

Blood and the immune system

Revision notes · The components of blood, how red blood cells carry oxygen, how white blood cells defend the body, vaccination and clotting.

For Pearson Edexcel International GCSE Biology 4BI1 and Science (Double Award) 4SD0. **Biology only** is not in the Double Award and is only examined on Paper 2.

Blood and the immune system

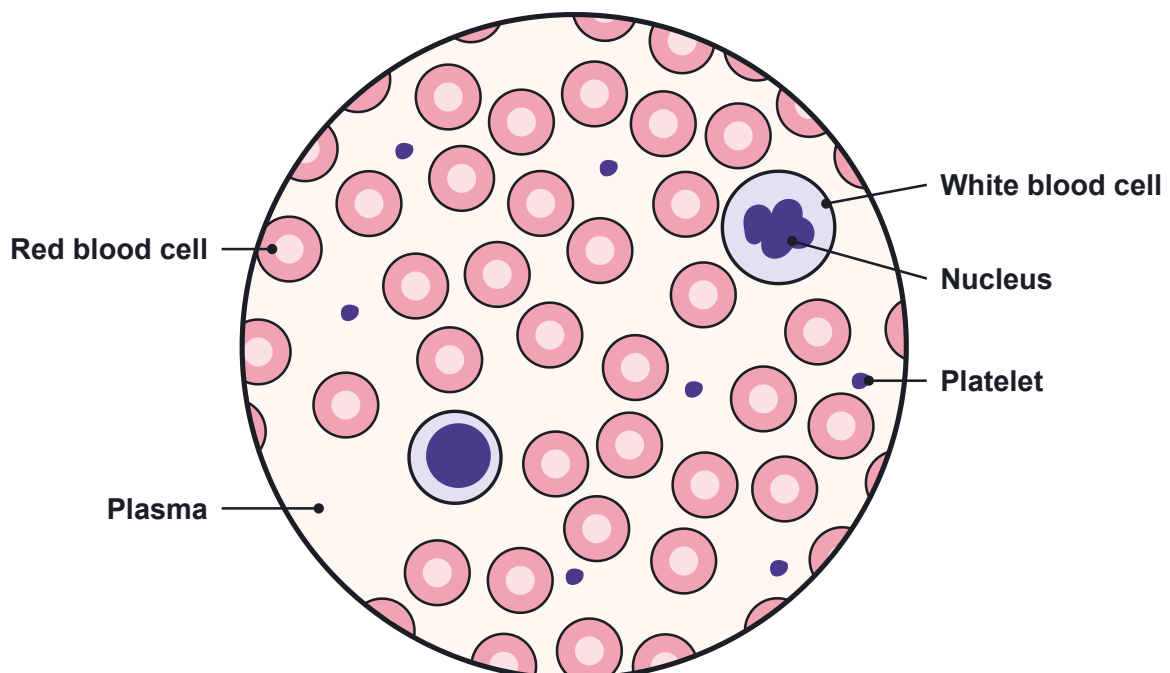
Spec 2.59-2.64B

Blood: composition, plasma and red blood cells

Spec 2.59, 2.60, 2.61

Blood is a tissue made of a liquid, **plasma**, with red blood cells, white blood cells and platelets suspended in it.

Components of blood		
Component	Description	Main job
Red blood cells	Biconcave discs with no nucleus, full of haemoglobin	Transport oxygen
White blood cells	Larger cells with a nucleus. Phagocytes and lymphocytes are two types	Defend the body against pathogens
Platelets	Small fragments of cells with no nucleus	Help the blood to clot
Plasma	Pale yellow liquid	Transports blood cells and dissolved substances



Red blood cells are the most numerous. White blood cells have a **nucleus**. Platelets are tiny fragments.

Plasma

Plasma is mostly water. It transports substances around the body, dissolved or carried in it.

Substances transported by plasma		
Substance	Transported from	Transported to
Carbon dioxide	Respiring cells	The lungs
Digested food (such as glucose and amino acids)	The small intestine	All the cells of the body
Urea	The liver, where it is made	The kidneys, to be removed in urine
Hormones	The glands that make them	Their target organs
Heat energy	Warm, active organs such as the liver and muscles	Other parts of the body, including the skin

Red blood cells

Red blood cells transport **oxygen** from the lungs to all the cells of the body. Three adaptations help them to do this.

- The **biconcave disc** shape gives a large surface area, so oxygen can diffuse in and out quickly.
- They contain **haemoglobin**, a red pigment that combines with oxygen in the lungs to form oxyhaemoglobin, and releases it in the tissues.
- They have **no nucleus**, which leaves more room inside the cell for haemoglobin.

Common mistake: Red blood cells carry oxygen. Haemoglobin is the substance inside them that binds to oxygen. Do not say that the cells 'carry haemoglobin'.

White blood cells and the immune response Spec 2.62

The immune system protects the body from disease. White blood cells are the main part of this defence. Two types do different jobs: **phagocytes** and **lymphocytes**.

Pathogen	A microorganism that causes disease.
Antigen	A molecule on the surface of a pathogen that the immune system recognises as foreign.
Antibody	A protein released by a lymphocyte that is specific to one antigen and helps to destroy the pathogen.

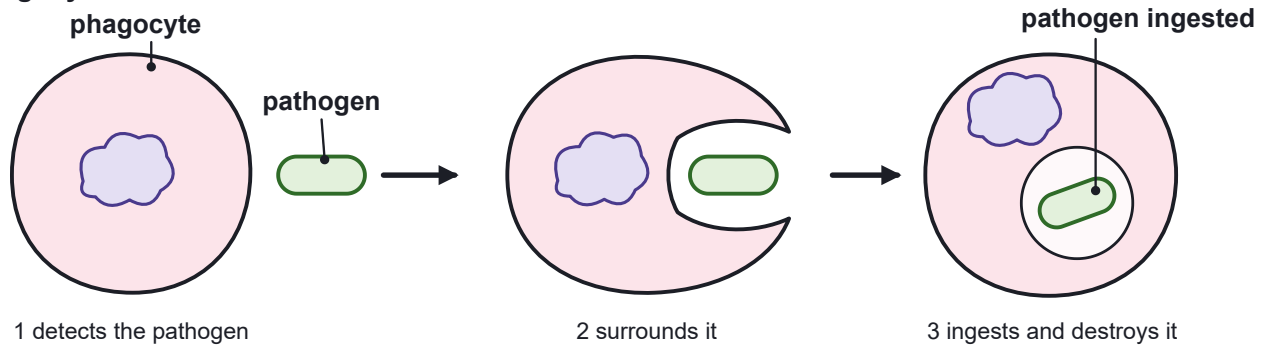
Phagocytes

1. A phagocyte detects a pathogen.
2. It surrounds the pathogen and **ingests** (takes in) it. This is called phagocytosis.
3. The pathogen is then destroyed inside the phagocyte.

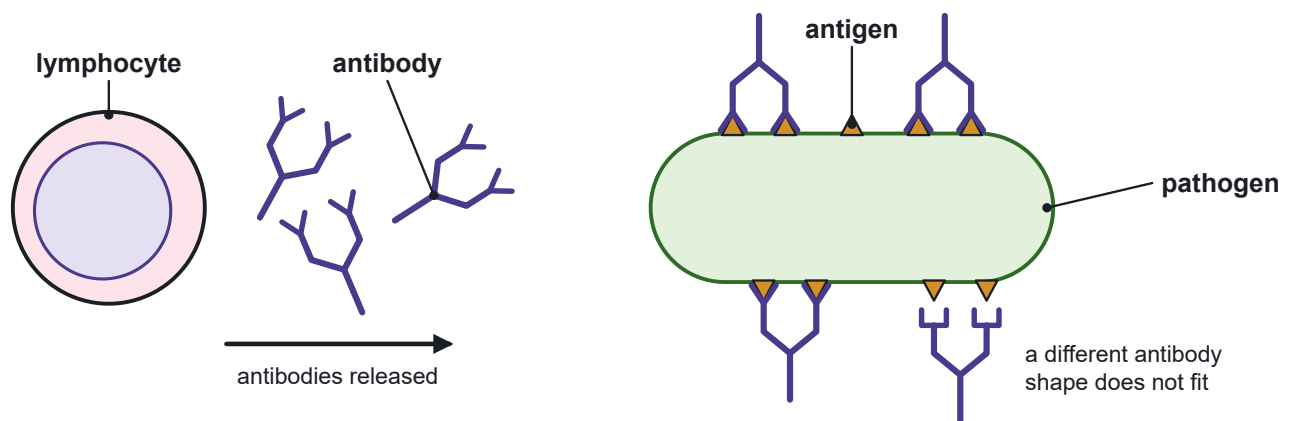
Lymphocytes

1. Lymphocytes recognise the antigens on the surface of a pathogen.
2. They release **antibodies** into the blood.
3. Each antibody is **specific** to one pathogen. Its shape fits the antigens on that pathogen only.
4. The antibodies attach to the pathogen and help to destroy it.

Phagocytosis



Antibodies



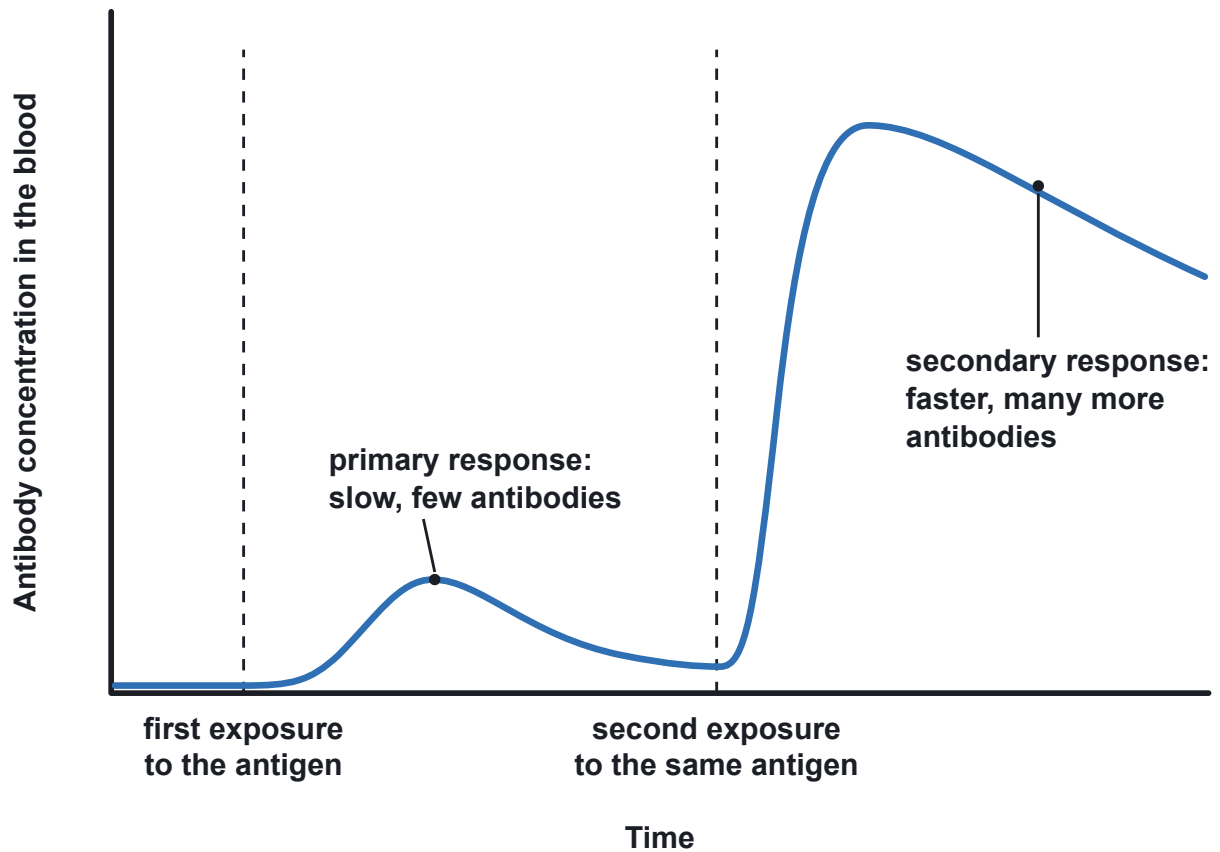
Phagocytes **ingest** pathogens. Lymphocytes release **antibodies** that fit only the matching **antigens**.

Exam tip: Antibodies are specific. Say that the antibody has a shape that fits the antigen on that pathogen, and that a different pathogen needs a different antibody.

Vaccination and memory cells Spec 2.63B Biology only

After an infection, some lymphocytes stay in the blood as memory cells. Vaccination uses this to protect a person before they meet the pathogen.

1. A person is given a **vaccine**: a harmless form of the pathogen, such as a dead or weakened one, with its antigens still present.
2. The antigens trigger lymphocytes to release antibodies. The person does not become ill.
3. The immune system makes **memory cells**, which stay in the body.
4. If the live pathogen enters later, the memory cells recognise it. Antibody production happens **sooner**, **faster** and in **greater quantity**.
5. The pathogen is destroyed before it can make the person ill.



Memory cells make the second response **sooner, faster and in greater quantity** than the first.

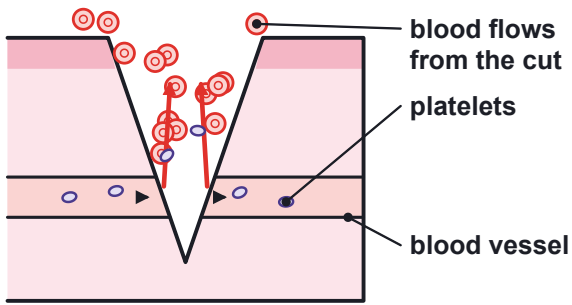
Common mistake: A vaccine does not put antibodies into the body. It makes your own body produce antibodies and memory cells.

Platelets and blood clotting Spec 2.64B Biology only

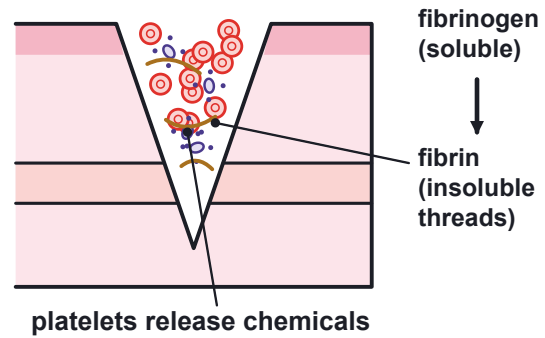
When a blood vessel is cut, the blood must clot. **Platelets** are small fragments of cells that take part in this. Clotting **prevents blood loss** and stops **micro-organisms entering** the body through the wound.

1. Platelets collect at the cut and release chemicals.
2. These chemicals cause the soluble protein **fibrinogen** in the plasma to change into insoluble **fibrin**.
3. Fibrin forms a mesh of fibres across the wound.
4. The mesh traps red blood cells and forms a clot.
5. The clot dries to form a scab, which seals the wound while the skin underneath repairs.

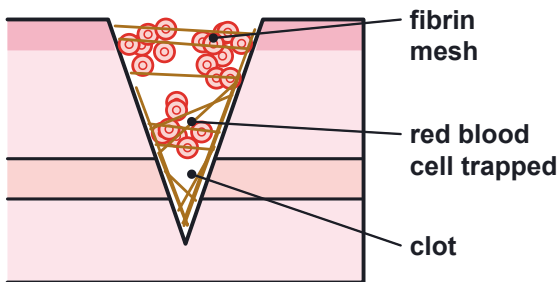
1 Platelets collect at the cut



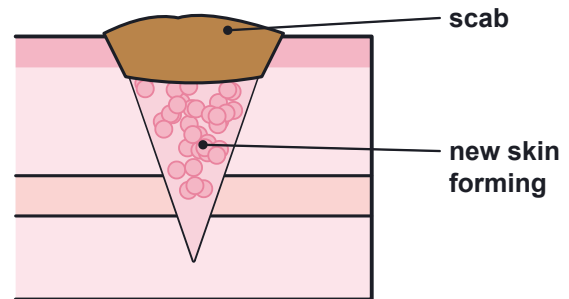
2 Fibrinogen is changed to fibrin



3 The fibrin mesh traps red blood cells



4 The clot dries to form a scab



Platelets trigger the change of **fibrinogen to fibrin**. The fibrin mesh traps red blood cells to form a **clot**, which dries to a **scab**.

Exam tip: Give two reasons why clotting matters: it stops blood loss and it stops pathogens (micro-organisms) entering the body.

Quick check

1. Name the four components of blood.
2. Give three adaptations of a red blood cell for carrying oxygen.
3. How do phagocytes destroy pathogens?
4. What do lymphocytes release?
5. **Biology only** What do memory cells allow after vaccination?

Quick check answers

Blood and the immune system

1. Red blood cells, white blood cells, platelets and plasma.
2. Biconcave shape, no nucleus, contains haemoglobin.
3. They ingest (engulf) them.
4. Antibodies that are specific to the pathogen.
5. Antibody production that is sooner, faster and in greater quantity if the pathogen enters again.