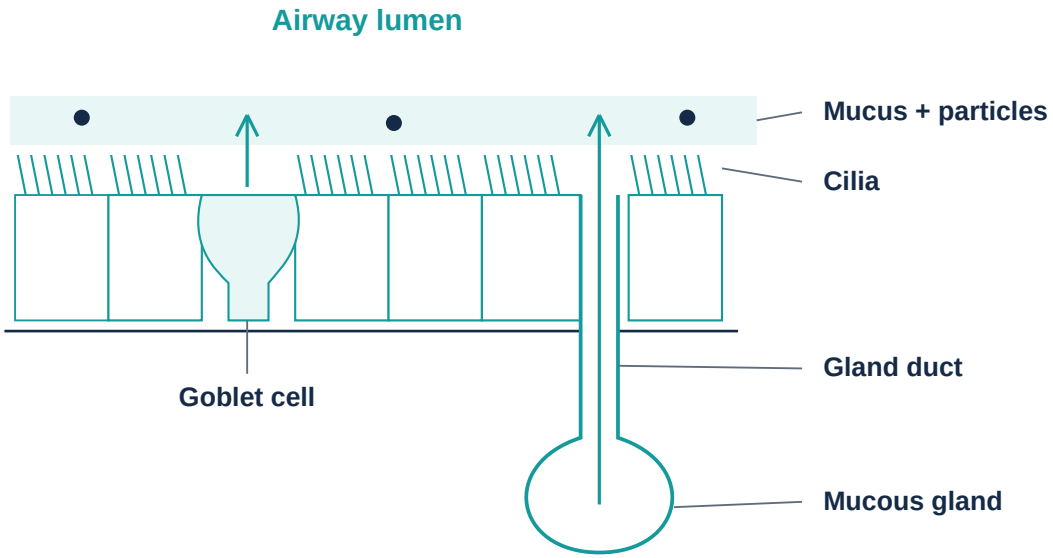
Two sources of protective mucus

Inhaled air can carry dust, pollen and pathogens. Secretions from the lining and glands of larger airways help stop this material reaching the delicate exchange surfaces.

1. SURFACE CELL OR GLAND BELOW THE LINING?



Simplified wall section, not to scale. Upward arrows show secretion onto the airway surface; they do not show the later movement of mucus towards the throat.

2. GOBLET CELLS: SECRETE AT THE SURFACE

Goblet cells are individual mucus-secreting cells among the airway epithelial cells, especially in the trachea and bronchi. Their secretion contributes to the sticky surface layer. A goblet cell is not a ciliated cell: it supplies mucus rather than sweeping it along.

3. MUCOUS GLANDS: ADD SECRETION THROUGH DUCTS

Mucous glands lie below the surface epithelium in larger airway walls. Their ducts deliver mucus to the lumen. Together with goblet cells, they maintain the trapping layer; they do not pump air or form the alveolar gas exchange surface.

Goblet cells and submucosal glands: University of Leeds, Conducting Portion.
Airway lining and protection: OpenStax Anatomy & Physiology 2e, section 22.1.

Scope: Cambridge Biology 9700 syllabus, section 9.1, outcome 5, p. 29.

Trap, transport, then remove

Mucus secretion and ciliary beating are complementary. The mucus captures material; coordinated cilia carry that material out of the lower airways.

1. FOLLOW THE MUCOCILIARY CLEARANCE PATHWAY

1	**Trap**	Dust and microorganisms become caught in the mucus coating the airway surface.
2	**Transport**	Cilia beat in coordinated waves, moving the mucus towards the throat, away from the alveoli.
3	**Remove**	Mucus reaching the throat can be swallowed; coughing can also help expel it.
4	**Protect**	Removing trapped material helps keep conducting airways clearer and reduces exposure of deeper lung tissue.

2. THE CELLS STAY PUT; THEIR CILIA MOVE

Cilia are small projections from the exposed surface of ciliated epithelial cells. Their repeated beating transports the overlying mucus. The epithelial cells do not crawl up the trachea, and cilia do not carry particles through the wall into the blood.

3. KEEP THE DIRECTION CLEAR

Within the lower airways, mucus travels towards the throat. It is not pushed deeper into the lungs for disposal. Breathing moves air in and out; mucociliary clearance moves the contaminated surface secretion towards removal. These are different processes.

Coordinated ciliary beating and removal: NHLBI, Primary Ciliary Dyskinesia overview.
Mucus transport towards the throat and swallowing: OpenStax, section 22.1.

Scope: Cambridge Biology 9700 syllabus, section 9.1, outcome 5, p. 29.

Why the whole system matters

A protective layer must be moved as well as produced. If transport becomes ineffective, trapping can continue while removal falls behind.

1. MATCH EACH COMPONENT TO ITS DIRECT JOB

Goblet cells	Secrete mucus from the surface epithelium.
Mucous glands	Supply mucus through ducts from deeper tissue.
Mucus	Traps inhaled particles and microorganisms.
Ciliated cells	Move mucus by coordinated ciliary beating.

2. IF CILIA FAIL, TRAPPING IS NOT ENOUGH

Poor ciliary movement slows clearance. Mucus and trapped material can accumulate, making it harder to keep the airways clear and increasing the risk of infection. This links a change in cell activity to a change in the health of the whole gas exchange system.

3. A BARRIER, NOT A GUARANTEE OF STERILITY

Mucus traps material, but trapping does not mean every pathogen is killed. Cilia transport the mucus; they are not phagocytes. The mechanism reduces exposure and helps prevent infection, but it does not guarantee that all inhaled particles are removed.

Recall chain: secretion creates the layer; the layer traps material; cilia move it; swallowing or expulsion removes it. Explain each step instead of assigning the entire process to one cell type.

Secretion and airway defence: University of Leeds, Conducting Portion.
Failed ciliary clearance, mucus accumulation and infection: NHLBI overview.

Scope: Cambridge Biology 9700 syllabus, section 9.1, outcome 5, p. 29.