Heart and Blood

Section 1: Circulatory System

• Why do humans need a transport system?

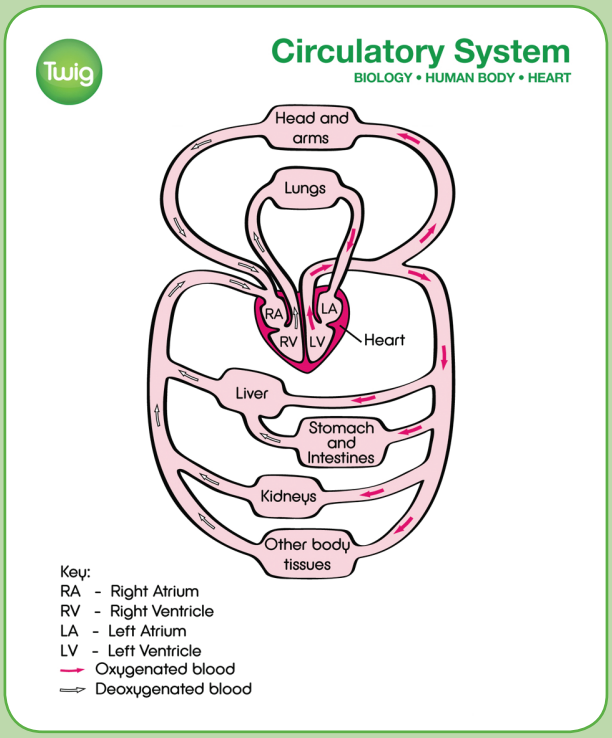
Blood vessels transport blood around the whole body

Humans are large organisms, therefore many of their cells are distant from those organs which gather required substances or remove wastes. For example, a transport system will collect food molecules, such as glucose and amino acids, from the digestive system and transport them all around the body to the cells. Similarly, waste materials like urea, which are made in the liver, have to be transported to the kidney for excretion.

• Suggested Film

– Blood

DIAGRAM 01:



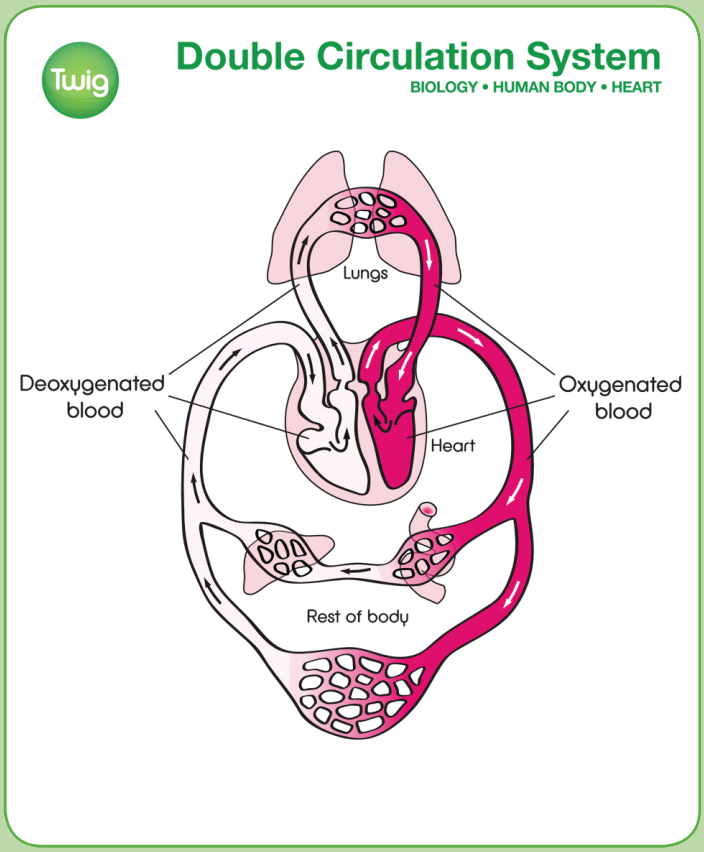
Extension Question

Q1. What substances are transported in the blood?

The important ones are oxygen, which the blood collects in the lungs and transports to every cell for respiration, carbon dioxide, glucose, amino acids, minerals, vitamins, urea, hormones and antibodies.

• What does the human transport system consist of?

DIAGRAM 02:



The transport system in humans consists of a number of types of tube (blood vessels called arteries, veins and capillaries), a pump (the heart) and a liquid (the blood) which circulates within the blood vessels.

The system is a closed circulatory system – this means the blood goes round and round, while substances are added or removed from it. During every complete circuit the blood travels through the heart twice, so the human transport system is known as a double circulatory system. The blood travels from the heart to the lungs in order to exchange gases (oxygen and carbon dioxide), and then returns to the heart before being pumped round the rest of the body. This is why the heart has two sides; one side pumps blood to the lungs, the other to the rest of the body.

• Suggested Film

– Blood

The heart connected to arteries and veins

Extension Question

Q2. What is the advantage of a double circulatory system?

Because the blood is pumped twice in a double circulatory system, higher pressures can be maintained and so the blood can flow at greater rates, delivering oxygen and nutrients more quickly to the cells.

Section 2: Blood

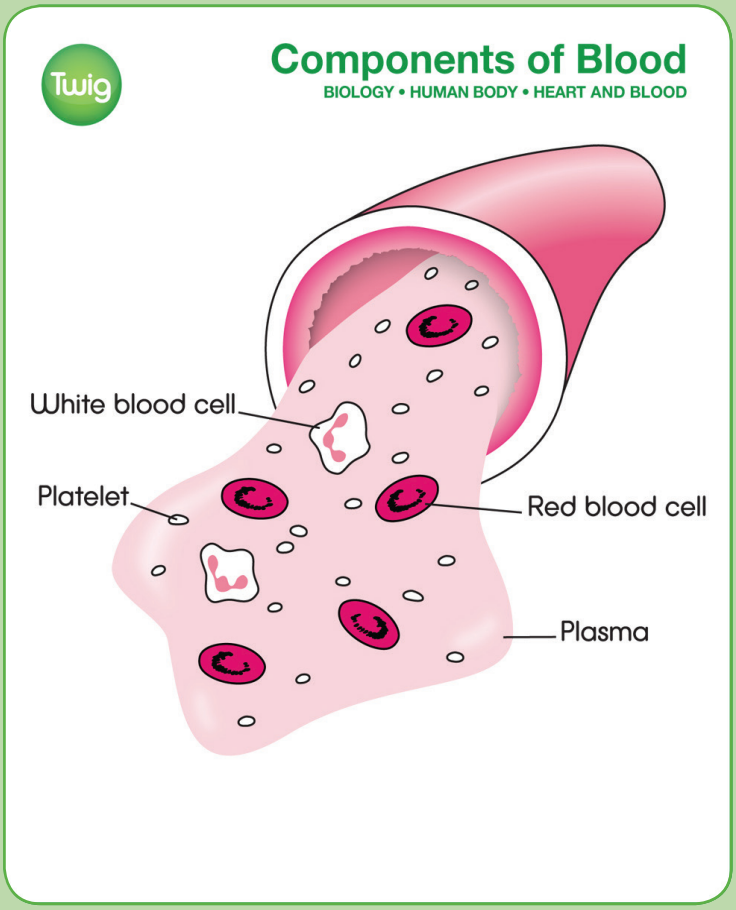
• How is the blood adapted for its transport function?

The blood is a watery liquid in which cells are suspended. The watery portion of the blood is called plasma and it makes up about half of the blood volume. Water is ideal for transporting substances as it is an excellent solvent, dissolving substances such as glucose, amino acids, minerals, ions and urea. The rest of the blood volume consists of three types of cell – red blood cells, white blood cells and platelets. The red cells are by far the most common. They have no nucleus and are packed full of a protein called haemoglobin, which makes them red. Oxygen can bind to the haemoglobin forming oxyhaemoglobin, and this is how oxygen is transported around the body to the cells which need it.

- **Suggested Films**
  - **Blood**
  - **Why Is Blood Red?**

- **Suggested Activity**
  - **Examine prepared blood smears under a microscope**

DIAGRAM 03:



Extension Questions

Q3. How are red blood cells adapted for their function?

Red blood cells are biconcave discs so provide a higher surface area for efficient oxygen exchange. They have no nucleus, so there is more room for the oxygen carrying protein haemoglobin.

Q4. How long do red blood cells live for?

Red blood cells live for about 120 days. Because they have no nucleus they cannot divide, so new ones have to be made by special stem cells in the bone marrow.

Extension Question

Q5. Why can carbon monoxide kill you?

Carbon monoxide is produced when carbon-containing compounds are burnt with a limited supply of oxygen. It is found in car exhaust fumes, cigarette smoke and emissions from faulty boilers. It can bind irreversibly with haemoglobin, preventing oxygen from binding as normal. If enough of a person's haemoglobin is blocked in this way it can lead to death.

• What do the white blood cells and platelets do?

The white blood cells are not involved in transport. They are part of the human immune system and help to defend the body against infection.

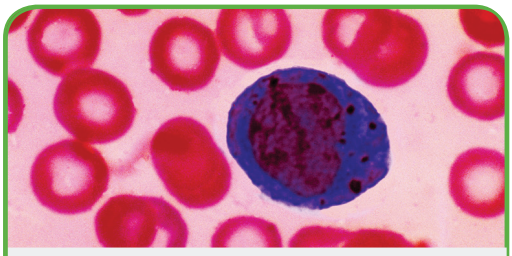
When the skin is cut, the platelets are involved in clotting the blood. They release chemicals which cause a soluble protein in the blood, called fibrinogen, to form insoluble fibrin strands. These help to trap other blood cells in the wound and gradually the blood clots. Eventually a scab forms and new skin is produced beneath.

• Suggested Films

- **Blood**
- **Blood Transfusion: Vietnam**
- **Blood Transfusion: Falklands**

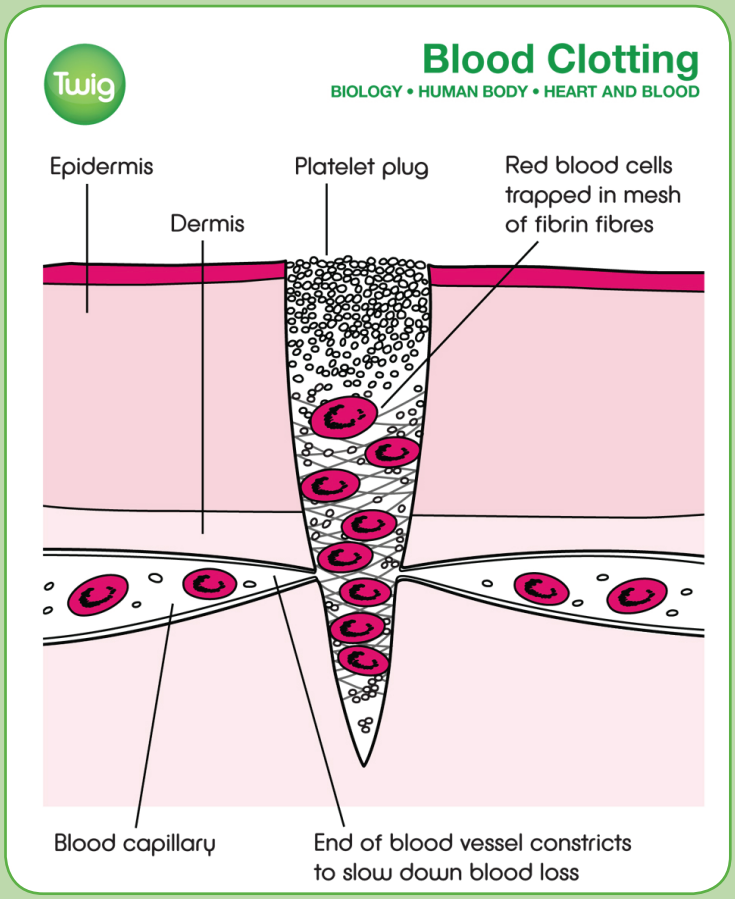
• Suggested Activity

- **Ask students to make an annotated poster showing the structure and function of blood**



Blood is composed of red and white blood cells, platelets and plasma

DIAGRAM 04:



Extension Question

Q6. What is haemophilia?

Haemophilia is an inherited disease in which a person is unable to clot their blood properly. They are missing the genes needed to make one of the clotting proteins. It is much more common in men and can lead to death.

• How are the blood vessels adapted to their function?

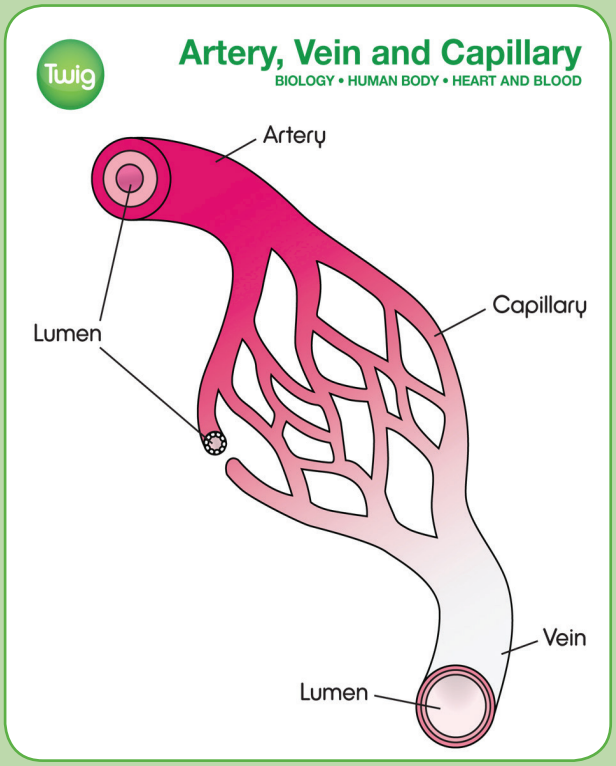
Arteries transport blood from the heart to the tissues of the body, whereas veins bring blood back from the tissues to the heart. Arteries are therefore receiving blood under high pressure and so they have thick, muscular, elastic walls to withstand the pressure, as pulses of blood surge down them. The blood in veins is under much less pressure, so the walls of veins are thinner and do not contain elastic fibres. Veins do, however, contain valves to prevent the blood flowing back in the wrong direction.

Arteries are linked to veins by tiny blood vessels called capillaries. These are found branching out throughout every tissue, and cells are never far from a capillary. Capillaries are only one cell thick and are found close to all cells so that substances can diffuse in and out of cells easily.

- **Suggested Film**
  - **Blood**

- **Suggested Activity**
  - **Examine sections of an artery and vein and compare their structure**

DIAGRAM 05:



Extension Question

Q7. What causes the pulse I can feel in my wrist?

Every time the heart contracts it forces a wave of blood into the arteries. This surge of blood moves rapidly through the arteries causing their walls to stretch under the pressure. This is what you can feel when you take your pulse, each pulse representing one heartbeat. You can't feel a pulse in a vein because the pressure is too low.

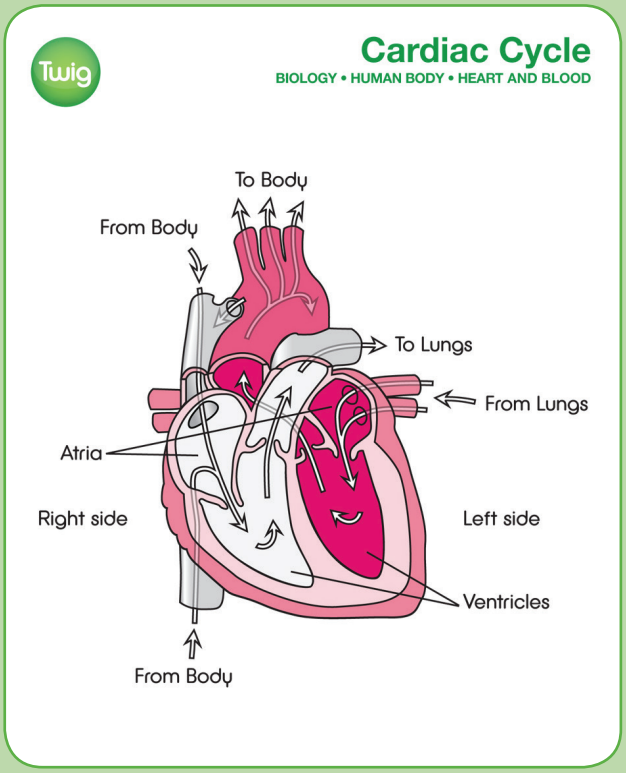
Section 3: Heart

• How is the heart adapted for its function?

The heart has two sides. The right side receives deoxygenated blood from the veins and pumps it to the lungs. The left side receives oxygenated blood from the lungs and pumps it round the body.

The heart is made of cardiac muscle, which contracts in order to pressurise the blood and force it around the circulatory system. Blood flows into upper chambers called atria, which contract and force blood into the ventricles. The ventricles contract to force blood out of the heart into the arteries. Valves prevent the blood from flowing in the wrong direction. The atrioventricular valves stop the blood flowing back into the atria from the ventricles, and the semilunar valves stop the blood flowing back into the heart from the arteries.

DIAGRAM 06:



Dissection of a heart

- **Suggested Film**
  - **Heart**
  - **FactPack: Heart**
- **Suggested Activity**
  - **Examine a model or dissected heart**
  - **Ask students to plan and carry out an investigation into the effect of exercise on heart rate**

Extension Questions

Q8. Why do the labels on the heart diagram appear to be back to front?

The diagrams show the heart as you look at it from the front, meaning the right side of someone's heart is on the left as you look at it, and vice versa.

Q9. Why is the muscle of the left ventricle wall thicker than that of the right ventricle?

The left ventricle pumps blood round the whole body, whereas the right ventricle only pumps blood to the lungs. So the left ventricle has to be able to generate much higher pressures.

Q10. What causes the heart sounds that a doctor hears when he listens with a stethoscope?

The familiar heart sounds 'lub/dub, lub/dub' are caused by the valves slamming shut. The 'lub' corresponds to the atrioventricular valves shutting and the 'dub' to the shutting of the semilunar valves. Sometimes a doctor can hear other sounds which might indicate problems with the heart, such as a leaking valve.

Q11. What is a heart attack?

The heart muscle needs its own blood supply in order to get the food and oxygen it needs. If the arteries which supply the heart muscle get blocked heart cells can die. If enough die, the heart contractions can become disorganised and cause the heart to stop beating. This is called a heart attack.

• Quizzes

Blood

Basic

• Which blood vessels take blood from the heart?

A – arteries
B – veins
C – venules
D – capillaries

• What are the smallest blood vessels in the human body called?

A – arteries
B – veins
C – venules
D – capillaries

• Which blood cells help to defend our bodies against disease?

A – white blood cells
B – red blood cells
C – platelets
D – plasma

• Which blood cells are the most numerous in the body?

A – white blood cells
B – red blood cells
C – platelets
D – plasma

Advanced

• What are the smallest blood vessels in the human body called?

A – arteries
B – veins
C – venules
D – capillaries

• Which blood cells help the blood to clot?

A – white blood cells
B – red blood cells
C – platelets
D – plasma cells

• What is the main constituent of plasma?

A – oxygen
B – carbon dioxide
C – proteins
D – water

• What do red blood cells primarily transport?

A – oxygen
B – carbon dioxide
C – proteins
D – water

Heart

Basic

• How many chambers does the heart have?

A – 1
B – 2
C – 3
D – 4

• What do you call the lower chambers of the heart?

A – atria
B – septa
C – ventricles
D – arteries

• Which side of the heart has a thicker ventricle wall?

A – right
B – left
C – upper
D – lower

• What do you call the structures in the heart which ensure that blood flows in only one direction?

A – atria
B – ventricles
C – valves
D – arteries

Advanced

• What do you call the upper chambers of the heart?

A – atria
B – septa
C – ventricles
D – arteries

• Which side of the heart receives deoxygenated blood?

A – right
B – left
C – upper
D – lower

• What is the function of heart valves?

A – to contract
B – to move blood
C – to prevent backflow
D – to protect the heart

• What makes the sound of a heartbeat?

A – the atria contracting
B – the ventricles contracting
C – the valves closing
D – the blood flowing

• Answers

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