Oxford International Resources

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Science

Teacher's Guide

Second Edition

Primary

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Teacher's Guide

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OXFORD
UNIVERSITY PRESS

OXFORD
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Great Clarendon Street, Oxford, OX2 6DP, United Kingdom

Oxford University Press is a department of the University of Oxford. It furthers the University's objective of excellence in research, scholarship, and education by publishing worldwide. Oxford is a registered trade mark of Oxford University Press in the UK and in certain other countries.

First published in 2014

British Library Cataloguing in Publication Data

Data available

ISBN 978-1-38-201735-0

1 3 5 7 9 10 8 6 4 2

Paper used in the production of this book is a natural, recyclable product made from wood grown in sustainable forests. The manufacturing process conforms to the environmental regulations of the country of origin.

Printed in Great Britain by CPI Anthony Rowe.

Acknowledgements

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Introduction

The joy of learning science

We are living in an ever-changing world, where the way we work, live, learn, communicate and relate to one another is constantly shifting. In this climate, we need to instill in our learners the skills to equip them for every eventuality so they are able to overcome challenges, adapt to change and have the best chance of success. To do this, we need to evolve beyond traditional teaching approaches and foster an environment where students can start to build lifelong learning skills for success. Students need to learn how to learn, how to problem solve, be agile and work flexibly. Going hand-in-hand with this is the development of self-awareness and mindfulness through the promotion of wellbeing to ensure students learn the socio-emotional skills to succeed.

Teaching and learning with *Oxford International Primary Science*

This series is based on the English National Curriculum Programme of Study for Primary Science. The books for each year (or stage) follow the scheme and meet all the learning objectives – including working scientifically. Each lesson includes the learning objectives from the curriculum and summary of the key teaching points. A full mapping grid identifying the unit and lesson where each objective can be found is available online at https://www.oxfordowl.co.uk/. Objectives are written in student-friendly language in the Student Book.

The teaching units in the series are flexible: they can be adapted as you see fit to meet the needs of your students. Each unit stands alone and can be taught in any order.

The books are designed for students aged 5 to 11. Each year has a **Student Book**, a **Workbook** and a **Teacher's Guide**. There are also numerous online resources and sources of support: these include further examples and support for formative and summative assessment, and can be found at: https://www.oxfordowl.co.uk/. Underpinning the rationale for the series is the strong belief that science provides a way of thinking and working. It helps us to make sense of the world we live in and provides intellectual skills that help us in all curriculum areas and in life.

This introduction shows how to use the resources to develop your students' scientific knowledge, skills and understanding.

This series has seven main aims:

1 To deliver scientific knowledge and facts

2 To deliver scientific understanding

3 To deliver scientific methods of enquiry

4 To deliver scientific thinking and reasoning

5 To help students understand the development of science and its uses in context in the world around them

6 To support the wellbeing of students

7 To give students a global outlook

1 Scientific knowledge and facts

The Student Book and Workbook introduce concepts in a logical sequence and ensure that new ideas are introduced sensitively. Key scientific concepts and ideas are explained. Students are then asked to discuss and apply their new knowledge.

2 Scientific understanding

Knowledge without understanding is only useful for recall. Understanding moves to a deeper intellectual level and enables students to think and apply that knowledge. Effective learning requires students to develop appropriate attitudes, skills and enthusiasm, and this can be encouraged by good teaching and exciting resources. This means students can gain an understanding of the principles and practice of science.

The knowledge, or content, in this series is based on the English National Curriculum. Each book has five units.

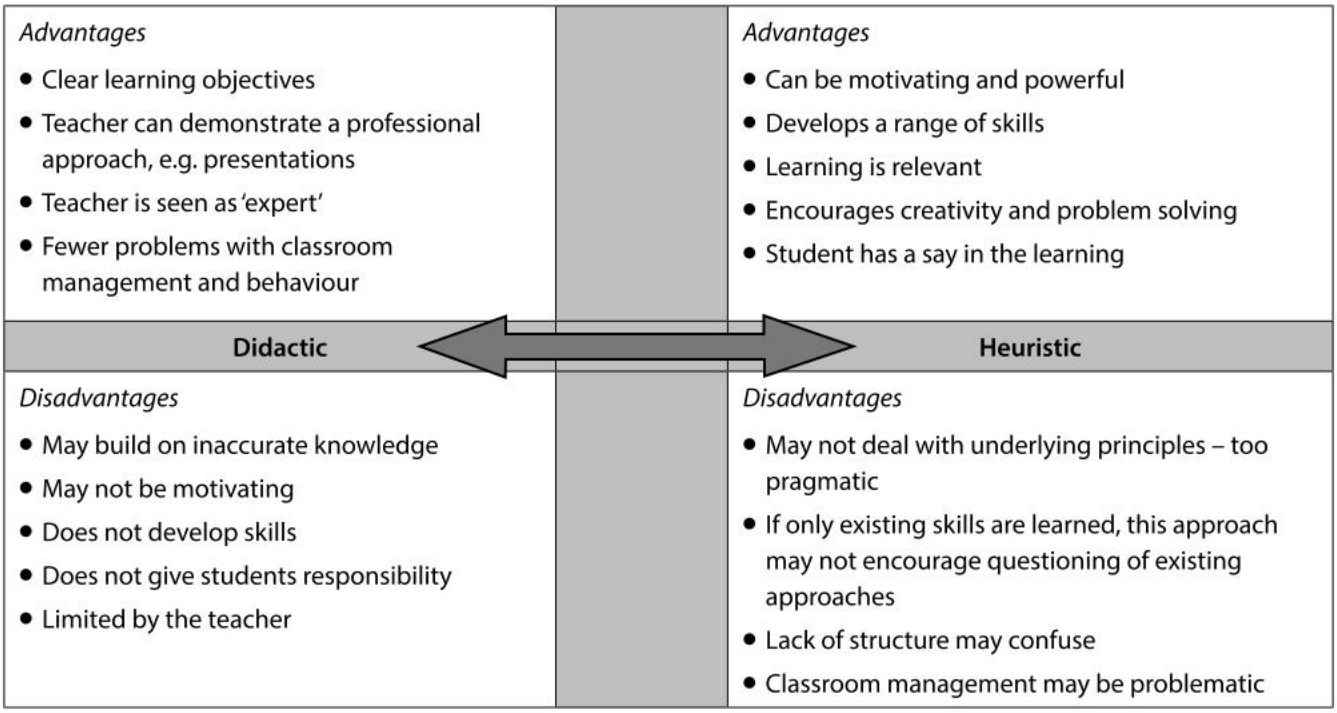
Though this is not a theoretical book, it is important to consider underpinning ideas that have informed good practice in the classroom:

- Teaching approach
- Cognitive style
- Active learning

Teaching approach

The kind of teaching strategies used are key to achieving understanding. Telling and giving students information is important but usually only improves students' short-term memory of scientific facts. This is often called 'passive learning' as students are not intellectually engaged in the process themselves.

Teaching and learning can either be teacher-centred (didactic) or student-centred (heuristic). Good teaching is a combination of these.



Advantages and disadvantages of teacher-centred and student-centred approaches (Cotton, J., 1995, *The theory of learning: an introduction,* Kogan Page, London) © Kogan Page 1995. Reproduced with permission of the Licensor through PLSclear.

Cognitive style

Cognitive style is a student's personal and preferred way of organising and representing information. The cognitive style, or way of thinking, impacts on how our students see and make sense of the world.

Cognitive styles can be split into four types:

1 Wholists like to see the whole picture when learning – the big picture.

2 Analysts prefer to get down to the detail and look at only one or two details.

3 Verbalisers welcome chances to talk through problems.

4 Imagers see mental pictures when dealing with information.

Most people are a combination of all of these but have a preference for one or two. These cognitive styles may have a major impact on the processing of information.

We need to be aware of the possible cognitive styles of our learners and ensure that our approach balances all four styles.

Lev Vygotsky stressed the importance of social relationships between the teacher and learners, and amongst learners. He stressed that language and discussion are key to development.

Benjamin Bloom proposed an 'educational taxonomy' identifying different learning 'domains':

- Cognitive (knowledge)
- Affective (attitudes)
- Psychomotor (skills)

The domain can be seen as a ladder that starts with remembering and proceeds to more complex tasks such as analysing. The 'rungs' of the ladder are:

1 Recall data

2 Understand

3 Apply (use)

4 Analyse

5 Synthesise

6 Evaluate

This ladder helps teachers to devise tasks, sequences of tasks and questions appropriate to the level of thinking of their students. Considering this will help develop your students' ability to think and reason.

Active learning

Active learning approaches encourage students to engage with tasks and to develop skills that they may not develop during teacher-led, didactic lessons. Active learning combines a number of models of teaching growing out of 'discovery learning' ideas.

Whole-class instruction can be as effective as individual instruction, especially in terms of the time students spend on tasks. The key to effective teaching is the appropriate selection of approaches at any particular time and with any particular group. The table opposite summarises common teaching approaches. It does not indicate poor teaching on the left (teacher-centred) and good teaching on the right (student-centred).

Possible active learning strategies

- Group discussion (talking and listening)
- Active reading
- Active writing
- Presentation
- Role-play and drama
- Information technology
- Visits, visitors and field trips
- Data handling
- Problem solving
- Video and audio tape recording
- Games and simulations

Questioning and group work are very important. These will be dealt with in more detail on pages ix–xi.

The Student Books present ideas in a range of ways – written, diagrams, charts, tables and photographs. The lessons contain a rich variety of learning and teaching approaches, such as individual reading and writing, paired and small group discussion work, whole-class discussion and activity, problem solving, investigations, research activities, presentations, surveys and review and reflection. In addition, suggestions for other activities, such as field trips and educational visits, are included in the Teacher's Guide.

3 Scientific methods of enquiry and working scientifically

This series promotes scientific enquiry and closely follows the working scientifically objectives in the English National Curriculum. Students are encouraged to use and reflect on the different ways that scientists work and think, which have produced the knowledge, theories and laws of science over the last 1000 years. It is based on 'empiricism'; arriving at knowledge and understanding through observation and experiment.

Scientists progress by observation and questioning what they see and already know. From this they develop hypotheses which they test by experiments and develop new knowledge. This will be further explored in the section 'How to be a Scientist' on pages 2–3 of this Guide and in the student resources.

Science teaches students to think in a structured way that is good for analysing and solving problems. However, students should understand that science is also a creative human endeavour. Imagination is vital to scientific progress.

The books in this series allow students to develop their skills to work scientifically by addressing each of the appropriate scientific enquiry processes at each stage. Students are encouraged to plan and carry out full-scale investigations in the later stages and, as such, apply the skills learned earlier.

4 Scientific thinking and reasoning

It is essential to encourage students to think and reason for themselves. Thinking and reasoning are important life skills. The abilities to think, reason and research make students independent learners who can interpret and understand new ideas more quickly. Unfortunately, this aspect of education is often neglected.

In this series, the ability to think and reason will be encouraged, nurtured, practised and assessed at each level. Scientists use deductive logical thinking to make sound inferences which take them from the known to discover the unknown. They use reason and argument based on fact and evidence to prove their case. Allowing students to experience these processes promotes their curiosity and enthusiasm. 'Discovery learning' approaches allow students to experience the thrill of finding out.

Resist the temptation to provide answers, solutions and too much support for your students. We hope that the learning activities within the books, and the support provided in the Teacher's Guide, will help you to create a learning environment where at times students can plan, find out and learn new ideas themselves – with you as a guide and facilitator. Allow them time to think and discuss ideas before gently guiding those who need support.

Teacher-centred learning	Student-centred learning
Teacher exposition	Group work
Accent on competition	Accent on cooperation
Whole-class teaching	Resource-based learning
Teacher responsible for learning	Student more responsible for learning
Teacher providing knowledge	Teacher as guide/facilitator
Students seen as empty vessels which need filling	Students have ownership of ideas and work
Subject knowledge valued	Process skills are valued
Teacher-imposed discipline	Self-discipline
Teacher and student roles emphasised	Students seen as source of knowledge and ideas
Teacher decides the curriculum	Students involved in curriculum planning
Passive student roles	Students actively involved in learning
Limited range of learning styles and activities	Wide range of learning styles employed

Select a variety of approaches to promote active learning

5 Science in context

It is vital to link what students learn in the classroom to the real world. This makes their learning relevant and helps them to relate new ideas to their own experiences:

- Stress that science involves an ongoing process of change and improvement in ideas. Explain that our ideas about science are built on earlier ideas. Point out that people in the past could only use what they knew at the time to make sense of the world. Sometimes this meant they put forward ideas that scientists now know are not correct. For example, many people thought that the world was flat, and the Sun orbited the Earth.
- Emphasise that some early thinkers created ideas that are still remarkably similar to our modern ideas. For example, over 2200 years ago Aristarchus suggested the Earth orbits the Sun. Democritus stated that matter is made of smaller particles more than 2300 years ago. Even our understanding of forces, based on Isaac Newton's laws of motion, were proposed by Philoponus over 1500 years ago.
- Explain that science theories develop when a person or a team puts forward new ideas. If other scientists test these ideas and agree then the idea becomes a part of science theory. It might be changed later with new evidence. This is how ideas develop.
- Explain that developing new technologies and materials also helps form new science ideas. For example, until the invention of the microscope 500 years ago, scientists could not see microorganisms and did not know they existed. Improvements in telescopes have resulted in changing ideas about the stars and even our nearest planets. Modern materials have allowed spacecraft and computers to be made.

The activities in each lesson provide you with many opportunities to relate the science content and processes to the real world. Whenever possible, take students out to see examples of science being used in the real world – such as on farms, in factories or even at an airport. You can invite people in to talk about their jobs and how they use science – for example, doctors, vets, farmers, gardeners and builders.

6 Wellbeing

The Student Book and Workbook provide opportunities for teachers to consider the vital importance of wellbeing and to weave this into their teaching. The enquiry-based approach encourages curiosity and helps students to think about the world around them.

Wellbeing does not mean feeling happy all of the time. Making mistakes, feeling challenged and even being confused at times can help to develop resilience.

The resources support wellbeing directly by:

- **Providing questions and science facts** to challenge and engage students. They can reflect on prior learning and apply new skills.

For example, students are asked to think back to their work on components of an electrical circuit in earlier lessons and list those they have used to build a circuit.

- **Encouraging active science.** This means an active brain and also an active body. Students learn better and make better progress when they are physically active in lessons.

For example, students play the role of particles by arranging themselves into a close packed pattern to represent solids, move slightly to represent liquids and then move around the room to model the particles in gases.

- **Promoting group work.** Collaborative work is used throughout the resources so that students have opportunities to develop their collaborative skills. This growth through practice develops confidence and happiness.

There are opportunities for group work and collaboration in every lesson. For example, students work together to decide on key questions to ask a visiting health professional and work in groups regularly to plan and carry out investigations and surveys.

- **Presenting 'stretch zone' challenges** to encourage students to develop thinking skills and welcome challenge. They will become more familiar with moving away from a 'comfort' zone into the 'stretch zone' without worrying.

For example, students are asked to apply their understanding of habitats and survey techniques to hypothesise why some animals are found in certain locations but not others.

- **Offering mindful moments.** These provide opportunities for students to pause and re-focus their attention.

For example, the end-of-unit questions in the Student Book and self-review statements in the Workbook offer ideal opportunities for students to think about their learning.

Teachers are encouraged to develop the following approaches:

- Providing praise with a growth mindset. Teachers should work to praise the process rather than the intelligence or marks. Giving positive feedback on how something is being done is highly effective. This includes praising effort, perseverance, resilience, teamwork, strategies, etc.
- Discussing and evaluating mistakes. Learning always involves making mistakes. Students should not fear or worry about mistakes. They should see them as opportunities to learn.

7 A global outlook

The *Oxford International Primary Science* resources are designed to address the idea that academic lifelong success is the result of both academic performance and emotional wellbeing. As educators we want to prepare our students for a workplace that is unknown to us. Ideas and activities identify areas where students can

develop skills while feeling safe and confident enough to apply themselves to the content of the lessons. Skills are separated into distinct categories designed to provide the opportunities to develop key lifelong skills. Students are inspired by images and information that result in curiosity and wonder. Students become confident problem solvers by taking risks that also develop creative skills. Real-world skills are encouraged through carefully designed projects and activities. Students are introduced to project management and aspects of literacy, for example financial and functional literacy. There is an emphasis on carrying out research and careful analysis of the information that they find in addition to their own findings and data. Students have opportunities to develop interpersonal skills through communication and relationship building. They are encouraged to voice their ideas through discussion activities. The projects particularly allow students to take part in leadership roles and the responsibility that comes with this. The resources address the students' self-development skills through critical thinking, ethics and motivation. There are a number of sections throughout the scheme where students are introduced to ethical and sensitive issues.

Wellbeing is an area that is emphasised in the resources with a desire to address mental health issues, supporting learners in and out of school. Students are encouraged to care for their own minds by promoting mindfulness and to manage stress more effectively. Students should become more optimistic about their lives and the world around them. They are encouraged to care for their bodies with an emphasis on being active and eating healthily. Students are encouraged through a number of activities to build and maintain relationships and friendships with family and others. They learn how to communicate confidently with a range of people and connect through kindness and thoughtful behaviours. Students are more conscious about the world beyond their immediate environment but know they have a valued role and place, resulting in becoming better and more responsible lifelong citizens from an early age.

Teaching techniques for this series

Science learning is made up of:

- Remembering science facts
- Gaining scientific knowledge
- Developing science skills
- Developing science understanding

Facts are important but being told facts does not ensure knowledge and understanding. Working out science problems and engaging with scientific processes is much more likely to help students develop understanding. This is why applying scientific skills – doing science rather than remembering it – is vital.

Think about the question below:

Question: Who was the scientist who discovered the force of gravity?

Answer: Isaac Newton.

Knowing the answer to this question takes the learner no further. It demands no higher order thinking skills and does not help with solving any other problems. However, if a student understands Newton's theory of gravity and motion, they can start to explain and predict how things move, float and fly. Understanding enables a student to apply knowledge and solve problems and furthers their learning.

This series aims to provide science facts and knowledge but also science understanding. Certain strategies are better at teaching understanding than others.

Effective questioning is the key

Students can learn to understand by listening and reading. This is only possible if they have acquired advanced learning techniques and have sufficient background knowledge and understanding in which to fit any new ideas. That is why you can enhance your understanding, for example about your teaching, through these approaches, but this is not true for young learners. For inexperienced and less skilled students, the teacher enables them to progress from memory recall to deeper understanding. This series focuses on teaching and learning approaches that promote understanding. Science facts and knowledge are covered, of course, otherwise there would be a lack of context and content but the activities are also designed to develop thinking and learning skills.

Research tells us that teachers ask up to 400 questions per day. That can be 30 per cent of teaching time. It is clear then that time spent improving our questioning techniques will have an important impact on learning.

To give you some idea about the complexity of questioning you may wish to think about your own practice:

- Why you are asking a question
- What type of questions you are going to ask
- When you are going to ask questions
- How you are going to ask questions
- Who you are going to ask questions to
- How you expect the questions to be answered
- How you will respond if the person does not understand the question
- How you will react to an inappropriate or wrong answer
- How you will react to an appropriate answer
- How long you will wait for an answer

As teachers we ask questions for a number of reasons:

- To get attention
- To check students are paying attention
- To check understanding
- To reinforce or revise a topic
- To increase understanding
- To encourage thinking
- To develop a discussion

Bloom describes six levels of thought process:

- Knowledge
- Comprehension
- Application
- Analysis
- Synthesis
- Evaluation

We need to ask questions that encourage deeper thinking. If we only ask questions at the knowledge end of the spectrum, we will not encourage students to analyse or synthesise new ideas.

We also need to think about the nature and style of our questions. Two major categories are closed and open.

Closed questions

These tend to have only one or a limited range of correct answers. They require factual recall. They are useful for whole-group question and answer sessions, to quickly check learning or refresh memory or as a link to new work. Examples include:

Question: What is the boiling point of water at sea level?

Answer: 100°C.

Question: What are the three stages of the water cycle?

Answer: Water; clouds; rain.

These are very good for knowledge recall but are generally non-productive regarding anything else.

Open questions

These may have several possible answers and it may be difficult to decide which are correct. They are used to develop understanding and encourage students to think about issues and ideas. They encourage students to think and manipulate information and are much more complex. We are not looking for a single right answer; we are looking for what the student thinks may be the right answer. Once the teacher gets the student thinking, then the teacher can use this information to move the learning on towards the right answer, while promoting understanding at the same time.

Examples include:

Question: Where do you think the water in rain clouds comes from?

Answer: Any answer will have a little 'rightness' in it that the teacher can use. The student may answer 'From the sea.'

The teacher then can follow several further lines of enquiry to extend the learning. For example, the teacher could ask, 'Do you know of any other places the water might have come from?' Or 'How do you think that the water got into the clouds?'

These follow up 'how' and 'why' questions encourage students to think more deeply about the science and their understanding of the key ideas and principles.

Open questions require students to make links between ideas and apply knowledge – they often require students to be logical and imaginative. They require a longer time to think and answer than closed questions, and may lead on to wider discussion and debate.

Question series

Closed and open questions can be linked together to form a series. A series must be well planned but can lead to much improved understanding. Start with a few relatively easy factual closed questions and move towards more open questions. This is known as 'agenda building'. At the same time, you can move from individual to paired and then to small group discussion as the questions become more open and demand higher-level thinking.

In this series we promote an 'enquiring classroom' where closed questions are used, but also open questions which promote enquiring minds.

Question and answer techniques – some tips

1 The 'don't lead students down dark tunnels' technique

Students need to know where they are going before they start their learning journey, so tell them. For example:

'Today we are going to learn how magnets react to each other.'

This gives students the big idea on which they can hang the information that follows and make sense of it.

2 The 'ask students what they think' technique

Students usually lack the confidence to answer questions like:

'How did the water from the sea get into the clouds?'

Unless they are confident they know the correct answer, they will probably be reluctant to answer because they are afraid of failure. However, rephrase the question and say:

'How do you think that the water might have got from the sea up into the clouds?'

Then you are giving them permission to try even if they are not sure they are correct. In this way you do not always get the same students volunteering answers and you can give other students confidence.

3 The 'praise all answers' technique

To encourage students to share their thinking and suggestions, we have to value and thank them for their efforts. We may say, 'Good try but not quite there yet. Let me see if I can help you – do you think it could have something to do with the heat of the Sun?'

There is usually an element of correctness in most students' attempts which we can praise.

4 The 'teach from students' answers' technique

In one Student Book there is a question which asks:

'Why does a watermelon contain 600 seeds?'

As a student, I do not know the answer and I am afraid of failure.

If the teacher asks students what they think and values their answers, then this productive line of enquiry will help take a student and the rest of the class to the correct answer as well as an understanding.

Select the element of correctness from the student and then expand and explain to help all the rest of the students understand. For example:

Student: I think it is because they want to grow lots of new watermelons!

Teacher: Good answer. It is all about germination and new life. However, do you think that when one watermelon sheds its seeds, there will be 600 new watermelons springing up beside it?

Student: No, not all 600!

Teacher: Good, that's important. You have told me that not all of them survive. How many do you think survive?

The teacher leads and expands and informs the student's answers to arrive at the understanding of 'producing many, so that a few can survive to carry on the species'. Because students have been actively involved in this journey they will not only remember; they will understand.

5 The 'do not let students struggle' technique

If you find that you are asking questions and the answers are nowhere near what you are looking for, then give students the answer or suggest a choice of answers. Without this, the progress of the lesson is halted and students and teacher get frustrated; move the lesson on. Tell them and expand and explain your answer.

6 The 'right answer' technique

If you get the right answer, then all is good, or is it? Only the person who has given the answer understands why it is correct so you need to expand and explain, so that the rest of the class can share in that student's understanding.

Teacher: Good answer, what made you think of that?

Teacher: I see what you mean; you made the connection between the boiling kettle and steam and thought the Sun's heat did the same with the sea only it is invisible. Well done!

Whole-class or group work

Whole-class question and answer methods work very well and highly structured whole-class activities can help to keep students on task. However, maximum contributions and participation are usually encouraged in small groups.

Group work can help students to learn more effectively. They can learn science better and cooperative learning can help social cohesion, motivation and improvements in self-esteem. The student who is shy is more likely to contribute to a discussion with another person or one or two other people than volunteer ideas in front of the whole class. In addition, by sharing work, students can cover more ground more quickly. The small group is also a good forum for generating creativity.

Another advantage is that small group work frees the teacher from having to be at the front and leading the whole class. The teacher can move around the room and direct attention and support when and where it is most needed. Individual needs can be better met in this way.

Some specific examples of group work are described below.

1 Short, informal discussions

These are sometimes called 'Buzz groups'. They are very useful as they do not need any structure and can be used at any time. Simply ask pairs or small groups to look at a picture or think about an issue and then give them a few minutes to share their ideas. There are numerous examples of these in the resources, linked to questions for the buzz groups to consider.

2 Think-pair-share

Students think about something individually for a few minutes and then work with a partner to compare their ideas. Finally, the pair present their ideas to the class.

3 Circle of voices

This works with larger groups of students (four, five or six). Students take it in turns to speak about their ideas on a topic or question. No one else is allowed to speak so this helps to develop social and listening skills.

4 1-2-4

Students think about an issue or carry out a task individually – for example, make a list of animals and plants they have seen – and then work with a partner to compare lists and discuss a slightly more complicated question – for example, which animals eat other animals? Finally, pairs join to form fours. They share ideas and then work together on a final task – for example, make some food chains.

5 Jigsaw

Students work alone to become experts on an aspect – for example, different habitats – then join back together to share their expertise and answer a larger question – for example, how are animals adapted to habitats?

Differentiation

Differentiation is closely linked to inclusion: ensuring all students have access to the curriculum. This means that learning and teaching approaches must consider individual needs. Not all learners will learn at the same pace or in the same ways.

Approaches supported by the resources are:

1 **Modifying content.** At times we can adjust the content for some learners to provide sufficient support or adequate challenge. Examples are support or challenge Workbook activities and stretch zone tasks in the Student Book. This is often called differentiation by task.

2 **Differentiating expected outcomes.** This allows all students to tackle the same tasks but outcomes are differentiated – usually in terms of 'All students should ... ', 'Most students will ... ' and 'Some students may ... '. These differentiated outcomes are given in each lesson section of this Teacher's Guide. This is often called differentiation by outcome.

3 **Differentiating the process.** This means providing more or less support as students are carrying out a task. Advice on this is in each Teacher's Guide lesson section and also there are additional support activities that can be given to some students. For example, investigation support pages.

4 **Questioning.** This is a very effective way of differentiating work. Use questions to check progress and decide when extra support or challenge is needed. Questions in the resources are designed to progress from low on Bloom's taxonomy (remember and understand) towards higher levels (analyse and evaluate).

5 **Varied approaches to assessment**. The resources include a wide range of assessment methods. These include verbal, written and drawn responses and individual and collaborative assessments. There are also differentiated questions ranging from easier introductory questions to more challenging ones.

Assessment

Assessment is an essential part of learning. Without being able to check progress, teachers and students will not be able to identify areas of strength and areas in need of development.

Assessment can be classified as either formative or summative.

Formative assessment takes place during learning and is used to address issues as they arise. This means learning and teaching can be modified during lessons to better meet the needs of learners. Feedback to students is ongoing.

Each activity within the Student Book and Workbook provides opportunities for formative assessment and feedback. This can be through teachers listening to discussions or presentations, observing the outputs of investigations and through assessing outcomes such as posters, reports and leaflets. Individual questions in discussion tasks can be used to monitor understanding and identify misconceptions. These can be addressed as they are noted. Some of these are noted in the Review and reflect sections in the lesson guidance in this Teacher's Guide.

Summative assessment is used to measure or evaluate student progress at the end of a process – for example, when a unit is completed or at the end of a year. Summative assessment compares students' attainment against a standard or benchmark.

The 'What have I learned?' features at the end of each unit can be used for summative assessment. Teachers can record which questions each student is answering correctly and use this to measure individual attainment. It can also indicate how well the class is progressing though the work. In this way, the assessment can inform individual interventions (extra support for a student) or whole-class interventions (reviewing work that is not well understood).

There is also a Quiz Yourself section in the Workbook, which contains questions from across the year. These quiz questions and activities are intended to encourage students to reflect on their learning and to reinforce their developing knowledge about scientific concepts in a fun way. They could also be used for formative or summative assessment.

Each activity – group and individual – can be assessed through observation and questioning and progress notes. Written or drawn responses for each activity, especially in the Workbook, can be assessed/marked using the school's marking policy and unit, end-of-term and end-of-year judgements made about individual and class progress.

Feedback is a crucial aspect of assessment. This should be as positive and encouraging as possible (see the wellbeing section on page viii) and identify clear targets. Involve students in assessment and target setting. This is encouraged through the 'formal' self-assessment statements in the Workbook at the end of each unit, where students are asked to rate their level of confidence. Assessment is done with learners not done to learners.

How to Support Non-English Speakers

Teaching Primary Maths and Science through English: identifying the challenges and providing the support

The challenges

Ministries of Education at both local and national level are increasingly adopting the policy of English Medium Instruction (EMI), for either one or two subjects or across the whole curriculum. The rationale for doing so varies according to the local context, but improving the levels of achievement in English is usually an important factor.

In international schools it is likely that students do not share a mother tongue with each other or perhaps the teacher. English is, therefore, chosen as the medium for instruction to level the playing field and to provide the opportunity to develop proficiency in an international language.

This does not mean that the maths or science teacher is now being asked to replace the English teacher, or to have the same skills or knowledge of English (though in many primary schools one teacher may indeed teach both). It does mean that the science or maths teacher needs to become more language aware.

This raises significant challenges, including:

- the teacher's knowledge of English
- students' level of English (which may vary considerably in international schools)
- resources which provide appropriate language support
- assessment tools which ensure that it is the content and not the language which is being tested
- differentiation which acknowledges different levels of proficiency in both language and content.

Meeting the challenges positively

Perhaps lack of confidence in their own English proficiency is one of the most common concerns among teachers. However, while it is a factor, success in EMI is not necessarily linked to the teachers' proficiency in the second language. Teachers who have English as their mother tongue may well lack the sensitivity to, or awareness of, the language that a non-native speaker has acquired through learning and studying the second language. Developing this awareness and demonstrating it in both materials and method is the key to effective EMI.

Classroom language/Teacher Talk

Often non-native-speaker teachers are more concerned about their ability to run and manage the whole class in English than they are about the actual teaching of the maths or science concepts. The resources or textbook should help them with the latter. However, this use of English in the class is very important as it provides exposure to the second language, which plays a valuable role in language acquisition. The Teacher Talk for purposes such as checking attendance and collecting homework does not have to be totally accurate or accessible to students.

When teaching the science concepts, however, it is essential that the Teacher Talk is comprehensible. Some basic strategies to ensure this include:

- simplify your language
- use short simple sentences and project your voice
- paraphrase as necessary
- use visuals, the board, gestures and body language to clarify meaning
- repeat as necessary
- plan before the lesson
- prepare clear simple instructions and check understanding.

Creating a language-rich environment

Primary teachers often excel at providing a colourful and engaging physical environment for students. In the EMI classroom this becomes even more important. Posters, Word walls, lists of key structures, students' work and English signs and notices all provide a backdrop which provides the opportunity for exposure and language acquisition.

Planning

When planning the teacher needs to identify what the Language Demands are. This means thinking about what language students will need to understand or produce, and deciding how best to scaffold the learning to ensure that language does not become an obstacle to understanding the concept. This involves providing Language Support and goes beyond the familiar strategy of identifying key vocabulary.

Support for listening and reading

Listening and reading are receptive skills, requiring understanding rather than production of language.

Here are some suggestions for approaching such tasks.

If you are asking your students to listen to or read texts in English, ask yourself the following questions when you are planning the unit:

1 Do I need to teach any vocabulary before they listen/read?

2 How can I prepare them for the content of the text so that they are not listening 'cold'?

3 Can I provide visual support to help them understand the key content?

4 How many times should I ask them to read/listen?

5 What simple question can I set before they listen/read for the first time to focus their attention?

6 How can I check more detailed understanding of the text? Can I use a graphic organiser (e.g. tables, charts and diagrams) or gap-fill task to reduce the Language Demands?

7 Do I need to differentiate the task for those students who find reading/listening difficult?

8 Could I make the tasks interactive (e.g. jigsaw reading i.e. when students access different information before coming together, and information share)?

9 How am I going to check their answers and give feedback?

Support for speaking and writing

Speaking and writing are productive skills and may need more language input from the teacher, who has to decide what language students will need to complete the task and how best to provide this. When you plan to use a task which requires students to produce English (speak or write), you need to think about how to help them do this.

This means that you have to think in detail about what language the task requires (Language Demands) and what strategies you will use to help them use English to perform the task (Language Support).

You need to ask yourself the following questions:

1 What vocabulary does the task require? (LD)

2 Do I need to teach this before they start? How? (LS)

3 What phrases/sentences will they need? Think about the language for learning maths/science: e.g. predicting and comparing. What structures do they need for these language functions? (LD)

4 While I am monitoring this task, is there any way I can provide further support for their use of English (especially for the weaker students)? (LS)

5 What language will students need to use at the feedback stage (e.g. when they present their task)? Do I need to scaffold this? (LD, LS)

Teaching vocabulary and structures

Vocabulary

Learning the key maths and science vocabulary is central to EMI and 'learning' means more than simply understanding the meaning. Knowing a word also involves being able to pronounce it accurately and use it appropriately. Below is a list of strategies which could be useful:

- Avoid writing the list of vocabulary on the board at the start of the unit and 'explaining' it. The vocabulary should be introduced as and when it arises in the unit. This helps students associate the word or phrase with the concept and context.
- Record the vocabulary clearly on the board and check that you are confident with the pronunciation and spelling.
- Give students a chance to say the word once they have understood it. The most efficient way to do this is through repetition drilling.
- Use visuals whenever possible to reinforce students' understanding of the word.
- Ensure students are recording the vocabulary systematically in their glossaries and, if possible, use a Word wall which lists the vocabulary under unit/topic headings.
- Remember to recycle and revise the vocabulary.

Structures

In order for students to talk or write about their maths/science they will need to go beyond vocabulary: they will also need to use those phrases and sentence frames which a particular task requires. For example, they may need the following expressions in maths and science:

X is the same as Y.

The sides are the same length.

The next number in the sequence.

I predict that X will happen.

If X happens, then Y happens.

The next step is …

The teacher needs to build up these banks of common maths/science phrases and encourage students to record them. This is an important part of identifying the Language Demands and providing the necessary support. The teacher does not have to focus on grammar here as the language can be taught as 'chunks' rather than specific grammatical structures.

How to use the language support in the classroom

The study of science involves becoming familiar with an extensive and specific vocabulary. This is sometimes referred to as the language of science. Add to this the fact that for many students the language of instruction – English – is not their first language, and it is clear that we need to be sensitive to the use of language and language support.

The Student Book supports language development by clearly identifying key words in the Word clouds on the WOW pages and making bold the key content and enquiry words for each lesson. The interactive glossary is also of vital importance in helping students understand the language. The Student Book topic pages also combine words with pictures as this is most effective in helping students understand the meanings of words. The linking of image to word is an essential factor in language development.

Repetition is also very important and the Student Book introduces and reinforces words by showing the words and asking students to use them in their discussions and answers.

Each section of the teaching notes linked to a particular activity or lesson also provides specific language support. Detailed and specific advice is provided for each key word and other words vital for scientific literacy. A range of strategies are suggested, including card sorts and card games, Word walls, team games to define or explain words, use of similar words to explain meaning and exploration of the origins of words.

Key principles underpinning language support in this series are:

- Words should be introduced and explained carefully.
- The word should be explained in context.
- Repetition is vital.
- Words should be linked to pictures or actions.
- Students should develop their own glossaries.
- The learning of vocabulary should be fun.
- Language should not be a barrier to learning.

Not all students will understand ideas and concepts at the same rate and there is likely to be variation in language skills. The Student Book pages are set out to be easy to follow and use, but there are also suggestions for further work and activities within each unit of this Teacher's Guide. These will help you to differentiate the learning and provide alternative learning opportunities. You should find the advice about pair and group work particularly valuable in helping you to meet individual needs.

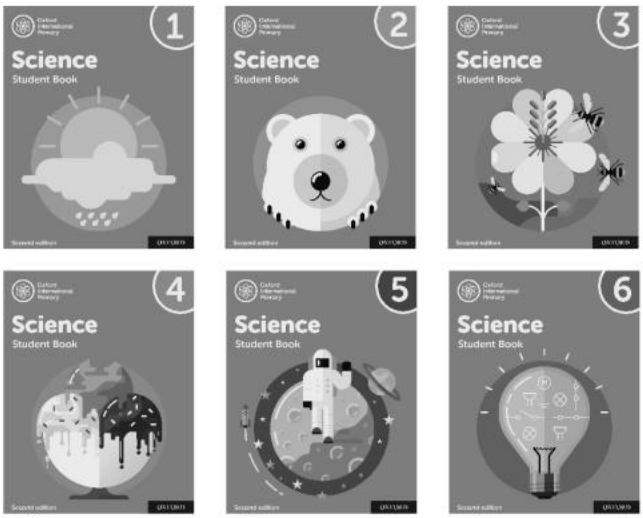
In addition, the Workbook contains a wide range of support activities and suggestions for extension work and home learning.

Component Overview

The Student Books

The Student Books are textbooks for students to read and use. The Student Books include everything you need to deliver the course to your students, guide their activities and assess their progress.

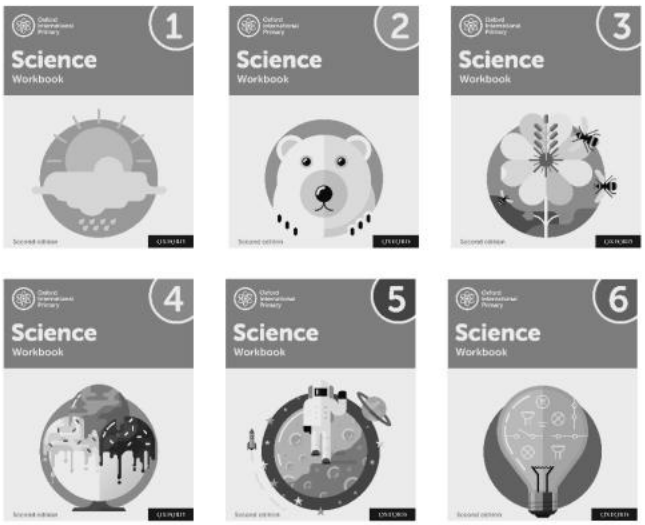
Student Book	Typical student age range
Student Book 1	Age 5–6
Student Book 2	Age 6–7
Student Book 3	Age 7–8
Student Book 4	Age 8–9
Student Book 5	Age 9–10
Student Book 6	Age 10–11



The Workbooks

Every activity in the Student Book is supported by an associated activity in the Workbook. The activities can be used as homework, but you may choose to use these additional practice exercises to supplement the class work.

Workbook	Typical student age range
Workbook 1	Age 5–6
Workbook 2	Age 6–7
Workbook 3	Age 7–8
Workbook 4	Age 8–9
Workbook 5	Age 9–10
Workbook 6	Age 10–11



The Teacher's Guides

Each Teacher's Guide includes:

- An introduction with advice about delivering science and using the Student Books and Workbooks.
- A brief lesson plan for every lesson in each Student Book and Workbook.
- Model answers to the activities and investigations; and answers to the assessment activities.

There are six Teacher's Guides:

Digital resources

Interactive eBooks

For the teacher:

Teachers can access the Student Books, Workbooks and Teacher's Guides online in eBook format, on the Oxford Owl website (www.oxfordowl.co.uk).

The enhanced eBooks show the course content on screen, making it easier for teachers to deliver engaging lessons.

For the students:

Teachers can allocate an eBook version of the Student Book to students for use at home. The Student eBooks include interactive activities, animations, and audio of all the key vocabulary.

Downloadable assessment materials

The downloadable assessments offer additional opportunities to assess, monitor and support students' progress. The assessments included are:

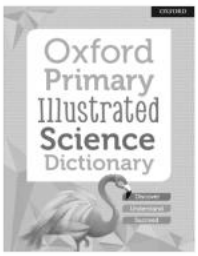
- end-of-unit tests – cover the content of each unit
- end-of-year practice papers – cover a sample of objectives from the year
- three transition papers – one to be taken at the end of Year 2 and two in Year 6. To support movement to the next phase of learning, the questions cover objectives from the preceding years.

Every test/paper comes with everything you need to assess and record progress including:

- objective coverage, transcripts (for lower years) and teaching advice
- answers, mark schemes and guidance on assessment.

Oxford Primary Illustrated Science Dictionary

The *Oxford Primary Illustrated Science Dictionary* gives comprehensive coverage of the key science terminology students use in the course. Each entry is in alphabetical order and, along with a clear and straightforward definition, has a fun and informative colour illustration or diagram to help explain the meaning. The dictionary is suitable for students with English as an additional language.



The curriculum

The *Oxford International Curriculum* offers a new approach to teaching and learning focused on wellbeing, which places joy at the heart of the curriculum and develops the global skills students need for their future academic, personal and career success.

Through six subjects; English, maths, science, computing, wellbeing and global skills projects, the *Oxford International Curriculum* offers a coherent and holistic approach to ensure continuity and progression across every student's educational journey, equipping them with the skills to shape their own future. Through this approach, we can help your students discover the joy of learning and develop the global skills they need to thrive in a changing world.

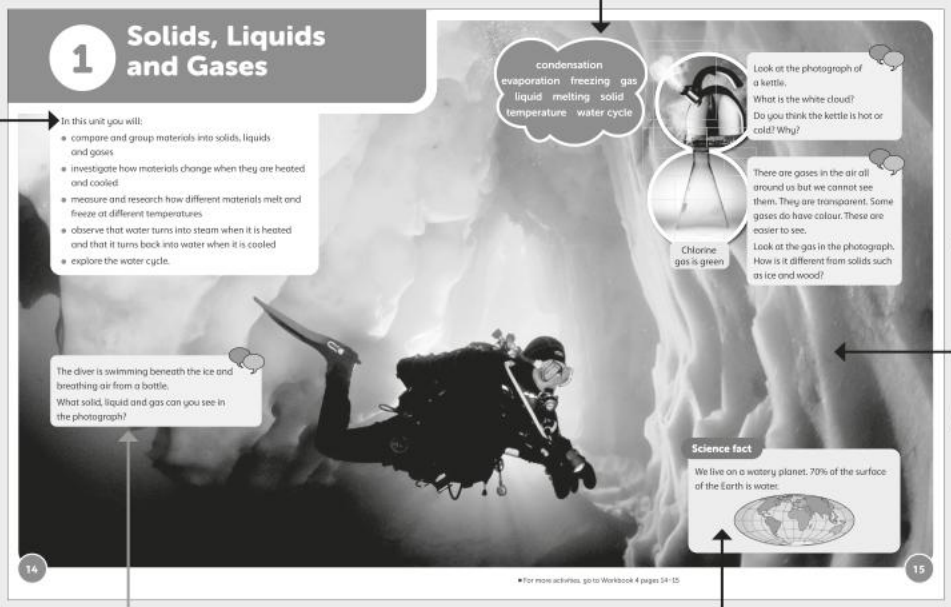
Tour of a typical unit

Unit starter

Student Book

Learning goals are stated clearly in every unit.

The Word cloud presents key words introduced in the unit. These are included in the write-in glossary for students to complete.



The introductory spread is bright and colourful to spark interest in young students.

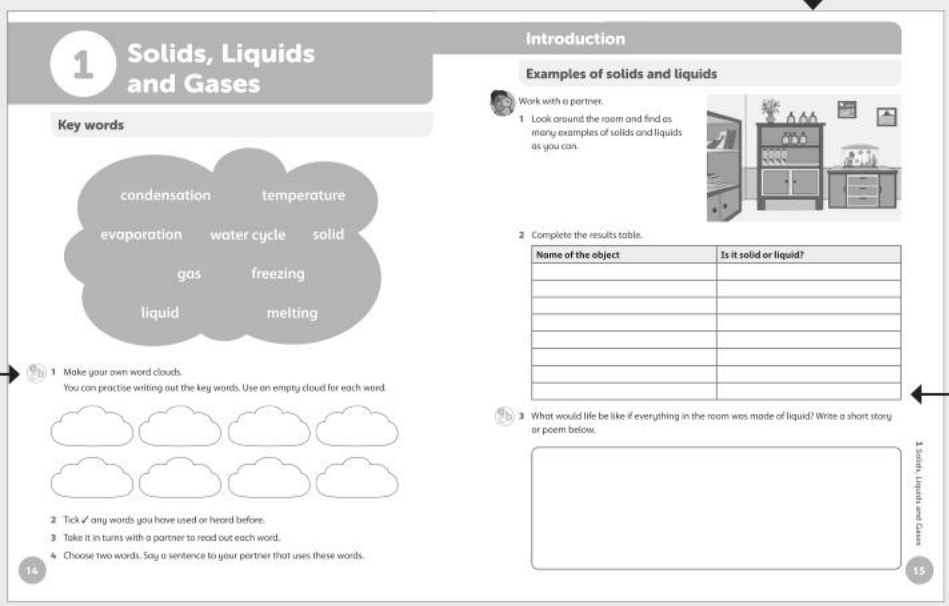
Discussion activities allow students to develop communication skills.

Science fact boxes engage students to think about how science has developed or is used in everyday life.

Workbook

Every unit provides Language support throughout.

Each spread matches the Student Book lesson and consolidates learning.



Write-in format allows students to record their work at school and at home.