Blood

**Plasma** – water (92%) with plasma proteins (7%) and 1% = nutrients, wastes, hormones and gases

**Formed Elements** – blood cells RBC and WBC; and cell fragments Blood platelets

Erythrocytes = RBC – Transport gases, 99.9% of blood cells

Leucocytes = WBC – body defense, 0.1% of blood cells

Blood Platelets – cell fragments, blood clotting

Erythrocytes: biconcave disc shaped, no nucleus, all membrane bound organelles absent, 99.9% of blood cells, transport gases O₂ and CO₂

Leucocytes: white blood cells, Normal cells with nucleus, 5 sub types:

- Neutrophils – 50-70%, main phagocytes, 3-5 lobed nucleus
- Eosinophils: 2-4%, detoxify, ↑ in parasitic infection/ allergies,
- Basophils: < 1%, S or U shaped nucleus, not clearly seen, initiate inflammatory response, prominent blue grains
- Monocytes: largest blood cells with notched nucleus, phagocytes, escape blood and → macrophages
- Lymphocytes: 20-45%, small cells, prominent indented nucleus, nucleus almost fills the cell, 2 types - B and T cells

Blood Platelets: cell fragments, 250,000/mm³, blood clotting role

Sickle-cell-anemia

Sickle-cell-anemia is caused due to a single N-base substitution in its gene.

Under low O₂ RBC’s change into stiff sickle shape that stick together and can block a small artery, may cause heart attack or stroke

Normal life span of 120 days but sickle-cell-anemia RBC’s can live for a fraction of full span and body cannot replace them at this rate.

Common in Americans of African descent

Recycling of Hemoglobin

RBC’s develop from spongy bone marrow.

Macrophages in liver, spleen and bone marrow eat worn out RBC’s by phagocytosis. Enzymes in macrophages break hemoglobin into Home (iron containing part) and globin (protein part).

Enzymes break globin into amino acids and biliverdin (green pigment). Enzymes then change biliverdin into bilirubin (orange-yellow pigment) which is released into blood or bile.

Failure of liver due to blockage or viral infection causes Jaundice or hepatitis.

Hemopoiesis-formation of blood cells

All formed elements develop from stem cells.

Blood platelets develop from large amoeboid bone marrow cells called Megakaryocytes.

RBC’s are produced in spongy bone marrow from erythroblasts – the last nucleated cells; these change
to reticulocytes – non-nucleated that change finally change into RBC’s.

**Erythropoiesis** is formation of new RBC’s

Kidneys when note a fall in oxygen supply in blood, secrete Erythropoietin. It is a hormone that stimulate stem cells to divide faster and add more RBC’s or erythrocytes.

**Blood Groups**

In America blood group O and Rh+ are most common types. Antigens and antibodies in different groups determine 4 types of ABO blood groups. Blood group O is universal donor and blood group AB is universal recipient.

Leucocytes – White Blood Cells: 5 subtypes

<table>
<thead>
<tr>
<th>Monocyte</th>
<th>Lymphocyte</th>
<th>Basophil</th>
<th>Eosinophil</th>
<th>Neutrophil</th>
</tr>
</thead>
<tbody>
<tr>
<td>No granules</td>
<td>No granules</td>
<td>Big granules</td>
<td>Big granules</td>
<td>Small granules</td>
</tr>
<tr>
<td>Bean shaped nucleus</td>
<td>Indented nucleus</td>
<td>S-shaped or U-shaped</td>
<td>Bilobed nucleus</td>
<td>3-5 lobed nucleus</td>
</tr>
<tr>
<td>Largest blood cell</td>
<td>Small cell, big nucleus</td>
<td>Dark blue stained</td>
<td>Orange or red stained</td>
<td>Light stained</td>
</tr>
<tr>
<td>Phagocyte, ↑chronic infection</td>
<td>B-cells, T-cells, Body immunity</td>
<td>Allergies, ↑ inflammation trigger</td>
<td>Allergies, ↑ parasitic infection</td>
<td>Phagocyte, ↑ acute bacterial infection</td>
</tr>
<tr>
<td>4-8%</td>
<td>20-45%, 2nd most common</td>
<td>0.5%, Most rare</td>
<td>1-4%</td>
<td>50-70%, Most common</td>
</tr>
</tbody>
</table>

**Hemostasis-blood clotting**

Hemostasis is technical term for blood clotting.

Blood clotting is initiated by release of blood platelet factor or by release of injured tissue factor.

It leads to activation of prothrombin to thrombin

Thrombin changes fibrinogen to fibrin – a network that traps RBC’s in it to form the clot.
Recap 1 Blood

1. Liquid part of blood is ----------------
2. Blood platelets, RBC and WBC are --------------  ------------------.
3. Plasma form about --------% of blood and formed elements form about ------% of blood.
4. 92% of plasma is ------------, 7% are -----------------------------, and other solutes together are 1%.
5. 60% of plasma proteins are ----------------- , 35% are -------------- and 4% is -----------------.
6. Most common cations = + ions in plasma are --------, ------------- and --------------.
7. Most common anions = - ions are ----------------- and -----------------
8. -------- are cell fragments and release a clotting factor.
9. ------ blood cells lose their nucleus and most organelles during differentiation.
10. ------ are stained with an acidic red stain, a bilobed nucleus and fight toxic substances in allergies and parasitic infections.
11. -------- are rarest of white blood cells, stain dark purple and release histamine to set an inflammatory response at the time of injury and infection.
12. -------- are smallest white blood cells with very large nucleus and fight infections.

Recap 2 Blood

1. ----------- are the largest white blood cells, may be with a nucleus with a notch and are phagocytes.
2. Most abundant WBC and main phagocytes are --------.
3. Single base mutation can cause blood disorder called ----- ----- anemia a disorder of red blood cells.
4. ------is formation new blood cells and takes place in spongy bone marrow. -----is formation of new RBC’s
5. -------------- large phagocytic cells in liver, spleen and bone marrow feed on worn out RBC’s.
6. Iron containing part of hemoglobin is ------------ protein part is --------------.
7. Iron and amino acids of hemoglobin of worn out RBC’s is reused but unusable part is excreted as ------------
8. Blood platelets develop from large amoeboid cells called ----------------------.
9. Kidneys secrete ------------ hormone to stimulate stem cells to form more RBC’s.
10. Average US people have most common--------------- blood group and Rh ------.
11. Activated factor 10 changes to prothrombinase that change prothrombin to --------------.
12. Thrombin changes fibrinogen to -------------- that forms a network and trap blood platelets and RBC’s in it to form a clot.