

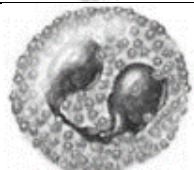
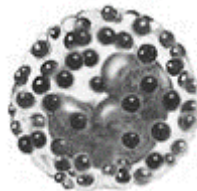

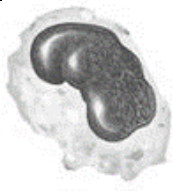
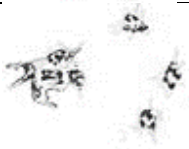


LAB 2: BLOOD

Chart 4: Formed Elements and their Characteristics

Using the provided powerpoint, you should be able to identify each type of cell shown below:

Formed Element	Characteristics	Draw a Picture	Function
Erythrocytes (Red Blood Cells)	<ul style="list-style-type: none"> no nucleus (anucleate) round, disk-shaped cell concave area in the center stains pink-red and appear pale 		Transport oxygen and carbon dioxide.
Leukocytes (White Blood Cells)	<ul style="list-style-type: none"> nucleus (various shapes) presence or lack of granules 		
Granulocytes	<ul style="list-style-type: none"> presence of granules 		
Neutrophils	<ul style="list-style-type: none"> multi-lobes of the nucleus granules stain pale 		Phagocytes—ingest and digest bacterial and dead cells.
Eosinophils	<ul style="list-style-type: none"> bi-lobed of the nucleus granules stain red or orange 		Phagocytes respond to parasitic worm infections; also involved in allergic reactions.
Basophils	<ul style="list-style-type: none"> nucleus is hard to see granules stain blue or purple 		Release histamine, results in inflammation.
Agranulocytes	<ul style="list-style-type: none"> cytoplasm lacks granules; appears gray 		
Lymphocytes	<ul style="list-style-type: none"> small in size (same size as RBC) large, round nucleus 		B Cells: produce antibodies. T Cells: activates immune system and directly destroy cancer cells.
Monocytes	<ul style="list-style-type: none"> folded or kidney-shaped nucleus the largest of the blood cells 		Forms macrophages, which are involved with phagocytosis
Platelets	<ul style="list-style-type: none"> cell fragments; formed from the rupture of megakaryocytes 		Involved in hemostasis (blood clotting).

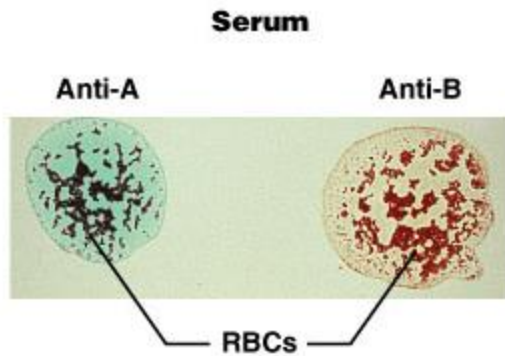
LAB 2: BLOOD

ACTIVITY 5/6: ANTIGENS AND ANTIBODIES

When blood type is unknown, cross matching can occur using the unknown blood and antibodies (anti-A, anti-B, and anti-RH). A drop of the unknown blood is placed on a slide, as shown below.

- If the antibody agglutinates or clumps the blood, then that tells us the blood carries that particular antigen. (*It's like knocking on doors to see who answers*)
- If the test shows agglutination with anti-A antibodies, *it's simple* – the blood carries the A antigen. If the test shows agglutination with anti-B antibodies, the blood carries the B antigen.
- If the test shows no agglutination, then the blood does *not* carry that antigen.)

For each of the following unknown samples, determine the blood type. The first one has been completed for you.



1. Look closely at the reaction between the anti-A antibodies and the RBC and between the anti-B antibodies and the RBC. Both of these antibodies have *agglutinated* or clumped the RBC. Why? The RBC carries both the A and B antigens. Therefore, the anti-A antibody agglutinates (clumps) the A antigen and same for the B. Now, what is the blood type? This blood carries an A antigen and a B antigen, so it is type **AB**.

2. Blood type: _____

Antigen(s) carried by this blood type: _____



3. Blood type: _____

Antigen(s) carried by this blood type: _____



4. Blood type: _____

Antigen(s) carried by this blood type: _____

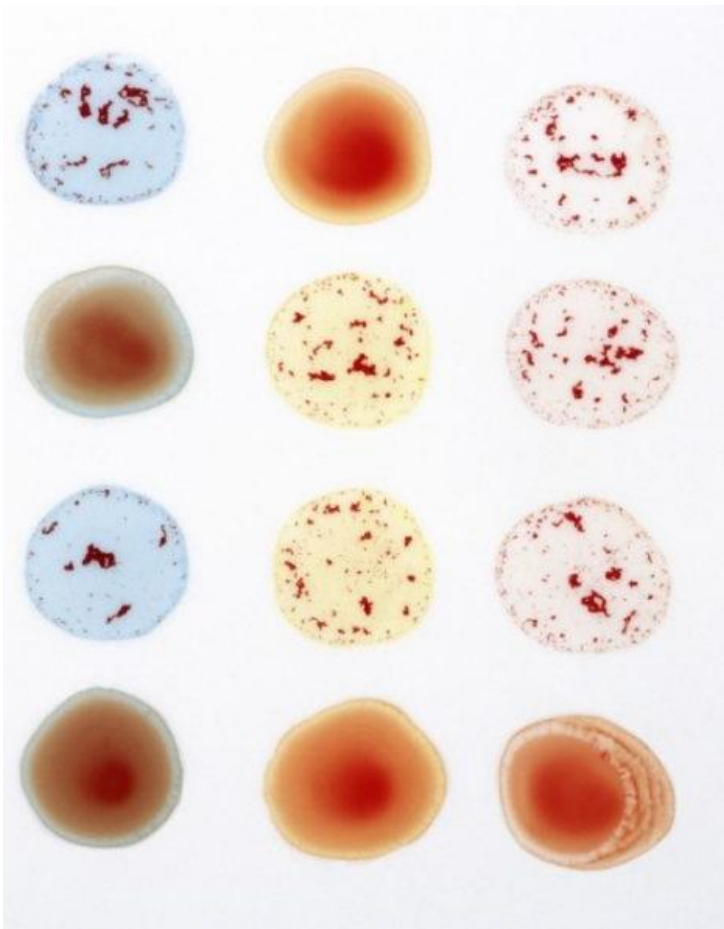
LAB 2: BLOOD

ACTIVITY 5/6: ANTIGENS AND ANTIBODIES

Anti-A

Anti-B

Anti-Rh



5. Blood type: _____

Antigen(s) carried by this blood type: _____

6. Blood type: _____

Antigen(s) carried by this blood type: _____

7. Blood type: _____

Antigen(s) carried by this blood type: _____

8. Blood type: _____

Antigen(s) carried by this blood type: _____

LAB 2: BLOOD

ACTIVITY 7: BLOOD ANALYSIS

Pre-Lab Help! Hematocrit Calculations

Why is hematocrit important? _____

What is a percent? A percent is a number or ratio as a fraction of 100. For example, I have 10 pieces of fruit. Eight of the ten pieces of fruit are apples. The percent of fruit that is apples = $8/10 = 0.8 \times 100 = 80\%$. Or, I have 100 coins and 20 of those coins are nickels. Therefore, the ratio of nickels to total coins is $20/100 = 20\%$.

How to determine percent hematocrit: Realize a common mistake is setting up the percentage “backwards.” **ALWAYS** put the largest number on the bottom of the fraction (denominator). The largest number **WILL** be the total height of the blood column, measured in millimeters (mm). *Do not assume the height of the column will be 100 mm.* Simply divide the component of interest by the total height and then multiply it by 100 (to determine the percent hematocrit).

Example: Total height of a column of centrifuged blood = 85 mm; hematocrit = 35 mm; buffy coat = 0.5 mm; plasma = 49.5 mm.

- What is the percent hematocrit? $(35 \text{ mm}/85 \text{ mm}) \times 100 = 41.2\%$
- What is the percent buffy coat? $(0.5 \text{ mm}/85 \text{ mm}) \times 100 = 0.6\%$
- What is the percent plasma? $(49.5 \text{ mm}/85 \text{ mm}) \times 100 = 58.2\%$

How to determine hematocrit when you have a missing component: The example, above, gave you all 3 components of centrifuged blood. What happens if the total height is given along with only 2 components, while the percentage of the 3rd component is requested? The trick here is to solve for the missing component. Add the 2 components and subtract that number from the total height. Total height – (component 1 + component 2) = height of missing component. Then calculate the percentage as previously shown.

Example: Total height = 74 mm; buffy coat = 1 mm; and the plasma is 40 mm.

- What is the percent hematocrit? Solve for the hematocrit *first* and *THEN* do the percent hematocrit.
 $74 \text{ mm} - (1 \text{ mm} + 40 \text{ mm}) = 33 \text{ mm}$ for the hematocrit.
 $(33 \text{ mm}/74 \text{ mm}) \times 100 = \mathbf{44.6\%}$

Reminder! Read the problem carefully and determine whether you are given all 3 components of centrifuged blood or just 2 of them.

LAB 2: BLOOD

ACTIVITY 7: BLOOD ANALYSIS

Hematocrit Determination and Hemoglobin Determination. Complete Activities 1 and 3.

Upon completion, you should be able to describe the procedure used to analyze blood for hematocrit and hemoglobin. You should also be able to predict the hematocrit value based on available oxygen (such as from high altitude or anemia) and the hemoglobin value based on health or blood disorder (anemia, polycythemia). Generally, a normal hematocrit range is considered to be: for men, **38.8 to 50%**; for women, **34.9 to 44.5%**.

Realize the height of the RBC layer deals with the hematocrit while the height of the buffy coat deals with the %WBC. Please round numbers to one decimal place.

Chart 6: Factors Influencing the Hematocrit

Blood Sample	Total Height Of Blood (mm)	Height of RBC Layer (mm)	Height of Buffy Coat (mm)	Hematocrit%	% WBC
Male Boston	100	48	1		
Female Boston	100	44	1		
Male Denver	100	55	1		
Female Denver	100	53	1		
Male with aplastic anemia	100	19	0.5		
Female with iron-deficiency anemia	100	32	1		

Activity 1 Hematocrit Determination Questions:

1. List the following values from Chart 1:

Hematocrit value for healthy male living at sea level in Boston: _____

Hematocrit value for healthy female living at sea level in Boston: _____

2. Were the values listed in question 1 within normal range? _____

3. Describe the difference between the male and female hematocrit for an individual living in Boston.

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4. List the following values from Chart 1:

Hematocrit value for healthy male living in Denver: _____

Hematocrit value for healthy female living in Denver: _____

5. How did these values differ from the values for Boston? _____

6. Describe the effect of living at high elevation on a person's hematocrit. _____

7. Describe how the kidneys respond to a decrease in oxygen and what effect this has on hematocrit. _____

8. List the following values from Chart 1:

Hematocrit value for male with aplastic anemia: _____

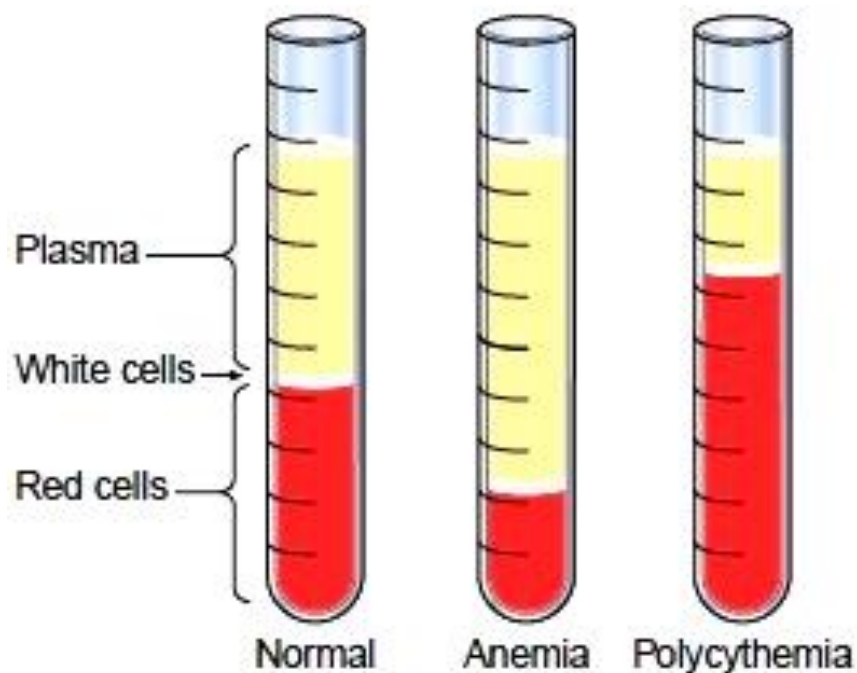
% WBC for male with aplastic anemia: _____

9. Were the values listed in question 8 within the normal range? Why or why not? _____

10. List the following values from Chart 1:

Hematocrit for female with iron-deficiency anemia: _____

11. Was the value in question 10 normal or not? Explain. _____



LAB 2: BLOOD

ACTIVITY 7: BLOOD ANALYSIS

Pre-Lab Help! Hemoglobin Ratio Calculations

Why is the ratio of hematocrit to hemoglobin important? _____

How to set up a ratio of packed cell volume (PCV) to hemoglobin (Hb or Hgb): In these hemoglobin calculations, you will be given the amount of packed cell volume (PCV), (% hematocrit = PCV), along with the amount of hemoglobin found in 100 ml of the blood. The ratio is written as:

PCV: amount of hemoglobin

Do NOT reverse the ratio or you will get the problem wrong. For example, a PCV of 48% and hemoglobin of 16 g/dL, then write the ratio as:

48:16

How to determine ratio of units of blood to hemoglobin: To get the ratio, perform two divisions to get the least common denominator (LCD, or the least common multiple):

- 1) Divide 48 by 16 to get the first number of the ratio = 3
- 2) Divide 16 by 16 to get the second number of the ratio = 1

Write the ratio like this:

3:1 (units of blood: Hb)

By the way, a 3:1 ratio is normal for a healthy person!

What does a 3:1 ratio mean? It takes 3 units of blood to give one unit of hemoglobin. If the LCD doesn't produce a whole number, then round to the nearest tenth.

- Ratios higher than 3:1, (such as a ratio of 5:1) indicate that not enough hemoglobin is present in the blood. A ratio of 5:1 means that it would take 5 units of blood to have the same amount of hemoglobin as compared to the normal case of a 3:1 ratio.
- By contrast, a ratio lower than 3:1, such as 2:1, means the blood has more hemoglobin than normal.

LAB 2: BLOOD

ACTIVITY 7: BLOOD ANALYSIS

Activity 3 Hemoglobin (Hb) Determination Questions (Please round the numbers to one decimal place)

Chart 7: Hemoglobin, Hematocrit and Packed Cell Volume (PCV)

Blood Sample	Hb in grams per 100 ml of blood	Hematocrit (PCV)	Ratio of PCV to Hb
Healthy male	16	48	
Healthy female	14	44	
Female with iron- deficiency anemia	8	40	
Male with polycythemia	20	60	
Female Olympic athlete	22	60	

1. Describe the ratio of packed cell volume to Hb (hemoglobin) obtained for the healthy male and female subjects.

2. Describe the ratio of packed cell volume to Hb (hemoglobin) for the female with iron-deficiency anemia.

3. Is the female with iron-deficiency anemia deficient in hemoglobin? _____

4. Is the male with polycythemia deficient in hemoglobin? _____

5. Is the female Olympic athlete deficient in hemoglobin? _____

6. List conditions in which Hb would decrease. _____

7. List conditions in which Hb would increase. _____

LAB 2: BLOOD

ACTIVITY 7: BLOOD ANALYSIS

Post-lab PCV to Hemoglobin Ratio and Percent Hematocrit Practice Problems

1. Calculate the ratio of PCV to hemoglobin (Hb) given: PCV = 33% and Hb = 16 g/dL
 2. Calculate the hematocrit given: Total height = 90 mm, plasma = 45 mm, buffy coat = 1 mm, and hematocrit = 44 mm
 3. Calculate the ratio of PCV to hemoglobin given: PCV = 80% and Hb = 20 g/dL
 4. Calculate the hematocrit given: Total height = 70 mm, plasma = 43 mm, and buffy coat = 1 mm
 5. Calculate the ratio of PCV to hemoglobin given: PCV = 43% and Hb = 12 g/dL
 6. Calculate the plasma given: Total height = 80 mm, buffy coat = 0.5 mm, and hematocrit = 37 mm
-

LAB 2: BLOOD

ACTIVITY 7: BLOOD ANALYSIS

Answers to the PCV to Hemoglobin Ratio and Percent Hematocrit Practice Problems

1. Calculate the ratio of PCV to hemoglobin given: PCV = 33% and Hb = 16 g/dL
 - a. Write the ratio of PCV to hemoglobin: 33:16
 - b. Divide out the least common denominator: $33/16:16/16 = 2.1:1$ (leave the ratio to the nearest tenth).
 - c. Analyze your results. A ratio of 3:1 is normal. 2.1:1 indicates the blood has more Hb than normal.
 2. Calculate the hematocrit given: Total height = 90mm, plasma = 45mm, buffy coat = 1mm, and hematocrit = 44mm
 - a. Ask yourself is all the necessary information given? In this case, the answer is yes.
 - b. The key numbers in this example is the total height of 90 mm and the hematocrit height of 44 mm. The other numbers are not needed although they are given.
 - c. % hematocrit = $(44 \text{ mm}/90 \text{ mm}) \times 100 = 48.9\%$ of the total blood volume is hematocrit
 3. Calculate the ratio of PCV to hemoglobin given: PCV = 80 % and Hb = 20 g/dL
 - a. Write the ratio of PCV to hemoglobin: 80:20
 - b. Divide out the least common denominator: $80/20:20/20 = 4:1$ (leave the ratio to the nearest tenth).
 - c. Analyze your results. Realize 3:1 is normal. A ratio of 4:1 indicates the blood has less Hb than normal. It takes 4 units of blood to give you 1 unit of Hb. Normally it takes 3 units of blood to give you 1 unit of Hb.
 4. Calculate the hematocrit given: Total height = 70mm, plasma = 43mm, and buffy coat = 1mm
 - a. Ask yourself is all necessary information given? In this case, the answer is NO.
 - b. Calculate the missing number. Total height – (buffy coat + plasma) = hematocrit
$$70 \text{ mm} - (1 \text{ mm} + 43 \text{ mm}) = 26 \text{ mm hematocrit}$$
$$\% \text{ hematocrit} = (26 \text{ mm}/70 \text{ mm}) \times 100 = 37\%$$
 of the total blood volume is hematocrit
 5. Calculate the ratio of PCV to Hemoglobin given: PCV = 43 % and Hb = 12 g/dL
 - a. Write the ratio. 43:12
 - b. Divide out the least common denominator $43/12:12/12 = 3.6:1$ (leave the ratio to the nearest tenth).
 - c. Analyze your results. Realize 3:1 is normal. A ratio of 3.6:1 indicates the blood has slightly less Hb than normal.
 6. Calculate the plasma given: Total height = 80mm, buffy coat = 0.5mm, and hematocrit = 37mm
 - a. Ask yourself is all necessary information given? In this case, the answer is NO.
 - b. Calculate the missing number. Total height – (buffy coat + hematocrit) = plasma. Read the question carefully. Note that the hematocrit is not always asked for. See what is asked for and go about figuring out the missing number.
$$80 \text{ mm} - (0.5 \text{ mm} + 37 \text{ mm}) = 42.5 \text{ mm plasma}$$
 - c. % plasma = $(42.5 \text{ mm}/80 \text{ mm}) \times 100 = 53\%$ of the total blood volume is plasma
-