

Week 25

A-Level Biology

Homework bundle for this week

本周作业合集

exercises.lol

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9. Gas exchange

Starter Quiz · 课前小测

A-Level Biology

Name: _____ Score: _____

- The C-shaped rings of cartilage in the trachea and bronchi:
 - ☐ hold the airway open so it cannot collapse
 - ☐ make mucus
 - ☐ sweep mucus upward
 - ☐ narrow the airway
- Alveoli have a large surface area and very thin walls for fast gas exchange.
 - ☐ True ☐ False
- The squamous epithelium of the alveoli is very thin and flat because this:
 - ☐ gives a very short distance for gases to diffuse
 - ☐ makes more mucus
 - ☐ holds the airway open
 - ☐ narrows the airway
- Which feature makes alveoli good for gas exchange?
 - ☐ a large total surface area with very thin walls
 - ☐ a small surface area and thick walls
 - ☐ a dry lining
 - ☐ no blood supply
- Bronchioles have no cartilage; their walls contain smooth muscle instead.
 - ☐ True ☐ False
- Oxygen diffuses:
 - ☐ from the alveolar air into the blood
 - ☐ from the blood into the air
 - ☐ from blood into the alveolus walls only
 - ☐ in no particular direction
- The tiny hair-like structures that beat to sweep mucus up out of the lungs are called _____.

8. Carbon dioxide diffuses from the blood into the alveolar _____, to be breathed out.

9. Breathing and the flow of blood keep gas exchange fast because they:

- ☐ maintain steep concentration gradients
- ☐ reduce the surface area
- ☐ thicken the walls
- ☐ dry out the lining

9. Gas exchange

Answers · 答案

A-Level Biology

1. hold the airway open so it cannot collapse

Cartilage supports the airway, keeping it open as air pressure changes during breathing.

2. True

A large surface area, thin walls, a rich blood supply and a moist lining all speed up gas exchange.

3. gives a very short distance for gases to diffuse

A thin, flat lining means a short diffusion distance, so gas exchange is fast.

4. a large total surface area with very thin walls

Large surface area, thin walls, a rich blood supply and a moist lining all speed up gas exchange.

5. True

The smallest airways lose the cartilage and have smooth muscle, which can narrow them.

6. from the alveolar air into the blood

Oxygen is higher in the alveolar air than in the blood, so it diffuses air → blood.

7. cilia

Cilia beat in a wave, moving the dirt-laden mucus up to the throat to be swallowed.

8. air

CO₂ is higher in the blood, so it diffuses blood → air and is then exhaled.

9. maintain steep concentration gradients

Fresh air and moving blood keep concentrations different on each side, so the gradients stay steep.

9.1 The gas exchange system

Name: _____ Class: _____ Date: _____

Total: 14 marks

KEY WORDS gas exchange 气体交换 • bronchi 支气管 • alveoli 肺泡 • bronchiole 细支气管
• trachea 气管

Objective

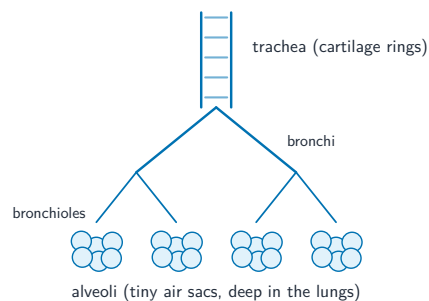
Build the skills to answer exam questions on **the gas exchange system** — its structure, the tissues of the airways, and **gas exchange** 气体交换 in the **alveoli** 肺泡.

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

1 Worked examples

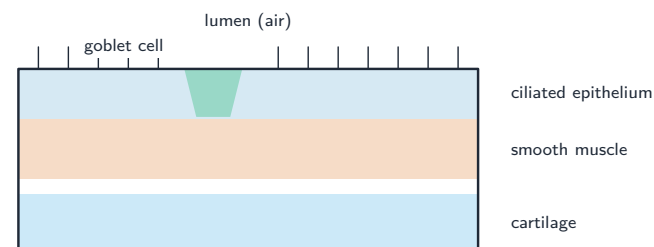
■ The airways



Air passes down the trachea, into the bronchi and bronchioles, to the alveoli

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

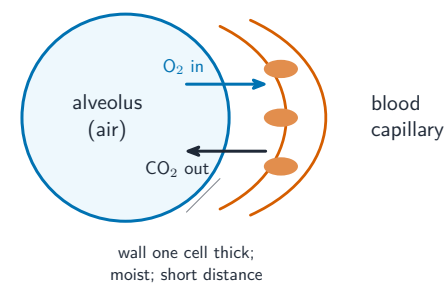
■ Tissues and their functions



Cilia and goblet cells line the lumen; smooth muscle and cartilage support the wall

- **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.

■ Gas exchange in the alveoli



Across the thin, moist wall: oxygen diffuses into the blood, carbon dioxide diffuses out

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.

2 Practice

2.1 State the function of (a) cartilage and (b) goblet cells in the airways. [2]

2.2 State **three** features that make the alveoli good for gas exchange. [3]

3 Exam-style questions

3.1 Which tissue keeps the trachea open when air pressure inside falls? [1]

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

3.2 Why do oxygen molecules diffuse from the alveolar air into the blood? [1]

- **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

3.3 Explain how the ciliated epithelium and goblet cells together keep the lungs healthy.[3]

3.4 An alveolus has a diameter of 250 μm . In a photomicrograph it measures 20 mm across.

(a) Calculate the magnification of the photomicrograph. [2]

(b) Explain why a one-cell-thick alveolus wall speeds up gas exchange. [2]

Solutions

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

2.2 any three: large surface area; thin (one-cell) walls / short diffusion distance; rich/good blood supply; moist surface.

3.1 A. Cartilage holds the trachea open.

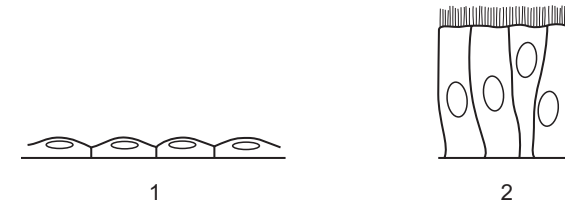
3.2 B. Oxygen diffuses down its concentration gradient from high (air) to low (blood).

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

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

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

34 Two types of epithelial cells, 1 and 2, occur in the mammalian gas exchange system in a healthy human.



Which row shows the function and distribution of these types of epithelial cells?

	cell type 1	cell type 2
A	absorption in bronchi	secrete mucus in alveoli
B	exchange surface in alveoli	secrete mucus in bronchi
C	absorption in bronchi	move mucus in alveoli
D	exchange surface in alveoli	move mucus in bronchi

35 Which tissues would be seen in a photomicrograph of the wall of the trachea?

	elastic fibres	smooth muscle
A	x	✓
B	✓	x
C	✓	✓
D	x	x

key

✓ = present

x = not present

36 The diagram shows parts of the gas exchange system in humans and the associated cells or structures.

alveolus

bronchiole

bronchus

trachea

ciliated cells

squamous epithelial cells

C-shaped rings of cartilage

ciliated cells and goblet cells

Which diagram shows the lines that correctly match the parts to their cells or structures?

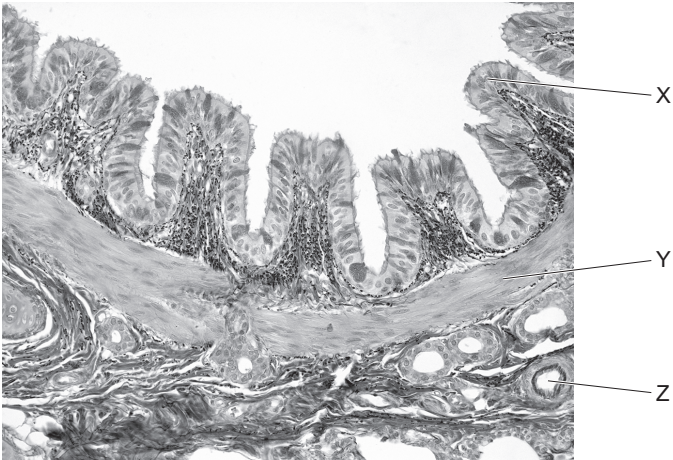
A

B

C

D

37 The photomicrograph shows the wall of a bronchus as seen with a light microscope.

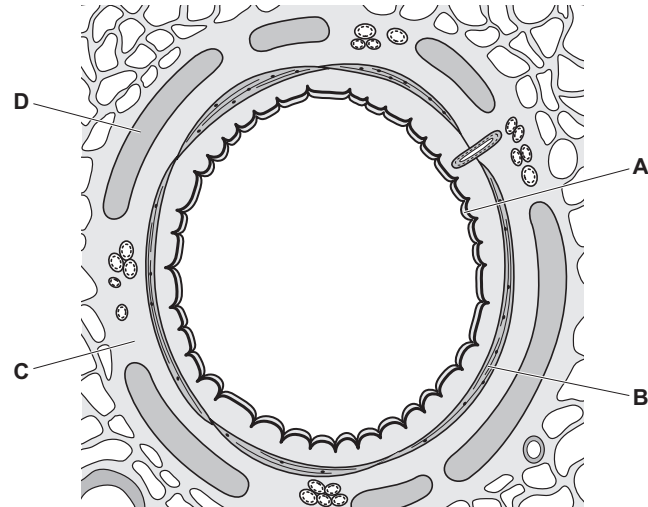


Which row correctly identifies the structures labelled?

	X	Y	Z
A	epithelium	elastic fibres	bronchiole
B	endothelium	smooth muscle	bronchiole
C	epithelium	smooth muscle	blood vessel
D	endothelium	elastic fibres	blood vessel

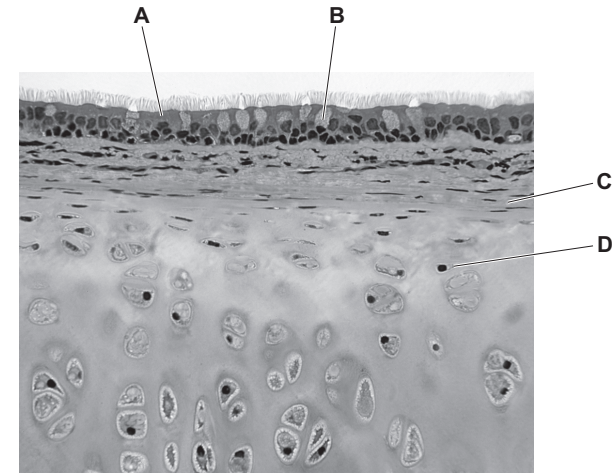
34 The diagram shows a transverse section through a human bronchus.

Which labelled tissue is the cartilage?



35 The photomicrograph shows a transverse section of part of the human gas exchange system.

Which row shows the correct name and function of one of the labelled structures in the photomicrograph?



	name	function
A	ciliated epithelial cell	traps particles
B	goblet cell	secretes mucus
C	cartilage	prevents collapse of trachea
D	smooth muscle	contracts to expand airways

6 (a) Alveolar macrophages are phagocytes found in the human gas exchange system. They produce hydrolytic enzymes, such as lysozyme, to digest pathogens entering the alveolus.

(i) State the term used to describe the sequence of nucleotides in the DNA of the alveolar macrophage that codes for a protein, such as lysozyme.

..... [1]

(ii) Synthesis of lysozyme occurs in two stages. The first stage occurs in the nucleus using one strand of DNA to synthesise mRNA.

State the name of the strand of DNA that is used to synthesise mRNA.

..... [1]

(iii) Name the organelle where the translation of mRNA takes place to produce lysozyme.

..... [1]

(iv) Lysozyme destroys bacterial cells by hydrolysing bonds in peptidoglycan.

Explain how the hydrolysis of bonds in peptidoglycan leads to the destruction of bacterial cells.

.....

 [2]

(b) (i) Alveolar macrophages are found in contact with squamous epithelial cells in the walls of alveoli.

Explain how the cells lining the alveoli are adapted for gas exchange.

.....

 [2]

(ii) Describe the role of elastic fibres in the wall of an alveolus.

.....

 [2]

[Total: 9]

- 4 In mammals, the gas exchange system includes a set of branching airways that carry air to and from the gas exchange surface.

Air from the external atmosphere passes through different types of airway to reach the gas exchange surface.

- (a) Name the type of airway of the gas exchange system that branches into airways known as bronchioles.

..... [1]

- (b) Fig. 4.1 is a photomicrograph of a section through a bronchiole.

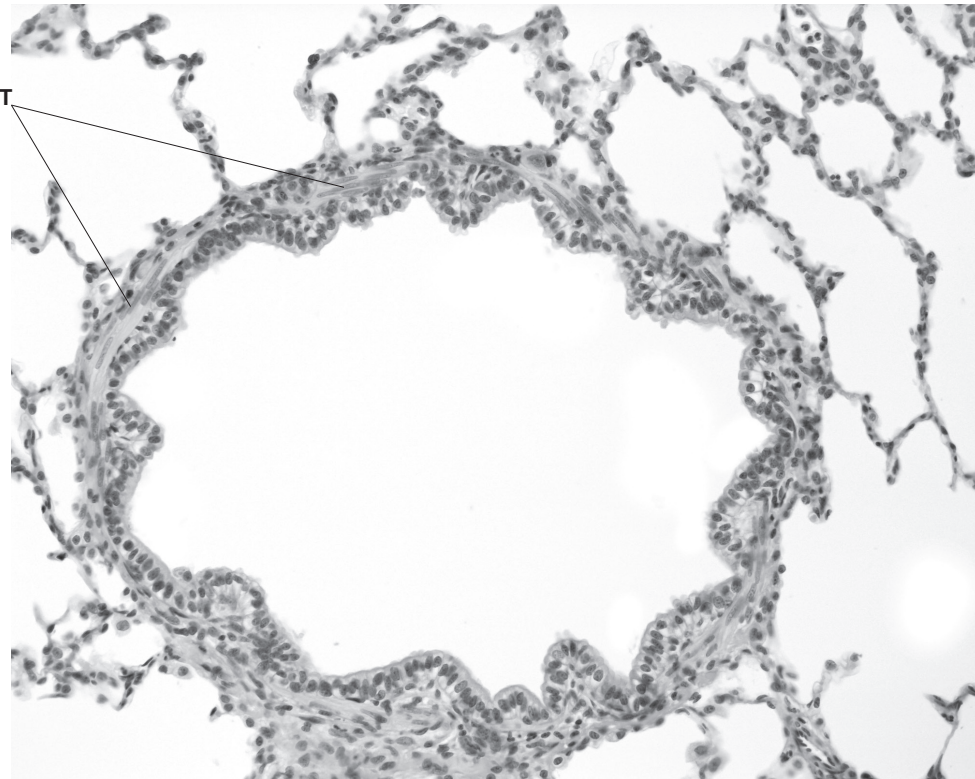


Fig. 4.1

- (i) The bronchiole shown in Fig. 4.1 is **not** part of the gas exchange surface.

Name **one** structure in the gas exchange system, **visible in Fig. 4.1**, where gas exchange is carried out.

..... [1]

- (ii) Name the type of cell found in the tissue labelled **T** in Fig. 4.1.

..... [1]

- (iii) State the features that help to identify the type of airway shown in Fig. 4.1 as a bronchiole and **not** the other types of airway present in the gas exchange system.

.....

 [3]

- (c) Blood is pumped to the lungs in the pulmonary circulation.

The lungs also receive a supply of blood from the systemic circulation.

Explain why the pulmonary circulation **and** the systemic circulation need to supply blood to the lungs.

.....

 [2]

[Total: 8]