

# GRAYS TUITION CENTRE – Online Tutoring

**WEEK: 12**

**Week Beginning: 08/03/21**

**Subject: SCIENCE**

**Year: 10**

## Lesson Objective:

- To learn about the Circulatory System
- To be able to describe how blood flows through the heart
- To be able to understand the role of the blood and the different types of blood vessels
- Any topic covered during online learning that students would like to review.

## Keywords/ Concepts

- Double Circulatory System
- Atria, Ventricles
- Erythrocytes
- Capillaries
- Arteries
- Veins
- Review

## Class Worksheets

- CGP: Circulatory system – Heart
- CGP: Circulatory System – Blood

## Homework

## Additional Notes

- Last Lesson of Online Tuition!
- I hope you all benefitted and learnt a lot from these sessions.
- Please take a moment to think about any questions you might have from any topic covered during online lessons or a topic you would like to review.
- See you soon!

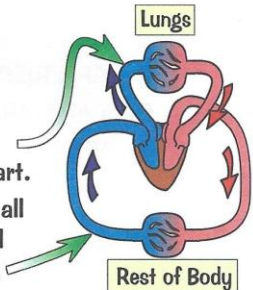
## Circulatory System — The Heart

The circulatory system carries food and oxygen to every cell in the body. As well as being a delivery service, it's also a waste collection service — it carries waste products to where they can be removed from the body.

### The **DOUBLE** Circulatory System, Actually

The circulatory system is made up of the heart, blood vessels and blood. Humans have a double circulatory system — two circuits joined together:

- 1) In the first one, the right ventricle (see below) pumps deoxygenated blood (blood without oxygen) to the lungs to take in oxygen. The blood then returns to the heart.
- 2) In the second one, the left ventricle (see below) pumps oxygenated blood around all the other organs of the body. The blood gives up its oxygen at the body cells and the deoxygenated blood returns to the heart to be pumped out to the lungs again.

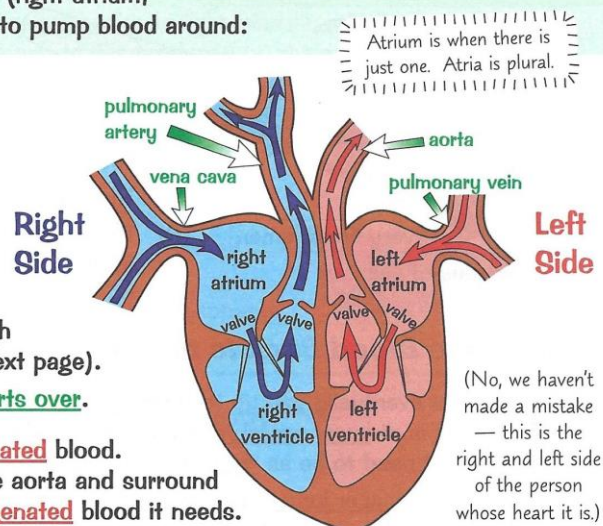


### The Heart Contracts to Pump Blood Around The Body

- 1) The heart is a pumping organ that keeps the blood flowing around the body. The walls of the heart are mostly made of muscle tissue.
- 2) The heart has valves to make sure that blood flows in the right direction — they prevent it flowing backwards.
- 3) This is how the heart uses its four chambers (right atrium, right ventricle, left atrium and left ventricle) to pump blood around:

- 1) Blood flows into the two atria from the vena cava and the pulmonary vein.
- 2) The atria contract, pushing the blood into the ventricles.
- 3) The ventricles contract, forcing the blood into the pulmonary artery and the aorta, and out of the heart.
- 4) The blood then flows to the organs through arteries, and returns through veins (see next page).
- 5) The atria fill again and the whole cycle starts over.

The heart also needs its own supply of oxygenated blood. Arteries called coronary arteries branch off the aorta and surround the heart, making sure that it gets all the oxygenated blood it needs.



### The Heart Has a Pacemaker

- 1) Your resting heart rate is controlled by a group of cells in the right atrium wall that act as a pacemaker.
- 2) These cells produce a small electric impulse which spreads to the surrounding muscle cells, causing them to contract.
- 3) An artificial pacemaker is often used to control heartbeat if the natural pacemaker cells don't work properly (e.g. if the patient has an irregular heartbeat). It's a little device that's implanted under the skin and has a wire going to the heart. It produces an electric current to keep the heart beating regularly.

### Okay — let's get to the heart of the matter...

Interesting fact — when doctors use a stethoscope to listen to your heart, it's the valves closing that they hear.

Q1 Which chamber of the heart pumps deoxygenated blood to the lungs?

[1 mark]

Q2 What is the function of the coronary arteries?

[1 mark]

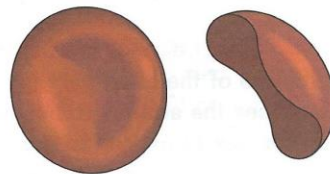


## Circulatory System — Blood

**Blood** is a **tissue**. One of its jobs is to act as a huge **transport** system. There are four main things in blood...

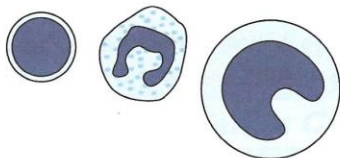
### Red Blood Cells Carry Oxygen

- 1) The job of red blood cells is to carry **oxygen** from the lungs to all the cells in the body.
- 2) Their shape is a **biconcave disc** (like a doughnut) — this gives a **large surface area** for absorbing **oxygen**.
- 3) They **don't** have a nucleus — this allows more room to carry oxygen.
- 4) They contain a red pigment called **haemoglobin**.
- 5) In the **lungs**, haemoglobin binds to **oxygen** to become **oxyhaemoglobin**. In body tissues, the reverse happens — oxyhaemoglobin splits up into haemoglobin and oxygen, to **release oxygen** to the **cells**.



The more red blood cells you've got, the more oxygen can get to your cells. At high altitudes there's less oxygen in the air — so people who live there produce more red blood cells to compensate.

### White Blood Cells Defend Against Infection



- 1) Some can change shape to gobble up unwelcome **microorganisms**, in a process called **phagocytosis**.
- 2) Others produce **antibodies** to fight microorganisms, as well as **antitoxins** to neutralise any toxins produced by the microorganisms.
- 3) Unlike red blood cells, they **do** have a **nucleus**.

### Platelets Help Blood Clot

- 1) These are **small fragments** of **cells**. They have **no nucleus**.
- 2) They help the blood to **clot** at a wound — to stop all your **blood pouring out** and to stop **microorganisms** getting in. (So basically platelets just float about waiting for accidents to happen.)
- 3) **Lack** of platelets can cause excessive bleeding and bruising.



### Plasma is the Liquid That Carries Everything in Blood

This is a pale straw-coloured liquid which **carries just about everything**:

- 1) **Red** and **white blood cells** and **platelets**.
- 2) Nutrients like **glucose** and **amino acids**.  
These are the soluble products of digestion which are absorbed from the gut and taken to the cells of the body.
- 3) **Carbon dioxide** from the organs to the lungs.
- 4) **Urea** from the liver to the kidneys.
- 5) **Hormones**.
- 6) **Proteins**.
- 7) **Antibodies** and **antitoxins** produced by the white blood cells.



### Platelets — ideal for small dinners...

When you're ill the doctor often takes a blood sample for analysis. Blood tests can be used to diagnose loads of things — not just disorders of the blood. This is because the blood transports so many chemicals produced by so many organs... and it's easier to take blood than, say, a piece of muscle.

Q1 Describe the purpose of platelets in blood.

[1 mark]

Q2 Outline three ways in which red blood cells are adapted to carry oxygen.

[3 marks]

Topic B2 — Organisation



# Circulatory System — Blood Vessels

Want to know more about the circulatory system... Good. Because here's a whole extra page.

## Blood Vessels are Designed for Their Function

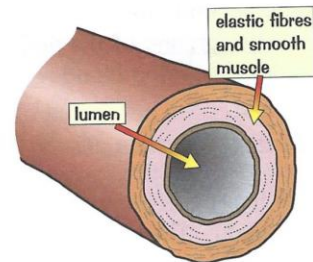
There are three different types of blood vessel:

- 1) **ARTERIES** — these carry the blood away from the heart.
- 2) **CAPILLARIES** — these are involved in the exchange of materials at the tissues.
- 3) **VEINS** — these carry the blood to the heart.

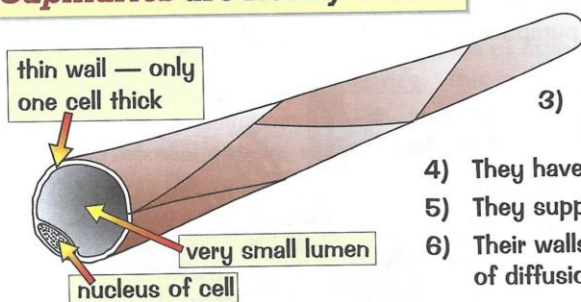


## Arteries Carry Blood Under Pressure

- 1) The heart pumps the blood out at high pressure so the artery walls are strong and elastic.
- 2) The walls are thick compared to the size of the hole down the middle (the "lumen" — silly name!).
- 3) They contain thick layers of muscle to make them strong, and elastic fibres to allow them to stretch and spring back.



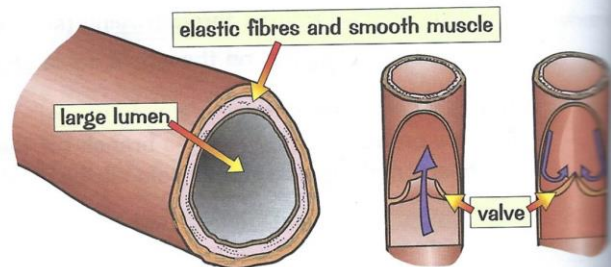
## Capillaries are Really Small



- 1) Arteries branch into capillaries.
- 2) Capillaries are really tiny — too small to see.
- 3) They carry the blood really close to every cell in the body to exchange substances with them.
- 4) They have permeable walls, so substances can diffuse in and out.
- 5) They supply food and oxygen, and take away waste like CO<sub>2</sub>.
- 6) Their walls are usually only one cell thick. This increases the rate of diffusion by decreasing the distance over which it occurs.

## Veins Take Blood Back to the Heart

- 1) Capillaries eventually join up to form veins. The blood is at lower pressure in the veins so the walls don't need to be as thick as artery walls.
- 2) They have a bigger lumen than arteries to help the blood flow despite the lower pressure.
- 3) They also have valves to help keep the blood flowing in the right direction.



## You Can Calculate the Rate of Blood Flow

You might get asked to calculate the rate of blood flow in your exam. Thankfully, it's not too tricky. Take a look at this example:

### EXAMPLE:

1464 ml of blood passed through an artery in 4.5 minutes.  
Calculate the rate of blood flow through the artery in ml/min.  
$$\text{rate of blood flow} = \text{volume of blood} \div \text{number of minutes}$$
$$= 1464 \div 4.5 = 325 \text{ ml/min}$$

## Learn this page — don't struggle in vein...

Here's an interesting fact for you — your body contains about 60 000 miles of blood vessels.

Q1 Describe how veins are adapted to carry blood back to the heart.

[2 marks]

Topic B2 — Organisation

## Circulatory System — The Heart

- 1 Humans have a double circulatory system. The heart pumps blood around the body through a network of veins and arteries. **Figure 1** shows a diagram of the heart.

Grade  
4-6

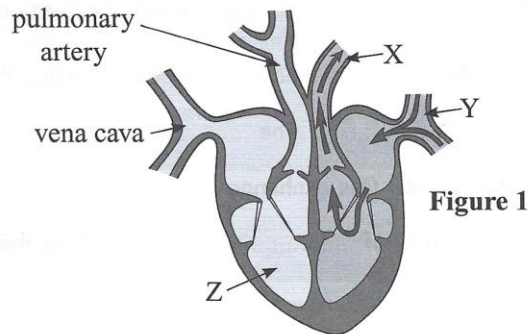


Figure 1

- 1.1 Name the parts of the heart labelled X, Y and Z in **Figure 1**.

X ..... Y ..... Z ..... [3]

- 1.2 Draw arrows on **Figure 1** to show the direction of blood flow through the right side of the heart. [1]

- 1.3 Explain why the human circulatory system is described as a 'double circulatory system'.

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[3]

[Total 7 marks]

- 2 The heart beats to circulate blood around the body.

Grade  
6-7

- 2.1 Describe how the heartbeat is controlled.

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[2]

- 2.2 Atrial fibrillation is a condition where the heartbeat is irregular. It is caused by problems with the heart's ability to control its own beat. Suggest how atrial fibrillation could be treated.

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[2]

[Total 4 marks]



## Circulatory System — Blood

- 1 Blood is made up of several different components, including white blood cells, red blood cells and platelets.



- 1.1 Some diseases affect the body's ability to produce enough white blood cells. Suggest why people with these diseases are more likely to experience frequent infections.

[1]

- 1.2 Explain how white blood cells are adapted to perform their function.

[3]

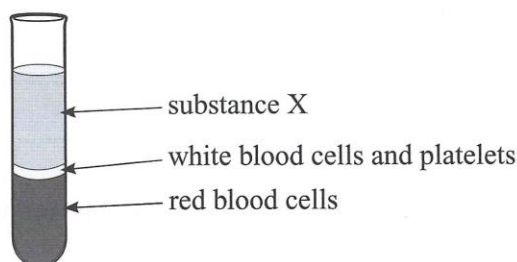
- 1.3 Red blood cells carry oxygen from the lungs to other tissues in the body. Explain how red blood cells are adapted for their function.

[3]

The components of blood can be separated by spinning them at high speed.

**Figure 1** shows a tube of blood that has been separated in this way.

**Figure 1**



- 1.4 Identify the substance labelled X.

[1]

- 1.5 A scientist analysing the blood sample found that it had a lower than normal concentration of platelets. Describe the structure and function of platelets.

[2]

[Total 10 marks]

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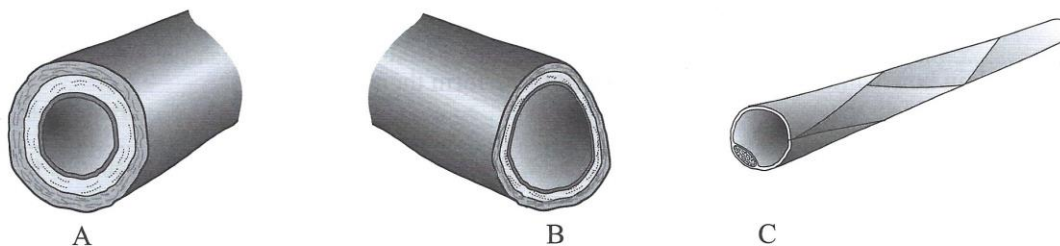
## Circulatory System — Blood Vessels

- 1 Blood is carried around the body in blood vessels.  
Different types of blood vessel perform different functions.



Figure 1 shows the three types of blood vessel.

Figure 1



- 1.1 Which of these blood vessels, A, B or C is an artery? Tick **one** box.

☐

A

☐

B

☐

C

[1]

- 1.2 The blood in arteries flows under high pressure.  
Explain how arteries are adapted to perform their function.

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[2]

- 1.3 Name the type of blood vessel that has valves.

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[1]

- 1.4 Why does the blood vessel named in 1.3 have valves?

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[1]

- 1.5 Explain why the walls of capillaries are only one cell thick.  
Refer to their function in your answer.

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[2]

[Total 7 marks]



Topic B2 — Organisation