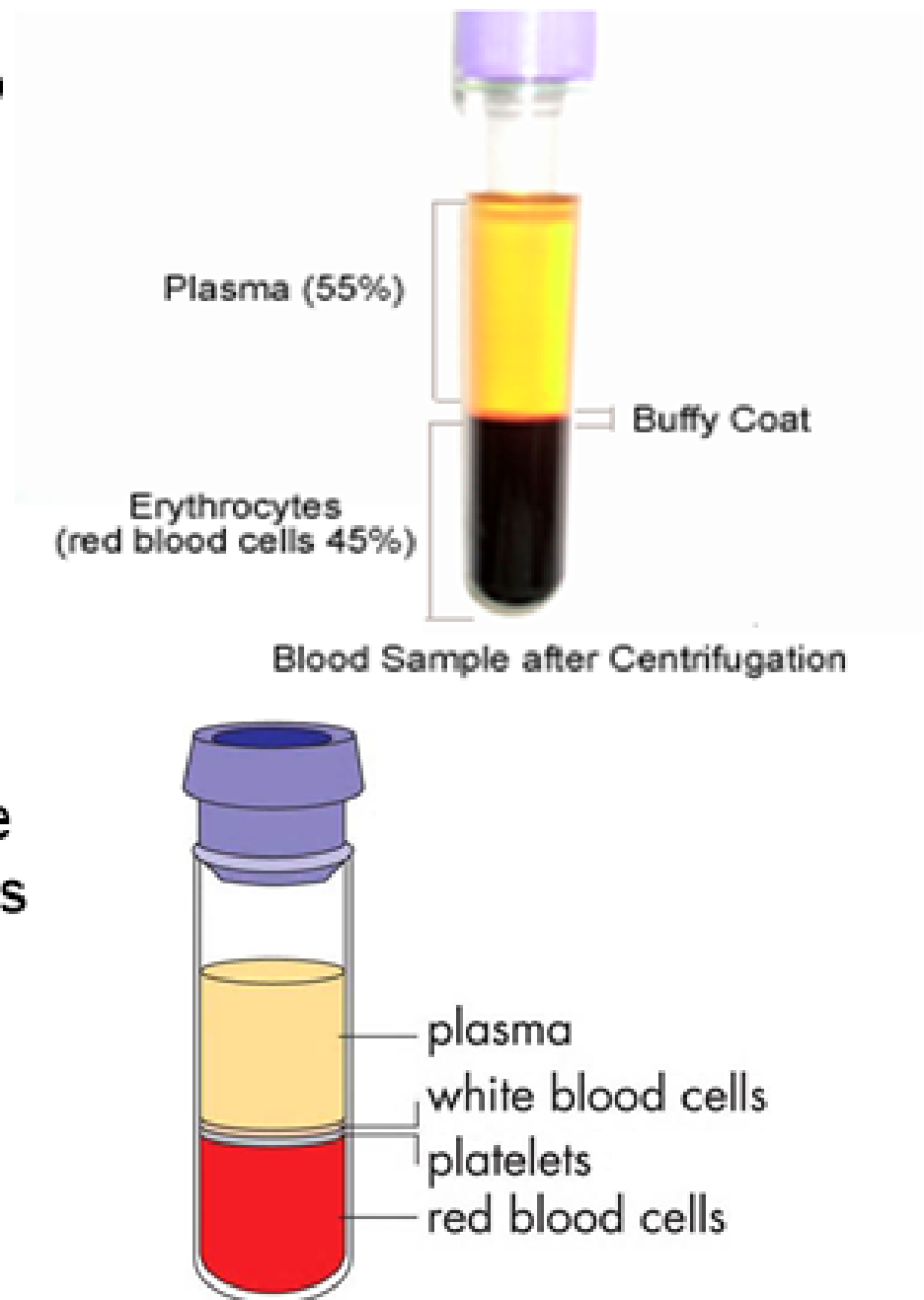


# Blood



# Composition and Function

- When centrifuged, blood makes two distinct layers
- Lower Layer =
  - (top of lower layer) white blood cells and platelets
  - (underneath top layer) a shiny layer called the buffy coat
  - (bottom most layer) red blood cells
- All three of these components of the lower layer are called formed elements and make up 45% of total blood volume
- The percentage of blood that is considered formed elements is called hematocrit



# Composition and Function

- Top Layer = Plasma (accounts for 55% of blood volume)

Picture: Vial of blood centrifuged and before centrifuge



# Functions of Blood

- Transport - blood travels from heart to all parts of the body making it a great way to exchange substances across capillary walls as blood moves
  1. oxygen from lungs
  2. nutrients from the digestive tract
  3. waste products from cells
  4. hormones and other chemicals

# Functions of Blood

## Cont.

- Defense - blood is body's defense against many harmful things
  - 1. pathogens (infections agents...i.e. viruses and bacteria)
    2. blood removes dead and dying cells
    3. destroys mutated cells
    4. white blood cells engulf and destroy pathogens or cancer cells
    5. blood also secretes antibodies and forms clots

# Functions of Blood Cont.

- Regulation - helps body maintain homeostasis
  1. Temperature regulation (mostly from active muscles)
  2. Water / Salt Balance through osmosis
  3. Regulates pH through buffers

# Plasma

- Plasma - the liquid portion of blood

1. About 92% water

2. About 8%

- salt ions (to maintain osmotic pressure and pH)

- small organic molecules (mostly for nutrition for cells ex. - glucose and amino acids, stored waste ex. - urea on its way to the kidneys and hormones)

- large organic molecules (hormones and plasma proteins)



# Plasma Proteins

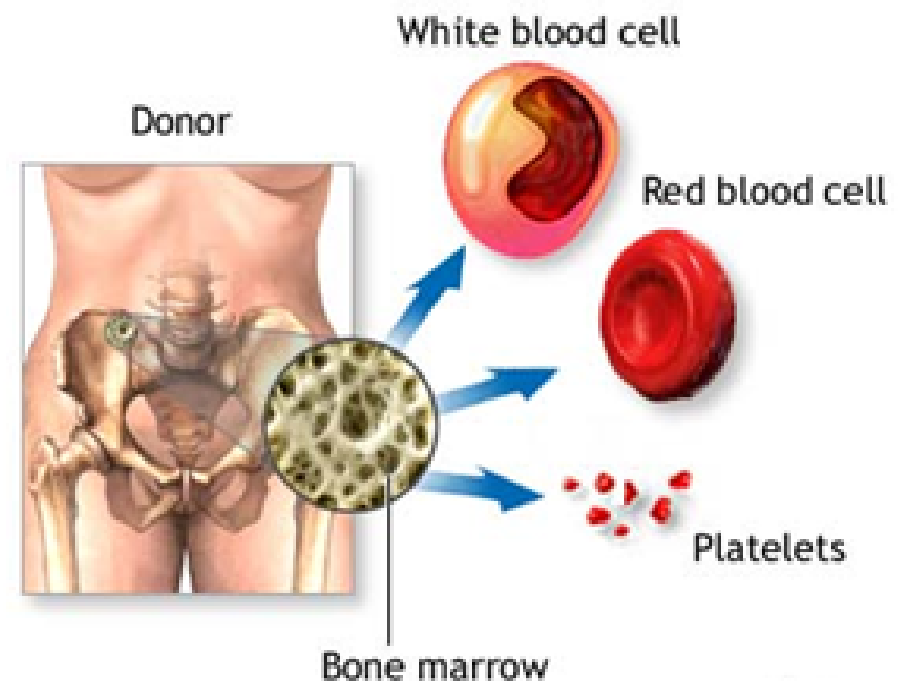
- Plasma Proteins - three major types; albumins, globulins, and fibrinogen (most of them made in the liver)
- Plasma proteins help maintain homeostasis by:
  1. Buffer blood to keep pH around 7.4
  2. Maintain osmotic pressure (Mainly albumins -keep concentrations of solutes balanced)
  3. Form lipoproteins and antibodies (mainly globulins)
  4. Transport large organic molecules (both albumins and globulins)
  5. Coagulation / Blood Clotting (fibrinogen)



# Formed Elements

The 'formed elements' consist of the blood cells and the platelets.

Formed elements are produced continuously in the red bone marrow of the skull, ribs, and vertebrae, the iliac crests and the ends of long bones.



# Formed Elements

- Hematopoiesis - the process by which formed elements are made
- Multipotent stem cells - the red bone marrow cells that mature into all the various types of blood cells
  - Multipotent stem cells replicate by mitosis
- The cells then either become a myeloid or a lymphatic stem cell

- Myeloid stem cells eventually make red blood cells, platelets and all white blood cells except one (cells that fight against basic infection, allergens, parasites, and viruses).
- Lymphatic stem cells eventually make lymphocytes (lymphocytes responsible for specific immunity to pathogens and toxins and recognizing and destroying cancer cells)

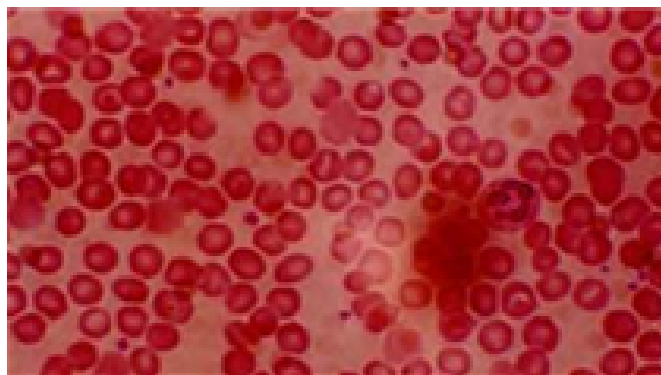
# Red Blood Cells

- AKA RBCs
- AKA Erythrocytes
- Formed from myeloid stem cells



# Red Blood Cells

- Lots of them (4-6 million per cubic millimeter of blood)
- Contains Iron that Makes Blood Red
- Each RBC contains hemoglobin to transport oxygen



# Red Blood Cells

- Lifespan is very short-lived (about 120 days - due to lack of a nucleus at maturity)
- Produced when oxygen counts are low in the blood
- When low oxygen occurs, the kidneys release erythropoietin (EPO) that stimulates mitosis of the stem cells and speeds up maturation of red blood cells (EPO can be given to patients who are anemic and can also be abused by athletes)

# Red Blood Cells

- 2 million red blood cells are destroyed per second
- When red blood cells die, hemoglobin is released and recycled by the body (heme breaks down and is made into bile by the liver), iron is recovered and returned to the bone marrow for reuse
- Hemolysis - the bursting of red blood cells is a main cause of anemia



1. This is the term for creating new blood cells \_\_\_\_\_
2. This is the term for destroying red blood cells \_\_\_\_\_
3. These are the three formed elements \_\_\_\_\_
4. This is the top layer of a centrifuged blood sample \_\_\_\_\_
5. This is the middle layer of a centrifuged blood sample \_\_\_\_\_
6. This is the bottom layer of a centrifuged blood sample \_\_\_\_\_
7. These are the two types of blood stem cells \_\_\_\_\_
8. Plasma is \_\_\_\_\_
9. These are the functions of blood \_\_\_\_\_

Hematopoiesis

92% Water

Proteins

Plasma

Platelets

Red Blood Cells

White Blood Cells

White Blood Cells

Myeloid

Lymphatic

Hemolysis

Platelets

Defense

Waste Transport

Hormone Transport

Oxygen Transport

Nutrients Transport

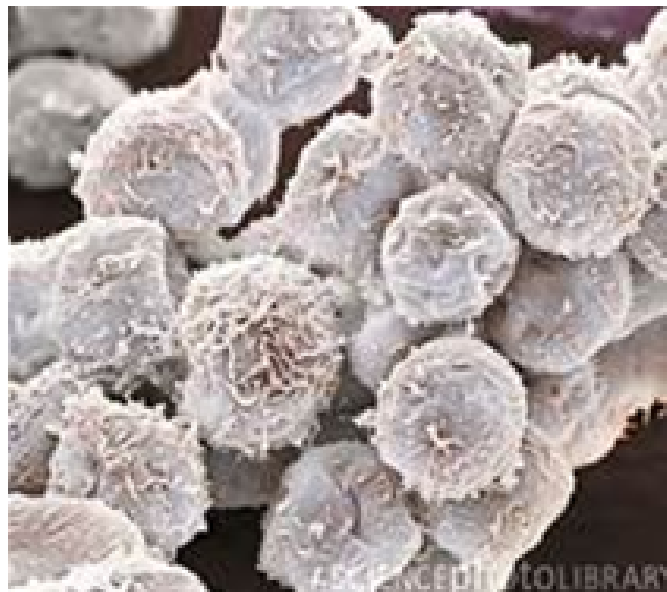
Regulation

Red Blood Cells



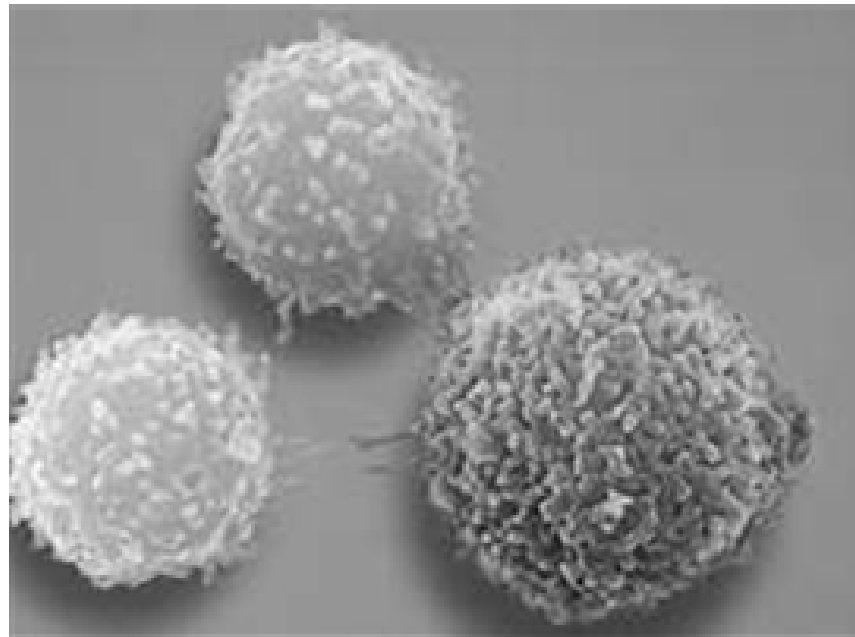
# White Blood Cells

- AKA WBCs
- AKA Leukocytes
- Formed from myeloid and lymphatic stem cells



# White Blood Cells

- Destroy dead or dying body cells
- Recognize and kill cancer cells



# White Blood Cells

- Unlike red blood cells, white cells leave the bloodstream and can squeeze through pores in the capillary wall
  - Most often found in a tissue fluid called 'lymph' and lymphatic organs
- Most live only a few days but some can live for months or years
  - Produce their own growth factor to stimulate its own production

# White Blood Cells

- If white blood cell counts are high, we can assume the body is fighting an infection
  - Specific white blood cells increase with particular infections making it a WBC count helpful in diagnosing the cause of a particular illness

# Platelets

- Not cells, but cell fragments (bity cell pieces)
- The result of breaking of certain large cells called megakaryocytes
  - Develop from myeloid stem cells
  - We make 200 BILLION per day
    - They help our blood clot