

## Did you know?

When a person stops breathing on their own, mechanical ventilation can be used until the patient is able to recover and again breathe independently. This is done by machines called ventilators.



# Gas exchange

## Keywords:

**Ventilation** - the movement of air into and out of the lungs

**Gas exchange** - the 'swapping' of gases between the alveolar air and the blood

**Thorax** - the upper part of the body where the lungs are located

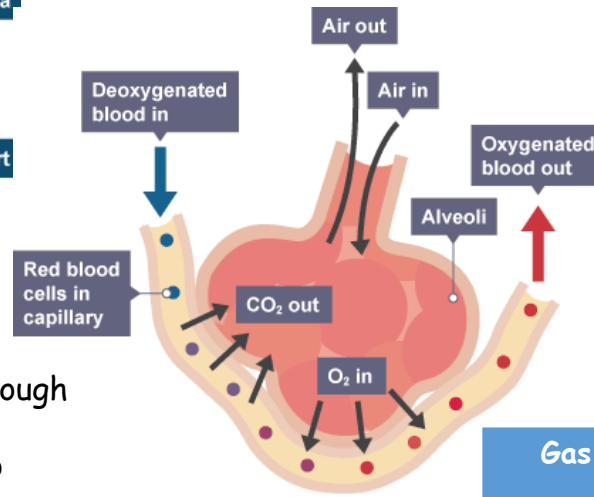
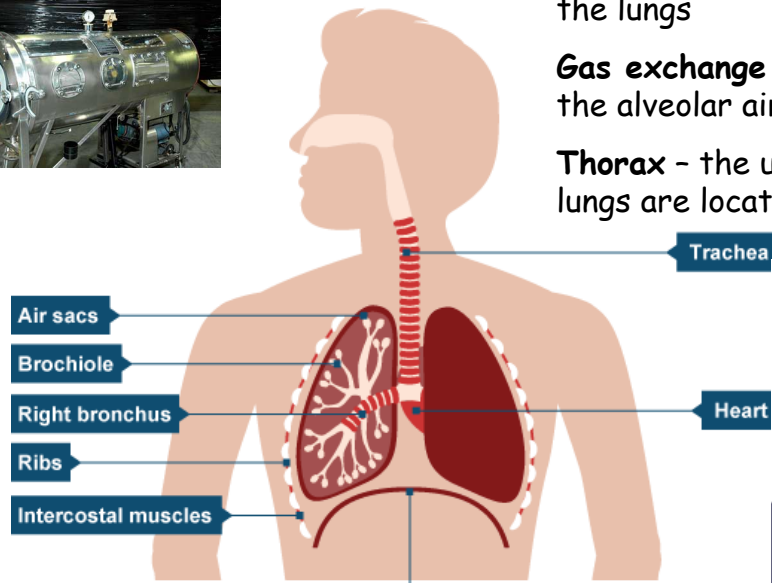


Table to show the differences in the composition of inhaled and exhaled air.

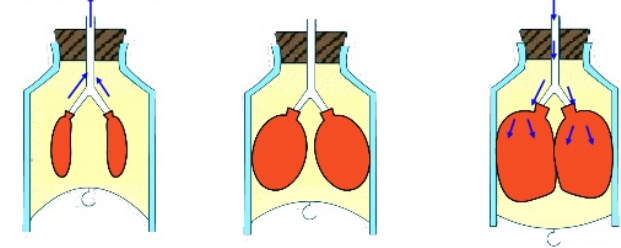
Gas	% of inhaled air	% of exhaled air
Oxygen	21	16
Carbon dioxide	0.04	4
Nitrogen	79	79

## Adaptations of the alveoli

To maximise the efficiency of gas exchange, the alveoli have several adaptations:

- They are folded, providing a much greater **surface area** for gas exchange to occur.
- The walls of the alveoli are only one cell thick. This makes the exchange surface very thin - shortening the diffusion distance across which gases have to move.
- Each alveolus is surrounded by blood **capillaries** which ensure a good blood supply. This is important as the blood is constantly taking oxygen away and bringing in more carbon dioxide - which helps to maintain the maximum concentration gradient between the blood and the air in the alveoli.
- Each alveolus is **ventilated**, removing waste carbon dioxide and replenishing oxygen levels in the alveolar air. This also helps to maintain the maximum concentration gradient between the blood and the air in the alveoli.

## Model of the breathing mechanism



This **Bell jar model lung** can show the basic principles of breathing. The space inside the bell jar is airtight. As the rubber sheet (diaphragm) is pulled down, the volume of the space increases. This causes the pressure to fall. Air rushes in to equalise the pressure causing the balloons to inflate.

## Breathing

- Air is warmed, moistened and filtered as it travels through the **mouth** and **nasal passages**.
- It then passes through the trachea and one of the two bronchi into one of the lungs.
- After passing into the many **bronchioles**, it finally arrives into some of the millions of tiny sacs called **alveoli**.
- This is where gas exchange takes place - **oxygen** passes out of the air into the blood, and **carbon dioxide** passes out of the blood into the air in the alveoli.

## When you inhale:

- the intercostal muscles contract, expanding the ribcage.
- the diaphragm contracts, pulling downwards to increase the volume of the chest.
- pressure inside the chest is lowered and air is sucked into the lungs.

## When you exhale:

- the intercostal muscles relax, the ribcage drops inwards and downwards
- the diaphragm relaxes, moving back upwards, decreasing the volume of the chest.
- pressure inside the chest increases and air is forced out.