

Transport in Mammals

A-Level Biology ■ Topic 8

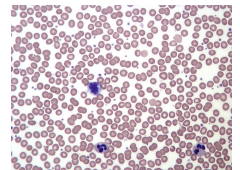
A-Level Biology



Transport in Mammals

What we will cover

- 1 Double circulation
- 2 Blood vessels & tissue fluid
- 3 Oxygen transport
- 4 Carbon dioxide transport
- 5 The heart
- 6 Controlling the heartbeat



red & white blood cells

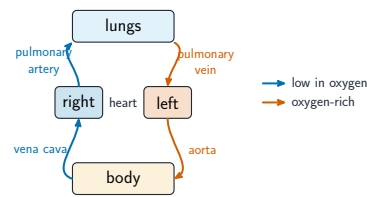
1

Circulation

Transport in Mammals

└ Circulation

Double circulation



A **closed double circulation** 封闭双循环: blood passes through the heart **twice** per trip.

- **pulmonary** 肺循环 loop – to the lungs
- **systemic** 体循环 loop – to the body

Order: **arteries** 动脉 → **capillaries** 毛细血管 → **veins** 静脉.

Transport in Mammals

└ Circulation

Blood vessels

- **artery** 动脉 – thick muscular & elastic wall; high pressure
- **capillary** 毛细血管 – one cell thick; fast exchange
- **vein** 静脉 – thin wall, **valves** 瓣膜 stop backflow



artery
thick muscular,
elastic wall;
narrow lumen
(high pressure)



vein
thin wall;
wide lumen;
valves
(low pressure)

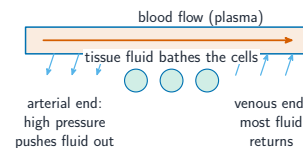


capillary
wall one cell
thick; very
narrow (exchange)

Transport in Mammals

└ Circulation

Tissue fluid



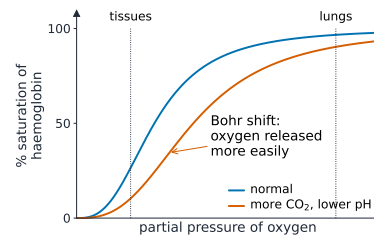
At the arterial end, high pressure pushes liquid (not cells/proteins) out of the **plasma** 血浆.

This **tissue fluid** 组织液 bathes the cells with oxygen & glucose; most returns at the lower-pressure venous end.

2 Gas transport

Transport in Mammals
└ Gas transport

Oxygen transport and the Bohr shift



Haemoglobin 血红蛋白 loads oxygen in the lungs (high **partial pressure** 分压) and unloads it in the tissues.

The **Bohr shift** 波尔位移: more CO_2 (lower pH) moves the curve **right**, so oxygen is released where it is most needed.

Transport in Mammals
└ Gas transport

Carbon dioxide transport

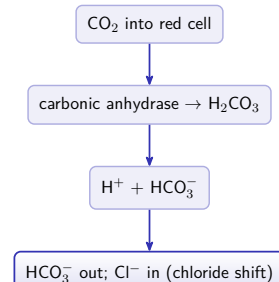
Most CO_2 travels as **hydrogencarbonate ions** 碳酸氢根离子:

- **carbonic anhydrase** 碳酸酐酶 speeds $\text{CO}_2 + \text{water}$
- the **chloride shift** 氯转移 keeps charge balanced
- haemoglobin mops up the H^+

Transport in Mammals
└ Gas transport

Carbon dioxide transport

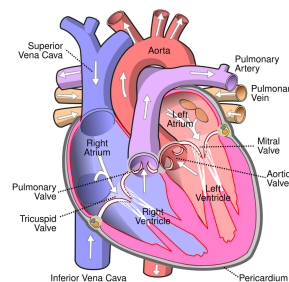
Most CO_2 travels as **hydrogencarbonate** 碳酸氢根 ions in the plasma.



3 The heart

Transport in Mammals
└ The heart

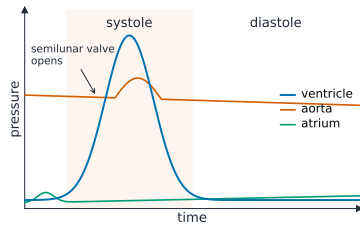
The heart



Four chambers: thin-walled **atria** 心房 above, thick **ventricles** 心室 below.

The **left ventricle** wall is thickest – it pumps blood all the way round the body; the right side only reaches the lungs.

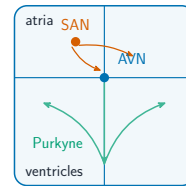
The cardiac cycle



One heartbeat: **systole** 收缩期 (contract) then **diastole** 舒张期 (relax & fill).

A pressure change opens or closes a **valve** 瓣膜 wherever two pressure curves cross – so blood flows one way only.

Controlling the heartbeat



SAN fires → atria contract → AVN delays → Purkyne → ventricles contract from the bottom up

The heart sets its own rhythm:

- the **SAN** 窦房结 (pacemaker) fires; the atria contract
- the **AVN** 房室结 delays, then passes it on
- **Purkyne tissue** 浦肯野组织 makes ventricles contract bottom-up

4 Recap

Worked example – the Bohr shift

Explain why the oxygen dissociation curve shifts right in an exercising muscle.

- An exercising muscle respire hard, so it releases more CO_2 .
- CO_2 forms carbonic acid in the blood $\Rightarrow$ pH falls.
- Lower pH slightly changes haemoglobin's shape, lowering its affinity for oxygen.
- At the same $p\text{O}_2$ it is now **less saturated** $\Rightarrow$ **more oxygen unloaded** exactly where it is needed.

Right shift = **unloads more readily**. The S-shape itself comes from **cooperative binding**: the first O_2 makes the next one easier to bind.

Topic 8 – key takeaways

1 Circulation

closed, double; arteries to capillaries to veins

2 Oxygen

dissociation curve; Bohr shift releases O_2

3 Carbon dioxide

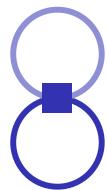
carried as hydrogencarbonate; chloride shift

4 Heart

SAN sets rhythm; left ventricle wall thickest

Check yourself

- 1 Which vessel has valves to stop back-flow?
- 2 Which way does the Bohr shift move the curve?
- 3 In which form is most CO_2 carried?
- 4 Which node is the heart's pacemaker?



Answers 1. veins 2. to the right 3. hydrogencarbonate ions 4. the sinoatrial node (SAN)