

Transport in animals

IGCSE Biology 0610 · Topic 9 revision notes

Everything from the 4 lessons of this topic on a few pages: the key idea of each lesson, the diagram to remember, the points to learn and the traps examiners set. Read it, cover it, test yourself.

1. Circulatory systems

2. The heart

3. Blood vessels

4. Blood

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1 Circulatory systems

Syllabus 9.1

The circulatory system is a **system of blood vessels with a pump (the heart) and valves that ensure a one-way flow of blood**. Extended: a fish has a **single circulation**, in which blood passes through the heart once in each complete circuit of the body. A mammal has a **double circulation**: blood passes through the heart twice in each circuit, once on the way to the lungs and once on the way to the rest of the body.

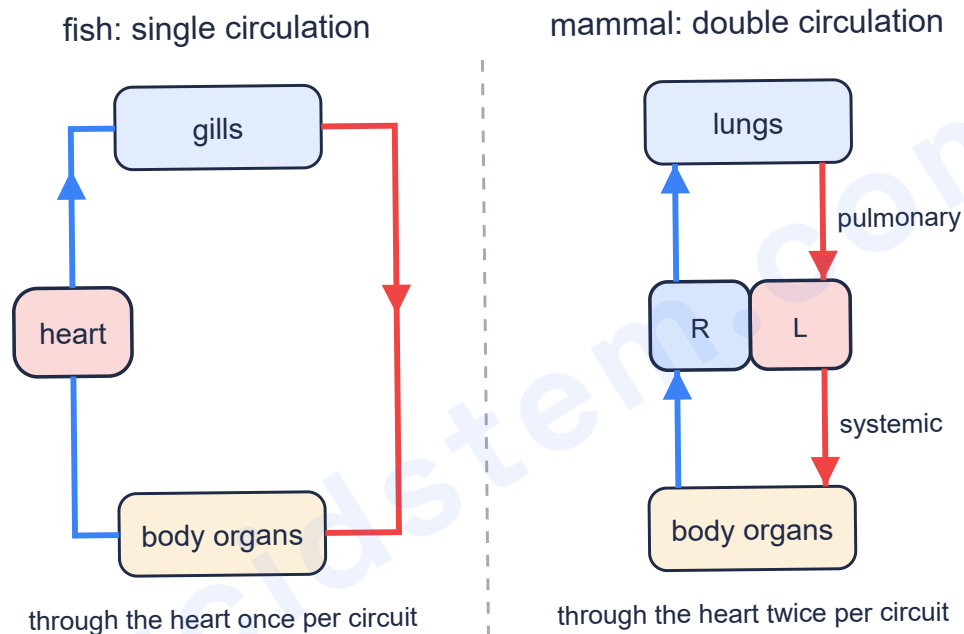


Fig. 1: in a fish, blood goes heart, gills, body, heart; in a mammal the right side of the heart pumps blood to the lungs and the left side pumps it to the body (red = oxygenated, blue = deoxygenated)

Count the trips through the heart.

- ✓ **Circulatory system:** blood vessels + a pump + valves for one-way flow.
- ✓ **Single (fish):** heart → gills → body → heart; once through the heart.
- ✓ **Double (mammal):** pulmonary circuit to the lungs, systemic circuit to the body; twice through the heart.
- ✓ **Advantage:** say high pressure to the body, so faster delivery of oxygen and glucose.

Watch out!

A circulatory system is not just "the heart and blood". The syllabus description has three parts: blood vessels, a pump, and valves to ensure one-way flow. Name all three.

"Twice through the heart" is a description, not an advantage. For an *explain the advantages* question, say what the second pumping achieves: higher pressure, faster delivery of oxygen and glucose to respiring cells.

2 The heart

Syllabus 9.2

The heart is a muscular pump with a **muscular wall**, a **septum**, **left and right atria**, **left and right ventricles**, **one-way valves** and **coronary arteries** that supply its own muscle. Blood is pumped **away from the heart in arteries** and **returns to the heart in veins**. Heart activity can be monitored by an ECG, the pulse rate and listening to the sounds of the valves closing. Blockage of the coronary arteries causes **coronary heart disease**.

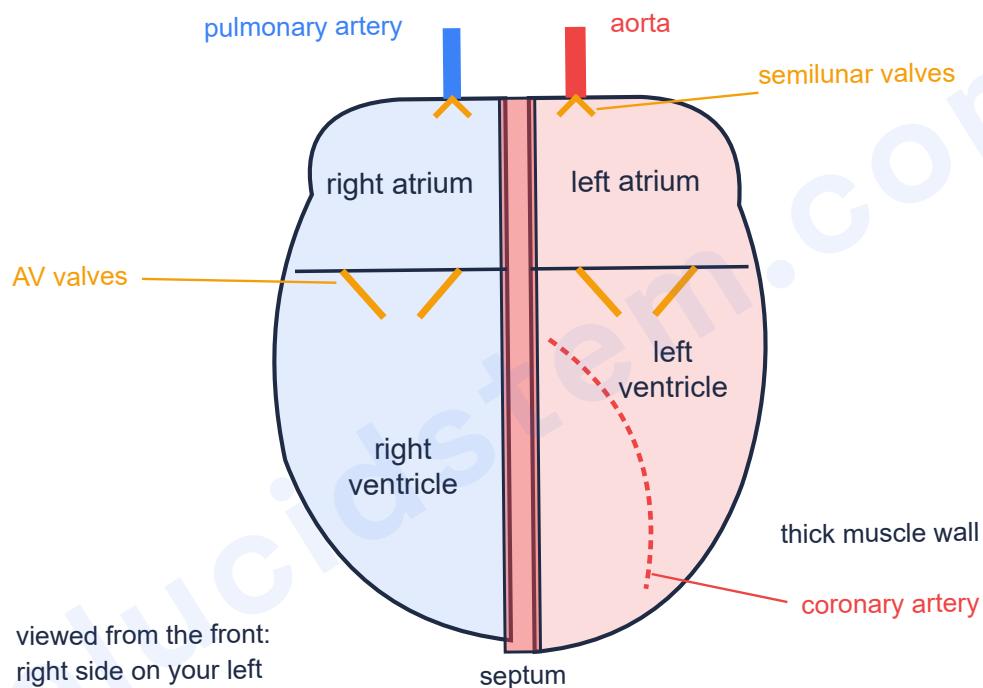


Fig. 1: a vertical section through the heart, seen from the front, so the right side is drawn on the left of the page

Atria in, ventricles out.

- ✓ **Away in arteries, back in veins:** aorta and pulmonary artery leave the ventricles; vena cava and pulmonary vein enter the atria.
- ✓ **Left side is on the right** of a heart diagram; find the thick left ventricle wall.
- ✓ **Extended valves:** AV valves shut when the ventricles contract (lub); semilunar valves shut when they relax (dub).
- ✓ **Exercise:** more respiration, more oxygen and glucose needed, more carbon dioxide to remove, so a faster heart rate.

Watch out!

Diagrams show the heart as if you are facing the person, so the left ventricle is on the right of the page. Find the thick-walled ventricle or the aorta first, then label left and right.

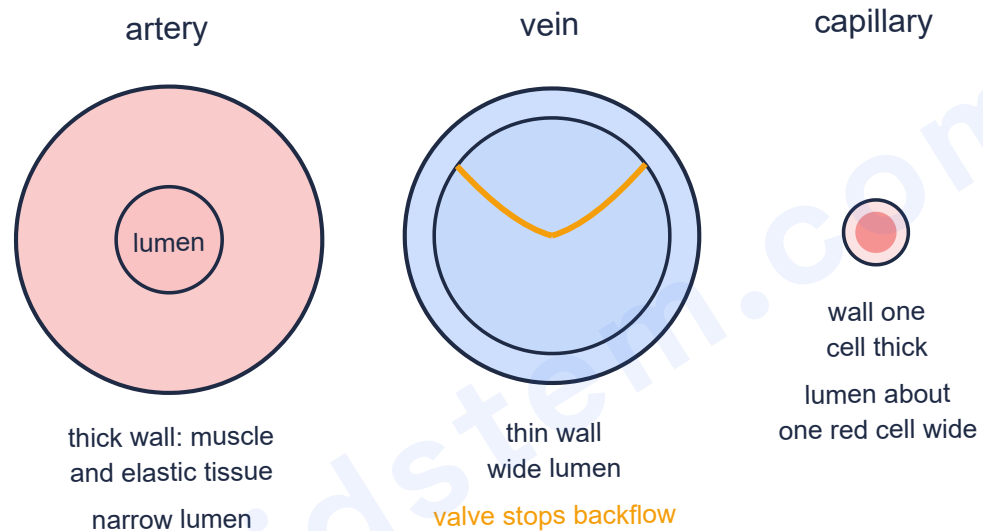
Do not write that the heart beats faster "to give the muscles more energy" or "to make more oxygen". Blood delivers oxygen and glucose faster so the muscle cells can release more energy by respiration.

Coronary arteries carry blood to the heart muscle, not blood through the chambers. The heart cannot use the blood inside its chambers for its own oxygen supply, which is why a blocked coronary artery is so serious.

3 Blood vessels

Syllabus 9.3

Arteries have thick walls and a narrow lumen; **veins** have thin walls, a wide lumen and **valves**; **capillaries** have walls only one cell thick and a very narrow lumen. Capillaries exchange substances between the blood and the tissues. The main vessels are the **vena cava**, **aorta**, **pulmonary artery** and **pulmonary vein** (heart and lungs) and the **renal artery** and **renal vein** (kidneys).



not to scale: the capillary is drawn far larger than real

Fig. 1: cross-sections of an artery, a vein and a capillary, showing wall thickness, lumen width and a valve in the vein

Direction, not colour.

- ✓ **Arteries:** away from the heart; thick muscular, elastic wall; narrow lumen; high pressure.
- ✓ **Veins:** back to the heart; thin wall; wide lumen; valves; low pressure.
- ✓ **Capillaries:** wall one cell thick; exchange with the tissues.
- ✓ **Organ vessels:** pulmonary (lungs), renal (kidneys), hepatic (liver, Extended); the hepatic portal vein comes from the gut.

Watch out!

Do not say arteries carry oxygenated blood and veins carry deoxygenated blood. The definition is direction: arteries carry blood away from the heart and veins carry it back. The pulmonary artery carries deoxygenated blood.

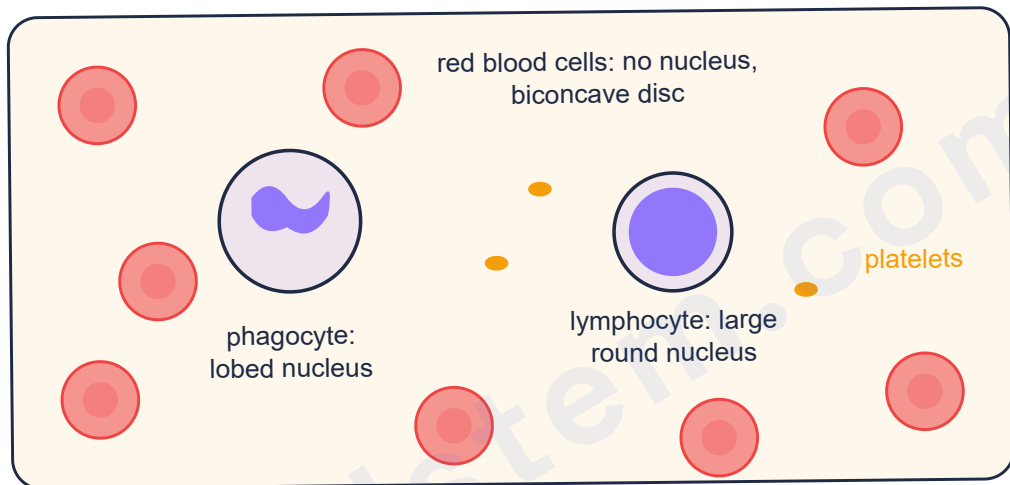
"Capillaries are thin" is too vague. Say the wall is one cell thick, so the diffusion distance is short. The lumen is narrow, which is a different point.

The hepatic portal vein runs from the gut to the liver, not from the liver to the heart. Blood leaves the liver in the hepatic vein.

4 Blood

Syllabus 9.4

Blood is made of **red blood cells**, **white blood cells**, **platelets** and **plasma**. Red blood cells transport oxygen using **haemoglobin**; white blood cells carry out **phagocytosis** and **antibody production**; platelets are involved in **clotting**; plasma transports blood cells, ions, nutrients, urea, hormones and carbon dioxide. Clotting prevents blood loss and the entry of pathogens.



plasma (straw-coloured liquid) carries all of these
white blood cells are larger than red blood cells and have a nucleus

Fig. 1: a blood smear as seen under a light microscope, with red blood cells, a phagocyte, a lymphocyte and platelets in plasma

Match each part to its job.

- ✓ **Red blood cells:** oxygen, using haemoglobin; no nucleus.
- ✓ **White blood cells:** phagocytes engulf (lobed nucleus); lymphocytes make antibodies (large round nucleus).
- ✓ **Platelets:** clotting; Extended: soluble fibrinogen to insoluble fibrin mesh.
- ✓ **Plasma:** blood cells, ions, nutrients, urea, hormones, carbon dioxide.

Watch out!

Plasma, not red blood cells, carries most carbon dioxide, along with glucose, urea and hormones. Red blood cells carry oxygen. Do not write that plasma carries oxygen.

Lymphocytes make antibodies; they do not engulf pathogens.

Phagocytes engulf pathogens; they do not make antibodies. Match the cell to its job.

Fibrinogen is soluble and always present in plasma; fibrin is the insoluble form that makes the mesh. Write "fibrinogen is converted to fibrin", not the other way round.