

Respiratory system

Tidal volume is the amount you breathe in and out in one normal

Respiratory rate is how many breaths you take per minute.

Minute volume is the volume of air you breathe in one minute.

Vital capacity is the maximum volume of air you can breathe out after breathing in as much as you can.

Residual volume is the amount of air left in your lungs after you have breathed out as hard as you can.

Aerobic respiration

glucose + oxygen → **energy + carbon dioxide + water**

Exam Practical Answer= Marathon running

Aerobic respiration

glucose → **energy + lactic acid**

Exam Practical Answer= 100m Sprinter, Long Jump

After anaerobic activity, **oxygen** is needed to neutralize the lactic acid. This is called an **oxygen debt**. It is repaid after exercise.

The oxygen reacts with the lactic acid to form CO₂ and water.

Rapid and deep breathing is needed for a short period after high intensity exercise in order to repay the debt.

This also helps to **remove the carbon dioxide** which accumulates in the blood during intense exercise

Breathing during exercise

Muscle cell **respiration** increases – more oxygen is used up and levels of CO₂ rise.



The **brain** detects increasing levels of CO₂ – a signal is sent to the lungs to increase breathing.



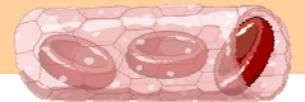
Breathing rate and the **volume of air** in each breath increase. This means that more **gaseous exchange** takes place.

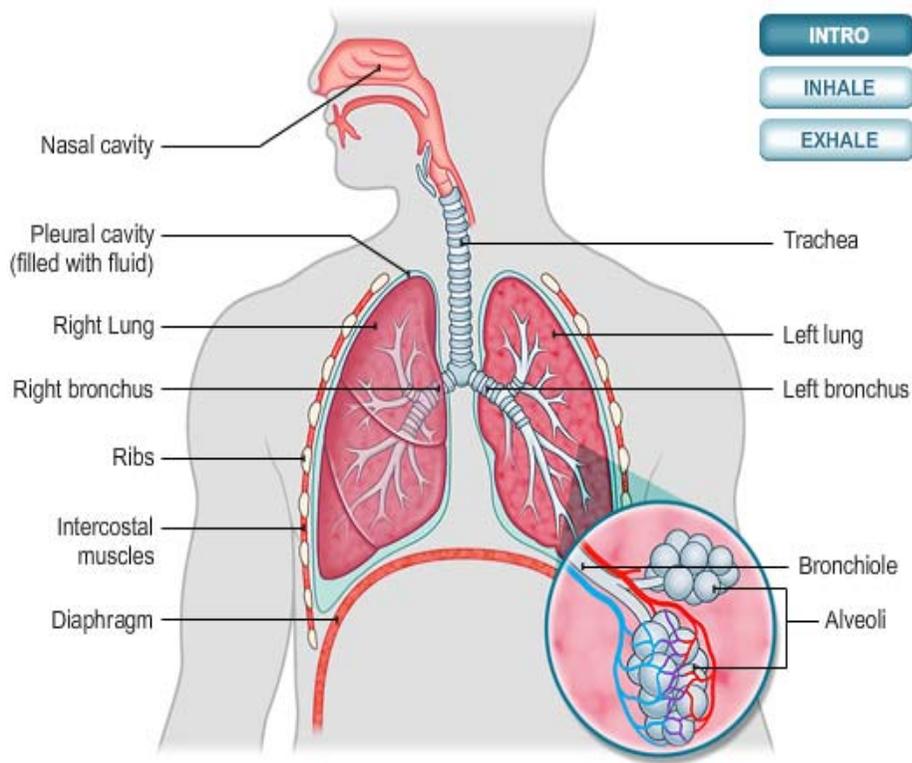


The brain also tells the **heart** to beat faster so that more blood is pumped to the lungs for gaseous exchange.



More **oxygenated blood** gets to the muscles and more CO₂ is removed.





Immediate effects of training:

- Increased rate of breathing
- Increase in tidal volume (amount of air breathed in or out of the lungs in one breath)

Effects of regular training:

- Stronger diaphragm and intercostal muscles
- Increased number of alveoli
- Increase in Vital Capacity (amount of air that can be forcibly exhaled after breathing in as much as possible)
- Increased rate of gaseous exchange
- More oxygen delivered to working muscles
- More efficient carbon dioxide removal through gaseous exchange

Breathing in / Inspiration

- The **intercostal muscles** between the ribs contract, pulling the chest walls up and out.
- The **diaphragm** muscle below the lungs contracts and flattens, increasing the size of the chest.
- The **lungs increase in size**, so the pressure inside them falls. This causes air to rush in through the nose or mouth.

Breathing out / Expiration

- The **intercostal muscles** between the ribs relax so that the chest walls move in and down.
- The **diaphragm** muscle below the lungs relaxes and bulges up, reducing the size of the chest.
- The **lungs decrease in size**, so the pressure inside increases and air is pushed up the trachea and out through the nose or mouth.

The **alveoli** are bunches of tiny air sacks inside the lungs. Each individual sack is called an **alveolus**. When you breathe in, they fill with air. The alveoli are covered in tiny **capillaries (blood vessels)**.

Gases can pass through the thin walls of each alveolus and capillary, and into the bloodstream.

Gases can also pass from the bloodstream into the alveolus

