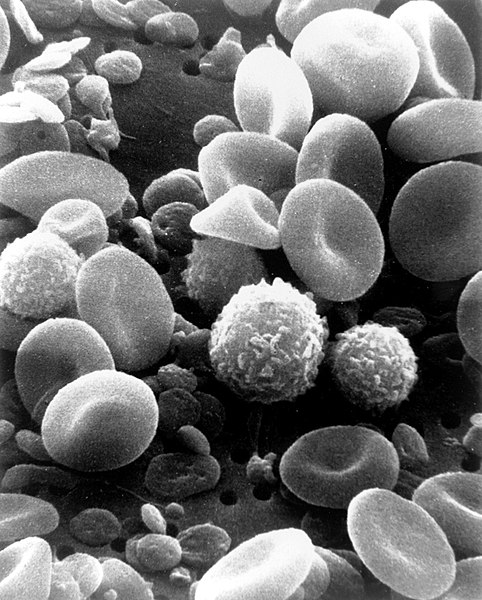
**Exercise 2: Blood**



**Figure 2.1** This image of blood was taken with a scanning electron micrograph. What types of blood cells can you see in this image?

**Exercise 2 Learning Goals**

**After completing this lab, you should be able to:**

* Describe the functions of blood
* Describe the cellular and extracellular components of blood, including plasma and the formed elements
* Identify the formed elements of blood in a blood smear
* Identify blood types and explain the physiological basis of blood type
* Be able to perform and interpret results from a basic blood typing test

# **Pre-Lab Activities for Exercise 2**

# **Pre-Lab Activity 2.1: The Functions of Blood**

Using your required textbook or lecture notes, complete the table below.

|  |  |
| --- | --- |
| Function | Description |
| Regulation |  |
| Protection |  |
| Transportation |  |

**Pre-Lab Activity 2.2: Blood Components**

In the table below describe the appearance and function of each blood component listed.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Function | Description of Appearance | Sketch |
| Extracellular Matrix | | | |
| *Plasma* | Protein-rich fluid that makes up 55% of blood, including water, and other solutes including electrolytes, nonprotein nitrogenous substances (urea, creatine), blood gases (oxygen, carbon dioxide, nitrogen), and regulatory substances (hormones, enzymes) |  |  |
| Formed Elements | | | |
| *1) Erythrocytes (Red Blood Cells)* | Specialized for the transport of oxygen and carbon dioxide | Biconcave discs with no nucleus; possess surface antigens (ex. A, B, O) |  |
| *2) Leukocytes (White Blood Cells)* |  |  |  |
| *Neutrophils* | The most common of the leukocytes | Cytoplasm does not stain dark; nucleus is composed of 3-5 lobes |  |
| *Eosinophils* |  | Cytoplasm stains red; nucleus composed of two lobes (bilobed) |  |
| *Basophils* |  | Cytoplasm stains dark purple; nucleus is S-shaped |  |
| *Lymphocytes* |  | Large spherical nucleus with slender region of cytoplasm that stains blue |  |
| *Monocytes* |  | Cytoplasm stains blue and U-shaped nucleus |  |
| *3) Thrombocytes (Platelets)* |  | Small |  |

**Pre-Lab Activity 2.3: Identify Formed Elements**

In the image below circle an example of a red blood cell, white blood cell and platelet.

Blood was smeared onto a glass slide, stained with Giemsa and then imaged using a light microscope. A close-up of many red blood cells, three white blood cells, and several small platelets are visible.

Description automatically generated

**Figure 2.2** The histological image above is of a normal human adult blood smear with a Giemsa staining.

**Pre-Lab Activity: 2.4 Blood Types**

Blood is a liquid connective tissue that is important in gas exchange and nutrient distribution in most body cells. The watery extracellular matrix of blood is known as blood plasma. Blood contains three formed elements as well: 1. Erythrocytes (red blood cells), 2. Leukocytes (white blood cells) and 3. Cell fragments known as platelets. Red blood cells are the most abundant and have a genetically unique assortment of glycoproteins and glycolipids embedded in their plasma membranes. These glycoproteins and glycolipids serve as antigens and occur in predictable combinations. The presence or absence of the characteristic antigens determine which blood group and blood type an individual has. There are 24 blood groups and over 100 antigens found on the surface of red blood cells. For this lab, we will only discuss the ABO and Rh blood groups. The ABO blood group is based on whether individuals possess glycolipid antigens known as A and B. Individuals with red bloods cells that have only A glycolipids would have type A blood, those with B glycolipids would have type B blood and some individuals are co-dominant for type A and B glycolipids which means their red blood cells display both glycolipids type AB blood. An individual that lacks A or B antigens on red blood cells have type O blood. The Rh blood group determines whether your blood type is positive or negative and is named because the antigen was first discovered in the Rhesus monkey. Individuals that are positive for Rh antigens have these antigens displayed on the plasma membrane of their red blood cells. Negative individuals for Rh antigens do not have these antigens shown on their red blood cells. The combination of these antigens displayed on your red blood cells determined your blood type which may be A+, A-, B+, B-, AB+, AB-, O+ or O-.

A diagram of blood types. A antigens represented as circles projecting off an A red blood cell. B antigens represented as diamonds projecting off a B red blood cell. A and B antigens projecting off an AB red blood cell. O red blood cell does not have antigens. 

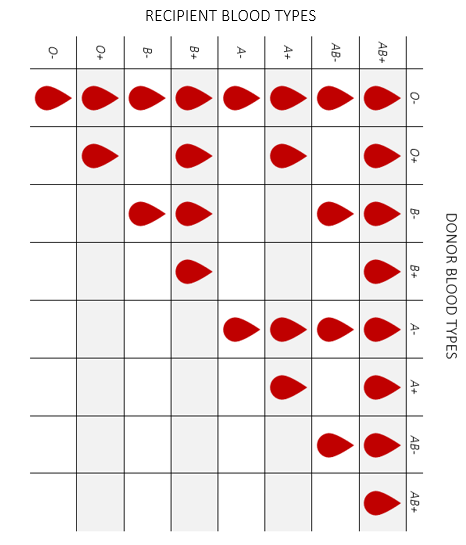
Plasma antibodies in A blood types are depicted as having binding sites for B antigens (anti-B). Plasma antibodies for B blood types are depicted as having binding sites for A antigens (anti-A). AB blood types have neither A nor B antibodies. Plasma antibodies for O blood is depicted as having binding sites for both A antigens and B antigens (anti-A and anti-B). 

https://upload.wikimedia.org/wikipedia/commons/1/1d/1913_ABO_Blood_Groups.jpg

**Figure 2.3** Table illustrating ABO blood types and compatible blood types for transfusions.

To better understand blood types and their importance, study the blood type compatibility table and answer these questions.

1. If a person that was A+ needed a blood transfusion, would they be able to receive AB+ donor blood? Explain.
2. Would a person with AB+ blood be able to receive a transfusion from an O+ donor? Explain.
3. Would a person with O- blood be able to receive a transfusion from a B- donor? Explain.
4. Which blood type can be used universally for transfusions?
5. Which recipient blood type can receive any donor blood type?



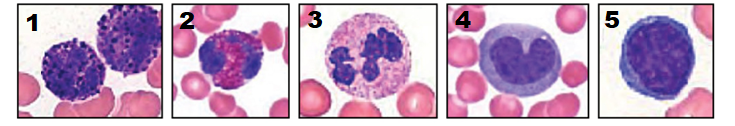
**Figure 2.4** Chart highlighting donor blood types with compatible recipient blood types. Diagram by Gina Profetto

**Pre-Lab Activity 2.5: Identify White Blood Cells**

White blood cells are a major formed element of blood and important in immune functions. White blood cells are also known as leukocytes and are significantly larger than both red blood cells and platelets, but their numbers are much fewer. White blood cells have uniquely shaped nuclei and are characterized as granular or agranular depending on whether their granules are easily viewed when stained.

Using the figure below match the image to the type of leukocyte: Basophil, Eosinophil, Monocyte, Lymphocyte or Neutrophil. Next, complete the description underneath the leukocytes by highlighting the unique features of the white blood cell type.

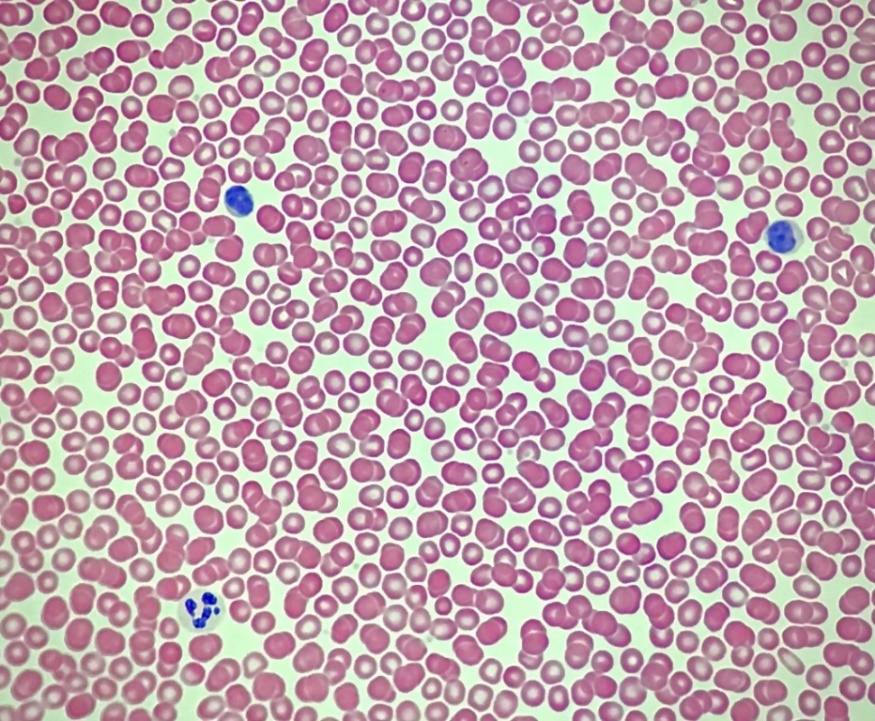
**Figure 2.5** Typical appearance of white blood cells.

****

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. Cell Type | 1. Cell Type: | 1. Cell Type: | 1. Cell Type: | 1. Cell Type: |
| Description: | **Description:** | **Description:** | **Description:** | **Description:** |

What leukocytes are you able to identify in the blood smear provided?

**Figure 2.6 Blood smear at low magnification with white and red blood cells**. Photograph by Amber Howard



# **Exercise 2 Activities: Blood**

**Lab Activity 2.1: Blood Typing**

Check for the following supplies at your lab bench:

* Blood typing slides
* Synthetic blood
* Synthetic anti-D (Rh) serum
* Synthetic anti-A serum
* Synthetic anti-B serum
* Mixing sticks (blue, yellow, and white)

**You will perform tests to determine the ABO properties of 4 unknown synthetic blood samples.**

1. Using the dropper vile, place a drop of the first synthetic blood sample in each well of the blood typing slide. Replace the cap and the dropper vile. **Always replace the cap on one vile before opening the next vile, to prevent cross contamination.**
2. Add a drop of synthetic anti-A serum (blue) to the well labeled A. **Replace the cap.**
3. Add a drop of synthetic anti-B serum (yellow) to the well labeled B. **Replace the cap.**
4. Add a drop of synthetic anti-D (Rh) serum (clear) to the well labeled D. **Replace the cap.**
5. Using a mixing stick of a different color for each well (blue for anti-A, yellow for anti-B, white for anti-Rh), gently stir the synthetic blood and anti-serum drops for 30 seconds. **Remember to discard each mixing stick after** **a single use to avoid contamination of your samples.**
6. Carefully examine the thin films of liquid mixture left behind. If a film remains uniform in appearance, there is no agglutination (negative). If the sample appears granular, agglutination has occurred (positive). Determine the blood type of the sample using the chart below. Answer yes or no as to whether agglutination (cell clumping) occurred in each sample. A positive agglutination reaction indicates the blood type.
7. Record the results for each blood sample in the data table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Sample # | Sample # | Sample # | Sample # |
| Anti-A |  |  |  |  |
| Anti-B |  |  |  |  |
| Anti-D (Rh) +or - |  |  |  |  |
| Blood Type |  |  |  |  |

1. Thoroughly rinse the blood-typing slide and repeat steps 1-7 for three different blood samples, recording the results of each test as you go (rinse and keep the slides after each time).

**Critical Thinking Question:** Mitchell is **blood type A**. When a lab technician mixes a sample of Mitchell’s blood with the serum taken from Anuran’s blood, Mitchell’s blood cells agglutinate. When Mitchell’s blood is mixed with the serum from Roberta’s blood, there is no agglutination. What is the explanation for this?

**Lab Activity 2.2: Histological Examination of Blood**

Supplies needed:

* Blood smear slide (normal)
* Compound microscope

1. Beginning with the 4x power objective, adjust your coarse then fine focus. Look over your slide and determine where cells are spread thinly, usually towards the end of your smear, this will allow you to visualize individual cells.

2. Increase the objective power to 10x and move the microscope stage as needed to view other areas. Be on the lookout for leukocytes. Use the fine focus to improve clarity.

3. Move to the 40x objective. **Remember to only use fine focus at this** power and SLOWLY turn the stage control knobs. Begin to document the different cells (red blood cells, white blood cells, and platelets) present in your field of view.

**Lab Activity 2.3: Identifying Components of Blood**

Supplies needed:

* Blood smear slides (normal, eosinophile and sickle-cell)
* Compound microscope

Using the 40x objective scan three different blood smear slides and see how many different cellular components of whole blood you can identify. Use the pre-lab exercise or your textbook to help you identify the specific blood cell types in the sample.

Take some photographs with your smartphone camera through one of the eyepieces when you find unique cell types. Work together with your lab partner to identify everything you find and complete the following table.

|  |  |  |
| --- | --- | --- |
| Sketch of Cells at 40x | Describe Appearance | Number of Cells |
| Normal |  | RBCs:  WBCs:  Platelets: |
| Eosinophilia |  | RBCs:  WBCs:  Platelets: |
| Sickle Cell |  | RBCs:  WBCs:  Platelets: |
|  |  |  |

**Post-Lab 2 Review**

**Post-Lab Activity 2.1: Blood Typing Questions**

1. An **O+ blood donor** may safely donate blood to individuals with which blood types?
2. **Rh-negative mothers** carrying a **Rh-positive baby** need medical intervention to carry the baby to full term. Why? What is the issue?
3. Define hematopoiesis and explain why this process is important.
4. Why might women have a lower erythrocyte count compared to men?
5. What might a higher-than-normal white blood cell count mean?
6. Define hemolysis and explain how it might occur in an individual following a transfusion.
7. While slicing tomatoes for a salad your roommate cut their finger and has difficulty stopping the bleeding. What is the potential problem? What formed element may be causing the problem?
8. If you have A negative blood type and your parents have O negative and B negative blood types. Are they your biological parents? Explain why/why not.
9. What are the specific blood types seen in the two unknown blood samples below?

**Unknown Type #1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **Unknown Type #2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Image of two blood typing trays with synthetic red blood in wells marked A, B and Rh. These wells have been treated with antiserum.

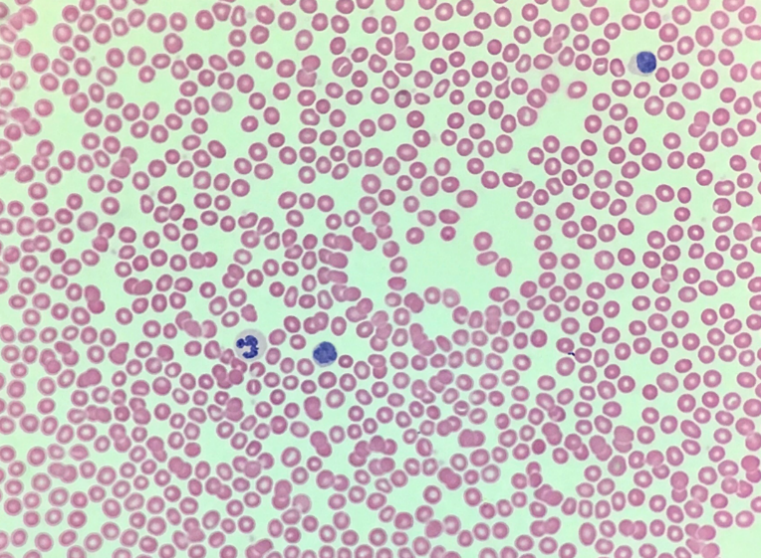
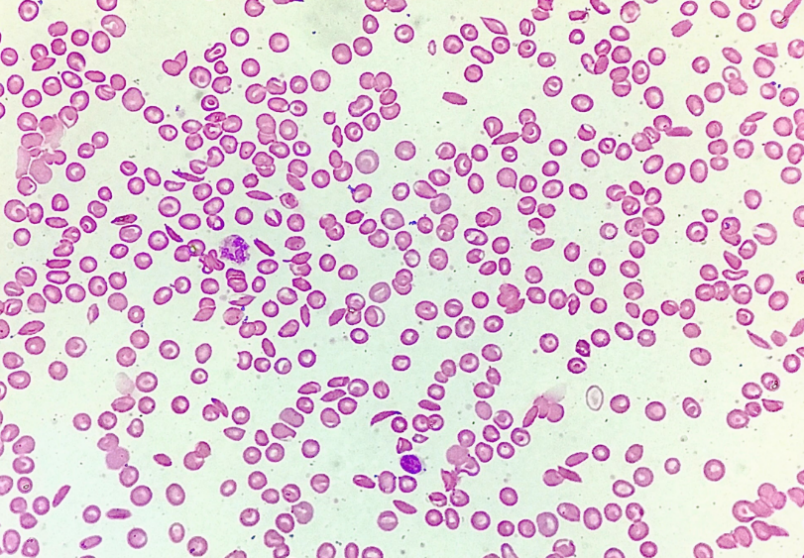
Image on the left shows agglutination of wells A and B, but no agglutination of well Rh. Image on the right shows agglutination of well A, but no agglutination of wells B or Rh.

**Figure 2.7 Blood typing unknowns**. Photograph by Gina Profetto

**Post-Lab Activity 2.2: Histology**

1. Using the images below, identify the sample taken from a **normal human blood smear** and the sample of blood from someone with **sickle cell anemia**.

**Figure 2.8** Representative micrographs from two different blood smear slides. Photograph by Amber Howard



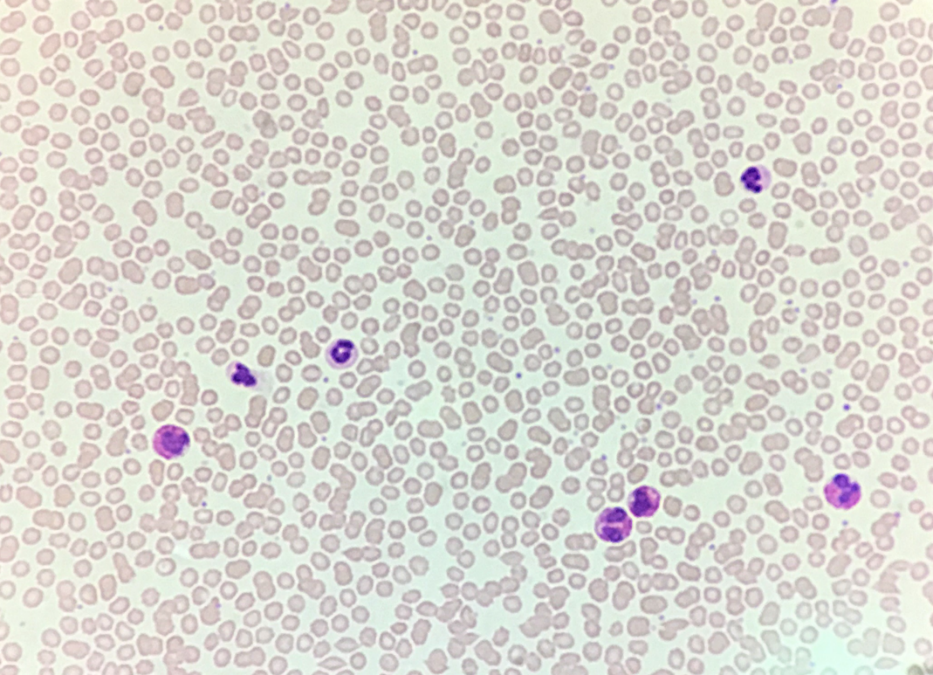
Sample: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Sample: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**\*In the image you identified as sickle-cell anemia, circle the sickled cells.**

1. The image below shows **eosinophilia**. Using the image, identify and record the number of each leukocyte identified, in the chart below.

|  |  |
| --- | --- |
| Leukocyte | # of cells |
| Neutrophil |  |
| Eosinophil |  |
| Lymphocyte |  |
| Basophil |  |
| Monocyte |  |



**Figure 2.9** Representative micrograph from an atypical blood smear. Photographs by Amber Howard