

Activity 3.1.1: Blood Detectives

Introduction

Sickle cell disease (SCD) affects millions of people throughout the world and is a major public health concern. In this activity you will look at a portion of Anna Garcia’s autopsy report which shows she had sickle cell disease, a blood disorder. You will learn more about the components and function of blood in order to better understand how sickle cell disease affects the body. You will examine Anna’s blood with a microscope and complete a blood test called a hematocrit in order to determine whether Anna’s sickle cell disease was causing her other related health problems.

Equipment

* Computer with Internet access
* Laboratory journal
* PBS Course File
* Microscope
* Anna’s blood smear slide
* Normal blood smear slide
* How to Use a Microscope Resource sheet
* Colored pencils
* 50 mL Erlenmeyer flask
* Clay
* Corn starch or baby powder
* Microcentrifuge
* Safety goggles
* Gloves
* 1.5 mL microtest tube of Anna’s blood
* Ruler
* Calculator
* Activity 3.1.1 Autopsy Report
* Colored pencils
* Career journal
* Career Journal Guidelines
* PLTW Biomedical Science Documentation Protocol

Procedure

Part I: Healthy Blood

1. Obtain an Activity 3.1.1 Autopsy Report from your teacher.
2. Read through the report. Portions of this report have been left blank. You will fill in this section as you proceed through this activity.
3. Note the presence of trace amounts of hydroxyurea in Anna’s blood. Hydroxyurea is a medication used in patients with sickle cell disease to prevent sickle cell crises (episodes of severe pain). In your laboratory journal, write down any information you know about sickle cell disease.
4. Note that sickle cell disease is a blood disorder. Therefore, it is important to understand the components and functions of healthy blood in order to understand the disease.
5. Use reliable Internet sources to research the function of the following components of blood: plasma, red blood cells (also called erythrocytes), white blood cells (also called leukocytes), and platelets (also called thrombocytes). Record your findings in the table below. Include a 1-2 sentence description of function for each.

|  |  |
| --- | --- |
| Component: | Function: |
| Plasma |  |
| Red Blood Cells (Erythrocytes) |  |
| White Blood Cells (Leukocytes) |  |
| Platelets (Thrombocytes) |  |

1. Answer Conclusion question 1.
2. Obtain a prepared slide of healthy human blood, a microscope, and a How to Use a Microscope Resource Sheet from your teacher. Be sure to carry the microscope with two hands – one hand under the base and the other hand holding the arm of the microscope.
3. Read through the directions on the How to Use a Microscope Resource Sheet.
4. Pay attention as your teacher points out all of the features on a microscope, such as the fine and coarse adjustment knobs, the diaphragm, the stage, and the different objectives.
5. Place the prepared blood slide onto the stage of the microscope and secure it with the stage clips.
6. Use the low power objective and proper microscope technique (as outlined in the resource sheet) to focus on the blood cells, and then use the high power objective to view the cells.
7. Carefully observe all the cells in the field of view. Move the slide around to observe various fields of view.
8. Create an accurate and detailed drawing in your laboratory journal using colored pencils of what you see. Identify the different components of blood that you researched in Step 5. Label this drawing as “Normal Blood.”

Part II: Sickle Cell Disease

1. Obtain a prepared slide of Anna Garcia’s blood from your teacher.
2. Place the prepared blood slide onto the stage of the microscope and secure it with the stage clips.
3. Use the low power objective and proper microscope technique (as outlined in the resource sheet) to focus on the blood cells, and then use the high power objective to view the cells.
4. Carefully observe all the cells in the field of view. Move the slide around to observe various fields of view.
5. Create an accurate and detailed drawing in your laboratory journal of what you see. Label the different components that you researched in Step 5. Label this drawing as “Anna Garcia.”
6. Compare what you saw in the normal blood slide versus Anna’s blood slide.
7. Record any abnormalities you see in Anna’s blood on the Activity 3.1.1 Autopsy Report under the section entitled *Microscopic Analysis of Blood.*
8. Answer Conclusion question 2.
9. Use the Internet to find a picture of a healthy normal red blood cell and a sickled red blood cell. Draw the two cells in your laboratory journal.
10. Obtain a 50mL Erlenmeyer flask and clay from your teacher. The flask will represent the blood vessels in the body. Red blood cells must flow through very small blood vessels in order to deliver oxygen to all of the cells in the body.
11. Use the clay to create 10 normal-shaped red blood cells. These should be formed in the shape of bi-concave disks or doughnuts and should be about the size of a large pea. Roll all of these normal-shaped red blood cells in corn starch or baby powder so they are no longer sticky. Alternatively, your teacher may have you use red apple Runts candies.
12. Create 10 sickle-shaped red blood cells. These should be crescent or banana-shaped and are a little less than twice as long as the normal red blood cells but half the width. Roll all of these sickle-shaped red blood cells in corn starch or baby powder so they are no longer sticky. Alternatively, your teacher may have you use banana Runts candies.
13. Place the 10 normal-shaped red blood cells into the flask. Put your finger over the top of the flask and slowly turn the flask upside down. Observe the red blood cells as they flow through the neck of the flask (representing a blood vessel in the body). Record your observations in your laboratory journal.
14. Empty the flask and replace with 10 sickle-shaped red blood cells. Put your finger over the top of the flask and slowly turn the flask upside down. Observe the red blood cells as they flow through the neck of the flask. Record your observations in your laboratory journal.
15. Answer Conclusion questions 3 and 4.

Part III: Anemia

Healthy red blood cells live between 90 and 120 days. Your body then removes old blood cells. A hormone called erythropoietin made in your kidneys signals your bone marrow to make more red blood cells. The red blood cells of patients with sickle cell disease do not live as long as healthy red blood cells. As a result, people with this disorder often have low red blood cell counts, which is called *anemia*. For this reason, sickle cell disease is commonly referred to as sickle cell anemia. Anemia is diagnosed through a test called a *hematocrit*. A hematocrit is a blood test that measures the percentage of the volume of whole blood that is made up of red blood cells. This measurement depends on the number of red blood cells and the size of red blood cells. The blood sample taken from the patient is *centrifuged*, meaning that it is spun at a very high speed. The percentage of blood that is red blood cells can be easily measured because the red blood cells settle to the bottom and the yellowish plasma, the white blood cells, and the platelets rise to the top. A sample of Anna Garcia’s blood was taken during her autopsy. You will run a hematocrit on Anna’s blood to determine the percent of red blood cells.

1. Obtain a 1.5 mL microtest tube containing a sample of Anna’s blood.
2. Centrifuge the blood sample in the microcentrifuge on low for 4 minutes.
3. Use a ruler to measure the total height of the blood in the tube and the height of the red blood cells in mm.

Total height of blood: \_\_\_\_\_\_\_\_\_\_\_\_

Height of red blood cells: \_\_\_\_\_\_\_\_\_\_\_

1. Use the following formula to determine Anna’s hematocrit:

$$\left(\frac{Red Blood Cell Level}{Total Blood Level}\right) x 100=Percent Red Blood Cell Volume=Hematocrit$$

1. Use the table below to determine if Anna’s red blood cell values were normal.

|  |  |  |
| --- | --- | --- |
| Low Hematocrit(%) | Normal Hematocrit(%) | High Hematocrit(%) |
| Male | Female | Male | Female | Male | Female |
| <42 | <35 | 42-54 | 35-46 | >54 | >46 |

1. Fill in the results of Anna’s hematocrit on the Activity 3.1.1 Autopsy Report.
2. Add any new ideas to the *Possible Causes of Death* section on the Activity 3.1.1 Autopsy Report.
3. File the Activity 3.1.1 Autopsy Report and the How to Use a Microscope Resource Sheet in the appropriate tabs of your course file. Use the PBS Course File – Table of Contents as a guide.
4. Note that the biomedical science professionals responsible for drawing blood from patients for various lab tests and procedures are called phlebotomists.
5. Follow the Career Journal Guidelines and complete an entry in your Career Journal for a phlebotomist.
6. Follow the PLTW Biomedical ScienceDocumentation Protocol to correctly document or cite the sources of information you used.
7. Answer Conclusion question 5.

Conclusion

1. You fall down and scrape your hand – describe what each component of blood would be doing at the injury site.
2. Anna has a condition called sickle cell anemia, a blood disorder. Based on the differences you observed between the normal blood slide and Anna’s blood slide, what do you think is a defining feature of this disease? Explain your answer.
3. How does the abnormal shape of a sickled red blood cell affect its movement through blood vessels?
4. People with sickle cell anemia often experience episodes of severe pain in their joints, chest, and abdomen and swelling in their hands and feet. Using what you know about the function of blood, why do you think the abnormal shape of sickled red blood cells causes these symptoms?
5. Anna’s autopsy shows that the nails on her fingers were a blue/gray color. How does Anna’s hematocrit level relate to these symptoms?
6. How might sickle cell disease have been related to Anna’s death?