

PROVISIONAL

DELIVERY GUIDE

Theme: Anatomy and Physiology: Structure and function of the cardiovascular system

June 2015

GCSE (9–1) Physical Education



We will inform centres about any changes to the specification. We will also publish changes on our website. The latest version of our specification will always be the one on our website (www.ocr.org.uk) and this may differ from printed versions.

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This resource is an exemplar of the types of materials that will be provided to assist in the teaching of the new qualifications being developed for first teaching in 2016. It can be used to teach existing qualifications but may be updated in the future to reflect changes in the new qualifications. Please check the OCR website for updates and additional resources being released. We would welcome your feedback so please get in touch.



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Introduction

Delivery guides are designed to represent a body of knowledge about teaching a particular topic and contain:

- Content: A clear outline of the content covered by the delivery guide;
- Thinking Conceptually: Expert guidance on the key concepts involved, common difficulties students may have, approaches to teaching that can help students understand these concepts and how this topic links conceptually to other areas of the subject;
- Thinking Contextually: A range of suggested teaching activities using a variety of themes so that different activities can be selected which best suit particular classes, learning styles or teaching approaches.

If you have any feedback on this Delivery Guide or suggestions for other resources you would like OCR to develop, please email resourcesfeedback@ocr.org.uk.

KEY



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Curriculum Content

Structure and function of the cardio-vascular system

- know the double-circulatory system (systemic and pulmonary).
- know the different types of blood vessel:
 - arteries
 - capillaries
 - veins.
- understand the pathway of blood through the heart:
 - atria
 - ventricles
 - bicuspid, tricuspid and semilunar valves
 - septum and major blood vessels:
 - aorta
 - pulmonary artery
 - vena cava
 - pulmonary vein.
- know the definitions of:
 - heart rate
 - stroke volume
 - cardiac output.
- know the role of red blood cells.



Thinking Conceptually

Approaches to teaching the content

As part of the compulsory content for GCSE physical education, students are required to develop their knowledge and understanding of key body systems. This guide focuses on the cardiovascular system and aims to provide teachers delivering course content suggestions of how they might approach this section of the specification. To understand the functions of the cardiovascular system students will need to undertake some initial learning of component structures. This understanding can then be applied to other areas of the specification. By frequently linking back and forth, across the specification, learning can be consolidated and students can be encouraged to think about the important role performed by the cardiovascular system in a range of different contexts.

Common misconceptions or difficulties students may have

One of the biggest problems faced by students studying anatomy and physiology is the terminology. For many it is such a different language that learning these new and confusing words is an uphill struggle. Teachers will need to use a range of different strategies to help students memorise the new words. Making learning a hands-on experience will help many PE students. Activities such as labelling or colouring diagrams, completing worksheets, using flashcards and testing with interactive quizzes are just some of the techniques which might be employed.

The next step involves helping students develop a more complete understanding and moves away from simple memorisation. Students will be required to recall the names structures and functions but students will also be examined on their understanding of how this knowledge can be applied to health, fitness and performance. Understanding other areas of the specification, for example the short and long-term effects of exercise, is much easier if students have first acquired a solid grasp of the functions of the key body systems.

Conceptual links to other areas of the specification – useful ways to approach this topic to set students up for topics later in the course

Effective learning of this topic underpins several other areas of the specification. A secure knowledge of the structure and understanding of the functions of the cardiovascular system is needed before these can be applied to an exercise, physical activity or physical training setting. Teachers should help students to understand that the body systems (muscular, cardiovascular and respiratory) do not work in isolation and that their responses to exercise are coordinated. Within the Applied Anatomy and Physiology section (1.1), functional links should therefore be made between the body systems when considering *the short-term and long-term (training) effects of exercise* of the CV system. The heart rate investigation activity provides the ideal opportunity for these links to be



Thinking Conceptually

made. Other areas where links can be made to encourage a comprehensive understanding of both topics include:

1.2 Physical training

Components of fitness – in particular, cardiovascular endurance

Principles of training - in particular, types of training

Optimising training – in particular, warm-up and cool down

2.2 Sociocultural influences

Drugs in sport – in particular, beta blockers and stimulants

2.3 Health, fitness and well being

Health benefits of physical activity and consequences of a sedentary lifestyle



ACTIVITIES

Links to a range of teaching and learning resources that can be used to enhance the delivery of the cardiovascular system in GCSE physical education are provided below.

The initial stage of teaching anatomy and physiology to physical education students involves helping them to build a foundation of knowledge. Much of this involves learning the names and functions of the structures of the cardiovascular system. Being able to remember the sequence of structures that a red blood cell will pass on its journey through the heart reinforces the learning of the structures and their functions. Flash card activities, word jumbles and interactive quizzes can be used to help students recall these structures and their functions. This foundation knowledge can then be applied to a range of physical education settings.

The heart rate investigation provides the opportunity for students to develop a better understanding of the function of the cardiovascular system and how it responds during exercise. The relationship between heart rate, stroke volume and cardiac output can be explored and the cardiovascular response can be related to the responses of other body systems and exercise scenarios.

BBC Education, ABPI Resources for Schools and YouTube channels such as Interactive Biology are examples of e-resources for both teaching and interactive learning. Students should be given the opportunity to learn via a wide range of resources in order to provide flexibility in the acquisition of subject knowledge and understanding.



Thinking Contextually

Activities	Resources
<p>ACTIVITY 1</p> <p>Heart Rate Investigation – Teacher Resource 1 and Learner Resource 1</p> <p>This activity links the topic areas 'structure and function of the cardiovascular system,' and 'short term effects of exercise.' The activity involves taking manual measures of heart rate using the radial pulse and is designed to help students contextualise their understanding of the functions of the cardiovascular system. It also provides an excellent opportunity for students to develop their skills of collecting, presenting and evaluating data.</p> <p>This activity is ideal for use in a practical lesson but can be adapted to a classroom environment. Teacher instructions accompany two choices of worksheet; one is more challenging and aimed at more able students. Teachers will need to offer students more guidance if they choose to use the simple version.</p>	
<p>ACTIVITY 2</p> <p>Racing RBCs</p> <p>Teacher instructions accompany a set of flash cards. The cards will need to be printed and laminated for use (Teacher Resource 2 Activity 1 and the green flash cards).</p> <p>This activity aims to help students learn the pathway of blood through the heart and uses: Use the green flash cards - each flash card has the name of a cardiovascular structure on one side and a description on the other side. Teachers may choose to print only one side of the card, the name of the structure, to make the task more challenging.</p> <p>Students are each given one of the 14 green flash cards. Students have to stand in the correct order; the order is the pathway that a red blood cell would take in one complete circuit of the body (vena cava – right atrium – tricuspid valve, etc.) Students race the clock or another group to complete the task.</p>	



Thinking Contextually

Activities	Resources
<p>ACTIVITY 3</p> <p>Flash Card revision/consolidation of learning</p> <p>Teacher instructions accompany a set of flash cards. The cards will need to be printed and laminated for use (Teacher Resource 2 Activity 2 along with both the green and blue flash cards).</p> <p>Flash cards are most frequently used for revision/consolidation purposes. Use the green and blue flash cards (20 cards in total). The name of each of the listed cardiovascular structures is on one side and a description on the other side. Two activities are suggested:</p> <p>What am I?</p> <p>Students work in pairs or small groups. Students take it in turns to read out the <i>description side</i> of the flash card. The other student(s) must work out the name of the structure being described.</p> <p>Describe me!</p> <p>Students work in pairs or small groups. Students take it in turns to read out the <i>structure side</i> of the card. The other student(s) recall as many facts as they can about the structure and its functions.</p>	
<p>ACTIVITY 4</p> <p>Word Un-Jumble: The pathway of a red blood cell (Teacher Resource 3, Learner Resource 2 and 3)</p> <p>This activity is designed to help students learn the names of the structures of the heart and the pathway of a red blood cell as it travels around the body in one complete circuit. Teacher instructions and answer sheet accompany two choices of activity:</p> <ul style="list-style-type: none"> • Simple Un-Jumble (Learner Resource 2): <i>the order of the structures is jumbled. A description is attached to each structure.</i> • Doubly-Difficult Un-Jumble (Learner Resource 3): <i>both the order of the structures AND their descriptions are jumbled, so there are two levels of 'un-jumbling' to complete.</i> <p>Students rearrange the list of structures and their descriptions to explain the pathway taken by a red blood cell as it travels around the body in one complete circuit. This can be completed by physically cutting and pasting the list of structures and descriptions onto a clean sheet of paper or by using Microsoft Word SmartArt Tools.</p>	



Thinking Contextually

Activities	Resources
<p>ACTIVITY 5</p> <p>BBC Education (Bitesize)</p> <p>A range of <i>cardiovascular system</i> learning materials and links to other useful resources can be found in the GCSE physical education and biology web pages: http://www.bbc.co.uk/education/subjects</p>	
<p>ACTIVITY 6</p> <p>ABPI Resources for Schools</p> <p>In the 14-16 biology section, the heart and circulation topic includes a number of interactive features: a glossary of terms, quick questions, animations and teacher downloads.</p> <p>http://www.abpischools.org.uk/</p>	
<p>ACTIVITY 7</p> <p>YouTube:</p> <p>There are a great many videos on YouTube which can be used to aid teaching, consolidation of learning or revision. Links to a selection of these are provided below:</p> <p>Interactive Biology</p> <p>Anatomy of the heart</p> <p>https://www.youtube.com/watch?v=6gV2tcwbD98</p> <p>This video, from interactive-biology.com, goes through the anatomy of the heart, including the four chambers, the valves and the major arteries and veins.</p> <p>How blood flows through the heart</p> <p>https://www.youtube.com/watch?v=VUtehbgbpRk</p> <p>This video, from interactive-biology.com, uses diagrams to explain how blood flows through the structures of the heart.</p>	



Thinking Contextually

Activities	Resources
<p>ACTIVITY 8</p> <p>At-Bristol Science Centre</p> <p>What's inside a heart? Heart Dissection</p> <p>https://www.youtube.com/watch?v=yE3Y-XR8Ax4</p> <p>This video from the At-Bristol Science Centre YouTube channel takes a close look at the anatomy of a pig's heart. While it is a very good video, it is quite graphic and may not be suitable for all students.</p>	
<p>ACTIVITY 9</p> <p>Science Music Videos</p> <p>These circulatory system resources, provided by the Science music videos YouTube channel, include a rap, interactive quizzes and flashcards.</p> <p>Circulatory System Rap (Pump it up!)</p> <p>https://www.youtube.com/watch?v=KSbbDnbSEyM</p> <p>links to:</p> <ol style="list-style-type: none">1. Circulatory System Musical Quiz (Heart Quiz) <p>https://www.youtube.com/watch?v=T2iVqTckmPQ</p> <ol style="list-style-type: none">2. Heart Anatomy Quizzes and Flashcards <p>http://www.sciencemusicvideos.com/heart-anatomy-flashcards/</p>	



Teacher resource 1 Heart Rate Investigation

AIM

The aims of this activity are:

1. For students to learn how to take someone's radial pulse
2. For students to investigate the short-term effects of exercise on heart rate.

There are two versions of the student worksheet:

Worksheet A – simplified version suitable for all GCSE students.

Worksheet B – a detailed version that aims to challenge more able students.

ORGANISATION

You will need stopwatches and copies of the worksheets. For this activity you will probably choose to work in a gym, fitness suite or sports hall, but the activities can be adapted for a classroom environment.

To make the most of this activity you need some way of ensuring that students are exercising at different intensities. Low intensity exercise might be a gentle jog or brisk walking; exercise they would describe as 'very light' work (approx. 50 Watts on a cycle ergometer). High intensity exercise might be faster running or cycling; exercise they would describe as 'hard' work (approx. 150 Watts on a cycle ergometer).

Teachers should check for any students with heart or breathing problems. Complete a physical activity readiness questionnaire (PAR-Q) if local regulations require this.

ACTIVITY

1. Explain the aim of the activity to the class
2. Help students to locate their own radial pulse before taking another student's. Students sometimes struggle with this as they apply too much/too little pressure or palpate the wrong location.
3. Ask students to work through the worksheet or as you choose to direct the activity.
4. Students to complete the review questions on the worksheet.
5. You may also choose to ask students to plot their results on a graph using graph paper or a programme such as Microsoft Excel. Remind students that HR should go on the Y axis (as it is the dependent variable) and exercise time/type should go on the X axis (independent variable). Look for selection of appropriate scales and labels on each axis, with values and units clearly marked. There should also be an appropriate title for the graph.

Other useful sources of information include:

In the Zone

In the Zone is the Wellcome Trust's major initiative inspired by the London 2012 Olympic and Paralympic Games. It provides a fun, free and fascinating way of using science to discover how our bodies work during sport, activity, movement and rest.

<http://www.getinthezone.org.uk/>

<http://www.getinthezone.org.uk/take-it-further/>

Teachers can download PowerPoints, editable Teacher and Student Notes, and extra resources to support you in delivering In the Zone investigations in your classroom.

11-19 year olds can use the [Live Data Zone](#) to upload the results of In the Zone experiments and compare to other students across the UK.

British Heart Foundation

<https://www.bhf.org.uk/heart-health/tests/checking-your-pulse>

American Heart Association

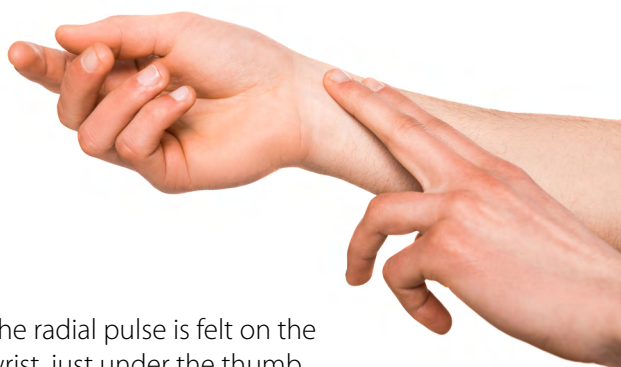
http://www.heart.org/HEARTORG/Conditions/More/MyHeartandStrokeNews/All-About-Heart-Rate-Pulse_UCM_438850_Article.jsp

Learner resource 1a Heart Rate Investigation

Worksheet A

AIMS OF THIS SESSION:

1. Learn how to take someone's radial pulse.
2. Investigate the short-term effects of exercise on heart rate.



The radial pulse is felt on the wrist, just under the thumb

What is your 'pulse'?

When the heart contracts it pumps blood into the arteries. The surge of blood passes along the arteries like a wave. You can feel the pressure of this wave of blood where an artery is close to the surface of the skin and rests on a hard structure, such as a bone. The surge of blood you can feel, is called your 'pulse'. Each pulse represents one heart beat.

ACTIVITY

Investigating the short-term effects of exercise on heart rate

1. Place your first two fingers (index and middle) on the inside of the wrist, at the base of the thumb. Move your fingers around until you find the radial pulse.
2. Count the number of pulses you feel in 15 seconds.
3. Multiply by four to calculate the resting heart rate in beats per minute (bpm).

Pulses in 15 seconds = _____

x 4

My resting heart rate is: _____ bpm

Learner resource 1a Heart Rate Investigation

4. In pairs, decide who the investigator is and who the participant is. The investigator takes the participant's resting heart rate and records this value in the table below.

What is a normal resting heart rate?

Most healthy adults and teenagers will have a resting heart rate between 60 and 100 bpm. Your heart rate may be lower if you are very fit and do lots of exercise. Some elite endurance athletes, like Mo Farrah and Bradley Wiggins, have resting heart rates lower than 40 bpm.



5. **Immediately before** exercising (2 minutes low intensity), measure heart rate. Record in the table below.
6. **Immediately after** exercising (2 minutes low intensity), measure heart rate. Record in the table below.
7. Allow **5 minutes rest**.
8. **Immediately after** exercising (2 minutes high intensity), measure heart rate. Record in the table below.

	Heart Rate (your measurements)
Sitting quietly	
Immediately before exercise	
Immediately after low intensity exercise	
Immediately after high intensity exercise	

Learner resource 1a Heart Rate Investigation

Questions

What happened to your heart rate...

1. When you were waiting to start exercise?

Why did this happen?

2. When you exercised at a low intensity?

Why did this happen?

3. When you exercised at a high intensity?

Why did this happen?

4. What other changes did you notice while you were exercising? Think about the short-term effects of exercise on the cardiovascular and respiratory systems.



Learner resource 1b Heart Rate Investigation

Worksheet B

AIMS OF THIS SESSION:

1. Learn how to take your own and someone else's radial pulse.
2. Investigate the short-term effects of exercise on heart rate.



The radial pulse is felt on the wrist, just under the thumb

What is your 'pulse'?

When the heart contracts it pumps blood into the arteries. The surge of blood passes along the arteries like a wave. You can feel the pressure of this wave of blood where an artery is close to the surface of the skin and rests on a hard structure, such as a bone. The surge of blood you can feel, is called your 'pulse'. Each pulse represents one heart beat.

ACTIVITY 1

Finding your radial pulse

One of the easiest places to feel your pulse is at your wrist.

1. Sit quietly and rest one of your hands in front of you, with your palm facing up and your elbow slightly bent.
2. Gently place the tips of the first two fingers (index and middle) of your other hand on the inside of your wrist, at the base of the thumb. Do not use your thumb to feel for your pulse – it has a strong pulse of its own.
3. Press lightly and feel for the pulse. You should be feeling between the bone on the outside of your arm (your radius) and the tendons that run along the front of the wrist. You may have to move your fingers around until you find the right place, or apply more or less pressure.
4. Now see if you can find the radial pulse on another person.

Learner resource 1b Heart Rate Investigation

ACTIVITY 2

Measuring heart rate using radial pulse

1. Sit quietly and locate your radial pulse.
2. Count the number of pulses you feel in 15 seconds.
3. Multiply by four to give your resting heart rate in beats per minute (bpm).

Pulses in 15 seconds = _____

x 4

My resting heart rate is: _____ bpm

What is a normal resting heart rate?

Most healthy adults and teenagers will have a resting heart rate between 60 and 100 bpm. Your heart rate may be lower if you are very fit and do lots of exercise. Some elite endurance athletes, like Mo Farrah and Bradley Wiggins, have resting heart rates lower than 40 bpm.



Learner resource 1b Heart Rate Investigation

ACTIVITY 3

Investigating the short-term effects of exercise on heart rate

- Work in pairs or small groups for this activity.
 - There should be one **investigator** (who takes all the measurements) and one **participant** (whose heart rate will be measured before and after exercise).
 - If working in a small group, one person might be the recorder, another might be in charge of timing or other equipment.
1. Read all the instructions (1- 6) before you start.
 2. Decide what your participant will be doing for the two minutes of low and high intensity exercise.
 - a. Low intensity exercise might be a gentle jog or brisk walking; exercise they would describe as 'very light' work (approx. 50 Watts on a cycle ergometer).
 - b. High intensity exercise might be faster running or cycling; exercise they would describe as 'hard' work (approx. 150 Watts on a cycle ergometer).
 3. Measure the participant's resting pulse. Record in the table below.
 4. Two minutes of low intensity exercise:
 - a. Measure the participant's heart rate immediately before exercise. Record in the table provided.
 - b. Measure the participant's heart rate immediately after exercise. Record in the table provided.
 5. Allow 5 minutes rest.
 6. Two minutes high intensity exercise. Measure the participant's heart rate immediately after two minutes of high intensity exercise. Record in the table below.

	Heart Rate (your measurements)	Stroke Volume (your calculations)	Cardiac Output (estimated values)
Sitting quietly			5 L
Immediately before exercise			5 L
Immediately after low intensity exercise			10 L
Immediately after high intensity exercise			15 L

Learner resource 1b Heart Rate Investigation

Calculate stroke volume

Using your knowledge of the relationship between heart rate, stroke volume and cardiac output, calculate your participant's stroke volume, based on the estimated values for cardiac output. Enter your calculated values in the table above.

Helpful hint!

Heart rate (bpm) X stroke volume (mL) = cardiac output (L)

Example: If measure heart rate is 70 bpm and estimated cardiac output of 5 L, to calculate stroke volume you would use this formula:

$$\frac{\text{CO (L)}}{\text{HR (bpm)}} = \text{SV (mL)}$$

**Remember to convert the calculated SV value (L) to mL by multiplying by 1000*

	Heart Rate (your measurements)	Stroke Volume (your calculations)	Cardiac Output (estimated values)
Sitting quietly	70 bpm	71 mL	5 L

Learner resource 1b Heart Rate Investigation

Questions

What happened to your heart rate...

5. When you were waiting to start your exercise?

Why did this happen?

6. When you exercised at a low intensity?

Why did this happen?

7. When you exercised at a high intensity?

Why did this happen?

8. What other changes did you notice while you were exercising? Think about the short-term effects of exercise on the cardiovascular and respiratory systems.



Teacher resource 2 Flash Card Activities

Activity 1: Racing RBCs

AIM

The aim of this activity is to help students learn the pathway of blood through the heart. Each flash card has the name of a cardiovascular structure on one side and a description on the other side. The structures are those named in the OCR GCSE (9–1) PE specification that a red blood cell (RBC) passes on its way around the body. This activity involves students putting these cards in the right order.

ORGANISATION

You will need to print and laminate the flash cards. For this activity you may choose to print only one side of the card, the name of the structure, to make the task more challenging. There are 14 cards so you may need to adapt the activity to suit your class size (green flash cards). This activity works well if you have a class of 28 as you can split the class into two groups of 14 so that the groups can race each other as well as the clock.

ACTIVITY

1. Explain the aim of the activity to the class.
2. Shuffle the flash cards and hand them out – one card per student.
3. The students need to read the card and on your command, race to stand in the correct order. The order is the pathway that a red blood cell would take in one complete circuit of the body.
4. The pathway starts and ends at the vena cava so the group should end up standing in a circle.

Activity 2: Revision/consolidation of learning

AIM

The aim of these activities is to help students consolidate their learning of the structures and functions of the cardiovascular system. Each flash card has the name of a cardiovascular structure on one side and a description on the other side. The activities outlined below are just two examples of ways in which the flash cards might be used. Tasking the students to create their own flashcards is also recommended.

ORGANISATION

You will need to print and laminate the flash cards. There are 21 cards in a full set of CV system flash cards (green and blue flash cards). You can choose to use the 'description' side of the card as the starting point OR the 'structure' side. Activities for each of these starting points are outlined below:

ACTIVITY

What am I?

1. Hand out a complete set of flash cards to each pair or group of students.
2. Students take it in turns to read out the *description side* of the flash card.
3. The other student(s) must work out the name of the structure being described.
4. Once they have correctly identified the structure the pair/group should recall as many other facts about the structure and its function as they can.

ACTIVITY

Describe me!

1. Hand out a complete set of flash cards to each pair or group of students.
2. Students take it in turns to read out the *named structure side* of the card.
3. The other student(s) try to recall as many facts as they can about the structure and its functions (remember that not all this information will be on the cards).



Vena Cava

**This is the largest vein in the body.
It carries deoxygenated blood back to the heart.**

Aorta

**This is the largest artery in the body.
It carries oxygenated blood away from the heart.**



**Pulmonary
artery**

**This blood vessel carries
deoxygenated blood
from the heart to the
lungs.**

**Pulmonary
vein**

**This blood vessel carries
oxygenated blood from
the lungs to the heart.**



Bicuspid valve

**This valve separates
the left atrium and left
ventricle.
It stops backflow of
blood from the ventricle
into the atrium.**

Tricuspid valve

**This valve separates the
right atrium and right
ventricle.
It stops backflow of
blood from the ventricle
into the atrium.**



**Semi-lunar
valve**

**This valve is found in the
pulmonary artery/the
aorta.**

**It stops backflow of
blood into the heart.**

**Semi-lunar
valve**

**This valve is found in the
pulmonary artery/the
aorta.**

**It stops backflow of
blood into the heart.**



Teacher resource 2 Flash Card Activities

**Right
atrium**

**This small heart
chamber receives
deoxygenated blood
from the vena cava.**

**Right
ventricle**

**This large heart
chamber receives
deoxygenated blood
from the right atrium.**



Left atrium

This small heart chamber receives oxygenated blood from the pulmonary vein.

Left ventricle

**This large heart chamber has a thick muscular wall.
It receives oxygenated blood from the left atrium.**



The lungs

This is where the blood is taken by the pulmonary circulation. Deoxygenated blood picks up oxygen here and then takes it back to the heart.

The body

This is where the blood is taken by the systemic circulation. Oxygenated blood is transported here and deoxygenated blood is taken back to the heart.



Capillaries

These are the smallest blood vessels.

They are so small that red blood cells can only just squeeze through them.

The walls are only one cell thick to allow the diffusion of important substances (e.g. carbon dioxide & oxygen) to and from the blood.

Arteries

These blood vessels carry blood away from the heart.

They have thick muscular walls. The largest of this type of blood vessel is the aorta.

All of this type of blood vessel carries oxygenated blood EXCEPT one (the pulmonary).



Veins

These blood vessels carry blood towards the heart.

They have thinner walls and contain valves to stop backflow. The largest of this type of blood vessel is the aorta.

All of this type of blood vessel carries deoxygenated blood EXCEPT one (the Pulmonary).

Heart rate

This is the number of times the heart beats in a minute.

Normal resting values for a healthy adult are between 60 – 100 beats per minute.

Trained endurance athletes will have a lower resting value (less than 40 beats per minute).

You can measure this value by feeling your radial pulse.



Stroke volume

This is the amount of blood that can be pumped out of the left ventricle in one beat.

A normal resting value for a healthy adult is approximately 70mL of blood. Trained endurance athletes will have higher resting values (more than 100 mL).

This is because endurance training increases the size and strength of the heart.

Cardiac output

This is the amount of blood that is pumped out of the left ventricle in one minute.

You can calculate this value using heart rate and stroke volume ($HR \times SV = \dots$)

A normal resting value for both a healthy adult and a trained athlete is approximately 5L of blood per minute. During exercise this value will increase.



Red Blood Cell

This is the component of blood which transports oxygen to the working muscles.

It contains haemoglobin, which is a red protein that carries the oxygen.

It has a strange flattened shape (no nucleus). This provides a large surface area for rapid diffusion of oxygen.

It is very small – there are 5 million in one drop of blood!



Teacher resource 3 Cardiovascular System

Word Jumble activities

Simple Word Jumble: The pathway of a red blood cell

Rearrange the list of structures and their descriptions to explain the pathway taken by a red blood cell as it travels around the body in one complete circuit.

You can do this in one of two ways:

1. Cut and paste

- Print the jumbled list of structures and their descriptions.
- Cut out each structure with its description using a pair of scissors.
- Place the structure and description in the right order (start with the vena cava).
- Paste them onto a clean sheet of A4 paper.
- Give the page an accurate title.

2. Using Word SmartArt Tools

- Copy the table into a new document in Word.
- To move the structure boxes so that they are in the right order you will need to click on the first structure box to open the SmartArt Tools bar.
- Then click the 'design' tab on the top ribbon. This opens the 'create graphic' options which enable you to move the boxes up and down.
- Remember to start with the vena cava.
- Give the page an accurate title and print the page.

Doubly-Difficult Word Jumble: The pathway of a red blood cell

Rearrange the list of structures and their descriptions to explain the pathway taken by a red blood cell as it travels around the body in one complete circuit.

NB both the order of the structures AND their descriptions are jumbled.

You can do this in one of two ways:

1. Cut and paste

- Print the jumbled list of structures and their descriptions.
- Cut out each structure and each description using a pair of scissors.
- Match the structure to the correct description.
- Place the matched structure and description in the right order (start with the vena cava).
- Paste them onto a clean sheet of A4 paper.
- Give the page an accurate title.

2. Using Word SmartArt Tools

- Copy the table into a new document in Word.
- First match the structure to the correct description. You will need to cut and paste the descriptions into the correct box using Ctrl X to cut and Ctrl V to paste the text.
- Next, move the structure boxes so that they are in the right order (start with the vena cava). You will need to click on the first structure box to open the SmartArt Tools bar. Then click the design tab on the top ribbon. This opens the 'create graphic' options which enable you to move the boxes up and down.
- Give the page an accurate title and print the page.

Teacher resource 3 Cardiovascular System

Teachers' Answer Sheet

vena cava	The largest vein in the body. Carries deoxygenated blood back to the heart.
right atrium	A small heart chamber which receives deoxygenated blood from the vena cava.
tricuspid valve	The valve that separates the right atrium and right ventricle. It stops backflow of blood from the ventricle into the atrium.
right ventricle	A large heart chamber which receives deoxygenated blood from the right atrium.
semi-lunar valve	This valve is found in the pulmonary artery. It stops backflow of blood into the heart.
pulmonary artery	The blood vessel that carries deoxygenated blood from the heart to the lungs.
the lungs	Where the blood is taken by the pulmonary circulation. Deoxygenated blood picks up oxygen here and then takes it back to the heart.
pulmonary vein	The blood vessel that carries oxygenated blood from the lungs to the heart.
left atrium	A small heart chamber which receives oxygenated blood from the pulmonary vein.
bicuspid valve	The valve that separates the left atrium and left ventricle. It stops backflow of blood from the ventricle into the atrium.
left ventricle	A large heart chamber which has a thick muscular wall. It receives oxygenated blood from the left atrium.
semi-lunar valve	This valve is found in the the aorta. It stops backflow of blood into the heart.
aorta	The largest artery in the body. Carries oxygenated blood away from the heart.
the body	Where the blood is taken by the systemic circulation. Oxygenated blood is transported here and deoxygenated blood is taken back to the heart.

Learner resource 2 Simple word jumble

The pathway of a red blood cell

vena cava	The largest vein in the body. Carries deoxygenated blood back to the heart.
aorta	The largest artery in the body. Carries oxygenated blood away from the heart.
pulmonary artery	The blood vessel that carries deoxygenated blood from the heart to the lungs.
pulmonary vein	The blood vessel that carries oxygenated blood from the lungs to the heart.
bicuspid valve	The valve that separates the left atrium and left ventricle. It stops backflow of blood from the ventricle into the atrium.
tricuspid valve	The valve that separates the right atrium and right ventricle. It stops backflow of blood from the ventricle into the atrium.
semi-lunar valve	This valve is found in the pulmonary artery. It stops backflow of blood into the heart.
semi-lunar valve	This valve is found in the the aorta. It stops backflow of blood into the heart.
the body	Where the blood is taken by the systemic circulation. Oxygenated blood is transported here and deoxygenated blood is taken back to the heart.
the lungs	Where the blood is taken by the pulmonary circulation. Deoxygenated blood picks up oxygen here and then takes it back to the heart.
right ventricle	A large heart chamber which receives deoxygenated blood from the right atrium.
left ventricle	A large heart chamber which has a thick muscular wall. It receives oxygenated blood from the left atrium.
right atrium	A small heart chamber which receives deoxygenated blood from the vena cava.
left atrium	A small heart chamber which receives oxygenated blood from the pulmonary vein.

Learner resource 3 Doubly-Difficult Word Jumble

The pathway of a red blood cell

vena cava	A small heart chamber which receives oxygenated blood from the pulmonary vein.
aorta	The valve that separates the right atrium and right ventricle. It stops backflow of blood from the ventricle into the atrium.
pulmonary artery	The largest artery in the body. Carries oxygenated blood away from the heart.
pulmonary vein	This valve is found in the the aorta. It stops backflow of blood into the heart.
bicuspid valve	Where the blood is taken by the pulmonary circulation. Deoxygenated blood picks up oxygen here and then takes it back to the heart.
tricuspid valve	The blood vessel that carries oxygenated blood from the lungs to the heart.
semi-lunar valve	A large heart chamber which has a thick muscular wall. It receives oxygenated blood from the left atrium.
semi-lunar valve	Where the blood is taken by the systemic circulation. Oxygenated blood is transported here and deoxygenated blood is taken back to the heart.
the body	This valve is found in the pulmonary artery. It stops backflow of blood into the heart.
the lungs	A large heart chamber which receives deoxygenated blood from the right atrium.
right ventricle	The valve that separates the left atrium and left ventricle. It stops backflow of blood from the ventricle into the atrium.
left ventricle	A small heart chamber which receives deoxygenated blood from the vena cava.
right atrium	The blood vessel that carries deoxygenated blood from the heart to the lungs.
left atrium	The largest vein in the body. Carries deoxygenated blood back to the heart.



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