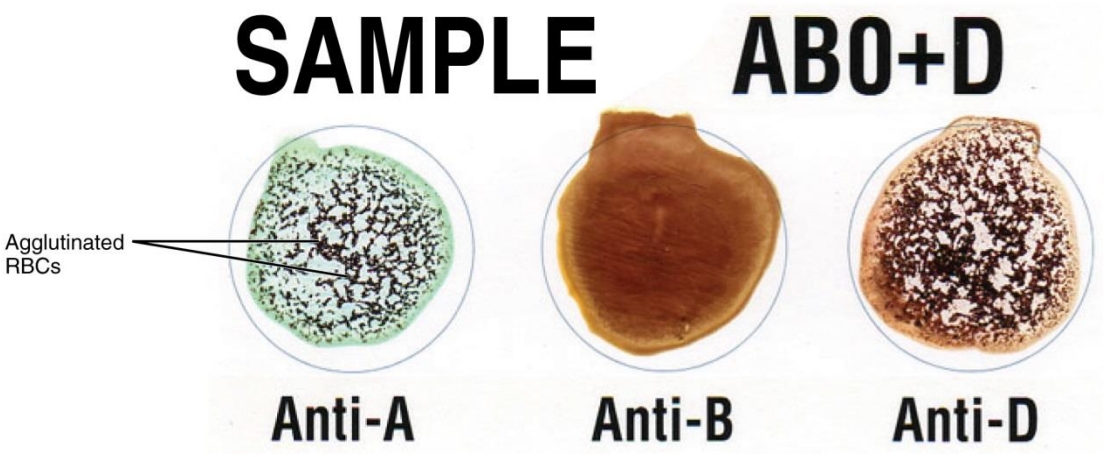
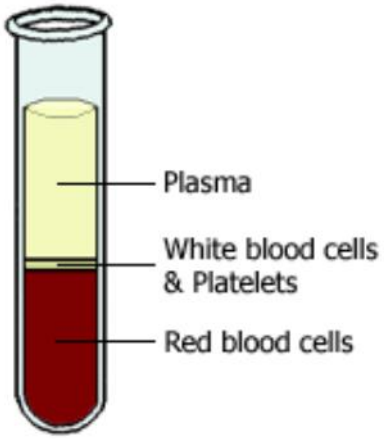
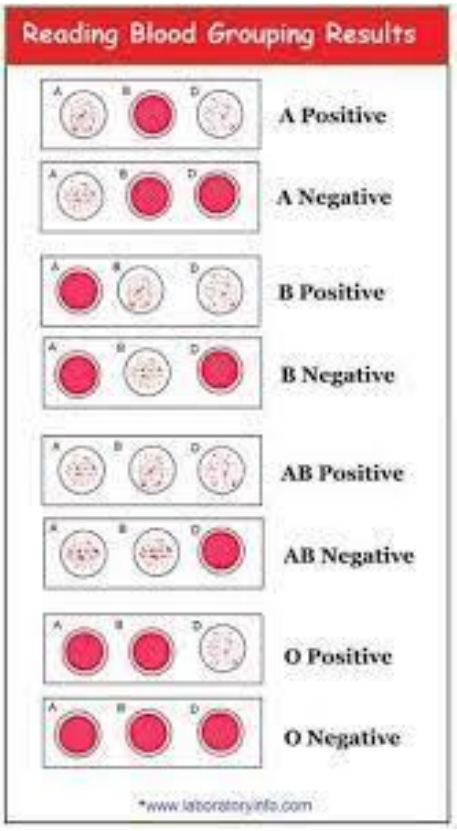
EXPERIMENT FOUR







BLOOD

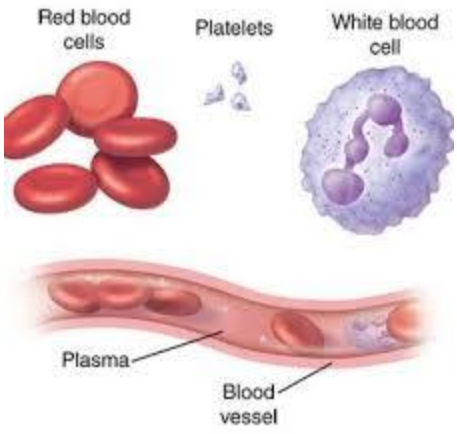


Figure 1 Blood Cells A single drop of blood contains millions of red blood cells, white blood cells and platelets

The average human adult has more than 5 liters of blood in his or her body. Blood carries oxygen and nutrients to living cells and takes away their waste products. It also delivers immune cells to fight infections and contains platelets that can form a plug in a damaged blood vessel to prevent blood loss.

Through the circulatory system, blood adapts to the body's needs. When you are exercising, your heart pumps harder and faster to provide more blood and hence oxygen to your muscles. During an infection, the blood delivers more immune cells to the site of infection. Blood is a fluid connective tissue critical to the transportation of nutrients, gases, and wastes throughout the body; to defend the body against infection and other threats; and to the homeostatic regulation of pH, temperature, and other internal conditions. Blood is composed of formed elements erythrocytes, leukocytes, and cell fragments called platelets and a fluid extracellular matrix called plasma. Because of the formed elements and the plasma proteins and other solutes, blood is sticky and more viscous than water. It is also slightly alkaline, and its temperature is slightly higher than normal body temperature.

1. Basic Hematology

A. Functions of Blood

1. **Transportation** of dissolved gases, nutrients, hormones, and metabolic wastes.
2. **Defense** against toxins and pathogens.
3. **Homeostasis:** Regulation of the pH, ion composition of interstitial fluids, water content, body temperature.

B. Characteristics of Blood

1. Blood is a **liquid connective** tissue which constitutes approximately 8% of human body mass.
2. Blood is 4-5 times more **sticky** than water.
3. Blood is somewhat sticky and has a salt concentration of about .85-.90%.
4. Blood temperature is slightly above normal body temperature (100.4^{o}F or 38^{o}C).
5. Blood pH ranges from 7.35 to 7.45 (slightly **alkaline**).
6. Blood volumes range from 4-6 liters:

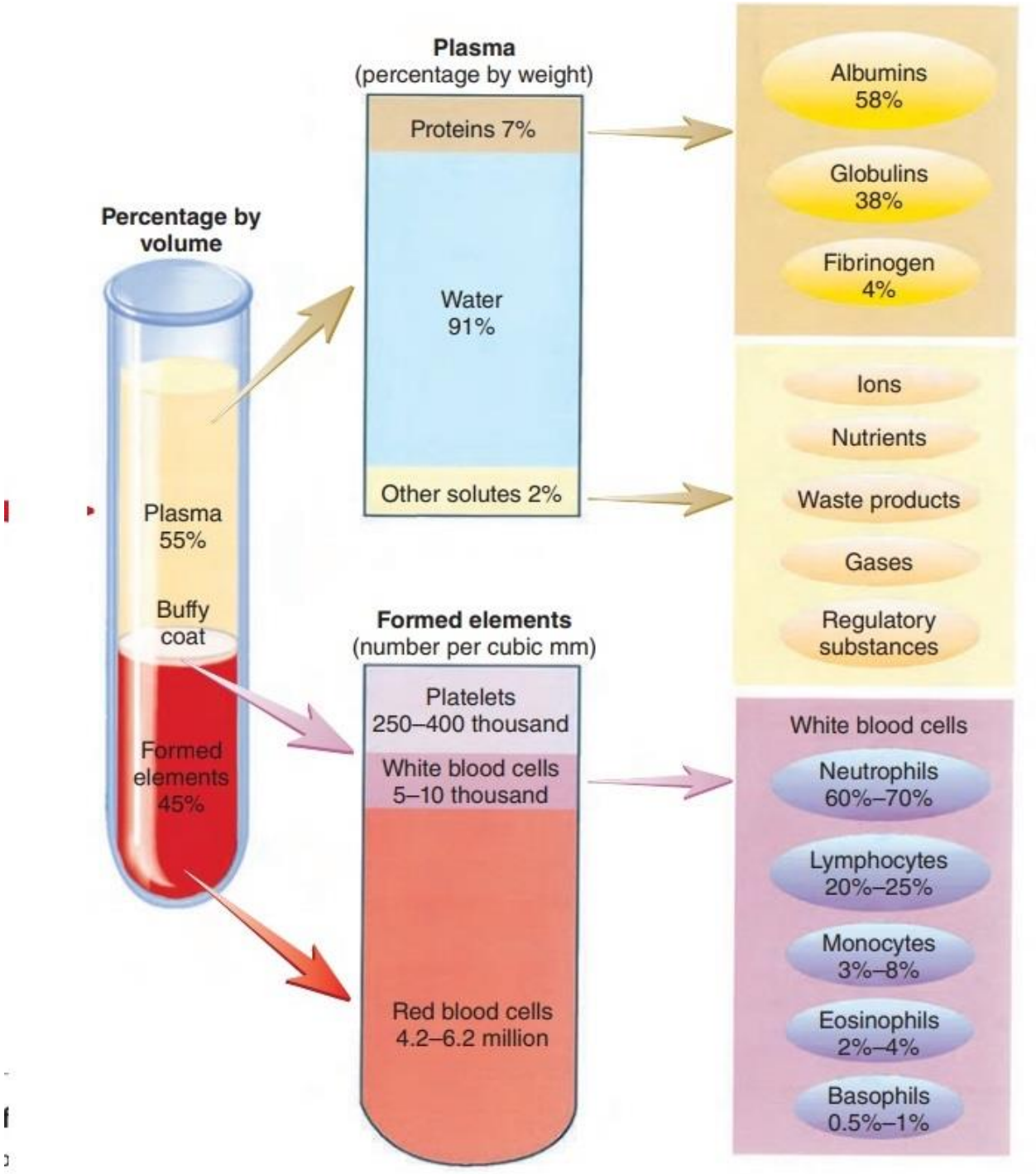
a. Males have 5-6 liters
b. Females have 4-5 liters

7. Whole blood is a **heterogeneous** mixture of non-living matrix called plasma (46 – 63%) and three formed elements (37 – 54%).

C. serum is the non-living component; it is composed of water and solutes (7% plasma proteins and 1% all other solutes.

Plasma is mainly water, but it also contains many important substances such as proteins (albumin, clotting factors, antibodies, enzymes, and hormones), sugars (glucose), and fat particles.

1. Water is the primary component of blood plasma (92%).
2. Plasma proteins are in solution rather than forming insoluble fibers like those in other connective tissues (such as the elastin and collagen fibers of areolar tissue, bone, or cartilage). If a test tube of blood is left to stand for half an hour, the blood separates into three layers as the denser components sink to the bottom of the tube and fluid remains at the top. The straw-colored fluid that forms the top layer is called plasma and forms about 60% of blood. The middle white layer is composed of white blood cells (WBCs) and platelets, and the bottom red layer is the red blood cells (RBCs). These bottom two layers of cells form about 40% of the blood. All of the cells found in the blood come from bone marrow. They begin their life as stem cells, and they mature into three main types of cells—RBCs, WBCs, and platelets. In turn, there are three types of WBC—lymphocytes, monocytes, and granulocytes—and three main types of granulocytes (neutrophils, eosinophils, and basophils).



D. Formed elements - blood cells and cells fragments suspended within the blood plasma.

1. **Erythrocytes** – also known as red blood cells; the most abundant blood cells and are specialized for the transport of oxygen.

2. **Leukocytes** – also known as white blood cells; participate in the body's defense mechanisms and are divided into five classes, each with a slightly different function.
3. **Thrombocytes** – also known as platelets; are not true cells but instead are only small, membrane-bound cellular fragments that contain enzymes and other substances important for the process of blood clotting.

The main difference between platelets and plasma is that platelets are a type of blood cells whereas plasma is the liquid that holds platelets. Platelets are small, colorless fragments, which are critical in blood clotting. Plasma suspends blood cells and other important substances.

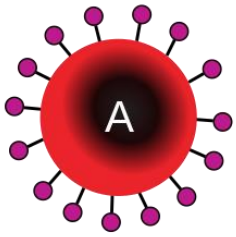
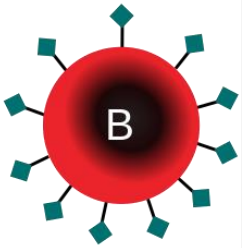
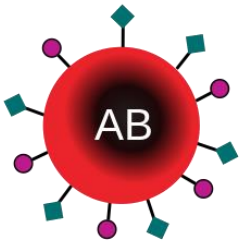
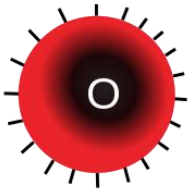
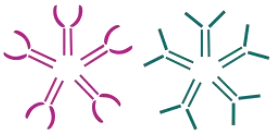
Blood Typing

Antigens are nonself molecules, usually large proteins, which cause an immune response. In transfusion reactions, antibodies attach to antigens on the surfaces of erythrocytes and cause agglutination and hemolysis. ABO blood group antigens are designated A and B. People with type A blood have A antigens on their erythrocytes, whereas those with type B blood have B antigens. Those with AB blood have both A and B antigens, and those with type O blood have neither A nor B antigens. The blood plasma contains preformed antibodies against the antigens not present on a person's erythrocytes.

A second group of blood antigens is the Rh group, the most important of which is Rh D. People with Rh^- blood do not have this antigen on their erythrocytes, whereas those who are Rh^+ do.

Antigens, Antibodies and Transfusion Reactions. Blood typing is based on antigens and antibodies

1. **Antigens/agglutinogens** found on the surface of red blood cells
2. **Antibodies/agglutinins** found in the plasma or serum.
3. Transfusion reactions occur due to incorrect blood types transfused into patient causing an immune reaction (large scale agglutination) possibly leading to hypoxia and kidney failure.

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in red blood cell	 A antigen	 B antigen	 A and B antigens	None

A. ABO Blood Group:

1. **A blood type** - person has only the A antigen on the RBC surface (will have the anti-B antibodies in their plasma).
2. **B blood type** - person has only the B antigen on the RBC surface (will have the anti-A antibodies in their plasma).
3. **AB blood type** - person has both the A and B antigen on the RBC surface (will have neither the anti-A nor anti-B antibodies in their plasma).
4. **O blood type** - person has neither the A nor B antigen on the RBC surface (will have both the anti-A and anti-B antibodies in their plasma).

1. **Universal donor** - blood type O; when injected will not agglutinate for lack of antigen.

2. **Universal recipient** - blood type AB; they possess no antibodies so no agglutination of cells will occur.