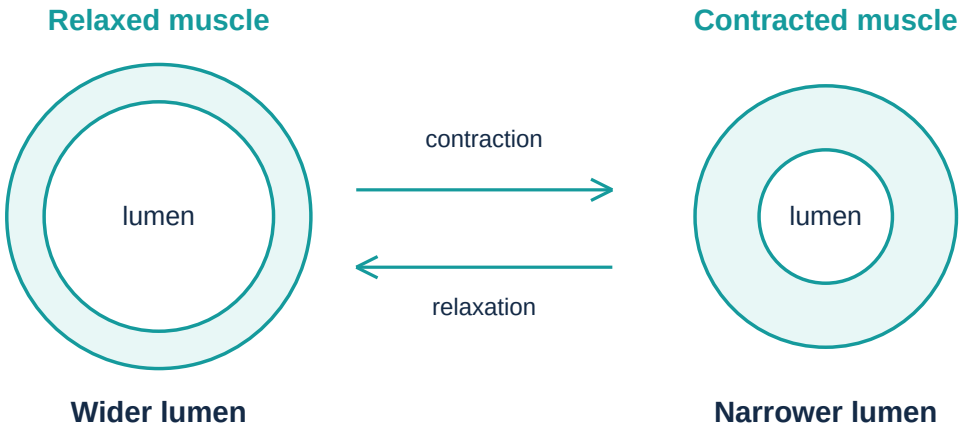
Support and control the airway

Cartilage resists collapse; smooth muscle changes airway diameter. These are different mechanical jobs that help maintain or regulate airflow.

1. CARTILAGE: KEEP A PASSAGE OPEN

The trachea has C-shaped cartilage supports; bronchi also contain cartilage. This firm tissue helps keep the lumen open when pressures change during breathing. Bronchioles lack cartilage: do not describe every airway as cartilage-supported.

2. SMOOTH MUSCLE: CHANGE LUMEN DIAMETER



Simplified bronchiole cross-sections. Coloured bands represent muscle around the airway, not cartilage; other wall layers are omitted.

3. DIAMETER CHANGES RESISTANCE

Contraction of airway smooth muscle narrows the lumen and increases resistance to airflow. Relaxation widens it and lowers resistance. For the same pressure difference, a narrower airway carries less air. Muscle changes the passage; it does not diffuse oxygen into blood.

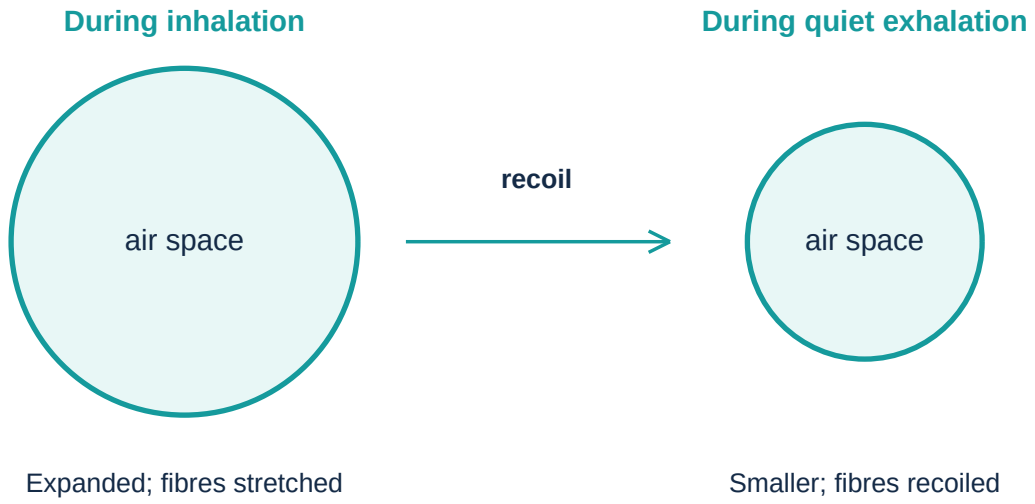
Cartilage and bronchiolar muscle: University of Leeds, Conducting Portion.
Airway resistance: OpenStax Anatomy & Physiology 2e, section 22.3.

Scope: Cambridge Biology 9700 syllabus, section 9.1, outcome 6, p. 29.

Stretch, then recoil

Elastic fibres deform when the lungs expand and return towards their original length afterwards. Recoil is passive, unlike active muscle contraction.

1. ELASTIC TISSUE HELPS THE LUNGS EMPTY



Schematic of changing alveolar size, not a microscopic wall section. The outline represents the elastic wall; fibres lie within surrounding tissue, not loose in the air space.

2. INHALATION STORES ELASTIC ENERGY

As the chest expands, the lungs are drawn outwards and elastic fibres stretch. Energy is stored in the stretched tissue. The fibres do not actively contract to inflate the lungs; expansion is driven by the action of the breathing muscles.

3. QUIET EXHALATION USES RECOIL

When inspiratory muscles relax, lung elastic recoil helps reduce lung volume. Alveolar pressure rises above atmospheric pressure and air flows out. Quiet exhalation is normally passive; forced exhalation can also recruit muscles. Recoil helps ventilation, not gas diffusion directly.

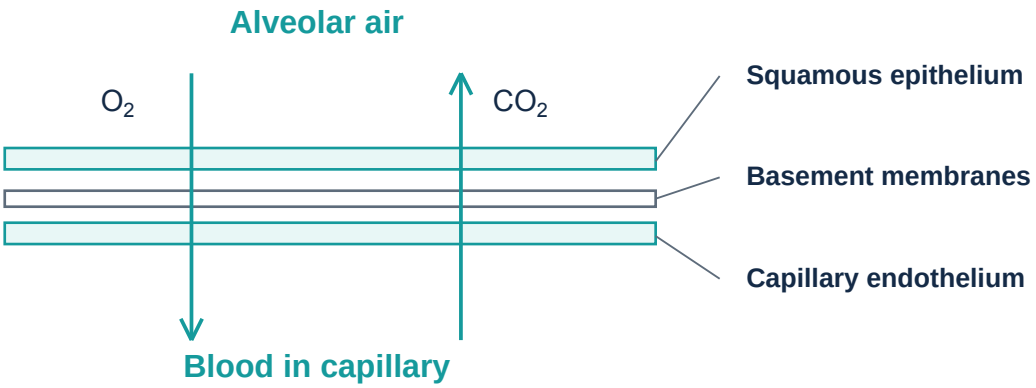
Elastic alveolar walls: OpenStax Anatomy & Physiology 2e, section 22.1.
Passive expiration and pressure changes: OpenStax, section 22.3.

Scope: Cambridge Biology 9700 syllabus, section 9.1, outcome 6, p. 29.

Make the diffusion path short

Most alveolar surface is covered by thin, flattened squamous epithelial cells. Their shape reduces the distance gases must travel between air and blood.

1. THIN CELLS FORM THE EXCHANGE BARRIER



Layer schematic, not to scale. Basement membranes are closely apposed or fused at the thin exchange region. The alveolar epithelium is only one part of the complete air-blood barrier.

2. STRUCTURE EXPLAINS THE RATE

Thin squamous cells create a short diffusion distance, helping rapid gas exchange for a given surface area and partial-pressure difference. Oxygen and carbon dioxide cross by diffusion, not by ciliary movement or contraction of the alveolar lining.

3. FOUR STRUCTURES, FOUR DIRECT FUNCTIONS

Cartilage	Supports larger airways against collapse.
Smooth muscle	Adjusts airway diameter and resistance.
Elastic fibres	Stretch and recoil to assist ventilation.
Squamous epithelium	Provides a short diffusion distance.

Alveolar cells and respiratory membrane: OpenStax, section 22.1.
Airway support and muscle: University of Leeds, Conducting Portion.

Scope: Cambridge Biology 9700 syllabus, section 9.1, outcome 6, p. 29.