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Mathematics | Rationale/Aims

Rationale

Learning mathematics enriches the lives of, and creates opportunities for, all Australians. The Australian mathematics curriculum provides students with essential mathematical skills and knowledge in number and algebra, measurement and geometry, and statistics and probability. It develops the numeracy capabilities that all students need in their personal, work and civic life, and provides the fundamentals required of mathematical specialists and professional users of mathematics.

Mathematics has its own value and beauty and it is intended that students will appreciate the elegance and power in mathematical reasoning. Mathematical ideas have evolved over centuries and across all cultures and they continue to expand. Digital technologies are contributing to this expansion of ideas and provide access to new tools for continuing mathematical exploration and invention. The Australian mathematics curriculum focuses on developing increasingly sophisticated and refined mathematical understanding, fluency, logical reasoning, analytical thought processes and problem-solving skills to enable students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

The Australian mathematics curriculum ensures that the links between the various components of mathematics, and to other disciplines, are made clear. Mathematics is composed of multiple but interrelated and interdependent concepts and systems which students apply in other disciplines. In science, for example, understanding sources of error and their impact on the confidence of conclusions is vital, as is the use of mathematical models; in geography, interpretation of data underpins the study of human populations and their physical environments; in history, students need to be able to imagine timelines and time frames to reconcile relativities of related events; and in English, deriving quantitative and spatial information is an important aspect of making meaning of texts.

The curriculum is written with the expectation that schools will ensure that all students benefit from access to the power of mathematical reasoning and be able to apply their mathematical understanding creatively and efficiently. The mathematics curriculum provides students with carefully paced, in-depth study of critical skills and concepts. It encourages teachers to facilitate students to become self-motivated, confident learners through inquiry and active participation in challenging and engaging experiences.

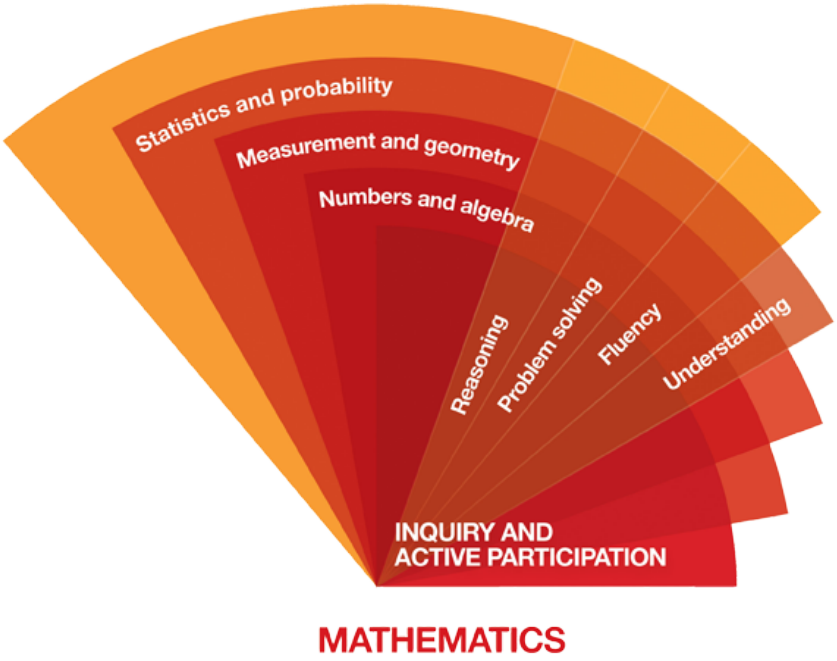
Aims

The Australian mathematics curriculum aims to ensure that students:

- are confident, creative users and communicators of mathematics, able to investigate, represent and interpret situations in their personal and work lives and as active citizens.
- develop increasingly sophisticated understanding of mathematical concepts and fluency with processes, able to pose and solve problems and reason in number and algebra; measurement and geometry; and statistics and probability.
- recognise connections between the areas of mathematics and other disciplines and appreciate mathematics as an accessible and enjoyable discipline to study.

Mathematics | Organisation

Content strands



Content structure

The *Australian Curriculum: mathematics* is organised around the interaction of three content strands and four proficiency strands.

The content strands are Number and algebra, Statistics and probability, and Measurement and geometry. They describe 'what' is to be taught and learnt.

The proficiency strands are Understanding, Fluency, Problem solving, and Reasoning, and describe 'how' content is explored or developed ie the thinking and doing of mathematics. They provide the language to build in the developmental aspects of the learning of mathematics and have been incorporated into the content descriptions of the three content strands described above. This approach has been adopted to ensure students' proficiency in mathematical skills is developed throughout the curriculum and becomes increasingly sophisticated over the years of schooling.

Content strands

Number and algebra

Number and algebra are developed together since each enriches the study of the other. Students apply number sense and strategies for counting and representing numbers. They explore the magnitude and properties of numbers. They apply a range of strategies for computation and understand the connections between operations. They recognise pattern and understand the concepts of variable and function. They build on their understanding of the number system to describe relationships and formulate generalisations. They recognise equivalence and solve equations and inequalities. They apply their number and algebra skills to conduct investigations, solve problems and communicate their reasoning.

Statistics and probability

Statistics and probability initially develop in parallel; progressively the curriculum builds the links between them. Students recognise and analyse data and draw inferences. They represent, summarise and interpret data and undertake purposeful investigations involving the collection and interpretation of data. They assess likelihood and assign probabilities using experimental and theoretical approaches. They critique the use of chance and data concepts and make reasoned judgments and decisions. They develop an increasingly sophisticated ability to critically evaluate statistical information and build intuitions about data.

Measurement and geometry

Measurement and geometry are presented together to emphasise their interconnections, enhancing their practical relevance. Students develop increasing sophistication in their understanding of size, shape, relative position and movement of two-dimensional figures in the plane and three-dimensional objects in space. They investigate properties and use their understanding of these properties to define, compare and construct figures and objects. They learn to develop geometric arguments. They make meaningful measurements of quantities, choosing appropriate metric units of measurement. They understand connections between units and calculate derived measures such as area, speed and density.

Proficiency strands

Understanding

Students build robust knowledge of adaptable and transferable mathematical concepts, make connections between related concepts and develop the confidence to use the familiar to develop new ideas, and the 'why' as well as the 'how' of mathematics.

Fluency

Students develop skills in choosing appropriate procedures, carrying out procedures flexibly, accurately, efficiently and appropriately, and recalling factual knowledge and concepts readily.

Problem solving

Students develop the ability to make choices, interpret, formulate, model and investigate problem situations, and communicate solutions effectively.

Reasoning

Students develop increasingly sophisticated capacity for logical thought and actions, such as analysing, proving, evaluating, explaining, inferring, justifying, and generalising.

Mathematics across K–12

Although the curriculum will be developed year by year, this document provides a guideline across three year-groupings:

Years K–2: typically students from 5 to 8 years of age

Years 3–6: typically students from 8 to 12 years of age

Years 7–10: typically students from 12 to 15 years of age

Senior Years: typically students from 15 to 18 years of age

What follows for each year grouping is a description of the major content emphases either as points of exposure, introduction, consolidation or extension; some of the underlying principles (and rationale) that apply in these considerations; key models or representations; and possible connections across strands and year levels.

Years K–2 (typically from 5 to 8 years of age)

The early years (5–8 years of age) lay the foundation for learning mathematics. Students at this level can access powerful mathematical ideas relevant to their current lives. Learning the language of mathematics is vital in these years.

Children have the opportunity to access mathematical ideas by developing a sense of number, order, sequence and pattern; understanding quantities and their representations; learning about attributes of objects and collections, position, movement and direction; developing an awareness of the collection, presentation and variation of data and a capacity to make predictions about chance events.

These understandings and the experiences in the early years provide a foundation for algebraic, statistical and multiplicative thinking that will develop in later years. They provide a foundation also for children to pose basic mathematical questions about their world, indentify simple strategies to investigate solutions, and strengthen their reasoning to solve personally meaningful problems.

Years 3–6 (typically from 8 to 12 years of age)

These years focus on the importance of students studying coherent, meaningful and purposeful mathematics that is relevant to their lives. Students still require active experiences that allow them to construct key mathematical ideas, but there is a trend to move to using models, pictures and symbols to represent these ideas.

The curriculum develops key understandings by extending the number, measurement, geometric and statistical learning from the early years; building foundations for future studies by emphasising patterns that lead to generalisations; describing relationships from data collected and represented, making predictions; and introducing topics that represent a key challenge in these years such as fractions and decimals.

Particularly in these years of schooling, it is important for students to develop deep understanding of whole numbers to build reasoning in fractions and decimals and develop their conceptual understanding of place value. With these understandings, students are able to develop proportional reasoning and flexibility with number through mental computation skills. These understandings extend students' number sense and statistical fluency.

Years 7–10 (typically from 12 to 15 years of age)

Traditionally, during these years of schooling, the nature of the mathematics needs to include a greater focus on the development of more abstract ideas, for example, through explorations that enable students to recognise patterns and explain why these patterns apply in these situations. From such activities abstract thoughts can develop, and the types of thinking associated with developing such abstract ideas can be highlighted.

The foundations built in the previous years, provide a solid basis for preparing for this change. The mathematical ideas built previously can be drawn upon in unfamiliar sequences and combinations to solve non-routine problems and develop more complex mathematical ideas. However, to motivate them during these years, students need an understanding of the connections between the mathematics concepts and their application in their world in contexts that are directly related to topics of relevance and interest to them.

During these years students need to be able to represent numbers in a variety of ways; develop an understanding of the benefits of algebra, through building algebraic models and applications, and the various applications of geometry; estimate and select appropriate units of measure; explore ways of working with data to allow a variety of representations; and make predictions about events based on their observations.

The curriculum lists fewer detailed topics with the intention to encourage the development of important ideas in more depth, and promote the interconnectedness of the mathematical concepts. An obvious concern is the preparation of students who are intending to continue studying mathematics in the senior secondary years. It is argued that it is possible to extend the more mathematically able students appropriately using challenges and extensions within available topics and the expectations for proficiency can reflect this. This can lead to deeper understandings of the mathematics in the curriculum and hence a greater potential to use this mathematics to solve non-routine problems they encounter at this level and at later stages in their mathematics education.

The national mathematics curriculum will be compulsory to the end of Year 10 for all students. It is important to acknowledge that from Year 10 the curriculum should enable pathway options that will need to be created and available for all students. This will enable all students to access one or more of the senior years' mathematics courses.

Senior Years (typically from 15 to 18 years of age)

Four mathematics courses have been designed for the senior years. The senior years curriculum content is organised around major topics relevant to the purposes of each course and the student cohort for which it has been designed. The elements of the content strands from K-10 are evident the senior years curriculum content, but are not used as the major organisers. The proficiency strands of understanding, fluency, reasoning and problem solving are integrated into the content descriptions as in the K -10 curriculum.

Essential Mathematics focuses on using mathematics to make sense of the world. The emphasis is on providing students with the mathematical skills and understanding to solve problems and undertake investigations in a range of workplace, personal, training and community settings. There is an emphasis on the use and application of information and communication technologies in the course.

General Mathematics is designed to equip students with the confidence, understanding, skills and strategies to apply mathematical techniques to the analysis and solution of problems. The course provides an introduction to some areas of discrete mathematics, including non-calculus methods of optimisation. It is designed for students wishing to undertake further studies in areas such as agricultural, health and social sciences, business and education. Statistics and financial mathematics and their applications are important parts of this course.

Mathematical Methods focuses on function, calculus and statistics and the course provides a strong foundation for further studies in disciplines in which mathematics has an important role, including economics, political and social sciences and all branches of physical and biological sciences.

Specialist Mathematics is designed for students with a strong interest in mathematics including those intending to study mathematics, physical sciences or engineering at university. The course focuses on functions and calculus, building on the ideas presented in the third course. It introduces vectors, complex numbers and recursive methods.

Relationship between the senior secondary courses

The four senior mathematics courses have been designed to allow flexibility for students, in consideration of a range of future pathways, and in recognition that some students reassess their choice of mathematics program partway through the senior years.

Essential Mathematics has been designed as standalone course. However it also provides for students who may wish begin at unit 2 or 3, having previously not studied mathematics in the senior years or have studied units 1 and/or 2 of General Mathematics.

General Mathematics has been designed as a standalone course or studied in conjunction with Mathematical Methods. Students may choose to move from General Mathematics to Essential Mathematics at the end of Unit 1 or 2.

Mathematical Methods has been designed as a standalone course or to be taken in conjunction with General Mathematics or with Specialist Mathematics.

Specialist Mathematics is designed to be taken in conjunction with Mathematical Methods. There has been consideration given to students who have studied units 1 and 2 in Mathematical Methods to enter Specialist Mathematics at unit 3.

Implications for teaching and learning K-12

In mathematics, challenging problems can be posed using basic content, and content acceleration may not be the best way to extend students. Choosing engaging experiences as contexts for a variety of tasks assists in making mathematics inclusive, differentiating both for students experiencing difficulty and those who complete tasks easily. The proficiency strands apply expectations of the range and nature of how mathematical content is enacted, and can help in focusing teaching.

Teachers should base their teaching on what the students already know, should make explicit the subsequent key ideas, should ensure tasks are posed at an appropriate level of challenge, and should offer feedback on activities, standards and directions as often as possible.

The development of key ideas across the years enables teachers to make informed classroom decisions, including the use of digital technologies to enhance the relevance of mathematics content and processes for learning.

General capabilities

The Australian Curriculum, Assessment and Reporting Authority (ACARA) has identified 10 general capabilities that will be specifically covered in the curriculum. In mathematics, there is specific reference to five of these in the content descriptions and achievement standards.

Literacy is an important aspect of mathematics. There is a particular way of writing and interpreting mathematical texts. Students will be taught to interpret mathematical symbols, understand the meaning of the language of mathematics and to read and write reports of their investigations.

Numeracy is fundamentally the responsibility of mathematics and is applied in other learning areas. It is crucial that the mathematics curriculum provides the opportunity to apply mathematical understanding and skills in context, both in other learning areas and in real world contexts. A particularly important context for the application of number and algebra is financial mathematics. In measurement and geometry there is an opportunity to apply understanding to design. The world in the 21st century is information driven and statistics and probability provide opportunities for students to interpret data and make informed judgements about events involving chance.

Information and communication technologies (ICT) allow students to solve problems and perform tasks that previously have been onerous. Calculators of all types from the simple four operations versions to the more complex graphical and CAS calculators allow students to make calculations, draw graphs and interpret data in ways that previously have not been possible. There are spreadsheets, dynamic geometry programs and other software that can engage students and promote understanding of key concepts. It is expected that mathematics classrooms will make use of all available ICT in teaching and learning situations. Notwithstanding this, there will be occasions where teachers will ask students to undertake tasks without using the technology. For example, it is still important for students sometimes to make geometric

constructions using a ruler and compass or to work out calculations using mental or written strategies.

Thinking skills are key to developing mathematical understanding. This general capability overlaps with the mathematics proficiency strands of reasoning and problem solving. The mathematics curriculum is designed to promote students thinking and reasoning about solutions to problems and the strategies they can use to find these solutions. Students will be encouraged to be critical thinkers, justifying for example, their choice of a particular calculation strategy or identifying the questions that need to be asked and answered when undertaking a statistical investigation.

Creativity is the essence of mathematical problem solving. The mathematics curriculum encourages approaching problems in different ways. For example, by identifying that a problem is similar to a previous one; that drawing diagrams could help; or that simplifying a problem to control some variables is a way of understanding and arriving at a solution.

The other general capabilities of self-management, teamwork, intercultural understanding, ethical behaviour and social competence are all relevant to the pedagogy used by teachers of mathematics.

It is important that students are encouraged to take responsibility for their own learning in mathematics and work collaboratively in teams. *Teamwork* should be inherent in explorations and investigations, which are essential processes through which students learn to be mathematicians. There is also the opportunity for students to use mathematics to examine issues of *ethical behaviour* and *social competence*.

Intercultural understanding can be enhanced if students are exposed to other cultures' view of mathematics, for example, through examining Aboriginal and Torres Strait Islander peoples' perceptions of time and weather patterns, the networks embedded in family relationships and the algebraic concepts inherent in storytelling. It is equally important for mathematics classes to explore the influences and contributions of many cultures, from the early work on geometry by the philosophers of ancient Greece to the origins of algebra that can be found in ancient Indian mathematics.

Cross-curriculum dimensions

Cross-curriculum dimensions are not explicitly tagged in the content descriptions.

The *Indigenous history and culture* dimension is included in the elaborations. It is imperative that all Australian students learn from the wisdom of the first Australians. For example, when considering the idea of seasons in measurement and geometry, the European tradition of four seasons can be compared and contrasted with the different constructs used by Aboriginal and Torres Strait Islander people in different parts of the country. The idea of using symbols as a way of generalising relationships can be enhanced by drawing on the perspectives of Indigenous Australians.

The cross-curriculum dimension of commitment to *sustainability* and the knowledge and understandings related to *Asia and Australia's engagement with Asia* provide engaging and rich contexts for mathematics learning.

Links to other learning areas

The Australian National Numeracy Review Report (2008) identified numeracy as requiring an across-the-school commitment, including mathematical, strategic and contextual aspects. This across-the-school commitment can be managed by including specific reference to other curriculum areas in the mathematics curriculum, and identification of key numeracy capacities in the descriptions of other curriculum areas being developed. For example, the following are indications of some of the numeracy perspectives that could be relevant to history, English, and science.

English: One aspect of the link with English and literacy is that, along with other elements of study, numeracy can be understood and acquired only within the context of the social, cultural, political, economic and historical practices to which it is integral. Students need to be able to draw on quantitative and spatial information to derive meaning from certain types of texts encountered in the subject of English.

Science: Practical work and problem solving across all the sciences require the capacity to: organise and represent data in a range of forms; plot, interpret and extrapolate graphs; estimate and solve ratio problems; use formulas flexibly in a range of situations; perform unit conversions; and use and interpret rates including concentrations, sampling, scientific notation, and significant figures.

History: Learning in history includes interpreting and representing large numbers and a range of data such as those associated with population statistics and growth, financial data, figures for exports and imports, immigration statistics, mortality rates, war enlistments and casualty figures, chance events, correlation and causation; imagining timelines and timeframes to reconcile relativities of related events; and the perception and spatial visualisation required for geopolitical considerations, such as changes in borders of states and in ecology.

Use of technology

The *Shape of the Australian Curriculum – Mathematics* states that available technology should be used for teaching and learning situations. Technology can include computer algebra systems, graphing packages, financial and statistical packages and dynamic geometry. These can be implemented through either a computer or calculator.

Technology can aid in developing skills and allay the tedium of repeated calculations. For example a technology can be used to complete recursive calculations.

There are many resources available on the internet and in state and territory portals that also have application for learning in the senior mathematics courses.

The decision about using technology in assessment programs is not within the province of the curriculum, jurisdictional assessment agencies will make that decision.

Mathematics | Strands

Kindergarten Content descriptions

Number and Algebra

1. Counting

Say, understand and reason with number sequences, initially to and from 20, and then beyond, moving to any starting point

2. Numeration

Understand numbers to 10, including matching number names, numerals and quantities, and work fluently with small numbers including subitising and partitioning

3. Comparing collections

Compare and order collections, initially to 20, and then beyond, and explain reasoning

4. Addition and subtraction

Model, represent and solve problems concerning additive and sharing situations involving combining, change and missing elements

5. Pattern

Sort and classify familiar objects, explain reasons for these classifications and copy, continue and create patterns with objects and drawings

Statistics and Probability

1. Data representation

Collect, represent and interpret data from simple questions with objects and drawings where one object or drawing represents one data value

2. Data investigation

Solve problems by collecting data and answering questions about obvious attributes of themselves and familiar objects and events

Measurement and Geometry

1. Geometry

Sort, describe, name, and represent familiar two-dimensional shapes and three-dimensional objects in the environment

2. Comparison

Use direct and indirect comparison to decide which is longer, heavier and holds more and explain reasoning in everyday language

3. Time

Read time on the hour on digital and analogue clocks, and make connections between common sequences such as days of the week and other familiar events and actions

4. Location

Describe the position and movement of objects, including themselves

Achievement standard (Kindergarten)

By the end of Kindergarten, students are able to confidently recall the sequence of numbers to 20, matching names and numerals and find the total of small collections by counting. They subitise small quantities, partition numbers to 10 and use one-to-one relations to share and count out quantities. Students collect data from straightforward questions about themselves and familiar events and, with assistance, can organise this data. They readily use everyday language to describe measurements found by direct comparison and sort and classify familiar shapes.

Year 1 Content descriptions

Number and Algebra

1. Counting

Say, understand and reason with number sequences to and from 100 by ones from any starting point, and say number sequences of twos, fives and tens starting from zero

2. Numeration

Recognise, model and represent numbers to 100, and read, write and order those numbers

3. Place value

Understand and work fluently with counting collections to 100 by grouping in tens, and counting the tens, and use place value to partition and regroup those numbers

4. Fractions

Understand one-half as one of two equal parts, and recognise and create halves of collections

5. Addition and subtraction

Model, represent and solve problems involving additive and sharing situations using efficient strategies including counting on

6. Number patterns

Copy, continue, create and describe patterns with objects and numbers to 100

Statistics and Probability

1. Data representation

Represent data using pictographs where one picture represents one data value

2. Data interpretation

Read and make connections between lists, tables and pictographs

3. Chance

Identify outcomes arising from familiar chance events and describe using everyday language such as yes, no or maybe

Measurement and Geometry

1. Geometry

Recognise, visualise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features such as number of corners or faces or length of sides

2. Length and capacity

Measure length and capacity using uniform informal units and compare measures explaining reasoning in everyday language

3. Time

Read analogue and digital clocks to the half hour and describe duration using months, weeks, days and hours

4. Money

Recognise, describe and order Australian coins

5. Location

Give and follow directions to familiar locations

Achievement standard (Year 1)

By the end of Year 1, students are able to quantify collections to 20 and can count forwards and backwards to 100. They understand and are fluent with partitioning numbers to 10. They can read, write, order and model two-digit numbers and understand that these numbers are comprised of units of tens and ones. They are beginning to understand the relationship between addition and subtraction and use this knowledge to model and solve simple additive problems. Students collect data about themselves and their peers and represent these data in lists, tables and pictographs. They use everyday language to describe simple geometry and measurement ideas and use uniform informal units to measure and compare length and capacity and use hours and half-hours to describe time.

Year 2 Content descriptions

Number and Algebra

1. Counting

Say, understand and reason with number sequences increasing by twos, fives and tens from any starting point including using calculators

2. Numeration

Recognise, model and represent numbers to 130, and read, write and order those numbers

3. Place value

Work fluently with counting increasingly larger collections up to 1000, grouping in hundreds and tens and counting the tens and hundreds and use place value to partition and regroup these numbers

4. Fractions

Recognise and interpret common uses of halves, quarters and thirds of everyday shapes, objects and collections

5. Addition and subtraction

Model, represent and make connections between simple additive situations, solving them using efficient written and calculator strategies and explaining the choice of strategy

6. Multiplication and division

Model, represent and make connections between simple multiplicative situations such as groups of, arrays, sharing, solving them using efficient mental and written strategies and calculators and explaining their choice of strategy

7. Number patterns

Copy, continue, create and describe patterns with numbers, especially place value patterns and identify missing elements

Statistics and Probability

1. Data representation

Record data using tallies and represent data using tables, pictographs and bar and column graphs

2. Data interpretation

Read and make connections between lists, tables and graphs showing data from familiar contexts, and explain interpretations

3. Chance

Experiment with chance devices and describe outcomes as likely or unlikely and identify some events as certain or impossible

Measurement and Geometry

1. Geometry

Describe features of two-dimensional shapes and three-dimensional objects, draw them and use materials to make models of these

2. Metric units

Measure and compare length and capacity using uniform informal and familiar metric units and measure mass using balance scales with familiar metric units

3. Area

Compare the area of regular and irregular shapes directly

4. Time

Read analogue and digital clocks to the quarter hour and to use a calendar to identify the date, and name and order months and seasons

5. Money

Count and order small collections of Australian coins

6. Transformations

Predict and draw the effect of 1-step sliding, flipping and turning of familiar shapes and objects including using digital technology and identify half and quarter turns from any starting point

7. Location

Interpret simple maps of familiar locations such as the classroom to identify the relative position of key features

Achievement standard (Year 2)

By the end of Year 2, students are able to understand the sequence of numbers to 130, recognising patterns in units of 10 and 100. They apply this understanding to efficiently represent collections larger than 100 and to partition numbers into units of tens and ones. They describe and connect patterns of twos, fives and tens, solve multiplicative problems and model everyday simple functions. Students describe events produced by simple chance devices and understand different ways of representing data. Students compare lengths, capacities and masses using informal units and familiar metric units and areas by direct comparison. They identify and describe properties of familiar shapes and objects, can visualise and represent them, and can use simple maps.

Year 3 Content descriptions

Number and Algebra

1. Counting

Understand and reason with number sequences increasing and decreasing by twos, fives and tens from any starting point, moving to other sequences, emphasising patterns and explaining relationships

2. Numeration

Recognise, model, represent and visualise numbers initially to 1000 and then beyond, and read, write and order those numbers

3. Place value

Justify various uses of the place value system to describe numbers to 1000, using the hundreds and tens as units, and to partition and regroup those numbers to assist calculation and solve problems

4. Addition and subtraction

Model, represent and solve problems involving additive situations using efficient mental and written strategies and calculators

5. Multiplication and division

Model, represent and solve problems involving multiplicative situations including 'for each' and 'times as many' using efficient mental and written strategies and calculators

6. Fractions

Solve problems involving everyday uses of fractions as equal parts of regular shapes or collections and as numbers, building connections between the number of parts and the size of the fraction

7. Calculation

Understand and become fluent with addition and related subtraction facts to 10 plus 10 and multiplication facts of 1, 2, 5 and 10

8. Number patterns

Copy, continue, create, describe and identify missing elements in patterns with numbers including patterns resulting from performing one operation and place value patterns

Statistics and Probability

1. Data investigation

Investigate data-oriented questions about familiar situations, predict what the data might show, carry out the investigation and report the results

2. Data representation

Construct, read and make connections between tables, diagrams and graphs including dot plots with prepared baselines

3. Chance

Conduct chance experiments and recognise that there will be variation in results as well as having expected outcomes

Measurement and Geometry

1. Symmetry

Use symmetry, identifying its occurrence in the environment to create symmetrical patterns, pictures and shapes

2. Metric units

Use direct and indirect comparison to order and compare objects by length and develop ‘real life’ benchmarks for familiar metric units of length, mass and capacity including centimetre, metre, kilogram and litre

3. Area

Measure and compare areas using uniform informal units, explaining reasoning in everyday language

4. Time

Read analogue and digital clocks to the five minutes and compare and order events according to their duration

5. Money

Represent money values in multiple ways and count out the change of simple transactions

6. Angles

Create angles and recognise that equivalence in angles such as two quarter turns is the same as a straight angle

7. Location

Create and interpret simple maps to show position and pathways between objects

Achievement standard (Year 3)

By the end of Year 3, students are able to understand place value to 1000 and connect this to comparing and ordering length, mass and capacity. They apply this understanding to choose efficient strategies (mental, written and calculator) to solve problems in everyday situations. They understand the relationship between the number of parts and the size of fractions, and use this understanding to solve everyday problems including describing quarter and half turns. They use number patterns including those found in the multiples of 2, 5 and 10 and apply these in contexts such as reading clocks to five minutes and using money. Students collect, represent and interpret data in tables, graphs and diagrams and conduct simple chance events. Students estimate and order length, mass and capacity using personal benchmarks. They use symmetry in designs and can represent positions and direction using simple maps.

Year 4 Content descriptions

Number and Algebra

1. Factors and multiples

Work and reason with number sequences increasing and decreasing from any starting point, and to recognise multiples of 2, 5, 10 and factors of those numbers

2. Numeration

Recognise, represent, visualise and work fluently with reading, writing and ordering numbers to 1 million

3. Place value

Justify various uses of the place value system to describe large numbers, and to partition and regroup those numbers to assist calculation and solve problems

4. Fractions

Compare and contrast everyday uses of halves, thirds, quarters, fifths, eighths and tenths, work fluently with renaming to find equivalent fractions and solve problems involving fractions as operators

5. Counting – fractions

Understand fractions as rational numbers, including working fluently with counting by quarters, and halves including with mixed numbers, and representing these numbers on a number line

6. Multiplication and division

Understand and become fluent with multiplication facts and related division facts of 2, 3, 5 and 10 extending to 4, 6, 8 and 9

7. Calculation

Select, explain, justify and apply mental, written strategies and use calculators to solve problems involving addition, subtraction and multiplication with one- and two-digit numbers and division by one digit numbers without remainders

8. Number patterns

Copy, continue, create, describe and identify missing elements in patterns with numbers including large numbers as well as patterns resulting from performing two operations

Statistics and Probability

1. Data investigation

Plan and undertake surveys, such as with the whole class, to answer questions posed, represent the data and report the results, including using ICT

2. Data representation

Construct, read, interpret and make connections between tables and simple graphs with many-to-one correspondence between data and symbols, including using ICT

3. Chance

Predict the outcomes of chance experiments involving equally likely events, and compare and contrast the predictability of outcomes of experiments with small numbers of trials to those with large numbers including using ICT to generate the trials

4. Unequal outcomes

Justify representations of simple situations with unequal outcomes such as constructing spinners using technology

Measurement and Geometry

1. Geometry

Generalise about the two-dimensional shapes that form the surfaces of common three-dimensional objects and make connections with the nets of these objects justifying reasoning

2. Metric units

Use metric units to estimate, measure and compare the length, mass and capacity of familiar objects reading scales to the nearest graduation

3. Area and volume

Measure and compare area using familiar metric units and compare volumes using uniform informal units

4. Time

Read analogue and digital clocks to the minute, understand equivalent representations of 12-hour time, and sequence daily and weekly events

5. Angle

Describe the connection between turns and angles and create and classify angles as equal to, greater than or less than a right angle

6. Location

Create, interpret and use basic maps using simple scales and legends and directions such as left, right, forward and backward

7. Visualising

Visualise the result of combining and splitting shapes and to represent all possible combinations of small numbers of triangles and squares

Achievement standard (Year 4)

By the end of Year 4, students are fluent with and evaluate the efficiency of mental and written strategies with one- and two-digit numbers and use these to solve problems. They identify and describe number patterns involving one or two operations and can find missing numbers in these patterns. Students pose questions that can be answered by data and plan and undertake data investigations, including the analysis of secondary data sets. They report their results using tables and graphs using one to one relationships between the data and the representation and evaluate their investigation. They can describe likelihood of familiar chance events using everyday language. They fluently choose appropriate tools and metric units to measure and compare the length, mass and capacity of objects and compare volumes using informal units. They can read scales to the nearest graduation. Their understanding of time extends to reading clocks to five minute intervals and to sequencing daily and weekly events, interpreting calendars and estimating duration. They confidently classify angles as equal to, greater than or less than a right angle and use these classifications to solve problems. They can identify obvious features of shapes and objects and visualise results of combining small numbers of squares and triangles.

Year 5 Content descriptions

Number and Algebra

1. Decimals

Recognise and represent numbers involving tenths and hundredths; read, write and order those numbers and connect them to fractions

2. Place value

Justify various uses of the place value system to describe decimal numbers, and to partition and regroup those numbers to assist calculations and solve problems

3. Fractions and decimals

Solve problems involving making comparisons using equivalent fractions and decimals and everyday uses of percentages, relating them to parts of 100 and hundredths

4. Multiplication and division

Solve realistic problems involving multiplicative situations with large numbers including division by one-digit numbers

5. Fractions

Understand and become fluent with and solve realistic additive problems involving addition and subtraction of fractions with the same or related denominators and fractions as operators

6. Estimation

Use estimation and rounding to check the reasonableness of answers

7. Algebraic thinking

Copy, continue, create and describe patterns with numbers and use graphs, tables and rules to describe those patterns

8. Factors and multiples

Identify and describe properties of numbers including factors, multiples and composites and solve problems involving those properties

Statistics and Probability

1. Data investigation

Solve problems involving the collection of data over time, carry out the investigation and report the results, including using ICT, and justify conclusions about the relationship between the variables

2. Summary statistics

Identify the mode and median in lists and on dot plots

3. Data representations

Use and compare the effectiveness of a range of data representations including for specific situations

4. Chance

Quantify chance with fractions, and apply this to investigate complementary events

Measurement and Geometry

1. Geometry

Make connections between different types of triangles and quadrilaterals using their features, including symmetry and explain reasoning

2. Time

Solve realistic problems involving time duration including using 12- and 24-hour time

3. Scales

Read and interpret scales using whole numbers of metric units for length, capacity, mass and temperature

4. Perimeter, area, volume

Explore different ways of calculating perimeter and area of rectangles and volume of rectangular prisms using metric units

5. Transformations

Visualise, demonstrate and describe the effects of translations, reflections, and rotations of two-dimensional shapes and describe line and simple rotational symmetry, including using ICT

6. Location

Describe locations and routes using a coordinate system such as road maps, the four main compass directions and the language of direction and distance

Achievement standard (Year 5)

By the end of Year 5 students are able to describe the place value system for whole numbers and can extend its use to two decimal places. Students choose efficient mental and written strategies for calculations with whole numbers, solve additive problems with fractions and relate fractions to decimals and percentages. Students choose appropriate graphs for single variable data, and begin to represent change in data over time. They use representation of single variable data to describe distributions including the use of median, mode and range. They use measurements effectively including time and can devise and use efficient ways of calculating perimeter, area and volume. They can describe

locations and routes and describe and demonstrate the effects of transformations.

Year 6 Content descriptions

Number and Algebra

1. Integers

Read, represent, write, interpret and order positive and negative integers

2. Decimals

Recognise and represent numbers involving thousandths, read, write and order those numbers, and connect them to fractions

3. Place value

Justify uses of the place value system to describe decimal numbers, and to partition and regroup those numbers to assist calculation and solve problems

4. Multiplication and division

Apply multiplication and related division facts to solve realistic problems efficiently using mental and written strategies and calculators justifying the reasonableness of answers and explaining reasoning

5. Ratio and rate

Recognise and solve problems involving unit ratio and everyday rates and check for reasonableness of answers

6. Decimals

Understand and work fluently with decimal numbers to thousandths, and multiply and divide numbers including decimals by whole numbers to solve additive problems, including using technology

7. Fractions

Understand and work fluently with and solve additive problems involving fractions with unrelated denominators, compare and contrast fractions using equivalence

8. Estimation

Estimate the outcomes of calculations involving decimal numbers and justify the reasonableness of answers

9. Number properties

Identify and describe properties of numbers including prime, composite and square numbers

Statistics and Probability

1. Data representation

Construct, read and interpret tables and graphs including ordered stem and leaf plots, and construct pie charts and other simple data displays including using technology

2. Data interpretation

Interpret secondary data presented in the media and elsewhere, identifying misleading representations and distinguishing between samples and populations

3. Variation

Explore concepts of variation and error by collecting repeated measurements

4. Chance

List all outcomes for chance events and quantify probabilities using simple fractions, decimals and percentages

Measurement and Geometry

1. Geometry

Visualise and solve problems relating to packing and stacking

2. Measurement

Solve problems involving comparison of length, area, volume and other attributes using appropriate tools, scales and metric units

3. Metric System

Work fluently with the metric system to convert between metric units of length, capacity and mass, using whole numbers and commonly used decimals

4. Angles

Estimate, compare and measure angles

5. Time

Create, interpret and use timetables and timelines including calculating elapsed time

6. Measurement formulas

Understand and use the formulas for calculating perimeters and areas of rectangles, and volumes of rectangular prisms

7. Transformation and symmetry

Describe patterns in terms of reflection and rotational symmetry, and translations including identifying equivalent transformations using ICT

8. Location

Describe and interpret locations and give and follow directions, using scales, legends, compass points, including directions such as NE and SW, distances, and grid references

Achievement standard (Year 6)

By the end of Year 6, students are able to work with numbers including fractions and decimals to thousandths and apply their place value understanding to establish equivalences. They confidently solve realistic problems including those involving rate and ratio choosing appropriately written and mental strategies or calculators. They use estimation strategies to predict and check reasonableness of calculations. Students represent data choosing appropriate displays including stem and leaf plots and distinguish between sample and population data. They are beginning to quantify probability. Students can visualise and connect two- and three-dimensional shapes and objects. Their facility with maps extends to the use and interpretation of scales and legends. They are beginning to connect algebra and measurement, understanding the basis for formulas for perimeter, area and volume of simple polygons and rectangular prisms.

Year 7 Content descriptions

Number and Algebra

1. Indices

Understand and work fluently with index notation and represent whole numbers as a product of powers of prime numbers

2. Integers

Order, add and subtract integers fluently and identify patterns for multiplication and division including using ICT

3. Calculation

Understand and become fluent with written, mental and calculator strategies for all four operations with fractions, decimals and percentages

4. Variables

Apply the associative, commutative and distributive laws and the order of operations to mental and written computation and generalise these processes using variables

5. Linear equations

Use symbols to represent linear relationships and solve problems involving linear relationships where there is only one occurrence of a variable

6. Coordinates

Plot points on the Cartesian plane using all four quadrants

Statistics and Probability

1. Data measures

Determine mean, median, and range and use these measures to compare data sets explaining reasoning including using ICT

2. Data investigation

Investigate questions involving the collection of univariate and simple bivariate data, including the use of back-to-back stem plots and scatter plots

3. Sample space

Construct sample spaces for single-step experiments with equally likely outcomes and use them to assign probabilities

4. Relative frequency

Calculate relative frequencies, and recognise variation between results of chance experiments

Measurement and Geometry

1. Geometry

Describe the properties of parallel and perpendicular lines, triangles and quadrilaterals to classify them and make geometric constructions including angle bisectors and perpendicular bisectors

2. Measurement formulas

Relate the formula for calculating the area of triangles to the formula for rectangles and parallelograms, to develop the formula for the volume of rectangular prisms, and use these to solve problems

3. Transformations

Visualise, demonstrate and describe translations, reflections, rotations and symmetry in the plane, including using coordinates and ICT

4. Time

Calculate duration using 12- and 24-hour time, explain and use time zones

5. Location

Interpret and create maps and plans, including using legends and scales, describe relative position, and plan journeys

Achievement standard (Year 7)

By the end of Year 7, students work fluently with index notation. They are able to use the operations to calculate accurately with integers, fractions and decimals, choosing appropriate operations when solving problems, and correctly applying the order of operations. They extend this understanding to algebraic representations, selecting and applying formulas for area and volume and begin to generalise arithmetic patterns, including linear functions, representing them algebraically and graphically. Students conduct systematic data-based enquiry using univariate and bivariate data, choosing appropriate graphs, calculating measures of spread and centre and drawing conclusions. They identify equally likely outcomes and calculate probabilities and relative frequencies from data. Students have a sound understanding of the geometric properties of angles, triangles and quadrilaterals and two-dimensional views of three-dimensional objects. They are beginning to construct logical geometric arguments about properties of triangles and quadrilaterals.

Year 8 Content descriptions

Number and Algebra

1. Ratio and rate

Solve problems involving use of percentages, rates and ratios, including percentage increase and decrease and the unitary method and judge reasonableness of results

2. Index laws

Understand, describe and use generalisations of the index laws with positive integral indices

3. Calculation

Solve problems involving fractions, decimals and percentages, including those requiring converting and comparing, and judge the reasonableness of results using techniques such as rounding

4. Algebra

Generalise the distributive law to expansion and factorisation of simple algebraic expressions and use the four operations with algebraic expressions

5. Linear equations

Create, solve and interpret linear equations, including those using realistic contexts using algebraic and graphical techniques

6. Coordinates

Plot graphs of linear functions and use these to find solutions of equations including using ICT

Statistics and Probability

1. Statistical measures

Use a mean or median from a sample to estimate the mean or median of a population and to recognise the limitations of samples

2. Data investigation

Collect samples and construct tables and graphs including frequency column graphs with and without technology for grouped data, and to select and justify the choice of measure of centre and spread used

3. Probability

Identify complementary events and use the facts that probabilities range between 0 and 1 and sum to 1 over the sample space to check probabilities

4. Representing probability

Use Venn diagrams or two-way tables to illustrate 'and', 'or', 'given' and 'not' criteria, and to calculate simple probabilities

Measurement and Geometry

1. Congruence

Identify properties and conditions for congruence of plane figures, and use coordinates to describe transformations

2. Measurement formulas

Generalise from the formulas for perimeter and area of triangles and rectangles to investigate relationships between the perimeter and area of special quadrilaterals and volumes of triangular prisms and use these to solve problems

3. Circles

Investigate the relationship between features of circles such as circumference, area, radius and diameter and generalise these to solve problems involving circumference and area

4. Congruence

Explain properties for congruence of triangles and apply these to investigate properties of quadrilaterals

5. Location

Solve problems involving interpreting and creating maps and plans using scales

6. Visualisation

Create, interpret and use two-dimensional representations of three-dimensional objects, including projections, isometric views and plans

7. Pythagoras

Use Pythagoras theorem to solve simple problems involving right-angled triangles

Achievement standard (Year 8)

By the end of Year 8, students are able to use number, algebraic conventions and formulas and apply this understanding to problem solving with ratios and scale, percentage increase and decrease, perimeters and areas of triangles, quadrilaterals and circles and volumes of triangular prisms. Students readily connect tabular, graphical and algebraic representations of linear functions, and choose appropriate models for solving real life problems. They use numerical and graphical summaries of data, interpret these to draw conclusions and calculate probabilities. They apply mathematical reasoning including congruence and transformations to solve geometric problems and generalise formulas for the perimeter for triangles and rectangles to other quadrilaterals and develop understanding of the volumes of simple prisms. They are able to visualise three-dimensional objects from two-dimensional representations including isometric drawing and plans.

Year 9 Content descriptions

Number and Algebra

1. Financial maths

Solve problems in financial mathematics including applications of simple and compound interest including using ICT and judge reasonableness of results

2. Index laws

Work fluently with index laws, in both numeric and algebraic expressions and use scientific notation, significant figures and approximations in practical situations

3. Linear and quadratic functions

Understand simplification techniques for linear and quadratic functions including collecting like terms, common factors, the expansion of binomial products and simple binomial factorisation

4. Linear equations

Solve problems involving linear equations and inequalities and substitution into, and rearrangement of formulas

5. Simultaneous equations

Solve problems involving linear simultaneous equations, using algebraic and graphical techniques including using ICT

Statistics and Probability

1. Data investigation

Investigate problems requiring data-based inquiry, collecting univariate and bivariate data, including from secondary sources, and justify conclusions

2. Sample space

Calculate probabilities for two- and three-step experiments with equally likely outcomes which involve ‘with replacement’ and ‘without replacement’

3. Probability

Compare theoretical and experimental probabilities for two- and three-step experiments

4. Sampling

Evaluate non-random and random sampling techniques

Measurement and Geometry

1. Geometry

Investigate properties of polygons and circles, including lines and angles, forming generalisations, explaining reasoning and solving problems

2. Pythagoras

Solve problems involving right angled triangles using Pythagoras’ theorem and trigonometric ratios and justify reasoning

3. Similarity

Apply transformations to triangles to explain similarity and congruence, to establish geometric properties

4. Circles

Solve problems involving circumference and area of circles and part circles, and the surface area and volume of cylinders and composite solids

5. Location

Interpret and create maps and plans, including relative location, directions and bearings, and optimal paths

6. Visualisation

Construct and identify elevations and cross-sections of three-dimensional objects, and explain reasoning

Achievement standard (Year 9)

By the end of Year 9, students are able to skilfully use number and algebra in problem-solving situations involving finance, right-angle triangle geometry and the calculation of area and volume. They have a sound understanding of linear functions and index laws, and are developing fluency with quadratic and simple non-linear functions. Students choose appropriate techniques, including sampling, in data-based inquiry and confidently represent sample spaces and use these to determine theoretical probabilities. They are confident users of maps and plans, and are developing the use of formal proofs in geometric contexts. They apply Pythagoras’ theorem to the solution of right-angled triangles and have a basic understanding of trigonometric ratios.

Year 10 Content descriptions

Number and Algebra

1. Financial maths

Solve problems in financial mathematics including ones using recursive techniques, and extend these techniques to investigate growth and decay including using ICT

2. Proportion

Solve problems involving direct and inverse proportion

3. Coordinate geometry

Understand and use graphical and analytical methods of finding distance, midpoint and gradient of an interval on a number plane

4. Quadratic expressions

Understand how to expand and factorise quadratic expressions using a variety of strategies

5. Functions

Connect algebraic and graphical representations of functions and relations such as parabolas, circles and exponentials

6. Equations

Solve non-linear equations algebraically and graphically and using technology

Statistics and Probability

1. Data representation

Construct and interpret box plots and compare data sets represented by parallel box plots

2. Data investigation

Pose data-orientated questions, plan sampling, data collection and representation, make and justify conclusions, report the investigation and evaluate choices

3. Chance

Identify, whether two events of the sample space are independent or not, or mutually exclusive, for one- and two-step experiments with equally likely outcomes

4. Data interpretation

Evaluate statistical reports in the media and other places by linking claims to displays, statistics and sampling

Measurement and Geometry

1. Geometry

Use formal mathematical language to classify shapes and objects including congruence and similarity

2. Trigonometry

Work fluently with trigonometric ratios and solve problems requiring their use in right-angled triangles including direction and angles of elevation and depressions using the three trigonometric ratios

3. Surface area and volume

Solve problems involving surface area and volume of pyramids, cones and spheres

4. Latitude and longitude

Solve problems involving latitude, longitude, and distances on the Earth's surface, using great circles

Achievement standard (Year 10)

By the end of Year 10, students are able to skilfully use number and algebra in problem-solving situations involving finance, proportion, trigonometry and the calculation of area, volume and distances on the Earth's surface. They readily interpret and connect algebraic and graphical representations of functions and use these to analyse and solve equations. Students choose appropriate numerical, technological and graphical techniques to interpret and compare data sets presented to them and confidently determine theoretical probabilities for one- and two-step experiments and understand the concept of independence. They readily interpret and construct geometric proofs involving the application of congruence and similarity. They routinely communicate solutions in appropriate formats and can judge the reasonableness of results and evaluate the strategies and techniques used.

Year 10A Content descriptions

Number and Algebra	Statistics and Probability	Measurement and Geometry
1. Surds	1. Bivariate data	1. Trigonometry
Work fluently with operations with surds and fractional indices and solve simple exponential equations	Model linear relations in bivariate numerical data sets using the least squares line of best fit and interpret the result including using ICT	Use the unit circle to graph trigonometric functions and solve simple trigonometric equations
2. Recursion		2. Sine and cosine rule
Apply recursive techniques to arithmetic integer sequences, generalise the nth term and solve related problems		Understand the sine and cosine rules and apply these to solve problems involving non-right-angled triangles
3. Functions and relations		
Solve a wide range of quadratic equations and construct graphs of parabolas and circles		

Achievement standard (Year 10A)

In addition to the Year 10 achievement standard, by the end of 10A students are able to reason mathematically in a wide range of contexts. Their understanding of the real number system is extended to irrational numbers including surds. They can use algebraic, including recursive, techniques to solve equations including quadratics and simple exponential equations. They can model linear relationships in bivariate data and are able to solve trigonometric equations and use trigonometric relationships to solve problems involving non-right-angled triangles.