

# Transport in Animals

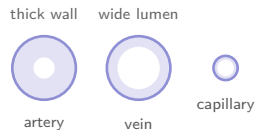
IGCSE Biology ■ Topic 9

IGCSE Biology



## What we will cover

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



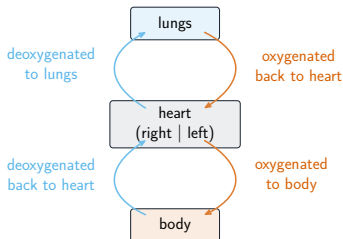
*blood vessels*

1

# Heart and circulation

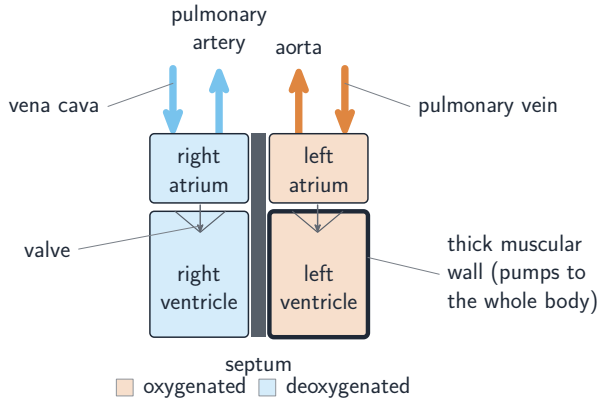
---

# 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 O<sub>2</sub> & glucose

### **coronary heart disease** 冠心病

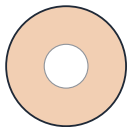
coronary arteries narrow; risks:  
fatty diet, smoking, no exercise

# 2

## Vessels and blood

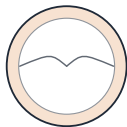
---

# 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

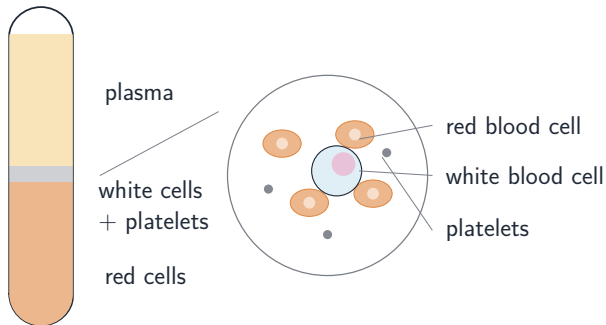
Make **antibodies** 抗体 shaped to one antigen, and leave memory cells behind.

### 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; **lympho-**

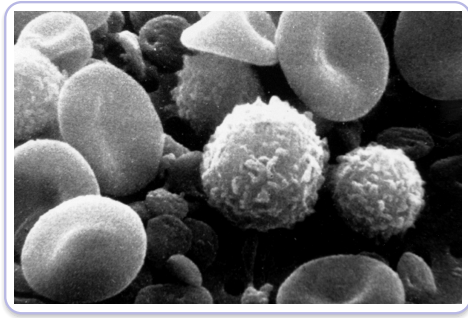
**cytes** 淋巴细胞 make **antibodies** 抗体

### clotting

**fibrinogen** 纤维蛋白原 →

**fibrin** 纤维蛋白 threads  
trap cells & seal the wound

## Red cells, white cells and platelets



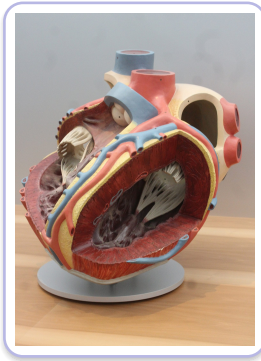
Real blood cells under an electron microscope: red cells (discs), white cells and platelets

# The vessels, the chambers, and what plasma carries

|                                    |                                                                                                                               |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <b>the lumen</b> 管腔                | the space inside a vessel – narrow in an artery, wide in a vein, tiny in a capillary                                          |
| <b>the atrium</b> 心房               | receives blood; the <b>ventricle</b> pumps it out, so its wall is far thicker                                                 |
| <b>atrioventricular valves</b> 房室瓣 | stop backflow from ventricle to atrium; semilunar valves stop it from the arteries                                            |
| <b>deoxygenated blood</b> 缺氧血      | right side of the heart, to the lungs; oxygenated blood returns to the left side                                              |
| <b>plasma</b> 血浆                   | a liquid carrying blood cells, <b>ions</b> 离子, <b>nutrients</b> 营养物质, <b>urea</b> 尿素, hormones and <b>carbon dioxide</b> 二氧化碳 |
| <b>the liver's vessels</b>         | (Supplement) <b>hepatic artery</b> 肝动脉 in, <b>hepatic vein</b> 肝静脉 out, and the <b>hepatic portal vein</b> 肝门静脉 from the gut  |

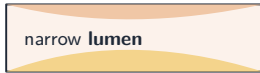
Clotting seals a wound: it stops blood loss **and** stops pathogens getting in. (Supplement) fibrinogen becomes insoluble fibrin, which traps the cells.

## Four chambers and a thicker left ventricle



A museum model of the heart: four chambers, and a left ventricle wall you can see is the thicker one

# Coronary heart disease



**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

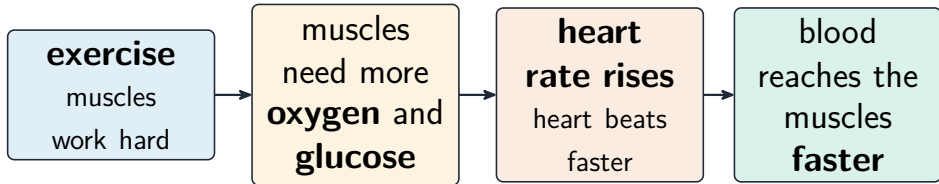
a healthy diet

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 O<sub>2</sub>, 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