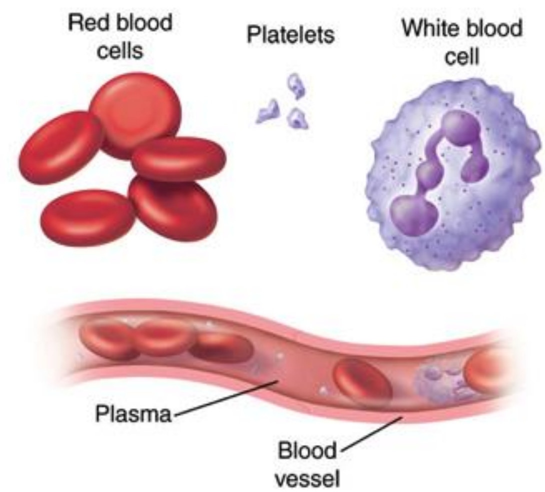
Complete Blood Cell Count

Name: ____________________ Due 4/9/2018

Background

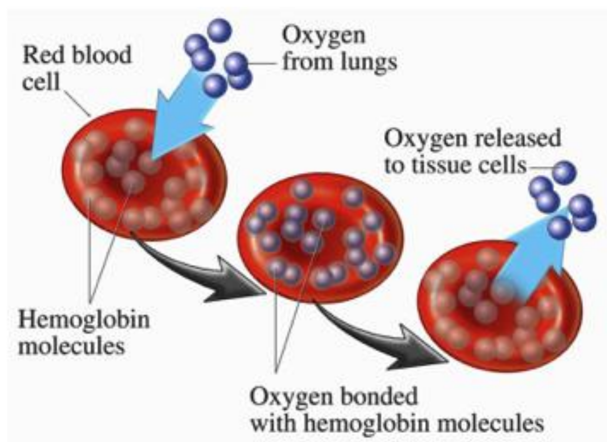


Blood appears to be just a red fluid, but is actually made up of many different types of cells, molecules, and liquids. The liquid portion of blood is called plasma and is 90% water. Plasma is also made up of dissolved minerals such as potassium, sodium, and calcium. Proteins, such as hormones and antibodies also travel through the blood. The most common cellular components of blood include platelets, red blood cells, and white blood cells. Blood cells are created within the bone marrow and then differentiate to perform different functions throughout the body.

Platelets

Platelets, or thrombocytes, are irregularly-shaped cells circulating in the blood. Platelets are responsible for preventing excess blood loss by forming a "scab." When platelets are exposed to the air, they begin to break apart and react with fibrinogen that then creates fibrin which are tiny thread-like fibers. Fibrin forms a web-like layer that prevents blood cells from passing through, and as this layer dries it hardens to form the scab that we see on the surface of a wound.

Red Blood Cells



Red blood cells (RBCs), or erythrocytes, are primarily responsible for delivering oxygen throughout the body. They are the most common type of blood cell, with approximately 20-30 trillion of them circulating within the blood vessels of an adult. A single red blood cell will live for about 120 days, and completely circulates the body more than 75,000 times within its lifetime.

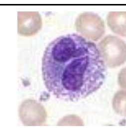
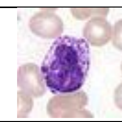
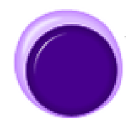
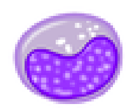
Mature red blood cells appear to be oval biconcave discs, and they do not have a nucleus in order to make room for hemoglobin. Hemoglobin is a large, iron-containing protein that is able to transport oxygen molecules and is also what gives red blood cells their red color.

Capillaries surround the alveoli in the lungs. As oxygen is brought into the alveoli, it will diffuse through the capillaries and bind to the hemoglobin on the red blood cells that are circulating. The red blood cells with bound oxygen travel back to the heart and through larger blood vessels to eventually reach capillaries in body tissues. The oxygen is released from hemoglobin to diffuse through the capillaries into the tissues that need it to survive.

White Blood Cells

White blood cells (WBCs), or leukocytes, are responsible for immunity. They have a much shorter life cycle than red blood cells, ranging from a few days to a few weeks. The number of white blood cells in the blood varies greatly depending on whether they are fighting an infection. They only make up approximately 1% of the blood volume in a healthy adult.

There are many different types of white blood cells based on their structure and function. A major feature used to categorize white blood cells is the presence of granules within the cytoplasm. White blood cells with granules are called granulocytes and without granules are agranulocytes. These groups can be further broken down. The table below summarizes the five most common types of white blood cells. The granulocytes include neutrophils, eosinophils, and basophils, while the agranulocytes include lymphocytes and monocytes.

Types of White Blood Cells				
Type	**Percent of WBCs**	**Target**	**Diagram**	**Actual Appearance**
Neutrophil	50 - 70%	Bacteria, fungi		
Eosinophil	1 - 3%	Large parasites, allergic response, inflammatory response		
Basophil	0.4 - 1%	Release histamine		
Lymphocyte	25 - 35%	B cells, T cells, natural killer cells		
Monocyte	4 - 6%	Differentiate into macrophages or dendritic cells		

Blood Cell Count

A healthy adult has about 4.5 to 5 million red blood cells and approximately 8,000 white blood cells in each drop of blood. Determining the number of red and white blood cells can assist a healthcare specialist in the diagnosis of disease. A decrease in the number of red blood cells may indicate a condition known as anemia. A lack of red blood cells means a lack of oxygen, which can lead to symptoms such as fatigue, headache, paleness, shortness of breath, and even fainting. The presence of anemia can help direct a physician to a specific diagnosis. A decrease or increase in the number of white blood cells can also indicate a problem. For example, a large increase in white blood cells is commonly indicative of an infection.

A complete blood cell count (CBC) is a common procedure performed to determine the number of red and white blood cells in an individual. A hemocytometer is a specialized counting chamber used for blood cell counts. Blood is diluted and added to the surface of the hemocytometer that contains a grid. The number and types of cells located within each square of the grid are counted using a microscope, and are used to estimate the total amounts in blood. In the following activity, you will use a simulated hemocytometer sample to estimate the red and white blood cell count for your patients.

Normal and Abnormal Blood Cell Count Levels

	Normal Value	*Causes of Low Values*	*Causes of High Values*
White Blood Cell Count (WBC)			
Men & Women *(pregnancy alters results)*	5,000 – 10,000 per mm^3	Aplastic anemia, viral infection, malaria, alcoholism, AIDS, Cushing's syndrome, lupus, enlarged spleen, chemotherapy, certain medications	Infection, inflammation, damage to tissues, extreme emotional or physical stress (trauma or surgery), burns, lupus, tuberculosis, rheumatoid arthritis, kidney failure, leukemia, endocrine disorders, certain medications
Red Blood Cell Count (RBC)			
Men	4.5 – 5.5 million per mm^3	*Called anemia*; heavy menstrual bleeding, stomach ulcers, colon cancer, IBD, tumors, thalassemia, sickle cell disorder, Addison's disease, lack of folic acid or B12	Lung disease, kidney disease, liver disease, heart disease, smoking, carbon monoxide exposure, some forms of cancer, alcoholism, dehydration, excessive diarrhea, excessive vomiting, use of diuretics, excessive sweating
Women	4.0 – 5.0 million per mm^3		
Platelet Count			
Men & Women	140,000 – 400,000 per mm^3	Pregnancy, idiopathic thrombocytopenic purpura (ITP), enlarged spleen	Bleeding, iron deficiency, cancer, bone marrow disorders

Procedure

Read each patient complaint. A blood smear sample in a hemocytometer grid has been provided, as well as information on any additional abnormal observations that may help in a diagnosis. Follow the directions to perform a red blood cell, white blood cell, and platelet count.

Patient Complaint

Patient Smith

A 16 y/o female was brought into the ER after she fainted while playing in a basketball game. She has been feeling fatigued and experiencing headaches over the last few weeks.

Patient Jones

A 6 y/o male has been experiencing weight loss, weakness, and fatigue. The parents have been worried that he has not been hungry and is bruising easily.

Patient Clark

A 71 y/o male was brought into the ER with extreme abdominal pain that is made worse by any movement. He has been experiencing some abdominal discomfort for the past few months.

Patient Miller

A 26 y/o female has been experiencing fever, headache, sweating, sleepiness, fatigue, and vomiting over the last 2 weeks.

Directions

Red Blood Cells

Step 1	Examine the patient hemocytometer results on the next two pages. They show what would be seen through a microscope when counting blood cells. The lines are part of the hemocytometer grid and are used to make counting easier.	
Step 2	Count the red blood cells for each patient. Start at the top left and move box by box to the right, row by row. Record your results on the "# of RBCs in Grid" column in Table 1.	
Step 3	To determine the number of cells per mm^3, multiply the counted red blood cells by 100,000. Record the RBC count for each patient in Table 1.	
Step 4	Use the information in the background section on normal values for a RBC count to determine whether the patient has normal RBC values. Record any abnormal results in Table 2.	

White Blood Cells

Step 5	Count the white blood cells for each patient. Start at the top left and move box by box to the right, row by row. Record your results on the "# of WBCs in Grid" column in Table 1.	
Step 6	To determine the number of cells per mm^3, multiply the counted white blood cells by 1,000. Record the WBC count for each patient in Table 1.	
Step 7	Use the information in the background section on normal values for a WBC count to determine whether the patient has normal WBC values. Record any abnormal results in Table 2.	

Platelets

Step 8	Count the platelets for each patient. Start at the top left and move box by box to the right, row by row. Record your results on the "# of Platelets in Grid" column in Table 1.	
Step 9	To determine the number of cells per mm^3, multiply the counted platelets by 10,000. Record the platelet count for each patient in Table 1.	
Step 10	Use the information in the background section on normal values for a platelet count to determine whether the patient has normal platelet values. Record any abnormal results in Table 2.	

Completing the Diagnosis

Step 11	Each patient also has an image with "Additional Observations." Read the observations and make a note in Table 2 of any observations that may help you with the diagnosis.	
Step 12	Use the patient complaint, blood cell count results, and additional observations to create a diagnosis. This may require some internet research. Record your hypothesized diagnosis for each patient in Table 2.	