

# Respiration

Respiration **transfers energy** from glucose. It occurs continuously in **all cells**. It is an **exothermic** reaction (transfers energy to the environment).

## Metabolism

Metabolism is the total of all the chemical reactions happening in a cell or the body.

Each reaction is controlled by enzymes and many reactions link together.

Some reactions break down large molecules into smaller ones (eg. glucose is broken down in respiration, protein is broken down to produce urea) and others produce large molecules from smaller ones (eg. joining together glucose molecules to make starch).

## Exercise

During exercise you need more energy, therefore the rate of respiration increases. This means cells require more oxygen and glucose:

- **Breathing rate increases** to get more oxygen into the blood.
- **Breath volume increases** to get more oxygen into the blood (also removes the increased amount CO<sub>2</sub> produced).
- **Heart rate increases** to pump more oxygen and glucose to the muscle cells (and remove waste CO<sub>2</sub>).

## Oxygen Debt

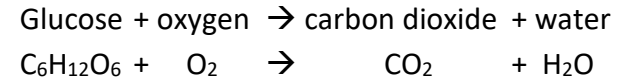
Vigorous exercise causes muscle cells to respire **anaerobically**, producing lactic acid. When you stop exercising you will have an **oxygen debt** – the amount of oxygen needed to react with and **break down the lactic acid** into

CO<sub>2</sub> and water. Heart rate and breathing rate remain high to deliver the oxygen to the muscle cells until the levels of lactic acid decrease.

The blood also carries lactic acid to the liver, where it is converted back into glucose.

## Aerobic Respiration

Require **oxygen** and is the most efficient way to transfer energy from glucose. Occurs in the **mitochondria** in plant and animal cells.



## Anaerobic Respiration

Occurs when there is a lack of oxygen in your muscles such as during vigorous exercise. This means glucose is not completely oxidised so the breakdown of glucose is incomplete and lactic acid is produced.



Anaerobic respiration cannot be sustained for very long and is less efficient (produces less energy) than aerobic respiration.

## Anaerobic Respiration in Plants and Yeast

Plants and yeast produce ethanol and CO<sub>2</sub> instead of lactic acid.



In **yeast**, anaerobic respiration is called **fermentation** and is used to make:

- **Beer and wine:** alcohol is produced giving drinks their alcohol content.
- **Bread:** the CO<sub>2</sub> produced causes the bread to **rise**.