Blood

4.2.2.3 · Organisation · revision notes

Blood is a tissue made of plasma, red blood cells, white blood cells and platelets. You need to know what each part does, recognise the cells in a photograph or diagram, and explain how they are adapted to their functions.

Key facts

- Blood = a tissue: plasma + red blood cells + white blood cells + platelets
- Red blood cell: haemoglobin carries oxygen; biconcave disc; no nucleus
- White blood cell: has a nucleus; phagocytosis, antibodies, antitoxins
- Plasma transports CO_2, urea, glucose, amino acids, hormones and antibodies
- Biconcave → large surface area → fast diffusion of oxygen
- Platelets: fragments of cells, no nucleus; help the blood to clot

Notes

What blood is made of

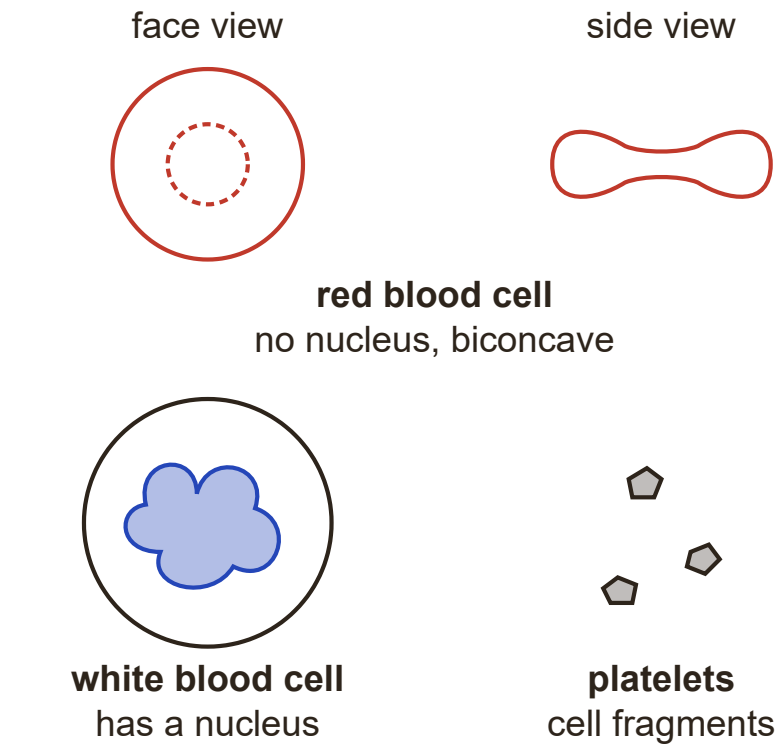
- Blood is a **tissue**. It is made of a liquid called **plasma**, in which red blood cells, white blood cells and platelets are suspended.
- **Plasma** is a pale yellow liquid that transports dissolved substances: carbon dioxide from the organs to the lungs, urea from the liver to the kidneys, soluble products of digestion (e.g. glucose, amino acids) from the small intestine to the cells, hormones and antibodies.
- Blood products from donors carry risks: pathogens could be passed on (so donations are screened), and blood not matched to the patient's blood group makes red blood cells clump.

Red blood cells

- Red blood cells carry **oxygen** from the lungs to the body cells.
- They contain **haemoglobin**, a red protein that binds to oxygen in the lungs and releases it in the tissues.
- They are **biconcave discs**: this shape gives a large surface area to volume ratio, so oxygen diffuses in and out quickly.
- They have **no nucleus**, which leaves more space for haemoglobin, so each cell carries more oxygen.
- They are small and flexible, so they can squeeze through narrow capillaries.
- More red blood cells (e.g. after training at altitude) mean more haemoglobin, so more oxygen reaches the muscles for aerobic respiration and more energy is released.

White blood cells and platelets

- **White blood cells** are part of the immune system and defend the body against pathogens. They are larger than red blood cells, far fewer, and have a **nucleus**.
- Some white blood cells engulf and digest pathogens (**phagocytosis**). Others produce **antibodies** or **antitoxins**.
- **Platelets** are small fragments of cells with no nucleus. They help the blood to **clot** at a wound. The clot stops blood loss and stops pathogens getting in.
- In a stained blood photo, red blood cells are the most numerous and look paler in the middle, white blood cells have a darkly stained nucleus, and platelets are tiny specks between them.



Red blood cells, a white blood cell and platelets (not to scale)

How to answer each type of question

Recall the function of a blood component

1 mark each | Grade 4

1. Match each part to one job: transport (plasma), oxygen (red cells), defence (white cells), clotting (platelets).
2. Be specific: red blood cells carry oxygen, not just 'gases' or 'blood'.

Example. Give the function of:
(a) platelets
(b) plasma
(c) red blood cells

Model answer.

(a) help the blood to clot (1)
(b) transports dissolved substances, e.g. glucose / carbon dioxide / urea (1)
(c) carry oxygen (1)

Explain how a red blood cell is adapted

2 to 4 marks | Grade 5

1. Give a feature, then link it to carrying oxygen.
2. No nucleus → more room for haemoglobin; biconcave → large surface area for diffusion; haemoglobin → binds oxygen.

Example. Explain **two** ways in which a red blood cell is adapted to carry oxygen.

Model answer. It has no nucleus (1), so there is more space for haemoglobin, which binds to oxygen (1). It is a biconcave disc (1), which gives a large surface area for oxygen to diffuse in and out quickly (1).

Identify blood cells in a photo or diagram

1 to 2 marks | Grade 5

1. Red blood cells: the most numerous, no nucleus, paler in the middle.
2. White blood cells: larger and fewer, with a clearly stained nucleus (often lobed).
3. Platelets: tiny fragments between the cells.

Example. A student looks at a stained blood smear under a microscope. Cell **X** is larger than most of the other cells and has a dark purple, lobed nucleus.
(a) Identify cell **X**.
(b) Give **one** way cell **X** protects the body.

Model answer.

(a) white blood cell (1)
(b) engulfs pathogens (phagocytosis) / produces antibodies / produces antitoxins (1)

Suggest the effect of a change in the blood 2 to 3 marks **Grade 5**

1. Work out which function is affected (oxygen, defence, clotting or transport).
2. Follow it through to the effect on the person.

Example. A person has far fewer platelets than normal.
Suggest **two** problems this could cause.

Model answer. Blood does not clot properly, so cuts bleed for longer / more blood is lost (1).

Pathogens can enter the body through wounds more easily, so infections are more likely (1).

Don't lose marks

- Saying plasma carries oxygen. Red blood cells carry oxygen; plasma carries dissolved substances such as carbon dioxide, urea and glucose.
- Calling platelets cells. They are fragments of cells.
- Saying white blood cells 'eat germs' instead of using the scientific words: engulf, phagocytosis, pathogens, antibodies, antitoxins.
- Saying red blood cells have a large surface area without linking it to faster diffusion of oxygen.
- Calling blood an organ. Blood is a tissue.
- Saying respiration 'produces' or 'makes' energy. Respiration releases (transfers) energy.

More tips

Memory tricks

- Red = oxygen; White = war on pathogens; Platelets = plug the wound; Plasma = the transport liquid.
- Neither red blood cells nor platelets have a nucleus, but for different reasons: red cells make room for haemoglobin; platelets are only bits of cells.
- Photo check: red blood cells hugely outnumber white blood cells.

Exam technique

- Use the word haemoglobin in any answer about red blood cells carrying oxygen.
- For 'explain how it is adapted' questions, give feature + effect for each pair of marks.
- If a photo or drawing is given, justify your identification with what you can see: size, nucleus and shape.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3 **Name the four components of blood**
Plasma, red blood cells, white blood cells and platelets.

Grade 4 **State the function of each component**
Plasma transports dissolved substances, red blood cells carry oxygen, white blood cells defend against pathogens and platelets help the blood clot.

Grade 5

Identify blood cells in a photo or diagram

Red blood cells are biconcave discs with no nucleus, white blood cells are larger with a nucleus, and platelets are tiny fragments.

Grade 5

List substances transported by the plasma

Carbon dioxide, urea, soluble products of digestion such as glucose and amino acids, hormones and antibodies.

Grade 5

Explain how red blood cells are adapted

A biconcave shape gives a large surface area, and having no nucleus leaves more room for haemoglobin, which carries oxygen.

Grade 5

Describe how white blood cells defend the body

They engulf pathogens (phagocytosis), produce antibodies and produce antitoxins.

Grade 5

Apply blood functions to unfamiliar situations

For example, explain the effects of having too few platelets or too few red blood cells.

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