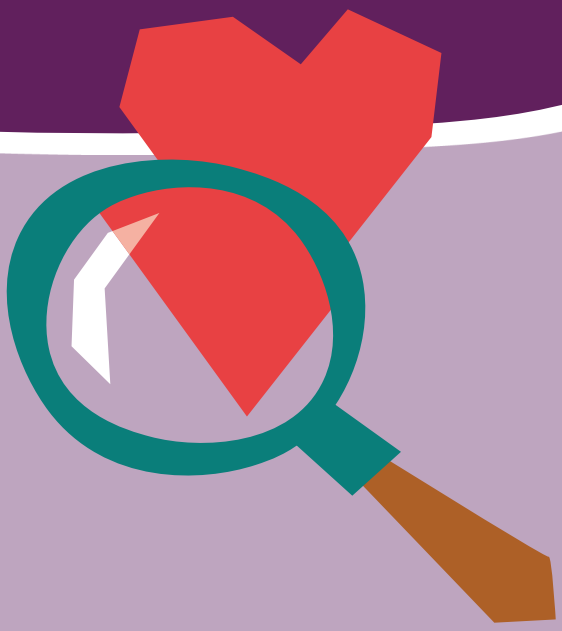
Winchester Science Centre
By Wonderseekers

The Science of Me

Pre-visit resources for KS3



The Science of Me KS3 Pre-visit Activities

These activities are designed to be completed before you visit for your Science of Me workshop. We recommend working through the activities from 1 to 3 but you are welcome to pick and choose depending on your group's prior knowledge and any ideas they may spark along the way.

Through these activities you will start exploring the circulatory system, involving your key organs such as your heart and your lungs. You and your students will get to examine their own heartbeat, and explore how blood moves around the body to keep us healthy.

Teacher Guide

Learning Objective

- To be able to identify the 4 chambers of the heart.
- To be able to describe the sequence of blood flow through the heart, lungs and body.
- To be able to explain the roles and physical differences between arteries and veins.
- To be able to understand how one-way valves ensure blood flows in one direction.
- To be able to differentiate the difference between oxygen-rich blood and oxygen-poor blood.

Key Science

Our human bodies are made up of lots of different components. We have our skeleton that provides us structural support, our muscles which help us move and our organs which carry out specific functions in the body.

Two of the most important organs in the body are the heart and lungs. Our heart is responsible for pumping the blood around our body. Our blood carries all the important nutrients and chemicals our body needs to function. This is why the heart is so important, as moving the blood around keeps our bodies working. One of the key elements it moves around our body is oxygen. Oxygen is key to powering the cells in our body, so it is really important our blood can get it to the rest of the body. To do this, we breathe in oxygen through our lungs which are connected to the heart in the circulatory system. This system starts with blood with no oxygen being pumped from the heart. through an artery up the lungs. Here the blood collects the oxygen before heading back to the heart through a vein. Then the blood is pumped by the heart through another artery to the rest of the body. Finally it returns through a vein. As blood travels through arteries it moves faster due to the force produced by the pumping heart. To support this the arteries are wider and have thicker walls to protect against this force.

Curriculum Links

- Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood
- Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function
- To understand how the circulatory system enables the body to function

Key terms

- **Lungs** - Lungs are baglike organs, or body parts, used for breathing
- **Heart** - A heart is an organ in the centre of the chest that pumps continuously. This pumping moves blood around the body, which is vital for providing parts of the body with nutrients and oxygen.
- **Vein** – A vein is one type of blood vessel that has the job of carrying deoxygenated blood away from the body's tissues and back to the heart.
- **Artery** – An artery is a type of blood vessel (something that carries blood) which has the job of taking the blood full of oxygen away from the heart.
- **Healthy** – beneficial for health.
- **Unhealthy** – harmful to health.
- **Organ** – An organ is made up of tissues, all working together to carry out a job in the body. An organ is an internal part of the body that carries out a specific function.
- **Tissue** – a group of similar cells and their intercellular material that work together to perform a function.
- **Cell** - A cell is a single, tiny building block that makes up living things.
- **Organism** - An organism is a term for any living thing.
- **Circulatory System** - The circulatory system is an organ system in the body of most animals. In humans, the system involves the heart, blood vessels (arteries and veins) and blood.
- **Atrium** – Each of the two upper cavities of the heart from which blood is passed to the ventricles. The right atrium receives deoxygenated blood from the veins of the body, the left atrium oxygenated blood from the pulmonary vein.
- **Ventricle** - The two bottom chambers are the right ventricle and the left ventricle. These pump blood out of the heart.
- **Aorta** - The aorta is the largest artery of the body and carries blood from the heart to the circulatory system
- **Vena Cava** - Your inferior vena cava, your body's largest vein, carries oxygen-depleted blood back to your heart from the lower part of your body.
- **Oxygen** – A gas essential for living organisms. We need it to breathe.
- **Nutrition** - Nutrition is about how our bodies get what they need to function from food and drink. We get nutrients from what we eat and drink

Activity 1 – Feel the Heartbeat (10 minutes)

Overview

This activity invites students to investigate their heart rate and understand how exercise affects the heart. They'll measure their pulse before and after movement to observe changes and learn why the heart reacts to physical exertion.

You will need (per group)

- Paper
- Pencil
- Timer

Instructions

1. Begin by discussing what a resting heart rate is and why it's important.
2. Have students locate their radial pulse (inside of the wrist). Demonstrate the following:
    - Turn your palm upwards.
    - Using your index and middle fingers, place them gently on your thumb.
    - Slide your fingers down to the base of the thumb where it meets the wrist.
    - Gently press to feel for your pulse.
3. If students struggle:
    - Encourage small finger adjustments and varied pressure.
    - Ensure gentle contact—too much pressure can block the pulse.
    - Help them find the groove between wrist bone and tendons.
    - Use a marker (safe for skin) to mark the correct location.
    - Remind them not to use their thumbs, which have their own pulse.
4. Once the pulse is located, set a timer for 60 seconds and have students count their heartbeats. Record the number on paper.
5. Ask students to predict what will happen to their heart rate after exercise.
6. Set a timer for another 60 seconds and have students do star jumps or jog on the spot.
7. Immediately after, reset the timer for 60 seconds and have students measure their heart rate again.
8. Record the new count and compare both numbers.

Activity 2: Cardiac Output Simulation Lab (20 mins)

Overview

In this activity heart function by exploring cardiac output, stroke volume, and heart rate. Learners will simulate different "heart types" using syringes and water and explore how different factors affect our heart rate and how much blood we move around the body.

You will need

- Timer
- 3 syringes (to represent different heart types)
- 3 beakers or cups
- 3000 ml tap water
- Optional: red food colouring or washable paint
- Paper and pen for data collection
- Printed student worksheets detailing each heart type profile

Heart Type	BPM (beats/min)	Stroke Volume (ml/beat)	Cardiac Output (ml/min)
The Olympic Athlete	45	200	9000
The Sunday Stroller	80	60	5200
The Poorly Patient	100	35	3500

Instructions

1. Split the class into three groups and assign each group one heart type from the table above.
2. Have students read their heart profile worksheet and highlight the BPM and stroke volume values that determine cardiac output.
3. Ask each student to calculate their predicted cardiac output by multiplying heart rate (BPM) by stroke volume (SV).
4. Start a 60-second timer. During this time, students simulate heartbeats by drawing water into the syringe (filling stroke volume) and expelling it into their beaker for each beat.
5. When the timer ends, students stop pumping and measure the total volume of water in their beaker.
6. Record the measured volume and compare it with the predicted cardiac output.
7. Complete the profile-specific questions on the worksheet regarding efficiency and discrepancies.
8. Exchange data between groups and hold a class discussion comparing which heart type performed most and least efficiently.

Activity 3: Engineering a Working Heart Model (30 mins)

Overview

Students will build a simple, three-bottle model of the heart and circulation. By manipulating "valves" with their fingers and squeezing the "ventricle," they'll observe how blood flows from the atrium, into the ventricle, and out to the body.

You will need

- 3 plastic water bottles, labels removed
- 2 water bottle caps
- 4 straws
- 3 cups of tap water
- Red food colouring (optional)
- Tape
- Modelling clay or play dough
- A sharp tool (e.g. pushpin) for making holes in bottle caps

Instructions

1. Prepare the caps
2. Poke two straw-sized holes in one cap.
3. In the second cap, poke one straw-sized hole and one slightly smaller hole.
4. If the smaller hole is too large, use clay or play dough to narrow it around the straw.
5. Colour the water
6. (Optional) Mix red food colouring into each cup of water.
7. Construct the straw assemblies
8. Bend two straws at 90° and slide one into the other.
9. Secure the joint with tape.
10. Repeat to make a second L-shaped straw assembly.
11. Set up the bottles
12. Line the three bottles on a flat surface.
13. Fill the first two bottles to three-quarters full; leave the third empty.
14. Cap the first bottle with the two-hole cap, the second with the mixed-hole cap, and leave the third uncapped.
15. Insert the straws
16. Push one end of each straw assembly through the holes so that the first bottle connects to the second, and the second connects to the third.
17. Seal any gaps around the straws in the mixed-hole cap with clay or play dough to ensure airtightness.

Take it Futher

1. Identify the parts
    - Bottle 1 = atrium
    - Bottle 2 = ventricle
    - Bottle 3 = body
    - Fingers pinching straws = heart valves
2. Simulate a heartbeat a. Pinch the straw between atrium and ventricle. Squeeze bottle 2—water flows from ventricle into body. b. Keep squeezing, then move your fingers to pinch the straw between ventricle and body. Release bottle 2—water flows from atrium into ventricle. c. Repeat the pinch-squeeze-release cycle to pump “blood” through the system. d. If the atrium runs low on water, transfer fluid from the body bottle back into the atrium.

Type 1 - The Olympic Athlete

Name = Alex
Age = 26
Profession = Olympic Athlete
Heart Rate = 45bpm
Stroke Volume = 200ml per beat

This heart belongs to an olympic athlete who runs long distance marathons. They have a very strict training schedule, working out 6 days a week for 5 hours per day (a total of 30 hours per week). They are under the guidance of a professional nutritionist who provides them with a strict diet to follow.

Activity instructions:

- You should have one cup that contains 1000ml of water, one empty cup, a syringe and a stopwatch.
- Have one person keep watch of the stopwatch, and start a timer for 60 seconds.
- The person with the syringe should transfer 150ml of water into the empty cup every 10 seconds. You will do this a total of 6 times, swap with other classmates to make sure everyone has a turn.
- The person watching the stopwatch should prompt their classmate when 10 seconds have passed.
- When the timer finishes, measure how much water ('blood') is in the second cup. Multiply that number by 10. This is your cardiac output (Litres per minute).
- Answer the questions below.

Do you think this heart is efficient? Why do you think this?	
What information within this person's profile have you identified that would help/hinder the person's cardiac output?	
What, if anything, would you recommend anything to this person to help them live a healthier lifestyle?	

Type 2 - The Sunday Stroller

Name = Sol
Age = 81
Heart Rate = 80bpm
Stroke Volume = 60ml per beat

This heart belongs to someone who has joined a group of 'shopping centre athletes' who get their exercise by walking laps around a local shopping centre. The group meets up once a week on Sundays and each session lasts around 2 hours. The group will usually finish each session by visiting the shopping centre's cafe and ordering a cup of tea and pastry.

Activity instructions:

- You should have one cup that contains 1000ml of water, one empty cup, a syringe and a stopwatch.
- Have one person keep watch of the stopwatch, and start a timer for 60 seconds.
- The person with the syringe should transfer 160ml of water into the empty cup every 5 seconds. You will do this a total of 12 times, swap with other classmates to make sure everyone has a turn.
- The person watching the stopwatch should prompt their classmate when 10 seconds have passed.
- When the timer finishes, measure how much water ('blood') is in the second cup. Multiply that number by 10. This is your cardiac output (Litres per minute).
- Answer the questions below.

Do you think this heart is efficient? Why do you think this?	
What information within this person's profile have you identified that would help/hinder the person's cardiac output?	
What, if anything, would you recommend anything to this person to help them live a healthier lifestyle?	

Type 3 - The Poorly Patient

Name = Quinn
Age = 32
Heart Rate = 100bpm
Stroke Volume = 35ml per beat

This heart belongs to someone who was born with a congenital heart defect. They are currently in the hospital, waiting to undergo a heart transplant so they can live a healthy and happy life. Before the transplant, this person could only exert their body for a short period of time, otherwise they feel breathless and dizzy. This person was put under the care of a professional nutritionist a year before their surgery date and was prescribed special electrolyte drinks to ensure their heart has the nutrients needed to function.

Activity instructions:

- You should have one cup that contains 1000ml of water, one empty cup, a syringe and a stopwatch.
- Have one person keep watch of the stopwatch, and start a timer for 60 seconds.
- The person with the syringe should transfer 30ml of water into the empty cup every 5 seconds. You will do this a total of 12 times, swap with other classmates to make sure everyone has a turn.
- The person watching the stopwatch should prompt their classmate when 10 seconds have passed.
- When the timer finishes, measure how much water ('blood') is in the second cup. Multiply that number by 10. This is your cardiac output (Litres per minute).
- Answer the questions below.

Do you think this heart is efficient? Why do you think this?	
What information within this person's profile have you identified that would help/hinder the person's cardiac output?	
What, if anything, would you recommend anything to this person to help them live a healthier lifestyle?	