OXFORD

STEM SPOTLIGHT

Making STEM practical and accessible for *every* teacher

Maths skills need to serve students beyond the next 30 minutes

By Peter Sullivan

Don't underestimate the value of practice in maths education

By Annie Facchinetti

How to make maths memorable

By Annie Facchinetti

Why flipped learning makes sense in the STEM classroom

By Andrew Douch

“

A renewed national focus on STEM in school education is critical to ensuring that all young Australians are equipped with the necessary STEM skills and knowledge that they will need to succeed.

”

– Education Council, National STEM school education strategy 2016–26

WELCOME

Throughout this brochure you'll find a selection of resources that will support STEM education in your classroom, from the early years through to lower secondary schooling. **Find more STEM resources at oup.com.au**

CONTENTS

P–6

Year 7 and beyond

SO WHAT IS STEM?

Anita L'Enfant

If you think that STEM is all about robotics and coding, then you only know half the story. STEM is really about bringing that computational thinking and design thinking methodology into the lives of our kids, and giving them the tools to become problem solvers. STEM allows creativity in areas that aren't traditionally known for that: science, mathematics, technology. And that's often the place that's a little bit scary for teachers. My favourite part of STEM is the 'E' – the engineering process. It's the bit that I know already connects us with STEM and learning, because this is what we've been doing for a while. If you've been doing the enquiry process, project-based learning, challenge-based learning – you've got some elements there of how to get started with design thinking methodology.

So why should you be doing STEM? Aside from the fact that there's a whole load of funding out there and it's part of the Australian Curriculum, it really is an avenue for creativity and gives your kids another opportunity to express their learning in a different way.

Anita L'Enfant

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HOW TO MAKE MATHS MEMORABLE

Annie Facchinetti, author of *Oxford Maths* and *OZBOX: Learning through Literacy*

Recent research in the area of neuroscience has revealed that the brain has a greater ability to change and adapt than was previously thought. However, brain changes are generally not instant. For lasting neurological pathways to be built, much like wearing a physical pathway between one place and another, they need to be travelled multiple times.

The idea that practice assists with the retention of knowledge is not a new one, but our understanding of the importance of practice in learning has been deepened by neuroscientific research. For example, a 2013 study by the Norwegian University of Science and Technology specifically examined the role of practice in the acquisition of maths skills. According to Professor Hermundur Sigmundsson, one of the study's authors, 'We found support for a task specificity hypothesis. You become good at exactly what you practice' (EurekAlert!, 2013).

The concept of practice is therefore an integral part of *Oxford Maths*. Each topic in the Student Books features a Guided Practice section that includes worked examples to support students in the early stages of learning about a concept or skill. The Independent Practice pages then allow students to use their skills and apply their knowledge, while the Extended Practice section provides the opportunity to apply learning in slightly more challenging contexts.

> 'Concerning positive emotions, one of most powerful triggers that motivates people to learn is the illumination that comes with the grasp of new concepts – the brain responds very well to this. A primary goal of early education should be to ensure that children have this experience of "enlightenment" as early as possible and become aware of just how pleasurable learning can be.' (*Understanding the Brain: the Birth of a Learning Science*, 2008)

To ensure that all students have the opportunity to feel successful in maths, the *Oxford Maths* Teacher Dashboards offer differentiated learning pathways to support students at their point of need. This includes teacher-led activities for students who require extra support, additional hands-on and collaborative learning experiences for students who are at standard, and a range of extension opportunities to challenge more able students. Suggestions for daily practice and ideas for whole-class activities offer a range of different opportunities to practise concepts and establish lasting neurological pathways. The pre- and post-assessment components also equip teachers to monitor student learning and make appropriate teaching adjustments.

> "The idea that practice assists with the retention of knowledge is not a new one, but our understanding of the importance of practice in learning has been deepened by neuroscientific research."

The *Oxford Maths* Student Book practice sections follow a gradual release of responsibility model, designed to scaffold students' learning and build confidence to tackle more complex work. Many students, and indeed many adults, would assert that they are not good at maths, and the approach used in *Oxford Maths* is designed to ensure that every student can experience success at their level. An OECD presentation about the role of the brain in learning reached the following conclusion:

In discussing the gradual release of responsibility model, Fisher and Frey (2008) assert that, 'Structured teaching requires that teachers know their students and content well, that they regularly assess students' understanding of the content, and that they purposefully plan interrelated lessons that transfer responsibility from the teacher to the student'. The structure of the *Oxford Maths* program also supports the 'I do it; we do it; you do it together; you do it independently' philosophy of the

gradual release of responsibility model, by working through a structured series of activities that foster collaborative learning supported by ongoing snapshot assessment.

As teachers, it is easy to overlook the importance of practice as we rush to cover all the content required while meeting the high demands of busy school life. *Oxford Maths* provides a clear and comprehensive mathematics program that draws on current research to ensure that content is not just 'covered' but taught in a way that leads to sustained learning and the development of problem-solving and reasoning skills.

Oxford Maths:

- is a balanced approach, including direct instruction, hands-on activities, small group and whole class tasks, skill practice and open-ended problem-solving
- incorporates key elements of inquiry, including making connections with mathematics in the real world, opportunities for higher-order thinking and multiple pathways for students
- supports students to build foundational maths skills needed for complex critical thinking and problem-solving tasks.

Further reading

EurekAlert! 2013, *No Math Gene: Learning Mathematics Takes Practice*, public released, accessed 28 June 2016, http://www.eurekalert.org/pub_releases/2013-12/nuos-nmg121313.php.

Fisher, D & Frey, N 2008, '*Better Learning Through Structured Teaching*', Association for Supervision and Curriculum Development, Alexandria, Virginia.

Sigmundsson, H, Polman RCJ & Lorås, H 2013, 'Exploring individual differences in children's mathematical skills: A correlational and dimensional approach', *Psychological Reports*, volume 113, issue 1, pp. 23-30. doi: 10.2466/04.10.PR0.113x12z2

OECD 2008, 'Understanding the brain: The birth of a learning science', OECD , Paris, accessed 28 June 2016, http://www.oecd.org/site/educeri21st/40554190.pdf.

WHICH MATHS RESOURCE

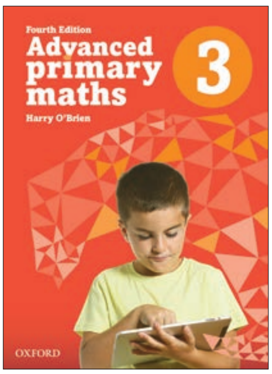
Teaching and learning program

Extension program for Years 3–6

Targeted teaching across F–6

Spiralled approach

Differentiation approach



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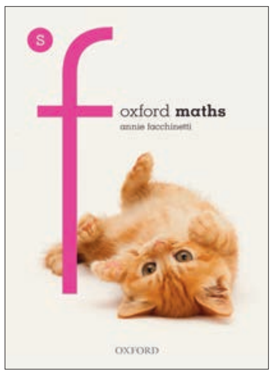

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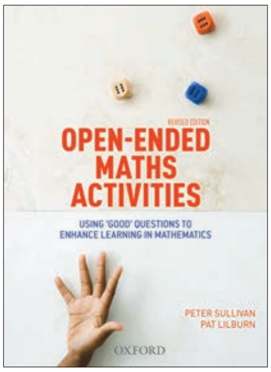
IS THE **RIGHT ONE FOR YOU?**

Mathematics teacher support only



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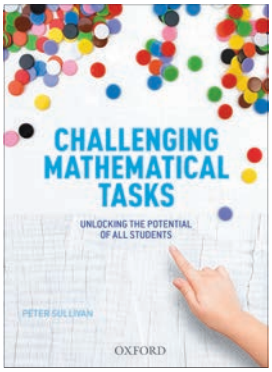

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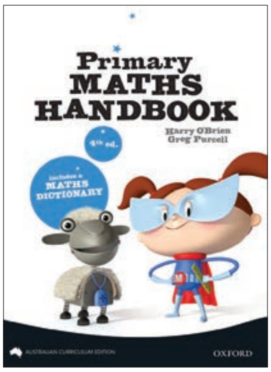

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oxford **maths**
for australian schools

Your differentiation solution for teaching mathematics

Oxford Maths **is a comprehensive, differentiated maths program that can be used from Foundation to Year 6. Differentiation is key to ensuring that every child can access the curriculum at their point of need.**

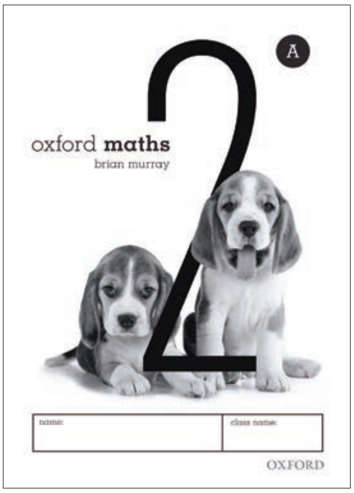
Oxford Maths:

- includes Student Books, Assessment Books that feature pre- and post-tests, and a Teacher Dashboard
- supports a 'gradual release of responsibility' approach that incorporates initial scaffolding, which is gradually reduced to allow students to become confident and independent mathematicians
- has been designed by experienced classroom teachers to support sequential acquisition of mathematical skills, concepts and knowledge
- is based on a developmental approach that is fully aligned with the Australian and Victorian Curricula, and the NSW Syllabus.

Incorporating an inquiry approach

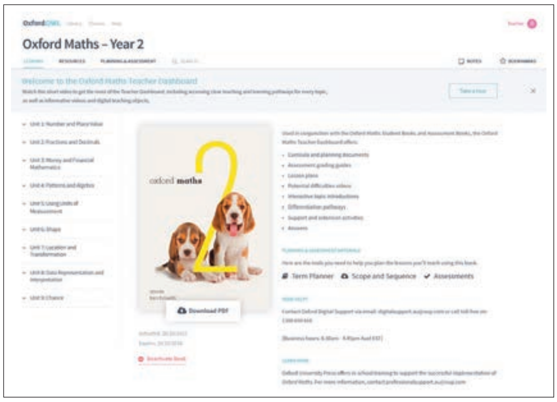
Oxford Maths offers a balanced approach to the teaching of mathematics, including hands-on activities, small-group and whole-class tasks, skill practice and open-ended problem solving. It incorporates key elements of inquiry, including making connections with mathematics in the real world, opportunities for higher-order thinking and reasoning, and multiple pathways for students.

What does *Oxford Maths* look like in the classroom?



Access the topic pre-test via the print Assessment Book or the Teacher Dashboard.

Choose the appropriate learning sequence for each student. Use the Teacher Dashboard to access lesson plans.



1

Assess and identify

Use the pre-test to quickly identify the current level of understanding that individual students have of a particular topic.

2

Choose the pathway

Allocate the appropriate learning sequence for your students, based on their pre-tests and your observations.

3

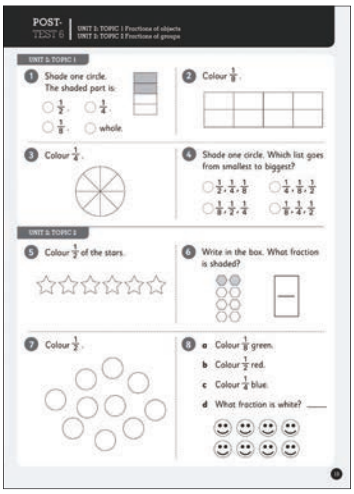
Plan and implement teaching

Use the Teacher Dashboard to choose and prepare for activities to effectively support student learning at point of need, incorporating opportunities for shared, guided and independent learning.

4

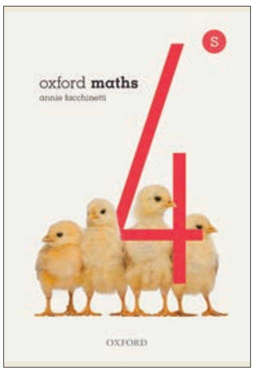
Assess the results

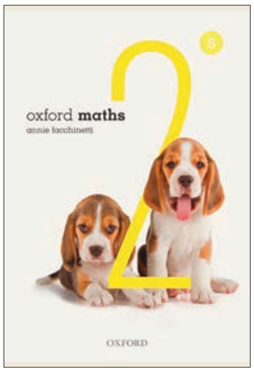
Conduct the post-test to measure student growth and identify areas of further need.



Access the topic post-test via the print Assessment Book or the Teacher Dashboard.

The Teacher Dashboard contains resources, lesson plans and explicit references to the Student Books to support student learning at point of need.





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maths
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Look inside

STUDENT BOOKS

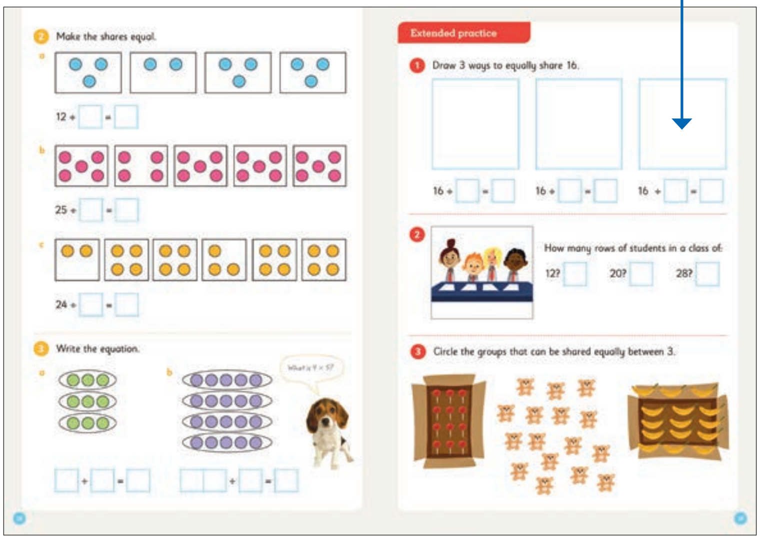
The *Oxford Maths* Student Books are an integral part of the *Oxford Maths* series and consist of:

- a clear and simple layout to support a developmental approach that incorporates initial scaffolding, which is gradually reduced to allow students to become confident and independent mathematicians
- student activity pages that cover the Mathematics content strands of Number and Algebra, Measurement and Geometry, and Statistics and Probability
- topics that follow a scope and sequence, which supports the sequential acquisition of mathematical skills, concepts and knowledge.

Australian Curriculum Proficiency Strands

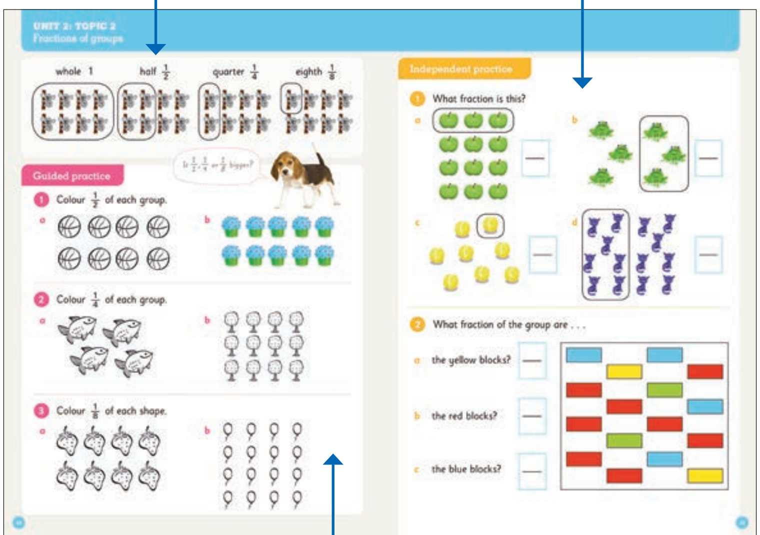
The *Oxford Maths* Student Books have an emphasis on the proficiencies of Understanding and Fluency in the Guided and independent practice sections. The extended practice section incorporates more Reasoning and Problem-solving as students apply their knowledge in new contexts.

The extended practice section offers students opportunities to apply their learning and extend their understanding in new contexts.



A worked example of the concept is provided.

The independent practice section allows students to consolidate their understanding of the concept in different ways, with a decreasing amount of scaffolding.

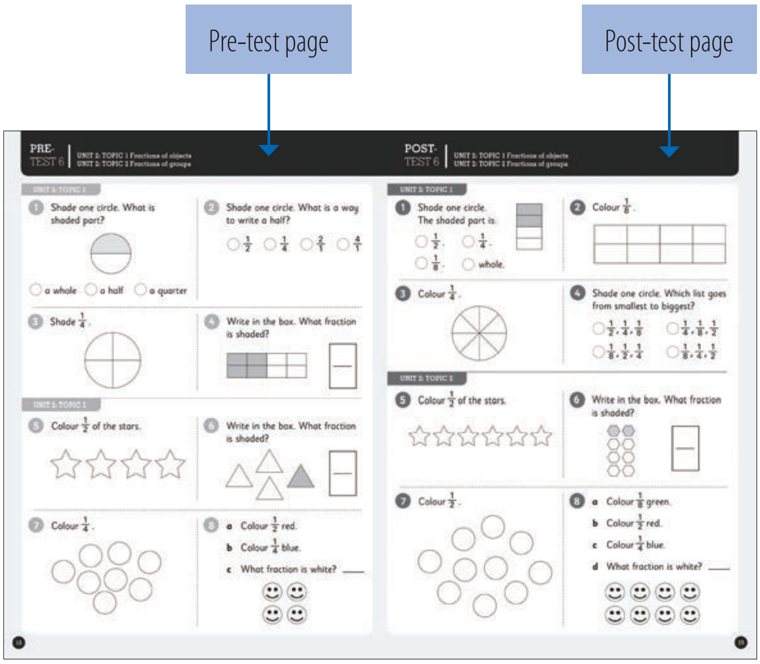


The guided practice section provides an opportunity to practise, supported by careful scaffolding.

ASSESSMENT BOOKS

The *Oxford Maths* Assessment Books provide teachers with an easily administered, yet comprehensive, assessment tool. They:

- include short pre- and post-tests for each topic or similar grouped concepts
- are supported by a suggested teaching and testing schedule
- provide a simple grading system, which allows educators to assign a grade to students for reporting.



Pre-tests:

- allow educators to identify students' point of need and choose teaching activities that will support their stage of learning
- cover foundational content from the previous year, as well as the breadth of subject matter for each topic at the target year level, allowing teachers to identify the learning pathway for each student.

Post-tests:

- provide the opportunity to measure growth and confirm the effectiveness of the teaching sequence
- comprehensively cover the target year level as well as some content from the next year level, allowing teachers to measure learning growth and identify students performing above the expected standard.

The *Oxford Maths* Assessment Book pre-tests allow teachers to quickly understand the current levels of student understanding of the topic or concept. Teachers can then choose an appropriate pathway to give struggling students extra support, extend competent students and consolidate the knowledge of all students with the suggested activities available on the *Oxford Maths* Teacher Dashboard.

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Look inside

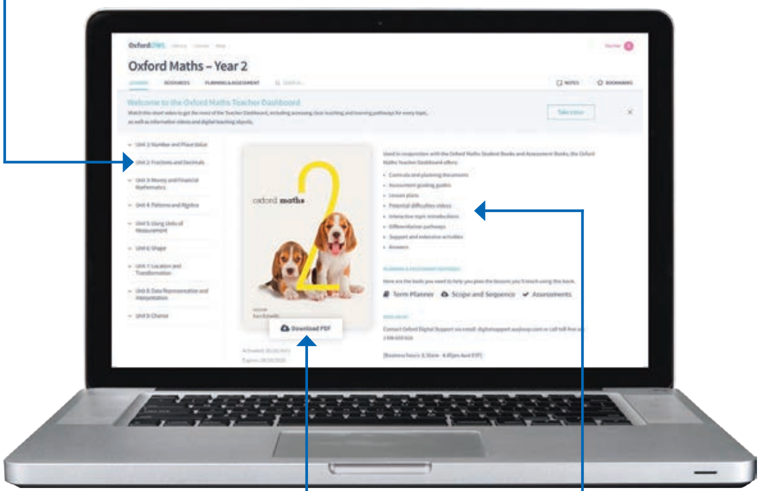
TEACHER DASHBOARD

The *Oxford Maths* Teacher Dashboard provides online access to a wealth of resources and support material for Foundation to Year 6.

Used in conjunction with the *Oxford Maths* Student Books and Assessment Books, the dashboard offers teachers access to clear teaching and learning pathways that will meet the diverse needs of students in a single class and across the whole school.

For Teacher Dashboard purchasing options, go to page 44 of the pricelist.

Access all units and topics via the menu

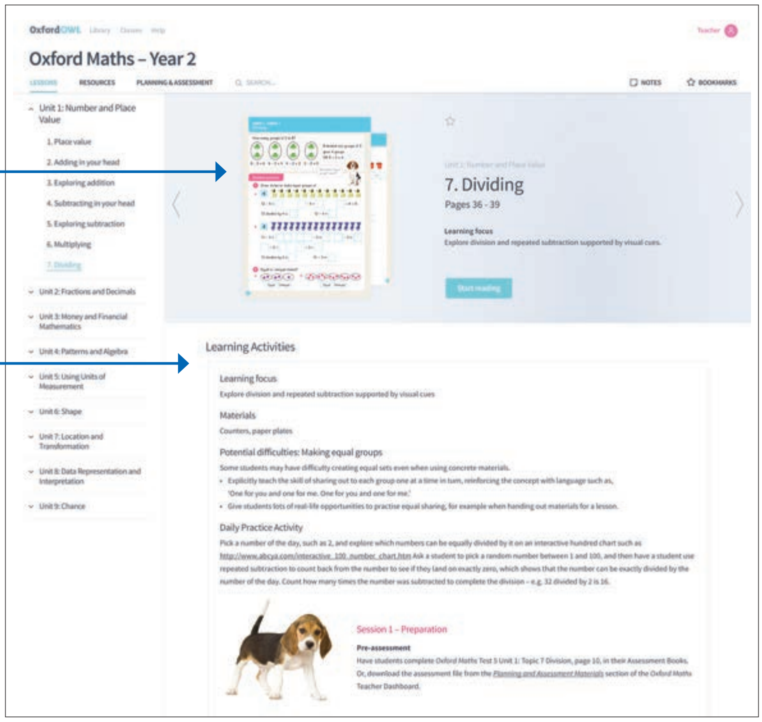


Access a downloadable *Oxford Maths* Student Book PDF*

Planning and assessment resources

Projectable Student Book pages for whole-class and small-group teaching

Learning activities, including hands-on activities and small-group and whole-class tasks.



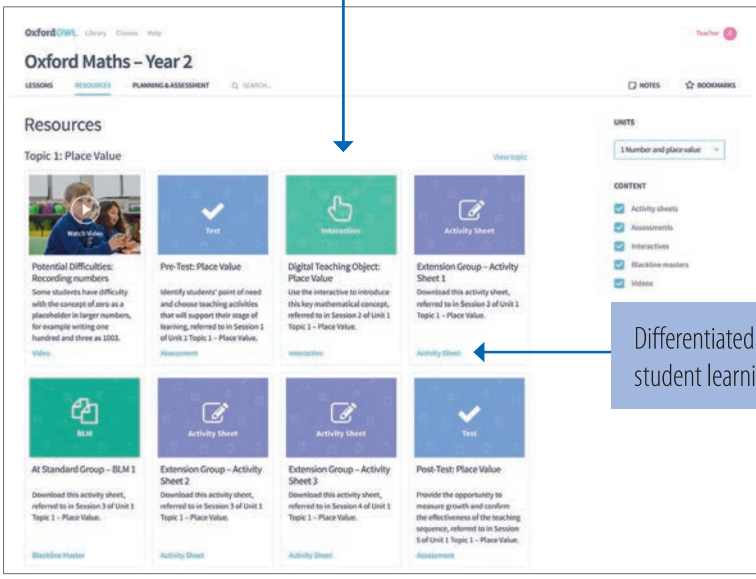
* Depending on the licence type chosen, Student Books can be viewed or downloaded.

Interactive teaching tools for whole-class learning

Potential Difficulties video tutorials

Downloadable and printable BLMs

Differentiated activities to support student learning at point of need

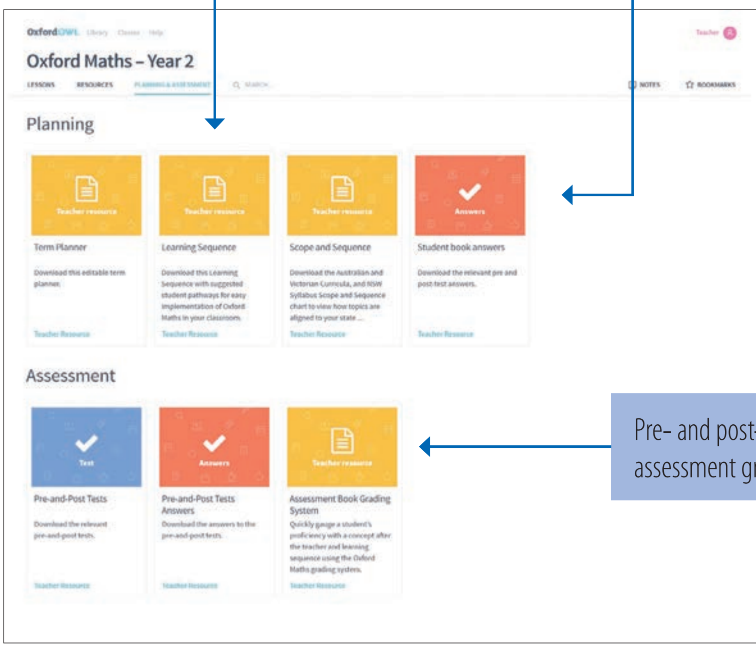


Learning sequence and suggested student pathways

Curriculum scope and sequence charts

Planners

Pre- and post-tests, answers and assessment grading systems



DON'T UNDERESTIMATE THE VALUE OF PRACTICE IN MATHS EDUCATION

Annie Facchinetti, author of *Oxford Maths* and *OZBOX: Learning through Literacy*.

It is often easy to assume that because students appear to have understood an idea or demonstrated a skill on a particular day, they have mastered the associated concept. However, research is increasingly confirming the importance of practice in embedding learning in long-term memory.

The adage 'practice makes perfect' is proving particularly relevant in the field of neuroscience, where studies show that exposure to repeated experiences of a topic are more likely to build lasting neurological pathways. Hohnen and Murphy (2016, p. 79), for example, found that repetition or practice results in what they call 'myelination of that circuit' (myelin is described as the insulating sheath around many nerve fibres, which increases the speed at which impulses are conducted), resulting in students developing greater efficiency with the target skill.

Practice, with a view to mastery, therefore underpins the spiral approach used in the *Maths Plus* program, both within and across year levels. In a 2007 report, Pashler et al concluded, 'Research has shown that delayed re-exposure to course material often markedly increases the amount of information that students remember. The delayed re-exposure to the material can be promoted through homework assignments, in-class reviews, quizzes, or other instructional exercises' (p. 5). *Maths Plus* offers students the opportunity to revisit mathematics topics at different points in the year, supported by the extra practice afforded by the Mentals and Homework Books.

The *Maths Plus* Teacher Dashboard also provides access to a range of resources that will enable students to experience mathematical concepts in a variety of different ways. These include digital interactives to introduce and explore topics, as well as support, extension and reflection activities. Problem-solving challenges included in the Student Books allow for skill application in a variety of contexts.

The final step in the *Maths Plus* process is assessment. Another of Pashler et al's (ibid., p. 21) findings was that, '. . . the act of recalling information from memory helps to cement the information to memory and thereby reduces forgetting. By answering the questions on [a] quiz, the student is practicing the act of recalling specific information from memory'. The comprehensive post-assessment components available as part of the *Maths Plus* program help consolidate learning and allow teachers to gauge student understanding, while the simple marking system provides evidence for A–E grading.

According to the UK's National Centre of Excellence in the Teaching of Mathematics, 'All pupils should become fluent in the fundamentals of mathematics, including through varied and frequent practice, so that pupils develop conceptual understanding and are able to recall and apply their knowledge rapidly and accurately to problems (NCETM 2014). The Practise, Master, Assess approach used in *Maths Plus* covers all these aspects, using proven strategies to develop the knowledge and skills to become proficient in mathematics.

Maths Plus:

- provides spiralling content where concepts are explored, then built on throughout the year and across year levels; this helps learners make connections over time, supporting recall and fluency
- offers varied learning experiences such as interactive concept exploration, learning, practice and consolidation activities, problem solving tasks, extra support and extension activities, and mentals and homework activities
- Assessment Books (bundled with Student Books) provide post-assessment tests that are simple to use and quick to administer, and allow teachers to track and review student learning
- is explicitly aligned to the new Victorian Curriculum, as well as the Australian Curriculum and the New South Wales syllabus.

Further reading

Bruner, J 1960, *The Process of Education*, Harvard University Press, Cambridge, Massachusetts.

Hohnen, B & Murphy, T 2016, 'The optimum context for learning; drawing on neuroscience to inform best practice in the classroom', *Educational & Child Psychology*, volume 33, issue 1, p. 79.

National Centre of Excellence in the Teaching of Mathematics 2014, *Mastery Approaches to Mathematics and the New National Curriculum*, Sheffield, United Kingdom.

Pashler, H, Bain, P, Bottge, B, Graesser, A, Koedinger, K, McDaniel, M & Metcalfe, J 2007, *Organizing Instruction and Study to Improve Student Learning* (NCER 2007–2004), National Center for Education Research, Institute of Education Sciences, U.S. Department of Education, Washington, DC, accessed 19 July 2016, http://ncer.ed.gov

MATHS PLUS

Practise, master, assess

Maths Plus is a whole-school maths program for the Australian Curriculum: Mathematics. It is fully aligned with the Victorian Curriculum and NSW syllabus.

Maths Plus:

- provides spiralling content where concepts are explored, then built on throughout the year and across year levels. This helps learners make connections over time, supporting recall and fluency
- offers varied learning experiences such as interactive concept exploration, practice and consolidation activities, problem-solving tasks, extra support and extension activities, and mentals and homework activities
- enables tracking and reviewing of student learning through post-test assessment.

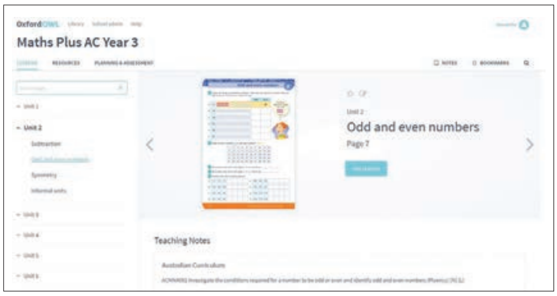
Practise, master, assess

Spiralling helps learners make connections over time, which creates more robust pathways for recalling information. *Maths Plus* follows a spiral approach, allowing teachers and students to build on, and revisit, content over time to consolidate learning and increase fluency.

and continue throughout the primary and secondary years.

What does *Maths Plus* look like in the classroom?

Access the resources and unit lesson to support student learning at point of need.



1

Plan and implement teaching

Use the Teacher Dashboard to download lesson plans, including explicit references to the Student Books.

2

Practise

The Student Books provide opportunities for the students to practise the concepts that have been introduced.

3

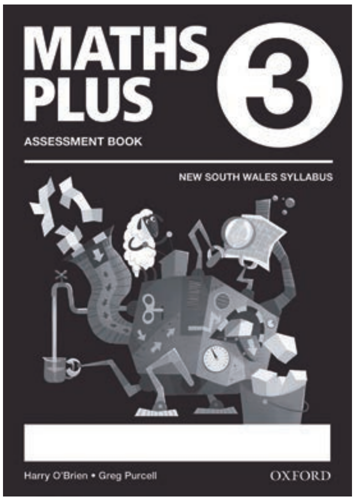
Master

Problem-solving activities in the Student Books challenge students' thinking and application of skills. The Mentals and Homework Book activities allow students to consolidate understanding and increase fluency.

4

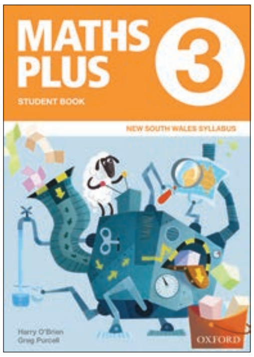
Assess the results

Conduct the post-test to measure student growth and identify areas of further need.



Post-test assessments allow teachers to gauge student understanding and can be accessed via the Assessment Book on the Teacher Dashboard.

The Student Book and the Mentals and Homework Book provide opportunities to practise learning, and develop skills and strategies.



MATHS PLUS

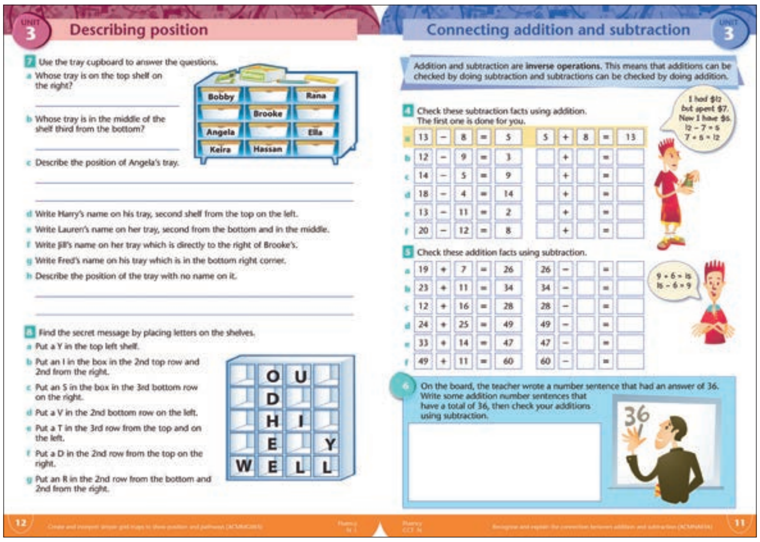
Look inside

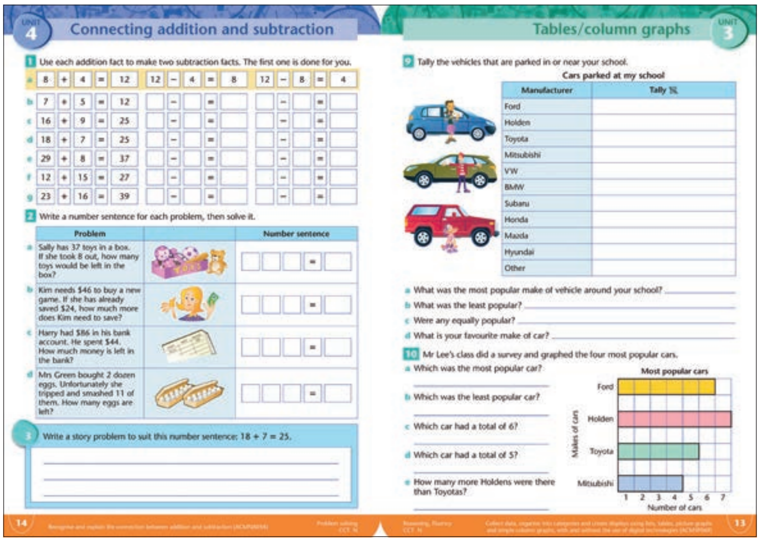
Student activity pages are colour-coded and cover the three Australian Curriculum: Mathematics content strands of Number and Algebra, Measurement and Geometry, and Statistics and Probability.

STUDENT BOOKS

The *Maths Plus* Student Books are an integral part of the *Maths Plus* series. They include:

- four diagnostic term reviews (Years 1–6) to assess concepts and skills
- opportunities for spiralled learning and practice
- opportunities for students to develop and consolidate skills in understanding, fluency, reasoning and problem-solving
- investigation units that allow students to apply their knowledge and show their understanding
- contextual support and examples.





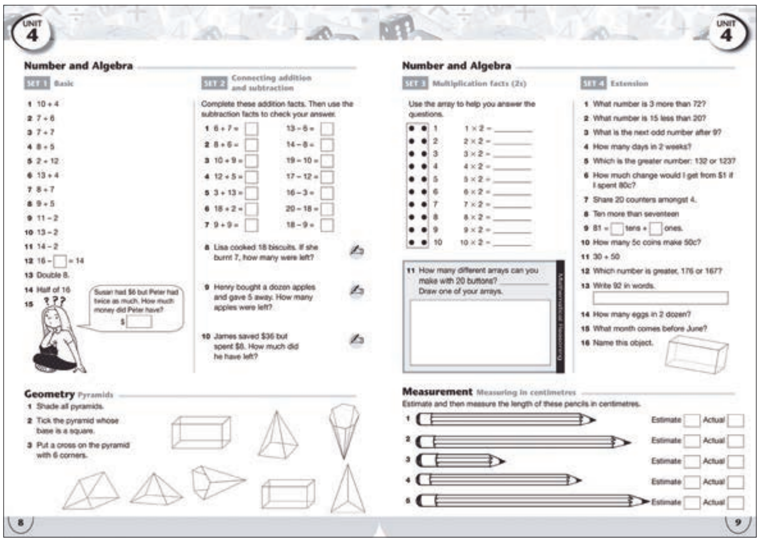
Australian Curriculum: Mathematics content descriptions, proficiency strands and general capability references are included at the base of every student activity page.

MENTALS AND HOMEWORK BOOKS

The *Maths Plus* Mentals and Homework Books:

- directly correspond to the concepts and units of work presented in the Student Books
- have all unit activities arranged under the three Australian Curriculum: Mathematics strands

Essential revision and consolidation activities



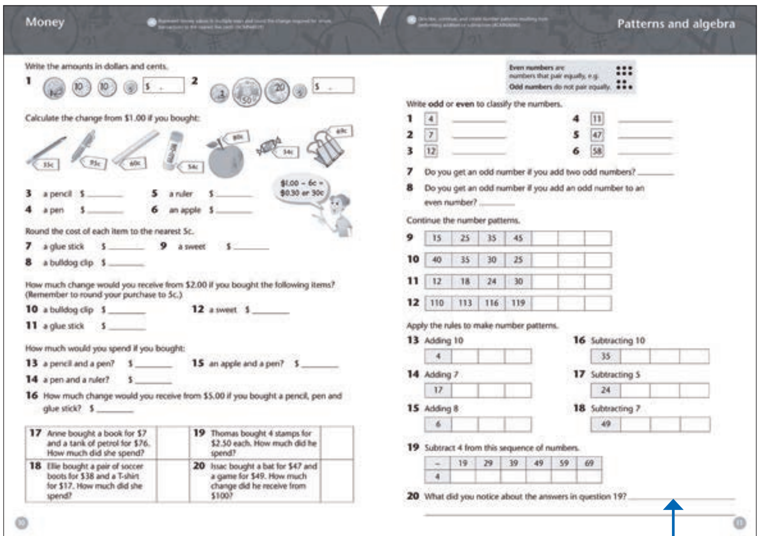
ASSESSMENT BOOKS

The *Maths Plus* Assessment Books provide teachers with an easily administered, yet comprehensive, post-assessment tool. They:

- provide opportunities for teachers to measure student growth
- include short post-tests for each topic
- include a simple marking system that enables easy conversion to percentages.

Each Assessment Book page is a snapshot of work that addresses a specific content description from the Australian Curriculum.

Post-tests are provided for each topic.



Post-tests are quick to administer and mark.

MATHS PLUS

Look inside

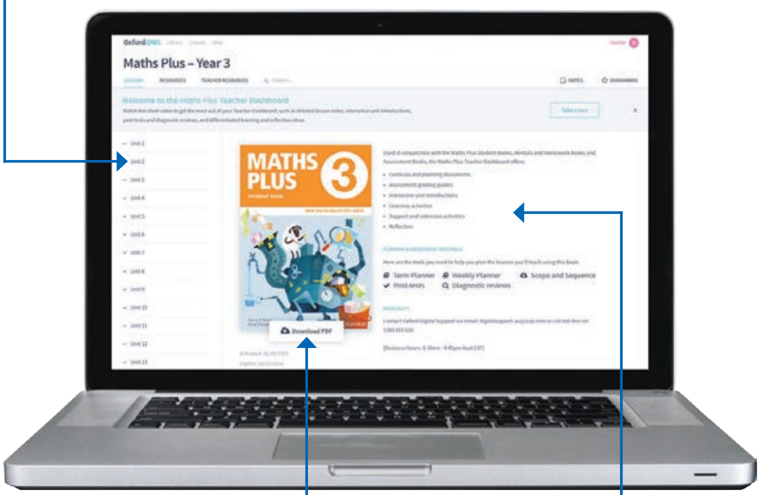
TEACHER DASHBOARD

The *Maths Plus* Teacher Dashboard provides online access to a wealth of resources and support material for Foundation to Year 6.

Used in conjunction with the *Maths Plus* Student Books and Assessment Books, the dashboard offers teachers access to clear teaching and learning pathways that will meet the diverse needs of students in a single class and across the whole school.

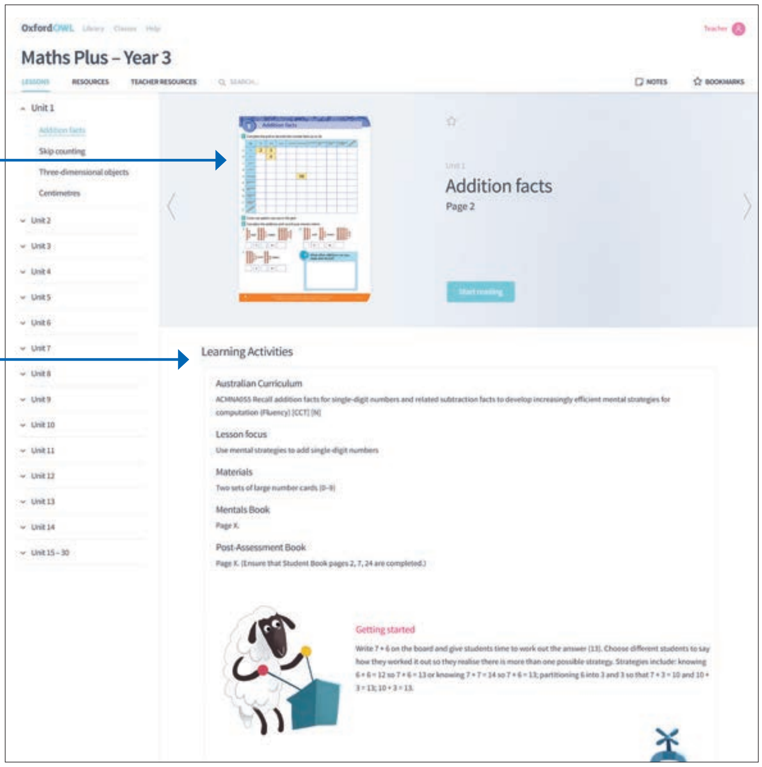
For Teacher Dashboard purchasing options, go to page 44 of the pricelist.

Access all units and topics via the menu.



Access a downloadable *Maths Plus* Student Book PDF*.

Planning and assessment resources



Projectable Student Book pages for whole-class and small-group teaching

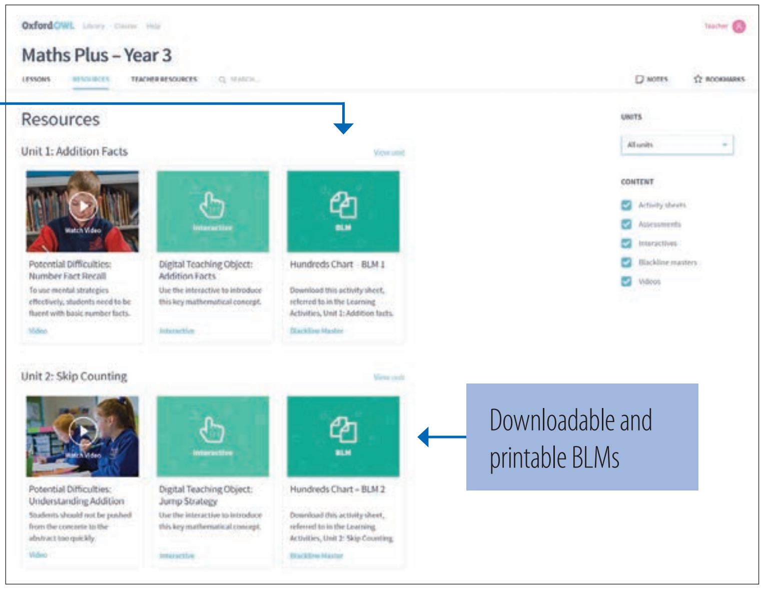
Learning activities

* Depending on the licence type chosen, Student Books can be viewed or downloaded.

Interactive teaching tools for whole-class learning

Potential Difficulties video tutorials

Downloadable and printable BLMs



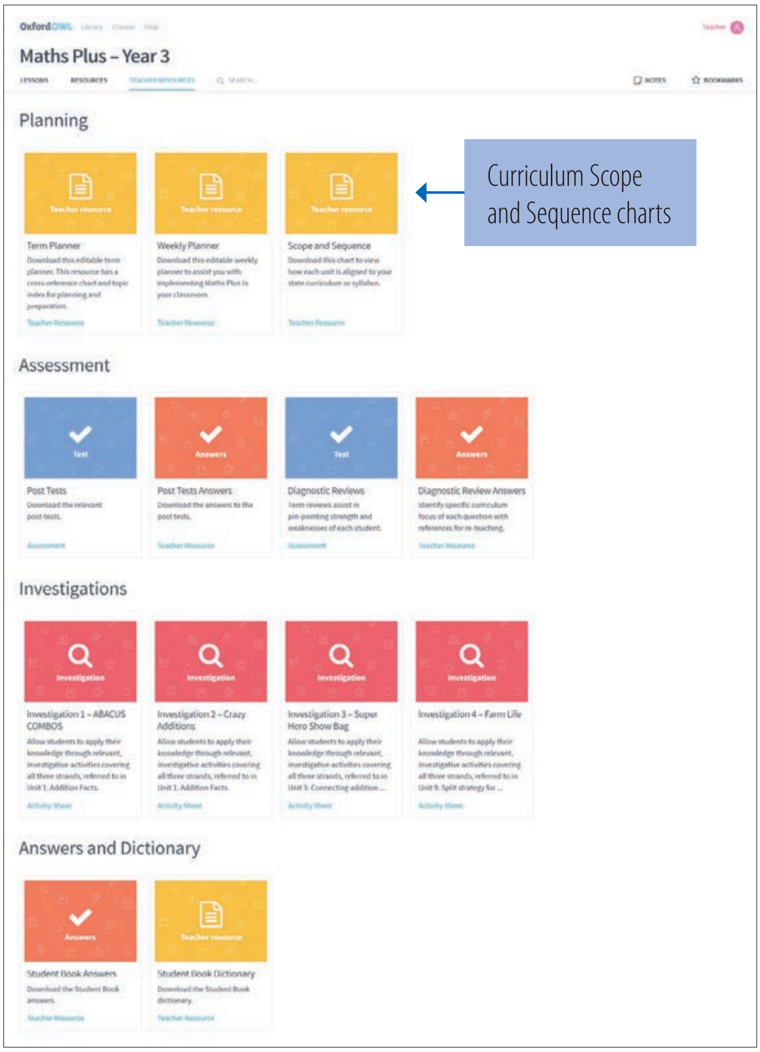
Planners

Curriculum Scope and Sequence charts

Post-assessment and diagnostic review resources

Investigations

Student Book answers and dictionary

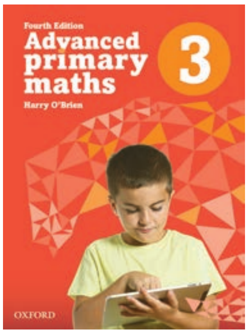


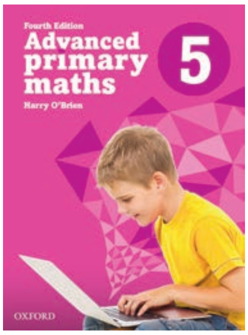
The effective teaching of mathematics is an essential component of STEM education.

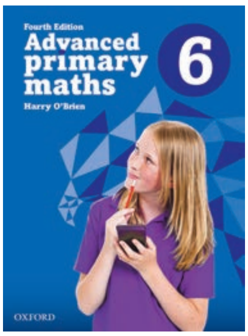
Advanced primary maths

Challenge and extend

NEW EDITION







Advanced Primary Maths is an accelerated maths program that extends students vertically and horizontally in line with the achievement standards of the Australian Curriculum, the objectives of the NSW Mathematics Syllabus and the outcomes of the Victorian Curriculum.

Advanced Primary Maths:

- is the only advanced maths series written for Australian primary students
- is written by a well-established author with a primary teaching background
- follows a spiral approach across 35 units of work
- addresses all forms of problem solving
- features Term Planners, Find a Topic pages, AC / NSW / VIC Curriculum Cross-reference Charts, Open-ended Challengers, Super Problem Solving pages, Weekly Testers, Diagnostic Reviews and Answers.

Challenge and extend

The effective teaching of mathematics, focusing on problem-solving and open-ended learning, is an essential component of STEM education. The activities in *Advanced Primary Maths* will engage, stimulate and motivate students, giving them every chance to achieve success.

The activities in *Advanced Primary Maths* will engage, stimulate and motivate students.

Look inside

TEACHER RESOURCES

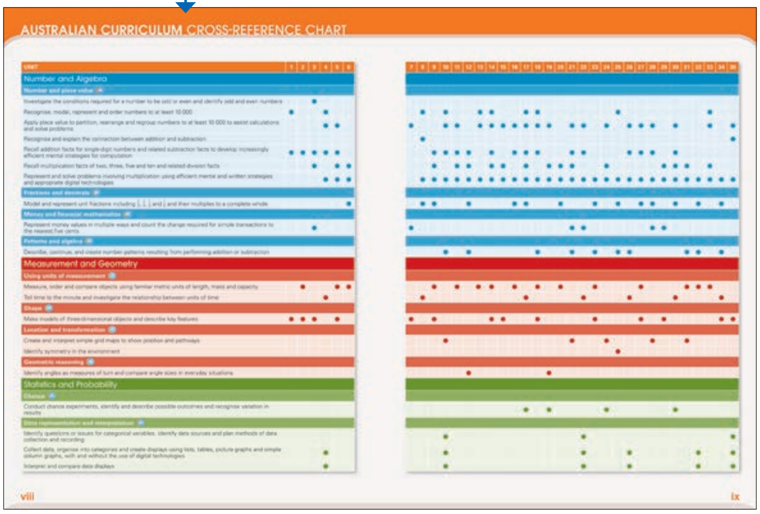
Plan and implement teaching

Use the Curriculum Cross-reference charts, Term Planners and Find a Topic pages to prepare your lessons.

Review and assess

Use the Diagnostic Reviews and answer section to assess students' work.

Australian Curriculum, Victorian Curriculum and NSW Syllabus cross-reference charts.



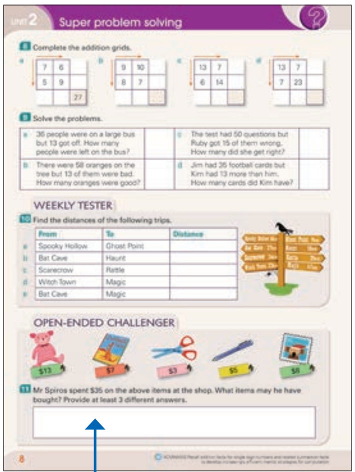
STUDENT RESOURCES

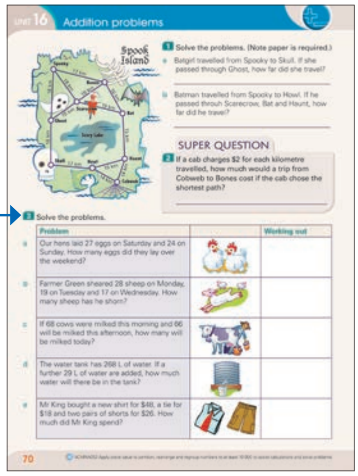
Practise and assess

Advanced Primary Maths follows a spiral approach, allowing students to build on and revisit content over time. The Diagnostic Reviews can be used to assess the students' understandings of concepts covered.

Challenge and extend

Students can use the Super Problem Solving pages, with Open-ended Challengers and Weekly Testers, to consolidate and extend their learning.





Open-ended Challenger questions with multiple solutions.

Super Questions for exploring concepts at a higher level.

MATHS SKILLS NEED TO SERVE STUDENTS BEYOND THE NEXT 30 MINUTES

**Peter Sullivan,
Professor of Science, Mathematics and Technology Education, Monash University.**

A lack of consensus about what works can make debates about education frustrating. This is especially true for the teaching and learning of mathematics. Not only is there a high level of disagreement about the teaching of the subject, but even the most fundamental approaches are debated.

One of the main areas of disagreement centres on whether students should be told explicitly what to do, or whether a problem-solving centred approach is more effective.

The first method, which some commentators support, involves teachers telling students what to do and having them practice multiple examples, which are then corrected. Such commentators see curriculum progress as climbing a series of micro-steps that are best taken in a particular order. This argument suggests that students work best by progressing through a textbook page-by-page and example-by-example.

As part of the same argument, it is recommended that students are taught in groups of similar levels of achievement, with students in lower groups being offered a limited mathematical diet. This approach is based, presumably, on an assumption that not all students can learn mathematics, and is most common in junior secondary classes.

However, a sample of Year 7 and 8 content that is on both the Year 7 and Year 9 NAPLAN assessments, reveals that students in those years hardly improve at all. (Schools can easily check this claim by comparing, for example, questions 5, 21 and 26 on the 2016 Year 7 Calculator paper that were also on the Year 9 paper). These items are explicitly on the content taught in years 7 and 8, yet, state-wide, the improvement is very limited. Even though these are not the same students, the comparisons give a clear indication that this approach is NOT working.

I, along with others, argue that a better way students can learn mathematics is through solving problems for themselves, by connecting related ideas together and working on tasks and experiences that are challenging, for which the solution path and type are not obvious, and which take time to reach. Through effective differentiation strategies, mathematics can be taught in mixed achievement groups, with students' own solutions and solution strategies being a central part of the teaching. The assumption is that all students can learn mathematics given time and opportunity.

Those who support the former argument (that students need to be directed explicitly) claim that students give up quickly if not told what to do, that they will not persist long enough to find solutions, and that they do not like ambiguity and risk-taking, but want to get correct answers.

> “One of the main areas of disagreement centres on whether students should be told explicitly what to do, or whether a problem-solving centred approach is more effective.”

However, these are inappropriate orientations for the world of employment and life that we can imagine current students will experience. The responsibility of schools and mathematics teachers is to overcome such limiting self-beliefs.

Of course, there are some aspects of mathematics which students cannot be expected to come up with themselves, such as the formula for the relationship between the circumference and diameter of a circle or the theorem of Pythagoras.

But there are other aspects of mathematics which students can explore for themselves using the knowledge they already have. To give an example, imagine we are introducing middle primary students to the concept of measurement errors and how to avoid them. We might pose the following task for students.

> Michael and Monica measured the basketball court. Michael said it was 20 rulers long. Monica said it was 19 ½ rulers long. How could this happen?

The teacher might ask the students to first work individually and then to collaborate with others to formulate a list of possible explanations for the discrepancy. There are many possible explanations that students can find for themselves. For example, when I have done this, students have suggested 'one of them left gaps', and others have suggested 'one of them measured crookedly'. There are, of course, many other possibilities but note how these two suggestions could be turned into student generated rules for measuring such as 'do not leave gaps' and 'measure in the shortest straight line'.

The task, which the students can work on prior to any instruction, is accessible for all students and can be used as a prompt to stimulate collaborative discussion focusing on possible sources of measurement error.

The task can also be extended by posing a problem like:

> Someone suggested that one of them left gaps. Who left the gaps: Michael or Monica?

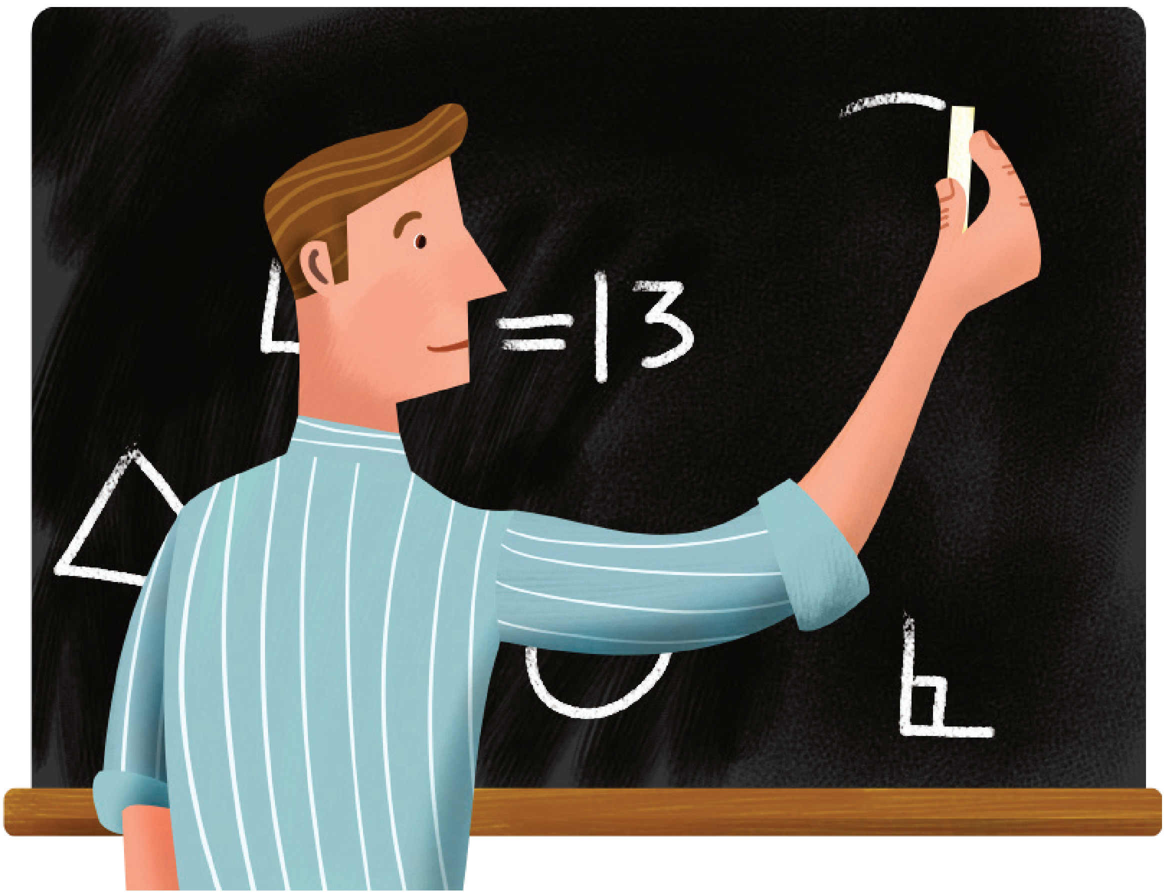
The answer, by the way, is not obvious. Write your answer down before looking at the end of the article.

Note that this task also addresses another important measurement principle that students can see for themselves, that the larger the unit the fewer the number of units.

It comes down to this. Telling students how to answer mathematics questions might work well for the next 30 minutes but it does not enhance the chance of students remembering what they have been told, nor of transferring this particular learning to a different context. The challenge is to find ways to engage students in their own learning.

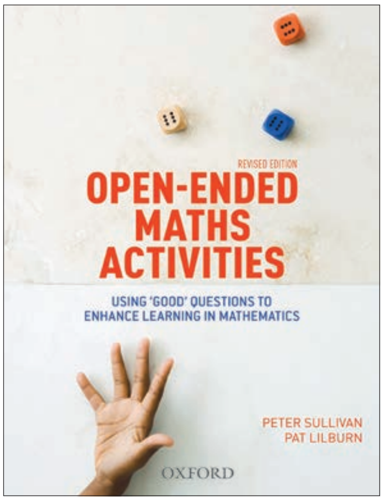
Hopefully the additional funding that many schools look likely to receive in new funding models might be allocated in ways that support such learning and teaching for the future.

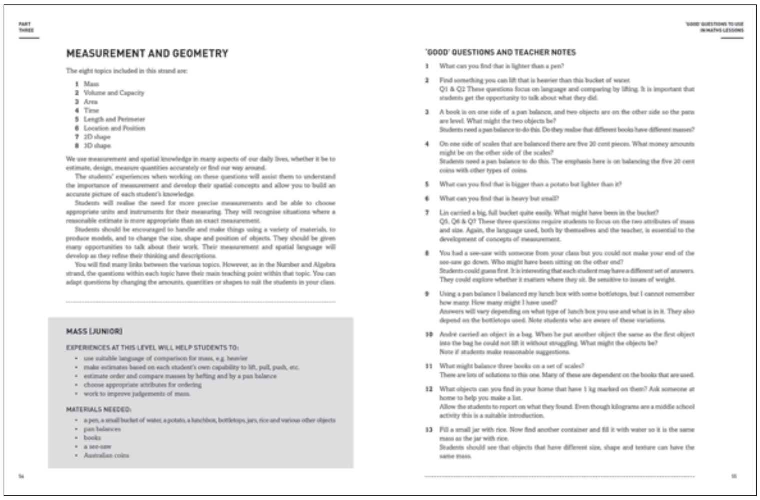
(Monica left the gaps).



OPEN-ENDED MATHS ACTIVITIES

Using ‘good’ questions to enhance mathematical learning





MEASUREMENT AND GEOMETRY

MASS (JUNIOR)

‘GOOD’ QUESTIONS AND TEACHER NOTES

NEW EDITION

Open-Ended Maths Activities discusses the features of ‘good’ mathematical questions. It provides practical advice on how teachers can create their own open-ended and problem-solving questions, and use them effectively in the classroom.

Open-Ended Maths Activities:

- includes over 80 pages of ‘good’ questions for teachers to use in the classroom
- organises questions into content areas (Number and Algebra, Measurement and Geometry, Statistics and Probability)
- indicates the suggested age level of students for each question
- is written by a well-established expert in the field of teaching and learning mathematics, and an experienced author with a primary teaching background.

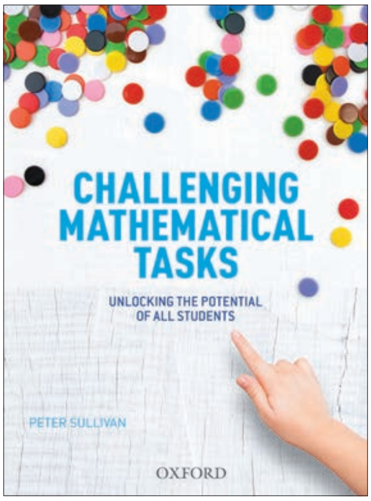
Asking the right questions

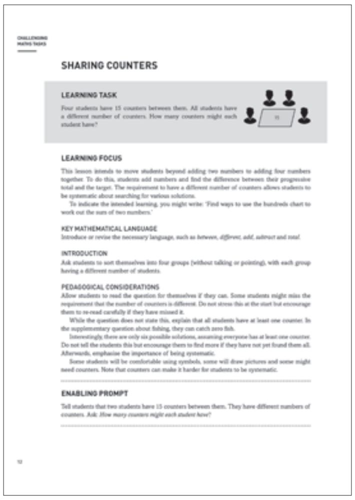
Teachers recognise the importance of asking questions that promote higher-level thinking and encourage active engagement in learning. Posing open-ended, problem-solving questions can enhance learning, teaching and assessment. *Open-Ended Maths Activities* offers ‘good’ questions that are a useful addition to effective teaching strategies.

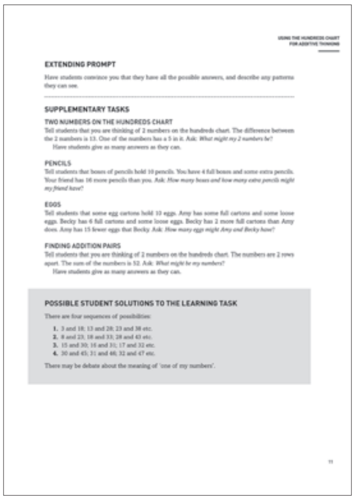
higher-order skills, including critical thinking, creativity, collaboration and problem-solving.

CHALLENGING MATHEMATICAL TASKS

Using challenging mathematical tasks to unlock the potential of students







NEW

Challenging Mathematical Tasks supports the idea that students learn best when they work on problems that they do not yet know how to solve. Peter Sullivan's research shows that many students do not fear challenges in mathematics, but welcome them. And rather than having teachers instruct them, these students prefer to work out solutions for themselves.

Challenging Mathematical Tasks:

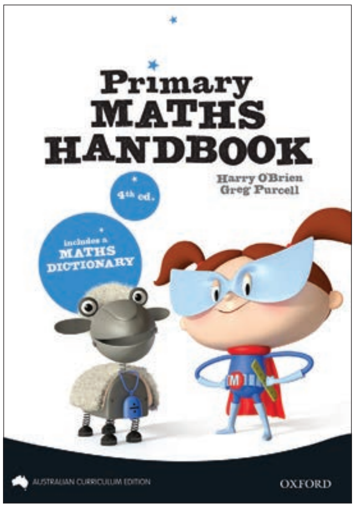
- includes activities that allow for sustained thinking, decision-making and risk-taking by the students
- features a 'Learning Focus', 'Key Mathematical Language', 'Pedagogical Considerations', 'Enabling and Extending Prompts' for each task, plus 'Supplementary Tasks' and 'Possible Solutions'
- is written by a well-established expert in the field of teaching and learning mathematics
- follows a set structure to help students approach and work through the tasks.

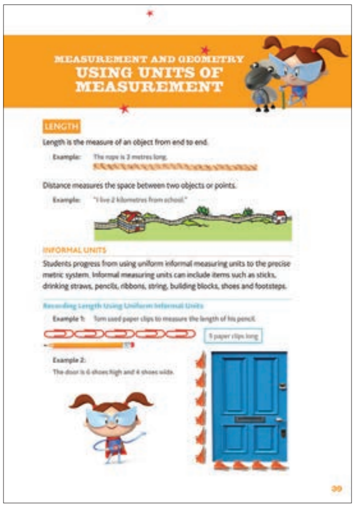
Persist and succeed

While it is possible for everyone to learn mathematics, it takes concentration and effort over an extended period of time to build the connections between concepts, to understand the coherence of mathematical ideas and to be able to transfer learning to practical contexts and new topics. *Challenging Mathematical Tasks* encourages students to persist and succeed in their learning.

Primary MATHS HANDBOOK

A must-have, user-friendly resource





Measurement and Geometry, *Primary Maths Handbook*.

Primary Maths Handbook **is the essential reference resource for middle years students, teachers and parents.**

- Updated to include all the latest terminology and mathematical concepts covered in the Australian Curriculum: Mathematics.
- Includes diagrams and worked examples.

Handbook Section

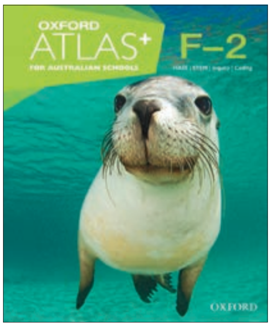
- Divided into the Australian Curriculum: Mathematics strands of Number and Algebra, Measurement and Geometry, and Statistics and Probability.
- Mathematical concepts explained in detail, with clear diagrams and illustrations to aid understanding.

Quick-Reference Dictionary

- Simple language with terms defined through mathematical contexts.
- Cross-referenced to the handbook section.

WHICH HISTORY, GEOGRAPHY OR SCIENCE RESOURCE IS **RIGHT FOR YOU?**

A complete HASS and STEM program



Page 28

Learning science, history and geography through literacy

Page 34

A highly visual approach to science

Page 40

OXFORD ATLAS+ FOR AUSTRALIAN SCHOOLS

Your essential HASS and STEM resource

Oxford Atlas+ for Australian Schools goes beyond a traditional atlas series by providing comprehensive coverage of the Science and Humanities and Social Sciences curricula for Years F–6, integrated into one program. There is also targeted support for the Technologies curriculum.

The atlases:

- teach essential map-reading skills and feature world, continent and country maps
- contain high-interest topics explicitly linked to outcomes in the Science curriculum and the Humanities and Social Sciences curriculum
- use practical, inquiry-based activities and experiments to teach topics and to develop students' critical thinking and problem-solving skills
- are accompanied by a wealth of digital resources that support the Technologies curriculum, including interactives designed to develop authentic design solutions and computational thinking across different subject areas.

Integrated learning within and across the curriculum

The integrated curriculum approach enables authentic learning experiences, while the application of cross-disciplinary and problem-solving skills encourages students to be innovative, creative learners.

> **"The atlases can be used in guided reading as an information text; to explore map references and grid lines in Maths; and during Inquiry Learning to explore the various geographical and geological features of countries."**
>
> **– Literacy Coordinator, Victoria**

within and across content areas to help students make real-world connections.

What does *Oxford Atlas+ for Australian Schools* look like in the classroom?

1

Introduction

Evaluate students' prior knowledge with the pre-assessment ideas on the Teacher Dashboard.

Play video relating to the topic as a class introduction.

2

Whole-class or guided-group work

Select some of the activities on the Teacher Dashboard to explore as a class or within small groups.

Demonstrate digital interactives related to the topic.

3

Independent work

Allocate activities from the Teacher Dashboard for students to do in pairs or small groups.

Assign a selection of relevant *OZBOX* cards to students for deeper exploration of topics. (Years 3–6 only)

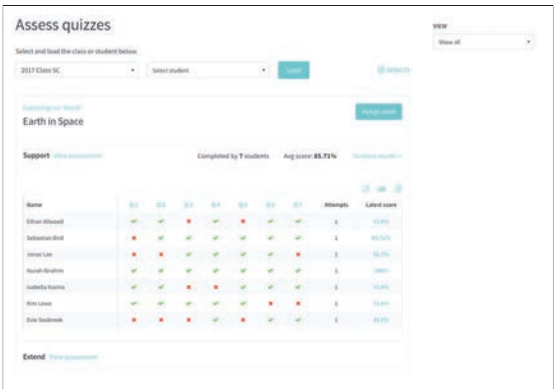
Assign students independent work to develop their research skills through questions and project work.

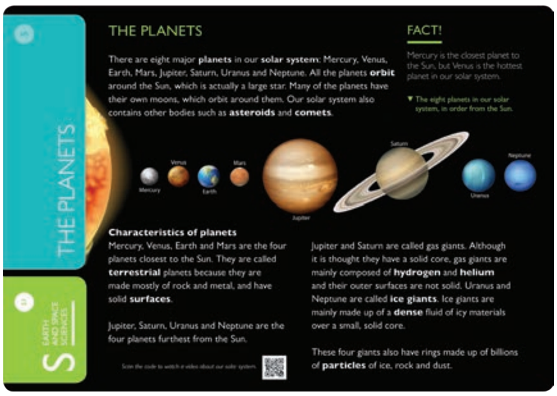
4

Assess

Implement suggested assessment activities from the Teacher Dashboard to evaluate student understanding and skill development.

View student quiz results on the Teacher Dashboard to analyse student achievement and identify trends. (Years 3–6 only)





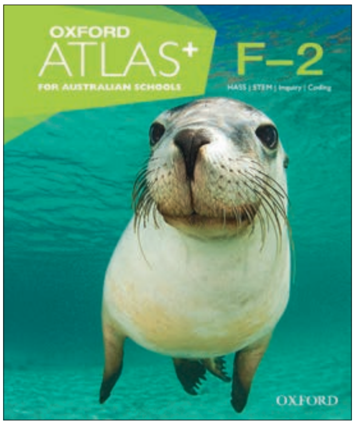
OXFORD ATLAS+ FOR AUSTRALIAN SCHOOLS

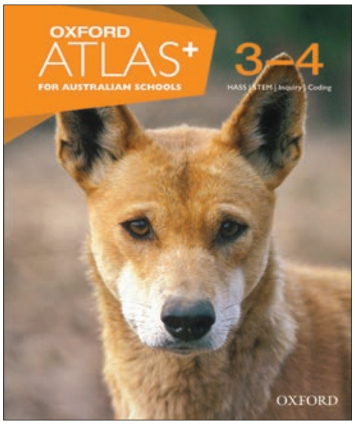
Look inside

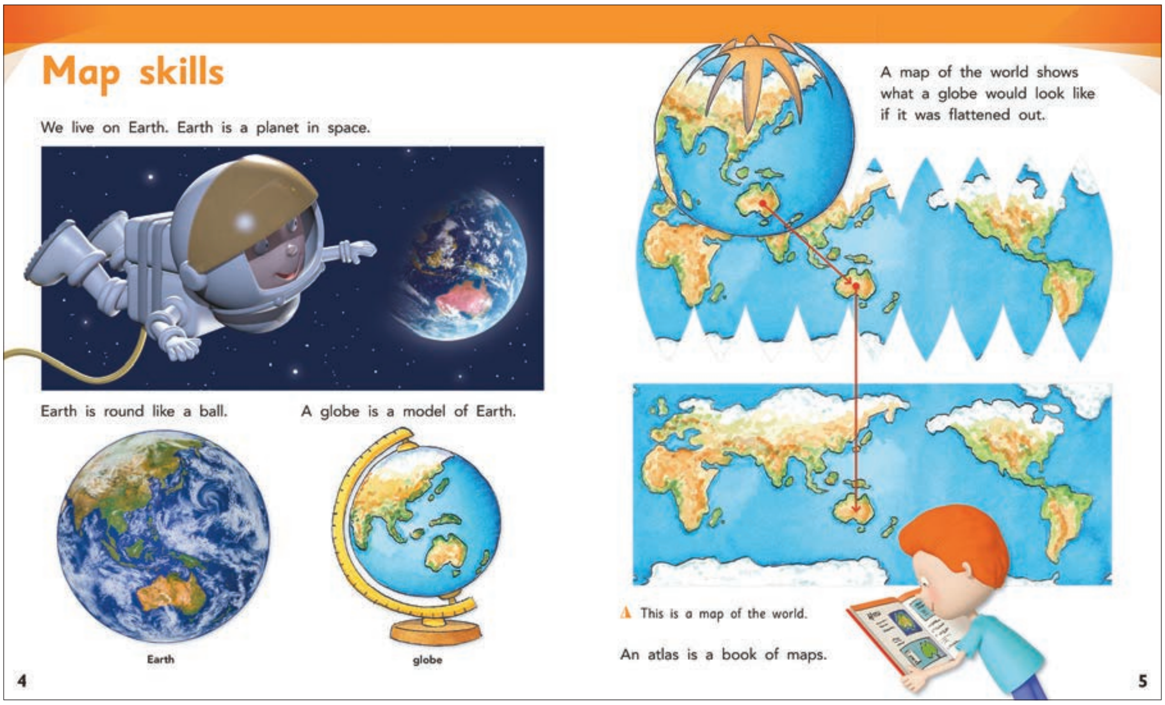
STUDENT RESOURCES

Print atlases

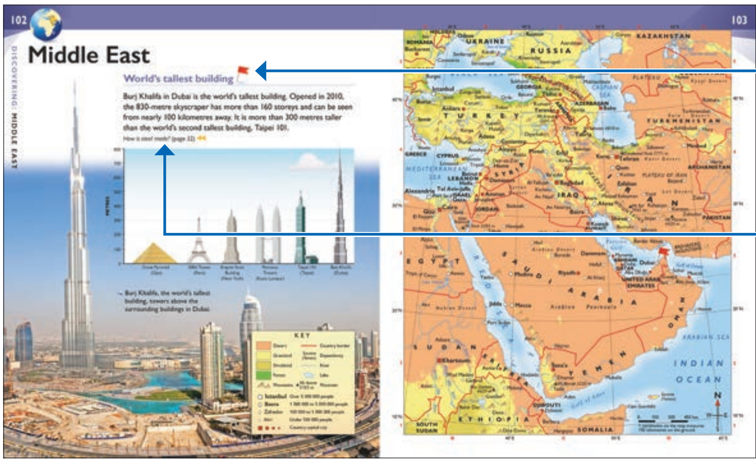
- Introduce, discover and explore essential map-reading skills.
- Contain world, continent, country and state maps, with case studies to help students explore the world.
- Provide high-interest topic spreads covering Science, History, Geography, Civics and Citizenship (Years 3–6), and Economics and Business (Years 5–6) content from the Australian Curriculum.
- Contain updated world facts and statistics.







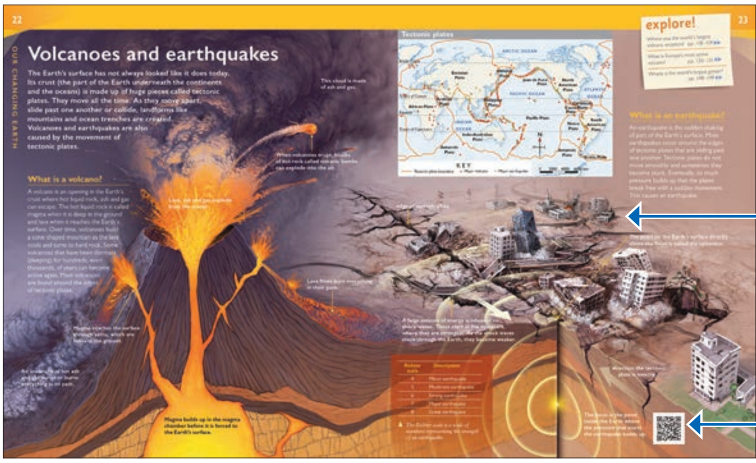
Oxford Atlas+ for Australian Schools F–2, Basic Mapping Skills.



Case studies link maps to real-world contexts.

Cross-references link to related facts and concepts within the atlas.

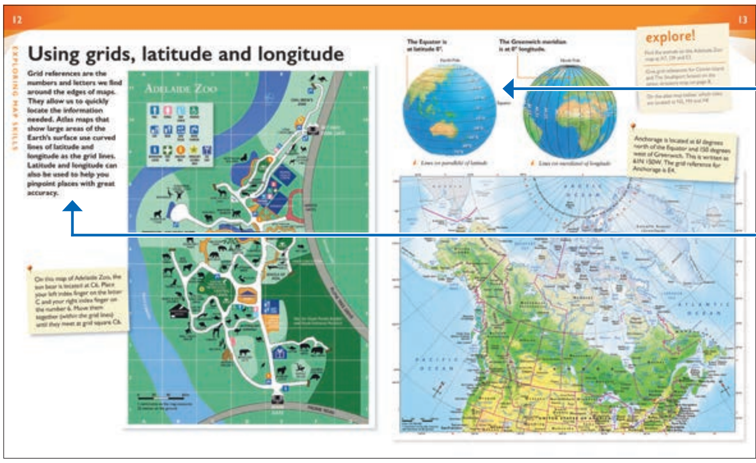
Oxford Atlas⁺ for Australian Schools 3–4, Physical and Political Map.



Stunning visuals and clear diagrams help engage students.

QR codes throughout the book link to videos.

Oxford Atlas⁺ for Australian School 5–6, Geography Topic Spread.



Explicit instruction to develop spatial reasoning.

Clear progression of learning concepts matched to students' developmental stages.

Oxford Atlas⁺ for Australian Schools 5–6, Advanced Map Reading Skills.

Visit our website for a **FREE** *Oxford Atlas⁺* digital trial.

OXFORD ATLAS⁺ FOR AUSTRALIAN SCHOOLS

Look inside

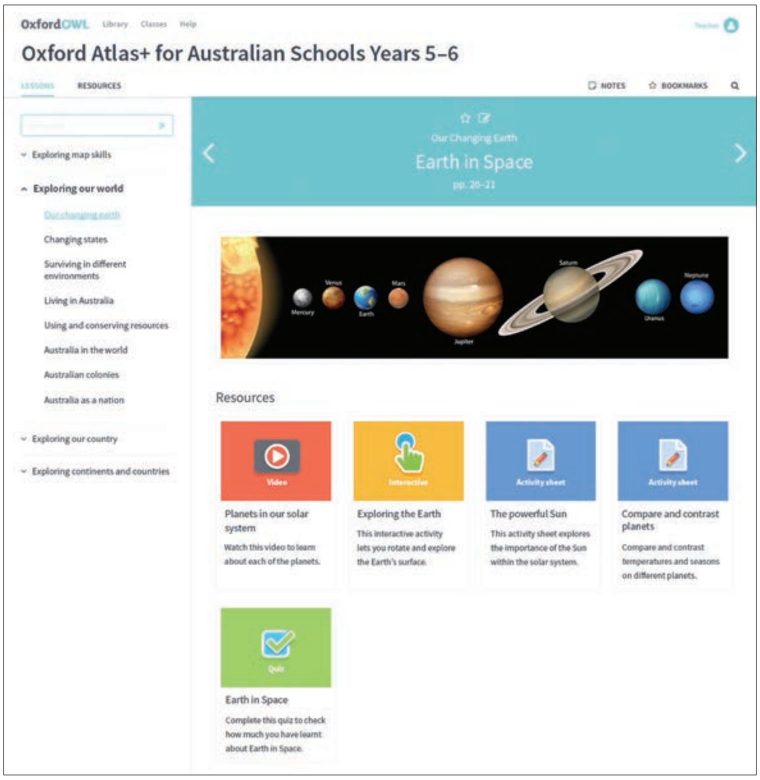
STUDENT DIGITAL RESOURCES*

- Digital interactive maps for deeper exploration of geographical regions.
- Mapping and skills interactives enrich and supplement the mapping skills section in the print books.
- Digital Technologies interactives based on themes found within the atlases help develop computational thinking.
- Video links connect to high-quality videos.
- *OZBOX* cards can be assigned by teachers for further exploration of topics and concepts in the atlases.
- Self-correcting quizzes help students test their knowledge and understanding.

*Years 3–4 and Years 5–6 only

Student and Teacher Dashboards coming Term 1, 2018!

Subscription options for the *Oxford Atlas⁺ for Australian Schools* Dashboards will be available for teachers and students in 2018. For more information, contact your local Oxford Primary Consultant.



Oxford Atlas⁺ for Australian Schools 5–6, Student Dashboard.

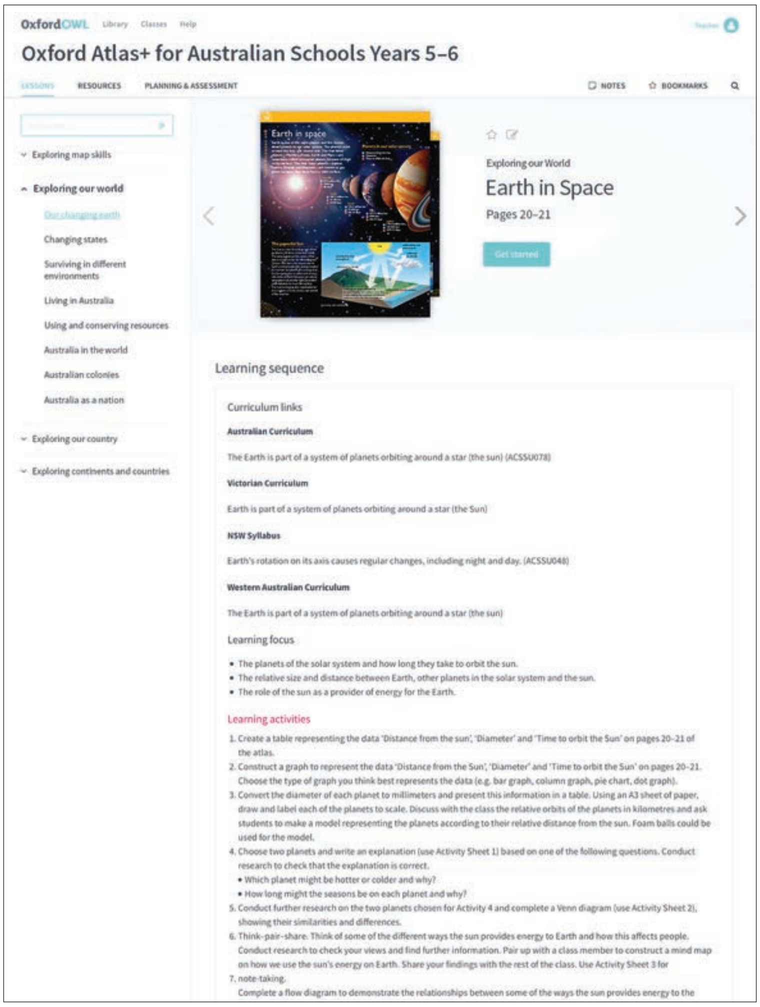
Oxford Atlas⁺ for Australian Schools 5–6, Geo-skills Interactive.

*Please note that images used are for illustrative purposes only. The final published product may differ.

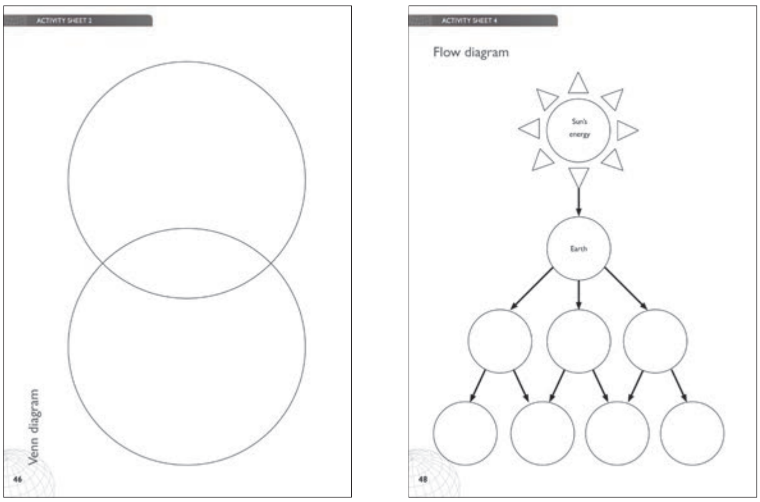
TEACHER RESOURCES

A suite of *Oxford Atlas+ for Australian Schools* online teaching resources can be found on *Oxford Owl*. A Teacher Dashboard is available for each stage of the atlas. Resources include:

- explicit links to specific Australian Curriculum Science, History, Geography, Civics and Citizenship (Years 3–6 only), and Economics and Business (Years 5–6 only) content descriptions
- professional support notes with teaching activities, ideas and experiments
- suggested pre-assessment and assessment activities
- videos, mapping skills interactives, interactive layered maps, and Digital Technologies interactives for front-of class teaching
- links to a selection of relevant *OZBOX* cards, with the ability to assign cards to students (Years 3–4 and Years 5–6 only)
- downloadable activity sheets and graphic organisers
- online tracking of student quiz results.



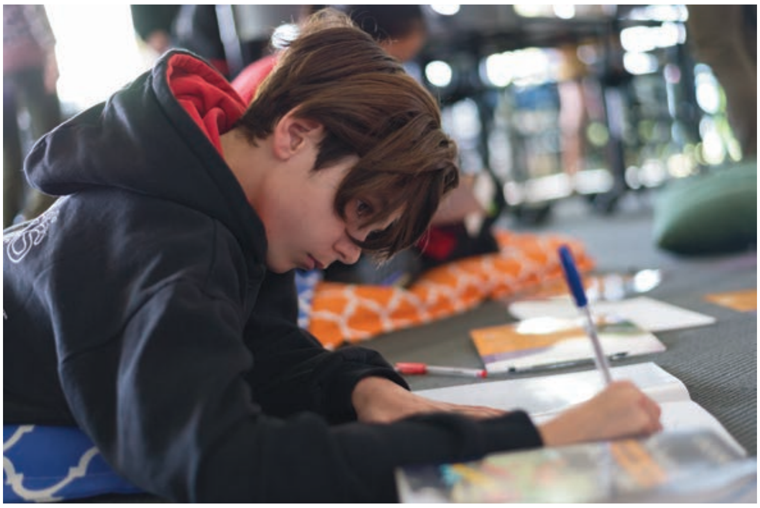
Oxford Atlas+ for Australian Schools 5–6, Teacher Dashboard.



Oxford Atlas+ for Australian Schools 5–6, Activity Sheets.

OZBOX
LEARNING THROUGH LITERACY

Learning science, history and geography through literacy



OZBOX: Learning Through Literacy is a comprehensive and engaging program for Years 3–6 that provides full coverage of the Australian Curriculum for Science, and Humanities and Social Sciences, specifically History and Geography.

OZBOX:

- contains highly visual, informative and detailed topic cards, giving students the opportunity to read, comprehend and engage with content aligned explicitly to the Australian Curriculum
- supports effective literacy pedagogies, including guided reading
- targets specific comprehension skills
- develops students' skills and knowledge through independent and group activities and inquiries
- guides students to connect topics to their own lives, environments and experiences.

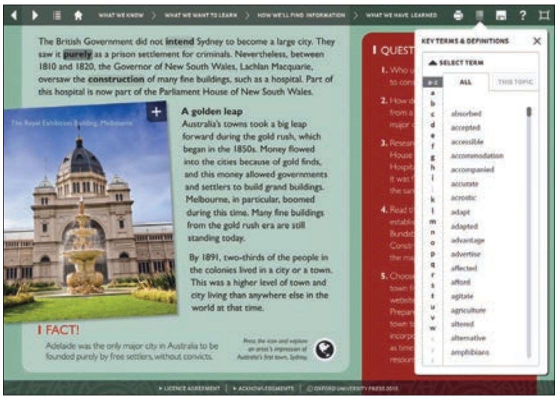
***OZBOX* – meaningful, connected learning**

Students not only create more real-world connections through integrated curriculum, but they are also actively engaged.

> ***OZBOX* – fantastic, engaging and covers the topics we are teaching ... great pictures and colour.**
>
> **– Primary Teacher, Victoria**

their own lives, environments and experiences.

What does *OZBOX* look like in the classroom?



1

Prepare and plan

- Choose your topic and evaluate students' prior knowledge with the *OZBOX* snapshot assessment.
- Select your learning activities from the online Professional Support materials and organise your groups by reading level and/or topic preferences.

2

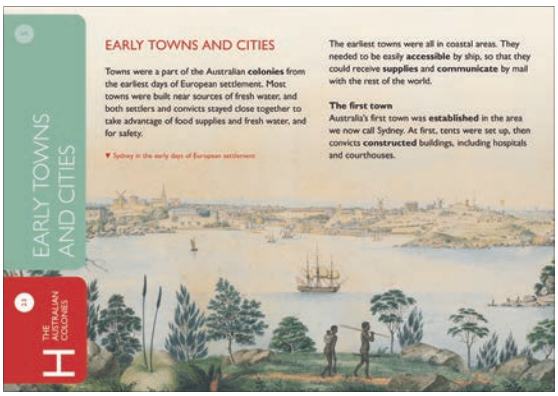
Introduce the topic

Use the online interactive cards to introduce, explore and discuss the topic as a group.

3

Explore the topic

Split the class into groups according to their reading level and/or topic preferences, and have them work through their topic card.



4

Review

Move around the class and check the students' work. Allocate extension work to students who have completed the assigned activities, using the activity sheets or other cards. Work with the struggling readers to find out where they are having trouble.

5

Evaluate

- Check student learning with the *OZBOX* snapshot assessment.
- Provide time for students to share their discoveries and reflect on activities and outcomes.

OZBOX
LEARNING THROUGH LITERACY

Look inside

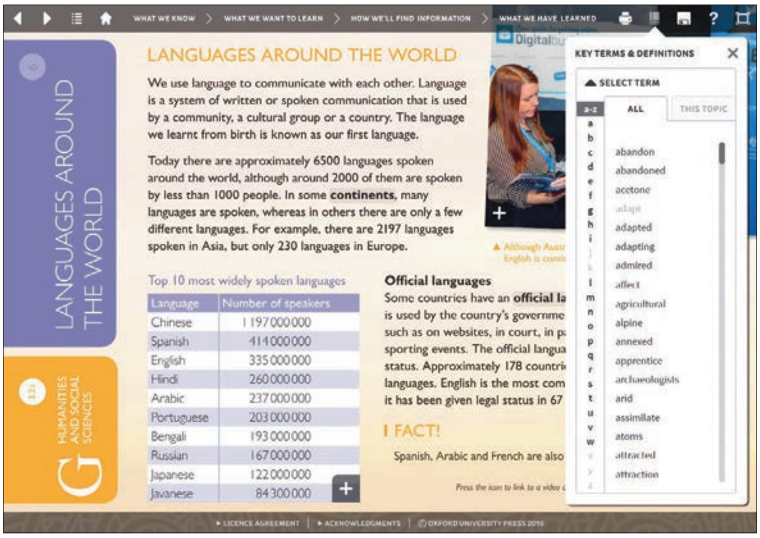
TEACHER RESOURCES

A suite of *OZBOX* online teaching resources can be found on *Oxford Owl.* Resources include:

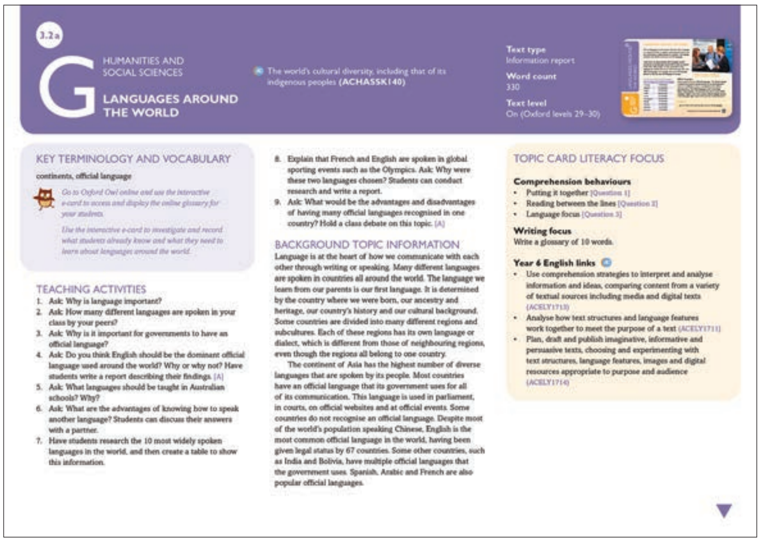
- interactive topic cards
- pre- and post-knowledge tests
- self-assessment rubrics
- graphic organisers
- activity sheets.

Each student topic card has corresponding teacher support notes, available online via *Oxford Owl.* These notes provide educators with comprehensive teaching and assessment support, including:

- explicit links to specific Australian Curriculum: Science, History and Geography content descriptions
- background topic information to save educator's time and facilitate broader classroom discussion
- identifying comprehension behaviours linked to topic card questions and teaching activities
- additional teaching activities that enable students to develop, use and demonstrate their knowledge of Australian Curriculum subject content
- explicit links to specific Australian Curriculum: English content descriptions.



OZBOX: Learning Through Literacy Year 6, Geography, interactive topic card.

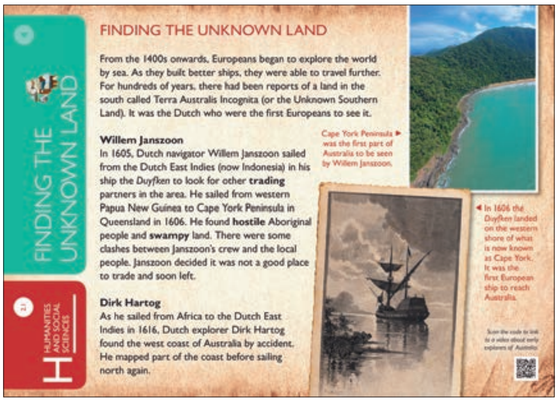


OZBOX: Learning Through Literacy Year 6, Geography, topic card teacher support notes.

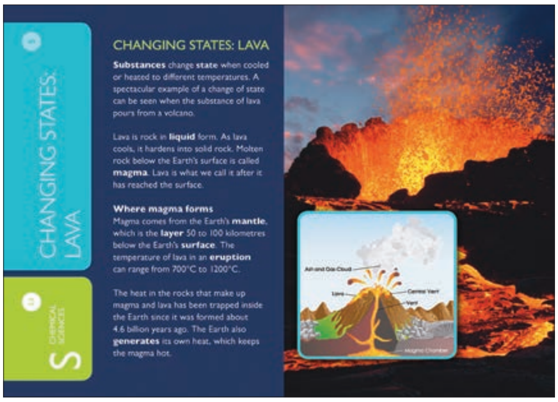
STUDENT RESOURCES

The student topic cards:

- provide opportunities for students to practise comprehension skills and strategies
- provide opportunities for students to demonstrate research and writing skills
- are suitable for shared, guided and independent reading and writing
- include QR codes that link to real-life videos, allowing for deeper learning and engagement with the subject content.



OZBOX: Learning Through Literacy Year 5, History, topic card.



OZBOX: Learning Through Literacy Year 5, Science, topic card.

OZBOX: Learning Through Literacy Year 3, Geography, topic card.

WHY FLIPPED LEARNING MAKES SENSE IN THE STEM CLASSROOM

**Andrew Douch,
Education Technology Consultant.
evolveeducation.com.au**

The current generation of STEM teachers is the first that must choose between teaching important skills and teaching urgent skills. In the past, there was no difference – the important skills were the urgent skills. Now there is a fork in the road, presenting a threshold challenge for STEM teachers that flipped classrooms can help us overcome.

'Importance' is about how much something matters. 'Urgency' is about how soon it matters. In previous generations, it was understood that the more knowledge students had when leaving school, the better their career prospects. The urgency of exam preparation incentivised students to learn the important skills that would later underpin their career success. But that is no longer true.

There is a growing, collective understanding among STEM teachers that the skills that prepared yesterday's students to thrive in a knowledge economy are inadequate preparation for today's students. As information continues to be commoditised and processes automated, retaining knowledge is less important than it once was. It is still helpful for a student to know the first 20 elements of the periodic table, but failing to know them is a much smaller handicap than it was 20 years ago. After all, you can ask Siri what the atomic mass of copper is, should you ever need that information.

I'm not saying, as some do, that knowledge has no value, or that looking something up (no matter how efficiently) is as good as remembering it. If students are ignorant on a topic, they have no filter through which to sift new information. In a 'post-truth' world, critical thinking is more valuable than ever and critical thinking is problematic for someone who lacks the context that knowledge affords. Nevertheless, YouTube is a pretty effective knowledge prosthesis.

Creativity, problem-solving, resourcefulness, computational thinking: these are skills that have always been valuable but are now at a premium. Teachers get this. Every time I mention it in a presentation I notice teachers nodding. But there seems to be a disconnect between that understanding and the way many teachers plan their classes. Many of us still spend a large portion of our class time teaching knowledge. Why? Because in November, students will sit an exam to answer questions that in any other context would be Googleable! If we have failed to prepare them for that we will have let them down. We won't have done any favours for our own reputation, either. Personally, I don't think exams effectively measure student learning in any meaningful way in 2017. But as a science teacher, I have no influence over the state's assessment processes ('God grant me the serenity...'). For as long as exams are the gate through which students must enter to pursue a STEM career, we need to hold that gate open for them.

Therein lies the dilemma we face. Do we spend our valuable class time on the most important or the most urgent things? Do we equip our students with the skills that will matter to them most, or those that will matter to them first? Do we prepare them to thrive in the economy of the future, or to thrive in the exams of November?

I don't think we can neglect either. But clearly there is insufficient time to do both.

Since we are unlikely to be given more time, we need to make more efficient use of the time we have.

This is where the flipped classroom comes in. A common criticism of the flipped classroom model is that it is still a fundamentally didactic, teacher-centred approach. I don't disagree with that – if done well, I do think that it is much more student-centred than it might seem.

Nevertheless, it is not my aim in this article to discuss different approaches to the flipped classroom model, how to do it well, nor to explain how it can be student-centred. The point I want to make, rather, is that the flipped classroom is much more efficient than traditional approaches. By taking didactic learning out of the classroom, class time is reclaimed for more 'important' learning tasks, those that prepare students for the economy of their future. At the same time, it allows students to cover the 'urgent' content they need for exams much more efficiently. They can, for example, listen to a lesson at double speed, while multi-tasking by washing the dishes (or some other mindless chore), thereby saving precious at-desk study hours for other tasks. It also makes that kind of learning demonstrably more effective.

In many ways, I think the term 'flipped learning' does a disservice to the concept of flipped learning by implying that it is the wrong way around. On the contrary, I think it should be the new normal — at least until we do away with high-stakes standardised testing.

Nobody races to the bank during lunchtime anymore to withdraw cash during bank hours. Instead, we enjoy lunch with our colleagues in the staffroom and multi-task cash-withdrawal with our grocery shopping that evening when the bank is closed. We don't call it 'flipped banking', but that is what we are doing! We are using technology to time-shift a necessary, 'urgent' errand to make more efficient use of our time, while also reclaiming our lunchtime to rest and cultivate rapport with colleagues — both of which are important but not urgent.

In the same way, the flipped classroom can lead us to a more efficient, effective future for students, equipping them with the urgent and important skills they need.

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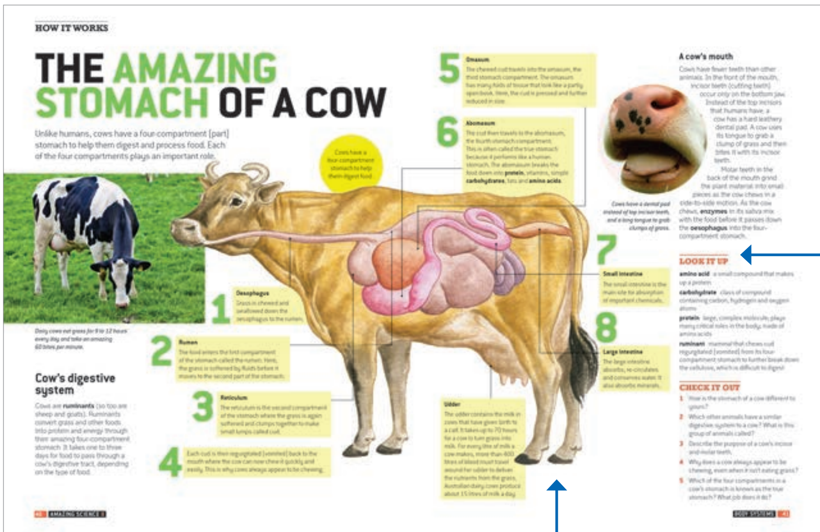

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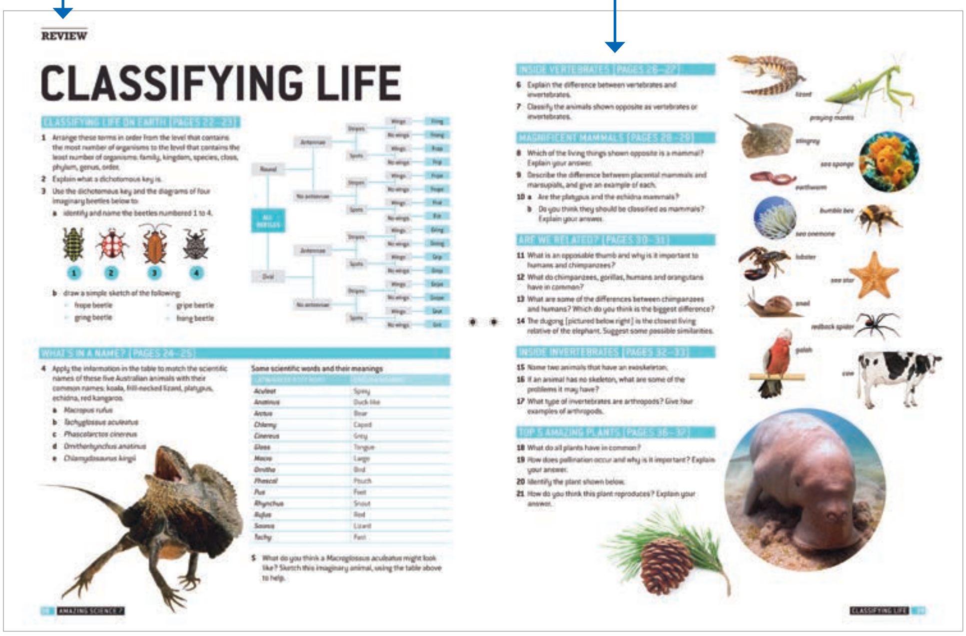

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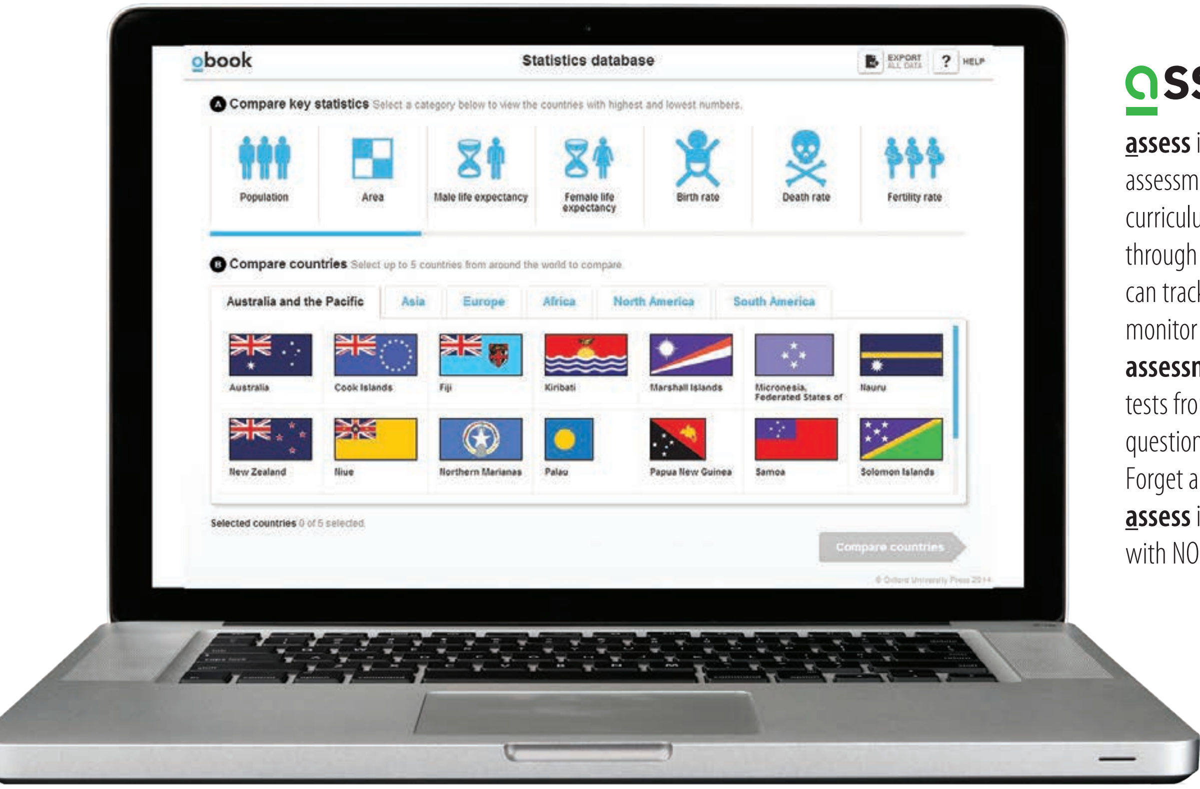

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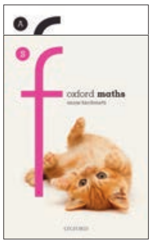

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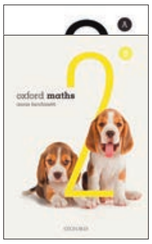

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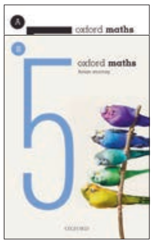

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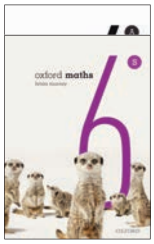

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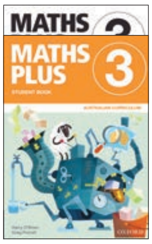

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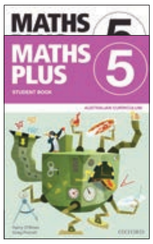

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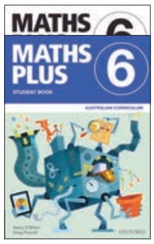

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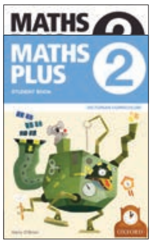

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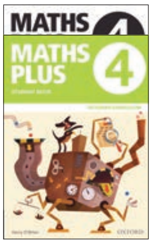

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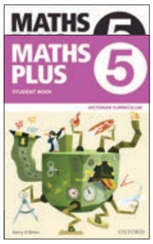

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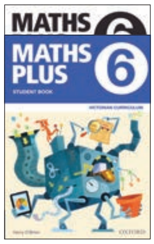

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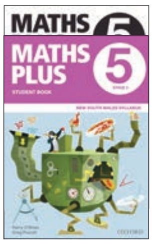

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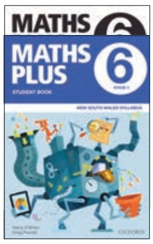

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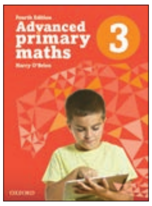

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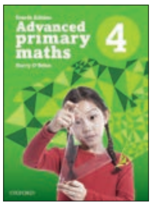

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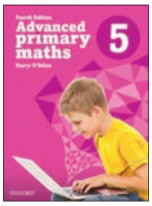

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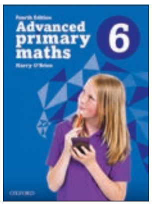

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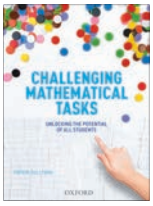

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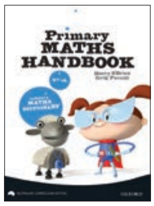

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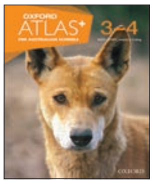

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