4 Parts of Blood

Introduction

The purpose of this lesson is to introduce students to the four different parts of blood and physiological problems that arise when the parts do not function properly. This lesson will allow different groups to solve different problems simultaneously. This lesson may or may not fit into one class period, depending on class time.

Student Background Knowledge

This lesson is an introduction to blood and circulation. Knowledge of blood flow through the heart and body will be beneficial, but is by no means required.

Teacher Background Knowledge

The teacher must know the four main parts of blood: **white blood cells, red blood cells, plasma, platelets**. The parts of blood each have different densities, and therefore will separate into four different and distinct layers if centrifuged.

Blood is composed of plasma, which is about ninety percent water. Plasma serves as the main transportation component in the body since it is the liquid part of blood. Besides needing water for respiration and glycolysis, students must drink enough water each day to keep their blood functioning properly. Nutrients such as calcium and all other components of blood travel via plasma.

Red blood cells have a “lifespan” of approximately 120 days. The primary function of red blood cells is to transport oxygen throughout the body. Red blood cells have a protein called hemoglobin on their outer surface. Hemoglobin has iron molecules attached to it (hence a major reason to have iron in a diet), and therefore has an extremely strong affinity for oxygen. The iron combining with the oxygen (oxidation) gives red blood cells their red color. Veins have blue blood because there is no oxygen left since the red blood cells have deposited the oxygen and are returning to the heart and lungs to obtain more oxygen. Sickle Cell Anemia is a genetic (inherited on chromosome 11, homozygous recessive gene), often fatal disorder that affects red blood cells. If a person inherits one recessive sickle cell allele from their mother and one recessive sickle cell allele from their father, they will have the gene for sickle cell anemia. This disease is characterized by the normally round red blood cells bending into a “sickle” shape, and thus not carrying as much oxygen as normal red blood cells. Also, the “sickle” cells clog capillaries, thus causing blood clots and preventing oxygen from reaching the organs. However, if one parent passes on a recessive sickle cell allele, and the other parent passes on a normal dominant allele, the child will have only slightly mutated cells. If the child is heterozygous, then they will have immunity from malaria, since the malaria parasite invades normal red blood cells. Many studies suggest that a strong correlation exists between the high incidence of sickle cell anemia and African-Americans because the ancestors of African-Americans lived in Africa, a hotspot for malaria. Therefore, a heterozygous genotype for sickle cell provided necessary protection, despite the increased risk of passing a recessive sickle cell allele to offspring.

White Blood Cells fight disease. There are many different types of immune cells, but middle school students need to know that white blood cells destroy invading objects. White blood cells use chemicals that they produce and pick up on chemical signals from helper cells to identify and destroy invasive objects. White blood cells destroy invasive objects using a variety of methods, including by enveloping ("eating") them, by attaching to the surface of the object so that the object cannot bind to other cells, or by using chemicals to disrupt the reproductive cycle of the invasive object. The average number of white blood cells present in a healthy person ranges varies, but on average five to ten thousand white blood cells per drop of blood is normal. A dramatic increase or decrease in the number of white blood cells could mean that a person is sick. If the teacher feels their class can handle knowing the specifics, an increased WBC count could mean an infection or leukemia, whereas a low WBC count could mean HIV, some cancers, or other diseases which have overwhelmed the immune system. **Caution: Do not go into specifics about what a low or high WBC count means with your class unless you feel they can handle the information. You do not want to create panic among the students!**

Platelets, along with other proteins, form blood clots. When blood is exposed to air, platelets become sticky and form internal and external "scabs" to catch the blood cells and plasma, thereby stopping bleeding. A lack of nutrients, such as calcium and vitamin K, are necessary to form blood clots. If a student is lacking in those nutrients, their blood will not clot as quickly. Another genetic disease, hemophilia, is an infamous genetic disorder that causes either the clotting to not happen at all, or the clotting occurs at an extremely slow rate. Therefore, in theory, a small cut could prove fatal to someone with hemophilia. A sex-linked disease (X chromosome), hemophilia was notorious for causing deaths in European history, especially among princes (boys are more likely to have hemophilia than girls.) For more information, please see the lesson on Genetics and Sickle Cell Anemia on the Houston Medical Forum page.

Objectives

Students will learn the following ideas and words using this lesson: *platelet, white blood cell, red blood cell, water, sickle cell anemia, immune system, hemoglobin, clot, hemophilia* (and any other words/diseases you can incorporate!). Students will identify the four core components of blood, will use the scientific method to identify and solve a problem, compare and contrast healthy and diseased blood parts, determine problems that could arise in healthy blood parts.

Alignment to TEKS

This lesson is designed to align to the following TEKS objectives:
SCI.7.2.A. Plan and implement investigative procedures
SCI.7.2.D Communicate valid conclusions
SCI.7.3.C Represent the natural world using models and identify their limitations
SCI.7.3.F Connect Grade 7 science concepts with the history of science and the contributions of scientists
SCI.7.9.A Identify the systems of the human organism and describe their functions

SCI.7.9.B Describe how organisms maintain stable internal conditions while living in changing external environments
SCI.7.11A Analyze changes in organisms that may result from internal stimuli
SCI.7.11.B Identify responses in organisms to external stimuli found in the environment
SCI 7.10.C Distinguish between dominant and recessive traits and recognize that inherited traits of an individual are contained in genetic material

Materials

1) 4 Problem Sheets (provided, labeled A, B, C, D)
2) Paper towel rolls (4 at least)
3) Construction paper (multiple colors, make sure to have red)
4) Tape (some for each of the 4 groups)
5) Toy soldiers (2 at least)
6) Foam Ball with slits cut in them (2 at least)
7) Cough Syrup (20 mL) in a beaker
8) Water (20 mL) in a beaker
9) Small pebbles (20)
10) Empty beakers (2)
11) Picture of Red Blood Cell (4)
12) Picture of White Blood Cell (4)
13) Picture of Plasma (4)
14) Picture of Platelets (4)
15) Index cards with four parts of blood defined (4 sets)

Lesson Plan

1) Warm-Up: Explain what you think would happen to your body if you suddenly lost half of your blood? Also, pass out a graphic organizer so that students can brainstorm what they know (or think they know) about blood. Have students discuss as a large group their ideas about blood.

2) Divide class into 4 groups. Distribute Problems A, B, C, and D to the groups. The teacher will determine how much time each group will work.

3) Each group will present their work to the class (see the directions on the Problem sheets). There is no necessary order in which the groups must present. Hopefully, the solutions to the problems look like this:

A) Best shape should be round and flat in order to fit the most objects into the tube (Red Blood Cells).
B) Generally, students will describe characteristics of white blood cells (super senses, good weapons, etc.)
C) The slits will be stuck back together somehow (platelets)
D) Water will work better than cough syrup for transportation (plasma)

4) State to the class that each of the four problems presented represents one part of the 4 parts of blood. Pass out a picture set to each group. Each picture set contains a picture of a red blood cell, a white blood cell, platelets, and plasma.

5) Have each group a) determine which picture is which part of blood and b) define, using their own words based on the groups' presentations, the four parts of blood.

6) Make sure that each group correctly states and defines the four parts of blood.

7) In a large group discussion, have each group write on the board/ a piece of poster board their definition for each part of blood. As a large group, have the class refine and synthesize a definition that they agree upon, based on each group's definition. Do this for each part of blood.

8) After reaching a common definition for each part of blood, have students return to their small groups. Now pass out the textbook definitions to each group. Have each group match the class definitions with the textbook definitions.

9) Make sure to state the definitions out loud for each part of blood so that each student hears the definitions from the teacher.

10) Assign each group a different part of blood than they had previously. Now that the parts of blood have been defined, have each group determine problems that could occur if the part does not function properly. Each group will be responsible for determining (at minimum) 3 mutations and presenting (however they want) the mutation and subsequent complication to the class. The students do not need to know the technical names of the mutations, but as the teacher, you can certainly give the group the names as they work.

11) Pose the following question: Pretend that you are a doctor here in Houston. What advice/tests/medication would you give a person who came to your office with the following symptoms: a) shortness of breath b) light-headed feeling c) lack of energy d) feeling tired. Have each small group present their diagnosis/advice to the class. As a class, determine the most probable diagnosis. (Symptoms might indicate a lack of oxygen, though there could be multiple reasons. Tests include a hematocrit – number of red blood cells, and capturing red blood cells to see their shape. A family history can prove valuable, especially if the patient is African-American, to see if sickle cell is in the family.)

12) Closure. Have each individual student complete the following questions:

    a) One part of blood is _____. It's function is _____ _____ _____. If this part of blood is not function properly, then the following will occur in the body:_____ _____ _____

_____
_____.

b) One part of blood is _____. It's function is
_____
_____
_____. If this part of blood is not function properly, then the following will occur in the
body:_____
_____
_____
_____
_____.

c) One part of blood is _____. It's function is
_____
_____.
If this part of blood is not function properly, then the following will occur in the body:_____
_____
_____
_____.

d) One part of blood is _____. It's function is
_____
_____.
If this part of blood is not function properly, then the following will occur in the body:_____
_____
_____
_____.

Homework: Pretend you are a genetic engineer. You want to make each part of blood more efficient and effective. What would you do to improve each part of blood? Why?

ESL/ELL/LEP Modifications
If necessary, here are some suggested ESL modifications. Use **Language labels** on the pictures of the red blood cell, the white blood cell, the platelets, and the plasma. Also, you can have the technical definition of the part of blood in both English and the other language for your students. When discussing mutations such as sickle cell anemia and hemophilia, find a lower grade level reading passage and have the students practice reading passages.

Assessment possibilities:
If you would like to have assessments on this particular lesson, some suggested assessments include the closure questions, creating a rubric for the presentations, and a daily participation grade for correctly aligning the classroom definitions, the technical definitions, and the pictures of the parts of blood.