

## **Biology Lab Activities: Blood Cells**

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# How to use this manual

This lab manual is intended for use with the [Visible Biology](#) product.

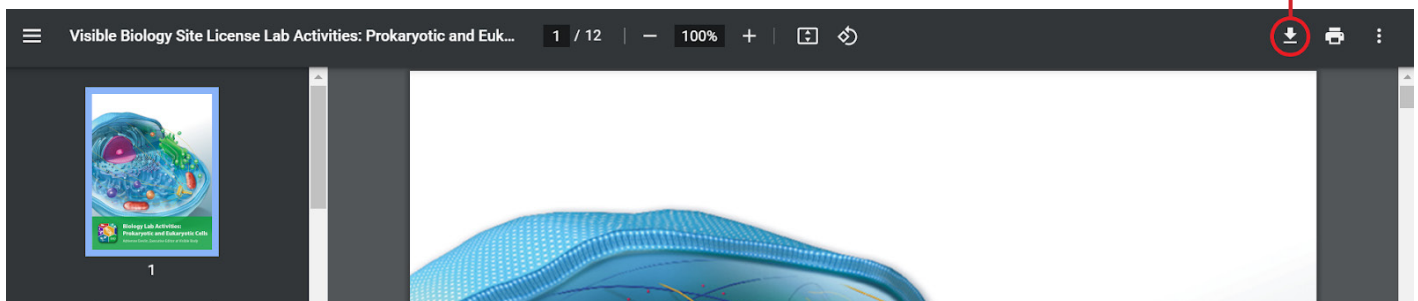
## Where to find 3D models

The screenshot shows the Visible Biology interface. At the top, there are three tabs: 'Units', 'Study', and 'My Library'. The 'Study' tab is active. Below the tabs, there are three sections: 'Quizzes', 'Lab Activities', and 'Get PDFs'. The 'Lab Activities' section is circled in red, with a red arrow pointing to it from the text 'Under the Study section of Visible Biology, there is a Lab Activities tab.' Below this, there is a section titled 'Lab activities that correspond to the following views are available as PDFs.' The 'Get PDFs' button is circled in red, with a red arrow pointing to it from the text 'Select "Get PDFs" to download the lab activities.' Below this, there is a section titled 'Prokaryotic and Eukaryotic Cells Lab' with three 3D models: '1. Bacterial Cell', '2. Animal Cell', and '3. Plant Cell'. A red arrow points to these models from the text 'Find the row of 3D views that corresponds to each lab manual and use the views to investigate and find answers.'

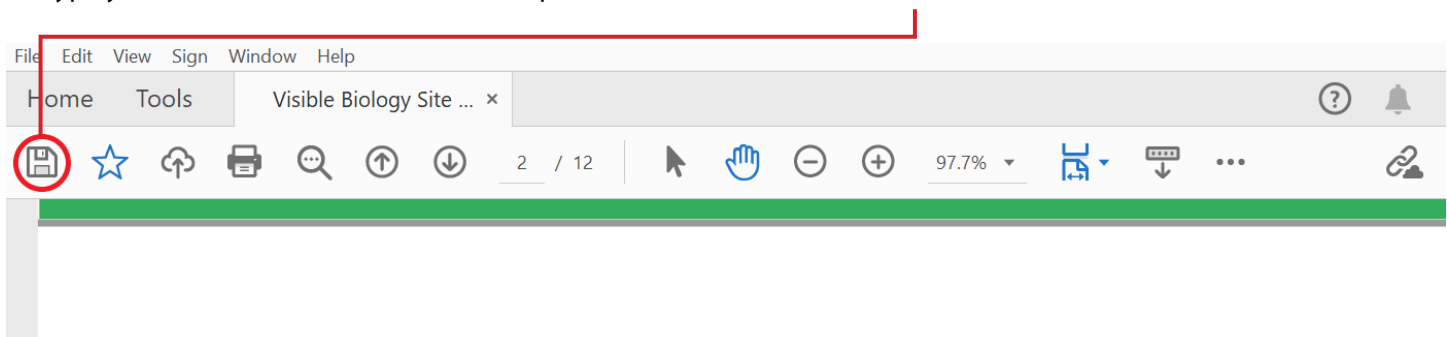
## How to save answers

1. Have Adobe Reader installed on your computer.  
Windows: <https://get.adobe.com/reader/>  
Mac: <https://helpx.adobe.com/acrobat/kb/install-reader-dc-mac-os.html>

2. Download each lab file to your computer.



3. Open the downloaded file in Adobe Reader.  
Right-click on the file. In the menu that appears, go to "Open with..." and select Adobe Reader from the submenu.
4. Type your answers into the boxes to complete the lab and select the "Save" icon to save the lab.



5. Submit your saved version of the lab to your instructor via email, dropbox, Google Drive, or however your instructor has requested.

**Any questions?**  
[visiblebiology.com](http://visiblebiology.com)

## Biology Lab Activities: Blood Cells

### Introductory Note About the Visuals in These Labs

In labs on blood cells, you'd normally be looking at blood smears using a microscope. In this set of labs, you'll examine 3D models of blood cells suspended in plasma.

- To make it possible for you to view the cells in 3D, we've created these models to look like drops of blood before they're smeared.
- To set the different structures apart, we've applied the stain colors as they would appear when viewed on a microscope slide. You can rotate the model and view it from above to see a 3D representation of what the cells might look like once they've been smeared, fixed, and stained.
- You can rotate the model and zoom inside the plasma to take a closer look at the structure of the blood cells, see how different types of blood cells compare to each other, and see how blood cells might be spatially distributed in a peripheral blood sample.

We've taken some artistic license with these models, so please keep the following in mind:

- We've grouped the blood cells into commonly used categories for comparison purposes. As a result, some of these models may group blood cells together that normally would not be seen in the same blood smear.
- Some of the white blood cells look very similar or identical to each other. To set them apart, we've used color and labels.
- In some cases, we've included structural characteristics that would not be visible using a normal light microscope, such as microvilli.

Name:

Date:

## Biology Lab Activities: Blood Cells

### Background Questions

Read through the Overview of Blood Cells article on the Visible Body Biology Learn Site (<https://www.visiblebody.com/learn/biology/blood-cells/blood-overview>).

Based on what you've learned in class, in your textbook, from the Biology Learn Site article, and from using Visible Biology, answer the following questions about the composition of blood and the types of blood cells.

1. What is the composition of blood?
  
  
  
  
  
2. What are the five main functions of blood?
  - a.
  - b.
  - c.
  - d.
  - e.
  
  
3. As you've probably learned, all blood cells originate from stem cells called hemocytoblasts in the red bone marrow. How do the major classifications of blood cells differentiate from hemocytoblasts?
  
  
  
  
  
4. What are the five types of white blood cells?
  - a.
  - b.
  - c.
  - d.
  - e.

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## **Lab 1: Red Blood Cells and Platelets**

### **Activity 1: Label red blood cells and platelets**

In this lab activity, you'll explore a 3D model of a peripheral blood droplet containing red blood cells, platelets, and plasma. This 3D model is an interactive tool to help you focus on the following characteristics of these blood cells:

- Their shape and structure
  - How they might be spatially distributed in a blood smear
  - Their relative abundance (compared to other types of cells) in a blood smear
  - The colors they may appear when certain histological stains are applied
  - How red blood cells and platelets compare, in terms of size and structure
  - How activated and inactivated platelets compare, in terms of structure
1. Launch the view
    - Launch Visible Biology.
    - Navigate to Study/Lab Activities, and find the Blood Cells Lab section.
    - Select view 1. Red Blood Cells and Platelets.
  2. Label the image below
    - Explore the 3D model of the red blood cells and platelets to find the structures you need to label.
    - Fill in the blanks to label the structures from the list below.

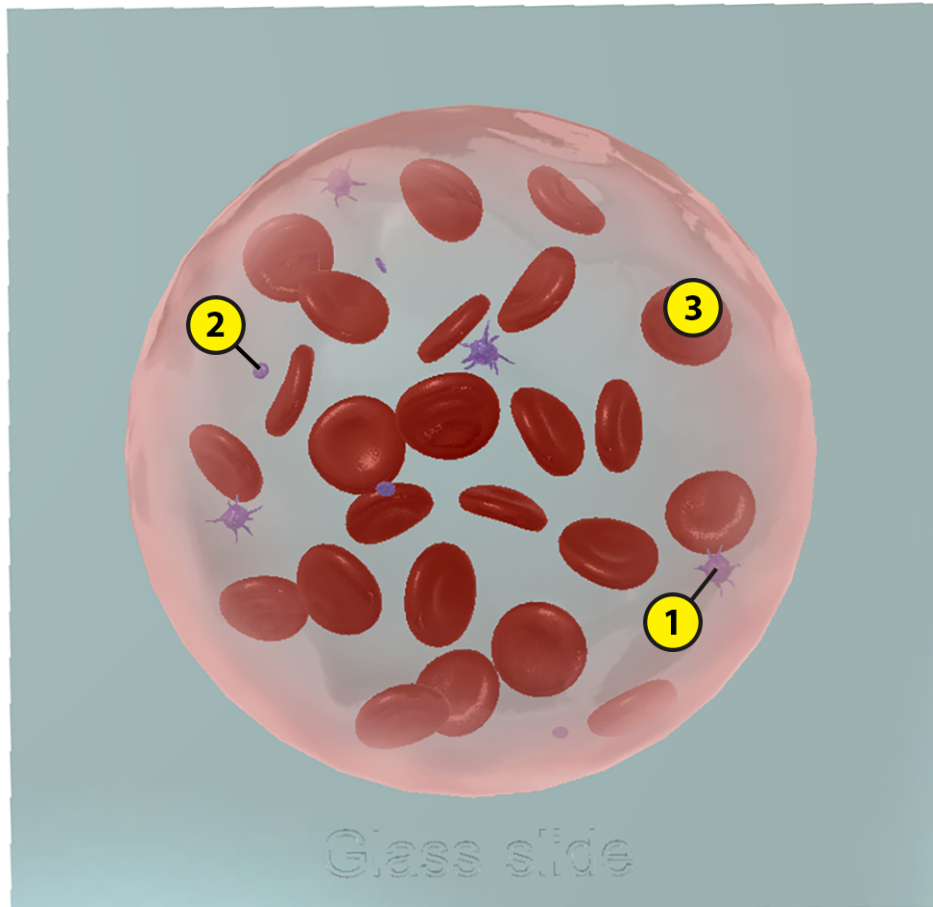
Word List:

Platelet (activated)

Platelet (inactivated)

Red blood cell

—  
—  
—



Name:

Date:

## Lab 1: Red Blood Cells and Platelets

### Activity 2: Explore the structure and functions of red blood cells

Refer to your labeled red blood cells and platelets image from Activity 1 and the content in Visible Biology to answer the following questions about the structure and functions of red blood cells.

1. Complete the following sentences on the production and characteristics of red blood cells.
  - a. The hormone \_\_\_\_\_ regulates red blood cell production.
  - b. It takes \_\_\_\_\_ days for red blood cells to develop from stem cells called \_\_\_\_\_ into mature red blood cells.
  - c. As red blood cells develop, they produce a protein molecule called \_\_\_\_\_.
  - d. Red blood cells, also known as \_\_\_\_\_, make up \_\_\_\_\_% of the total blood volume.
  - e. A red blood cell's functional life span is \_\_\_\_\_ days.
2. What structures do red blood cells eject before they enter the bloodstream and why do they eject them?
3. What is the shape of red blood cells when they are in the bloodstream?
4. What is the primary function of red blood cells?

Name:

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## Lab 1: Red Blood Cells and Platelets

### Activity 3: Explore the structure and functions of platelets

Refer to your labeled red blood cells and platelets image from Activity 1 and the content in Visible Biology to answer the following questions about the structure and functions of platelets.

1. Complete the following sentences on the production and characteristics of platelets.
  - a. The hormone \_\_\_\_\_ regulates platelet production.
  - b. This hormone causes some myeloid stem cells to differentiate into \_\_\_\_\_, which break up into fragments called platelets that enter the bloodstream.
  - c. Platelets have many \_\_\_\_\_, which contain the chemicals necessary to carry out their functions, but they lack a \_\_\_\_\_.
  - d. Platelets, also known as \_\_\_\_\_, make up \_\_\_\_\_% of the total blood volume.
  - e. A platelet's functional life span is about \_\_\_\_\_ days.
  
2. In 2–3 sentences, how would you compare the shape of inactivated and activated platelets?
  
  
  
  
  
  
  
  
  
  
3. What is the primary function of platelets?



Name:

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## **Lab 2: Granular Myeloid White Blood Cells**

### **Activity 1: Label a neutrophil, a basophil, and an eosinophil**

In this lab activity, you'll explore a 3D model of a peripheral blood droplet containing a neutrophil, a basophil, an eosinophil, red blood cells, and plasma. This 3D model is an interactive tool to help you focus on the following characteristics of these blood cells:

- Their shape and structure
- How they might be spatially distributed in a blood smear
- The colors they may appear when certain histological stains are applied
- How neutrophils, basophils, and eosinophils compare, in terms of the shape of their nuclei and the size and distribution of their granules

#### 1. Launch the view

- Launch Visible Biology.
- Navigate to Study/Lab Activities, and find the Blood Cells Lab section.
- Select view 2. Granular Myeloid White Blood Cells.

#### 2. Label the image below

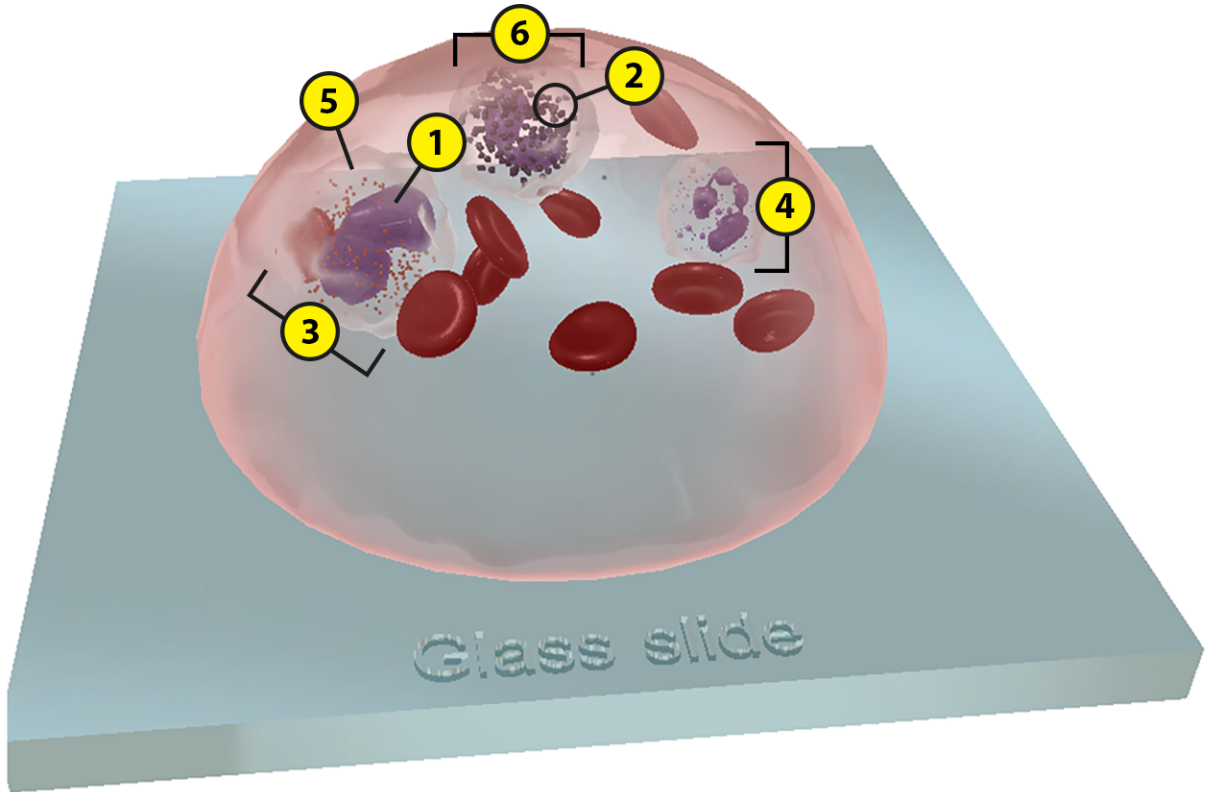
- Explore the 3D model of the granular myeloid white blood cells to find the structures you need to label.
- Fill in the blanks to label the structures from the list below.

Word List:

Basophil     \_\_\_  
Cytoplasm    \_\_\_

Eosinophil    \_\_\_  
Granules       \_\_\_

Neutrophil    \_\_\_  
Nucleus       \_\_\_



Name:

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## Lab 2: Granular Myeloid White Blood Cells

### Activity 2: Compare neutrophils, basophils, and eosinophils

Refer to your labeled granular myeloid white blood cells image from Activity 1 and the content in Visible Biology to answer the following questions comparing the structure and functions of neutrophils, basophils, and eosinophils.

1. One of the types of granular myeloid white blood cells makes up 60–70% of the total circulating white blood cells found in blood and is the most abundant phagocyte. Which one is it?
2. What percentage of the total circulating white blood cells in blood is made up of each of the other two types of granular myeloid white blood cells?
3. Complete the following table to compare the structure of neutrophils, basophils, and eosinophils.

	Neutrophils	Basophils	Eosinophils
Granule Size & Location			
Granule Contents			
Granule Stain			
Nucleus			

4. As you may have learned from studying neutrophils, basophils, and eosinophils, their nuclei can vary in terms of shape and number of lobes. Because of this, these cells are often referred to as \_\_\_\_\_ leukocytes.

5. Complete the following sentences on the location and function of neutrophils, basophils, and eosinophils.
- a. Neutrophils are numerous at sites of \_\_\_\_\_. They kill and digest \_\_\_\_\_ through phagocytosis.
  - b. Basophils are numerous at sites of \_\_\_\_\_ and \_\_\_\_\_ reactions. They control these reactions by releasing the contents of their granules to \_\_\_\_\_ the blood vessels and attract other white blood cells. They also decrease clotting to maintain blood flow.
  - c. Eosinophils are found in the loose connective tissue of the skin and the intestinal and respiratory mucosa. They help control allergic and inflammatory reactions by combating the effects of \_\_\_\_\_. They also help fight \_\_\_\_\_ and virus infections, and they are responsible for excess inflammation and tissue damage in many diseases, including asthma.

Name:

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### **Lab 3: Agranular Myeloid White Blood Cells**

#### **Activity 1: Label activated and inactivated monocytes**

In this lab activity, you'll explore a 3D model of a peripheral blood droplet containing monocytes, red blood cells, and plasma. This 3D model is an interactive tool to help you focus on the following characteristics of these blood cells:

- Their shape and structure
- How they might be spatially distributed in a blood smear
- The colors they may appear when certain histological stains are applied
- How activated and inactivated monocytes compare, in terms of their structure

1. Launch the view

- Launch Visible Biology.
- Navigate to Study/Lab Activities, and find the Blood Cells Lab section.
- Select view 3. Agranular Myeloid White Blood Cells.

2. Label the image below

- Explore the 3D model of the agranular myeloid white blood cells to find the structures you need to label.
- Fill in the blanks to label the structures from the list below.

Word List:

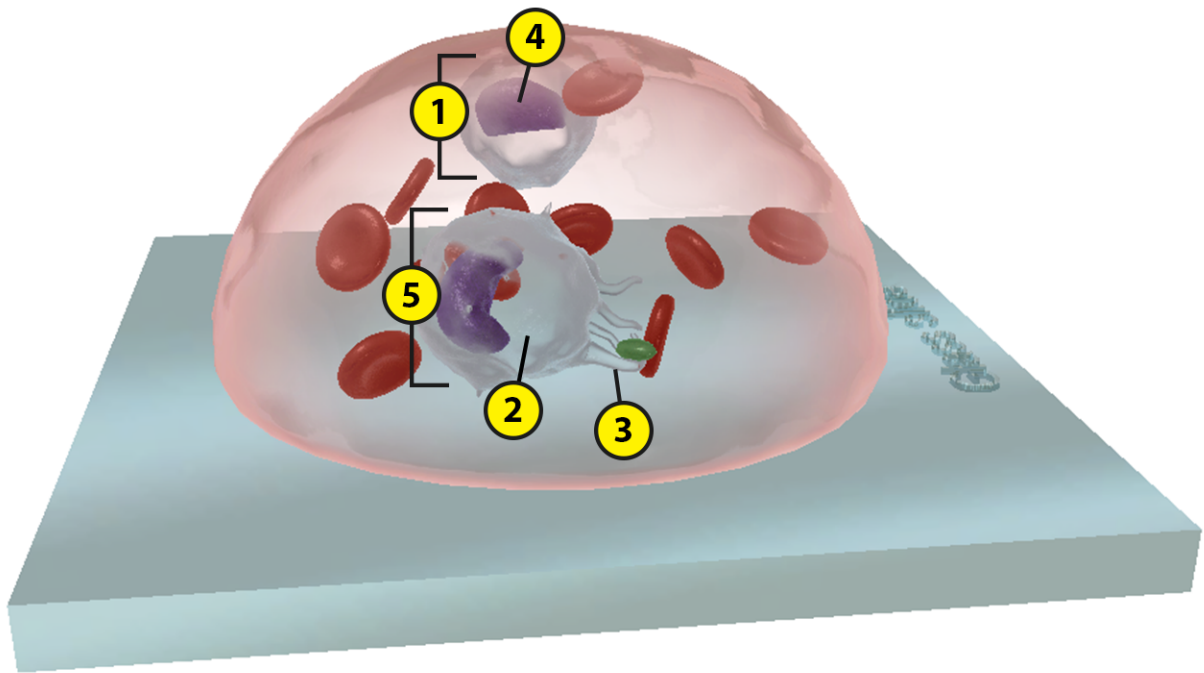
Cytoplasm

Monocyte (activated)

Monocyte (inactivated)

Nucleus

Pseudopodia



Name:

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### Lab 3: Agranular Myeloid White Blood Cells

#### Activity 2: Explore the structure and functions of monocytes

Refer to your labeled agranular myeloid white blood cells image from Activity 1 and the content in Visible Biology to answer the following questions about the structure and functions of monocytes.

1. Explore the basic structure of monocytes.
  - a. Do monocytes have visible granules?
  - b. Monocytes have \_\_\_\_\_ shaped nuclei that stain \_\_\_\_\_, surrounded by pale blue \_\_\_\_\_ that contains lysosomes.
2. What percentage of the total circulating white blood cells in blood is made up of monocytes?
3. In 2–3 sentences, how would you compare the shape and structure of inactivated and activated monocytes?
  
4. What happens to monocytes when they leave the bloodstream and enter the tissues?

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## Lab 4: Lymphoid White Blood Cells

### **Activity 1: Label a B cell, a T cell, and a natural killer cell**

In this lab activity, you'll explore a 3D model of a peripheral blood droplet containing a B cell, a T cell, a natural killer cell, red blood cells, and plasma. This 3D model is an interactive tool to help you focus on the following characteristics of these blood cells:

- Their shape and structure
- How they might be spatially distributed in a blood smear
- The colors they may appear when certain histological stains are applied
- How structurally similar all lymphocytes are
- How B cells and T cells compare to natural killer cells, in terms of their size and structure

#### 1. Launch the view

- Launch Visible Biology.
- Navigate to Study/Lab Activities, and find the Blood Cells Lab section.
- Select view 4. Lymphoid White Blood Cells.

#### 2. Label the image below

- Explore the 3D model of the lymphoid white blood cells to find the structures you need to label.
- Fill in the blanks to label the structures from the list below.

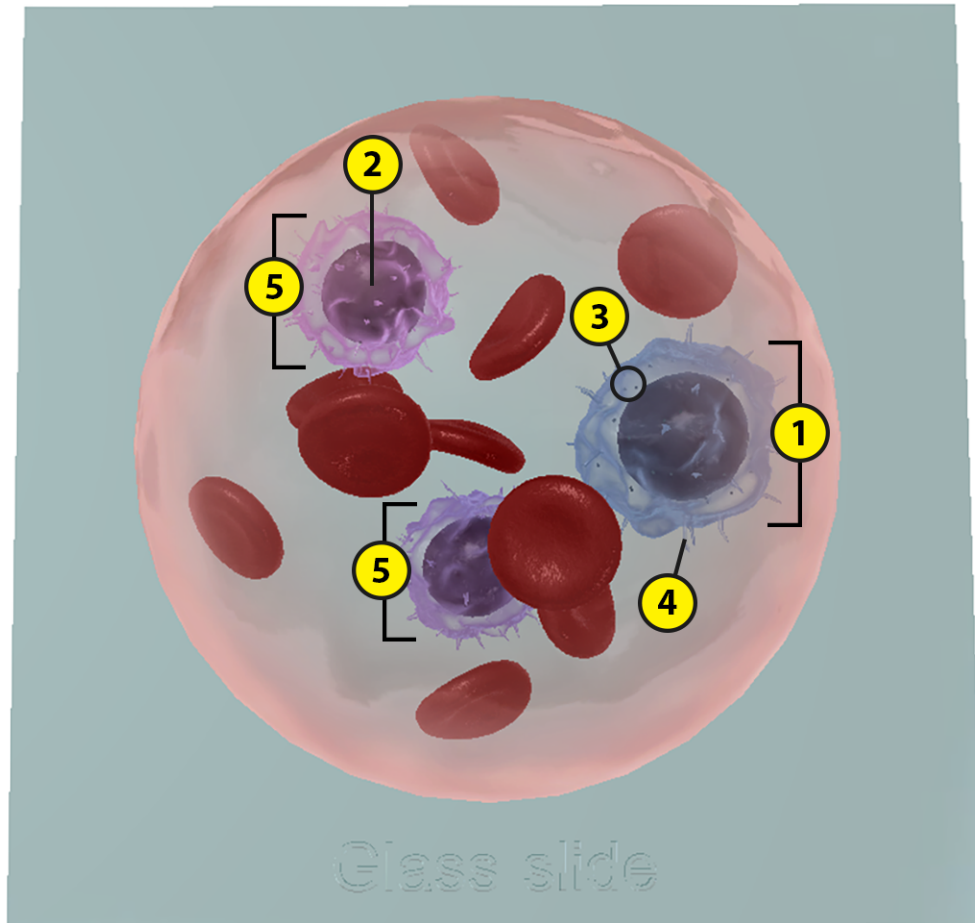


Word List:  
B cell or T cell  
Granules  
Microvilli

—  
—  
—

Natural killer cell  
Nucleus

—  
—



Name:

Date:

## Lab 4: Lymphoid White Blood Cells

### Activity 2: Compare B cells, T cells, and natural killer cells

Refer to your labeled lymphoid white blood cells image from Activity 1 and the content in Visible Biology to answer the following questions comparing the structure and functions of B cells, T cells, and natural killer (NK) cells.

1. As you've probably noticed, B cells, T cells, and natural killer cells all look the same, so they can be difficult to tell apart. As a result, in blood slides, they are often identified simply as lymphocytes. Answer the following questions to explore the characteristics that all lymphocytes share.
  - a. Lymphocytes are the second most common type of white blood cell, making up \_\_\_\_\_% of the total circulating white blood cells in blood.
  - b. Do lymphocytes have visible granules?
  - c. Lymphocytes have large, \_\_\_\_\_ nuclei that stain \_\_\_\_\_, surrounded by a thin layer of pale blue \_\_\_\_\_.
  - d. Lymphocytes have numerous fingerlike projections called \_\_\_\_\_ that provide extra surface area for receptors on the plasma membrane. An interesting fact is that they have way more of these projections when they are activated.
  - e. Where would you find lymphocytes?
  - f. Generally, lymphocytes play a major role in the body's \_\_\_\_\_ response.
2. B cells and T cells have some key similarities and differences. Answer the following questions to explore them.
  - a. B cells and T cells are both produced by stem cells in the bone marrow. However, B cells mature in the \_\_\_\_\_, whereas T cells mature in the \_\_\_\_\_.
  - b. There are several different types of B cells and T cells.
    - i. What are the two main types of B cells?
    - ii. What are the four main types of T cells?
  - c. How are B cells and T cells similar, in terms of their functions?
  - d. How do B cells and T cells differ, in terms of how they carry out their functions?

3. What is the function of natural killer cells?

Name:

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### Lab 5: Compare the Five Types of White Blood Cells

Refer to your labeled white blood cell images from Labs 2–4, as well as the 3D white blood cells in Visible Biology, to help you answer the following questions comparing the structure and functions of neutrophils, basophils, eosinophils, monocytes, and lymphocytes. You can also use the White Blood Cells articles on the Biology Learn Site to help you

(<https://www.visiblebody.com/learn/biology/blood-cells/granular-myeloid-white-blood-cells>, <https://www.visiblebody.com/learn/biology/blood-cells/agranular-myeloid-white-blood-cells>, and <https://www.visiblebody.com/learn/biology/blood-cells/lymphoid-white-blood-cells>).

1. Complete the following sentences on the general characteristics of white blood cells and how they are categorized.
  - a. White blood cells are also known as \_\_\_\_\_.
  - b. Together, all the types of white blood cells account for \_\_\_\_\_% of the total blood volume in healthy adults. Their numbers increase during \_\_\_\_\_, \_\_\_\_\_, or leukemia because their main function is \_\_\_\_\_.
  - c. White blood cells are categorized as either \_\_\_\_\_ or \_\_\_\_\_, depending on whether they contain specific staining granules in their cytoplasm.
  - d. They can be categorized further based on the type of stem cells that differentiate to produce them. Some of them originate from \_\_\_\_\_ stem cells and others originate from \_\_\_\_\_ stem cells.
  
2. In 3–5 sentences, describe which category each of the five types of white blood cells fits into, based on the presence or absence of granules and the type of progenitor cells that produce them.
  
  
  
  
  
  
  
  
  
  
3. The amount of each type of white blood cell circulating in blood varies, depending on whether the person is healthy or sick. What is the percentage range for each type of circulating white blood cell in peripheral blood?
  - a. Neutrophils: \_\_\_\_\_%
  - b. Basophils: \_\_\_\_\_%
  - c. Eosinophils: \_\_\_\_\_%
  - d. Monocytes: \_\_\_\_\_%
  - e. Lymphocytes: \_\_\_\_\_%

4. Which type of white blood cell is the most numerous in peripheral blood?
5. Which type of white blood cell is the largest?
6. Complete the following table to compare the structural characteristics of the five types of white blood cells.

	<b>Granules?</b>	<b># of Nuclear Lobes</b>	<b>Typical Nucleus Shape</b>
<b>Neutrophils</b>			
<b>Basophils</b>			
<b>Eosinophils</b>			
<b>Lymphocytes</b>		Not lobed	
<b>Monocytes</b>		Not lobed	

7. Match each of the following types of white blood cells with its function.
  - a. Neutrophils
  - b. Basophils
  - c. Eosinophils
  - d. Lymphocytes
  - e. Monocytes

\_\_\_\_\_ Attack parasites and help control allergic and inflammatory reactions by combating the effects of histamine

\_\_\_\_\_ Kill and digest bacteria via phagocytosis

\_\_\_\_\_ Identify, target, and destroy specific antigens, infected cells, and tumors

\_\_\_\_\_ Migrate into the tissues and develop into macrophages, large phagocytic cells that defend the body from pathogens and defective cells

\_\_\_\_\_ Control allergic and inflammatory reactions by releasing histamine to dilate blood vessels, heparin to reduce blood clotting, and chemicals to attract other white blood cells