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SCIENCE 2017-2018

KS3 • GCSE • International GCSE
A-level • Revision

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Welcome to the 2017–2018 Science Catalogue

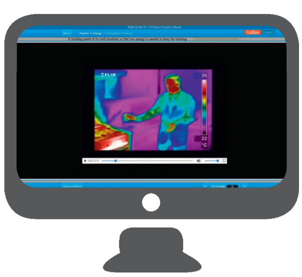
Inside you'll find lots of useful information on resources for KS3, GCSE and A-level from Collins, including revision guides and information on free teaching support. See below for details of some of the exciting new publishing and features available from Collins.

Want to take a closer look? If you would like more information on any of our series, please don't hesitate to contact one of our sales consultants – they'll be happy to answer your questions or visit your school. Find your local representative's details on the back page.

What's new?

Find out how we support mastery learning at KS3 with our engaging two-year course for the new AQA KS3 Science syllabus.

Turn to page 4 for more information.



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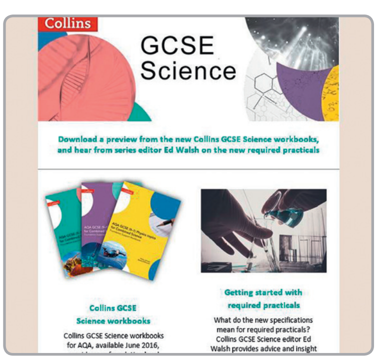

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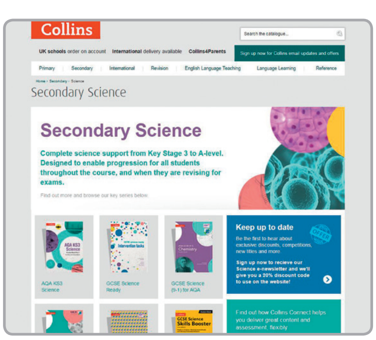

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Contents

Key icons used in the catalogue

- NEW — New resources
- Age 11–14 — Age range
- KS3 — For Key Stage 3
- GCSE — For GCSE
- AS/A — For AS and A-level

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GCSE Science on Collins Connect

Engaging lessons:

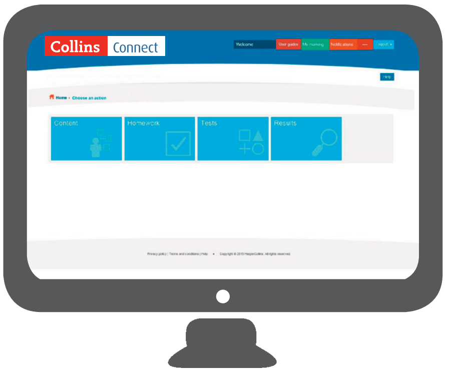
- **Engage students** with informative videos and interactives of key concepts, theories and practicals
- **Teach flexibly**, the book view feature provides total fluidity between digital and print
- **Quickly access planning tools and activities** – the corresponding section from the teacher guide is included with the lesson content

Build skills:

- **Build maths skills** using maths activities to help students develop the skills they need for the GCSE exam
- **Support practical work** – resources for all required practicals are available to help students consolidate and practice their learning
- **Build confidence in answering longer questions** with downloadable, editable exam-style practice questions with full mark scheme

Track progress:

- **Easily track pupils' progress** with diagnostic
- **Quickly check understanding of a topic** with online auto-marked test questions such as multiple choice and fill-in-the-blanks



Sample from
GCSE (9–1) Science on Collins Connect

Watch our GCSE Science on Collins Connect trailer at www.collins.co.uk/SecondaryScience

AQA KS3 Science on Collins Connect

Collins Connect supports you and your students by providing further opportunities for assessment and home learning:

- **Teach flexibly** with an interactive version of the student book, ideal for whiteboard use
- **Quickly access teaching resources** – the corresponding section from the teacher guide is included with the lesson content

- **Trial Collins Connect free for 14 days.** Contact education.support@harpercollins.co.uk
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AQA KS3 Science

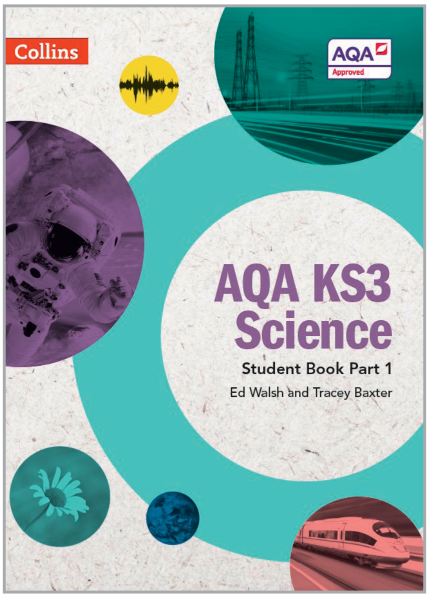
NEW | Age 11–14 | KS3

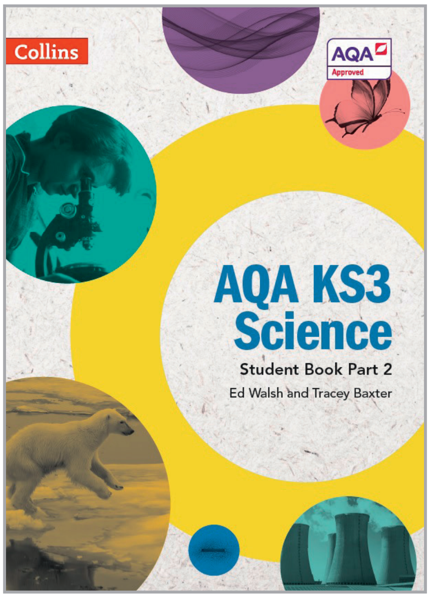
Collins Connect

AQA Approved

Author: **Ed Walsh and Tracey Baxter**

Develop mastery at KS3 with an engaging two-year course for the new AQA KS3 Science syllabus.





The Student Books have been approved by AQA.

Student Books:

- **Teach with confidence**, the Student Books have been approved by AQA
- **Ensure progression throughout the course** with Know, Apply and Extend concepts from the AQA syllabus embedded in each spread
- **Develop working scientifically skills** with enquiry processes integrated into each lesson
- **Guide students confidently through the AQA Mastery Goals and 10 big ideas,** which are reflected in the learning objectives for each lesson
- **Check understanding and track progress** with questions at the end of each topic and chapter
- **Prepare students for GCSE and develop key skills** with maths, literacy and extended writing skills embedded throughout
- **Engage and excite students** with material and activities that bring science to life

Teacher Packs:

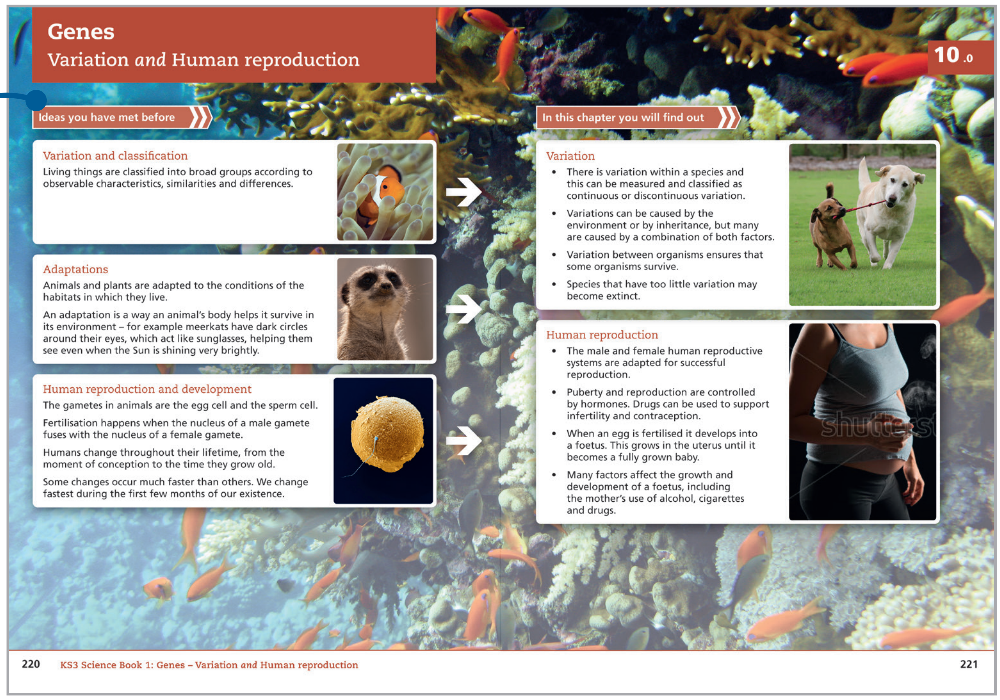
- **Deliver the new course confidently** with teacher support fully matched to the AQA KS3 Science syllabus, the big ideas framework and enquiry processes
- **Support students in meeting AQA's mastery goals,** each lesson maps to the Know, Apply and Extend concepts with three levels of learning outcomes
- **Support your planning** with 2 and 3 year schemes of work
- **Teach your way,** all Teacher Pack resources are available as editable, printable documents on a CD Rom

Collins Connect:

- **Teach flexibly and encourage home learning** with online versions of the Student Book and Teacher Pack on Collins Connect

Find out more about AQA KS3 Science on Collins Connect, turn to page 3.

Chapter opening spreads connect topics within the Big Idea by showing how ideas are linked to earlier learning and where they will lead to next


Genes

Variation *and* Human reproduction

10.0

Ideas you have met before

Variation and classification

Living things are classified into broad groups according to observable characteristics, similarities and differences.

Adaptations

Animals and plants are adapted to the conditions of the habitats in which they live.

An adaptation is a way an animal's body helps it survive in its environment – for example meerkats have dark circles around their eyes, which act like sunglasses, helping them see even when the Sun is shining very brightly.

Human reproduction and development

The gametes in animals are the egg cell and the sperm cell.

Fertilisation happens when the nucleus of a male gamete fuses with the nucleus of a female gamete.

Humans change throughout their lifetime, from the moment of conception to the time they grow old.

Some changes occur much faster than others. We change fastest during the first few months of our existence.

In this chapter you will find out

Variation

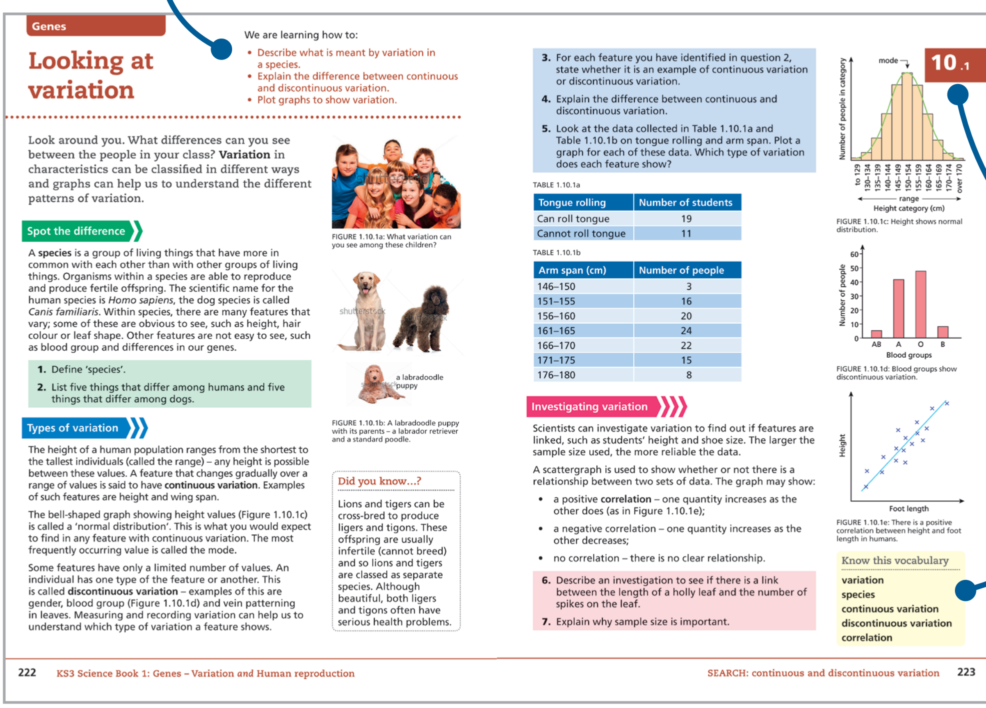
- There is variation within a species and this can be measured and classified as continuous or discontinuous variation.
- Variations can be caused by the environment or by inheritance, but many are caused by a combination of both factors.
- Variation between organisms ensures that some organisms survive.
- Species that have too little variation may become extinct.

Human reproduction

- The male and female human reproductive systems are adapted for successful reproduction.
- Puberty and reproduction are controlled by hormones. Drugs can be used to support infertility and contraception.
- When an egg is fertilised it develops into a foetus. This grows in the uterus until it becomes a fully grown baby.
- Many factors affect the growth and development of a foetus, including the mother's use of alcohol, cigarettes and drugs.

220 KS3 Science Book 1: Genes – Variation *and* Human reproduction 221

Each lesson focuses on one or more of AQA's 16 Enquiry Processes


Genes

Looking at variation

We are learning how to:
- Describe what is meant by variation in a species.
- Explain the difference between continuous and discontinuous variation.
- Plot graphs to show variation.

Look around you. What differences can you see between the people in your class? **Variation** in characteristics can be classified in different ways and graphs can help us to understand the different patterns of variation.

FIGURE 1.10.1a: What variation can you see among these children?

Spot the difference

A **species** is a group of living things that have more in common with each other than with other groups of living things. Organisms within a species are able to reproduce and produce fertile offspring. The scientific name for the human species is *Homo sapiens*, the dog species is called *Canis familiaris*. Within species, there are many features that vary; some of these are obvious to see, such as height, hair colour or leaf shape. Other features are not easy to see, such as blood group and differences in our genes.

1. Define 'species'.
2. List five things that differ among humans and five things that differ among dogs.

a labradoodle puppy

FIGURE 1.10.1b: A labradoodle puppy with its parents – a labrador retriever and a standard poodle.

Types of variation

The height of a human population ranges from the shortest to the tallest individuals (called the range) – any height is possible between these values. A feature that changes gradually over a range of values is said to have **continuous variation**. Examples of such features are height and wing span.

The bell-shaped graph showing height values (Figure 1.10.1c) is called a 'normal distribution'. This is what you would expect to find in any feature with continuous variation. The most frequently occurring value is called the mode.

Some features have only a limited number of values. An individual has one type of the feature or another. This is called **discontinuous variation** – examples of this are gender, blood group (Figure 1.10.1d) and vein patterning in leaves. Measuring and recording variation can help us to understand which type of variation a feature shows.

Did you know...?

Lions and tigers can be cross-bred to produce ligers and tigons. These offspring are usually infertile (cannot breed) and so lions and tigers are classed as separate species. Although beautiful, both ligers and tigons often have serious health problems.

3. For each feature you have identified in question 2, state whether it is an example of continuous variation or discontinuous variation.
4. Explain the difference between continuous and discontinuous variation.
5. Look at the data collected in Table 1.10.1a and Table 1.10.1b on tongue rolling and arm span. Plot a graph for each of these data. Which type of variation does each feature show?

TABLE 1.10.1a

Tongue rolling	Number of students
Can roll tongue	19
Cannot roll tongue	11

TABLE 1.10.1b

Arm span (cm)	Number of people
146–150	3
151–155	16
156–160	20
161–165	24
166–170	22
171–175	15
176–180	8

Investigating variation

Scientists can investigate variation to find out if features are linked, such as students' height and shoe size. The larger the sample size used, the more reliable the data.

A scattergraph is used to show whether or not there is a relationship between two sets of data. The graph may show:
- a positive **correlation** – one quantity increases as the other does (as in Figure 1.10.1e);
- a negative correlation – one quantity increases as the other decreases;
- no correlation – there is no clear relationship.

6. Describe an investigation to see if there is a link between the length of a holly leaf and the number of spikes on the leaf.
7. Explain why sample size is important.

10.1

FIGURE 1.10.1c: Height shows normal distribution.

FIGURE 1.10.1d: Blood groups show discontinuous variation.

FIGURE 1.10.1e: There is a positive correlation between height and foot length in humans.

Know this vocabulary

variation

species

continuous variation

discontinuous variation

correlation

222 KS3 Science Book 1: Genes – Variation *and* Human reproduction SEARCH: continuous and discontinuous variation 223

Chapters are colour-coded to the Big Ideas in the AQA syllabus for ease of reference

Boost literacy skills and ensure students have the required vocabulary with 'Know this Vocabulary' boxes in each topic

Pages from *AQA KS3 Science Student Book Part 1*

NEW AQA KS3 Science: Student Book Part 1	9780008215286	£14.99	Out now
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NEW AQA KS3 Science: Teacher Guide Part 1	9780008215309	£150.00	Out now
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Please note that only the Student Books and Digital Student Books were entered in the AQA approval process. The Student Books have been approved by AQA.

GCSE science ready: Transition Tests and Intervention Tasks

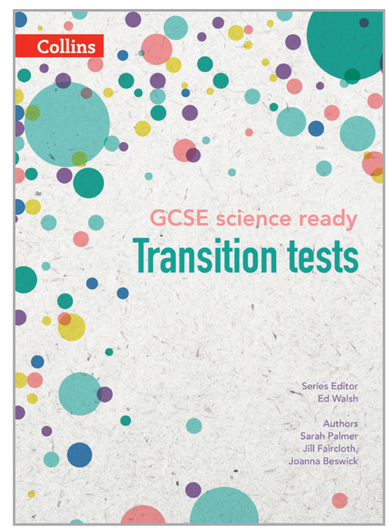
NEW | Age 11–14 | KS3 | GCSE

Authors: **Mark Gadd, Ed Walsh, Alex Holmes and Emily Quinn**

Track pupil progress and diagnose gaps in knowledge at KS3 using the Transition Tests, and resolve them with targeted Intervention Tasks. An ideal assessment companion to AQA KS3 Science.

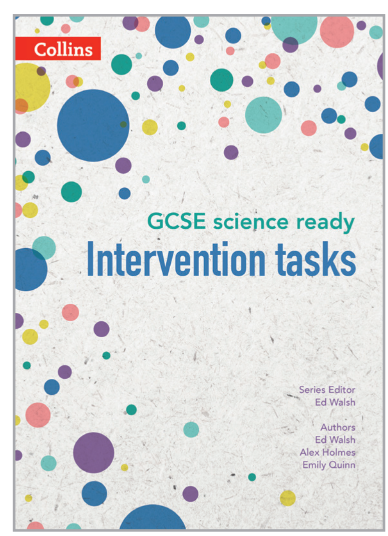
Transition Tests:

- **Ensure all pupils have acquired the 'mastery' required at KS3** to succeed in the new, more challenging GCSEs
- **Support diagnosis and intervention** with a simple tracking spreadsheet that records test results by difficulty of question
- **Meet the requirements of the AQA KS3 syllabus** with Enquiry Processes and Working Scientifically skills embedded throughout, and complete coverage of AQA's Big Ideas and mastery statements
- **Prepare students for the demands of GCSE** with coverage of key maths skills and a question breakdown that matches the new GCSE Assessment Objectives – 40% 'know', 40% 'apply' and 20% 'analyse and interpret'



Intervention Tasks:

- **Provide support where gaps in knowledge have been identified by the Transition Tests,** with 20 tasks each looking at two 'strands' of the AQA KS3 syllabus
- **Maintain interest and avoid assessment fatigue** with a variety of assessment activities including discussion, using equipment and group interaction
- **Comprehensive support for assessing whether students have made the required progress** and giving student feedback, as well as providing further interventions to address persistent weaknesses
- **Ensure complete coverage of all 16 Enquiry Processes and Working Scientifically Skills,** which are embedded throughout



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Collins KS3 Science

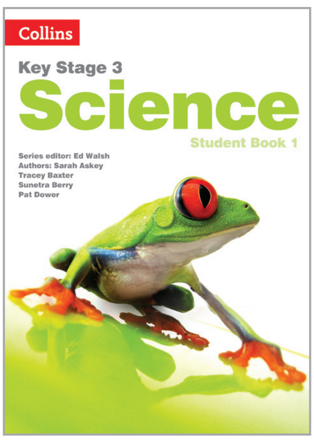
Age 11–14 | KS3

Collins Connect

Second Edition

Series Editor: **Ed Walsh**
Authors: **Sarah Askey, Tracey Baxter, Sunetra Berry, Pat Dower, Anne Pilling and Pete Robinson**

Collins Key Stage 3 Science, Second Edition is fully matched to the 2014 curriculum and designed to help students secure the key skills, knowledge and interest in science to succeed at KS3 and beyond.



- **Ensure progression throughout the key stage** with an in-depth scheme of work that supports you in delivering inspiring lessons
- **Provide flexibility with a 2 and 3 year route through the course**, whether you need more time to cover the new content or prefer to cover KS3 in 2 years before moving on to GCSE preparation
- **Monitor your students' progress** with assessment embedded throughout the course, which helps you check students' understanding of key concepts at the end of each unit and each topic
- **Support students to develop the skills required for GCSE success** with thinking scientifically, working scientifically and learner development integrated into the learning activities, objectives and outcomes of each lesson
- **Develop skills for further study** with questions designed to build students' ability to write longer answers, a key factor in GCSE success
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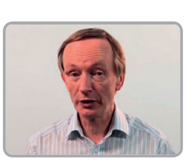
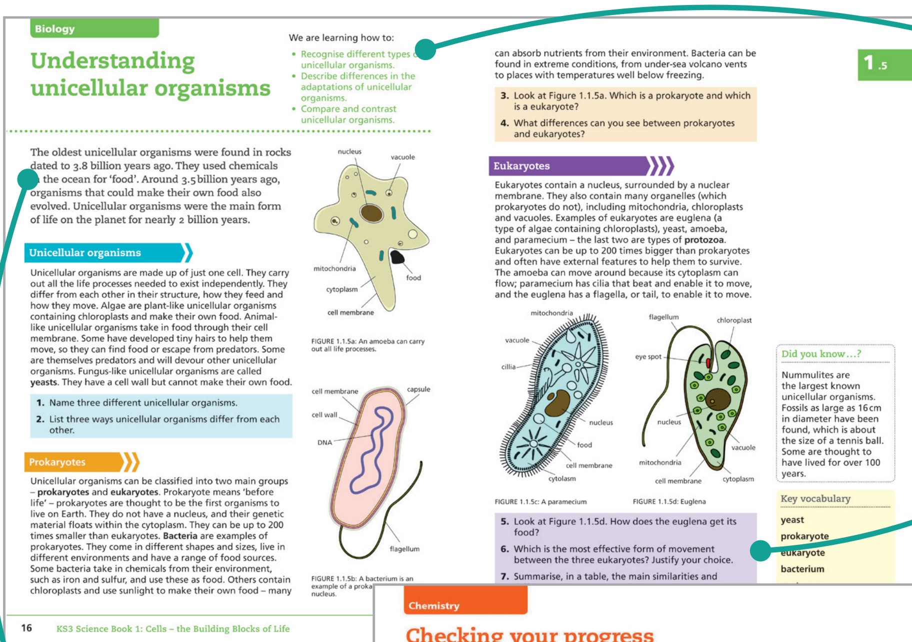


Want to hear more? Visit **www.collins.co.uk/KS3Science** and see what Series Editor Ed Walsh has to say about assessment and the new programme of study in our video series.



Biology

Understanding unicellular organisms

We are learning how to:

- Recognise different types of unicellular organisms.
- Describe differences in the adaptations of unicellular organisms.
- Compare and contrast unicellular organisms.

The oldest unicellular organisms were found in rocks dated to 3.8 billion years ago. They used chemicals in the ocean for 'food'. Around 3.5 billion years ago, organisms that could make their own food also evolved. Unicellular organisms were the main form of life on the planet for nearly 2 billion years.

Unicellular organisms

Unicellular organisms are made up of just one cell. They carry out all the life processes needed to exist independently. They differ from each other in their structure, how they feed and how they move. Algae are plant-like unicellular organisms containing chloroplasts and make their own food. Animal-like unicellular organisms take in food through their cell membrane. Some have developed tiny hairs to help them move, so they can find food or escape from predators. Some are themselves predators and will devour other unicellular organisms. Fungus-like unicellular organisms are called **yeasts**. They have a cell wall but cannot make their own food.

1. Name three different unicellular organisms.
2. List three ways unicellular organisms differ from each other.

Prokaryotes

Unicellular organisms can be classified into two main groups – **prokaryotes** and **eukaryotes**. Prokaryote means 'before life' – prokaryotes are thought to be the first organisms to live on Earth. They do not have a nucleus, and their genetic material floats within the cytoplasm. They can be up to 200 times smaller than eukaryotes. **Bacteria** are examples of prokaryotes. They come in different shapes and sizes, live in different environments and have a range of food sources. Some bacteria take in chemicals from their environment, such as iron and sulfur, and use these as food. Others contain chloroplasts and use sunlight to make their own food – many can absorb nutrients from their environment. Bacteria can be found in extreme conditions, from under-sea volcano vents to places with temperatures well below freezing.

FIGURE 1.1.5a: An amoeba can carry out all life processes.

FIGURE 1.1.5b: A bacterium is an example of a proka[ryote …] nucleus.

1.5

3. Look at Figure 1.1.5a. Which is a prokaryote and which is a eukaryote?
4. What differences can you see between prokaryotes and eukaryotes?

Eukaryotes

Eukaryotes contain a nucleus, surrounded by a nuclear membrane. They also contain many organelles (which prokaryotes do not), including mitochondria, chloroplasts and vacuoles. Examples of eukaryotes are euglena (a type of algae containing chloroplasts), yeast, amoeba, and paramecium – the last two are types of **protozoa**. Eukaryotes can be up to 200 times bigger than prokaryotes and often have external features to help them to survive. The amoeba can move around because its cytoplasm can flow; paramecium has cilia that beat and enable it to move, and the euglena has a flagella, or tail, to enable it to move.

FIGURE 1.1.5c: A paramecium

FIGURE 1.1.5d: Euglena

5. Look at Figure 1.1.5d. How does the euglena get its food?
6. Which is the most effective form of movement between the three eukaryotes? Justify your choice.
7. Summarise, in a table, the main similarities and

Did you know…?

Nummulites are the largest known unicellular organisms. Fossils as large as 16 cm in diameter have been found, which is about the size of a tennis ball. Some are thought to have lived for over 100 years.

Key vocabulary

yeast
prokaryote
eukaryote
bacterium

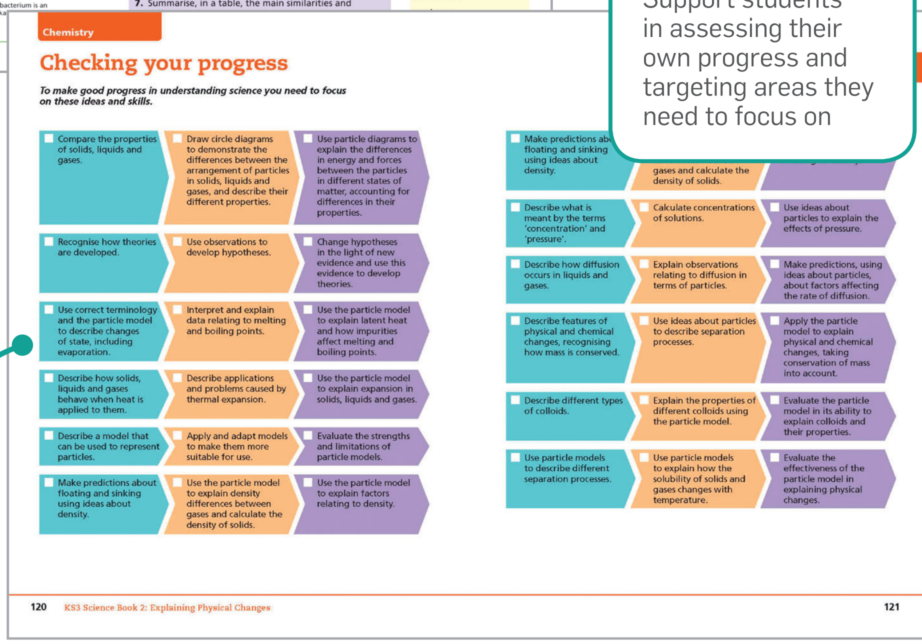
16 KS3 Science Book 1: Cells – the Building Blocks of Life

Sample from *Key Stage 3 Science, Second Edition Pupil Book 1*

Objectives for every lesson

Questions at the end of every topic test understanding before moving on

Engaging introduction puts the science into context



Chemistry

Checking your progress

To make good progress in understanding science you need to focus on these ideas and skills.

Compare the properties of solids, liquids and gases.	Draw circle diagrams to demonstrate the differences between the arrangement of particles in solids, liquids and gases, and describe their different properties.	Use particle diagrams to explain the differences in energy and forces between the particles in different states of matter, accounting for differences in their properties.
Recognise how theories are developed.	Use observations to develop hypotheses.	Change hypotheses in the light of new evidence and use this evidence to develop theories.
Use correct terminology and the particle model to describe changes of state, including evaporation.	Interpret and explain data relating to melting and boiling points.	Use the particle model to explain latent heat and how impurities affect melting and boiling points.
Describe how solids, liquids and gases behave when heat is applied to them.	Describe applications and problems caused by thermal expansion.	Use the particle model to explain expansion in solids, liquids and gases.
Describe a model that can be used to represent particles.	Apply and adapt models to make them more suitable for use.	Evaluate the strengths and limitations of particle models.
Make predictions about floating and sinking using ideas about density.	Use the particle model to explain density differences between gases and calculate the density of solids.	Use the particle model to explain factors relating to density.

120 KS3 Science Book 2: Explaining Physical Changes

Make predictions ab[out] floating and sinking using ideas about density.	… gases and calculate the density of solids.	
Describe what is meant by the terms 'concentration' and 'pressure'.	Calculate concentrations of solutions.	Use ideas about particles to explain the effects of pressure.
Describe how diffusion occurs in liquids and gases.	Explain observations relating to diffusion in terms of particles.	Make predictions, using ideas about particles, about factors affecting the rate of diffusion.
Describe features of physical and chemical changes, recognising how mass is conserved.	Use ideas about particles to describe separation processes.	Apply the particle model to explain physical and chemical changes, taking conservation of mass into account.
Describe different types of colloids.	Explain the properties of different colloids using the particle model.	Evaluate the particle model in its ability to explain colloids and their properties.
Use particle models to describe different separation processes.	Use particle models to explain how the solubility of solids and gases changes with temperature.	Evaluate the effectiveness of the particle model in explaining physical changes.

121

Support students in assessing their own progress and targeting areas they need to focus on

Colour coding demonstrates how key ideas develop

Collins Key Stage 3 Science components

Available on **Collins** Connect

Turn to pages 2–3 for more information.

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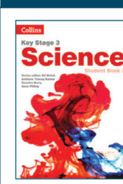
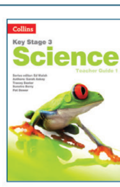
Pupil Books	 978-0-00-750581-4 £14.99	 978-0-00-754021-1 £14.99	 978-0-00-754023-5 £14.99
Teacher Packs	 978-0-00-754020-4 £150.00 + VAT	 978-0-00-754022-8 £150.00 + VAT	 978-0-00-754024-2 £150.00 + VAT
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* The Online Package allows unlimited access for teachers and students to the online content in school and enables the resources to be used for front of class teaching, including whiteboard use.

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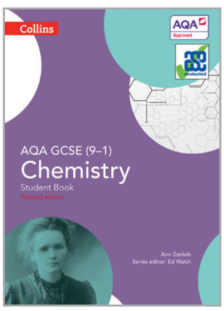
GCSE (9–1) Science

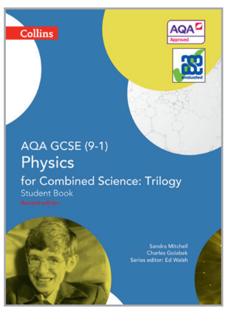
OCR endorsed | Collins Connect | AQA Approved | NEW | Age 14–16 | GCSE

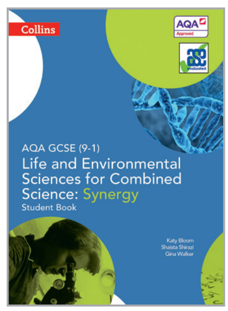
Series Editors: **Ed Walsh**

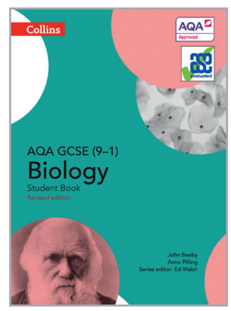
Authors: **John Beeby, Ann Daniels, Sandra Mitchell and Anne Pilling**

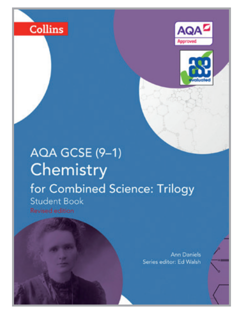
Written for the **AQA** and **OCR Gateway** (9–1) specifications, our resources will develop and embed the skills your students need to succeed in all three assessment objectives, while providing a clear and supportive route through the new, more challenging GCSE content.

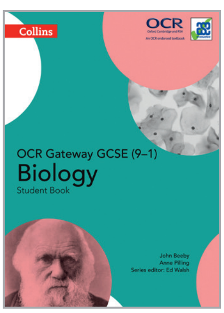


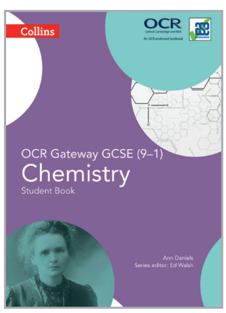


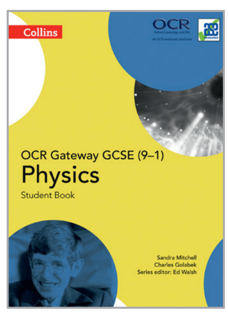


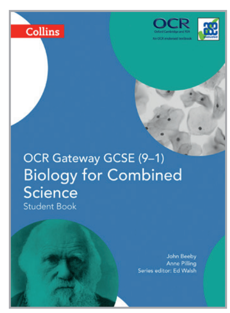


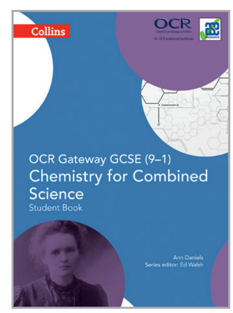












How our resources support your students to tackle the new GCSE (9–1) Science requirements:

- **Increased maths element:** a dedicated maths spread in every chapter and skills at the appropriate level embedded throughout, provide a wealth of support and practice
- **Practical assessment:** Coverage of the required practicals to develop and test skills in analysing, interpreting and evaluating information and ideas so students are well prepared for the indirect assessment
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- **Teach with confidence:** The AQA Student Books are approved by AQA and the OCR Gateway Student Books are endorsed by OCR. The Teacher Packs and digital resources have not entered an AQA approval process or an OCR endorsement process

Turn to page 12 for the full Collins GCSE (9–1) Science component chart.

GCSE (9–1) Science

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Written by a team of expert authors for the 2016 specifications, the student books combine clear and comprehensive explanations with a wealth of practice opportunities, to help build the skills that students will need to succeed.

Co-teach both Foundation and Higher tier with a single book


Biology

Cells at work

Learning objectives:
- explain the need for energy
- describe aerobic respiration as an exothermic reaction.

KEY WORDS
active transport
respiration
aerobic
respiration
exothermic

This runner is using energy to run a marathon. But we all need a continuous supply of energy – 24 hours a day – just to stay alive.

We need energy to live

Organisms need energy:
- to drive the chemical reactions needed to keep them alive, including building large molecules
- for movement.

Energy is needed to make our muscles contract and to keep our bodies warm. It's also needed to transport substances around the bodies of animals and plants.

In other sections of the book, you will also find out that energy is needed:
- for cell division
- to maintain a constant environment within our bodies
- for **active transport**. Plants use active transport to take up mineral ions from the soil, and to open and close their stomata
- to transmit nerve impulses.

1 List four uses of energy in animals.
2 List four uses of energy in plants.

Figure 1.37 An average runner uses around 13 000 kJ of energy for a marathon

Aerobic respiration

Respiration is the process used by all organisms to release the energy they need from food.

Respiration using oxygen is called **aerobic respiration**. This type of respiration takes place in animal and plant cells, and in many microorganisms.

The word equation for aerobic respiration is:

glucose + oxygen → carbon dioxide + water (+ energy released)

Glucose is a simple sugar. It is the starting point of respiration in most organisms. The food that organisms take in is, therefore, converted into glucose.

1.11

This chemical reaction is **exothermic**. A reaction is described as exothermic when it releases energy. Some of the energy transferred is released as heat.

Figure 1.38 Birds and mammals make use of heat energy to maintain a constant body temperature

3 Write down the word equation for aerobic respiration.
4 How do birds and mammals make use of the waste heat energy?

HIGHER TIER

Bioenergetics

These are the word and symbol equations for aerobic respiration:

glucose + oxygen → carbon dioxide + water (energy released)

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + H_2O$ (energy released)

This equation describes the overall change brought about through each of a series of chemical reactions. A small amount of energy is actually released at each stage in the series.

The first group of steps occurs in the cytoplasm of cells, but most of the energy is transferred by chemical reactions in the mitochondria.

5 Write down the symbol equation for aerobic respiration.
6 Give one characteristic feature of actively respiring cells.

Figure 1.39 Insect flight muscles have huge numbers of well-developed mitochondria

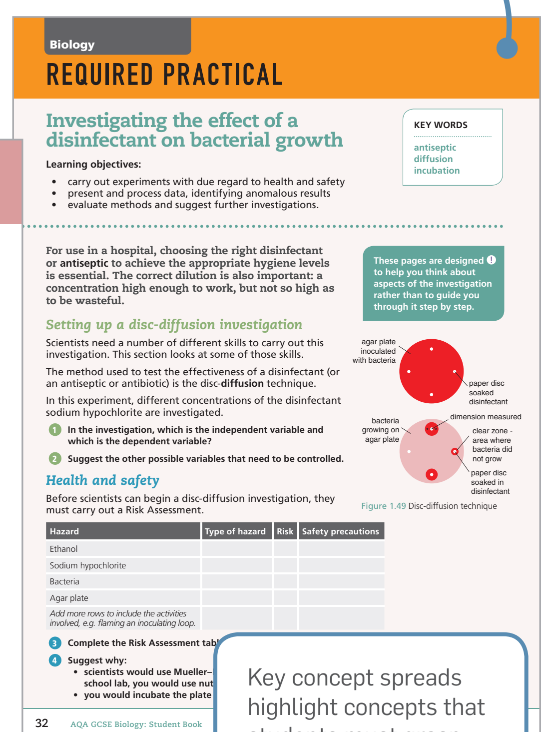
DID YOU KNOW?
The muscle an insect uses to fly is the most … tissue found in …

HINTS & TIPS
Don't forget that organisms respi… equation is the … of photosynthe… don't confuse th… Photosynthesis … in which plants … food.

Google search: 'aerobic respiration' 25

Required practicals spreads in each chapter build and test students' development of the appropriate skills

Prepare students for the demands of the new specification with differentiated questions, worked examples and lots of opportunities to practice


Biology

REQUIRED PRACTICAL

Investigating the effect of a disinfectant on bacterial growth

Learning objectives:
- carry out experiments with due regard to health and safety
- present and process data, identifying anomalous results
- evaluate methods and suggest further investigations.

KEY WORDS
antiseptic
diffusion
incubation

For use in a hospital, choosing the right disinfectant or **antiseptic** to achieve the appropriate hygiene levels is essential. The correct dilution is also important: a concentration high enough to work, but not so high as to be wasteful.

These pages are designed to help you think about aspects of the investigation rather than to guide you through it step by step.

Setting up a disc-diffusion investigation

Scientists need a number of different skills to carry out this investigation. This section looks at some of those skills.

The method used to test the effectiveness of a disinfectant (or an antiseptic or antibiotic) is the disc-**diffusion** technique.

In this experiment, different concentrations of the disinfectant sodium hypochlorite are investigated.

1 In the investigation, which is the independent variable and which is the dependent variable?
2 Suggest the other possible variables that need to be controlled.

Figure 1.49 Disc-diffusion technique

Health and safety

Before scientists can begin a disc-diffusion investigation, they must carry out a Risk Assessment.

Hazard	Type of hazard	Risk	Safety precautions
Ethanol			
Sodium hypochlorite			
Bacteria			
Agar plate			
Add more rows to include the activities involved, e.g. flaming an inoculating loop.			

3 Complete the Risk Assessment tab…
4 Suggest why:
- scientists would use Mueller-… school lab, you would use nut…
- you would incubate the plate…

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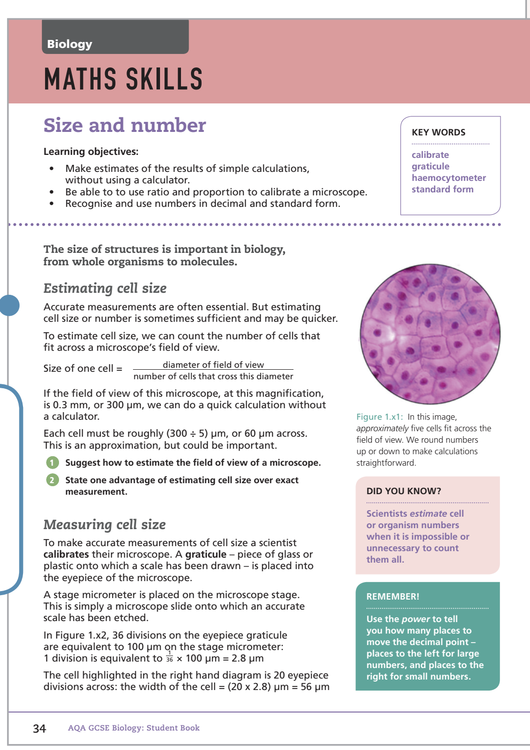
Biology

MATHS SKILLS

Size and number

Learning objectives:
- Make estimates of the results of simple calculations, without using a calculator.
- Be able to to use ratio and proportion to calibrate a microscope.
- Recognise and use numbers in decimal and standard form.

KEY WORDS
calibrate
graticule
haemocytometer
standard form

The size of structures is important in biology, from whole organisms to molecules.

Estimating cell size

Accurate measurements are often essential. But estimating cell size or number is sometimes sufficient and may be quicker.

To estimate cell size, we can count the number of cells that fit across a microscope's field of view.

Size of one cell = $\frac{\text{diameter of field of view}}{\text{number of cells that cross this diameter}}$

If the field of view of this microscope, at this magnification, is 0.3 mm, or 300 µm, we can do a quick calculation without a calculator.

Each cell must be roughly (300 ÷ 5) µm, or 60 µm across. This is an approximation, but could be important.

1 Suggest how to estimate the field of view of a microscope.
2 State one advantage of estimating cell size over exact measurement.

Figure 1.x1: In this image, *approximately* five cells fit across the field of view. We round numbers up or down to make calculations straightforward.

DID YOU KNOW?
Scientists *estimate* cell or organism numbers when it is impossible or unnecessary to count them all.

Measuring cell size

To make accurate measurements of cell size a scientist **calibrates** their microscope. A **graticule** – piece of glass or plastic onto which a scale has been drawn – is placed into the eyepiece of the microscope.

A stage micrometer is placed on the microscope stage. This is simply a microscope slide onto which an accurate scale has been etched.

In Figure 1.x2, 36 divisions on the eyepiece graticule are equivalent to 100 µm on the stage micrometer: 1 division is equivalent to $\frac{1}{36}$ × 100 µm = 2.8 µm

The cell highlighted in the right hand diagram is 20 eyepiece divisions across: the width of the cell = (20 x 2.8) µm = 56 µm

REMEMBER!
Use the *power* to tell you how many places to move the decimal point – places to the left for large numbers, and places to the right for small numbers.

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Maths spreads in every chapter provide extra support and practice

Key concept spreads highlight concepts that students must grasp before they move on

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Teacher Guides

Deliver the new curriculum with confidence and help all students make progress using our comprehensive support, including schemes of work, editable lesson plans and a wealth of differentiated materials.

Assessment

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Checklists at the end of every chapter provide an opportunity for students to assess their own progress

Encourage independent study with worked examples at the end of every chapter

Chemistry

Check your progress

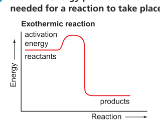
You should be able to:

recognise that when a reaction has stopped one of the reactants has been used up →	describe the reactant that is used up first in a reaction as the limiting reactant →	explain the effect of a limiting quantity of a reactant on the amount of products it is possible to obtain, using moles or grams
relate mass, volume and concentration →	calculate the mass of solute in a solution →	relate concentration in mol/dm³ to mass and volume
describe how to carry out titrations →	calculate the concentrations in titrations in mol/dm³ and in g/dm³ →	explain how the concentration of a solution in mol/dm³ is related to the mass of the solute and the volume of the solution
identify the balanced equation needed for calculating yields →	calculate the theoretical amount of products from the amounts of reactants →	calculate the percentage yield from the actual yield and the theoretical yield
identify the balanced equation for a reaction →	calculate the atom economy of a reaction to form a desired product →	explain why a particular reaction pathway is chosen to produce a product given the atom economy, yield, rate, equilibrium position and usefulness of by-products
explain that the same amount of any gas (in moles) occupies the same volume at room temperature and pressure (rtp) →	calculate the volume of a gas at rtp from its mass and relative formula mass →	calculate volumes of gases from a balanced equation and a given volume of a reactant or product
identify how to measure the amount of gas given off in a reaction →	calculate the mean rate of a reaction →	draw tangents to the curves as a measure of the rate of reaction
identify which factors affect the rate of reactions →	explain how the changes of surface area affect rates →	explain how rates are affected by different factors
analyse experimental data on rates of reaction →	predict the effects of changing conditions on rates of reactions →	explain the effects of changes of factor on rates of reaction using collision theory
identify catalysts in reactions →	explain catalytic action →	explain activation energy
identify a reversible reaction →	describe how equilibrium is reached →	predict the effects of changes on systems at equilibrium
identify reactants and products in a reversible reaction →	explain how changing concentrations changes equili… →	interpret data to predict the effect of a change in …
explain how exothermic reactions behave if the temperature of systems at equilibrium changes →	expla… reacti… temp…	
predict the effects of changes in pressure →	expla… of pre…	

228 OCR Gateway GCSE Chemistry: Student Book

Worked example

1. **Explain how catalysts work.**
   They speed up a reaction because they lower the activation energy.
2. **Draw the equation symbol used to show a reversible reaction.**
   $\rightleftharpoons$
3. **Draw an energy profile to show the activation energy needed for a reaction to take place.**



4. **Explain how increasing temperature increases the rate of reaction.**
   The particles move faster so hit each other more likely.
5. **Look at the table. Fill in the missing number and describe the pattern shown by this reaction at equilibrium. Predict the percentage of product probably formed at 150°C and suggest what the owner of the factory making this product should do.**

Temperature in °C	100	200	300	400
% reactants at equilibrium	22	37	52	59
% products at equilibrium	78	63	48	*41*

The higher the temperature the less products are made, so the owner should do this at a low temperature.

This answer is correct as the description of what catalysts do is linked to the explanation.

The answer is correct

The profile is for a chemical reaction. The activation energy is the *difference between* the energy levels of the reactants and products not the initial energy level.

This answer is worth one mark as a better word would be collide and an explanation is needed. A better answer is the particles move with more energy so there are more successful collisions

The data on the table is completed and the pattern is correctly described. The student has made a good suggestion to use a low temperature but needs to be careful to use the word lower not low. This reaction may not work at a low temperature and may not be fast enough. This time the 'benefit of doubt' is given. The answer is not complete though as they have missed the prediction. An answer of 60%–61% would give the fourth mark.

Worked example 229

Differentiated end of chapter questions help students apply their learning

Chemistry

End of chapter questions

Getting started

1. **Which one of the following statements about catalysts is true?**
   a They increase the amount of product formed.
   b Large quantities of catalyst are needed.
   c Catalysts are changed at the end of reaction.
   d They increase the rate of reaction. — 1 Mark
2. **How does rate change during a chemical reaction?**
   a Increases then decreases to zero. **b** Decreases to zero.
   c Stays the same. **d** Increases from zero. — 1 Mark
3. **Write down two factors that can be changed to make a reaction go faster.** — 2 Marks
4. **The top is left off of a fizzy drink bottle. Explain why the carbon dioxide gas cannot reach equilibrium with dissolved carbon dioxide.** — 1 Mark
5. **Magnesium reacts with hydrochloric acid solution. Explain why the rate increases when the concentration of hydrochloric acid increases.** — 1 Mark
6. **Acid is added to sodium carbonate in a flask and left on a digital balance. Explain why the mass of flask and contents goes down.** — 2 Marks
7. **A student was expecting to make 2.8 g of a chemical, but instead made 2.2g. Calculate the percentage yield.** — 2 Marks

Going further

8. **One of the characteristics of an equilibrium is that it has to be a closed system. Give two other characteristics.** — 1 Mark
9. **Nitrogen and oxygen gases react together to form nitrogen(II) oxide. Explain why increasing the pressure increases the rate of this reaction.** — 1 Mark
10. **Hydrogen peroxide solution decomposes into oxygen and water. Suggest two ways that the rate of reaction can be followed experimentally.** — 2 Marks
11. **Put these reactions in order of their atom economy by looking at their equations only, the desired product is in bold:**
    a i $Zn + 2HCl \rightarrow \mathbf{ZnCl_2} + H_2$ ii $Zn + 2HCl \rightarrow ZnCl_2 + \mathbf{H_2}$
    iii $2Mg + O_2 \rightarrow \mathbf{2MgO}$
    b Check your answer by calculating the atom economy for each reaction.
    [Zn = 65, H = 1, Cl = 35.5, Mg = 24, 0 = 16] — 4 Marks
12. **The activation energy for a reaction was measured with and without a catalyst. The values were 72 kJ/mol and 55 kJ/mol. Explain which value was the value for the catalysed reaction.** — 2 Marks

More challenging

13. **Explain why the combustion of natural gas in a Bunsen burner cannot reach equilibrium.** — 1 Mark
14. **In industry, there is a high risk of an explosion from flour, coal and other types of combustible dust. Suggest why.** — 1 Mark

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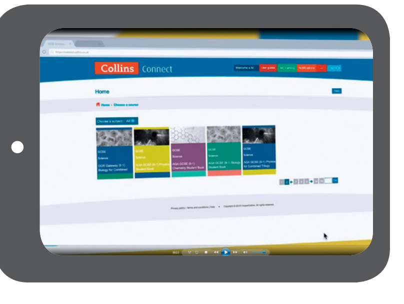

Collins GCSE Science: Component chart

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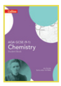
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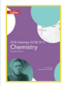
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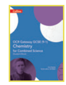
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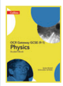
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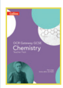
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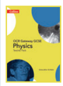
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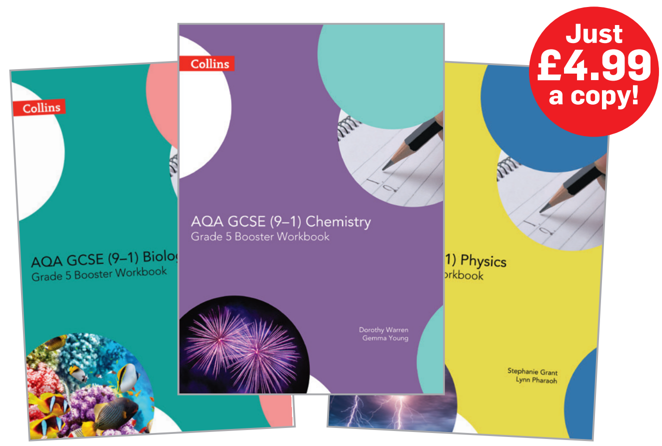

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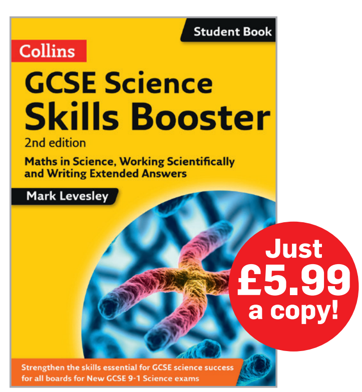

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Age 14–16

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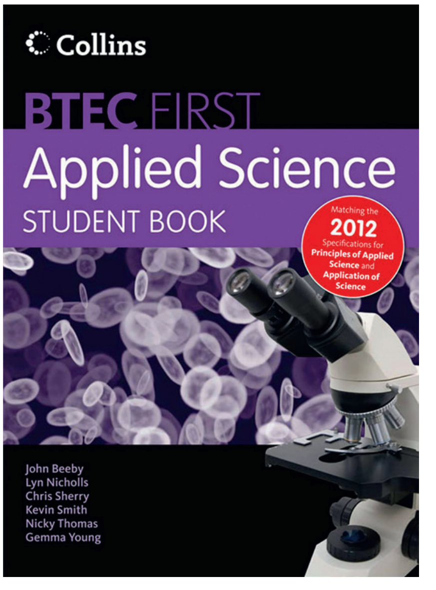

Teacher Pack:

Comprehensive support for teachers is provided in Teacher Pack 1: Principles of Applied Science (Units 1-4) and Teacher Pack 2: Application of Science (Units 5-8):

- **A cost-effective solution** as units 1–4 are available in a printed pack, and units 5–8 are in a downloadable pack from our website
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Units covered:

Collins BTEC First Applied Science contains all units for the 2012 qualifications

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Unit 5: Application of Chemical Substances
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Age 14–16

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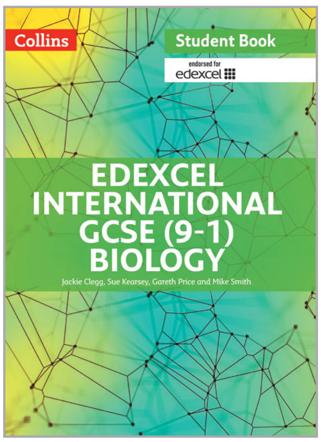

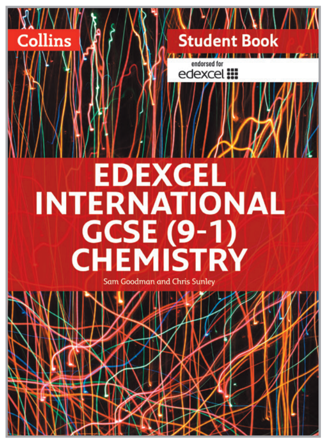

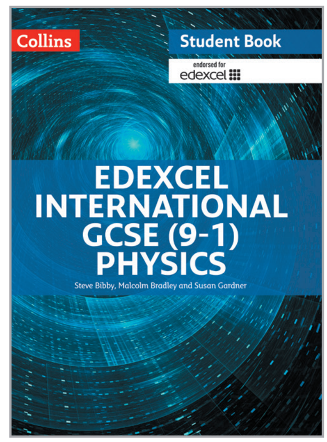

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Student Books:

- **Co-teach separate Science and Double Award Science with confidence** with Student Books for Biology, Chemistry and Physics, and material for separate Science clearly indicated
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Age 14–16

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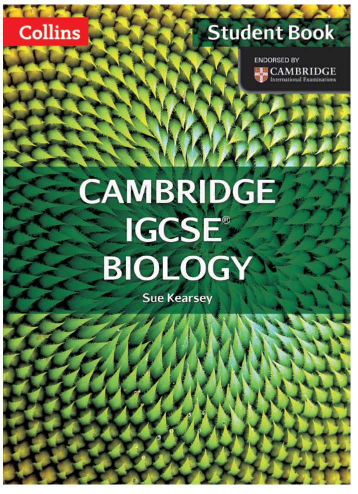

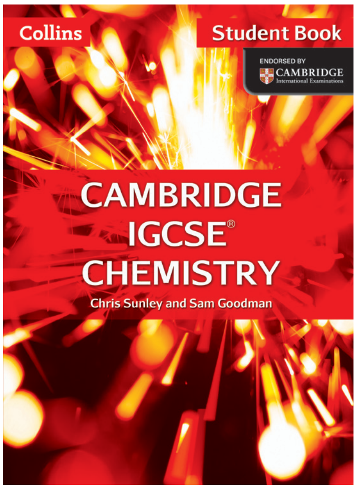

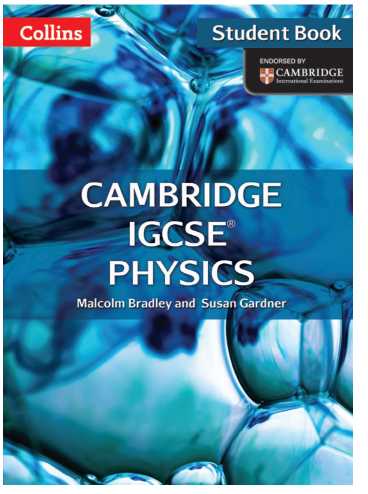

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- **Check understanding and help to prepare for assessment** with lots of practice exam-style questions at the end of each section
- **Help prepare for practical assessment** with a dedicated chapter
- **Support students with English as a Second Language** with a detailed glossary

Teacher Packs:

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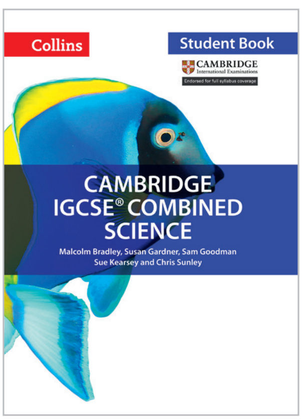

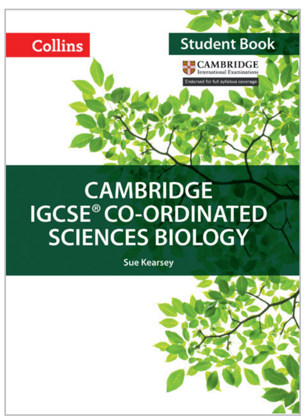

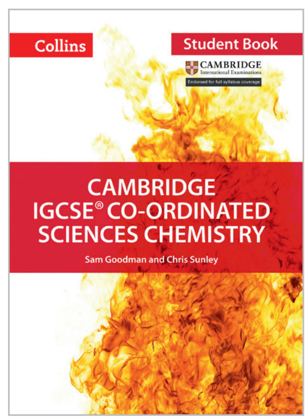

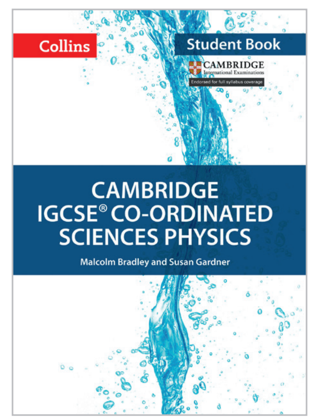

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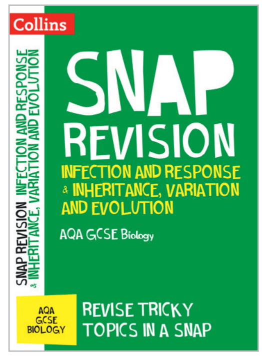

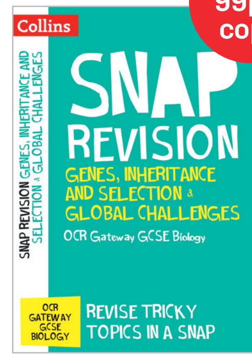

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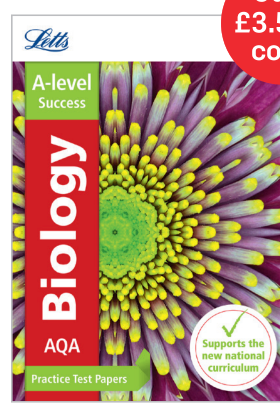

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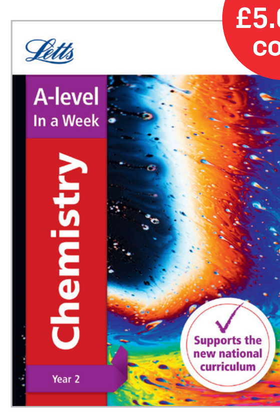

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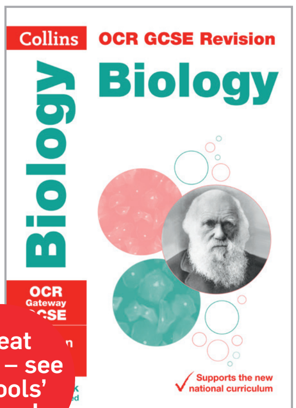

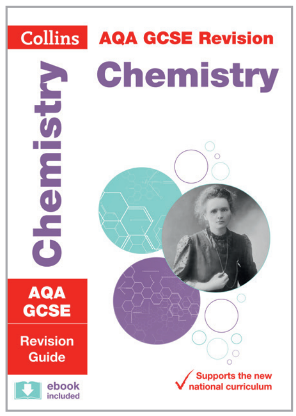

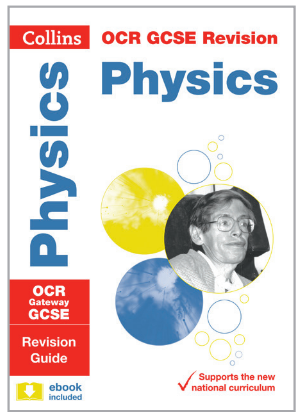

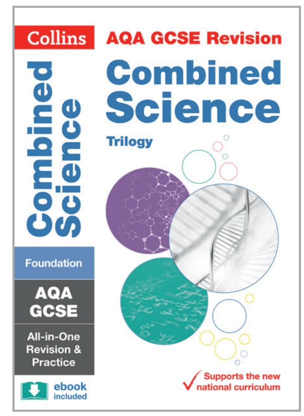

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Key Point and Key Words boxes on every page reinforce the knowledge students need to progress

Key Point

Nitrate ions are needed to make proteins because amino acids contain nitrogen, but glucose does not.

Key Words

endothermic
chlorophyll
limiting factor
HT inverse square law

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Age 16–18 | AS/A | AQA Approved

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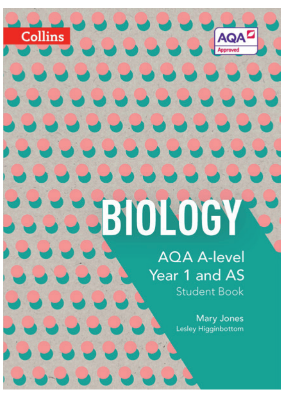
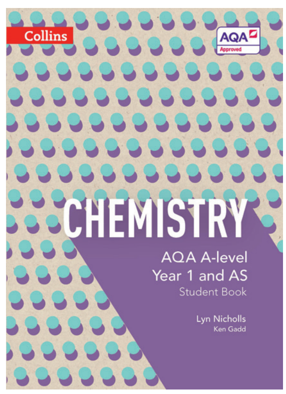
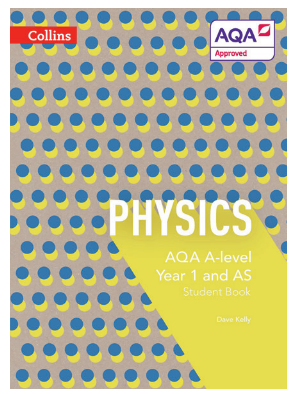
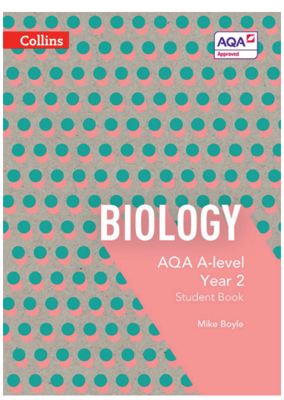
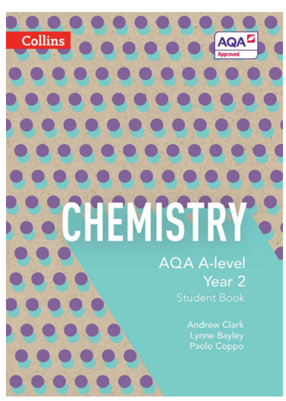
Help your students develop the increased maths skills and stronger practical skills needed to successfully tackle the demands of A-level Science.

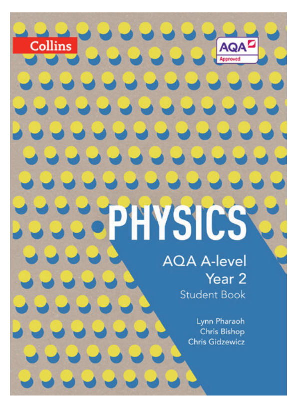












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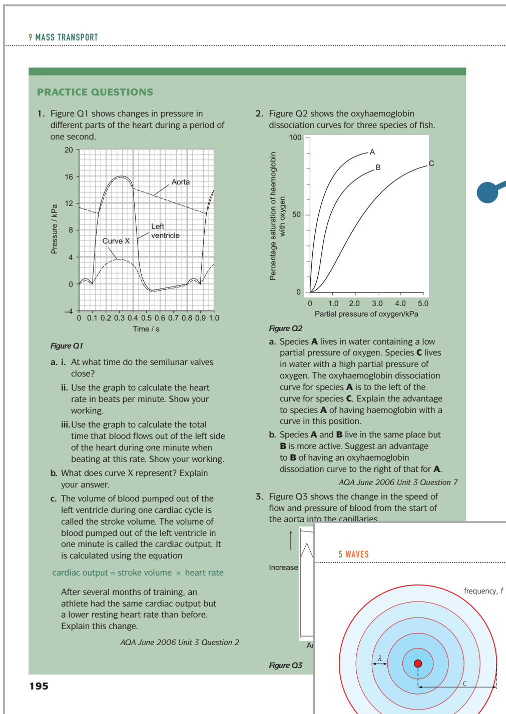

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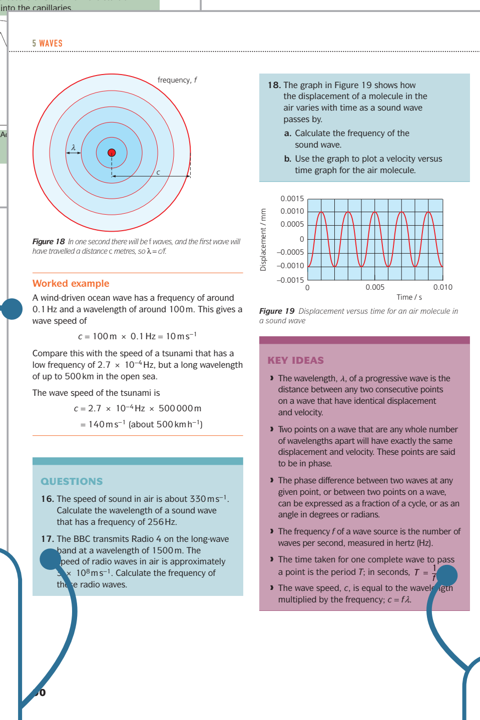

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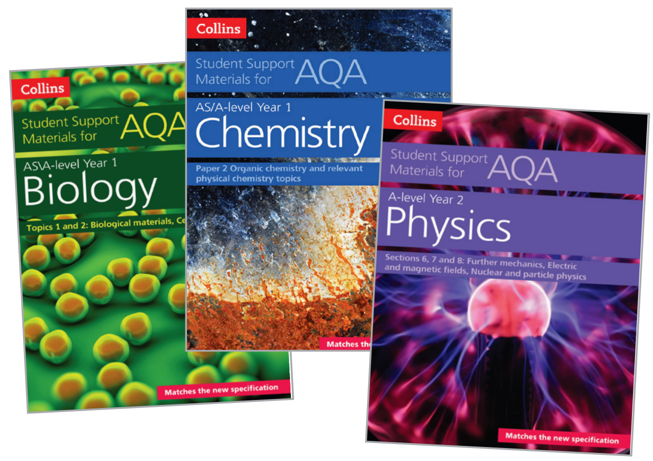

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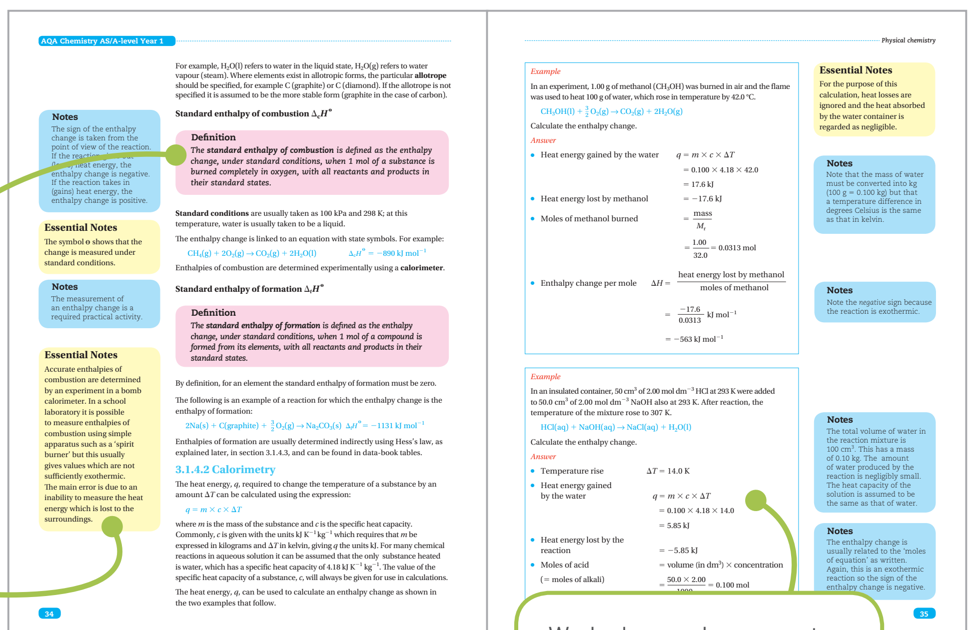

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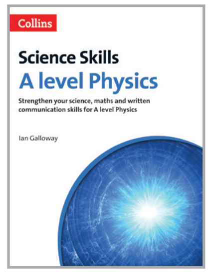

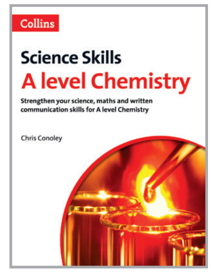

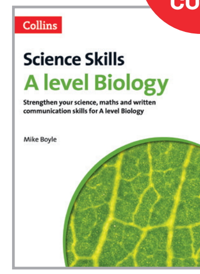

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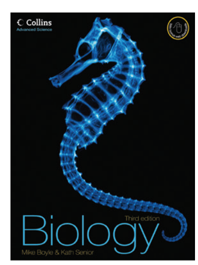

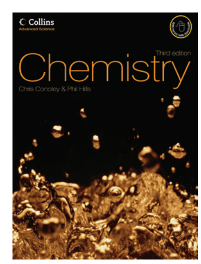

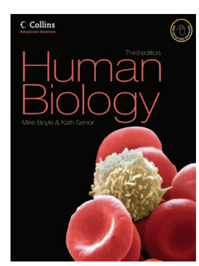

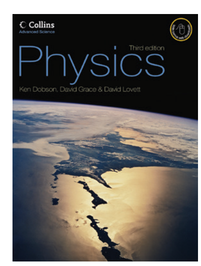

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