Blood
Blood

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Summary activities
What is blood?

**Blood** is a specialized liquid that circulates around the body in blood vessels. An average adult has 4–6 litres of blood.

Blood has a range of functions, including to:

- transport substances
- defend against pathogens
- control body temperature
- maintain pH of fluids.
Blood moves around the body in arteries, veins and capillaries. Each blood vessel is adapted to its function.

Press on each blood vessel to learn more about its structure and function.
Blood transports plasma

The blood vessels circulate blood around the body:

- Blood is carried from organs and muscles to the lungs to collect oxygen and get rid of carbon dioxide.

- Glucose and other soluble products of digestion are taken from the small intestine and delivered to other organs.

- Waste products, such as urea, are delivered from the liver to the kidneys, where they are filtered.
What is the composition of blood?
What is blood made up of?

Blood consists of particles suspended in a fluid called **plasma**. Plasma carries carbon dioxide, glucose, urea, antibodies, as well as **red blood cells**, **white blood cells** and **platelets**.

Press on each component to find out more about its function.
Match each blood component to its function

- **red blood cell**: plays an important role in blood clotting
- **white blood cell**: carries oxygen around the body
- **platelet**: engulfs invading pathogens
- **plasma**: fluid which carries other blood components
Features of red blood cells

What are the specialized features of a red blood cell?

**flattened, biconcave disc shape:**
ensures large surface area to volume ratio for efficient gas exchange

**diameter (6–8µm) larger than capillary diameter:**
slows blood flow to enable diffusion of oxygen

**large amount of haemoglobin:**
for transporting oxygen

**no nucleus or organelles:**
maximizes space for haemoglobin, so more oxygen can be transported
Haemoglobin

Red blood cells are packed with **haemoglobin**, which is a red protein that gives blood its colour. Haemoglobin makes up 95% of the dry mass of a red blood cell.

Haemoglobin is made up of four protein chains, each bound to one **haem group**.

In the lungs, the haem group combines with oxygen to form **oxyhaemoglobin**.

When blood reaches the organs, oxyhaemoglobin splits to reform haemoglobin and oxygen, where the oxygen is free to diffuse into cells.
Artificial blood products

The circulatory system must contain a sufficient volume of blood to ensure that enough oxygen reaches all the tissues.

Press "start" to learn about artificial blood products that are being developed.
Blood

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Blood clotting

At the site of a cut or wound the blood will **clot**. This prevents further blood loss, reduces the risk of pathogens entering and forms a framework for repairing the damaged tissue.

**Platelets** rapidly stick to a damaged area, releasing chemicals that start a series of reactions.

This results in a network of **fibrin fibres** which form a mesh. This mesh traps blood cells and debris, forming a solid clot.
Why can blood clots be dangerous?

Blood clots normally occur at the site of a cut. However, they can arise within blood vessels. This can be dangerous as a clot could **obstruct** the flow of blood to a major organ. A blood clot can cause organ damage and even death.

**Anti-coagulant** drugs, such as warfarin, heparin and aspirin can be taken when a person’s blood is clotting too quickly.

These drugs can control clotting by reducing the ability of the blood to clot. Substances such as vitamin K, alcohol, green vegetables and cranberries can also affect clotting.
The formation of a blood clot, known as **coagulation**, involves a complex series of chemical reactions, involving cells and proteins.

Press **"play"** or the blood vessel to see what happens.
What is haemophilia?

Haemophilia is an **inherited** disease that prevents the body from controlling bleeding properly.

Haemophilia is a recessive **sex-linked** disease that mainly affects males.

People with haemophilia (haemophiliacs) are partly or completely missing a clotting factor that is needed to make their blood clot properly.

There are about 6,000 people with haemophilia in the UK.
The symptoms of haemophilia include:

- bruising easily
- prolonged bleeding
- spontaneous bleeding.

Bleeding from minor grazes and cuts can usually be stopped relatively easily using just a sticking plaster.

However, deep cuts and haemorrhaging can be very serious, affecting the joints, muscles and soft tissue.
Haemophilia in males

Haemophilia is far more common among males than females because it is a recessive X-linked disease.

Males only have one X chromosome, which is inherited from their mother.

Any allele contained within the chromosome, whether it is dominant or recessive, will always be expressed.

This is because there is only one version of the allele and its effects will therefore not be masked by another version.
Haemophilia in females

What happens if a female inherits one haemophilia allele?

\[ \text{X}^H \text{X}^h \]

The recessive haemophilia allele is masked by the dominant normal allele on the other X chromosome. The female is therefore not affected by the disease, but is a carrier.

What happens if a female inherits two haemophilia alleles?

\[ \text{X}^h \text{X}^h \]

She will develop haemophilia. This is extremely rare.
Patterns of inheritance: haemophilia

What is the pattern of haemophilia inheritance in this family?

- unaffected
- carrier
- haemophiliac

(solve)
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A blood donation occurs when someone volunteers to give a safe proportion of their blood for transfusions or medical use. The National Blood Service obtains, transports and tests blood from donors before it is used.

Hospitals store donated blood to give to patients who need transfusions in the future.

Blood transfusions involve receiving blood. These may be needed to replace the blood lost in accidents, during and after surgery or to treat blood conditions.
Cells contain markers on their surface, called antigens. Red blood cells can contain two types of antigens. These form the basis of a type of blood grouping called the **ABO blood system**.

Press on each tab to find out more.
### Donating ABO groups

#### How much do you know about ABO grouping?

<table>
<thead>
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<th>blood group</th>
<th>antigens</th>
<th>antibodies</th>
<th>can receive</th>
<th>can donate to</th>
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<tbody>
<tr>
<td>O</td>
<td>none</td>
<td>anti-A and anti B</td>
<td>O</td>
<td>?</td>
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<td>A</td>
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<td>?</td>
<td>A and B</td>
<td>none</td>
<td>all</td>
<td>AB</td>
</tr>
</tbody>
</table>

- **A and B**
- **anti-B**
- **B and O**
- **AB**
- **all**
- **none**
Rhesus blood grouping

Blood can be categorised using Rhesus blood grouping. Individuals either do or do not possess the Rhesus antigen on the surface of their blood cells.

Those with the antigen will have Rhesus positive or +blood, and those without will have Rhesus negative or –blood.

This type of blood grouping can be used alongside the ABO grouping. For example, people with group A blood will either be A+ or A–.

It is important that Rhesus blood grouping is considered during blood transfusions, as the wrong type may cause clotting.
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Glossary of keywords: blood

**agglutination** – The clumping of red blood cells, caused when antibodies (agglutinins) bind to specific antigens on red blood cells.

**agglutinin** – A substance that causes particles to clump together. For example, blood serum antibodies cause specific antigens to clump together.

**anti-coagulant drug** – A drug that helps to control blood clotting in the blood vessels.

**antibody** – A protein produced by the body that
Can you pump through this quiz about blood?

Press "start" to begin.