

Exercise walk-through

The gas exchange system ■ 9.1

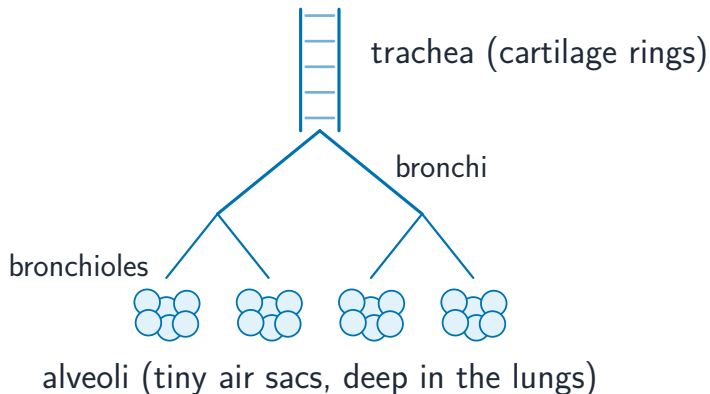
eXercise

You must be able to

- describe the structure of the gas exchange system and the distribution of its tissues
- describe the functions of cartilage, ciliated epithelium, goblet cells, smooth muscle and squamous epithelium
- explain how the alveoli are adapted for gas exchange

Method — The airways

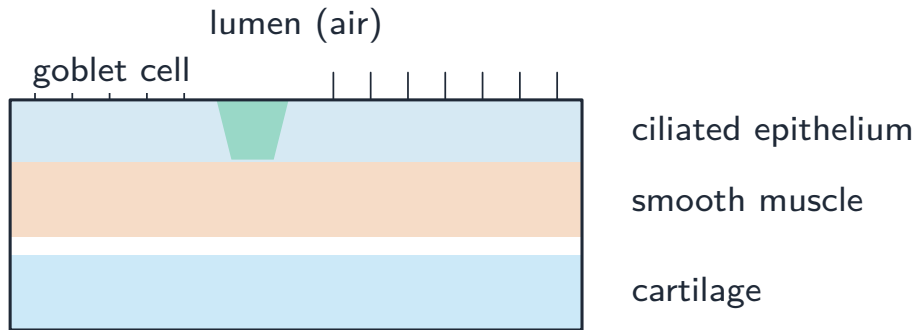
Air path: **trachea** 气管 → **bronchi** 支气管 → **bronchioles** 细支气管 → **alveoli**, each wrapped in **capillaries** 毛细血管.



Method — Tissues and their functions

- **cartilage** 软骨 — holds the airway open.
- **ciliated epithelium** 纤毛上皮 — cilia sweep **mucus** 黏液 up to the throat.
- **goblet cells** 杯状细胞 — make mucus that traps dust and microbes.
- **smooth muscle** 平滑肌 — narrows the airway; **elastic fibres** recoil to push air out.
- **squamous epithelium** 扁平上皮 — very thin alveolus lining → short diffusion distance.

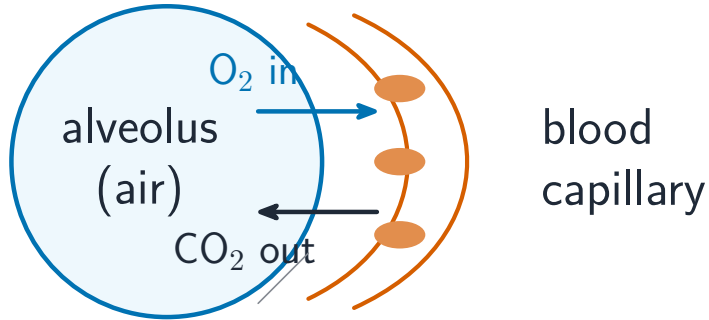
Method — Tissues and their functions



Method — Gas exchange in the alveoli

Alveoli are adapted by: a **large surface area** (millions of sacs), a **thin wall** (one cell thick — short diffusion distance), a **rich blood supply**, and a **moist lining**. Breathing and blood flow keep the **concentration gradients** 浓度梯度 steep.

Method — Gas exchange in the alveoli



wall one cell thick;
moist; short distance

Practice 2.1 ■ 2 marks

State the function of (a) cartilage and (b) goblet cells in the airways.

Solution 2.1

Method: Tissues and their functions

Worked steps

(a) cartilage holds the airway open / stops it collapsing **B1**; (b) goblet cells make mucus that traps dust and microbes **B1**.

Practice 2.2 ■ 3 marks

State **three** features that make the alveoli good for gas exchange.

Solution 2.2

Method: Gas exchange in the alveoli

Worked steps

any three: large surface area; thin (one-cell) walls / short diffusion distance; rich/good blood supply; moist surface **B1** *each, max 3.*

Exam-style 3.1 ■ 1 mark

Which tissue keeps the trachea open when air pressure inside falls?

- A** cartilage
- B** ciliated epithelium
- C** goblet cells
- D** smooth muscle

Solution 3.1

A cartilage



B ciliated epithelium

C goblet cells

D smooth muscle

Worked steps

A. Cartilage holds the trachea open.

Exam-style 3.2 ■ 1 mark

Why do oxygen molecules diffuse from the alveolar air into the blood?

- A** the blood is warmer than the air
- B** oxygen is at a higher concentration in the alveolar air than in the blood
- C** the alveolus wall is thick
- D** carbon dioxide pushes the oxygen across

Solution 3.2

Method: Gas exchange in the alveoli

- A the blood is warmer than the air
- B oxygen is at a higher concentration in the alveolar air than in the blood** 
- C the alveolus wall is thick
- D carbon dioxide pushes the oxygen across

Worked steps

- B. Oxygen diffuses down its concentration gradient from high (air) to low (blood).**

Exam-style 3.3 ■ 3 marks

Explain how the ciliated epithelium and goblet cells together keep the lungs healthy.

Solution 3.3

Method: Tissues and their functions

Worked steps

goblet cells secrete mucus that traps dust and microbes **B1**; the cilia beat to sweep the mucus up towards the throat **B1**; it is swallowed, keeping the airways clear of pathogens **B1**.

Exam-style 3.4 ■ 2 marks

An alveolus has a diameter of $250\text{ }\mu\text{m}$. In a photomicrograph it measures 20 mm across.

- (a) Calculate the magnification of the photomicrograph.
- (b) Explain why a one-cell-thick alveolus wall speeds up gas exchange.

Solution 3.4

Method: Gas exchange in the alveoli

Worked steps

(a) $20 \text{ mm} = 20\,000 \text{ }\mu\text{m}$ (M1); magnification = $\frac{20\,000}{250} = \times 80$ (A1).

(b) a thin wall gives a short diffusion distance (M1), so gases cross faster (A1).