Objectives

B8.9 Describe cellular respiration as an exothermic reaction which occurs continuously in living cells to release energy for metabolic processes, including aerobic and anaerobic respiration.

B8.10 Compare the process of aerobic respiration with the process of anaerobic respiration.

B8.11 *Core Practical: Investigate the rate of respiration in living organisms.*

Maths requirements

1a Recognise and use expressions in decimal form.

2a Use an appropriate number of significant figures.

2f Understand the terms mean, mode and median.

4a Translate information between graphical and numeric form.

4c Plot two variables from experimental or other data.

Learning outcomes

6th **SB8.9** Explain why organisms need to respire.

6th **SB8.9** Recall the word equation for aerobic respiration.

6th **SB8.9** Recall the word equation for anaerobic respiration in humans.

8th **SB8.9** Explain why respiration is an exothermic process.

8th **SB8.10** Compare aerobic and anaerobic respiration.

Exploring

1. Respiration rates

This practical forms part of the core practical requirement of the specification. It is supported by the information on Students' sheet CP7(*Rates of Respiration)* and in the Student Book.

Students follow the instructions on Worksheet SB8e.1 and use a simple respirometer to investigate the effect of temperature on the rate of aerobic respiration in some small invertebrates. Instructions for the practical and questions are also found on *SB8e Core practical – Respiration rates* in the Student Book.

A variety of organisms can be used in the respirometers, including mealworms, waxworms and blowfly larvae (maggots are best). Between 5 and 10 g of the organisms works well. It is best if students use fresh organisms for each temperature tested. Students can simply use the number of organisms as a control variable, although more able students should be encouraged to measure the masses of organisms used.

The suggested range of temperatures is 20–35 °C. Classroom management is easier if water baths are prepared at different temperatures within this range and then students choose which of two or three to try. Encourage students to work together to decide between the groups which temperatures they will investigate, to ensure an even spread of data, which can then be pooled and analysed as a class set.

It is envisaged that most students will follow the method on page 1 of the worksheet and answer the directed questions at the bottom of the sheet.

⚠ Safety

Living organisms must be handled with care.

Students must wash their hands after completing this practical.

Soda lime is corrosive. Do not allow students to handle this.

Support: Go through the parts of the apparatus carefully with students, explaining the purpose of the soda lime (to absorb carbon dioxide so that gases are only being used up and no gases from respiration are being allowed to take their place). Also explain that as the oxygen is used up, the volume of the gases in the respirometer will reduce, which in turn will allow atmospheric pressure to push the air bubble further along the tube. Students can fill in their results and draw conclusions using the scaffolded questions on page 2 of the worksheet.

Stretch: Encourage students to measure the masses of the organisms used and to use these values to calculate respiratory rate in terms of oxygen use per minute per gram of living material. Some students may be given the diameter of the glass tubing and be challenged to calculate the actual volume of oxygen used (the volume of a cylinder is given by $V = \pi r^2 h$), and to use this to give their results using the units $mm^3\ min^{-1}\ g^{-1}$.

Students should be able to record their results, present their data and draw conclusions without help. (Consider removing the directed questions at the bottom of page 2 of the worksheet before printing/photocopying.)

Expected results

Students should find a clear increase in the rate of respiration with temperature. This is largely due to the fact that temperature speeds up chemical reactions by increasing the mean speed of the particles involved.

Course resources

Bio Students' sheet CP7

Equipment

respirometer (consisting of a boiling tube containing a spatula of soda lime, held in place with cotton wool, capillary tube, cored bung, millimetre scale), small invertebrates (e.g. waxworms, mealworms, blowfly larvae), electric water baths set at different temperatures in the range 20–35 °C, coloured liquid (100 cm^3 water, enough food dye for a strong colour, and five drops of washing-up liquid), weighing boat, stop clock

Optional: balance, paint brush (to move organisms), graph paper