmful intruders in your body, like **bacteria** and **viruses**.
- **Immature granulocytes.** Immature granulocytes are neutrophils, eosinophils, or basophils that haven't fully developed yet.

The shape of the nucleus of **WBCs** is irregular. Different types of **WBCs** have different shapes. The nuclei may be bilobed, trilobed, pentalobed, kidney-shaped, or round, depending on the WBC:

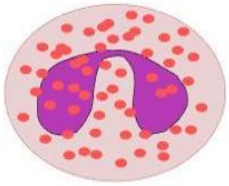
- ✓ **Neutrophils** (Multinucleated)
- ✓ **Eosinophils** (Bi-lobed)
- ✓ **Monocytes** (Kidney-shaped)
- ✓ **Basophils** (Bi-lobed or tri-loped)

WHITE BLOOD CELLS



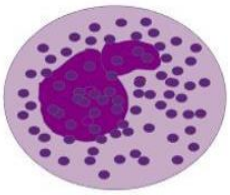
NEUTROPHIL

- Multi-lobed Nucleus
- Pale Red and Blue Cytoplasmic Granules



EOSINOPHIL

- Bi-lobed Nucleus
- Dark Pink Stained Cytoplasmic Granules



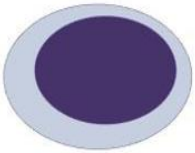
BASOPHIL

- Bi-lobed Nucleus *(usually can't be seen)*
- Lots of Dark Purple Stained Cytoplasmic Granules that Take up the Entire Cell



MONOCYTE

- Kidney-Shaped Nucleus that May Appear Lobed
- No Granules
- Cytoplasm is Very Faintly Stained Blue



LYMPHOCYTE

- Large Spherical Nucleus
- No Granules
- Thin Outer Rim of Faintly Blue-Stained Cytoplasm

