

Grade 6: The Heart and Circulatory System

Lesson 1: The Heart

Lesson 2: The Heart Rate

Lesson 3: The Circulatory System and Blood

Objectives:

1. Students will identify the four chambers of the heart
2. Students will identify four important structures of the Circulatory System and what they do.
3. Students will explain heart rate and be able to take their resting and active heart rates.
4. Students will describe the major functions of the Circulatory System.
5. Students will explain the role of the heart in circulation
6. Students will give a basic explanation of the cardio-pulmonary sequence.
7. Students will describe systemic circulation.

Materials:

Lesson 1:

- Animal heart (Example: cow, pig, sheep)
- Note cards
- Picture of the heart (**See Figure 1**)
- Dissection tools (Scissors, pan, etc.)

Lesson 2:

- Small drum
- Watch or clock with second hand, or time
- Optional: Stethoscope

Lesson 3:

- Corn Syrup
- Plastic Beads: flat red disks, white ovals, green or blue seed beads
- “Explain” experiment (per group):
 - Two small balloons or large finger cots
 - One clear tube (1/2” diameter) about 8” long
 - One clear tube (3/4” diameter) about 8” long
 - 16 - 20 oz. water
 - Red food coloring
 - Measuring cup
 - Funnel
 - Two empty plastic containers (such as cottage cheese or yogurt cartons)

Activity Summary:

In this lesson students will learn the basic functioning of the heart, Circulatory System and blood, the connection to lung functioning, and the activity of the

Circulatory System in the body. Students will be able to identify their heart rate and measure it at rest and after activity.

Background Information for the Teacher:

The main function of the heart is to send blood throughout the body. It is the primary engine that drives the all-important Circulatory System. The blood vessels are the roadways of transport, and the blood functions as both cargo and cargo container in one.

The Heart

Made of specialized muscle tissue, the heart is located in the chest cavity between the lungs. The bony sternum (breastbone) and ribs protect this vital organ from exterior harm. The heart is about the size of a fist, and in the average adult weighs approximately 10-11 ounces (approximately 300 grams). The heart pumps about 2,000 gallons (more than 7,570 liters) of blood a day. We have more than 60,000 miles (96,560 kilometers) of blood vessels in our body that the blood travels through in its journey to nourish and cleanse every living tissue in our body.

The heart is a hollow organ and is divided into four chambers: two ventricles and two atria. Blood moves into the heart from the body, then to and throughout the lungs, back through the heart and ultimately becomes distributed throughout the entire body. The atria are the receiving chambers of the heart, accepting blood from the body (right atrium) and from the lungs (left atrium). The ventricles are the pumping chambers, moving blood to the lungs (right ventricle) and into the body (left ventricle). Valves control movement of blood into the heart chambers and out to the aorta and the pulmonary artery.

Heart and Lungs Together

Blood moves in a special circuit between the heart and lungs. The pulmonary circulatory sequence is:

1. Blood is brought into the right atrium from the body. The veins return blood to the heart through the superior vena cava.
2. Passing through a valve, blood moves from the right atrium to the right ventricle.
3. The right ventricle pumps the blood through another valve into the pulmonary artery and on to the lungs. Blood moves through the lungs, releasing carbon and being replenished with oxygen.
4. Pulmonary veins return oxygenated blood to the heart via the left atrium.

5. Moving through a third valve, blood enters the fourth chamber, the left ventricle. This ventricle is the most thickly muscled chamber. The additional musculature gives it the extra power it needs to push blood into the aorta and around the body.
6. A fourth valve controls blood entry from the fourth ventricle into the aorta. This is the primary artery of the body. From the aorta, blood travels to the organs and muscles of the body by means of the arteries and capillaries of the blood vessel system. Veins return blood to the heart. Movement of blood throughout the body is known as **systemic circulation**.

The pumping action of the heart chambers is accomplished through muscle contraction stimulated by specialized electrical impulses. The cardiac cycle is one complete heartbeat and takes about .8 seconds. The rhythm and sound of blood into and out of the atrium and ventricles is the **cardiac cycle**.

Heart Rate

The average adult heart rate is 72 beats per minute. The average heart rate for children is somewhat higher, depending on age. A heart rate of 80 would not be unusual. Heart rate can be measured by feeling the pulse.

- Place two fingertips of one hand on the underside of the other wrist.
- Place the two fingertips lightly (at first) in the skin creases on the wrist just below the base of the thumb.
- Slowly increase fingertip pressure on this area until a slight pump or throb is felt under the tips.
- Count the number of pulse pumps in a 10- or 15-second period. Multiply that number by six (for ten seconds) or four (for 15 seconds) to get the heart rate.
- If unsure of the accuracy, repeat once or twice to verify.

Heart rate can vary in order to meet different needs of the body. During exercise we need more oxygen and blood in the muscles so the rate increases. When we eat, our Digestive System needs more blood during and after our meal, so the heart beats more quickly. Furthermore, when we have a fever more blood is pumped to the surface so that heat can be released through the skin.

Our heart rate is also influenced by the Nervous System, hormones, emotions and substances, such as drugs. When our stress response is triggered, the sympathetic nervous system (a division of the autonomic nervous system) increases the heart rate and the volume of blood pumped through the heart. (This is known as cardiac output). The parasympathetic nervous system restores the heart rate to normal.

The Circulatory System and Blood

Our Circulatory System is the body's delivery system, transporting blood throughout the body. Our blood is the holding and transport vessel for **nutrients, oxygen, antibodies** and **hormones** as well as the removal mechanism for waste material. Blood moves nutrients, oxygen, etc., from the heart and lungs to cells everywhere in the body and takes waste out of and away from cells to organs such as the liver and kidneys, as well as back to the lungs. The heart is the power pump for all of this activity.

Major structures of the Circulatory System are the heart and the blood vessels. The blood vessel system is comprised of the arteries, veins, and capillaries.

Blood

The average adult has about **five liters** of blood. Whole blood contains:

Plasma = 55%

- Plasma itself is 91% water and about 8% proteins
- A thick, yellowish liquid, plasma is the transport medium for blood cells as well as waste.

Formed Elements = 45%

- White (1/2%) and red (99%) blood cells plus platelets (1/2%) constitute the formed elements of whole blood.
- Red blood cells contain hemoglobin and carry oxygen.
- White blood cells are part of the body's immune system and are involved in fighting infections and disease.
- Platelets assist in healing wounds by helping make blood clots.

Blood Vessels and Systemic Circulation

Arteries carry blood away from the heart. The pulmonary artery takes blood from the heart to the lungs. The aorta carries blood from the heart to the body. The large aorta branches into smaller and smaller arteries in order to supply the organs, muscles, and brain with oxygen and nutrient-rich blood. The smallest arterial transport mechanisms are the capillaries.

Conversely, blood return occurs through the body's **venus branching system** of tiny **venules**, becoming small veins and then larger veins. These finally feed into the largest vein, the vena cava. The superior vena cava returns blood directly into the left atrium of the heart.

Blood returning to the heart from our extremities--especially our feet and legs, and our hands and arms--has to contend with gravity. Veins are thinner than

arteries and don't have as strong a muscle structure to facilitate blood movement. Veins have a tough job that can be likened to sending water uphill. Veins depend on the action of surrounding muscles to keep blood moving and an interior one-way valve feature that opens to allow blood to move "up" the vein before closing to prevent it from falling back "down" the vein.

Blood Pressure

The pumping action of the heart is the force that moves blood through the arterial system and all the way into our brain, our fingertips and our toes. Arterial walls are more muscular (thicker and firmer) than veins. They are also flexible and smooth. This elasticity helps move blood throughout the body. If the arteries become hardened or thickened because of calcium or cholesterol deposits, blood has a more difficult time making its journey and the heart has to work all that much harder to accomplish its job.

Blood pressure depends on the pumping of the heart and the elasticity of our blood vessels. A definition of blood pressure is that it **measures the forced movement of blood in the body**. There are two blood pressure measures: diastolic and systolic.

- **Systolic pressure** is the measure of blood at its highest pressure when the ventricles pump a new spurt of blood into the aorta (for systemic circulation) and the pulmonary artery (for pulmonary circulation).
- **Diastolic pressure** measures blood at its lowest pressure. The low pressure happens when the heart ventricles relax and fill with blood from the atria.

Two measures of blood pressure are tracked. The first number measures systolic pressure, the second the diastolic pressure. So a blood pressure of 120/80 (120 over 80) means the systolic pressure is 120, and the diastolic is 80. A blood pressure of 120/80 is considered "normal."

High blood pressure is a very common chronic circulatory problem. Blood pressure over 140/90 is considered hypertension. It can be a precursor to other more serious and life-threatening cardiovascular health problems such as a stroke. However chronic low blood pressure can be harmful to health as well, since that means not enough blood (oxygen and nutrients) is flowing to the brain.

Functions of the Circulatory System

- Moves nutrients, oxygen, antibodies, and hormones throughout the body
- Removes waste material from the cells
- Modulates temperature
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Heart and Circulatory Disease

The two most common forms of heart problems are heart attack and stroke, which are caused by reduced or blocked blood supply to the heart (heart attack) or brain (stroke). Cholesterol in the bloodstream and plaque and calcium deposits in the arteries narrow the arterial passage causing the full, normal, and necessary flow and volume of blood and oxygen to be disrupted. Arteries can also become hard and rigid, losing the elasticity needed to assist the heart in maintaining normal blood pressure.

The earlier a person adopts heart-healthy habits, the healthier and easier that life is likely to be. These habits involve nutrition, exercise, and healthy lifestyle choices, such as:

- **no** smoking
- moderate (or zero) alcohol consumption

Both nutrition and exercise impact weight, blood pressure, and cholesterol, heart disease risk factors about which we can make positive, health-affirming choices. (These issues are dealt with in much more depth with the Healthy Body, Healthy Nutrition, and Healthy Mind & Emotions lessons.)

- **Teacher's Note:** *The information provided in this Background is intended to directly support the basic teaching content of this lesson. Additional excellent in-depth background information regarding the Circulatory System, the heart, blood, etc., can be found at the websites listed at the end of the lesson.*

Vocabulary:

Circulatory System
Systemic circulation
Aorta
Vena Cava
Ventricles
Atria
Arteries
Veins
Capillaries
Cardiac cycle
Heart rate
Pulmonary
Cholesterol

Lesson 1: The Heart

Engage:

Go to a meat market, meat locker, or butcher store. Ask for a cow heart, sheep heart, pig heart, or other large animal heart. Let the students look at the heart. Discuss. Encourage students to ask questions.

Explore:

Write each of the following terms on a note card:

- Right Atrium
- Left Atrium
- Right Ventricle
- Left Ventricle
- Pulmonary Artery
- Pulmonary Vein
- Aorta

Divide the class into eight groups. Each group gets one note card with one of the terms listed above and will need to research where their particular part is located in the heart. Students will also need to determine where the blood came from to get to their part and where it will go when it leaves their part of the heart.

Next, students will create a station where they can teach their classmates about their part of the heart. The station should include a diagram showing where their part is within the structure of the heart. After each group selects a representative from their group, the representatives will all meet and discuss in what order each of the groups will present their information so that they are in the proper sequence. The representatives will also create a map of how the classroom can be set up so that the stations will be in a circle around the classroom in the correct sequence in which the blood is pumped through the heart.

Suggested Website: www.kidshealth.org

Using a model heart or the animal's heart, have each group demonstrate where their part is located.

Explain:

As groups present their research, take the opportunity to guide them, providing additional information and/or correcting any misconceptions. Let each group try to demonstrate to the class where their part of the heart is located on the real animal heart. (**See Figure 1** for a picture of the heart with each of the parts labeled to use as a guide.)

Open up the animal heart. *NOTE: The following directions were taken from a website that is no longer in existence. For further information, please consult the following websites:*

Home Science Tools: The Gateway to Discovery:

www.hometrainingtools.com – Contains resources for parents, teachers and kids to make learning science both fun and accessible. Features detailed dissection guides.

Anatomy and Physiology:

www.gwc.maricopa.edu/class/bio202/heart/anthrt.htm -

Features many different views of the heart with an interactive component that lets you click on any part of the heart for help with locating and identifying various structures.

The University of Michigan Medical School:

http://anatomy.med.umich.edu/cardiovascular_system/heart_vid.html -

Features a lab video of an actual dissection of a human heart. (Note: Not for the faint of heart!)

1. Place the heart in the dissecting pan so that the front or ventral side is towards you (the major blood vessels are on the top and the apex is down). The front of the heart is recognized by a groove that extends from the right side of the broad end of the heart diagonally to a point above and to your left of the apex.
2. Use scissors to cut through the side of the pulmonary artery and continue cutting down into the wall of the right ventricle. Be careful to cut just deep enough to go through the wall of the heart chamber. (Your cutting line should be above and parallel to the groove of the coronary artery.)
3. With your fingers, push open the heart at the cut and examine the internal structure. If there is any dried blood inside the chambers, rinse out the heart completely before continuing.
4. Locate the right atrium. Notice the thinner muscular wall of this receiving chamber.
5. Find where the inferior and superior vena cava enter this chamber and notice the lack of valves.
6. Locate the valve that is between the right atrium and right ventricle. This is called the tricuspid valve. This valve allows blood flow from the right atrium into the right ventricle during diastole (period when the heart is relaxed). When the heart begins to contract (systole phase), ventricular pressure increases until it is greater than the pressure in the atrium, causing the tricuspid to snap closed.
7. Use your fingers to feel the thickness of the right ventricle and its smooth lining.
8. Inside the right ventricle, locate the pulmonary artery that carries blood away from this chamber. Find the one-way valve called the pulmonary valve that

controls blood flow away from the right ventricle at the entrance to this blood vessel.

9. Using your scissors, continue to cut open the heart. Start a cut on the outside of the left atrium downward into the left ventricle, cutting toward the apex to the septum at the center groove. Push open the heart at this cut with your fingers and rinse out any dried blood with water.
10. Examine the left atrium. Find the openings of the pulmonary veins from the lungs.
11. Inside this chamber, look for the valve that controls blood flow between the upper left atrium and lower left ventricle. This valve is called the bicuspid or mitral valve.
12. Examine the left ventricle. Notice the thickness of the ventricular wall. This heart chamber is responsible for pumping blood throughout the body.
13. Using your scissors, cut across the left ventricle toward the aorta & continue cutting to expose the valve.
14. Using scissors, cut through the aorta and examine the inside of the structure.

Explain what happens when the blood goes to the lungs via the pulmonary artery and returns via the pulmonary vein. Ask: **“How does oxygen get into the blood?”** (*Blood moves from the heart to the lungs.*) **“Then what happens?”** (*Oxygenated blood comes back to the heart and then gets a big push out of the heart and into the body. The heart pumps about 2,000 gallons--more than 7,570 liters--of blood a day.*)

This part of blood circulation is called pulmonary circulation. Ask: **“Why is it called pulmonary circulation?”** (*Blood moves from the heart through the lungs and back to the heart.*)

The Pulmonary Circulatory Sequence:

1. Blood is brought into the right atrium from the body via the superior vena cava.
2. Passing through a valve, blood moves from the right atrium to the right ventricle.
3. The right ventricle pumps the blood through another valve into the pulmonary artery and on to the lungs. Blood is carried through the lungs, releasing carbon dioxide and becoming replenished with oxygen.
4. Pulmonary veins return oxygenated blood to the heart via the left atrium.
5. Moving through a third valve, blood enters the left ventricle. This ventricle is the most thickly muscled chamber. The additional musculature gives it the extra power it needs to push blood into the aorta and around the body.
6. A fourth valve controls blood movement from the fourth ventricle into the aorta. This is the primary artery of the body.
7. From the aorta, blood travels to all the organs and muscles of the body. This is called **Systemic Circulation**.

Extend: Homework

Have students to do the following activity individually. Using any material they choose, have students create a basic model of the heart. Encourage students to be creative. Students will need to identify and label the Right Atrium, Left Atrium, Right Ventricle, Left Ventricle, Pulmonary Artery, Pulmonary Vein, and Aorta.

Evaluate:

Have students return their homework from the Extend portion and evaluate whether or not the students created and identified each portion of the heart

Lesson 2: The Heart Rate

Engage:

Ask: “**How many times does the heart beat in a minute?**” (**Seventy-two beats per minute for an adult, up to 80 for children.**) Write these numbers on the board, then have students figure out the answer by tapping the beat out for 15 seconds and converting that to the correct number of beats for 60 seconds.

First, do the tap rhythm yourself using your hand and a hard surface or a small drum. Do 20 beats in 15 seconds but don't tell them how many beats you are going to do. Next, have the students do the 20 beats/15 seconds rhythm **with you** by tapping their hands on their desks and counting the number of beats. Have students do the math to convert it to the number of beats per minute.

The cardiac cycle is one complete heartbeat and it takes about .8 seconds. (**Bonus math question:** If your heart beats 80 times a minute, how long does one complete heartbeat [cardiac cycle] take?)

Explore:

1. Question: “**Is your heart rate always the same? If not, why is it different?**” Discuss.
2. Demonstrate how to take a carotid pulse. (*For instructions on how to take a carotid pulse, go to: www.tutorials.com/09/0902/0902.asp. Have students practice before attempting the following activities.*)
3. Have students work in pairs to take each others' pulse. Have them count and record their partner's number of heartbeats for **15 seconds**.
4. Optional: If stethoscopes are available, pair up students according to gender and have them listen to the heart beating. Ask: “**What is the sound of the heart beating?**” If they can hear the heartbeat clearly enough, have them count and record the number of heartbeats for 15 seconds for their partner.

5. Next have them take their partner's **resting pulse** and their pulse **after** doing three minutes of jogging in place. (*Optional-- if stethoscopes are available--ask students to listen to the heart again after they measure their partner's active heartbeat.*)
6. Have the pairs hypothesize about why the heart rate changes with activity. Each pair should present their theory to the class for discussion.

Explain:

1. Heart rates vary in order to meet the different needs of the body. During exercise we need more oxygen and blood in the muscles so the heart rate increases.
2. Ask: **“What are some other times when our heart rate changes?”**
 - **Eating:** Our Digestive System needs more blood during and after meals, so our heart beats more quickly.
 - **Illness:** When we have a fever more blood is pumped to the surface so heat can be released through the skin.
 - **Stress:** The Sympathetic Nervous System (a division of the Autonomic Nervous System) increases the heart rate and the volume of blood pumped through the heart. (This is known as cardiac output.) The Parasympathetic Nervous System restores the heart rate to normal.

Ask: **“What is the primary job of the heart?”** (*The main function of the heart is to distribute blood throughout the body. It is the primary engine that drives the all-important Circulatory System.*)

Ask: **“How big is the heart?”** (*About the size of a fist.*) **“Is it a solid muscle?”** (*No – it is a hollow organ.*)

Explain further by asking the following questions:

- **“What kind of tissue is the heart made of?”** (*Specialized muscle tissue.*)
- **“How much does it weigh?”** (*In an adult, about 10-11 oz. or 300 grams.*)
- **“What is INSIDE the heart?”** (*Four chambers: two ventricles and two atria.*)

(NOTE: since students will probably not know the answers, you may have to guide their thinking.)

Extend:

1. Conduct a study of heart rates in different individuals. Working in small groups, have the students design a study of resting and active heart rates in a variety of people. Encourage the students to design their study to examine a hypothesis or to find the answer to a question about heart rates. (Example: “The active heart rate for men is greater than for women.” An example of a question could be: “Do men have a higher heart rate than women after exercise?”)
2. In designing the study, groups also need to determine the protocols of their study, such as;
 - The number of participants needed
 - The number of male and female participants
 - Age groups to include or exclude
 - What heart rates will be measured and how
 - Recordkeeping charts
 - Time frames for the study
 - Tools needed
 - How results will be compiled and analyzed
 - Format for final report (including charts, graphs, and conclusions)
3. Groups should brainstorm other factors they need to consider in designing and completing their study.
4. Each member of the group should be assigned a responsibility, such as recording heart rate results, preparing the final report, arranging for participants, writing up the study protocols, etc.
5. Each group should make a presentation to the class regarding their study and results.

Evaluate: Home Activity

1. Conduct an experiment. Take your resting heart rate and the resting heart rate of two other people. (Parent, guardian, sister, brother, grandparent, etc.)
2. Next, have everyone do the same exercise for a set amount of time. (Example: jump rope for two minutes.) Take their heart rate again **immediately after the activity**.
3. Create a bar graph. Include the resting heart rate and the heart rate after activity. Graph the resting heart rate in red and the heart rate after activity in green. Compare the **red** bars and draw conclusions. Compare the **green** bars and draw conclusions. Finally, compare the red bars to the green bars and draw conclusions.

Lesson 3: The Circulatory System and Blood

Engage: Let's Make Blood

1. Ask: “**What’s in blood?**” Ask for ideas and write answers on the board.
2. Blood contains four main ingredients: **plasma**, **red blood cells**, **white blood cells**, and **platelets**.
3. Ask for a group of volunteers to help make up some blood for the class.
4. Ask: “**What is the primary ingredient in blood?**” (*Plasma, which makes up about 55% of whole blood. It is very thick and kind of syrupy--that’s what makes blood “sticky”--and looks yellowish.*)
5. Have one volunteer pour 4.5 oz of clear syrup (corn syrup) with some yellow food coloring into a clear container.
6. Ask: “**What’s next? What do we have the most of: red or white blood cells?**” Red cells are the next most prevalent ingredient, making up about 44% of our blood. White blood cells and platelets make up the last 1% of whole blood.
7. Use three different kinds of plastic beads to use for these components:
 - Round flat red beads in red (red blood cells)
 - Oval white beads (white blood cells)
 - Small round green or blue seed beads (platelets)
8. Have students add enough beads in the appropriate proportions to complete the blood. (For example: 18 red beads, plus one white and one seed bead.) **Total volume** of the whole blood mixture should be about eight ounces.
9. Ask: “**Why do we need . . .**
 . . . **Plasma?**” (Transportation medium)
 . . . **Red Blood Cells?**” (Contain hemoglobin and oxygen)
 . . . **White Blood Cells?**” (Fight infection and disease)
 . . . **Platelets?** (Help wound healing by making blood clots)

Explore:

1. Ask: “**After blood leaves the heart, where does it go?**” Break students into groups of four. Students will need to look up the definition of **ARTERY**, **VEIN** and **CAPILLARY**, then review the definition of **VENA CAVA** and **AORTA**. Next they will need to outline one member of their group on a sheet of butcher paper, drawing the heart, labeling the parts of the heart, and including all of the terms listed above.

2. Have students color each part of the heart as follows:
 - aorta (purple)
 - arteries (red)
 - veins (blue)
 - capillaries
 - vena cava (green)
3. Have each group present their information, making sure students have defined each word listed above and have displayed it clearly on their student outline.
4. After each group gives their presentation, the other groups will need to agree with what was presented or disagree and explain why. Guide students as needed.
5. Reiterate: **“From the aorta, blood travels to the organs and muscles of the body. What are the pathways throughout our body that blood travels through?”** (*Blood vessels: arteries, veins, and capillaries.*)
6. Ask: **“How does blood get from our heart to our toes and back again?”** (*Systemic circulation.*)
7. Explain: **The movement of blood throughout the body is known as Systemic Circulation and works like this:**
 - **The aorta carries blood from the heart to the body.**
 - **The large aorta branches into smaller and smaller arteries. Arteries carry blood away from the heart.**
 - **The smallest arterial transport mechanisms are the capillaries. Blood moves through the capillaries into very small veins.**
 - **Small veins branch into larger veins.**
 - **These finally feed into the largest vein, the vena cava.**
 - **The superior vena cava returns blood directly into the left atrium of the heart.**
8. Question: **“What makes blood move in our body?”** (*Muscles--the heart is a muscle, and movement is created through the skeletal muscles in our body, and the muscles in the blood vessel walls.*)
9. The pumping action of the heart is the force that moves blood through the arterial system and all the way into our brain, our fingertips and our toes.

Arterial walls are muscular. They are also flexible and smooth. This elasticity also helps move blood throughout the body. Finally, the muscles in the body help move blood through our system, especially back “up” from our toes.

10. Ask: **“Why is it especially hard for blood to move from the toes and fingertips to the heart?”** (*Gravity. Blood needs to flow “up” against the force of gravity to get back to the heart.*)
11. Ask: **“What helps blood move through the veins and back up the body?”** (*Veins depend on the action of surrounding muscles to keep blood moving. They have a special one-way valve feature that opens to allow blood to move “up” the vein and then closes to prevent it from falling back “down” the vein. Veins are thinner than arteries and they don’t have as strong a muscle structure as arteries. Veins have a tough job that can be likened to sending water uphill.*)

Extend:

Ask: **“What is blood pressure?”** (*A definition of blood pressure is that it measures the forced movement of blood in the body.*) Our blood pressure depends on the pumping of the heart, the elasticity of arteries, and how open and unobstructed the arteries are to allow the maximum blood flow.

Present students with the following problem: **“What happens if a blood vessel is blocked or not as open as it should be?”** Have students do a simple experiment to understand how blood flow changes when arteries are narrowed. Students can work in small groups to do this activity.

Each group will need: two small balloons or large finger cots, one clear tube (1/2” diameter) about 8” long, one clear tube (3/4” diameter) about 8” long, 16 - 20 oz. water, red food coloring, a measuring cup, a funnel, and two empty plastic containers, such as cottage cheese or yogurt cartons.

1. Put some drops of red food coloring into the water so that it has the color of blood.
2. Measuring carefully, pour the same amount (4-6 oz.) of water into each balloon or finger cot.
3. Securely insert each tube into one of the balloons. Have one group member hold the filled balloon with the larger tube in his/her hand.
4. Direct the open end of the tube into the empty container. Have the balloon somewhat lower than the container so the contents get more of an effect of being pumped rather than being moved by gravity.
5. Pump the filled balloon until the balloon is empty. Count the number of pumps it takes to move the contents from the balloon to the container.

6. Repeat the activity with the smaller tube, counting the number of pumps. (Have the same student do the pumping of the balloon both times so that the amount of pump force remains approximately the same.)
7. Compare the results.

Ask for conclusions about this experiment: **“What was the difference between the two arteries (tubes)? What was the effect of that difference on the effort it took to move the same volume of liquid?”**

When arteries become hardened or thickened, blood has a more difficult time making its journey. The heart has to work much harder to accomplish the same job. Cholesterol in the bloodstream and plaque and calcium deposits in the arteries can cause the full, normal, and necessary flow and volume of blood and oxygen to be disrupted.

The two most common forms of circulatory problems are **heart attack** (reduced or blocked supply of blood to the heart) and **stroke** (reduced or blocked blood supply to the brain.)

Ask: **“How can we have a healthy heart and circulatory system?”** (*Nutrition and exercise impact weight, blood pressure, and cholesterol-- heart disease risk factors about which we can make healthy choices.*)

Evaluate: Home Activity

For this activity students will need to explain to a parent or guardian what blood consists of, as well as what they've learned about veins, arteries, and capillaries. The parent or guardian will then need to write down what they learned from their child.

Optional Enrichment Activity/Group Project: Researching the Incidence of Heart Disease Around the World

Arrange students into groups to conduct research about the incidence of heart disease in different countries around the world compared to the United States. Groups can be assigned to study the U.S. and other countries in Europe, Asia, Africa, Australia, North America or South America. (Comparisons should include countries representative of each continent.)

Research material can be found on the internet or in reference materials such as encyclopedias and almanacs.

Have each group prepare charts or graphs with their results, then work together as a class to compare/contrast the information obtained. Discuss **why** the incidence of heart disease might be different in different places. What impact does diet, lifestyle, etc., have on heart disease?

Additional Web Resources:

- The Heart: An Online Exploration - <http://sln2.fi.edu/biosci/heart.html>
- KidInfo-The Human Body:
http://www.kidinfo.com/Health/Human_Body.html
- KidsHealth.org:
http://www.kidshealth.org/teen/your_body/body_basics/heart.html

Missouri Standards: Frameworks (K-4)

I. Functions and Interrelationships of Systems

A. Body Systems

What All Students Should Know:

6. The Cardiovascular System includes the heart and blood vessels. The heart pumps blood to all body cells. The blood delivers oxygen and nutrients and removes carbon dioxide and other waste materials.

Figure 1

