THE CIRCULATORY SYSTEM

Grade 10

A FACILITATOR'S GUIDE

This activity is short and is meant to be done along with the digestive system activity to fit a one-hour or so time slot. If you are only allotted a one-hour slot, do the digestive system first without the art work and then do this one.

Photo

*Developed by **Sue McKee** for Let's Talk Science in Ottawa*
This activity was adapted from a role-play idea by the National Office of Let's Talk Science

Thank you for volunteering for Let's Talk Science! The following manual will help guide you through the workshop. Please read this manual before visiting the group you are working with.

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Important Notes

Introduction & Guidelines

- This manual is meant as a guide to help you prepare for your activity. The introduction includes questions that get at the curriculum link/science concept the workshop covers. You are not expected to memorize this manual. It is a guide and we want you to bring your own experiences and your style of teaching into it.

- As a general guideline, do not speak longer than the age of the students at one time.

- Most workshops fit well in a 1-hour time period but some like bridge building or some high school activities are a little longer.

- Practice your introduction and test out the activities beforehand so you can anticipate sections that may take more time or may be difficult for students.

- If you are working with a partner, work out roles and responsibilities before the visit.

Safety

As a Let's Talk Science volunteer, safety must be foremost in our minds during all activities. As STEM role models, volunteers must always also model safe science practices.

Always keep in mind the following precautions:

- Emphasize and demonstrate appropriate safety procedures throughout the presentation.
- Be professional but have fun.
- Keep workspaces clean to avoid tripping hazards.
- Allergens should have been checked before reserving the kit (e.g. allergies to latex).
- **Activity Specific Safety:** na

WHMIS

An overview of Canada's Workplace Hazardous Materials Information System (WHMIS) is included in these materials at the end of this manual where needed. No WHMIS sheets are included with this activity.

Overview of the Workshop

Grade Level and Curriculum Learning

Grade 10 academic and applied: *explain the primary functions of a variety of systems in animals (e.g., the circulatory system transports materials through the organism; the respiratory system supplies oxygen to and removes carbon dioxide from the body; explain the interaction of different systems within an organism (e.g., the respiratory system brings oxygen into the body, and the circulatory system transports the oxygen to cells) and why such interactions are necessary for the organism's survival.*

Materials

Activity 1: Role play of blood through the heart (per student)

1 red crayon
1 blue crayons
1 strip (about 6 inches long and 1 inch wide) of red felt
1 strip blue felt cut in strips
1 colouring page
For the teacher Laminated cards with parts of the heart (inferior vena cava, right atrium, right ventricle, pulmonary artery, left atrium, left ventricle, lungs, pulmonary vein)
1 roll of blue electrical tape and 1 roll of red electrical tape

PowerPoint (optional)

Timing of the Workshop

	Approx. Time	Description
Introduction	5-7 minutes	Introduce yourself, find out what they already know, add in bits to fit with the curriculum learning
Activity 1	15-20 minutes	Colouring blood flow through the heart and then role play (don't spend much time on the colouring -just a quick go through)
Wrap up	5 minutes	

Activity

*The **questions** you might ask are in **bolded blue font**. Some things you might say are in blue font and the possible answers are in square brackets in black font. Actions are in purple font.*

Introduction

Hi everyone! We are Let's Talk Science volunteers. We come to schools and do hands-on activities. I study [simple terms] _____ at the University of Ottawa/Carleton University. I decided to study _____ because [when I was your age I loved… I think it's important to… I'm curious about…].

We're/I'm here today to learn a bit about how blood flows through our bodies.

Ask the teacher if she/he can pick students to answer questions as you ask them. Also, you might not be able to hear the answers so the teacher might have to repeat the answers. If you cannot see the students because the camera doesn't extend to where they can see you on a screen, you'll have to rely on the teacher to know if the students are ready for the next step.

What body system is our heart a part of? [circulatory system]

What does our heart do? [to pump blood through our bodies]

Why do we need blood to go through our bodies? [carries nutrients and oxygen to other parts of our body where they are needed] [Our blood is our transport system and takes nutrients from our digestive system and oxygen from our lungs to give us energy. Our blood brings oxygen to our muscles, nerves, brain and other cells to keep all our body working properly. Our blood takes the wastes from our cells and organs (e.g. carbon dioxide) and carries it to other systems like our lungs so it can be taken out of our bodies.]

Does anyone know what the vessels that carry our blood are called? [veins and arteries]

What does a vein do? [brings blood to the heart—most students will say veins carry carbon dioxide or blood without oxygen (deoxygenated blood) to the heart which is mostly true, however, the pulmonary artery (the artery that goes from the lungs to the heart) carries oxygen from the lungs to the heart. The definition of a vein is: a vessel that brings blood to the heart (rather than a vessel that carries deoxygenated blood)—clarify this with them if need be]

Now that you know the definition of a vein, how would you define an artery? [a vessel that brings blood away from the heart—again, most arteries carry blood with oxygen in it but the pulmonary artery carries blood that is deoxygenated so the definition of a vessel that carries blood away from the heart is more accurate]

Most veins look bluish under our skin – does anyone know why? [It has to do with light, the thickness of veins compared to arteries and the deepness under the skin. Veins tend to be closer to the skin and thinner-walled than arteries and our brains see them as bluish]

If you go for a check-up as an adult the doctor will often check our pulse or the number of times our heart beats in a minute. Let's see if we can find our pulse. The easiest places are on our wrist or our neck. These are where the arteries are close to the skin. There are other areas like

the back of our knees, our groin, neck, temple and parts of the foot. We'll use the neck or wrist today.

Have everyone take their two fingers (index and middle finger) and place them on their wrist near their thumb until they feel the pulsing. If they do not feel pulsing on their wrist have them try on their neck.

What do you think happens to our pulse or heart rate when we exercise? [goes up]. Let's test this to see if it's true.

Get students to find their pulse. Then let them know you will time them for 15 seconds and they are to count (not aloud) how many times they feel the pulse. Make sure everyone has found their pulse and then do a countdown 3-2-1 start. Stop them at 15 seconds. And then ask them to multiply the number by 4 to give an estimate of their heart beat per minute. Ask a few to give you the number they got.

Next have them stand up and jump or run on the spot vigorously for one minute. Let them know as soon as the 1 minute is up, you want them to find their pulse again and when you say 'go' start counting until you say 'stop'. Then repeat what was done for the pulse at rest so they get number of beats per minute right after exercise. Ask again for a few to give you the number this time. [You could graph this increase on the board if you wanted but don't take too long]

Another thing your doctor might measure is your blood pressure. We're going to do a couple of activities and then we'll come back to blood pressure. It's helpful for us to know how blood flows through a heart and parts of the heart before we talk about blood pressure.

Blood Transport Through Heart (Colouring)

Today we're going to model how blood flows through your heart – you are going to be the blood and a model of the heart will be on the floor.

Ask the teacher to distribute the colouring pages anda red and blue crayon to each student.

You could also have the teacher make the model on the floor at this point. She/he needs to make 4 large boxes – large enough for a student to stand in. The two on her/his right should be done using blue tape with the one closest to her/him being slightly smaller than the one further away. The two on her/his left should be red and again the one closest to her/his feet smaller than the one further away. He/she could also add in the inferior vena cava (blue), aorta (red), pulmonary vein (blue), pulmonary artery (red) as in the photo. The teacher can also leave red felt pieces in the lung area.

Before we do this, let's use this colouring sheet to follow the flow of blood through the heart. Then we'll model it with us being the blood and chambers of the heart.

Slide 1 or just use a print out of the page if you have one. (Note answers are on slide 2 if you need them)

Take them through the flow of blood:

You can see there are numbers on each of these and that shows us the order of the flow. Let's start with #1. Does anyone know what that vein is called? [the inferior vena cava]

We'll colour veins carrying deoxygenated blood blue and arteries which are rich with oxygen, red.

The inferior vena cava and the superior vena cava (top left hand side of the picture) bring blood from the body to the heart. Trace the arrows on the inferior and superior vena cava in blue crayon.

Now where does the blood go? [right atrium – they might not know the names of each part but you can help them as needed] **Has it picked up any oxygen yet?** [no] **What colour should you outline that arrow?** [blue]

Continue the same way to the right ventricle. Note there is a valve (#3) that opens and closes as the heart contracts and relaxes allowing blood to flow from one chamber to another. **Does anyone know what this valve is called?** [tricuspid valve]

From the right ventricle, the blood moves to this large artery. **Has the blood picked up any oxygen yet?** [no] **Does anyone know what this artery is called [hint, it is taking blood to the lungs]?** [pulmonary artery]. Outline the arrows to the pulmonary artery and to the lung in blue.

The blood is now in the lungs. **What happens here?** [gas exchange - it exchanges carbon dioxide for oxygen].

Now the blood comes back to the heart through the pulmonary veins. **What colour is the blood now?** [red, representing blood with oxygen in it] Outline the arrow from the lungs to pulmonary vein in red.
Continue in a similar way through the left atrium and left ventricle outline the arrow in red and up through the aorta where the blood leaves to go to the rest of the body. Valve (#8) is the bicuspid or mitral valve.

Now, we'll see how much you remember and have you pretent you are blood and go through the heart saying each chamber of the heart and the veins and arteries (and valves if you can remember).

Let's see if we can now pretend we are blood and flow through the heart to exchange our carbon dioxide for oxygen and bring it to the rest of our body.

Ask the students to guide the teacher (without looking at their paper if they can) to lay out the names of each part on the floor using the word cards.

Have the teacher distribute a blue piece of felt to each student and then one at a time each student can go through the heart flowing as blood would, saying each part as they go through it, and exchanging their blue ribbon for red at the lungs, etc.

You could probably just have a few students do this.

Wrap-Up

Now that we've seen how blood flows through the heart, let's go back to what is blood pressure. **Does anyone know what blood pressure is?** [Blood pressure is a measure of the force of blood against the walls of your arteries]. An adult's normal blood pressure is somewhere around 120/80 mmHg (we measure this in millimetres of mercury). For you (youth) blood pressure differs by height, age and gender and so the averages are different depending on these things and others.

The pressure (force of pushing) inside each of the 4 heart chambers (i.e. the atria and ventricles) is different. For example, for adults the pressure in the left ventricle is about 120 mmHg and the pressure in the right is 30 mmHg.

Blood pressure is measured as systolic and diastolic pressure.

Systolic pressure (the top number) is the pressure it takes to push the blood forward into your artery. It is the highest number achieved when the heart contracts. In an average adult that would be 120 mmHg.

Diastolic pressure (bottom number) is the small amount of pressure the heart has when it is relaxing between beats. In an average adult that would be 80 mmHg.

There are many diseases of the heart with *coronary artery disease or atherosclerosis* being the most common form of heart disease.

Extra if you have time but this might take too long if you are also doing the digestive system

Slide 3

There are 2 *coronary arteries* (blood vessels) that branch from the main aorta about the size of a drinking straw that encircle the heart with a lacy-type network. These blood vessels supply blood and oxygen to the heart itself.

With atherosclerosis, fatty substances, cholesterol, cellular waste products, and calcium build up in blood vessel walls and narrow the passageway for the movement of blood often leading to heart attack. A heart attack is when the heart muscle is damaged. Sometimes the plaque causes a blood clot to form blocking the artery further. Sometimes you get reduced blood flow from a spasm which is a temporary tightening of the artery.

Atherosclerosis is something that builds up over time and may even start in childhood.

Before moving to the next slide which has the answer to this question, ask**, Why do you think our arteries get clogged?**

Some causes you can't control –men more likely than women until a certain age, age (as you get old you are more likely to have atherosclerosis, heredity or a family history of heart disease, and some races are more likely than others.

These are some you might be able to control and many of them are related. **Does anyone know what any of these are?**

Cholesterol is a waxy substance in our blood that comes in 2 forms. One called HDL (high density lipoproteins) is 'good' and helps build cells and remove the second form of cholesteral (LDL) which is not good for our bodies. It can get built up in our blood vessels. Some things we eat cause LDL to get high in our blood (e.g. fatty foods, processed foods, etc.).

Slide 5

High blood pressure happens when the force of the blood moving through the vessels Is stronger than it needs to be. High blood pressure is linked to the foods we eat and how much exercise we do as well as stress and other factors.

Obesity is a disease where the body has too much body fat and can be genetic, environmental, or from poor diet and lack of exercise.

Diabetes is a set of diseases that affect how your body uses blood sugar and means you have too much blood sugar. It can be genetic or due to poor diet.

Slide 6

Does anyone know any tests we do for our hearts? [use info below to fill in anything they don't know]

Electrocardiogram – measures the electrical activity of the heart, including the heart rate and regularity of the heart beats, as well as the size and position of the chambers, any damage to the heart, and effect of drugs or devices to regulate the heart. If there are any issues with these it can be the first indicator that something isn't quite right.

Stress tests – measure how well your heart works when it is stressed (exercises make your heart pump harder and faster) which can also indicate that there may be problems.

Angiograms – are processes that use small tubes which can be inserted into your arteries (often your leg) that use a dye and an x-ray machine to see the arteries in your heart (coronary arteries). These tests will tell you if you have atherosclerosis ("clogged arteries").

Doctors also use *blood tests*, chest x-rays, echocardiograms (graphs of your heart's rhythm), and ejection fractions (how well your heart pumps blood with each beat).

Slide 7

In real life there are a few common types of surgery we can use to fix a clogged artery: a stent, angioplasty (balloon), and by-pass surgery.

The first method is called a *stent*. Stents are introduced into a blood vessel on a balloon catheter into the blocked area of the artery. The balloon is inflated which causes the stent to expand until it fit to the inner wall of the blood vessel. The balloon is then deflated and drawn back. The stent stays in place permanently, holding the vessel open and improving the flow of blood.

When performing *angioplasty*, a balloon catheter is passed into the artery, inflated so it compresses the plaque to the wall making the space for blood to flow through larger. The balloon is then deflated and removed.

Another surgery is *bypass surgery*. This is when the blood vessels are removed from the leg, arm, or chest an used to create a new blood flow path to your heart so the blood bypasses the clogged artery altogether.

Wrap-Up

We don't know when atherosclerosis begins but we know it takes a long time to develop. **What might you do now to help prevent getting heart disease when you are older?**

Slide 8

Stay active – exercise daily. You don't have to be an athlete but taking a 20-30 minute walk a day will help you get into the habit and stay in the habit of exercising.

Don't smoke or vape. Besides heart disease smoking causes cancer and other health problems.

Eat a balanced healthy diet when you are able to. This one can be a bit harder even as an adult, but staying active and choosing not to smoke are two that we can all do. It's not always easy to eat a balanced healthy diet and sometimes healthy foods like fresh fruits and vegetables are too expensive to purchase. So we do the best we can and limit how much sugar we have and highly processed foods. Canada's food guide gives many ideas on how to eat healthier.

Does anybody have any questions?

If you have extra time, you can ask if they have any questions about university or being a student or about your research.

Thank you for having us in your class today!