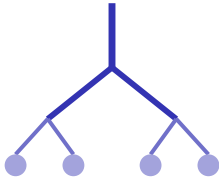


Gas Exchange

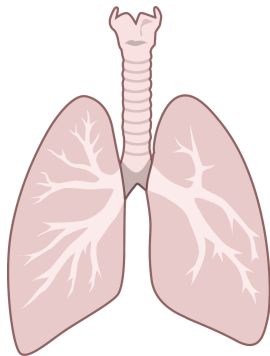
A-Level Biology ■ Topic 9

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

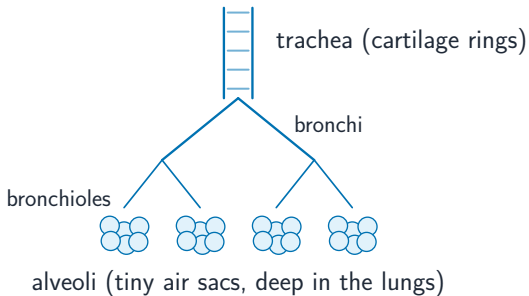


millions of alveoli

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

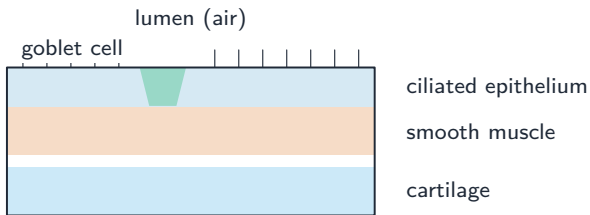
beat the mucus **upward** to the throat, where it is swallowed

smooth muscle

in the bronchiole walls, changing the airway diameter

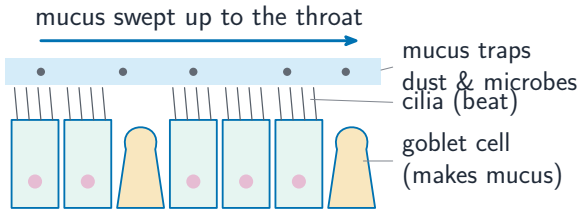
The airway wall is a defence system as much as a tube. Every layer – cartilage, muscle, mucus, cilia – has a job that the exam asks for by name.

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



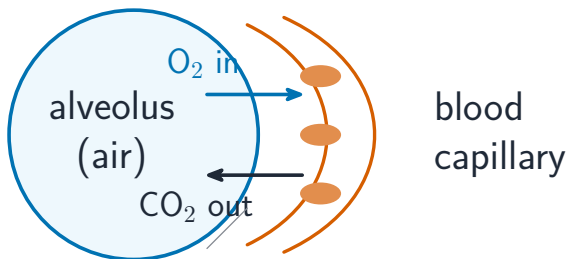
Goblet cells 杯状细胞 make **mucus** 黏液 that traps dust & microbes.

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

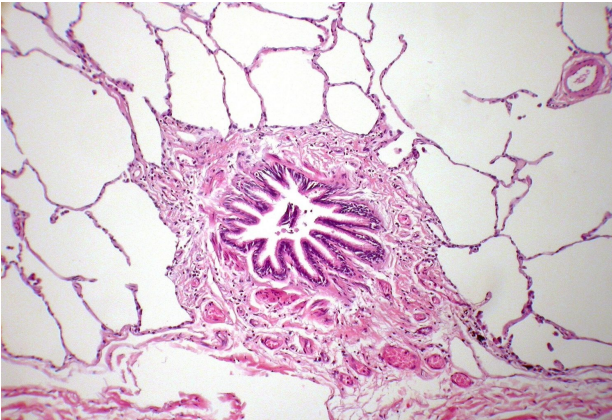


wall one cell thick;
moist; short distance

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

- O₂ diffuses air → blood
- CO₂ diffuses blood → 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: $\text{rate} \propto \text{surface area} \times \text{concentration difference} \div \text{distance}$.

3

Recap

Worked example – why alveoli work so well

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

- Fick: $\text{rate} \propto \frac{\text{surface area} \times \text{concentration difference}}{\text{distance}}$
- **Huge area:** millions of alveoli give $\approx 70 \text{ m}^2$.
- **Short distance:** alveolar and capillary walls are both one flattened cell $\Rightarrow$ under $1 \mu\text{m}$.
- **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

O₂ in, CO₂ 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