

Gas exchange

A-Level Biology 9700 · Topic 9 revision notes

Everything from the 2 lessons of this topic on a few pages: the key idea of each lesson, the diagram to remember, the points to learn and the traps examiners set. Read it, cover it, test yourself.

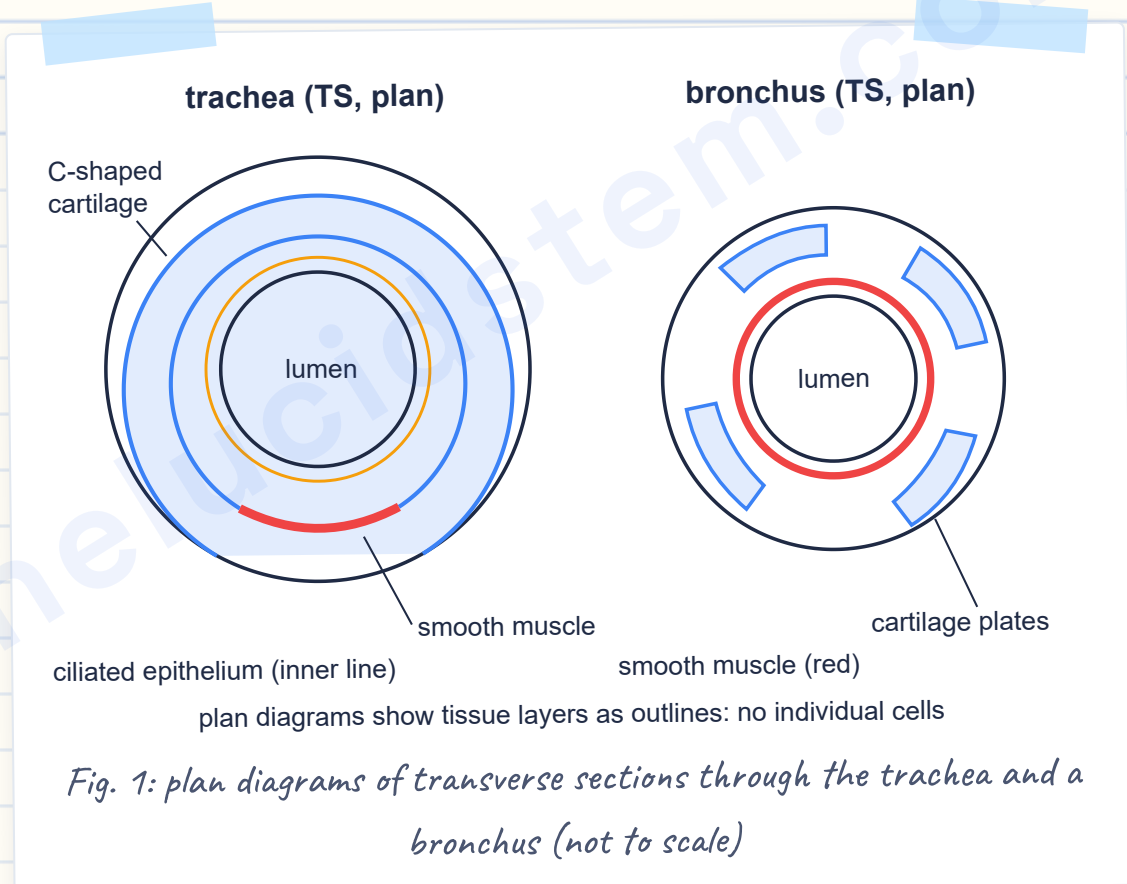
1. The gas exchange system and its airways
2. Alveoli, gas exchange and the airway tissues

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1 The gas exchange system and its airways

Syllabus 9.1

Air passes through the **trachea**, which divides into two **bronchi**, one to each **lung**; these branch into many **bronchioles**, which end in clusters of **alveoli** surrounded by a **capillary network**. **Cartilage** is found as C-shaped rings in the trachea and irregular plates in the bronchi, but not in bronchioles or alveoli. **Ciliated epithelium** with **goblet cells** lines the trachea, bronchi and larger bronchioles. **Smooth muscle** and elastic fibres are in the walls of all the airways, with relatively most smooth muscle in the bronchioles. **Squamous epithelium** forms the alveolar walls, which are wrapped in **capillaries**. **Goblet cells** and **mucous glands** secrete mucus that traps dust, pollen and bacteria, and the **cilia** beat to sweep the mucus up to the throat, where it is swallowed.



Cartilage first, then lining.

- ✓ **Trachea:** C-shaped cartilage rings, ciliated epithelium, goblet cells, glands.
- ✓ **Bronchus:** cartilage plates, otherwise like the trachea.
- ✓ **Bronchiole:** no cartilage, relatively more smooth muscle, few goblet cells.
- ✓ **Alveolus:** squamous epithelium, elastic fibres, capillaries only.

Watch out!

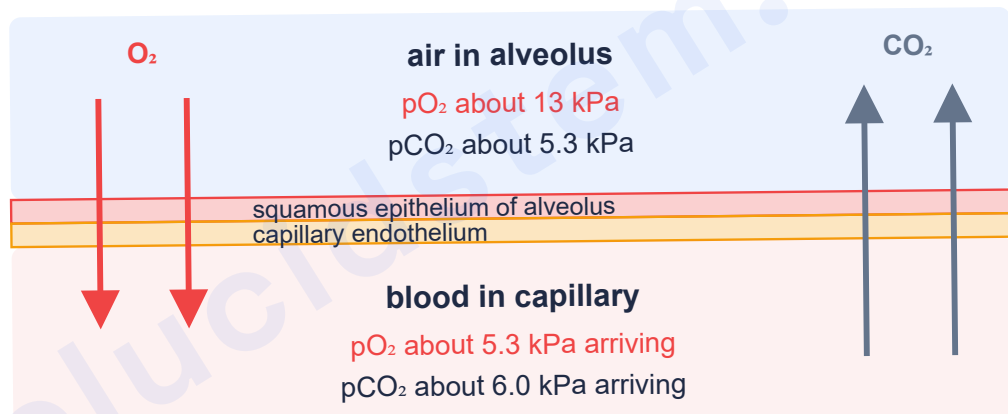
Bronchioles have **no cartilage**; that is the quickest way to tell a bronchiole from a bronchus on a slide. Do not say the trachea has complete rings: the rings are C-shaped, and the gap at the back, next to the oesophagus, is bridged by smooth muscle.

Cilia do **not** trap particles and they do not make mucus. Mucus (from goblet cells and mucous glands) traps; cilia **move** the mucus. Keep the two jobs separate in your answer.

2 Alveoli, gas exchange and the airway tissues

Syllabus 9.1

In the alveoli, **oxygen** diffuses from the air (high partial pressure, about 13 kPa) into the blood in the capillaries (about 5.3 kPa), and **carbon dioxide** diffuses from the blood into the alveolar air, each down its own concentration gradient. Diffusion is fast because the **surface area** of the millions of alveoli is huge, the **diffusion distance** is less than $1\text{ }\mu\text{m}$ (the **squamous epithelium** of the alveolus plus the **capillary endothelium**), and the gradients are kept steep by **ventilation**, which replaces the alveolar air, and **blood flow**, which carries oxygenated blood away. **Cartilage** holds the trachea and bronchi open; **smooth muscle** contracts or relaxes to change the diameter of the airways, especially the bronchioles; **elastic fibres** stretch as the alveoli fill and **recoil** to help push air out.



two flattened cells: diffusion distance less than $1\text{ }\mu\text{m}$
ventilation keeps alveolar air fresh; blood flow carries gases away
so both concentration gradients stay steep (not to scale)

Fig. 1: gas exchange across the alveolar wall and the capillary wall, with typical partial pressures

Area, distance, gradient.

- ✓ **Area:** millions of alveoli, each wrapped in capillaries.
- ✓ **Distance:** squamous epithelium plus endothelium, under 1 μm .
- ✓ **Gradient:** ventilation in, blood flow away.
- ✓ **Tissues:** cartilage supports, smooth muscle narrows, elastic fibres recoil.

Watch out!

Gases cross by **diffusion**, not active transport, and each gas moves down **its own** gradient. Say down a concentration (partial pressure) gradient, and name both layers of cells: the alveolar epithelium and the capillary endothelium.

Bronchioles have **no cartilage**, so it is the smooth muscle and elastic fibres in their walls that control their width. Cartilage does not contract; muscle does. Elastic fibres do not contract either: they **recoil** passively after being stretched.