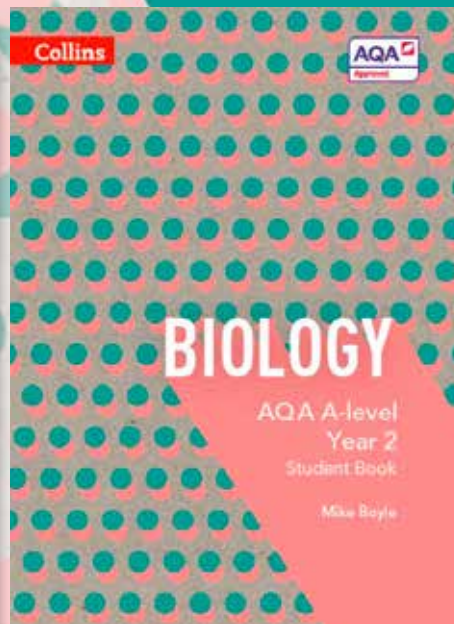
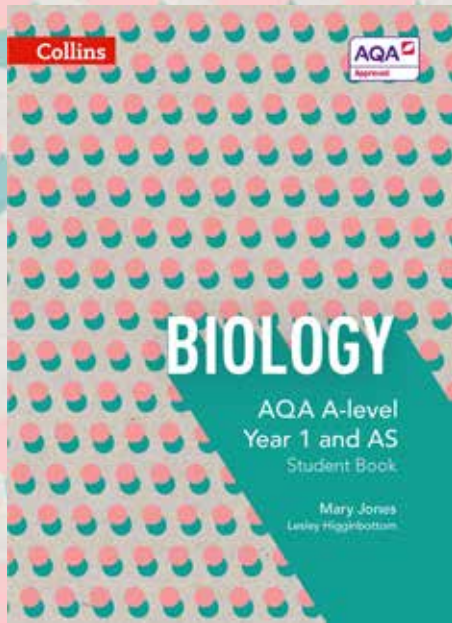


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BIOLOGY

AQA A-level Biology



Authors:
Mary Jones,
Lesley Higginbottom
and Mike Boyle

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BIOLOGY

Teaching A level Biology, how the resources support you:

Linear assessment

Terminal assessment in the form of three 2 hour papers at A-level and two 1.5 hour papers on the first four topics at AS Level



- Extensive practice questions embedded throughout help build synoptic understanding
- Prior knowledge section at the start of each chapter consolidates knowledge from GCSE
- Key ideas summaries in every topic allow students to check progress easily and revise effectively

Practicals

Assessment of practical skills will be by written exam only. Practical-based questions will form 15% of the total assessment



Comprehensive Required Practical sections advise students on apparatus, techniques and how best to avoid common errors

Maths

10% of assessment marks require the use of Level 2 mathematical skills



Test and build mathematical skills with signposted Assignments throughout and a dedicated Maths chapter in the Student Book

Standalone AS qualification

The AS becomes a separate qualification, which doesn't contribute to the A-level grade



AS and Year 1 content is fully co-teachable using Student Book 1

Comprehensive Student Books

- Help students build knowledge, application and evaluation skills through clear explanations set in real-life contexts supported by skills-focused assignments
- Prepare for the new practical assessment with comprehensive Required Practical sections that advise on apparatus, techniques and best practice to help develop students' theoretical understanding
- Build confidence across the linear course with extensive practice questions integrated throughout to check knowledge, test skills and consolidate learning
- Extend students' understanding and prepare them for further study and scientific careers with plenty of stretch and challenge questions that develop higher-order thinking skills
- Develop students' confidence in tackling the maths requirements of the specification with step-by-step worked examples and plenty of maths practice questions

In text questions provide opportunities to check understanding and progress, whether learning a topic for the first time or revisiting it as part of revision

Required practicals pages provide comprehensive guidance on apparatus, experimental techniques and how best to avoid common errors

ENZYMES

Exp 3 - no enzyme

Time 0, 30, 60, 90, 120, 150, 180, 210, 240 seconds = 0, 0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4

He needs to display his results and calculate the rate of reaction, in mol min⁻¹, for both experiments at 60 seconds, and has asked for your help.

First, use his notes to create a table, making sure all the data points are recorded to one decimal place, and each column has a clear heading with the units specified.

Time/seconds	Amount of product/moles	
	Experiment 1 (enzyme)	Experiment 2 (no enzyme)
0	0.0	0.0
30	2.3	0.5
60	3.8	1.0
90	4.5	1.5
120	5.0	2.0
150	5.4	2.6
180	5.6	3.1
210	5.7	3.6
240	5.7	4.1

Next, create a graph. Label the y-axis 'Amount of product formed/moles', and the x-axis 'Time/seconds', and choose suitable scales. Give the graph a title (for example, 'Effect of enzyme on rate of reaction').

Then plot the results, and add lines of best fit to both sets of data. Use different coloured lines and label them 'enzyme' and 'no enzyme'.

Now use your graph to calculate the rate of reaction for each experiment at 60 seconds.

Experiment 2 (no enzyme)

The orange line is linear, so the rate of reaction is the same at all points in time - it is constant.

$$\text{rate of reaction} = \frac{\text{change in } y}{\text{change in } x}$$

In your friend's experiment, after 120 seconds the amount of product had changed from 0 to 2 moles.

$$\text{rate of reaction} = \frac{2}{120} = 0.016 \text{ mol sec}^{-1}$$

The question asks for the rate in mol min⁻¹, so you need to multiply your answer by 60.

$$\text{rate of reaction} = 0.016 \times 60 = 1 \text{ mol min}^{-1}$$

We can show that this is the same at other points in a linear graph by choosing another time period. For example, between 150 seconds and 210 seconds (a period of 60 seconds) the change in y is $3.6 - 2.6 = 1$ mole.

$$\text{rate of reaction} = \frac{1}{60} = 0.016 \text{ mol sec}^{-1} = 1 \text{ mol min}^{-1}$$

Experiment 1 (enzyme)

The blue line does not a straight line, the rate of reaction slows over time.

You can calculate the rate of reaction at any point in time by drawing a tangent - a straight line which touches the curve at one point only - and then calculating the gradient of the tangent.

So, since your friend wants to know the rate of reaction at 60 seconds, draw a tangent at 60 seconds.

$$\text{rate of reaction} = \frac{\text{change in } y}{\text{change in } x} = \frac{(4.4 - 3.2)}{(80 - 40)} = \frac{1.2}{40} = 0.03 \text{ mol sec}^{-1} = 1.8 \text{ mol min}^{-1}$$

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MASS TRANSPORT

REQUIRED PRACTICAL ACTIVITY 5: APPARATUS AND TECHNIQUES

Dissection of animal or plant gas exchange system or mass transport system or of an organ within such a system

This practical activity gives you the opportunity to show that you can:

- Safely use instruments for dissection of an animal or plant organ

(PS 4.1, A1)

Apparatus

Dissection is a key skill in biology. It requires you to be observant, patient and to have a steady hand. Safety and the ability to follow instructions are most important.

Figure P2 Shows basic dissection

Figure P3 A hand lens

Figure P4 The dissection of a pig's heart showing the coronary arteries

Figure P5 This girl is drawing an outline of a model frog. She is using a hand lens to help her see the details.

Apparatus	Use
Scissors and Forceps	To probe tissues gently, lift flaps of tissue without tearing, or hold tissues out of their way, mounted needles
Scissors	For cutting tissues, often more useful than a scalpel on tough tissue
Forceps	To hold or tear tissues; they may be blunt ended or sharp ended
Scalpel	To cut tissue, most useful for fine dissection. Note: great care must be taken as many scalpels are surgically sharp (and not longly used)
Hand lens	To magnify, and enable you to see more clearly, what you are cutting
Protective gloves	To keep your hands clean, most commonly used if you are dissecting animal tissues
Wooden dissection board	Used for large specimens, such as the dissection of a mammalian gas exchange system. Also used when carrying out a whole organism dissection (a rat, for example) as pins can be placed in the wood to hold the organisms in place
Metal tray	Used for smaller specimens, especially those that may contain blood, such as a mammalian heart dissection. Some metal trays have a layer of wax in the bottom which can be used to pin tissues in place when dissecting an earthworm or insect, for example
White tile	Used for small specimens which are not going to produce significant amounts of fluid - when dissecting a plant stem, for example

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3.4

Factors affecting enzyme activity

Substrate concentration and enzyme activity

Concentration is a measure of the relative proportions of solute and solvent molecules in a solution. A concentrated solution has a large number of solute molecules in a given volume.

Imagine a solution containing enzyme and substrate molecules. All of the molecules are in constant motion. If there are only very few substrate molecules in the solution, then the chance of these hitting an active site is low. If there are a lot of substrate molecules, the chance is much higher. So the rate of reaction is much greater in a concentrated solution containing a high number of substrate molecules than in a dilute solution with a low concentration of substrate molecules (Figure 8).

Figure 8 The effect of substrate concentration on an enzyme-catalysed reaction.

Now imagine that we keep on increasing the substrate concentration, while making no change to the concentration of the enzyme. Eventually, we will reach a point where all the active sites are fully occupied. No enzyme molecules are all working as fast as they can receiving substrates, turning them into products and releasing them. No matter how much more substrate is available the enzyme cannot work any faster. This explains why the curve in Figure 8 levels off at high substrate concentrations.

Enzyme concentration and enzyme activity

If we keep the substrate concentration constant and increase the enzyme concentration, what effect does this have on the rate of the reaction? This is shown in Figure 9. You can see that the shape of the curve is very similar to that in Figure 8. As we increase the enzyme concentration, the chance of an enzyme molecule colliding with a substrate molecule increases, so the rate of reaction increases. However, at high

enzyme concentrations, there may not be enough substrate molecules to keep them all busy all the time, so the rate levels off.

Figure 9 The effect of enzyme concentration on the rate of reaction.

QUESTIONS

10. Explain in terms of active sites why the curve in Figure 9 flattens out.

Stretch and challenge

11. The graph in Figure 9 is labelled with the letters X and Y. Do the following descriptions, a-e, match part X, Y or Z on the graph?

- At this point, there is an excess of substrate in the reaction.
- At this point, the enzyme's active sites are saturated with substrate.
- At this point, adding more enzyme could increase the rate of reaction.
- At this point, adding more substrate could increase the rate of reaction.
- At this point, increasing the temperature could increase the rate of reaction.

Worked maths example: Rate of reaction
(MS 1.3, MS 3.2, MS 3.5, MS 3.6, PS 3.1, PS 3.2)

Your friend carried out an experiment to investigate the rate of a reaction with and without an enzyme. Here are his notes.

Exp 1 - enzyme

Time 0, 30, 60, 90, 120, 150, 180, 210, 240 seconds = 0, 0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4

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9.4

Blood vessels

MATHS ASSIGNMENT 2: ANALYSING THE EFFECTS OF EXERCISE ON BLOOD FLOW

(MS 1.3, MS 3.2, PS 1.2, PS 3.1, PS 3.2)

Figure A2 How does exercise affect blood flow?

Exercise has been shown to have many effects on the mind, including relief from stress, depression and anxiety, and improved self-esteem. The effects of regular exercise on the body are well documented and include improved cardiovascular performance and increased muscle mass and bone density.

In the short term, exercise has the greatest effect on blood flow. The table shows the volume of blood flowing through different parts of the body when resting and during exercise.

Part of body	When resting	Light exercise	Moderate exercise	Vigorous exercise
Brain	750	750	750	750
Digestive system	1400	1100	700	500
Heart muscle	250	350	600	1000
Kidneys	1100	900	600	250
Skeletal muscles	1200	4500	13 000	22 000
Skin	500	1500	1150	600
Rest of the body	600	400	400	600
TOTAL	5800	9500	15500	12000

Figure 15 summarises the differences in structure between the different types of blood vessel.

Tissue fluid and capillary beds

We have seen that capillaries are tiny vessels that carry blood deep into the tissues of the body. Figure 16 shows the composition of this blood. As the capillaries branch out among the cells in the tissues, they form a network called a **capillary bed**. The capillaries in the bed then gradually rejoin with each other, eventually forming a **venule**.

Capillary beds are exchange surfaces. Capillaries are leaky, allowing water and other substances with small molecules to seep out of them, into the spaces between the body cells. The fluid that collects between the cells is called **tissue fluid** (Figure 17).

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Stretch and challenge questions and activities encourage stronger students to move beyond the specification

Boost understanding and mathematical skills with worked maths examples

Signposted assignments throughout build confidence in Maths skills, practical skills, extended writing, AO2 and AO3

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