

Biology Knowledge Organiser

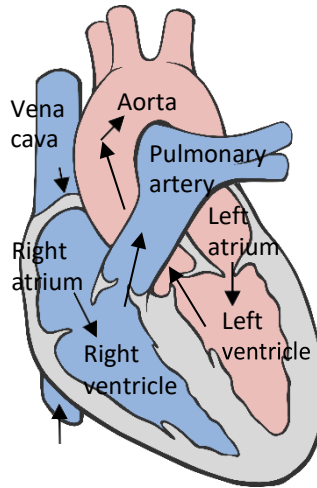
B4 - Organising animals and plants

The heart

The heart is an organ whose role is to pump blood around the body. In humans and other mammals, the heart is part of a **double circulatory system**. This means the blood goes through the heart twice on its route around the body. It goes: right side of heart → lungs → left side of heart → body (and back to the heart again).

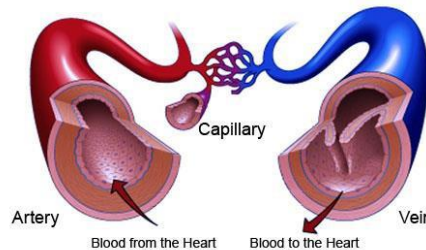
Learn the labelled parts of the heart. The arrows show the direction of blood flow. The heart walls are made mainly of muscle – when the heart ‘beats’, the muscle contracts to pump the blood.

The natural resting heart rate is controlled by a group of cells in the right atrium that act as a **pacemaker**. These cells set off the impulses that make the heart muscle contract. If there is a fault in the heart and the heart rate is irregular, an **artificial pacemaker** can be fitted to correct these irregularities.



Blood vessels

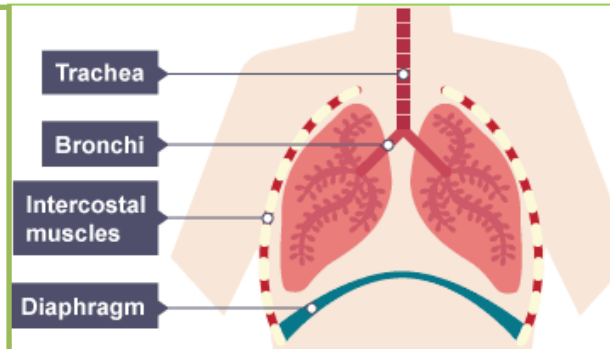
Blood is restricted to blood vessels in the body (unless you cut yourself!). There are three types: **arteries**, **capillaries** and **veins**. Blood being pumped by the heart always travels in the order arteries → capillaries → veins and veins return the blood to the heart. Arteries carry the blood at high pressure, so they have **thick, elastic** walls. Capillaries are where **exchange** takes place, so their walls are **only one cell thick** (for a *short diffusion pathway*). Veins carry the blood back to the heart at low pressure, so their walls are thinner than arteries (much thicker than capillaries though). However, to prevent blood flowing back the wrong way, veins have **valves** in them, which you can see on the diagram.



The lungs

The lungs are the organs responsible for gas exchange in humans and other mammals. Air flows in while breathing in, through the **trachea** (windpipe), through the **bronchi** to each lung, and eventually to the **alveoli**, that you’ve looked at before. Muscle contraction allows us to breathe in – the **diaphragm** and **intercostal muscles** contract. When they relax, we breathe out.

The lungs are adapted for efficient gas exchange with their short diffusion pathway, huge surface area, and good blood and air supplies.



Key Terms	Definitions
Ventricles	The larger chambers in the heart. The right ventricle pumps blood to the lungs; the left ventricle pumps blood around the whole body.
Atria	Smaller chambers of the heart. These fill with blood from the vena cava and pulmonary vein, then pump the blood into the ventricles.
Aorta	The artery leaving the left ventricle. It branches off to supply, in the end, every cell of the body with blood.
Vena cava	The major vein transporting blood from the whole body back to the heart (to the right atrium)
Pulmonary artery	The blood vessel leaving the right ventricle, carrying blood to the lungs.
Pulmonary vein	Vein leading from the lungs back to the heart (to the left atrium).
Artery	Blood vessel that carries blood away from the heart, at relatively high pressure.
Capillary	Very small, thin-walled blood vessel where exchange of substances between the blood and body cells takes place.
Vein	Blood vessels that return blood to the heart at relatively low pressure. Only these vessels have valves in them.
Coronary blood vessel	The heart muscle needs its own blood supply. This comes from branches from the aorta as soon as it leaves the heart called coronary arteries.

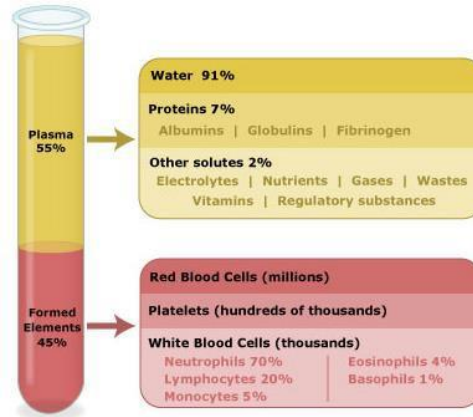
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B4 - Organising animals and plants

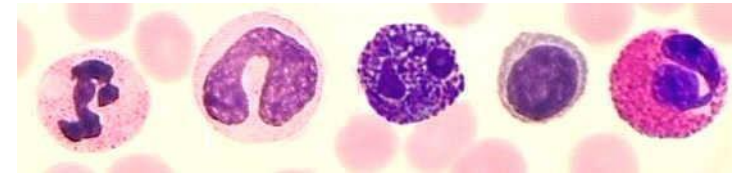
The blood

Blood is a tissue. When separated into the components (parts), we find that just over half of it is made up of plasma. The cells components (mostly red blood cells) are **suspended** in the plasma – meaning they are normally mixed evenly throughout the plasma.

The majority of the cell parts is made up of red blood cells, which transport oxygen. The other components are white blood cells and platelets.



Key Terms	Definitions
Plasma	The liquid part of the blood, mostly made of water, but with substances like glucose, proteins, ions and carbon dioxide dissolved in it.
Red blood cells	Disc-shaped cells that contain haemoglobin , which can bind to oxygen, so it can be transported from the lungs to tissues.
White blood cells	Cells in the blood that fight infection caused by pathogens.
Platelets	Fragments of cells that cause clotting of blood at a wound, to reduce blood loss.
Clot	A solid clump of blood formed when there is an injury.



Red blood cell



Red blood cells

As you can see in the photograph (taken with a microscope of course!), red blood cells are disc shaped and have a concave surface on each side. This increases their surface area for absorbing and transporting oxygen from the lungs to body tissues. Red blood cells are unusual in that they don't have a nucleus or other organelles. This makes more room for **haemoglobin** – the red-coloured chemical that oxygen actually binds to for transport.



White blood cell

White blood cells

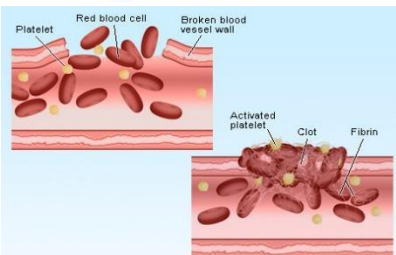
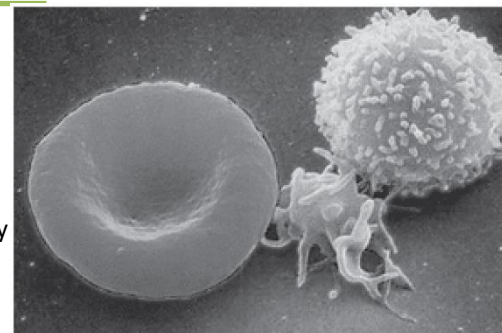
There are actually numerous types of white blood cell, as the photo shows, but they are all part of the immune system and fight communicable disease (disease caused by **pathogens**). They all have large nuclei, because they are very active cells. They can also change shape, which is useful because they can get out of the blood (through tiny gaps in the walls of capillaries) and so they can **engulf** microorganisms – like the photo below of a white blood cell engulfing a yeast cell.



Platelet

Platelets

Platelets are *fragments* of cells – produced deliberately by your body (they aren't simply broken cells!). The photograph here shows a platelet between a red blood cell and a white blood cell. Their role is to initiate (start off) the process of **clotting** at a wound, as shown in the diagram to the left. They create a clot, which blocks the injury in the blood vessel until proper healing can happen, preventing excessive blood loss.



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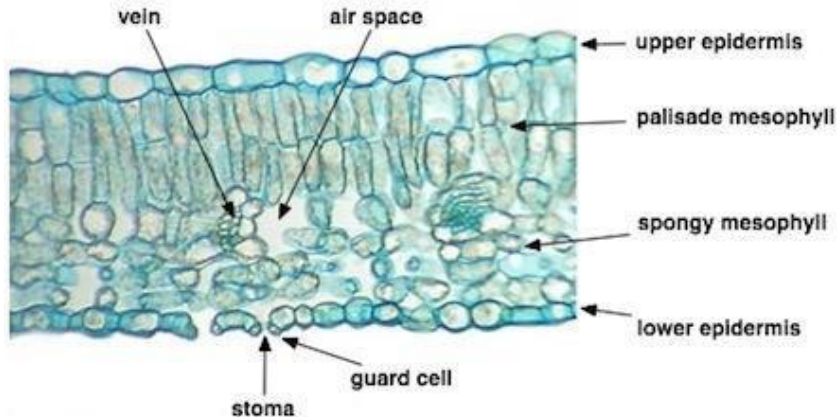
B4 - Organising animals and plants

Plant tissues in the leaf and transpiration

Look at the key terms and definitions for the key types of plant tissue. Leaves are **organs** in plants that contain many of those types of tissue. Together with the stem and roots, they form an **organ system** for transport of substances around the plant. The photograph shows the **transverse section** of a leaf – a thin slice through the leaf, looking edge-on.

The **vein** contains the **xylem** and **phloem** vessels. The **stomata** (singular: stoma) are the holes through which gases are exchanged. This includes **water vapour**. Plants absorb **all** their water in the roots (you've already looked at root hair cells), and keep water moving constantly through by losing water as vapour from the leaves. The constant flow of water up the plant is called the **transpiration stream**. This loss of water vapour from the leaves is called **transpiration**. Transpiration is **sped up** by:

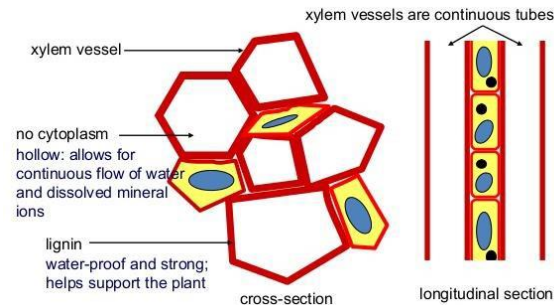
- a **higher temperature**, since water molecules have more kinetic energy so diffusion out of stomata is faster
- **Lower humidity** (drier air), since there is a steeper concentration gradient if the air outside the plant is relatively drier than the air in the air spaces
- **Higher air flow** (being windier!), since this refreshes the concentration gradient all the time, as water vapour is blown away from the leaves
- **Higher light intensity**: this increases the rate of photosynthesis, which uses water, so water flows more rapidly up through the plant.



Stomata, guard cells and transpiration

Stomata must be open at least some of the time, to allow carbon dioxide to enter the leaf for photosynthesis. However, guard cells can control how many stomata are open, and how wide open they are. This is useful in dry conditions, because the plant can conserve water instead of losing lots of it through transpiration.

Key Terms	Definitions
Epidermal	Type of plant tissue that covers the surface of a plant
Palisade mesophyll	Tissue in the leaf where photosynthesis takes place
Spongy mesophyll	Tissue in the leaf with air spaces between cells – specialised for gas exchange
Xylem	Narrow tubes in the roots, stem and leaves, which transport water and mineral ions up the plant levaees from the roots
Phloem	Other tubes that run alongside xylem, but transport sugars dissolved in water instead – a process called translocation
Meristem	Type of tissue found at growing tips of roots and shoots, containing stem cells so they can differentiate into different sorts of plant cell
Guard cell	In pairs, guard cells form the stomata on leaves – the holes through which gases are exchanged. They can open and close the stomata as required by the plant.
Transpiration	The process by which plants lose water, as vapour, from their leaves through the stomata.



Xylem and Phloem

Xylem tissue is made of hollow tubes, formed from the cell walls of dead cells, and strengthened by a substance called **lignin**. The diagram shows their adaptations to the function of transporting water and minerals.

Phloem, on the other hand, is a tissue made of living cells. They are **elongated** and stacked to form tubes. Phloem tubes transport food – dissolved sugars – made in the leaves to other parts of the plant, for use in respiration or for storage. The sugary substance they transport is called cell sap, and its transport is called **translocation**. Cell sap flows from one phloem cell to the next through **pores** (holes) in the ends of the cells.



