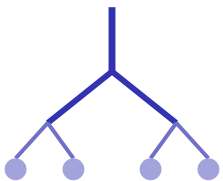
Gas Exchange

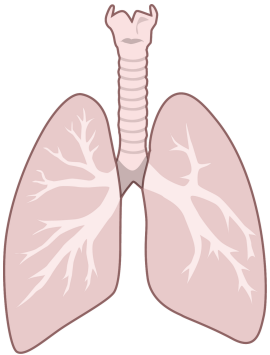
A-Level Biology ▪ Topic 9

A-Level Biology



What we will cover

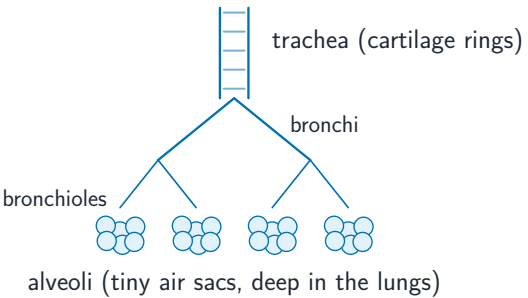
1. The airway path
2. The airway wall
3. Keeping the lungs clean
4. Gas exchange in alveoli
5. Real lung tissue



millions of alveoli

1 The airways

The gas exchange system



Air follows one path in:

trachea 气管

↓

bronchi 支气管

↓

bronchioles 细支气管

↓

alveoli 肺泡

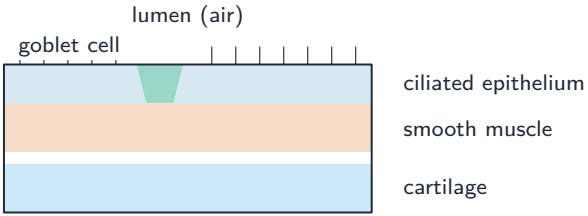
Each alveolus is wrapped in **capillaries** 毛细血管, bringing air & blood very close.

The route air takes, and the cells lining it

gas exchange 气体交换	taking in **oxygen** 氧气 and getting rid of **carbon dioxide** 二氧化碳
the route	trachea → two bronchi → many smaller **bronchioles** 细支气管 → alveoli
cartilage	C-shaped rings hold the trachea and bronchi open; bronchioles have none, so they can constrict
mucous glands 黏液腺 and goblet cells	secrete mucus, which traps dust and bacteria
ciliated cells	beat the mucus upward to the throat, where it is swallowed
smooth muscle	in the bronchiole walls, changing the airway diameter

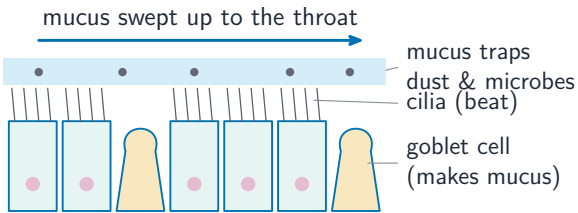
> The airway wall is a defence system as much as a tube. Every layer – cartilage, muscle, mucus, cilia – has a job that the exam asks for by name.

The airway wall



- **cartilage** 软骨 – holds the airway open
- **smooth muscle** 平滑肌 – narrows it
- **elastic fibres** 弹性纤维 – recoil to push air out
- **squamous epithelium** 扁平上皮 – thin, for a short diffusion path

Keeping the lungs clean

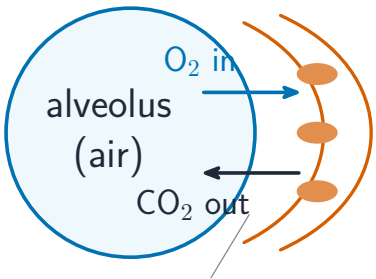


Goblet cells 杯状细胞 make **mucus** 黏液 that traps dust & microbes.

> The beating **cilia** 纤毛 of the **ciliated epithelium** 纤毛上皮 sweep the mucus up to the throat to be swallowed.

2 Gas exchange

Gas exchange in the alveoli



Alveoli are great exchange surfaces: huge area, walls one cell thick, rich blood supply, moist lining.

- O_2 diffuses air $\rightarrow$ blood
- CO_2 diffuses blood $\rightarrow$ air

Real lung tissue

The open spaces are alveoli; the thin pink walls are where gases cross.

> Breathing renews the air and flowing blood carries gases away – keeping the **concentration gradients** 浓度梯度 steep, so exchange stays fast.

Exam tips

- Link each **alveolar** feature to fast diffusion: large surface area, thin (one-cell) walls, moist surface, good blood supply – a "surface area, short distance, steep gradient" answer.
- Match airway tissue to function: cartilage (holds airways open), ciliated + goblet cells (trap and sweep mucus), smooth muscle and elastic fibres.
- Frame answers with **Fick's law** ideas: rate $\propto$ surface area $\times$ concentration difference $\div$ distance.

3 Recap

Worked example – why alveoli work so well

Use Fick's law to explain why alveoli are efficient gas exchange surfaces.

- Fick: rate $\propto \dfrac{\text{surface area} \times \text{concentration difference}}{\text{distance}}$
- Huge area: millions of alveoli give $\approx 70\,\mathrm{m}^2$.
- Short distance: alveolar and capillary walls are both one flattened cell $\Rightarrow$ under $1\,\mu\mathrm{m}$.
- Steep gradient: ventilation and blood flow constantly renew it $\Rightarrow$ fast diffusion.

Answer gas-exchange questions with all three of Fick's terms. Ventilation and circulation are what maintain the gradient – name them.

Topic 9 – key takeaways

1 Airway path

trachea, bronchi, bronchioles, alveoli

2 Airway wall

cartilage, muscle, cilia & goblet cells

3 Alveoli

huge area, thin moist walls, rich blood supply

4 Exchange

O_2 in, CO_2 out by diffusion

Check yourself

1. Which tissue holds the trachea open?
2. What do goblet cells make?
3. What sweeps mucus up to the throat?
4. How thick is the alveolus wall?

Answers **1.** cartilage **2.** mucus **3.** cilia **4.** one cell thick