

# TOPIC 6.4: GAS EXCHANGE

## Ventilation

Ventilation is the exchange of gases between the lungs and the atmosphere (achieved by the physical act of breathing)

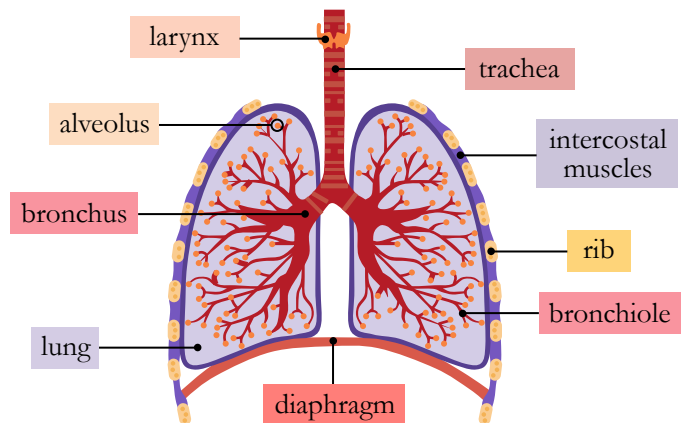
These gases are integral to the process of cell respiration

- Oxygen is an input, carbon dioxide is a by-product

Ventilation maintains the concentration gradient necessary for passive diffusion ( $O_2$  = into lungs,  $CO_2$  = out of lungs)

Ventilation rates will change with exercise and can be measured via **spirometry** (measures amount / rate of air)

## Lung Structure



## Mechanism of Breathing

Breathing utilises antagonistic sets of respiratory muscles in order to facilitate the passage of air (inhalation / exhalation)

- Muscles change lung volume to create negative pressure
- Negative pressure is equalised by air from atmosphere
- Air flows in / out according to the volume of the thorax

### Inhalation

- Diaphragm muscles contract (diaphragm flattens)
- External intercostal muscles pull ribs up (outwards)
- This increases the volume of the thoracic cavity
- Pressure in lungs decreases below atmospheric pressure
- Air flows into the lungs in order to equalise the pressure

### Exhalation

- Diaphragm muscles relax (diaphragm curves upwards)
- Internal intercostal muscles pull the ribs down (inwards)
- Abdominal muscles contract to push diaphragm upwards
- This decreases the volume of the thoracic cavity
- Pressure in lungs increases above atmospheric pressure
- Air flows out of the lungs to equalise the pressure

## Pneumocytes

Pneumocytes (alveolar cells) line the alveoli and comprise the majority of the inner surface of the lungs

### Type I pneumocytes:

- Involved in gas exchange between alveoli and capillaries
- Are extremely thin (minimises gas diffusion distances)

### Type II pneumocytes:

- Responsible for the secretion of pulmonary surfactant
- This creates a moist surface that reduces surface tension (prevents sides of alveoli from adhering to each other)

## Lung Disorders

### Lung Cancer

Cancer is uncontrolled cell proliferation, leading to tumors

- Lungs possess a rich blood supply (for gas exchange), increasing the chances of metastasis (spread of cancer)

There are many factors that contribute to lung cancer:

- **Intrinsic:** Genetics, age, certain diseases / infections
- **Extrinsic:** Smoking, asbestos, radiation exposure

### Emphysema

Emphysema is the abnormal enlargement of the alveoli

- These form air spaces and lower the overall surface area

Emphysema is most commonly caused by smoking

- Chemicals in the cigarettes damage the alveoli
- Phagocytes release elastase as part of immune response
- Elastase destroys the elastic fibres in the alveolar walls
- Huge air spaces (pulmonary bullae) develop in the lungs

