A Partnership with Youth

United Blood Services

Funded by grants from:
Blood Systems Foundation
Alberta B. Farrington Foundation

A Partnership with Youth

The program is designed to educate students about the elements of Blood, Blood Donation, Blood Typing and Compatibility with hands-on, measurable activities. Also provided are activities in related subjects such as how the heart and cardiovascular system work.


United
Blood
Services
your non-profit community blood center

What is Blood?

B L O O D

Whole Blood

Blood is a living tissue composed of cellular elements and a watery fluid called plasma. The cellular elements make up 45 percent of the volume of whole blood. The plasma, which is 92 percent water, makes up the other 55 percent. Roughly 7 percent of a person's body weight is whole blood. Women maintain an average of 9 pints of blood while men maintain about 12 pints.

Blood transports oxygen from the lungs to the body tissues and also transports carbon dioxide from the body tissues to the lungs to be exhaled. Blood transports nourishment, hormones, and disease-fighting proteins throughout your body as well. Blood also acts to transport waste byproducts to the kidneys to be filtered out of the body.

Basic blood components consist of red blood cells, white blood cells, plasma and platelets.

E L E M E N T S O F B L O O D

Red Blood Cells (Erythrocytes)

Cells that travel through your body delivering oxygen and removing carbon dioxide. They acquire their red color from an iron-containing protein called hemoglobin. As RBCs pass through the lungs, the oxygen molecules attach to the hemoglobin. As RBCs pass through the blood tissues, the homoglobin is released. Red blood cells absorb the CO_2 released from the tissues and transport this back to the lungs. An RBC's life cycle is about 120 days. A normal RBC count for humans is 4.2 to 6.2 billion/mL (microliter = one thousandth of a liter) of blood.

White Blood Cells (Leukocytes)

A variety of cells that travel through the body fighting disease and bacteria. WBCs consist of lymphocytes, monocytes, neutrophils, eosinophils and basophils. Each type of WBC has its own plan of attack. A WBC's life cycle varies by cell type from hours to years. The normal human WBC count measures 4.5 to 11 million/mL of blood.

Plasma

Plasma is a straw colored liquid, 92 percent water, that carries blood elements throughout the body. Plasma is a solution of dissolved salt, minerals and antibodies (proteins that fight off disease, bacteria and viruses). Plasma also contains protein which functions as clotting factors, such as factor VIII that promotes coagulation, and other coagulation proteins, such as fibrinogen, which are consumed in the coagulation process to seal breaks in blood vessels. Plasma also contains compounds such as hormones, adrenaline, or waste urea.

Platelets

These cellular fragments function to maintain the blood vessel walls and start the process to seal breaks such as bruises, scrapes, or cuts. Platelets, combined with calcium and other clotting proteins found in your plasma, adhere together to form a clot. (Platelets) + (Calcium) + (Clotting Factors/Proteins) = Fibrin Clot

Cryo (Cryoprecipitated Antihemophilia Factor)

Extracted through a series of freezing and thawing steps, Cryoprecipitate contains the clotting protein known as Factor VIII which is absent in patients who have hemophilia, an inherited disorder of blood clotting.

All of these components are necessary for your body to function normally. When any of these components are lacking, due to heredity, illness or injury, it is important to have them replenished. The body is always reproducing blood. But, when the body's blood supply becomes depleted to a point that it has to be replaced through a blood transfusion, donor blood becomes necessary.

That is where you, the donor, enter the picture!

What's Your Type?

United Blood Services
High School Blood Typing Program

United Blood Services is pleased to offer a complete blood typing demonstration for your school. This program is designed to complement your studies of blood types and/or the circulatory system.

United Blood Services will provide:

- Skilled Medical Technologist to perform a blood typing screen
- All supplies needed to perform the demonstration
- Parental consent letter
- Display with photos
- Slide presentation
- Handouts for the students

For more information about this program, contact **United Blood Services.**

Blood Types:

Blood is grouped into four types: A, B, AB and O. Each type is also classified by an Rh factor: either positive or negative. When a blood transfusion is necessary, donor and patient bloods must be compatible. If not, the patient's body will react to the incompatible donor cells, leading to complications, maybe even death.

ABO BLOOD GROUP SYSTEM

The ABO blood groups system was discovered by Austrian physiologist Karl Landsteiner in 1900. The fourth main blood type, AB, was discovered in 1902. This system obeys the laws of genetics with three genes controlling the four blood types. Genes A and B dominate over the O gene but do not dominate over each other. Each person has two genes to determine blood type. Red blood cells contain complicated proteins on their surface which create what are referred to as red cell antigens.

- Type A blood has one or two A genes and no B genes. This produces an A antigen on the red blood cells and results in anti-B antibodies in the plasma.

- Type B blood has one or two B genes but no A genes. This produces a B antigen on the red cells and results in anti-A antibodies in the plasma.

- Type AB blood has one A gene and one B gene. This produces both A and B antigens on the red cells, but neither anti-A nor anti-B antibodies in the plasma.

- Type O has no A or B genes, but does have two O genes. This produces an O antigen on the red cells, and results in both anti-A and anti-B antibodies in the plasma.

Blood is life itself.

The Rh factor, which represents a group of membrane proteins, (the most potent of which is known as D), is found on the red blood cells of 85 percent of the population. These people have Rh positive blood. The remaining population lacks the Rh factor and are considered to be Rh negative. This blood group was discovered in 1940 by Dr. Landsteiner and Dr. Alexander Wiener. Because the Rh factor was discovered while studying Rhesus monkeys, the first two letters of the word Rhesus are used to identify it. The genetics of the Rh system are far more complex than the ABO system, and there are many subtypes.

Compatibility

O-positive is the most common blood type. Although 37 percent of the population has O-positive blood, more than half the patients who need blood receive O-positive transfusions. Because patients cannot form anti-O antibody, all other Rhesus positive blood types can safely receive O-positive blood.

O-negative blood is found in 6 percent of the population, but is transfused to nearly 9 percent of all patients. O-negative blood can be received safely by patients of all blood types. It is often transfused in emergency situations when there is no time to type the patient and perform a crossmatch with donor blood. An O-negative donor is therefore referred to as the "universal donor."

A-positive is one of the most common of the eight blood types. In fact, 34 percent of the population is A-positive, however not all A-positive patients who need blood receive A-positive transfusions. In emergency situations, A-positive patients may receive O-positive or O-negative blood. A-negative blood can also be transfused to A-positive patients, but that is seldom done since A-negative is more rare.

Only 6 percent of the population has **A-negative** blood. A-negative patients can receive one other blood type: O-negative.

B-positive is found in 10 percent of the population. They can safely receive B-positive, O-positive, O-negative, and B-negative.

B-negative is one of the least common blood types. Only 2 percent of the population has B-negative blood. These people can also receive O-negative blood.

AB-positive is found in 4 percent of the population. Although it is a fairly rare blood type, individuals with this blood type can safely receive transfusions of any other blood types.

The least common of all blood types is **AB-negative**. Only 1 percent of the population has AB-negative blood. Not all AB-negative patients receive AB-negative transfusions, since they can safely be transfused with O-negative, A-negative and B-negative. Since AB donors do not form either anti-A or anti-B antibody their plasma may be safely transfused to any recipient and is commonly used to transfuse small (premature) children who need blood transfusions.

Note: Percentages apply to Caucasions and do vary for African Americans, Native Americans, and Asians.

How is Blood Used?

Donated blood is used to help patients who are sick, require surgery or have been injured in an accident. Once the blood is tested, it is shipped to area hospitals. Blood must be ready and at the hospital even before it's needed. Most blood centers keep a three to five day supply of blood at the hospitals for both planned and emergency use.

Making sure the blood goes to the right place.

Managing Inventory

Hospitals with routine or emergency blood orders call the Hospital Services Department at the blood center. Staff there make sure all required procedures have been done and safeguards met, then pack the blood in special, temperature controlled containers and transport it to the hospital. At the hospital the blood is confirmed for ABO and Rh type, then either stored for later use or matched to a patient with an immediate need. Generally a supply of O-negative blood goes to the emergency room because it can be transfused as a universal donor.

Three kinds of blood donations.

- An **allogeneic** blood donation is made from the heart (altruistic) for someone you will probably never meet. For more than 55 years volunteer blood donors have generously rolled up their sleeves to help others.

- An **autologous** blood donation is one that an individual gives for their own planned surgery. If a surgeon determines that a patient is well enough and strong enough, they might prescribe donating blood for the patient's own surgical procedure such as a knee or hip replacement.

- **Directed** blood donations come from friends or relatives of a patient who needs blood.

Not all patients are able to donate blood for their own use or have friends and relatives able to donate for them. That's why allogeneic donations are so important. In fact, allogeneic donations provide more than 90 percent of the blood used by patients.

Blood Components

A single blood donation may be separated into four basic components to help many different patients with various needs. The blood is collected into separate packs which are connected by sterile tubing. These allow separation of the component parts of the blood.

Red Blood Cells: First, the blood is spun in a large refrigerated centrifuge. The red cells are the heaviest, so they are packed at the bottom. On top of the red cells, floating in the plasma since they are lighter in weight, lie the platelets. These white cells settle on top of the red cells and because they are lighter in color, this portion is known as the buffy coat.

Plasma: The platelet-rich plasma portion is squeezed off the top into a satellite bag with an instrument called an expressor.

Platelets: The plasma bag is then spun. Platelets, the heaviest component, settle to the bottom while the plasma, which is the lightest of all, lies on top. The plasma is squeezed off into a third satellite bag.

Cryo: The plasma is rich in clotting factors known as cryoprecipitate. This product is sometimes further extracted from the plasma. This process requires freezing the plasma followed by slow thawing. The last 10 percent to thaw contains more than half the clotting factor (Factor VIII), also known as antihemophiliac factor, and half of the fibrinogen.

Basic Components

These basic components are treated several ways in order to meet the special needs of the recipient. Most components are made from allogeneic donations: healthy people donating blood to meet the needs of patients whom they will never meet. Below is a brief description for each component that is produced in the Component Laboratory.

Whole Blood: Whole blood contains the red blood cells, white blood cells, platelets and plasma components of donor blood. This component increases the oxygen-carrying capacity of the blood by increasing the number of circulating red blood cells. It also increases the total volume of circulating blood and is sometimes used to treat shock trauma victims.

Red Blood Cells: Red blood cells are prepared by centrifugation of whole blood (the red cells are separated from the plasma). This component increases the oxygen-carrying capacity of the blood by increasing the number of circulating red blood cells. It's the most commonly used blood component for patients undergoing surgical procedures.

Leukoreduced Red Blood Cells: These are red blood cells filtered with a leukocyte-reducing filter. Removing leukocytes, also called red blood cells, reduces the risk of temperature elevations and other reactions in transfusion recipients. It is most commonly used to treat patients receiving multiple tranfusions.

Platelets: A unit of platelets is the concentrated platelets separated from a single unit of whole blood and suspended in a small amount of the original plasma. Platelets are essential in the process of initiation of blood clotting. Most platelets are transfused to patient on anti-cancer drug treatments.

Cryoprecipitate AHF: Cryo is prepared by thawing FFP at 4 degrees Celsius and recovering the precipitate, or the last portion to thaw. The cold-insoluble precipitate is refrozen. This precipitate is a source of coagulation Factor VIII which is used in the control of bleeding in patients who have Hemophilia, an inherited lack of this protein. This may also be transfused as a source of fibrinogen to patients who have stressed coagulation systems from a variety of causes.

Fresh Frozen Plasma: This is plasma that is separated from whole blood and frozen within eight hours of collection. This product contains plasma proteins including all coagulation factors. FFP is used to control bleeding in patients who have clotting factor deficiencies as a result of liver disease or use of certain “blood thinning” medications.

Plasma: This is plasma frozen within 24 hours after collection of whole blood. This plasma product contains a smaller amount of Factor VIII and coagulation factors. Plasma is not directly transfused as often as fresh frozen plasma and is commonly utilized as starting material of an extraction/fractionation process to prepare purified concentrates of special blood proteins, such as purified Factor VIII.

Recovered Plasma - Liquid or Frozen: Again, plasma is separated from whole blood. Recovered plasma-liquid may be separated from whole blood up to five days after the expiration of the whole blood. Recovered plasma (both liquid and frozen) is used for manufacturing purposes only and is utilized to prepare purified Albumin, the simplest and most abundant protein present in human plasma. Albumin is often the first human blood product transfused to shock trauma victims.

United Blood Services offers a complete education program on the safety of donating blood. All tests that are performed on each pint of blood are completely explained.

It is important to remember that it is impossible to get AIDS from donating blood. Each donation kit contains a new, sterile needle that cannot be reused.

"Our Blood Supply is Among the Safest in the World" *Surgeon General of the United States*

Today, there is very little chance of getting HIV from a blood transfusion, certainly not enough to stop you from receiving blood if your doctor feels you need it. Nearly all people infected with the HIV virus through blood transfusions received those transfusions before 1985, the year it became possible to test donated blood for HIV.

Since mid-1983, all blood donations in the United States have come from persons who are questioned about risk factors associated with HIV infection. People at increased risk of being infected are not allowed to donate blood. Since mid-1985, all donated blood has been tested for HIV and other viruses (12 different tests are now conducted on each blood sample). Blood that tests positive for HIV is destroyed in a safe fashion and is not used for transfusion. If a donor tests positive for HIV, this is confirmed by performing supplemental tests. Truly positive donors are then confidentially told that they are infected with HIV, and they are not allowed to donate blood again.

There is NO RISK of getting infected with HIV by GIVING blood because a new, sterile needle is used for each donation.*

* Reprinted from Surgeon General's Report to the American Public on HIV Infection and AIDS

Standard Tests

Every Unit of Blood is Tested for:

- ABO
- Rh
- Unexpected Red Blood Cell Antibodies
- Hepatitis B Surface Antigen
- Hepatitis B Core Antibody
- ALT
- Anti-Hepatitis C Virus
- Syphilis
- Anti-HIV 1/HIV 2
- HIV Antigen
- HIV & HCV Nucleic Acid

United Blood Services

High School Educational Program

Setting up a Blood Drive:

1. Set a date that is convenient for the school
2. Schedule a time
3. Schedule equipment and staff through your United Blood Services Representative
4. Schedule a 20-25 minute presentation for the students, either in individual classes or an assembly.

The learning experience for students is at two levels. One reinforces the messages presented in the lesson plan and the other emphasizes the importance of assuming community responsibility. Students have shown an enthusiastic response to becoming blood donors. They also act as leaders by persuading their parents and teachers that donating blood is a very important and necessary thing to do for their community.

United Blood Services will provide you with:

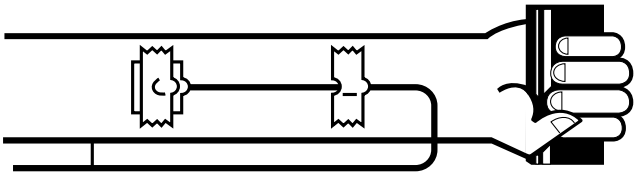
1. Recruitment materials (posters, fliers, etc.)
2. Staff for presentations
3. Trained staff and equipment to conduct the blood drive

Involving your school in this worthwhile program will teach your students to become more community minded and provide a much-needed community service. Maintaining an adequate blood supply for patients in an ever-increasing challenge.

Call United Blood Services to set up your blood drive.

Who can donate blood?

Blood donors are healthy men and women who weigh at least 110 pounds and are 17 or older. Anyone who is at risk of catching or spreading a number of transfusion transmissible viruses must not donate blood.

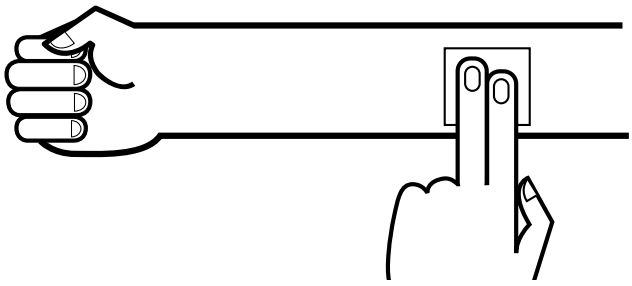


What's it like to donate?

The entire donation process takes less than an hour and begins with a brief interview. Next, temperature, pulse, blood pressure, and red cell number are checked. The actual donation takes only 10 minutes. The donor relaxes in a comfortable chair while one unit, about a pint, of blood is collected in a special container. You cannot get AIDS or any other infectious disease by donating blood, because all materials are sterile and disposable, used once, then thrown away. Afterward, donors rest and enjoy light refreshments, then resume their normal routine. The bone marrow replenishes the donated blood over the next two to four weeks.

What happens after the donation?

All donated blood is typed to determine ABO group and Rh factor and tested for safety, including a test for the HIV virus that causes AIDS. Most blood is separated into components, allowing one donation to help several people.



Activities!

ACTIVITY 1:

Your Hardworking Heart (from Reader's Digest: *How the Body Works*)

"When you are at rest, each heartbeat sends about 1/3 pint (150 ml, about 5 oz.) of blood into the arteries. In an adult, this happens between 60 and 80 times each minute. See how hard the heart works by getting your hand and arm to work at the same rate."

TRY THIS:

You will need: a plastic cup that holds 1/3 pint, two large bowls, water, and a stopwatch.

1. One partner will be the timekeeper. Use the stopwatch to measure one minute.

2. The other partner will be the "hardworking heart." His or her job is to try to bail the water from one bowl to another, at 70 cupfuls per minute…the same speed as a normal heart rate.

3. Try it. Can you bail 70 cupfuls per minute? Keep going. How long can you keep up the pace?

ASSESSMENT QUESTIONS:

- What did you learn about your heart from this activity?

- How long does your heart keep pumping (bailing) without resting?

- Parker, Steve: *How the Body Works*, Reader's Digest, 1994

A C T I V I T Y 2 :

Seeing your Pulse (from Reader's Digest: *How the Body Works*)

"Your pulse rate gives you a rough guide to the general health of your heart and body. You can take your pulse in different ways. In this activity, you will see your pulse by making a simple visual pulse meter with a soda straw and a piece of clay."

T R Y T H I S :

You will need: soda straw, clay and a stopwatch

1. Feel with your fingertips on the inside of your wrist, below your thumb, until you detect pulsations. (Do not use the tip of your thumb, as that has its own pulse, which you may feel instead.)

2. Place a blob of clay at the place where you can feel the pulsations most strongly. Carefully push one end of the straw into this blob so that it sticks upright from your wrist.

3. Let your arm lie flat on the table. The straw should twitch slightly to and fro as the surge of blood produced by each heartbeat passes through your wrist into your hand. Measure your pulse rate by counting the number of times the straw moves in one minute. (The average resting pulse rate is about 80-100 for teenagers.)

4. Repeat this activity checking your pulse rate after exercise. Jump in place for one minute.Then find your pulse, attach the clay and straw, and measure your pulse rate. What did you find out?

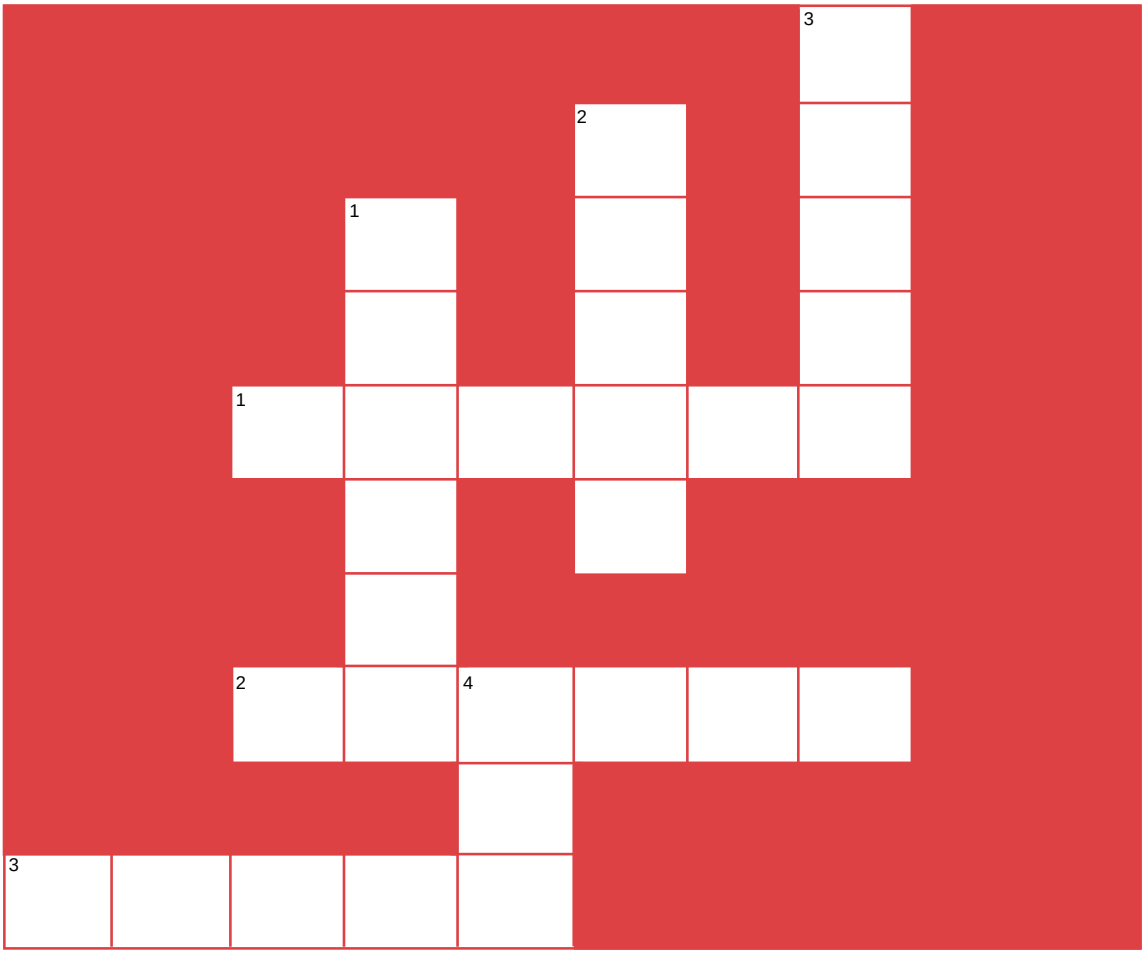
A S S E S S M E N T Q U E S T I O N S :

- Why were the pulse rates different when you were rested and active?

- What did you notice about your heart beat after exercising 1 minute?

- Parker, Steve: *How the Body Works*, Reader's Digest, 1994

BLOOD CROSSWORD PUZZLE



A C R O S S :

1. Blood takes _____ away from the cells.
2. Red cells are made in the bone _____.
3. _____is made up of cells, suspended in a straw-colored liquid.

D O W N :

1. Red blood cells are carried by the _____ to various parts of the body.
2. _____ blood cells help to fight germs and destroy them.
3. Platelets help make _____.
4. _____ cells transport oxygen to the body cells.

W O R D L I S T :

Marrow Clots Wastes Blood Plasma Red White

WORD SEARCH

R O G P C W H E A R T Q
E A A L M H D O N O R K
D P R A B I S B A X A L
C U T T L T Y N P Y N O
E L E E O E L U N G S X
L S R L O C P O V E F G
L E I E D E L L E N U S
S E E T X L A C I C S B
V E S S E L S L N R I C
B E S O E S M O S S O P
C I R C U L A T I O N H
Q J Y U Z O K Y T T X Q

WORDS TO LOCATE:

RED CELLS
PLATELETS
VESSELS
BLOOD
CIRCULATION
ARTERIES
TRANSFUSION
WHITE CELLS
LUNGS
PLASMA
HEART
OXYGEN
DONOR
PULSE
VEINS
CLOT

Complete these questions:

Review

P R A C T I C E Q U E S T I O N S

1) What is the short name used for Cryoprecipitated AHF? _____

2) Why do some patients need filtered red blood cells? _____

3) What does an anticoagulant prevent? _____

4) Factor _____ is one of the coagulation factors found in both FFP and CRYO.

5) Red Blood Cells increase the _____ -carrying capacity of the blood by increasing the circulating red blood cell mass.

6) _____ is the straw-colored liquid portion of unclotted blood.

7) What percent of plasma is water? _____

8) What are the four blood types? _____

9) _____ is the name for the most common plasma protein purified from Recovered Plasma.

10) _____ are most commonly used to treat patients receiving multiple transfusions.

11) How many tests are performed on a unit of blood after it has been collected? _____

12) How much blood is collected in one donation? _____

13) What blood type is known as the universal donor? _____

14) Allogeneic donations provide more than _____ percent of the blood used by patients.

15) Why can you not get AIDS from a blood donation? _____

Answer Key:
1. Cryo **2.** They reduce the risk of temperature elevations and other reactions in transfusion recipients. **3.** blood clotting **4.** VIII **5.** oxygen **6.** plasma **7.** 92 percent **8.** A, B, AB and O **9.** albumin **10.** leukoreduced red blood cells **11.** twelve **12.** 150 ml, about 5 oz. **13.** O-negative **14.** 90 **15.** You cannot get AIDS or any other infectious disease by donating blood because all materials are sterile and disposable, used once, then thrown away.

Glossary

ABO

The most important of several blood group systems for typing human blood based on the presence or absence of two antigens (A and B) on the surface of red blood cells. Types A, B, AB and O.

Allogeneic

A blood donation that is made from the heart (altruistic) for someone the donor will probably never know.

Altruistic

The unselfish concern for the welfare of others. Ninety percent of all blood donations are made for altruistic reasons. The remainder comes from people giving for their own use or for a friend or family member.

Anemia

A condition of the blood in which the red cell content of the blood is below normal limits. The most common cause for anemia is iron deficiency. Iron is an element necessary for the formation of hemoglobin.

Antibody

Protein produced by the immune system in response to a specific foreign substance (antigen). It attempts to eliminate the foreign substance from the body.

Anticoagulant

Solution that prevents the clotting of RBCs. It is added to the blood when a unit is collected from a donor.

Antigen

A protein or carbohydrate substance that is recognized by the body and stimulates an immune response.

Apheresis

Method of separating platelets or plasma from the donor's blood and returning all but that component to the donor.

Autologous

From auto (self) and logos (relation). It is a blood donation from yourself for your own use.

Bone Marrow

The site of blood cell production found within the bone cavities. This is where all blood cells originate.

Centrifugation

Method used in the process of separating lighter portions of a solution from heavier portions. Used when making components of blood.

Circulation

Constant movement and motion of the blood and its elements throughout the body.

Clot

Platelets + clotting factors = fibrin clot. Result of platelet aggregation and a method in which the body reacts to a cut or injury in the vascular and tissue system.

Components

RBCs, Platelets, Plasma, Cryoprecipitate. Components are the elements of whole blood separated for various uses in transfusion medicine.

Cryoprecipitate

Component of plasma obtained through freezing and thawing. Contains some clotting factors, e.g. Factor VIII.

Directed Donation

A blood donation that comes from a friend or relative of a patient who needs blood.

Erythrocytes

Red Blood Cells. Contain hemoglobin which carries oxygen to cells and CO_2 and waste from cells.

Expiration Dates

The date the component's shelf life ends.

Fibrinogen

A clotting protein that controls bleeding by blocking the leaks in the system. It is found in the plasma portion of the blood.

Hemoglobin

The iron-containing protein pigment found in red blood cells whose primary function is to transport oxygen from the lungs to the body.

Hematocrit

Measure of the volume of red cells as a percentage of the total volume of blood.

Hemophilia

A disease characterized by an inherited lack (or reduced levels) of a critical coagulation protein leading to impaired clotting of the blood and a tendency to bleed.

Hepatitis

Inflammation of the liver.

Leukocytes

White blood cells. Helps fight infections and disease.

Leukopoor

Components in which white cells have been reduced in number, usually by filtration.

Plasma

Straw-colored liquid portion of blood in which the blood elements are suspended and circulated throughout the body.

Platelets

Irregular shaped structures found in the blood which play an important role in the clotting of blood.

Precipitate

Settling of solid particles of a substance in a suspension.

Rh Factor

An antigen present on the red blood cells. Called Rh because it was first identified in the blood of rhesus monkeys. People with this antigen are Rh positive and those without are Rh negative.

Recipient

The person which is receiving blood and/or component(s).

Transfusion

Infusion of blood or other components into a patient intravenously.

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