

Transport in Animals

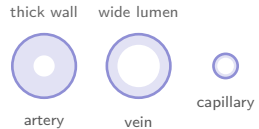
IGCSE Biology ■ Topic 9

IGCSE Biology



What we will cover

- 1 Single & double circulation
- 2 The heart
- 3 Heart rate & disease
- 4 Blood vessels
- 5 Blood & its defence

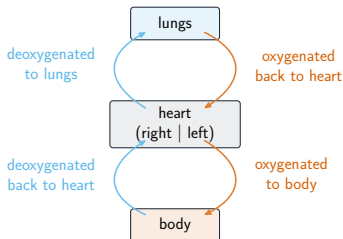


blood vessels

1

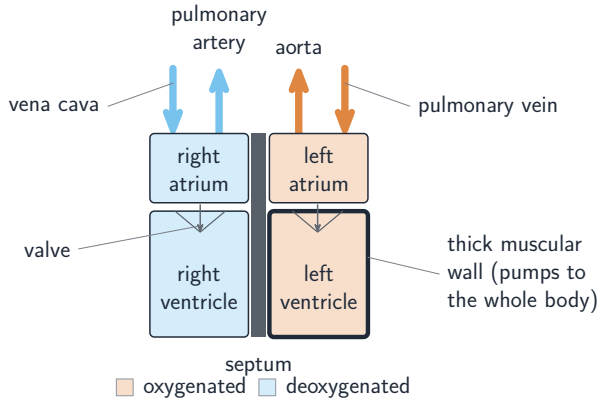
Heart and circulation

Single and double circulation



- A fish has a **single circulation** 单循环: the blood passes through the heart **once** on each trip around the body.
- A **mammal** 哺乳动物 has a **double circulation** 双循环: the blood passes through the heart **twice** on each full trip – once on the way to the lungs, and once on the way to the rest of the body.
- The advantage of a double circulation: the blood can be pumped again at **high pressure** 压力 before going to the body, so it travels faster and delivers **oxygen** 氧气 quickly.

The heart



Four chambers: two **atria** 心房 (top) & two **ventricles** 心室 (bottom), split by the **septum** 隔膜.

- left ventricle wall is **thickest** (pumps to the whole body)
- valves stop backflow

The four great vessels, and where each goes

Vena cava

Brings deoxygenated blood from the body into the right atrium.

Pulmonary artery

The **pulmonary artery** 肺动脉 carries deoxygenated blood from the right ventricle to the lungs – the one artery that carries deoxygenated blood.

Pulmonary vein

The **pulmonary vein** 肺静脉 returns oxygenated blood from the lungs to the left atrium – the one vein that carries oxygenated blood.

Aorta

Leaves the left ventricle for the whole body, which is why that wall is the thickest. To the kidney: **renal artery** 肾动脉 in, **renal vein** 肾静脉 out.

An artery carries blood away from the heart and a vein back to it. Oxygen is not part of the definition – the two pulmonary vessels prove it.

Heart rate and disease

exercise

heart rate 心率 rises, so
blood reaches muscles
faster with O₂ & glucose

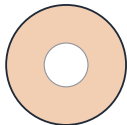
coronary heart disease 冠心病

coronary arteries narrow; risks:
fatty diet, smoking, no exercise

2

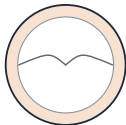
Vessels and blood

Blood vessels



artery

thick muscular,
elastic wall;
narrow lumen;
high pressure



vein

thin wall;
wide lumen;
has **valves**;
low pressure



capillary

wall one cell
thick; lets
substances be
exchanged

- **arteries** 动脉 – thick, away at high pressure
- **veins** 静脉 – thin, wide, **valves** 瓣膜, back
- **capillaries** 毛细血管 – one cell thick; exchange

Main: **aorta** 主动脉/**vena cava** 腔静脉, pulmonary, renal.

What the blood is carrying, and what defends it

Red blood cells

Red blood cells 红细胞 carry oxygen using the red pigment **haemoglobin 血红蛋白**. No nucleus, and a biconcave shape – both give more room and more surface for oxygen.

Phagocytes

Phagocytes 吞噬细胞 carry out **phagocytosis 吞噬作用**: they surround and digest pathogens.

Lymphocytes

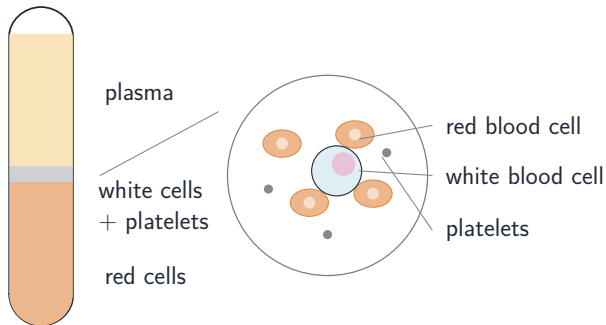
Make **antibodies 抗体** shaped to one antigen, and leave memory cells behind.

Capillaries

One cell thick and very narrow, giving a large **surface area 表面积** and a short diffusion distance – the whole point of the circulation.

Every structure here is a shape that fits a job. Say the feature *and* the job it serves.

Blood



- **red cells** 红细胞 – carry O_2 via **haemoglobin** 血红蛋白
- **white cells** 白细胞 – defence
- **platelets** 血小板 – **clotting** 凝血
- **plasma** 血浆 – carries everything else

Defence and clotting

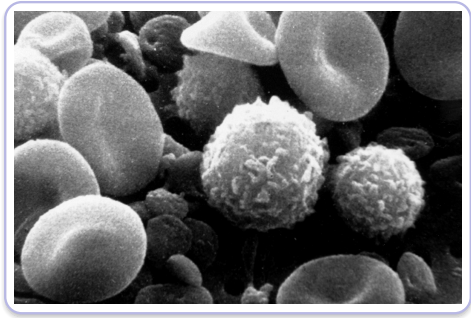
white blood cells

phagocytes 吞噬细胞 engulf
pathogens 病原体;
lymphocytes 淋巴细胞
make **antibodies** 抗体

clotting

fibrinogen 纤维蛋白原 →
fibrin 纤维蛋白 threads
trap cells & seal the wound

Blood, continued



Real blood cells under an electron microscope: red cells (discs), white cells and platelets

The vessels, the chambers, and what plasma carries

the lumen 管腔

the space inside a vessel – narrow in an artery, wide in a vein, tiny in a capillary

the atrium 心房

receives blood; the **ventricle** pumps it out, so its wall is far thicker

atrioventricular valves 房室瓣

stop backflow from ventricle to atrium; semilunar valves stop it from the arteries

deoxygenated blood 脱氧血

right side of the heart, to the lungs; oxygenated blood returns to the left side

plasma 血浆

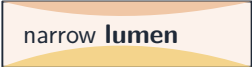
a liquid carrying blood cells, **ions** 离子, **nutrients** 营养物质, **urea** 尿素, hormones and **carbon dioxide** 二氧化碳

the liver's vessels

(Supplement) **hepatic artery** 肝动脉 in, **hepatic vein** 肝静脉 out, and the **hepatic portal vein** 肝门静脉 from the gut

Clotting seals a wound: it stops blood loss **and** stops pathogens getting in. (Supplement) fibrinogen becomes insoluble fibrin, which traps the cells.

Coronary heart disease

A diagram of a coronary artery. The artery is shown as a horizontal tube. The interior of the tube is labeled 'narrow lumen'. The tube is wider at the ends and narrower in the middle, with a yellowish-orange color gradient indicating a fatty build-up in the center.

narrow **lumen**

coronary heart disease: fatty build-up narrows the coronary artery, so the heart muscle cannot get enough **oxygen**

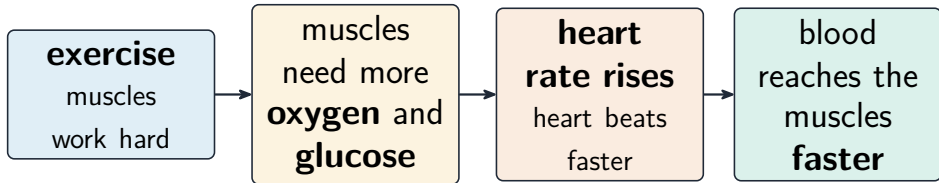
risk factors

high-fat diet smoking lack of exercise stress family history older age

a healthy diet regular exercise **lower the risk**

Coronary heart disease narrows the artery; several risk factors raise it and a healthy lifestyle lowers it

Heart rate and exercise



check the heart's activity by feeling the **pulse**, listening to the valves, or with an **ECG**

During exercise the heart rate rises so blood reaches the muscles faster

Exam tips

- Circulatory system = pump (heart) + vessels + valves for one-way flow.
- Double circulation (mammals): blood passes through the heart twice. The left ventricle wall is thickest because it pumps to the whole body.
- Arteries carry blood **away** (thick, high pressure); veins carry it **back** (valves, low pressure); capillaries are for exchange (one cell thick).
- Blood = red cells (oxygen, haemoglobin) + white cells (defence) + platelets (clotting) + plasma (transport).
- Phagocytes engulf pathogens; lymphocytes make antibodies.

3

Recap

Worked example – why is one wall thicker?

Explain why the left ventricle wall is much thicker than the right.

- The **right** ventricle pumps blood only to the **lungs** – a short trip, and delicate capillaries.
- Too high a pressure would **damage** them.
- The **left** ventricle pumps to the **whole body**, a much longer distance.
- A thicker **muscle** wall contracts harder $\Rightarrow$ **higher pressure**.

Thicker wall = more **muscle** = more force = higher pressure. Say **muscle**, and say **how far the blood must travel**.

Topic 9 – key takeaways

1

Double

blood passes the heart twice each trip

2

Heart

left ventricle is thickest; valves stop backflow

3

Vessels

arteries away, veins back, capillaries exchange

4

Blood

red O₂, white defence, platelets clot, plasma

Check yourself

- 1 Why is the left ventricle wall the thickest?
- 2 Which vessel carries blood away from the heart?
- 3 What pigment lets red cells carry oxygen?
- 4 How do lymphocytes fight pathogens?



Answers 1. it pumps blood to the whole body 2. an artery 3. haemoglobin 4. they make antibodies