

Respiration

Revision notes · Aerobic and anaerobic respiration, how they compare, and the core practical to investigate the rate of respiration in living organisms.

For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Respiration Spec 8.9–8.11

Cellular respiration Spec 8.9

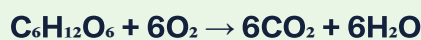
Cellular respiration is an **exothermic** reaction. It transfers energy to the surroundings, and some of this energy is released as heat. It happens **continuously** in living cells (in plants as well as animals) to release energy for **metabolic processes**.

Metabolic processes include building larger molecules from smaller ones, muscle contraction, and keeping the body warm in mammals and birds.

Aerobic respiration

Aerobic respiration uses oxygen to break down glucose.

glucose + oxygen → carbon dioxide + water



Anaerobic respiration

Anaerobic respiration happens without oxygen. In animal cells, such as muscle cells working hard, glucose is broken down to **lactic acid**. In plant cells and yeast, glucose is broken down to **ethanol** and carbon dioxide.

glucose → lactic acid

glucose → ethanol + carbon dioxide

Common mistake: Respiration is not breathing, and it is not the same as gas exchange. Respiration is a chemical reaction in cells that releases energy.

Comparing aerobic and anaerobic respiration Spec 8.10

Aerobic and anaerobic respiration compared		
	Aerobic respiration	Anaerobic respiration
Oxygen needed?	Yes	No
Glucose breakdown	Complete breakdown	Incomplete breakdown
Energy released	A large amount per glucose molecule	Much less per glucose molecule
Products in animals	Carbon dioxide and water	Lactic acid
Products in plants and yeast	Carbon dioxide and water	Ethanol and carbon dioxide
When it happens	Whenever enough oxygen is available	When oxygen is not available, for example in muscles during vigorous exercise

Aerobic respiration releases much more energy because glucose is completely broken down. Anaerobic respiration releases less energy because glucose is only partly broken down. Both types of respiration are exothermic and both release energy from glucose.

Exam tip: A comparison needs both sides in the same sentence, for example: aerobic respiration releases more energy per glucose than anaerobic respiration.

Core practical: the rate of respiration in living organisms Spec 8.11

Respiration can be investigated by measuring how fast a living organism, such as germinating seeds or small invertebrates, uses up oxygen. This is done with a **respirometer**.

1. Place the organisms in a boiling tube. Put a layer of soda lime (or another carbon dioxide absorber) in the tube, separated from the organisms by cotton wool or gauze.
2. Connect the tube to a capillary tube containing a drop of coloured liquid, and seal the apparatus so that no air can get in or out.
3. Place the tube in a water bath at a set temperature and leave it to settle.
4. Measure the distance the coloured liquid moves in a set time, for example 5 minutes.
5. Repeat at different temperatures, and repeat each temperature to calculate a mean.
6. Set up a control tube with an equal volume of an inert material, such as glass beads, instead of organisms.

The organisms use up oxygen. The carbon dioxide they produce is absorbed, so the volume of gas in the tube falls and the coloured liquid moves **towards the organisms**. The further it moves in a given time, the faster the rate of respiration.

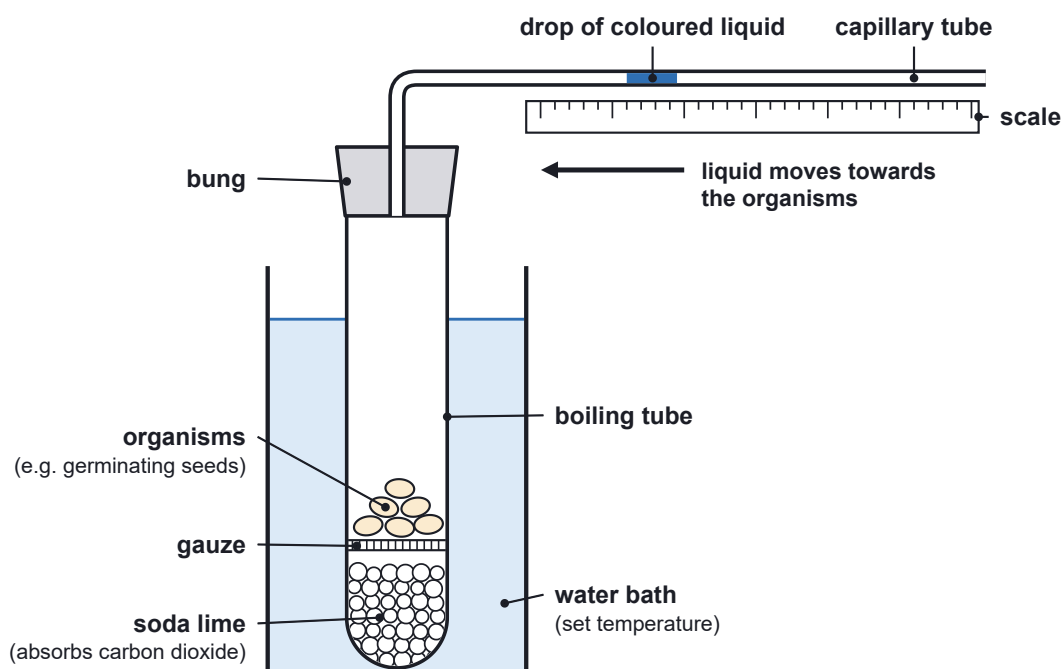
$$\text{rate of respiration} = \text{distance moved by liquid} \div \text{time}$$

Variables in the investigation

Type of variable	Example
Independent variable	Temperature (or the type of organism, if comparing organisms)
Dependent variable	Distance moved by the liquid in a set time
Control variables	Mass of organisms, volume of soda lime, time, volume of the apparatus, start position of the liquid

Core practical: Typical result: the rate of respiration increases as temperature increases (up to a point), because enzymes in respiration work faster. Soda lime is corrosive, so wear eye protection and avoid skin contact. Handle living organisms gently and wash your hands afterwards.

A suggested practical for anaerobic respiration is to investigate the effect of glucose concentration on the rate of anaerobic respiration in yeast. The rate can be found by measuring how quickly carbon dioxide is produced, for example by counting bubbles or measuring the volume of gas collected.



As the organisms use up oxygen, the **coloured liquid moves towards them**. Soda lime absorbs the carbon dioxide they release.

Quick check

1. What does exothermic mean?
2. Write the word equation for aerobic respiration.
3. What are the products of anaerobic respiration in yeast?
4. Why does the coloured liquid move towards the organisms in a respirometer?

Quick check answers

Respiration

1. Energy is transferred to the surroundings.
2. Glucose + oxygen $\rightarrow$ carbon dioxide + water.
3. Ethanol and carbon dioxide.
4. The organisms use up oxygen and the carbon dioxide is absorbed, so the volume of gas decreases.