CIE Biology GCSE

12: Respiration

Notes

(Content in **bold** is for Extended students only)

Respiration is a **chemical reaction** which happens in almost all cells in the body to **produce energy from nutrient molecules**. This energy can be used in a variety of processes including:

- Muscle contraction
- Protein synthesis
- Cell division
- Active transport
- Growth
- Nerve impulses
- Maintaining body temperature

Respiration usually occurs with the presence of oxygen (**aerobic respiration**), although it can occur in the absence of oxygen (**anaerobic respiration**). Anaerobic respiration is **less efficient** and leads to **fatigue** in humans. Both types of respiration are **catalysed by enzymes**. This means that the **rate of respiration** can be influenced by factors such as **temperature and pH**.

Aerobic Respiration:

Aerobic respiration occurs in the presence of **oxygen**. **Glucose** is broken down into **carbon dioxide, water and energy** with the help of oxygen. This occurs in the cell **mitochondria**. Cells which require lots of energy, such as muscle cells, therefore have high amounts of mitochondria.

Equations for aerobic respiration:

- glucose + oxygen → carbon dioxide + water
- **$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$**

Anaerobic respiration:

Anaerobic respiration occurs when **oxygen is not present**. It is **less efficient** than aerobic respiration and **produces less energy** per glucose molecule. It occurs in the cell **cytoplasm** and thus does not require mitochondria.

Animal cells undergo anaerobic respiration during **vigorous exercise** as not enough oxygen is delivered to muscles. In this reaction, glucose is broken down to produce lactic acid, as well as releasing energy. **This lactic acid builds up in muscles and causes muscle fatigue. Anaerobic respiration also produces an 'oxygen debt'. To repay this, the lactic acid must be transported to the liver where it is broken down into carbon dioxide and water using oxygen. This is the reason why the breathing and heart rates remain high after exercise.**

Microorganisms, such as **yeast**, also undergo anaerobic respiration. Yeast breaks down anaerobically to form **alcohol and carbon dioxide** instead of lactic acid.

Equations for anaerobic respiration in yeast:

- glucose → alcohol + carbon dioxide
- **$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$**

Equation for anaerobic respiration in animal cells:

- glucose → lactic acid