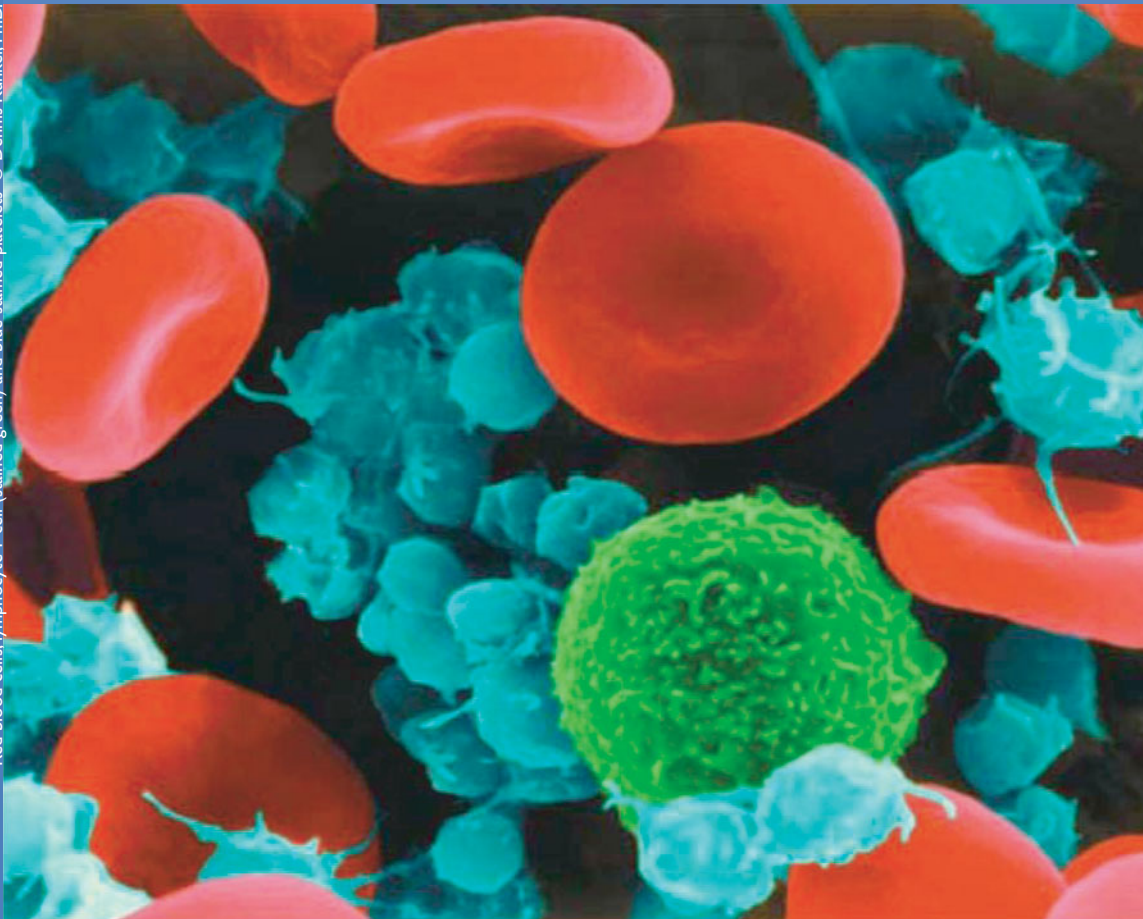




My Blood,[®] Your Blood

Red blood cells, lymphocyte T cell (stained green) and blue-stained platelets. © Dennis Kunkel, Ph.D.



**America's Blood[®]
Centers**
It's About *Life.*

**MIDDLE & HIGH SCHOOL
TEACHER'S GUIDE**



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Introduction

America's Blood Centers and the Foundation for America's Blood Centers are committed to increasing public awareness about the need for blood donation to help ensure that all Americans have access to a safe and adequate blood supply. The creation of *My Blood, Your Blood* underscores this commitment. While fostering altruism and community spirit, this Teacher's Guide and the entire *My Blood, Your Blood* curriculum provide up-to-date information and creative strategies to help teach the science of blood. Developed by a team of physicians and educators, *My Blood, Your Blood* is designed to be a turnkey education program easily adapted to a variety of learning levels. America's Blood Centers hopes you and your students enjoy the learning activities. We encourage you to visit the *My Blood, Your Blood* Web site at www.MyBloodYourBlood.org.

Our *My Blood, Your Blood Guide* follows current National Science Education Standards:

The National Science Education Standards, developed by the National Research Council and the National Academy of Sciences, are criteria for the development of curricula to increase science literacy of all students.

The *My Blood, Your Blood Video* and *Teacher's Guide* can assist educators in designing science lessons that will aid student understanding in the following content areas established by the National Science Education Standards:

Life Sciences:

- Structure and Function in Living Organisms (Level 5-8)
- The Cell and Matter, Energy, and Organization in Living Systems (Level 9-12)

Science in Personal and Social Perspectives:

- Personal Health (Level K-8)
- Personal and Community Health (Level 9-12)
- Science and Technology in Local Challenges and Society (Level K-12)

Blood is a Mixture

LESSON PLAN



Lesson Plan

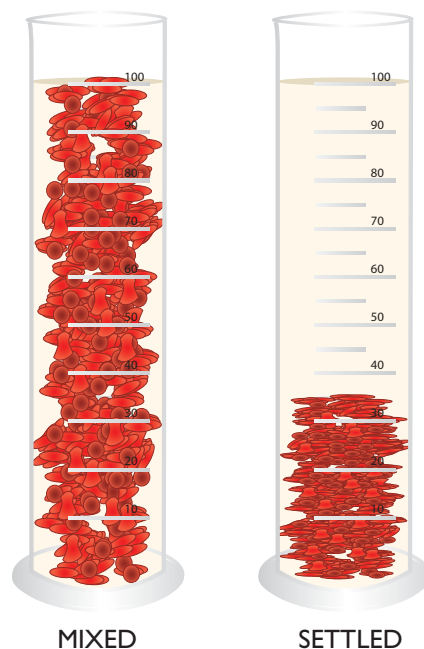
Estimated Time: two class periods

- Show *MBYB* video segment (Start 00:00; End 11:00)
- Demonstration: Blood is a Mixture; Teach concepts presented in teacher background info (30 minutes)
- Use PowerPoint® slides 1-4 and Blood facts poster
- Students read worksheet and complete questions (in class or as homework)
- Lab: Healthy Hematocrit (30 minutes)

Demonstration: Blood is a Mixture

1. Create a mixture of red sequins (representing red blood cells (RBCs)) and glass or plastic beads (representing white blood cells (WBCs) and platelets) to demonstrate the concept that blood is a mixture of cells suspended in plasma.
2. Plasma is a straw colored liquid. To simulate this color, add a few drops of yellow food color and a bit of cola to about 100 mL of water to get a pale straw color.
3. At a craft store, purchase red sequins in a large bag. You will need enough of these to fill 40 mL of a graduated cylinder.
4. Also purchase a small amount of glass or plastic spherical beads (glass beads with colored bits inside look very realistic) to be leukocytes and some smaller, asymmetrical lumpy looking beads for platelets. The ratio should be approximately 1,000 RBCs for every WBC and 100 platelets. No need to count them out, just estimate the ratio.
5. Mix the “cells” and the plasma in a clear plastic cup to show the students that the suspension looks red.
6. Then pour the mixture into a glass or clear plastic 100 mL graduated cylinder.
7. As the beads settle out, point out that the blood cells are suspended in the plasma.
8. After the beads have settled, discuss what the hematocrit is and how this measurement of blood cell volume is used in medicine (see background info below).

Note: You may wish to scale this up to a 1 L graduated cylinder to make it more visible for a large class. A large 60 cc syringe can be used in place of a graduated cylinder for a more graphic approach.



Teacher's Guide to Healthy Hematocrit L A B



Overview

Students will measure the hematocrit of a patient's blood by centrifuging a blood sample. The simulated blood is actually red-colored sugar crystals suspended in vegetable oil. The simulated blood can be centrifuged or left to settle on its own. The student then determines the hematocrit by using a ruler to measure the percent of "blood" that is packed cells.

Teacher Background Information on Anemia and Hematocrit

In order to measure the proportion of the blood that is made up of red blood cells, a drop of blood is drawn into a tiny capillary tube with a sealed end. The tube is centrifuged and the percentage of blood that is red blood cells can easily be seen because the red blood cells (RBCs) will have settled to the bottom leaving the yellowish plasma and the white blood cells and platelets in the top portion of the tube. A normal hematocrit is from 37-45 percent blood cells.

If the hematocrit is too low, the person may be anemic. The word anemia means "lacking blood." Anemia is a sign of many conditions and not a disease itself. People may be anemic if they:

- Do not produce enough RBCs in the bone marrow because of disease, radiation therapy, or toxins;
- Have red blood cells that do not survive for a normal period of time; or
- Have lost blood.

A hormone called erythropoietin is produced by the kidneys and stimulates the bone marrow to produce RBCs. Recombinant human erythropoietin is now available to help those people who have kidney disease and those whose bone marrow has been temporarily damaged by chemotherapy.

Unfortunately, some long distance athletes abuse recombinant erythropoietin to artificially increase the amount of RBCs so that they can carry more oxygen to their muscles. The hematocrits of athletes are now routinely tested to determine if "blood doping" with recombinant erythropoietin is suspected. A hematocrit over 50 percent is suspicious. Not only is this practice unethical, and against the rules of competition, it is also dangerous. If the blood becomes too thick with RBCs, it can turn to sludge, flowing sluggishly and forming clots.

Day before lab:

1. Purchase three containers of red colored sugar crystals per class from a grocery store. It is usually in the section with the cake decorating supplies. You may be able to find larger containers at a craft store that has a cake decorating section.
2. Purchase one bottle of corn or canola oil.

Day of or day before the lab:

1. Mix up a batch of "blood" by adding about 40 percent sugar crystals by volume to corn oil (use a pale yellow colored oil to make it look like plasma).
2. Mix it up just before setting out samples of it in clear plastic cups or beakers at the lab stations.
3. You may wish to make up different batches of blood to be different "patient" samples. A few of the samples can be less than 40 percent sugar crystals and a few can be at 40 percent and a few can be closer to 50 percent. Remember that the percentage is based on the total volume. To make up blood with a 40 percent hematocrit reading, follow the recipe below.

Normal Hematocrit Level Simulated Blood Recipe

1. Measure out 40 mL of sugar crystals into a dry graduated cylinder
2. Pour the sugar crystals into a 150 mL beaker
3. Add oil while stirring until the total volume reaches 100 mL

If you have access to a table top centrifuge:

If you are going to have the students centrifuge the samples, you may want to grind the sugar up into smaller crystals with a mortar and pestle so that the mixture doesn't settle quickly on its own and it looks more like a homogeneous mixture to begin with. The small crystals also make the blood look more realistic because there won't be large, visible particles sticking to the sides of the tube.

If you do not have a centrifuge:

Make up the simulated blood using the whole crystals. When the students put the blood into their tubes, the crystals (cells) will settle out in 5-10 minutes.

Measuring the Hematocrit

Students can use a ruler to measure the height of the blood in the tube and then measure the height of the cells. Use the following formula to determine the hematocrit.

$$(\text{Cell level cm} / \text{Blood level cm}) \times 100 = \text{percent blood cell volume} = \text{hematocrit}$$

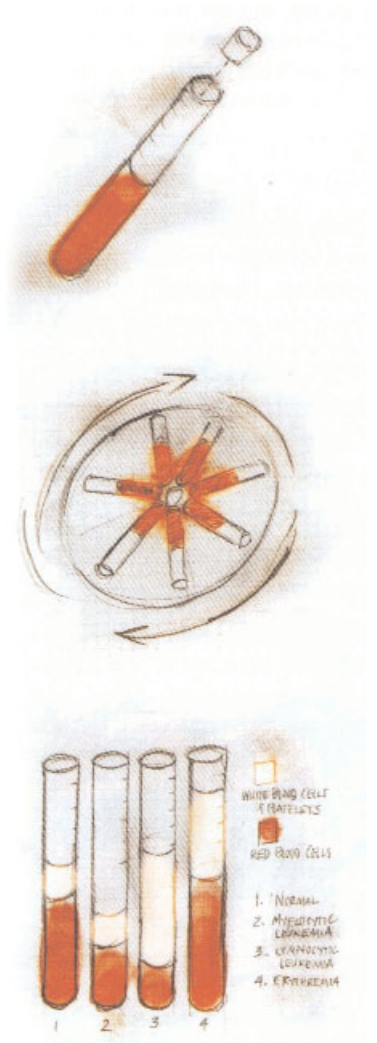
Note: If you use centrifuge tubes that have volumetric graduations, a ruler isn't necessary.

Answers to Worksheet Questions

1. Iron is needed to produce hemoglobin. Hemoglobin carries oxygen.
2. The answer is C. Either A (they do not have enough hemoglobin) or B (they do not have enough RBCs) would cause someone to feel tired and weak.
3. Red blood cells outnumber white blood cells about 1,000:1.
4. Red blood cells would flow out of the wound, and then get stuck together by platelets and fibrin. Platelets would patch up the wound by becoming sticky and activating the process to produce fibrin. White blood cells would attack bacteria and remove debris.
5. A person could become anemic by not eating enough iron or by losing blood.
6. Transfusion and iron supplements are both treatments for anemia.
7. Transfusion would be helpful to an accident victim.
8. The blood center will check to ensure that donors have enough iron in their blood at the time of donation; donors should drink plenty of water before donating to ensure their hematocrit measurement is accurate.

Suggested Answers to Lab Questions

1. Answers will vary depending on the hematocrit level.
2. Answers will vary depending on the student's viewpoint.



Form and Function of Blood Cells

LESSON PLAN



Lesson Plan

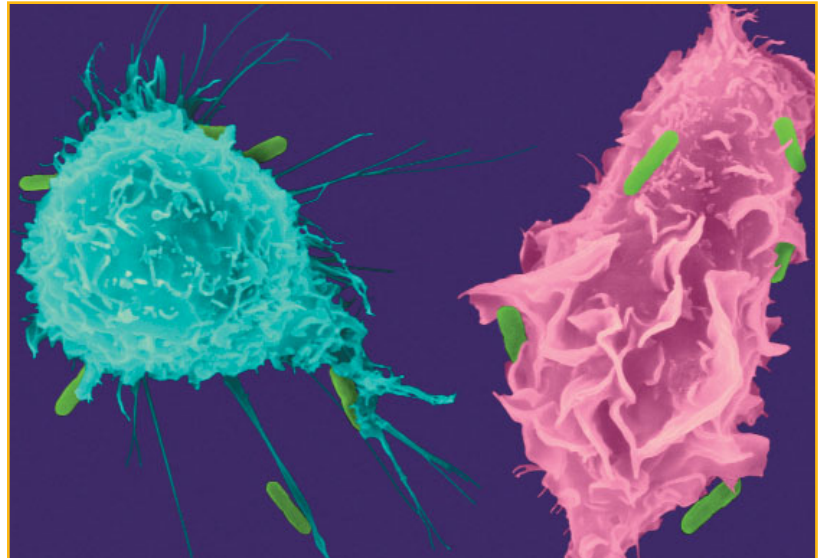
Estimated Time: 1-2 class periods

- Replay *MBYB* video segment (Start 02:30; End 08:25)
- Demonstrations (red blood cell shape, white blood cell and antibody interaction) (20 minutes)
- PowerPoint® slides 1-3, 9-11 and poster
- Students read and complete student worksheet (15 minutes or as homework)
- Lab: Cell Hunt (30 minutes)

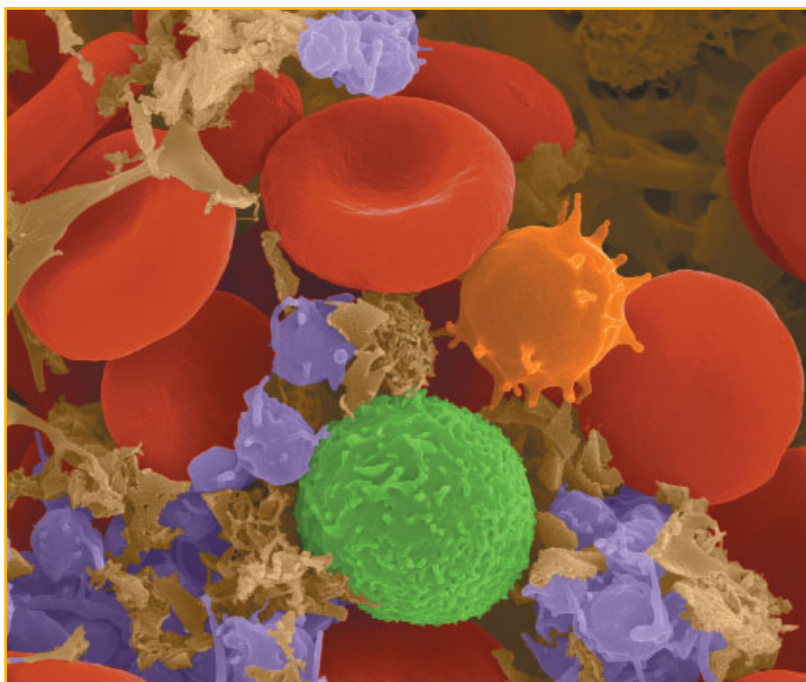
Demonstration: Form and Function of Blood Cells

A. Shape of red blood cells (RBCs)

1. Blow up a red balloon and tie it off.
2. Push in both sides of the balloon by shoving both fists into the balloon on opposite sides.
3. Explain that this is the shape of RBCs. Red blood cells are basically sacks of hemoglobin. The concave sides mean that more of the hemoglobin in the cell is close to the surface (in a sphere, a lot of the hemoglobin would be in the middle, far from the cell membrane). Platelets, on the other hand, are irregularly shaped to provide more area when adhering to blood vessel walls to form clots.



Blue-stained macrophage and pink-stained monocyte attacking *E. coli* bacteria.
© Dennis Kunkel, Ph.D.



Red blood cells, Lymphocyte T cell (green), Monocyte (gold) and Platelets.
© Dennis Kunkel, Ph.D.

B. Action of monocytes and antibodies

This is a fun activity that gives students a visual image of how monocytes and antibodies work together to capture microorganisms and viruses.

1. Give each student a small plate with a few spoonfuls of crispy rice cereal on it.
2. Tell the students that they will be acting as monocytes (the largest of the engulfing white blood cells which mature into macrophages or “big eaters”). Students lick their finger and pick up the crispies one at a time and eat them. Time them for 30 seconds and see how many they can eat this way.
3. Then explain how antibodies are like very specific glue and bind to the micro-organisms clumping them together.
4. Hand out rice crispy treats. Ask them what the marshmallow represents. Now how many crispies can the monocyte eat at one time? You may want to have them estimate how many crispies are in a treat.

Teacher's Guide to Cell Hunt

L A B



Overview

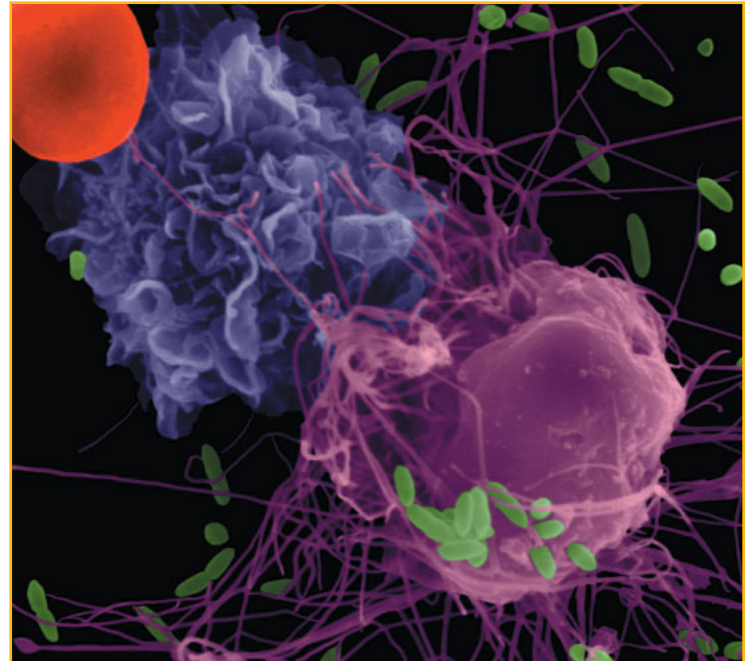
Students will observe the shape and relative abundance of red blood cells, white blood cells and platelets.

A week or more before the lab:

Purchase or gather prepared slides of human blood smears stained with Wright's stain. You will need one slide for each team of students.

Safety Note: there is no risk of blood-borne pathogens because the blood is fixed and glued to the cover slip.

Classroom management tip: The students will be given a description of each of the types of cells for which they will be hunting. Once they find them, you may wish to verify that they have found the correct cell type before they can check it off their checklist. Once a student has found all the types, they can be "certified" and enlisted to help you verify the cell findings of the other students.



Two macrophages engulfing E.coli bacteria (stained green) in the lungs. Notice the smooth type with filopodia, and the ruffled type. © Dennis Kunkel, Ph.D.

Answers to Worksheet Questions

1. Granulocytes and monocytes engulf bacteria. Lymphocytes produce antibodies which clump bacteria together so that the phagocytic white blood cells can destroy them more efficiently.
2. Plasma transfusions or transfusions of blood factors isolated from plasma have helped hemophiliacs to live longer lives by restoring the ability to form clots.
3. The blood can be separated. Platelets can be given to one patient, plasma proteins to another and red blood cells to a third patient.

Answers to Lab Questions

1. The chart should be filled in with appropriate functions of the blood cells.
2. Red blood cells are flexible and smooth to maneuver through tiny capillaries. Also, the concave sides mean that more of the hemoglobin in the cell is close to the surface (in a sphere, a lot of the hemoglobin would be in the middle, far from the cell membrane).
3. Platelets are irregularly shaped to provide more area when adhering to blood vessel walls.
4. Red blood cells should be the numerous.
5. Lymphocytes are generally the hardest to locate.

Arteries, Capillaries and Veins: The Roads Blood Cells Travel

LESSON PLAN



Lesson Plan

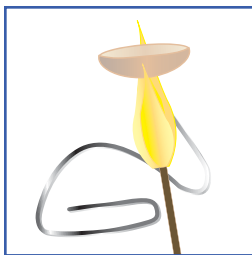
Estimated Time: 1-2 class periods

- Show *MBYB* video segment on blood vessels and oxygen transport (Start 08:25; End 11:00)
- Students read worksheet and answer questions (15 minutes)
- PowerPoint® slides 1-11
- Demonstration - burn a peanut (5-10 minutes)
- Lab: Mystery Vessel (30 minutes)

Demonstration:

Arteries, Capillaries and Veins: The Roads Blood Cells Travel

Objective: To demonstrate what the body cells need in order to survive and have energy.



1. Bend a paperclip into a tripod shape.
2. Place a half a peanut or marshmallow on the end of the paperclip.
3. Ask students what gives your body cells energy. Most will say food some will say oxygen.
4. Demonstrate the energy available in food by burning a half of a peanut and/or a mini marshmallow. Most students understand a flame contains energy (heat energy and light energy).
5. As the food is burning, explain that our cells use a series of chemical reactions to release the energy out of the food in a controlled fashion. But what else is needed for energy besides the food?
6. Place a glass jar over the burning peanut. As the flame goes out, ask students what made the flame go out? Most students will know that the flame used up the oxygen. Just like the energy being released by burning, our cellular energy production requires food and oxygen. How do all of our cells get food and oxygen? The blood transports food and oxygen to each cell of our body! Oxygen and food molecule exchange occurs in the capillaries.

Teacher's Guide to Mystery Vessel L A B



Overview

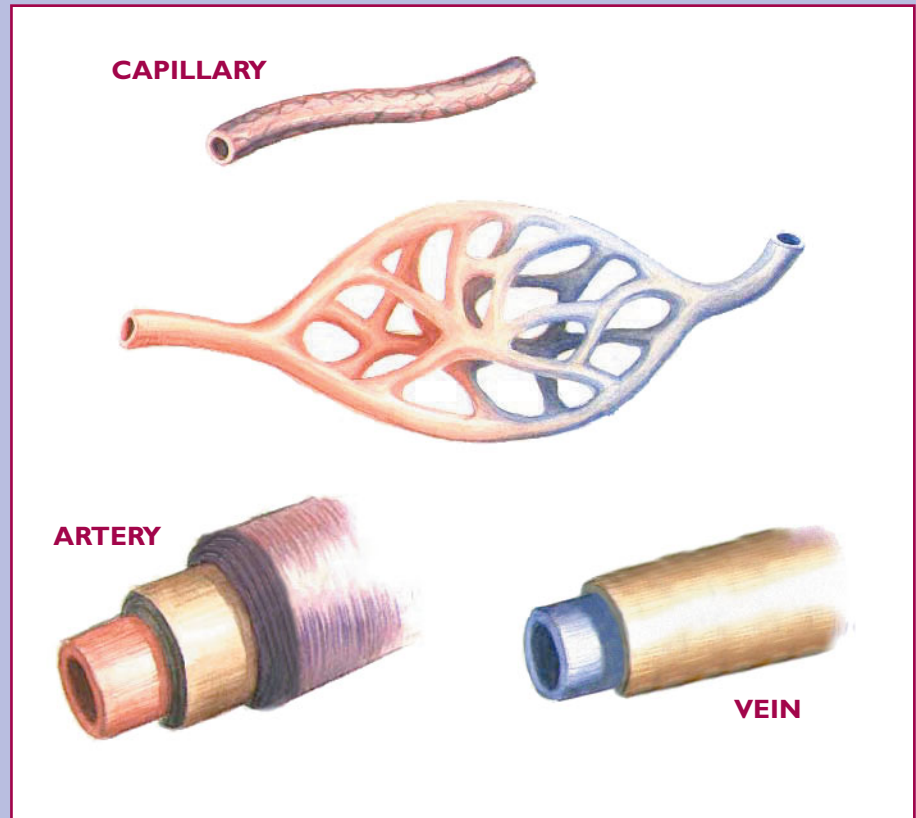
The students need to use the information given in the *Arteries, Capillaries and Veins: The Roads Blood Cells Travel* worksheet to identify the different vessels.

A week or more in advance:

1. Purchase or gather prepared slides of artery and vein cross sections.

A day before the lab:

2. Place a square of white paper over each label and tape it in place. Number the slides 1 and 2.



Teacher Background Information on Anemia and Hematocrit

Classroom Management Tip: If there aren't enough slides for each group to have a set, each group can have one to identify and then go to other groups and see if they agree with their identification. The collaboration can be a great way for students to communicate their understanding to their peers.

Answers to Worksheet Questions

1. Arteries should have the thickest muscular layer.
2. Veins should have the thinnest walls since they do not need to stretch or contract.
3. Body movements (mostly in the legs) help move blood from the feet to the heart. Much of the work is done by the pressure from the other side of the capillaries: the movement created by the beating heart. Obviously, if you aren't moving, blood still gets from your feet to your heart. This movement can be important, though. People who sit for many hours on long airplane trips can develop sluggish circulation or blood clots in the veins of their legs and feet - some doctors suggest doing exercises or getting up to walk around once an hour when on a long flight.

Answers to Lab Questions

1. The arteries would change in diameter.
2. The arteries would become wider (dilate) to decrease blood pressure.

Oxygen and Carbon Dioxide Exchange

LESSON PLAN



Lesson Plan

Estimated Time: 1-2 standard periods

- Show **MBYB** video segment on oxygen and carbon dioxide exchange (Start 08:25; End 12:30)
- Students read and complete worksheet (10-15 minutes)
- PowerPoint® slides 9-11
- Demonstration: Oxygen diffusion in the alveoli (15 minutes)
- Lab: Bubbling Carbon Dioxide (30 minutes)

Demonstration:

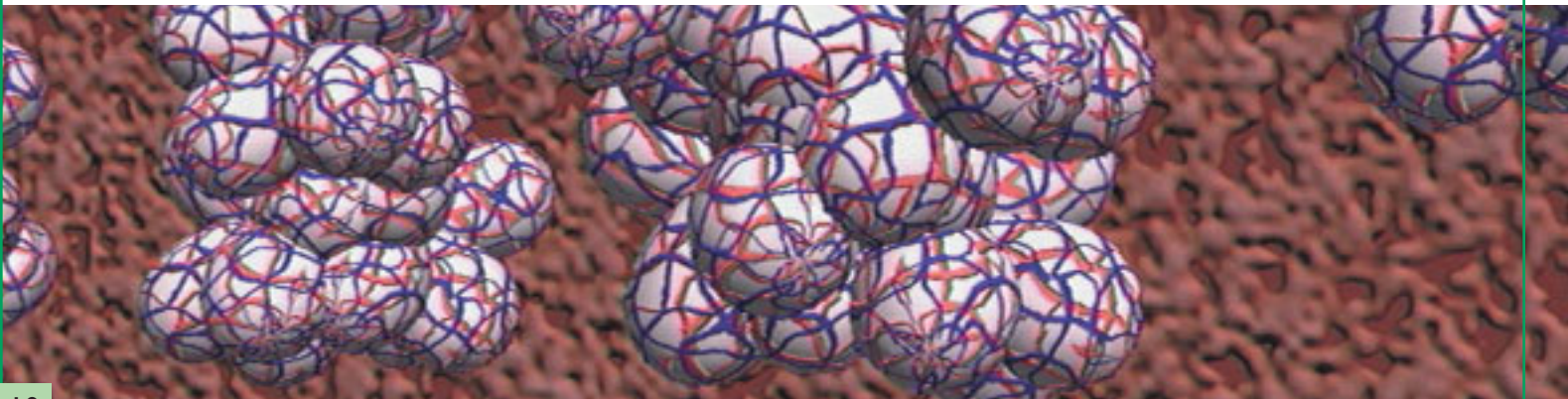
Oxygen and Carbon Dioxide Exchange

Objective: This demonstration gives students a visual image of the diffusion of oxygen from the alveolus to the surrounding blood.

1. Fill an inexpensive sandwich-sized zip-top plastic bag with a solution of baking soda and water (about two tablespoons of baking soda to 200 mL of water).
2. For quick results make a tiny hole in the bag with a fine needle. If no hole is punched, diffusion of bicarbonate will occur across the semipermeable plastic into the surrounding liquid, but it will take several hours so the results won't be visible until the next day.
Note: Do not tell students that there is bicarbonate in the "alveolus" because it will be confusing since they just learned about the role of bicarbonate in the blood.
3. The "alveolus" (plastic bag with baking soda) is then placed into a clear bowl containing a solution of water, congo red and vinegar (recipe below). As the baking soda diffuses into the bowl, the purple-red solution will turn bright red, simulating the color change that occurs as hemoglobin becomes oxygenated.

Recipe for Congo Red Solution

1. Fill the bowl 2/3 full of water.
2. Add just enough congo red powder to get a bright red, but still transparent solution. This will require only a tiny dusting of powder. Mix well.
3. Add vinegar to the bowl one drop at a time while stirring until the solution turns purplish.



Teacher's Guide to Bubbling Carbon Dioxide

L A B

Overview

Students visually see that more carbon dioxide is exhaled after exercise.

A few weeks prior

Locate or order bromthymol blue pH indicator solution or powder

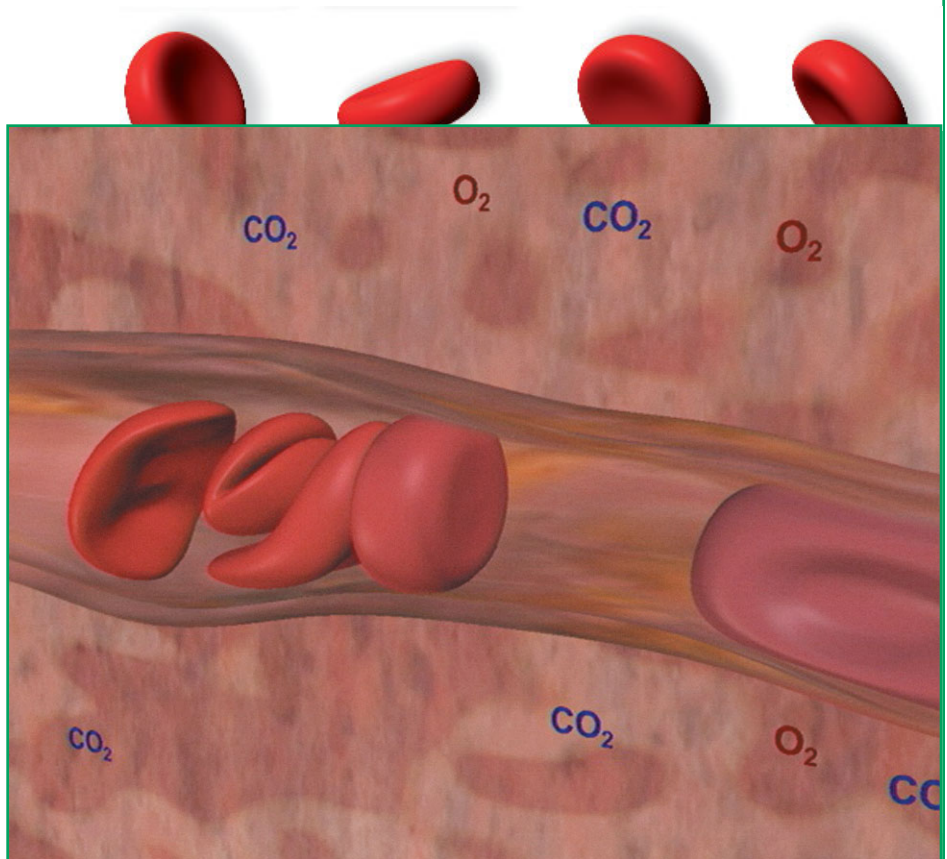
One day or more before the lab:

Purchase one straw, one large balloon and one clear plastic cup for each student

Day of the lab:

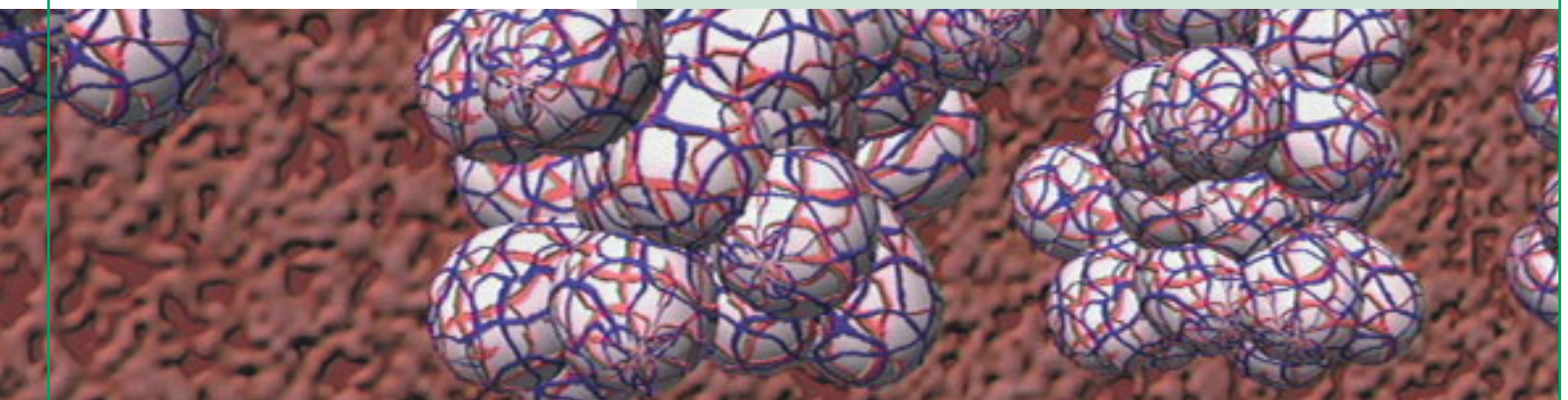
Prepare a dilute bromthymol blue solution.

1. To 1 L of tap water add enough bromthymol blue to obtain a bright blue or green color (depending on the pH of your water).
2. If the solution above is blue, it is ready. If it is green, you need to stir in bleach or ammonia one drop at a time just until the solution turns blue. It may only require one drop.
3. Divide the solution into several smaller containers to be placed in stations around the room.



Answers to Worksheet Questions

1. Hemoglobin can bind to carbon dioxide. Also, there is an enzyme in red blood cells which converts carbon dioxide into bicarbonate which can be stored in the plasma.
2. Cells need food and oxygen.



Heart Cycle

LESSON PLAN



Lesson Plan

Estimated Time: 2 standard periods

- Show **MBYB** video segment (Start 08:25; End 10:56)
- Students read worksheet and answer questions (20 minutes)
- Use PowerPoint® slides 4-8
- Lab: Squirting and Filling (30 minutes)

Teacher's Guide to Squirting and Filling LAB

Overview

Students measure their pulse rate and then listen to their heart sounds using stethoscopes. They determine the rate of their heart sounds and compare it to their pulse rate to make the connection between pulse and heart contraction.

Note: This lab can be done with a set of class stethoscopes or stethoscopes borrowed from a local blood center or clinic. It can also be done with homemade stethoscopes. A funnel can be attached to rubber tubing for a student to listen to their own heart beat by placing the wide end of the funnel on their chests. Toilet paper or paper towel rolls can be used to listen to another person's heartbeat. If you do this, girls prefer to have female partners.

If you are using stethoscopes, sanitize the earpieces with alcohol soaked cotton.

Stopwatches make this lab easier, but are not necessary.

Answers to Worksheet Questions

1. Because your muscles are working harder, your heart has to pump the blood faster so that more oxygen and food (sugar, etc.) can get to the cells and so that the waste product, carbon dioxide, can be released out of the lungs.
2. The muscles downstream of the clot would be stressed and then die if blood circulation wasn't returned to that area quickly.

Second Section

3. You feel a pulse when the heart is squirting blood into the arteries.
4. Yes, each time your heart contracts, you should feel a pulse.

Answers to Lab Questions

1. No, but they are close.
2. We only measured our heart rate and pulse rate for six seconds, so this isn't a very accurate measurement.
3. It is easier and more convenient to measure the pulse rate.

Blood Comes In Different Types

LESSON PLAN



Lesson Plan

- Show **MBYB** video segment on blood typing and blood donation (Start 10:56; End 12:17)
- PowerPoint® slide 12
- Students read worksheet and answer questions
- Lab: A Critical Decision (30-40 minutes)

A Critical Decision Lab Teacher's Guide

Objective: Students learn how to blood and learn the importance of blood donation.

Two weeks before the lab:

Order a simulated blood typing kit from a biological supply company

One day or more before the lab:

Allocate different types of simulated blood into micro-centrifuge tubes. Use the chart below to create the samples.

PATIENT NUMBER	BLOOD GROUP	BLOOD GROUP PATIENT CAN ACCEPT	RECOMMENDED BLOOD TO BE TRANSFUSED (one solution to the puzzle - other solutions are possible)	BLOOD AVAILABLE
1	A-	A-, O-	A-	O-
2	O-	O-	O-	
3	O+	O+, O-	O+	
4	O+	O+, O-	O-	O+
5	B+	B+, B-, O+, O-	B+	
6	B+	B+, B-, O+, O-	B+	
7	A+	A+, A-, O+, O-	A+	A+
8	A-	A-, O-	A-	
9	O+	O-, O+	O+	
10	O+	O-, O+	O+	A-
11	A+	A-, A+, O-, O+	A-	
12	AB+	AB+, AB-, O+, O-, B+, B-, A+, A-	A+	
13	A-	A-, O-	O-	B+
14	B+	B+, B-, O-, O+	B-	
15	O+	O+, O-	O+	
16	O-	O-	O-	B-
17	O+	O+, O-	O+	
18	A-	A-, O-	O-	
19	B+	B+, B-, O+, O-	B-	2 units
20	O+	O+, O-	O+	

Blood Comes In Different Types

LESSON PLAN CONTINUED



Answers to Worksheet Questions

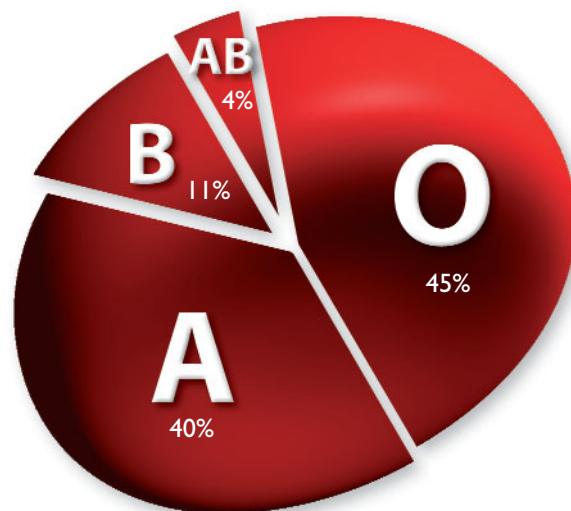
DONOR	RECIPIENT			
	A	B	AB	O
A	☺	☹	☺	☹
B	☹	☺	☺	☹
AB	☹	☹	☺	☹
O	☺	☺	☺	☺

DONOR	RECIPIENT	
	NEGATIVE (-)	POSITIVE (+)
NEGATIVE (-)	☺	☺
POSITIVE (+)	☹	☺

- Group O Rh-negative blood is universal donor blood.
- Group AB Rh-positive patients can receive blood of any group or type.
- Yes. A person with B Rh-positive blood can safely receive O Rh-negative blood.
- No, people who are Rh-negative produce anti-Rh antibodies.

Answers to Lab Questions

- Group O Rh-negative blood is precious because it can be given to anyone.
- You never know how much you will need or what group and type you will need.
- Yes, there was enough blood to go around, but if the blood types were different, there could have been a crisis. For example, if there were more group O Rh-negative people, there wouldn't be enough group O Rh-negative blood to go around.
- Give IV fluids to the people and helicopter to another facility or helicopter blood in from another facility.
- It should be based on need; whoever is most critically injured and has a chance of recovering should be given first priority.
- Organize a blood drive, donate money to a blood center, give blood regularly, encourage others to give blood.



Distribution of blood types in the USA

Researching for Cures

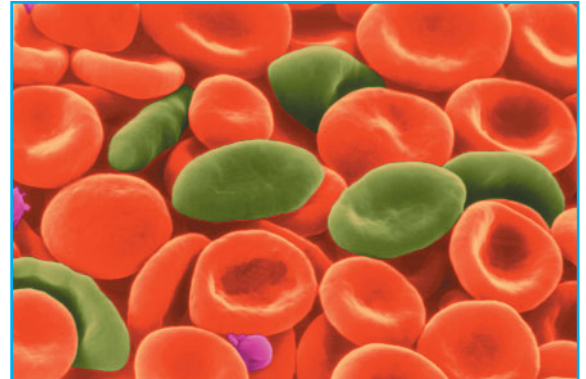
LESSON PLAN

Lesson Plan

- Show **MBYB** video segment: science and research - saving lives (Start 12:30; End 30:00)
- Students read worksheet and answer questions
- Lab: Break the Sickle Cycle

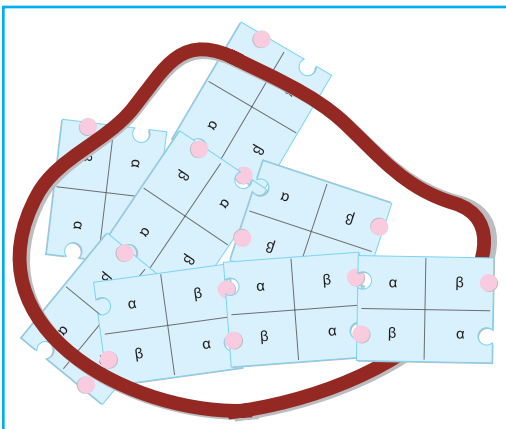
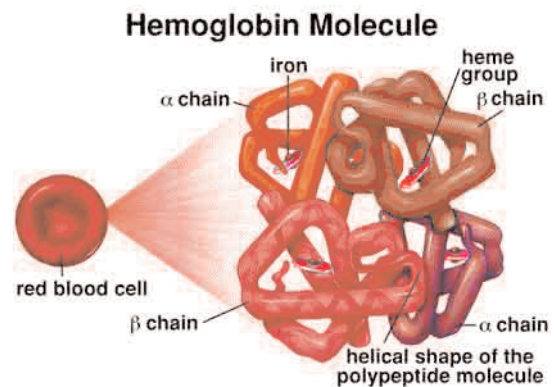
Demonstration: Sickle Cell Disease

Objective: In order for students to have a better understanding about how sickle cell disease affects people, it is helpful to understand the structure of the hemoglobin molecule.



Sickle cells (stained green) among healthy red blood cells.
© Dennis Kunkel, Ph.D.

1. Make a model of a hemoglobin molecule from pipe cleaners and large buttons. You will need two pink pipe cleaners (alpha globin) and two red pipe cleaners (beta globin).
2. In the center of each pipe cleaner, thread one red button.
3. Fold up each pipe cleaner to resemble the four globin chains of hemoglobin. Hold all four globins together to form hemoglobin.
4. To make sickle hemoglobin, attach a small piece of masking tape to both beta globin chains in approximately the same place. This will represent the altered amino acid (glutamic acid to valine).



Key to model of deoxygenated sickle hemoglobin

Teacher's Guide to Break the Sickle Cycle Lab

The non-polar R group of valine (sickle cell hemoglobin substitution) on the beta globin chain fits into the non-polar groove on the beta hemoglobin chains of an adjacent hemoglobin molecule. This causes the hemoglobin to form stiff polymers which make the red blood cell rigid and disfigured. Sometimes it causes the RBCs to burst, causing anemia. More often, the irregular cells are removed from the blood stream.

Answers to Worksheet Questions

1. Low oxygen starts the crisis; then clotting makes it worse.
2. One amino acid is different on the beta globin chain.
3. There are two globin molecules on each hemoglobin molecule.

Answers to Lab Questions

1. Without the groove in the alpha chain, the hemoglobin won't make a chain.
2. Normal hemoglobin doesn't have the altered amino acid which fits into the groove. There won't be anything to fit in the groove.
3. Normal red blood cells won't sickle even in low oxygen so these normal cells can dilute out the effect of the sickled cells and deliver oxygen.

Becoming Part of the Solution:

Organizing a Blood Drive at Your School



Your students have learned just how important blood is and how critical blood donation is to saving lives. Organizing a blood drive at your school is a wonderful opportunity for students who are eager to make a difference.

Delegation of the tasks involved in a successful blood drive not only makes the job easier, it builds teamwork and gives more people the opportunity to get involved. Create a committee by nominating four responsible students. These students in turn nominate other students to help them. Visit www.MyBloodYourBlood.org for samples and templates of useful letters and other documents.

Blood Drive Committee

Faculty Advisor (you!)

Student Positions

Blood Drive Coordinator

Donor Recruitment Chairperson

Promotion Chairperson

Site Preparation Chairperson

Responsibilities of each Blood Drive Committee Member:

Faculty Advisor

- Choose the student leadership.
- Contact America's Blood Centers at 1-888-USBLOOD or www.AmericasBlood.org to find out how to reach your local community blood center.
- Meet with the representative of the local blood center and the principal of your school to set up a date for the blood drive.
- Set up meetings with the blood drive committee.
- Check on the progress of the student leadership.

Blood Drive Coordinator

- Contact parents, faculty and staff and ask them to donate.
- Make announcements to students before the sign-up week and also prior to the blood drive as a reminder.
- Ensure that all chairpersons carry out their responsibilities.

Donor Recruitment Chairperson

- Form a team of students who will recruit student donors. Your team should know the importance of blood donation, be familiar with the typical reasons why people do not donate and understand who can donate blood.
- When a student volunteers to donate blood, they need to make an appointment to donate blood during the blood drive. Get the student's home phone number so you can contact them the day before to remind them of their appointment. The blood center will provide you with appointment cards for this purpose.

Promotion Chairperson

Organizing a Blood Drive at Your School



- Promote and publicize the blood drive through posters, school publications and announcements.
- Community blood centers will provide posters with the date and information for your blood drive printed on them. Find out where you can place these posters at your school. Get permission from your principal before putting up posters or passing out fliers.
- Obtain deadline for getting a story in the school newspaper. The blood center will give you personal stories from people whose lives have been saved through blood donation. Weave these feature stories with facts about blood donation dispelling the common myths, which can also be provided by your local community blood center. If possible, include quotes from donors.
- Coordinate with your principal and blood center to see if an assembly can be held to increase the awareness of the entire student body for the need for blood donations.
- Encourage the PTA to get involved to solicit parent blood donations during the blood drive.
- As a group, brainstorm ways to encourage your friends who are of eligible age to donate blood. However, be aware that there are many reasons an individual may not be able to donate blood (medications, medical conditions, high-risk behaviors, etc.) and some of those reasons are very personal. You must recognize that if someone chooses not to donate, they should not be pressured or coerced into donating because that could compromise the safety of the blood supply and because blood donation is a personal decision which needs to be respected. Individuals who cannot or do not want to donate may contribute to the blood drive in many other ways by educating others about the need, passing fliers, signing up donors for appointments, staffing the blood drive canteen, etc.
- Ask your teachers if you can make an announcement before your classes or over the intercom about the blood drive. Make the announcement personal: include what you have learned about the importance of blood donation. If possible, use snippets from the *My Blood, Your Blood* video to add a human face to the need for blood.

Site Preparation Chairperson

- Make sure the area being used for the blood drive is ready.
- Arrange for parking for the blood center close to an entrance.
- Be sure that the area being used will be at a comfortable temperature (heating or air conditioning as needed).
- Provide a table and several chairs.

Worksheet: *Blood is a Mixture*

Name: _____



What makes blood red?

Your blood contains cells called erythrocytes or red blood cells (RBCs). Red blood cells are packed full of a protein molecule called hemoglobin. The heme in the hemoglobin is red in color. Each molecule of hemoglobin contains four iron atoms. The iron atoms in the hemoglobin molecules bind to oxygen molecules. This is how your body transports oxygen from your lungs to all the cells of your body. Each RBC contains millions of hemoglobin molecules, and each drop of blood contains millions of RBCs.

More than Red Blood Cells

But there is a lot more to blood than RBCs. There are two other types of cells in blood, white blood cells (leukocytes or WBCs) and platelets (thrombocytes). Red blood cells outnumber WBCs 1,000:1. White blood cells are an important part of our immune or defense system. They fight infection from bacteria and viruses. Platelets are responsible for creating a clot to stop bleeding from a wound. The RBCs, WBCs and platelets float around in pale yellow liquid called plasma. Plasma is more than just water. It contains important proteins, hormones and salts. Red blood cells live for only four months. Therefore, your bone marrow is always at work producing new blood cells. As you heard in the video, your bone marrow makes 4-5 billion RBCs every hour! Red blood cells make up 40-45 percent of your blood volume.

What causes anemia?

In order to make hemoglobin, you need to eat enough protein, iron and certain vitamins. Causes of anemia include an iron-poor diet or chronic disease.

Sometimes the cause of anemia is that the bone marrow is not producing enough RBCs. This can be caused by the effects of cancer treatment, radiation, toxins or kidney failure as well as by iron deficiency. Healthy kidneys produce a hormone called erythropoietin. This hormone stimulates the bone marrow to produce RBCs.

Anemia can also be caused by a loss of blood. Women who have very heavy menstrual periods or people who have lost significant blood due to an injury or surgery can become anemic.

How can people with low numbers of red blood cells recover?

If an injury or surgery has caused a loss of blood, a transfusion will correct the problem immediately. A common treatment for mild anemia is to take supplemental iron in the form of pills or infusions. Chronic anemia is treated by identifying and eliminating its cause. A blood transfusion can bring relief to patients while they are waiting for a proper diagnosis. Depending on the underlying cause of anemia, other treatments may correct the problem so that no further transfusions are necessary.

Can donating blood cause the donor to become anemic?

The answer is usually no. Before donating blood, a person's hematocrit is measured. Only those with healthy hematocrit levels can donate blood. The red blood cells lost in a blood donation are quickly replaced in a healthy person in about four to six weeks.

Questions

Name: _____

1. Why is it important to get enough iron in your diet?

2. Without oxygen, our cells cannot work. Which of the following might be an explanation why someone feels weak?

- a. They do not have enough hemoglobin
- b. They do not have enough red blood cells
- c. Either **a** or **b** would cause someone to feel tired and weak

3. What type of blood cell far outnumber the others in the blood?

4. If you fell down and scraped your knee, describe what each type of blood cell would be doing at the site of injury.

5. What are two ways someone can become anemic?

6. What are two treatments for anemia?

7. Which treatment would work best to help someone who has been in a car accident and lost a lot of blood?

8. What would you tell someone who's not sure if they can give blood because they think they might be anemic?

Lab: *Healthy Hematocrit*

Measuring Blood Cell Volume to Diagnose Potential Anemia

Name: _____



Purpose: To measure the percent of red blood cells volume of a simulated blood sample to determine the hematocrit. Once you have measured the hematocrit of your “patient” you can determine if the person has a low hematocrit, normal hematocrit or is polycythemic (too many red blood cells).

Materials

Test tube
Simulated blood sample
Centrifuge (optional)
Metric ruler
Marking pen

Procedure

1. Obtain a sample of simulated blood.
2. Mix it up with a stirring rod and fill a test tube 2/3 full.
3. If you have a centrifuge available, mark this test tube with your initials and place it in a centrifuge across from another sample (the centrifuge needs to be balanced - every tube must have a tube across from it). Centrifuge for three minutes.
4. If you do not have a centrifuge, let the blood cells settle for 10 minutes.
5. Using the centimeter side of a ruler, measure the distance from the bottom of the test tube to the top of the blood sample. Record this measurement below.

Height of blood _____ cm

6. Now measure the height of the blood cell layer from the bottom of the test tube. Record this measurement below.

Height of blood cells _____ cm

7. To determine the hematocrit, (which is simply the percentage of the blood that is made up of cells) divide the height of the blood cells by the total height of the blood and multiply that by 100.

Height of blood cells in cm/ total height of blood x 100 = hematocrit

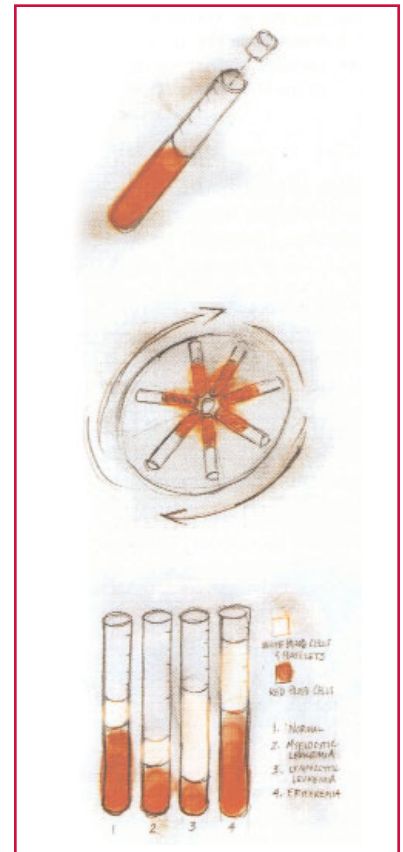
Hematocrit of “patient” _____

Compare your results to the chart below to diagnose your patient

38-50 percent = NORMAL

Less than 38 percent = POSSIBLE ANEMIA (low hematocrit level for the purpose of blood donation)¹

More than 50 percent = POSSIBLE POLYCYTHEMIA (excess blood cells)



¹ A reading less than 38 percent is below the level mandated by the US Food and Drug Administration (FDA) for blood donors but does not necessarily mean that the donor is anemic.

Worksheet: *Form and Function of Blood Cells*

Name: _____



As you learned from the *My Blood, Your Blood* video, all blood cells are produced in the bone marrow from stem cells.

“White blood cells (WBCs) are part of the body’s defense system. There are three types of WBCs: granulocytes, lymphocytes and monocytes. They all fight infection from bacteria, viruses - all those nasty microbes that can cause disease.”

White blood cells (leukocytes) make up a mobile army that seek out and destroy harmful micro-organisms and viruses. These helpful cells can move out of the blood vessels and patrol in amongst your body tissues.

There are two main types of WBCs: engulfing and antibody producing. Granulocytes and monocytes are engulfing WBCs and lymphocytes are antibody-producing white blood cells. Engulfing WBCs reach out cellular arms like an amoeba and engulf bacteria and other micro-organisms. This process is called phagocytosis. These engulfing WBCs communicate with the antibody-producing white blood cells called lymphocytes. Antibodies are protein molecules that stick to the invading microorganisms, clumping them together. Once the invading organisms are all clumped together, they can be engulfed more efficiently by monocytes and granulocytes.

Platelets (thrombocytes), which are actually not cells but cell fragments, form clots to stop bleeding. When a blood vessel gets torn during an injury, platelets throw themselves over a tear in a vessel wall. They become sticky and adhere to the vessel wall and to each other. They also trap RBCs and together they form a clot. Platelets also produce a chemical that activates a chain of events that turn a soluble blood protein called fibrinogen into a long fibrous solid protein called fibrin. Fibrin molecules create a network to hold the clot in place. All this together is what you think of as a scab. Most of what you see on the outside of a scab is just dried blood. On the inside of a scab is where the intricate fibrin/platelet plugs of each individual broken blood vessel can be found. The fibrin/platelet plugs will form and reform until the damaged tissues have been repaired. Picking at a scab will reopen these plugs and the process has to start over. That is why wounds heal much faster if you leave them alone. Platelets also function extensively internally throughout the body.

A genetic disorder called hemophilia is caused by a lack of one of the clotting proteins. This blood protein can be isolated from blood through a chemical fractionation process and given to hemophilic patients as a concentrate.

Cancer patients often have blood clotting difficulties because their bone marrow can become damaged as a result of chemotherapy or radiation, so it may not produce as many platelets as they need. These patients are often given a transfusion of platelets.

One blood donation can help save three lives. This is because the blood someone donates can be separated into three or more parts. For example, a pint of donated blood can give a hemophilic patient plasma, a cancer patient platelets and an anemic patient red blood cells.

Questions

Name: _____

1. Describe how the two types of white blood cells work together to kill disease-causing micro-organisms.

2. Fifty years ago, hemophiliacs did not live very long. Now people with this disorder live much longer, healthier lives. What has made this possible?

3. Describe in your own words how one pint of blood can help three different people.

Lab: Cell Hunt

Name: _____



Purpose: To learn to identify the different blood cell types and to relate their structure to their function.

Materials

Prepared slide of stained human blood

Microscope

Background

You will be going on a cell hunt. You need to find all of the types of cells below. Use this description of the structure of the blood cells to help you. You need to verify your findings with your teacher or a “certified” student helper.

CELL TYPE	DESCRIPTION	FUNCTION	LOCATED IN MICROSCOPE (teacher or student helper verification)
Erythrocyte (RBCs)	Red disks with dark red border and light red center (no nucleus).		
Granulocyte (WBCs)	Round cell with grainy appearance; lobed or indented blue nucleus.		
Monocyte (WBCs)	Large, irregularly shaped cell with lobed or indented nucleus.		
Lymphocyte (WBCs)	Round or elongated cell often with spikey edges. Nucleus is usually round.		
Thrombocyte (Platelet)	Small, irregularly shaped bodies with no nucleus. ¹		

¹ Platelets have *no* nucleus because they are fragments that “break off” of a megakaryocyte in the bone marrow.

Lab Questions

Name: _____

1. Fill in the function for all the blood cell types in the above chart

2. How does the shape of the red blood cell fit its function?

3. How does the shape of the platelet fit its function?

4. Which blood cell is the most numerous on your slide?

5. Which blood cell was the hardest to find?

Worksheet: Arteries, Capillaries and Veins: The Roads Blood Cells Travel

Name: _____

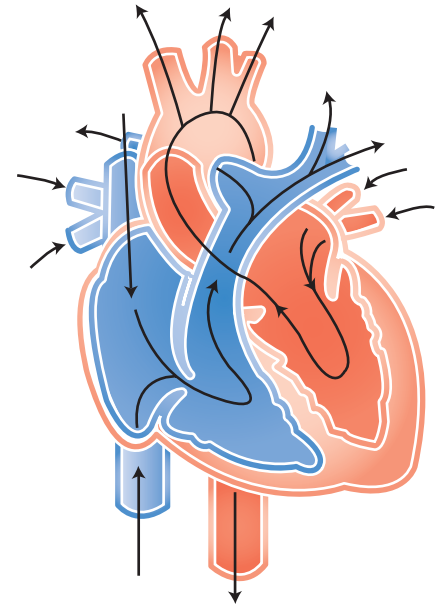


The heart is the pump that forces blood to flow through the blood vessels. Blood vessels that take blood away from the heart are called arteries. The largest artery leading away from the heart is the aorta. When the heart squirts out blood, it is under pressure. Arteries therefore must have strong, elastic walls in order to withstand the pressure. Muscles lining the artery walls also enable the body to control the pressure of the blood by either relaxing (lowering the pressure) or constricting (raising the pressure).

Arteries branch off into smaller and smaller arteries called arterioles. Arterioles branch into smaller and smaller arterioles until they lead to the thin-walled capillaries. Capillaries are so narrow that the blood cells have to proceed single file. This is where the blood can do its work. The walls of the capillaries are only one cell thick and oxygen and small food molecules such as glucose can easily pass through into the tissues. Carbon dioxide produced as waste from cellular respiration passes out of the tissues into the blood through the capillary walls.

The blood now needs to return to the heart. The capillaries lead to tiny blood vessels called venules. The venules then lead to veins which eventually collect into the very large veins of the inferior (or lower) and superior (or upper) vena cava which bring the blood back to the heart. Veins have much thinner walls because they are not under very much pressure. The motion of your body helps squeeze the blood back to the heart through the veins because your muscles push up against the walls of the vein. Your veins have valves in them that keep the blood from moving backward in response to the gravitational force.

The diagram shows the blood flow through the heart. The blood that returns to the heart from the body has to go to the lungs to release the carbon dioxide and pick up oxygen.



Questions

1. Which blood vessels would you expect to have the thickest muscular layer?

2. Which blood vessels have the thinnest walls? How does this structure fit their function?

3. How does blood get from your feet back up to your heart?

Lab: *Mystery Vessel*

Name: _____



Purpose: To learn about the form and function of arteries and veins.

Materials

Prepared slides of the cross sections of an artery and a vein

Microscope

Colored pencils

Blank paper

Procedures

1. Using the description of the structure and function of arteries and veins from the background handout, determine which numbered slide you have is the artery and which is the vein.
2. Once you have identified the artery and vein, and confirmed your decision with your instructor or lab aid, create a sketch of each of the cross sections.
3. Label the cross sections according to the diagram given.

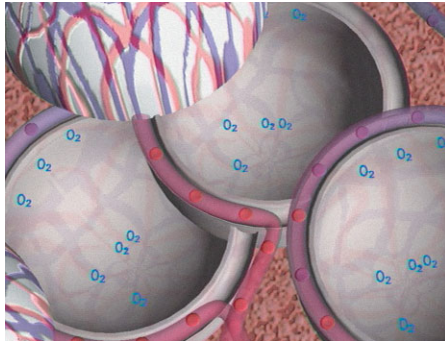
Lab Questions

1. If someone's blood pressure were too low, which blood vessel would change diameter to correct the problem?

2. Would that vessel become wider or narrower to correct high blood pressure?

Worksheet: Oxygen and Carbon Dioxide Exchange

Name: _____



The O_2 molecules pass easily into the blood vessels and bind or attach to our hemoglobin.

The airways in the lungs dead end into millions of tiny little air sacs called alveoli. Each alveolus is covered by a network of capillaries. The oxygen gas diffuses from the air in the alveoli into the blood. The iron atoms of the hemoglobin molecules inside the red blood cells (RBCs) bind to the oxygen molecules. Since each RBC contains millions of hemoglobin molecules, the oxygen is quickly taken from the lungs and is then on its way to the heart and then to the body tissues.

In the capillaries of the body tissues, the oxygen moves off the hemoglobin and into the body cells. The body cells produce carbon dioxide which diffuses into the blood. Some of the carbon dioxide is carried by the hemoglobin molecules. There is also an enzyme inside the RBCs that combines carbon dioxide and water to form bicarbonate. The bicarbonate remains in the plasma until the blood returns to the lung capillaries. Then the bicarbonate is converted back into carbon dioxide and water and the carbon dioxide is released into the lungs.

Questions

1. What role does the red blood cell play in oxygen transport?

2. What are two ways the red blood cell is involved in carbon dioxide transport?

3. What are two things that all the body cells need in order to work?

Lab: Bubbling Carbon Dioxide

Name: _____



Purpose: You will measure the effects of exercise on carbon dioxide production. You will be using a carbon dioxide indicator solution to determine how much carbon dioxide is in the breath you exhale. The more carbon dioxide there is in the solution, the quicker the solution will turn from blue to green and finally to yellow.

Materials

- Balloon
- Cup
- Straw
- Carbon dioxide testing solution
- Piece of string
- Marker



Procedures

1. Fill the plastic cup 1/3 full of carbon dioxide testing solution.
2. Blow up the balloon with one full breath of air (your exhaled air contains carbon dioxide).
3. While pinching off the balloon with one hand, attach the straw to the neck of the balloon by inserting the straw until it reaches the point where you are pinching it off.
4. Try to keep the air from escaping from the balloon end of the straw with your fingertips.
5. Insert the other end of the straw into the bottom of the cup containing the carbon dioxide testing solution.
6. Release the air slowly so that it bubbles into the solution. As soon as the solution turns yellow, pinch off the balloon and measure its circumference with a length of string. Mark the string with a marker so you know how big the balloon was when the solution turned yellow.
7. Exercise for one minute (according to your teacher's instructions) and repeat steps 2-6.
8. Measure the difference in the length of string with and without exercise.

Lab Questions

1. Record your results below

Length of string before exercise: _____ cm

Length of string after exercise: _____ cm

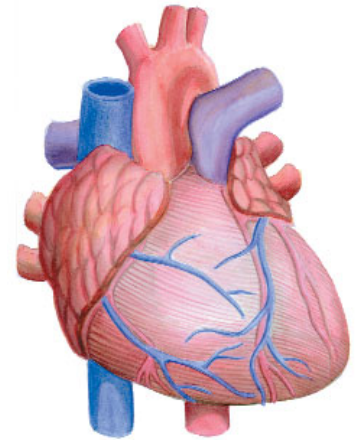
Difference in the length of string before and after exercise: _____ cm

2. According to your lab results, when was there a greater concentration of carbon dioxide in your breath?

Worksheet: Heart Cycle

Name: _____

The heart is responsible for pumping the blood through the blood vessels. It squirts blood out, fills with blood and squirts it out again. Squirt, fill, squirt, fill... over and over throughout your life. In the lab activities that follow, you will get a chance to listen to the sounds your heart makes and calculate how many times your heart squirts out blood every minute you are at rest and when you are exercising.



There are two sounds your heart makes. The two sounds come right after one another. The sounds are sometimes called "lub-dub." The first sound, "lub," is made when the heart is squirting blood out of the large chambers called ventricles. The sounds actually come from the closing of the valves between the atria and the ventricles (so blood won't go back the way it just came). The second sound, "dub," comes when the heart is filling with blood and the valves close that keep blood from flowing out of the heart while it is filling.

Lub = squirt

Dub = fill

Less than one second rest

Lub = squirt

Dub = fill

Rest...

Questions

1. You probably noticed that when you are exercising your heart beats faster. Explain why your heart needs to beat faster based on what you know about blood. Give as many details as you can.
2. The heart muscle needs blood too. There are blood vessels (coronary arteries) that go straight to the heart muscle from the main artery (aorta) that leads away from the left ventricle. These arteries branch into smaller and smaller arteries that bring oxygen and nutrients to the hard working heart muscle. If one of the smaller coronary arterioles in the heart muscle became blocked, what do you think happens when someone has a heart attack? How is the heart muscle damaged?

Pulse Rate

When your heart squirts blood out of the ventricles, the blood is under pressure. The left ventricle is especially muscular and can force the blood through the aorta in powerful squirts. Arteries can stretch and absorb this pressure. If you put your fingers along the side of your throat, you can feel the pulse of the blood squirting through your carotid artery.

3. Do you feel a pulse in an artery whenever your heart squirts, fills or at both times?

4. Would your pulse rate be the same as your heart rate? Why or why not?

Lab: *Squirting and Filling*

Name: _____



Purpose: To listen to the sounds made by your heart and to compare heart rate to pulse rate before and after exercise.

Materials

Stethoscopes

Stopwatch or clock with second hand

Procedures

1. Using a stethoscope, listen to your own heart sounds. The diaphragm of the stethoscope should be placed in the center of your chest. Move the diaphragm around until you hear the sounds clearly. It is critical that the room be quiet during this process.
2. Try to distinguish the “lub” sound from the “dub” sound. Visualize your heart squirting when you hear the “lub” sound and filling when you hear the “dub” sound.
3. Using a stopwatch, count how many times you hear your heart beat in six seconds. Multiply this by 10 to get your heart rate per minute. Fill in the chart below with your data.
4. Exercise for one minute and listen to your heart again. Count how many times you hear your heart beat in six seconds to get your heart rate. Fill in the chart below with your data.
5. Rest for a few minutes to be sure your heart rate has returned to its normal resting rhythm.
6. Place your fingers at a pulse point on the side of your throat or on your wrist. Count how many times you feel your pulse in six seconds. Multiply that by 10 to get your pulse rate. Fill in the chart below.
7. Exercise for one minute and measure your pulse rate again. Fill in the chart below.

AT REST	IMMEDIATELY AFTER EXERCISE
HEART RATE (beats/minute)	HEART RATE (beats/minute)
PULSE RATE (pulses/minute)	PULSE RATE (pulses/minute)

Lab Questions

1. Compare your heart rate to your pulse rate. Are they exactly the same?

2. If they aren't exactly the same, why might they be different?

3. When your doctor wants to measure your heart rate, why does he or she feel your pulse rather than listen to your heart?

Worksheet: Blood Comes in Different Types

Name: _____

Blood cells have proteins on the outside of the cell membrane. Some of these markers are the same on all blood cells of humans and some markers have variations (different people have different types). Your immune system recognizes the markers on your blood cells as “self.” Any blood cells with different marker molecules will be treated like foreign invaders and the antibodies and white blood cells will clump them together and destroy them. The destruction of incompatible blood cells can produce reactions harming the recipients.

There are two main categories of blood typing, the ABO system blood group and the Rh system blood type. In the ABO grouping system, there are four group of blood: A, B, AB and O. In the Rh system, there are two types, Rh-positive and Rh-negative. Each person has a combination of those two, for instance, someone can have group A Rh-negative blood or group B Rh-positive blood, and so on.

In a person with group A blood, the body only “recognizes” the group A marker. So that person’s body would not recognize the B carbohydrate, and would try to destroy cells with the B marker. The body (or immune system) of someone with group B blood can only recognize the B carbohydrate, so they would make anti-A antibodies. Someone with type AB blood wouldn’t make anti-A or anti-B antibodies, because their body would recognize both markers. Group O blood cells lack any ABO markers.

When someone has lost a great deal of blood, she or he needs an immediate supply to replenish it. There is no substitute for human blood; replacement blood must come from a healthy blood donor. So how do people receive donated blood without causing a clumping reaction to occur? The donor blood is matched to the recipient with the same type of blood or a compatible type.

The chart below illustrates the different blood groups and who can receive which group. Part of the chart is filled in for you.

1. Study the charts below and then fill in the blank spaces with ☺ for a safe match or ☹ for a bad match. Check your answers with your teacher.

DONOR	RECIPIENT			
	A	B	AB	O
A	☺	☹	☺	☹
B				
AB	☹	☹		☹
O	☺	☺	☺	

DONOR	RECIPIENT	
	NEGATIVE (-)	POSITIVE (+)
NEGATIVE (-)	☺	☺
POSITIVE (+)	☹	

- The “universal donor” is the type of donor who that can donate to all other patients. Which blood group and type is the universal donor? _____
- The “universal recipient” is the type of patient who can receive transfusions from any other blood type. Which blood group and type is the universal recipient? _____
- A person with B+ blood is in an automobile accident and needs an immediate transfusion. Only O+ blood is available, would that group and type of blood be safe to give to that person? _____
- A person with A- blood had knee surgery and they needed one unit of blood. Would A+ blood be safe to transfuse into this knee surgery patient? _____

Lab: A Critical Decision

Name: _____

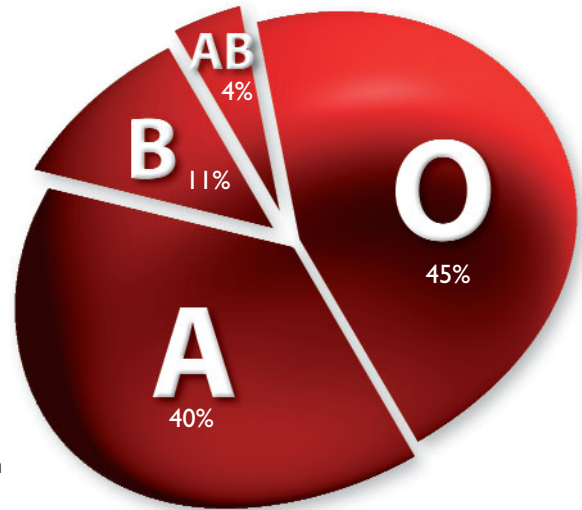


Purpose: To learn how blood types can be determined and to understand which blood types can be safely transfused into different people.

Background information:

A bus full of people returning from a ski trip overturns on an icy road. Twenty badly injured people are rushed to a local hospital. All 20 people need blood transfusions because of the extent of their injuries. The small hospital they have been transported to has 20 units of blood, but it only has five units of type O- blood. Therefore, it is necessary to type the blood of the patients to determine how to distribute the blood safely.

You will be given two blood samples to type. The patients are numbered 1-20. Determine the blood type of your patients, then as a class, you can determine how to distribute the available blood.



Distribution of blood types in the USA

Materials

- 2 simulated blood samples
- Anti-A, anti-B and anti-Rh simulated antibodies
- Blood typing plate or slides
- 6 toothpicks

Procedure

1. Place one drop of blood in the A, B and Rh sections of the typing plate.
2. Add one drop of “anti-A” in the A section, one drop of “anti-B” in the B section and one drop of “anti-Rh” in the Rh section.
3. Mix each section with a separate toothpick.
4. Wait three minutes. If a reaction has occurred, the blood will gel and get clumpy.
5. To determine the type, look for the sections that clumped. The ones that clumped will tell you the type. For example, if A and Rh clumped, then the person is A+. If A and B clumped but not Rh, then the person is AB-. If none of them clump, then the person is O-.
6. Fill in the chart with the information before you type the second patient’s blood. Rinse out the blood typing plate and dry it completely before typing the second person.
7. Repeat steps 1-4 for the second blood sample.

PATIENT NUMBER	BLOOD TYPE

Lab: A Critical Decision

Name: _____



8. Look at the chart below to see the units of available blood. As a class determine which patients should receive which units of blood.

PATIENT NUMBER	BLOOD GROUP	BLOOD GROUP PATIENT CAN ACCEPT	RECOMMENDED BLOOD TO BE TRANSFUSED (one solution to the puzzle - other solutions are possible)	BLOOD AVAILABLE
1				O-
2				5 units
3				
4				O+
5				6 units
6				
7				A+
8				3 units
9				
10				A-
11				2 units
12				
13				B+
14				2 units
15				
16				B-
17				2 units
18				
19				
20				

Lab: A Critical Decision

Name: _____



Lab Questions

1. If you have blood group O-type Rh-negative, why is it especially important for you to become a regular blood donor?

2. Why is it important for hospitals to always have more blood on hand than they will need in one day?

3. In this accident scenario, was there enough blood to go around? If the patients had different blood types, what might have happened?

4. Propose a solution to a crisis situation where there was not enough blood to distribute to patients in an emergency.

5. On what criteria should doctors base a decision on who should receive blood when the blood supply is insufficient?

6. What can you do to ensure that your local blood center has enough blood for the patients in your area? List as many things as possible.

Worksheet: *Break the Sickle Cycle*

Name: _____

Accident victims are not the only people who need blood transfusions. There are many people who have chronic illnesses that require frequent blood transfusions. In the video you met Klaryssa, who has a disorder called sickle cell disease.

In the “Break the Sickle Cycle Lab,” you will discover why the sickle hemoglobin molecules cause the symptoms of sickle cell anemia. In order to prepare for that activity, it is important to understand some things about the structure of the hemoglobin molecule.

One hemoglobin protein molecule is made of four separate smaller globin proteins clumped together. There are two alpha globin molecules and two beta globin molecules in each molecule of hemoglobin. In the center of each globin is a heme group. The heme group contains an iron atom.

You may have learned that proteins are a chain of molecules called amino acids. There are 20 different types of amino acids. In sickle cell anemia, one of the amino acids on the beta globin proteins is different. This is a very small change since there are 146 amino acids in each beta globin protein. In the “Break the Sickle Cycle Lab,” this different amino acid will be represented by a round dot.

When red blood cells (RBCs) filled with sickle hemoglobin lose oxygen, they sometimes change shape and lose their smooth, flexible appearance. These pokey, irregularly shaped (sickle shaped) RBCs often stick together and block blood flow. This causes neighboring red blood cells to lose their oxygen as well and they in turn will sickle. Sickle-shaped cells are lost from circulation much faster than normal cells, which will leave the patient with fewer functioning red blood cells than normal (anemia). This causes overall oxygen deprivation which can lead to more sickling of red blood cells. If the sickled cells that have stuck together form a blood clot, the tissues downstream from the clot become starved of oxygen. This is always painful and sometimes life threatening. This chain reaction of events is sometimes called the “sickle cycle.” To break this cycle, a blood transfusion is often needed.

Questions

1. What causes a sickle cell crisis (sickle cycle)?

2. How is sickle hemoglobin different from normal hemoglobin?

3. How many globin molecules are in one hemoglobin molecule?

Lab: *Breaking the Sickle Cycle*

Name: _____

Purpose: To understand why the blood cells of people with sickle cell disease sometimes change shape.

Materials

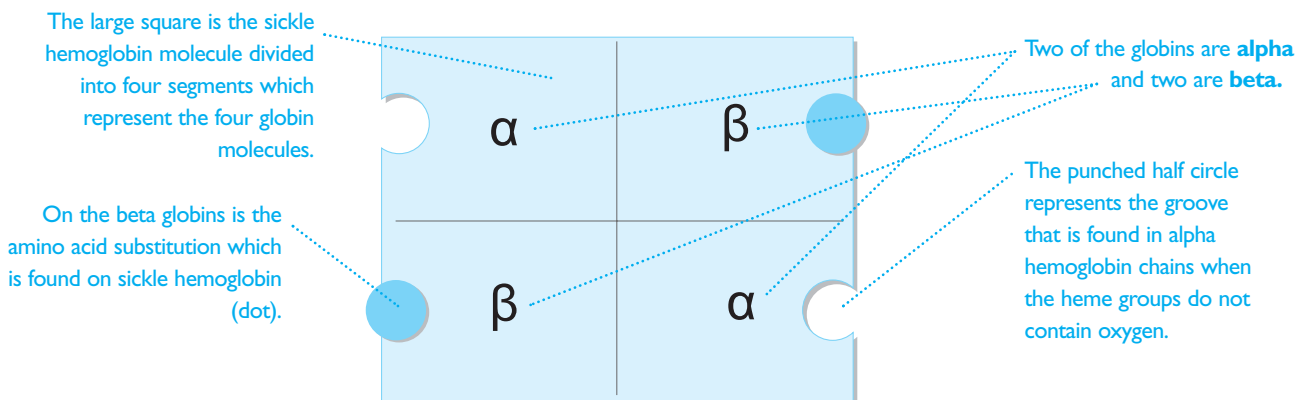
- 2 red pipe cleaners
- 10 small self-sticking notes, such as Post-It®
- 1 single hole punch
- 1 piece of paper
- Glue stick
- Pen

Procedure

You and your partner will make 10 sickle hemoglobin molecule models (five each). Follow the instructions below and then think about what might cause a red blood cell with sickle hemoglobin to change shape.

Making Sickle Hemoglobin Models

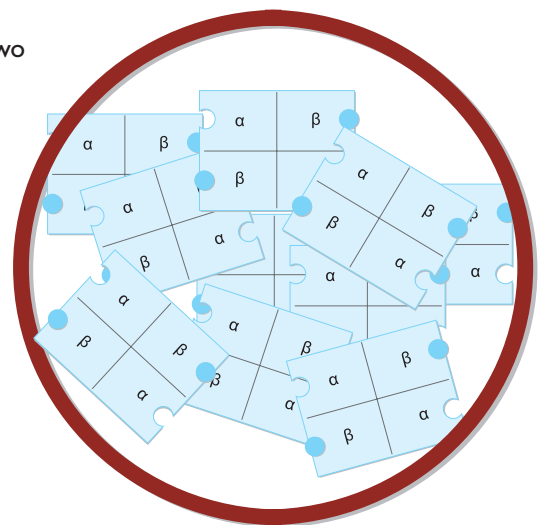
- Using small self-sticking notes, a single hole punch, paper and a pen, create 10 sickle hemoglobin molecules as shown below.



- Place all 10 sickle hemoglobin molecules inside a “red blood cell” made of two red pipe cleaners twisted together to form a ring.
- The grooves in the alpha globin chains only form when the iron is not bound to oxygen. In this deoxygenated red blood cell, why do you think the red blood cell changes shape? Look carefully at the structure of the hemoglobin molecules to discover this.

Note: In a real red blood cell, the hemoglobin molecules are much smaller compared to the size of the red blood cell. Also, there are millions of hemoglobin molecules in each red blood cell.

- Once you have figured out what causes the “sickle cycle” show your teacher your sickled model, then answer the questions below.



RELATED TERMS USED IN THIS GUIDE

Alveoli ✓ Air cells of the lungs, formed by the terminal dilation of tiny air passageways.

Antibody ✦ A protein that is made by certain white blood cells (lymphocytes), in the body, in response to the invasion of a foreign substance.

Antigen ✕ A substance that when introduced into the body stimulates an immune response.

Aorta ✓ The main trunk of the arterial system, carrying blood from the left ventricle of the heart to all of the body except the lungs.

Arteries ✓ Blood vessels that carry blood from the heart to any part of the body.

Bacteria ✓ One-celled organisms, spherical, spiral, or rod-shaped and appearing singly, in chains, or in clusters.

Blood ✓ The fluid that circulates in the principal vascular system of human beings and other vertebrates; in humans consisting of plasma in which the red blood cells, white blood cells, and platelets are suspended.

Bronchi ✓ The main branches of the trachea.

Capillaries ✓ The tiny blood vessels between the terminations of the arteries and the beginnings of the veins.

Chemotaxis ✓ Movement of a cell toward or away from a chemical stimulus.

Cytoplasm ✦ A jellylike material that surrounds the nucleus of a cell and contains most of the cell's organelles.

Differentiation ✓ (of cells or tissues) to change from relatively generalized to specialized kinds, during development.

Erythrocyte ✓ A red blood cell.

Fibrin ✓ The insoluble protein end product of blood coagulation.

Germ ✦ Any microorganisms that cause disease.

Granulocyte ✓ A circulating white blood cell having prominent granules in the cytoplasm and a nucleus of two or more lobes.

Hemoglobin ✓ The oxygen-carrying protein of red blood cells that gives them their red color and serves to carry oxygen to the tissues.

Immunity ✓ The condition that permits either natural or acquired resistance to disease.

Leukocyte ✓ A white blood cell.

Lymphocyte ✓ A type of white blood cell having a spherical nucleus surrounded by a thin layer of nongranular cytoplasm.

B Lymphocyte ✕ A lymphocyte that is involved in the production of antibodies.

T Lymphocyte ✕ A lymphocyte that helps in the priming of B lymphocytes to make antibody or is directly involved in attacking foreign cells, such as tumor cells.

Marrow ✓ A soft, fatty, vascular tissue in the interior cavities of bones that is a major site of blood cell production.

Megakaryocyte ✓ A large bone marrow cell having a lobulate nucleus (one with lobes); the source of blood platelets.

Mitosis ✓ The usual method of cell division.

Monocyte ✓ A large, circulating white blood cell, formed in bone marrow and in the spleen, that ingests large foreign particles and cell debris.

Nucleus ✦ The part of the cell that holds genetic information as DNA. Bacterial cells have no nucleus.

Nutrients ✦ Substances that give sustenance to an organism.

Organelle ✓ A specialized part of a cell having some specific function.

Phagocyte ✓ Any cell that ingests and destroys foreign particles.

Phagocytosis ✓ The ingestion of a smaller cell or a fragment.

Plasma ✓ The liquid part of blood or lymph, as distinguished from the suspended elements.

Platelets ✦ Small non-nucleated (having no nucleus) cells which form the first plug to stop bleeding.

Red Blood Cells ✓ One of the cells of the blood, which, in mammals, are non-nucleated disks concave on both sides, containing hemoglobin and carrying oxygen to the cells and tissues and carbon dioxide back to the respiratory organs.

Spleen ✓ A highly vascular, glandular, ductless organ, situated in humans at the cardiac end of the stomach, serving chiefly in the formation of mature lymphocytes, in the destruction of worn-out red cells, and as a reservoir for blood.

Transfusion ✓ The direct transferring of blood, plasma, or the like into a blood vessel.

Virus ✦ A tiny object that is composed of RNA or DNA and is surrounded by a protein cap or capsid.

Stem Cells ✓ Cells that upon division replace their own numbers and give rise to cells that differentiate further into one or more specialized types, such as various B cells and T lymphocytes.

Veins ✓ Branching vessels or tubes carrying blood from various parts of the body to the heart.

Vessel ✓ A tube or duct such as an artery or vein, which contains or conveys blood or some other body fluid.

White Blood Cells ✓ Any of various nearly colorless cells of the immune system that circulate mainly in the blood and lymph.

Shopping List

Below is a list of all the items that you will need to complete all of the demonstrations and labs presented in this guide.

- 100 mL graduated cylinder (alternatively, 1 L cylinder or 60 cc syringe)
- Baking soda
- Balloons
- Bleach or ammonia
- Bromthymol blue pH indicator solution or powder
- Clear plastic cups
- Cola
- Congo red powder
- Corn or canola oil (1 bottle)
- Crispy rice cereal
- Glass or white plastic beads (spherical and irregular shape)
- Glue stick
- Large red buttons
- Marking pen
- Metric ruler
- Pipe cleaners
- Post-It® notes
- Red sequins (large bag)
- Red-colored sugar crystals (3 containers)
- Rice crispy treats
- Sandwich-sized zip-top plastic bags
- Simulated blood typing kit
- Slides of artery and vein cross sections
- Slides of human blood smears stained with Wright's stain
- Stethoscope (may be homemade, see p. 12)
- Straws
- Test tubes
- Toothpicks
- Vinegar
- Yellow food color



America's Blood Centers
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www.AmericasBlood.org
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Resources

Recommended Reading

- A.D.A.M. *The Inside Story*. (CD-ROM 6 I I) A.D.A.M. 1997
- Kittredge, Mary. *Organ Transplants*. Chelsea House, 2000
- Llewellyn, Claire. *The Big Book of Bones*. Peter Bedrick Books, 1998
- Parker, Steve. *Fitness, Health, Hygiene and Relaxation Tonic*. Copper Beech Books, 1996
- Parker, Steve. *How the Body Really Works*. Dorling Kindersley Limited, 1994
- Parker, Steve. *Human Body*. Dorling Kindersley, 1994
- Parramon, Mercé. *How Our Blood Circulates*. Chelsea House, 1994
- Simon, Seymour. *The Heart*. Morrow Junior Books, 1996

Recommended Web Sites

America's Blood Centers
www.AmericasBlood.org

My Blood, Your Blood
www.MyBloodYourBlood.org

American Library Association's Great Web Sites for Kids
www.ala.org/greatsites

Cells Alive
www.cellsalive.com

Center for Disease Control
www.cdc.gov

Dennis Kunkel Microscopy, Inc.
www.denniskunkel.com

Human Anatomy Online
www.innerbody.com

Nobel e-Museum: Play the Blood Typing Game!
www.nobel.se/medicine/educational/index.html

Puget Sound Blood Center's High School Partnership Program
www.psbchighschool.org

UK's National Blood Service "Fun Zone"
www.blood.co.uk/pages/bzone.html