

CIRCULATION STATION

Grade Level or Special Area: 4th Grade

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Length of Unit: Five lessons (approximately 2.5 weeks (13 days); one day = 45 minutes)

I. ABSTRACT

During the course of this unit students will discover how vital the circulatory system is in conjunction with all other body systems and will learn about its main components including the heart, blood, and blood vessels. Stimulating hands-on projects centered around these components include monitoring pulse rate, making a stethoscope, diagramming the path of blood throughout the body, simulating a blood clot, creating a diet/exercise log, setting personal drug-free goals, learning about the pioneering work of William Harvey and Charles Drew, and researching own blood types.

II. OVERVIEW

A. Concept Objectives

1. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations. (Colorado State Science Standard #1)
2. Students will know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment. (Colorado State Science Standard #3)
3. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world. (Colorado State Science Standard #5)
4. Students will understand that science involves a particular way of knowing and understand common connections among scientific disciplines. (Colorado State Science Standard #6)

B. Content from the *Core Knowledge Sequence* p. 104

1. Pioneering work of William Harvey
2. Heart: four chambers (auricles and ventricles); aorta
3. Blood: red blood cells (corpuscles); white blood cells (corpuscles); platelets; hemoglobin; plasma; antibodies, blood vessels: arteries; veins; capillaries, blood pressure; pulse, coagulation (clotting)
4. Filtering function of the liver and spleen
5. Fatty deposits can clog blood vessels and cause a heart attack.
6. Blood types (four basic types: A, B, AB, O) and transfusions

C. Skill Objectives

1. Students will recognize the three main parts of the circulatory system.
2. Students will connect William Harvey's contributions in science to the circulatory system.
3. Students will understand the basic structure of the heart, its purpose, and function in the body.
4. Students will label the four chambers (left ventricle, right ventricle, left atrium, right atrium), aorta, and septum on a diagram of the heart.
5. Students will realize the importance of blood and blood vessels to the circulatory system.
6. Students will trace the path of blood flow throughout the body on a heart diagram, differentiating between oxygenated and deoxygenated blood with different colors.

7. Students will learn various effects of drugs and alcohol on the circulatory system and will brainstorm ways to remain drug/alcohol free.
8. Students will identify the excess of fatty foods, foods high in cholesterol, and lack of exercise as contributors of heart disease by causing clogged arteries and a weakened heart.
9. Students will list the four basic blood types and infer that blood donations can be helpful for themselves or others that may need compatible blood in an emergency.
10. Students will judge the effect of Charles Drew's discoveries on their lives as well as formulate opinions in regard to ironic circumstances of his death and how people's prejudicial attitudes prevented his recovery. Additionally, students will compile a list of other examples where people's preconceived notions or prejudices have hindered scientific progress.

III. BACKGROUND KNOWLEDGE

- A. For Teachers
 1. Allison, Linda. *Blood and Guts*. New York, NY: Scholastic Inc., 1977. 0-590-45858-2.
 2. VanCleave, Janice. *The Human Body for Every Kid*. New York: John Wiley and Sons, Inc., 1995. 0-471-02413-9.
 3. Walker, Richard. *Encyclopedia of the Human Body*. New York, NY: DK Publishing, Inc., 2002. 0-7894-8672-5.
- B. For Students
 1. Kindergarten: Human Body (Taking Care of Your Body)
 2. Grade 1: Human Body (Body Systems)
 3. Grade 2: Human Body (Cells)

IV. RESOURCES

- A. Appendices A-I
- B. *How the Body Works* pp. 94-95, by Steve Parker (Lesson One)
- C. *The Human Body for Every Kid* pp. 143-147, 151-153, by Janice VanCleave (Lessons Two and Three)
- D. *Blood and Guts* pp. 50-51, 55-57, by Linda Allison (Lessons Two and Three)
- E. *Look at Your Body: Blood* pp. 24-29, by Steve Parker (Lesson Four)
- F. *Encyclopedia of the Human Body* pp. 138-139 by Richard Walker (Lesson Five (optional))

V. LESSONS

Lesson One: Circulatory System Introduction (one day)

- A. *Daily Objectives*
 1. Concept Objective(s)
 - a. Students will know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment. (Colorado State Science Standard #3)
 - b. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world. (Colorado State Science Standard #5)
 2. Lesson Content
 - a. Pioneering work of William Harvey
 3. Skill Objective(s)
 - a. Students will recognize the three main parts of the circulatory system.

- b. Students will connect William Harvey’s contributions in science to the circulatory system.
- B. *Materials*
 - 1. *How the Body Works* pp. 94-95, by Steve Parker (one copy per group of four-five students)
 - 2. Appendix A: Circulatory System Information (one copy per student)
 - 3. Appendix B: Human Body Outline (transparency and one copy per student)
- C. *Key Vocabulary*
 - 1. Circulatory system – body’s internal transportation system which consists of arteries, veins, and capillaries and the blood which flows through them
 - 2. Heart – muscular pump that pushes blood around the body
 - 3. Blood – red liquid that is carried by blood vessels through the body
 - 4. Blood vessels – tubes that carry blood throughout the body
 - 5. Arteries – blood vessels that carry blood away from the heart
 - 6. Veins – blood vessels that carry blood toward the heart
 - 7. Capillaries – smallest type of blood vessel that connects arteries and veins
- D. *Procedures/Activities*
 - 1. Ask students which organs are most important for the body to live. After jotting down ideas, tell students they are going to study two of the most important body systems (respiratory will be the next unit). Say that one includes the heart and blood. Ask if anyone knows the name of this system (circulatory).
 - 2. Have students work in groups of four-five to read about the circulatory system; pp. 94-95 from *How the Body Works*. Have half of the groups read p. 94; the other p. 95. Each group is to highlight three interesting facts they find on their assigned page. Give no more than five minutes to search and highlight their facts.
 - 3. Read information about the circulatory system together as a class (Appendix A). Have each group share their highlighted facts. Add this information under the “Notes” section on Appendix A.
 - 4. Sum up main parts of circulatory system and its function. Show transparency of Appendix B: Human Body Outline. Label the heart and blood vessels. Explain that some of the tubes (vessels) carry blood away from the heart and shade these tubes in red. Next explain that others carry blood back to the heart and shade these in blue. Tell students that a third kind of blood vessel connects those two (capillaries) and that they will learn more about these blood vessels in a future lesson. For now they need to know and be able to identify within the body the parts of the circulatory system: heart, blood, and blood vessels.
 - 5. Review system parts along with key components from pp. 94-95 and Appendix A. If groups did not highlight information about William Harvey, make sure to explain his contributions at this time including the fact that he was the first person to show that blood circulated through the body. Discuss how this impacted science. Compare his discovery to what people used to think about blood circulation.
- E. *Assessment/Evaluation*
 - 1. Students will illustrate the parts of the circulatory system by labeling the heart, blood, and blood vessels in an outline of the human body (Appendix B). Underneath this diagram, students will complete the phrase “William Harvey discovered...”

Lesson Two: The Heart (two days)

A. Daily Objectives

1. Concept Objective(s)
 - a. Students will know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment. (Colorado State Science Standard #3)
 - b. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world. (Colorado State Science Standard #5)
 - c. Students will understand that science involves a particular way of knowing and understand common connections among scientific disciplines. (Colorado State Science Standard #6)
2. Lesson Content
 - a. Heart: four chambers (auricles and ventricles); aorta
3. Skill Objective(s)
 - a. Students will understand the basic structure of the heart, its purpose, and function in the body.
 - b. Students will label the four chambers (left ventricle, right ventricle, left atrium, right atrium), aorta, and septum on a diagram of the heart.

B. Materials

1. *The Human Body for Every Kid* pp. 151-153, by Janice VanCleave
2. Appendix C: Heart Diagram (transparency and one copy per student)
3. *Blood and Guts* pp. 50-51, by Linda Allison
4. One tennis ball
5. Stethoscope materials per group of four-five students:
 - a. one plastic funnel
 - b. a two-foot piece of plastic tubing (both can be found at a hardware store)
6. Appendix D: Heart Evaluation (one copy per student)

C. Key Vocabulary

1. Ventricles – the two lower chambers of the heart (singular-ventricle)
2. Auricles (atria) – the two upper chambers of the heart (singular- atrium)
3. Aorta – the main artery that leaves the left ventricle of the heart
4. Septum – dividing wall within a body part, such as the heart (separates the right and left halves)

D. Procedures/Activities

1. (Day One) Ask students to draw a quick diagram of the human heart. As a group (four-five students per group) they are to answer the following questions about the heart:
 - a. Where in the body is the heart located?
 - b. How big is the heart?
 - c. How many times does the human heart beat per minute?
 - d. Do pets have different heart rates than humans?
 - e. What are some ways to keep your heart healthy?
 - f. How many miles of tubing (vessels) connect to the heart?Have students set quizzes faced down and refer to later.
2. Read pp. 151-153 from Janice VanCleave's *The Human Body for Every Kid*. Point out the heart diagram on p. 153.
3. Show transparency of heart (Appendix C) and together label the four chambers, the aorta, and the septum. Give an extra point to anyone that can remember an additional heart label (such as artery, vein, or valve). Explain that on paper the sides of the heart are flip-flopped because you are looking at a diagram. If you

were to wear this picture on the outside of a shirt, you would have to turn it around. Therefore the labels for the left atrium and left ventricle are actually on the right hand side of the paper.

4. Check diagrams and pop quizzes and mark how many questions were correct. Correct answers that are incorrect.
 5. (Day Two) Tennis ball demonstration: Explain that the heart is the strongest muscle in the body and that it pumps day and night nonstop for life. The force needed to squeeze a tennis ball is similar to the force needed to squeeze blood out of the heart. If you squeeze seventy times a minute (the average adult pulse), you can get an idea of how hard your heart works. Have volunteers take turns squeezing a tennis ball with one hand. Other volunteers may count the number of squeezes they can do with one hand in one minute. Emphasize again the difficulty and how hard the heart works.
 6. Read "Listen In," pp. 50-51 from *Blood and Guts* and do stethoscope activity. Each group of four-five students will need materials for making a stethoscope (two-foot long piece of rubber tubing and a plastic funnel). Students are to assemble their stethoscope by fitting the end of the plastic funnel into the rubber tubing tightly so that no air can pass through the opening. Then they may take turns listening to each other's heartbeats. If groups have trouble, demonstrate making one. Also let them know they have a better chance of hearing the heartbeats if the room is very quiet.
 7. After each person has listened to another and/or his/her own heartbeat, explain that this is what a doctor listens to in a stethoscope. The heart sound lub-dub is made from the opening/closing of valves. Heart sounds lubb-shhb DUB or lubb-DUB rumble means that valves are not working properly and there is some leakage. This is called a murmur and is very rare.
- E. *Assessment/Evaluation*
1. Students will complete an evaluation of twelve questions about the heart, including important facts, structure, and function (Appendix D).
 2. Given a diagram of the heart (Appendix C), students will correctly label the following parts: left ventricle, right ventricle, left atrium, right atrium, aorta, and septum.

Lesson Three: Blood (four days)

A. *Daily Objectives*

1. Concept Objective(s)
 - a. Students will understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations. (Colorado State Science Standard #1)
 - b. Students will know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment. (Colorado State Science Standard #3)
 - c. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world. (Colorado State Science Standard #5)
2. Lesson Content
 - a. Blood: red blood cells (corpuscles); white blood cells (corpuscles); platelets; hemoglobin; plasma; antibodies, blood vessels: arteries; veins; capillaries, blood pressure; pulse, coagulation (clotting)

3. Skill Objective(s)
 - a. Students will realize the importance of blood and blood vessels to the circulatory system.
 - b. Students will trace the path of blood flow throughout the body on a heart diagram, differentiating between oxygenated and deoxygenated blood with different colors.

B. *Materials*

1. *The Human Body for Every Kid* pp. 143-147, by Janice VanCleave
2. Appendix E: Blood Clotting Experiment Form (one copy per student)
3. Blood Clotting Activity materials:
 - a. scissors
 - b. one sheet cardstock (file folder works)
 - c. clear drinking glass
 - d. paper hole-punch
 - e. one sheet of red, white, and yellow construction paper
 - f. one cotton ball
4. *Blood and Guts* pp. 55-57, by Linda Allison
5. Appendix F: Pulse Activity (one copy per student)
6. Appendix G: The Path of Blood (transparency and one copy per student)
7. Red and blue overhead markers
8. One red and blue marker/pen/pencil per student

C. *Key Vocabulary*

1. Red blood cells – most numerous type of cell carried by the blood; carries oxygen
2. White blood cells – colorless cells found in blood; less numerous than red; fight infection
3. Platelets – cell fragments found in blood; release chemical called fibrin that forms blood clot
4. Plasma – the yellowish, liquid part of blood
5. Hemoglobin – orange-red colored substance found in red blood cells that gives blood its color and carries oxygen from the lungs to all parts of the body
6. Blood pressure – pressure exerted by the blood on the walls of the blood vessels through which it is pumped
7. Pulse – the rhythmic beating produced by contractions of the arteries that can be felt at various places where arteries pass close to the skin surface
8. Coagulation – blood clotting; the formation of a semisolid gel

D. *Procedures/Activities*

1. (Day One) Review parts of the circulatory system again: heart, blood, and blood vessels. Ask students what blood is and if anyone knows what it is made up of. Ask students if the heart pumps blood through the body, where does this blood travel and how does it get to other parts of the body and back to the heart?
2. Read “Around and Around,” pp. 143-147 from *The Human Body for Every Kid*. Students read page 143 and half of page 145 silently. Review the parts of blood: solid- red blood cells, white blood cells, platelets; liquid- plasma. Explain that red blood cells contain hemoglobin - a pigment containing iron. Combined with oxygen, hemoglobin gives blood its red color. It also has the ability to combine loosely with oxygen, allowing red blood cells to deliver oxygen to the body cells. Discuss platelets and how they form fibrin to make a blood clot (coagulation). Read together the last part of pages 145-146 about blood vessels. Discuss how to remember the blood flow: arteries-away, veins-toward, capillaries-connect. Review the path of blood picture on 144 and point out the difference between the

veins, arteries, and capillaries. Go over follow-up questions on pp. 146-147 together.

3. (Day Two) Blood Clotting Activity: Review how platelets help blood vessels by coagulation. Hand out Appendix E: Blood Clotting Experiment Form. Read together the question they will be answering and the materials. Allow a few minutes for students to fill out their hypotheses. Next, read together the procedures while demonstrating the steps. Repeat the demonstration a second time if needed. Have students record results. Check to make sure they write down something along the lines that without the cotton strands covering the opening in the cardstock, the hole-punched pieces fell through; however with the cotton strands stretched across the top, they collected in a pile on the fibers and did not fall through. Give students a few minutes to formulate a conclusion based on their results. Remind them to refer back to the question before answering. Go over conclusions together. Explain that the hole in the cardstock represented a cut in the skin, which usually breaks the wall of one or more blood vessel. As the blood flows out of the cut, the body performs an automatic healing process of plugging up this hole in the skin. Like the fibers of the cotton ball, strands of fibrin are formed and weave a web across the opening that traps the red blood cells, white blood cells, and platelets, as shown by the red, white, and yellow hole-punched paper pieces. A hardened blood clot forms on top of the skin, which we call a scab.
4. (Day Three) Ask students if they remember ever having had their blood pressure taken. Let them know this is a pushing force given to blood by the heart and is measured by placing a special cuff around the arm that is attached to a gauge. It is important to keep this down to keep your heart healthy. Another way to keep the heart healthy is by strengthening it through exercise. You can keep track of this by monitoring your pulse. Read together pp.55-57 from *Blood and Guts*. Discuss the different pulse rates between different sizes of animals and that the stronger the heart muscle, the lower the pulse rate, in turn causing a healthier heart.
5. Hand out Appendix F: Pulse Activity. Find pulse together. Time for one minute and record pulse. (It is easier to count pulse beats for six seconds and multiply by ten.) Repeat after walking around the room for one minute. Repeat after hopping in place for one minute. Repeat one last time for a choice activity. Have students answer the four questions on their sheets. Compare and discuss differences including the amount of oxygen intake into the body.
6. (Day Four) Review parts of the circulatory system: heart, blood, and blood vessels. Tell students since they now have learned about each part, they will have a chance to see how they all work together to get blood throughout the body. Hand out Appendix G: The Path of Blood. Have students label their sheets while labeling the transparency. First label previously learned parts of the heart: left atrium (b), right atrium (h), left ventricle (d), right ventricle (i), septum (k), and aorta (e). Next point out and label the pulmonary artery (j), pulmonary vein (a), superior vena cava (f), and inferior vena cava (g). Explain that valves are like one-way doors that push blood along from one part of the heart to another and are all labeled (c).
7. Next, have students take out a red and blue pencil or pen to label arrows for the path of blood flow on their diagrams (still Appendix G). Begin with the red pencil at the pulmonary vein and explain the following while drawing a red arrow from one part to the next:

- a. From the lungs, oxygenated blood (blood rich in oxygen) flows into the pulmonary veins (a). The blood is a bright red color because it is high in oxygen.
 - b. It then flows into the left atrium (b), travels through a valve (c), and goes into the left ventricle (d). From here, the blood is pumped into the aorta (e). The aorta is the largest artery and it branches into smaller arteries, which take the blood to all parts of the body.
 - c. (Switch to the blue pencil and continue explaining steps while drawing blue arrows from one part to the next.)
 - d. From the body, the blood picks up carbon dioxide and becomes a dark red or brownish-bluish color. This deoxygenated blood (blood poor in oxygen) flows into the heart through the superior vena cava (f) and inferior vena cava (g), which leads into the right atrium (h). It travels through a valve (c) and into the right ventricle (i). It travels through another valve (c) and into the pulmonary artery (j).
 - e. From the pulmonary artery, the blood is pushed away from the heart and into the lungs to pick up oxygen. There the cycle is repeated.
8. Repeat steps of blood flow several times, checking to make sure students marked their sheets correctly. They may wish to draw in the lungs to the sides of the heart. A good idea is to orally repeat these steps once each subsequent lesson while pointing to the transparency until students have the process down concretely.

E. *Assessment/Evaluation*

1. On a heart diagram (Appendix G), students will label the four heart chambers, the septum, and the aorta. Students will then draw arrows of different colors through the diagram to show what direction the blood flows. In four-five sentences, students will explain the path blood takes through the heart to the body, and back. For extra credit, students may label the pulmonary artery and vein, the superior and inferior vena cava, and use these terms in their explanation.

Lesson Four: Keeping a Healthy Heart (two days)

A. *Daily Objectives*

1. Concept Objective(s)
 - a. Students will know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment. (Colorado State Science Standard #3)
 - b. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world. (Colorado State Science Standard #5)
 - c. Students will understand that science involves a particular way of knowing and understand common connections among scientific disciplines. (Colorado State Science Standard #6)
2. Lesson Content
 - a. Filtering function of the liver and spleen
 - b. Fatty deposits can clog blood vessels and cause a heart attack.
3. Skill Objective(s)
 - a. Students will learn various effects of drugs and alcohol on the circulatory system and will brainstorm ways to remain drug/alcohol free.
 - b. Students will identify the excess of fatty foods, foods high in cholesterol, and lack of exercise as contributors of heart disease by causing clogged arteries and a weakened heart.

- B. *Materials*
1. *Look at Your Body: Blood* pp. 24-29, by Steve Parker
 2. Appendix H: Personal Exercise/Diet Log (one copy per student)
- C. *Key Vocabulary*
1. Cholesterol – a fatty substance made by the body mainly in the liver; if excessive amounts deposit on artery walls, circulation disease may occur
 2. Aerobic exercise – exercise that makes that heart and lungs work hard
 3. Anaerobic exercise – exercises that do not cause the heart and lungs to work hard
 4. Drugs – substance taken for its effect and not for medical reasons
 5. Alcohol – intoxicating liquor
 6. Liver – body’s largest organ which controls the level of sugar in the blood, processes proteins, and produces bile
 7. Spleen – a glandlike organ located next to the liver which stores blood and helps filter foreign substances from the blood
- D. *Procedures/Activities*
1. (Day One) Review the structure of arteries. Hypothesize what might happen if they were to get clogged and blood could not flow freely through. Mention that this is what happens when fat cells deposit on the inside of the arteries. Discuss the possibilities of heart attacks and breathing troubles this may cause. Remind them that heart disease is the leading cause of death presently in the U.S. Brainstorm ways to prevent this from happening, even at a young age.
 2. Read about “Food and Blood” and “Blood Diseases”, pp. 24-25, 28-29 from *Look at Your Body: Blood*. Point out the impact of drugs and alcohol on the blood’s filtering system including the liver and the spleen. Also emphasize that smoking as well as exercise can cause damage to arteries. Discuss other damages drugs and alcohol can do to the body and why it is important to avoid such things. Brainstorm ways to remain drug and alcohol free.
 3. (Day Two) Read “Exercise and Blood”, pp. 26-27 from *Look at Your Body: Blood*. Compile a list on the board of exercises students enjoy. Put them into two columns: aerobic exercise and anaerobic exercise, defining the difference between the two. Emphasize the importance of finding a sport or activity they enjoy early on and making it a lifelong activity (especially an aerobic exercise to strengthen their heart and lungs). Show students Appendix H: Personal Exercise/Diet Log and explain that they will need to track what exercises they are doing for a week.
 4. Discuss eating healthy. Mention foods to avoid such as foods with excessive fat, salt, and/or cholesterol. Explain that early habits make lifelong habits easier later. Mention that on their exercise/diet logs, students are to also record their diet for a week. After the end of the week, discuss positives/negatives of log data. Suggest strategies for making good changes.
- E. *Assessment/Evaluation*
1. Students will keep a weekly exercise log showing different types of aerobic and anaerobic exercises important to them and record meals consumed throughout the week. They will then circle foods that were high in fat or cholesterol.
 2. On the back of their exercise/diet log, students will include an explanation of why exercise and a healthy diet are important in keeping a healthy diet. They will also reiterate their personal goal for keeping drug/alcohol free along with how this helps keep their circulatory system healthy.

Lesson Five: Blood Typing (two days)

A. *Daily Objectives*

1. Concept Objective(s)
 - a. Students will know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment. (Colorado State Science Standard #3)
 - b. Students will know and understand interrelationships among science, technology, and human activity and how they can affect the world. (Colorado State Science Standard #5)
2. Lesson Content
 - a. Blood types (four basic types: A, B, AB, O) and transfusions
3. Skill Objective(s)
 - a. Students will list the four basic blood types and infer that blood donations can be helpful for themselves or others that may need compatible blood in an emergency.
 - b. Students will judge the effect of Charles Drew's discoveries on their lives as well as formulate opinions in regard to ironic circumstances of his death and how people's prejudicial attitudes prevented his recovery. Additionally, students will compile a list of other examples where people's preconceived notions or prejudices have hindered scientific progress.

B. *Materials*

1. *Encyclopedia of the Human Body* pp. 138-139, by Richard Walker (optional)

C. *Key Vocabulary*

1. ABO blood typing system – a blood classification system in which the four main groups are called A, B, AB, and O depending upon the presence or absence of certain substances in red blood cells
2. Antigens – foreign substances in the body which triggers the production of antibodies
3. Antibodies – proteins that attack invading germs and foreign chemicals
4. Rh factor – any one group of inheritable antigens in the red blood cells of most persons
5. Blood transfusion – transfer of blood from one person to another

D. *Procedures/Activities*

1. Ask students a week beforehand if they can find out their blood type. (Sending a letter home to parents is very beneficial. It is harder to track this information down than it seems.)
2. (Day One) Ask students if they know the four main blood types. Write them on the board. Ask if they know how a person gets this blood type and how this can be important in an emergency. Tell students that people belong to different blood types due to antigens (chemicals) that occur in their red blood cells. The blood type system most commonly used is called the ABO system. It has two antigens (A and B). The four types are A (carries A antigen), B (carries B antigen), AB (carries both antigens), and O (carries neither antigen). Discuss that blood transfusion is the donation of blood by one person to another and that people who share blood types can give or receive blood safely because their blood is compatible. (A good optional resource on blood transfusions is pp. 138-139 from *Encyclopedia of the Human Body*.)
3. Talk about compatibility. Mention that in an emergency, however, people with O blood type can give blood to any other group and therefore is called a universal donor. Type AB can receive any type of blood and is called a universal recipient.

Tell students it is a good idea to store up to one pint of blood in the hospital for emergency situations.

4. Compile the following information into a blood type chart on the board of how receiving an allele from each parent combines to form a certain blood type:
Allele from mother + allele from father= Offspring blood type
 $A+A=A$; $A+B=AB$; $A+O=A$; $B+A=AB$; $B+B=B$; $B+O=B$; $O+O=O$
Discuss Rh factor and how this is inherited from parents to alter the blood type further. If there is a presence of Rh in the blood, then a person's Rh factor is positive (+). If no Rh is present in the blood, they are lacking the Rh factor and are Rh negative (-).
5. (Day Two) Summarize for students information on Dr. Charles Richard Drew. Include details about his hard work to become a doctor and many achievements gained during his medical years. He became interested in blood research just before his internship and taught university students for awhile. While working at a hospital for two years in New York, he developed a technique for long-term blood plasma preservation. He was recognized as one of the world's leading physicians in the 1940s, but resigned his position at a blood bank when a directive was sent out stating that white and black blood may not be mixed. This discrimination kept many hospitals from giving blood transfusions to black people. This was also the case after Drew was in a serious automobile crash requiring a blood transfusion to save his life. Since he was black, the hospital would not give him his necessary life-saving transfusion, and he died. It was ironic because this man gave so much to medicine and the study of blood through his work, however it was not enough to save his life due to racial discrimination. Discuss with students how much his blood studies contributed to medicine and how class and racial clashes of the time period affected his practice. Emphasize the ironic circumstances surrounding his death.

E. *Assessment/Evaluation*

1. Students will take a survey of different students' blood types in the class. They will record the data and make a bar graph of the prevalence of the four differing blood types. A more sophisticated graph would include those with + and - Rh factors. Underneath the graph students are to state what kind of blood would be compatible to theirs and why donations are a good idea.
2. Upon receiving information about Charles Drew; his impact upon blood research and long-term preservation, as well as the ironic circumstances of his death, students will work in groups to formulate other examples of how peoples' prejudicial attitudes toward social status or race can and have hindered scientific progress.

VI. CULMINATING ACTIVITY (two days)

- A. **Culminating Examination:** As a class review information covered throughout the unit. Have students formulate review questions about this material, ten questions per person. Write questions and answers on separate small index cards. Make sure partner sets have the same color cards. Students will shuffle cards and play a memory game where they have to match the question with its correct answer to obtain the set. The player with the most sets at the end of the game (when all the cards have been matched and collected) is the winner. Several days later have students complete a cumulative exam on the circulatory system, which includes a variety of questions about blood, the heart, and blood vessels. It also contains an essay asking them to retrace the steps of blood flow throughout the body (Appendix I).

VII. HANDOUTS/WORKSHEETS

- A. Appendix A: Circulatory System Information
- B. Appendix B: Human Body Outline
- C. Appendix C: Heart Diagram
- D. Appendix D: Heart Evaluation and Heart Evaluation Answer Key
- E. Appendix E: Blood Clotting Experiment Form
- F. Appendix F: Pulse Activity
- G. Appendix G: The Path of Blood
- H. Appendix H: Personal Exercise/Diet Log
- I. Appendix I: Circulatory System Unit Test
- J. Appendix J: Circulatory System Unit Test Answer Key

VIII. BIBLIOGRAPHY

- A. Allison, Linda. *Blood and Guts*. New York, NY: Scholastic Inc., 1977. 0-590-45858-2.
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Appendix A

Name _____ # _____
Date _____

CIRCULATORY SYSTEM INFORMATION

The circulatory system is similar to a transportation system. It distributes food and nutrients, carries oxygen to the body, and also removes waste from every cell in the body. This system consists of three main parts: the heart, blood, and blood vessels. The network of blood vessels reaches every part of the body, so that blood flowing through it brings vital nutrients and oxygen to every cell. The three types of blood vessels are veins, arteries, and capillaries.

Blood is the liquid flowing through this system. An average person has about ten pints of blood. Blood is made up of both liquid (plasma) and solids. The solid part of blood is made up of red blood cells (rbc), white blood cells (wbc), and platelets.

The liquid portion of the blood, plasma, makes up 55% of the body's blood. It is a clear yellow liquid containing water, proteins, and salts. It helps to transport digested food substances and waste materials throughout the body.

The remaining 45% of blood is made up of red blood cells, white blood cells, and platelets. Red blood cells bring carbon dioxide to the lungs and carry oxygen from the lungs to the heart. These doughnut-shaped cells are produced mainly in bone marrow. A person's bones produce around one-half cup of red blood cells each day. They live about 120 days. Old, damaged, and abnormal red blood cells need to be replaced. The liver and spleen work together to help repair and clean these red blood cells, making them reusable.

White blood cells (also called leukocytes) are the body's defenders against germs. These colorless cells kill bacteria and help repair tissue. There is only about one white blood cell for every 700 red blood cells.

Platelets are tiny fragments of cells. Chemicals from platelets cause threadlike fibers, called fibrin, to form at the site of a wound, forming a blood clot.

The heart acts as the pump of the circulatory system. It actually has two pumps that work side by side. It has four main parts, divided into two halves- the right and the left. Two chambers are in each half- auricles (plural for atrium) and ventricles. The heart keeps the blood flowing in a continuous circle throughout the body, with no beginning or end, thus giving the system its name: the *circulatory* system. It takes about one minute for blood to complete a full circle around the body.

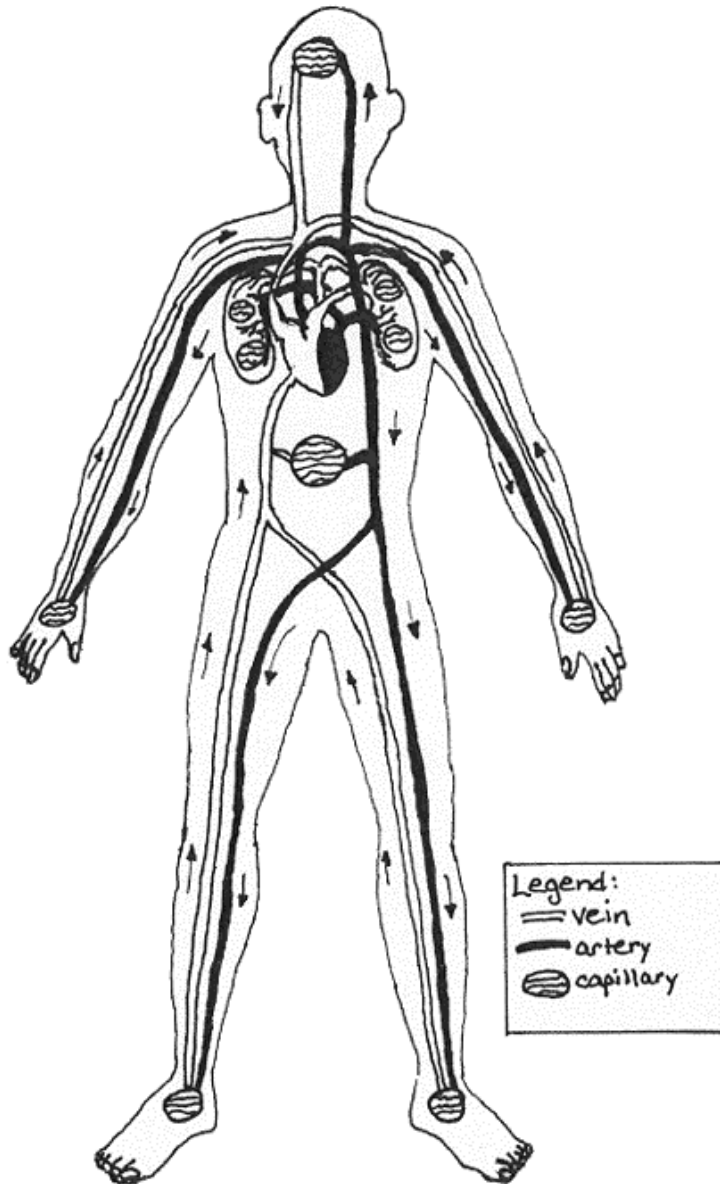
NOTES:

Appendix B

Name _____ # _____
Date _____

HUMAN BODY OUTLINE

Directions: Label the body outline below with the three major components of the circulatory system.



Complete this phrase:

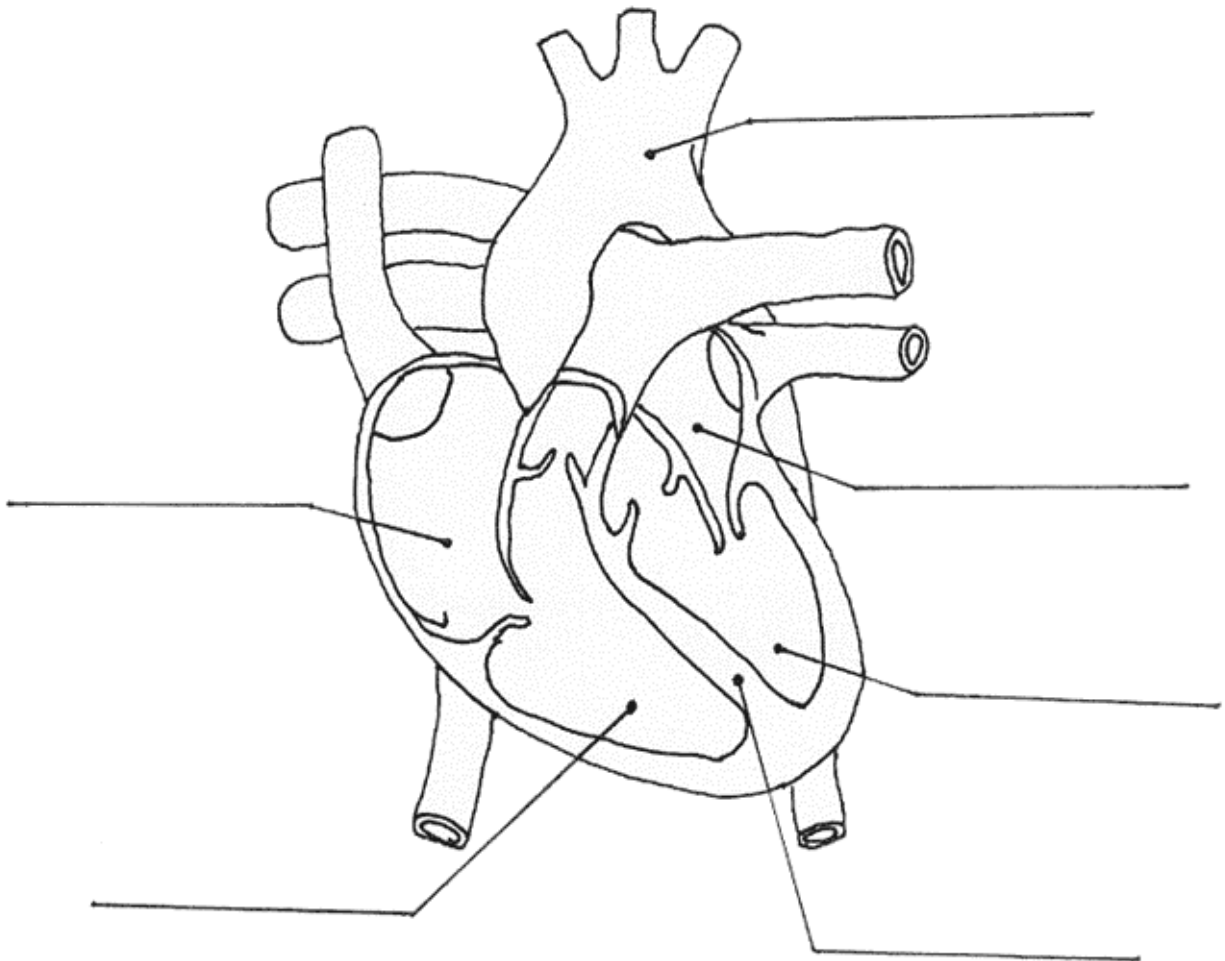
William Harvey discovered _____

Appendix C

Name _____ # _____
Date _____

HEART DIAGRAM

Directions: Label the parts of the heart that each line points to.



Appendix D, page 1

Name _____ # _____
Date _____

HEART EVALUATION

1. How many pumps are there in the heart? _____
2. What is the size of the heart? _____
3. How many chambers are in the heart? _____
Name these chambers: _____
4. What is the name of the fluid pumped by the heart? _____
5. What is the average number of heartbeats per minute for an adult human? _____
6. Do all people have the same number of heartbeats per minute? _____
7. How does a person's heartrate change with exercise? _____
8. Which side of the heart pumps the blood with oxygen? _____
9. What part of the heart separates the two halves? _____
10. What separates the upper and lower sections of the heart? _____
11. How many miles of vessels are connected to the heart? _____
12. The brain controls the function of the heart. True _____ False _____

Appendix D, page 2

Name _____ # _____
Date _____

HEART EVALUATION ANSWER KEY

1. How many pumps are there in the heart? two
2. What is the size of the heart? the size of a fist
3. How many chambers are in the heart? four
Name these chambers: left atrium, left ventricle, right atrium, right ventricle
4. What is the name of the fluid pumped by the heart? blood
5. What is the average number of heartbeats per minute for an adult human? 70
6. Do all people have the same number of heartbeats per minute? no
7. How does a person's heartrate change with exercise? the heart beats faster with exercise
8. Which side of the heart pumps the blood with oxygen? left
9. What part of the heart separates the two halves? septum
10. What separates the upper and lower sections of the heart? valves
11. How many miles of vessels are connected to the heart? 60,000
12. The brain controls the function of the heart. True _____ False X

Appendix E

Name _____ # _____
Date _____

BLOOD CLOTTING EXPERIMENT FORM

Question: How can we simulate the formation of blood clots using the materials listed below?

Hypothesis: _____

Materials: scissors
cardstock (file folder works)
clear drinking glass
paper hole-punch
one sheet each of red, white, and yellow construction paper
cotton ball

- Procedure:**
1. Cut a square piece of cardstock large enough to rest on top of the glass.
 2. Fold the cardstock piece in half, and cut out a notch about 1" x ½."
 3. Unfold the paper square and place it across the top of the glass.
 4. With the hole-puncher, punch out 20 red circles, 5 white circles, and 20 semicircles from the edge of the yellow paper.
 5. Hold half of the pieces of each color a couple inches above the cardstock hole, then release them.
 6. Stretch a small piece of a cotton ball across the cardstock hole so that thin cotton fibers cover it.
 7. Hold the remaining pieces a couple inches above the hole and drop them in.

Results: (What actually happened?) _____

Conclusion:

How did the materials simulate the formation of a blood clot? _____

Appendix F

Name _____ # _____
Date _____

PULSE ACTIVITY

Activity	Heartbeat/ minute
Sitting	___ x 10 =
Walking	___ x 10 =
Hopping	___ x 10 =
Other	___ x 10 =

Questions:

1. Why is the second pulse so much higher than the first? _____

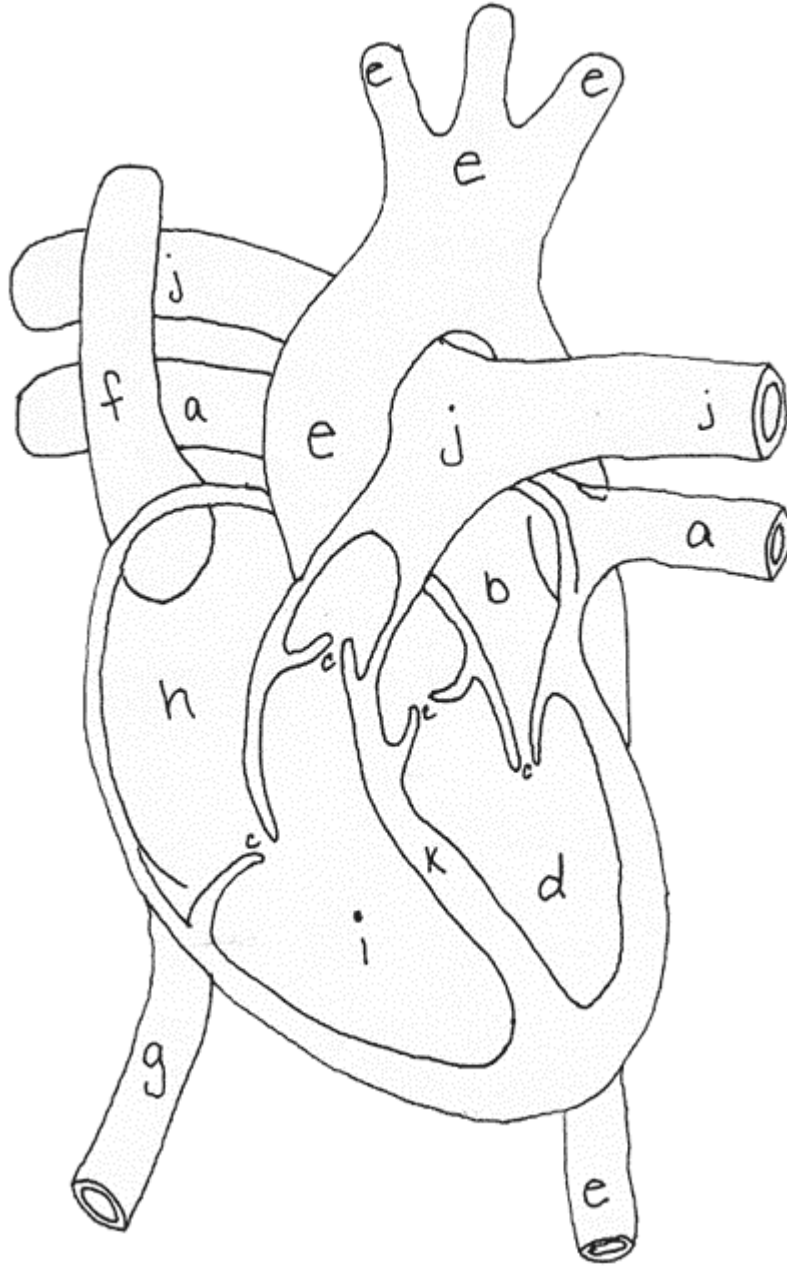
2. Did the amount of oxygen that your body needed increase or decrease when you were hopping? _____

3. Did you need more energy or less energy to hop? _____
4. What do you think happened to the amount of carbon dioxide produced when you were walking or hopping? Where did it go? _____

Appendix G

Name _____ # _____
Date _____

THE PATH OF BLOOD



Appendix H

Name _____ # _____
Date _____

PERSONAL EXERCISE/ DIET LOG

Directions: Record any type of exercise you do for a full week.

Type of Exercise	How Long? (minutes)	Where?

Directions: Record the meals you eat for a full week (be sure to include snacks if there are any).

Breakfast	Lunch	Dinner

Appendix I, page 1

Name _____ # _____
Date _____

CIRCULATORY SYSTEM UNIT TEST

Name the three parts of the circulatory system.

1. _____
2. _____
3. _____

Name a machine that the heart resembles. _____

Why is the circulatory system like a transport system? _____

What are two causes of heart disease?

1. _____
2. _____

Name the three types of blood vessels:

1. _____
2. _____
3. _____

Fill in the blanks:

The blood vessels that carry blood *to* the heart are called _____.

The blood vessels that carry blood *away from* the heart are _____.

_____ are blood vessels that look like tree branches and *connect* the other two types of blood vessels together.

True or False: Read the statement and decide if the statement is true or false. Write the word *true* if it is true and *false* if the statement is false.

1. _____ The heart is a hollow, muscular organ that pumps blood through blood vessels.
2. _____ The average size of your heart is three fists clenched together.
3. _____ Our hearts are located in the middle of our chests.
4. _____ The heart is a cardiac muscle.
5. _____ Our heart works 12 hours a day.
6. _____ The heart rests and does not beat fast or slow.
7. _____ The heart beats slower during exercise.

Appendix I, page 2

Matching: Find the word in the right column that matches the definition in the left column.

- | | |
|---|---------------------------------|
| _____ is in red blood cells. It helps pass oxygen into your blood. | A. Blood Transfusion |
| _____ is the donation of blood by one person to another. People who share blood types can give or receive blood safely. | B. Hemoglobin |
| _____ is a pulsing force given to blood from the heart. It is measured using a cuff and gauge. | C. Blood Clotting (Coagulation) |
| _____ is the process of sealing wounds to prevent blood loss. | D. Blood Pressure |

Fill in the blanks: Use the words below to fill in the blanks:

white blood cells	platelets
red blood cells	plasma

1. We make up 99% of all blood cells. We are disc-shaped, like doughnuts, and carry oxygen. We work for about 120 days and then are destroyed. What are we? _____
2. We are a part of the blood that controls bleeding. We form a plug and help reduce blood loss when a cut happens. We release a chemical called fibrin that forms thread-like fibers at a wounded site and stops blood from escaping. What are we? _____
3. I am the yellowish, liquid part of the blood. I am mostly water and contain proteins, minerals, and salt that built and repair cells. What am I? _____
4. We are colorless and large. We defend your body from germs and infections. Another name for us is leukocytes. What are we? _____

Use the two scientists' names to fill in the blanks below:

William Harvey and Charles Drew

1. _____ was an African-American doctor who was born in 1904. He was in charge of organizing blood banks for the Red Cross. He was a world leading doctor.
2. _____ discovered that blood traveled in a circle throughout the body along blood vessels. He concluded that blood traveled in one direction only and was pumped by the heart. He was born in 1578.

Appendix I, page 3

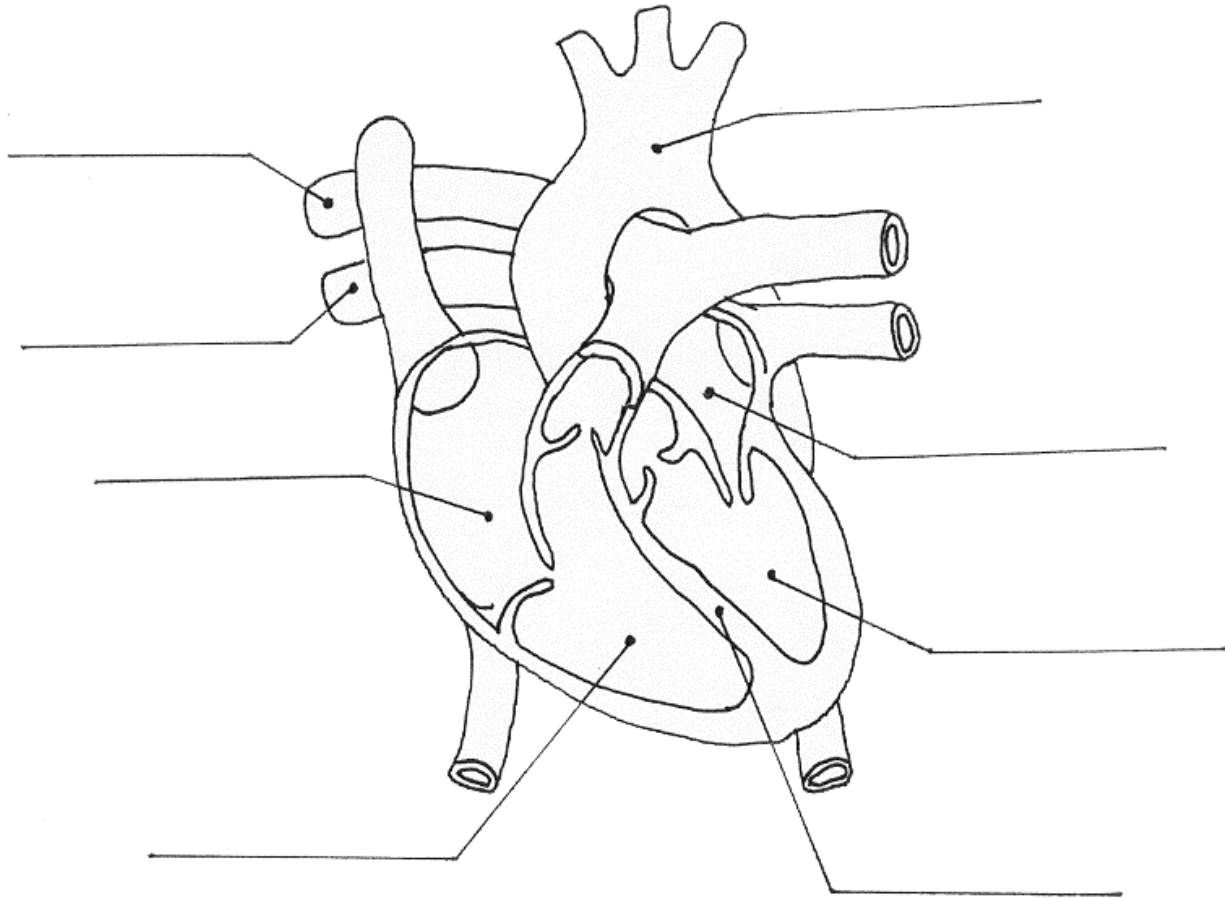
Essay Question:

On a separate sheet of paper, write a paragraph (using 5-6 *complete* sentences) on the path of blood through the body. Include an introduction sentence, at least three sentences on how the blood goes through the four chambers, and a concluding sentence. (Discuss in your paragraph how the blood goes through the aorta, right atrium, right ventricle, left atrium, left ventricle). Be sure to follow the correct order. Use the diagram below if needed.

HEART DIAGRAM

Directions: Label the parts of the heart that each line points to using all of the following once:

left atrium, left ventricle, right atrium, right ventricle,
aorta, septum, pulmonary artery, pulmonary vein



Appendix J, page 1

CIRCULATORY SYSTEM UNIT TEST ANSWER KEY

Name the three parts of the circulatory system.

1. **Heart**
2. **Blood**
3. **Blood vessels**

Name a machine that the heart resembles. **Pump**

Why is the circulatory system like a transport system? **The circulatory is like a transport system because it takes food, nutrients, and oxygen to the body and removes waste from every cell in the body.**

What are two causes of heart disease?

1. **Smoking**
2. **Diet high in fat**

Name the three types of blood vessels:

1. **Veins**
2. **Arteries**
3. **Capillaries**

Fill in the blanks:

The blood vessels that carry blood *to* the heart are called **veins**.

The blood vessels that carry blood *away from* the heart are **arteries**.

Capillaries are blood vessels that look like tree branches and connect the other two types of blood vessels together.

True or False: Read the statement and decide if the statement is true or false. Write the word *true* if it is true and *false* if the statement is false.

1. **True** The heart is a hollow, muscular organ that pumps blood through blood vessels.
2. **False** The average size of your heart is three fists clenched together.
3. **True** Our hearts are located in the middle of our chests.
4. **True** The heart is a cardiac muscle.
5. **False** Our heart works 12 hours a day.
6. **False** The heart rests and does not beat fast or slow.
7. **False** The heart beats slower during exercise.

Appendix J, page 2

Matching: Find the word in the right column that matches the definition in the left column.

- | | |
|--|---------------------------------|
| B _____ is in red blood cells. It helps pass oxygen into your blood. | A. Blood Transfusion |
| A _____ is the donation of blood by one person to another. People who share blood types can give or receive blood safely. | B. Hemoglobin |
| D _____ is a pulsing force given to blood from the heart. It is measured using a cuff and gauge. | C. Blood Clotting (Coagulation) |
| C _____ is the process of sealing wounds to prevent blood loss. | D. Blood Pressure |

Fill in the blanks: Use the words below to fill in the blanks:

white blood cells	platelets
red blood cells	plasma

1. We make up 90% of all blood cells. We are disc-shaped, like doughnuts, and carry oxygen. We work for about 120 days and then are destroyed. What are we? **Red blood cells**
2. We are a part of the blood that controls bleeding. We form a plug and help reduce blood loss when a cut happens. We release a chemical called fibrin that forms thread-like fibers at a wounded site and stop blood from escaping. What are we? **Platelets**
3. I am the yellowish, liquid part of the blood. I am mostly water and contain proteins, minerals, and salt that build and repair cells. What am I? **Plasma**
4. We are colorless and large. We defend your body from germs and infections. Another name for us is leukocytes. What are we? **White blood cells**

Use the two scientists' names to fill in the blanks below:

1. **Charles Drew** was an African-American doctor who was born in 1904. He was in charge of organizing blood banks for the Red Cross. He was a world-leading doctor.
2. **William Harvey** discovered the circulatory system. He found that the heart pumped blood all over our body through the arteries and veins. He was born in England in 1578.

HEART DIAGRAM

Labels beginning at the top blank and going clockwise are as follows: **aorta, left atrium, left ventricle, septum, right ventricle, right atrium, pulmonary vein, pulmonary artery.**