

# Mathematics

Victorian Curriculum F–10  
Version 2.0

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We acknowledge Aboriginal and Torres Strait Islander people as Australia's first peoples and as the Traditional Owners and custodians of the lands and waters on which we rely. We pay respect to Elders past and present of the lands where we conduct our work and recognise their ongoing contributions as the first educators on the land now known as Victoria.

# Mathematics

## Introduction

**Watch now:** To find out more about this curriculum area, watch 'Understanding the Victorian Curriculum F–10 Version 2.0, Mathematics' on the [Resources](#) page.

## Rationale and Aims

### Rationale

The study of mathematics is central to the learning, development and prospects of all young Victorians. Mathematics provides students with essential mathematical knowledge, skills, procedures and processes in number, measurement, space, statistics and probability. Equally important are the essential roles that algebra, functions and relations, logic, mathematical structure and working mathematically play in people's understanding of the natural and human worlds, and the interaction between them. The Mathematics curriculum provides the foundation for all students to develop the numeracy capabilities that they need in their personal, work and civic lives, as well as the fundamentals on which mathematical specialties and professional applications of mathematics are built.

Mathematics has its own value and aesthetic, and the Mathematics curriculum aims to build students' appreciation of the power of mathematical reasoning as they develop mastery of the content in mathematics. It provides students with learning opportunities to develop mathematical proficiency, including a sound understanding of and fluency with the concepts, skills, procedures and processes needed to interpret contexts, choose ways to approach situations using mathematics, and reason and solve problems arising from these situations.

Mathematics is composed of multiple but interrelated and interdependent concepts and structures that students apply beyond the mathematics classroom, and the curriculum clarifies the links between the various aspects of mathematics as well as the relationship between mathematics and other disciplines. For example, in Science, understanding sources of error and their impact on the confidence of conclusions is vital; 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 related events; and in English, deriving quantitative, logical and spatial information is an important aspect of making meaning of texts.

Mathematical ideas have evolved across cultures over thousands of years and are continually developing. The modern world is influenced by ever-expanding computational power, digital systems, automation, artificial intelligence, economics and data-driven societies. This leads to the need for a capable science, technology, engineering and mathematics (STEM) workforce.

Mathematics is integral to quantifying, thinking critically and making sense of the world. It is central to building students' pattern recognition, visualisation, spatial reasoning and logical thinking. Interdisciplinary STEM learning can enhance students' scientific and mathematical literacy, design and computational thinking, problem-solving and collaboration skills. Developing these competencies supports students in pursuing a variety of careers and occupations within STEM and other fields.

Mathematics provides opportunities for students to apply their mathematical knowledge creatively and efficiently, sharpen their sense of discovery and develop an appreciation of structure. It enables teachers to help students to become self-motivated, confident learners through practice, inquiry and active participation in relevant and challenging experiences.

## Aims

Mathematics aims to ensure that students:

- develop useful mathematical and numeracy skills for everyday life and work, as active and critical citizens in a technological world
- become confident, proficient, effective and adaptive users of mathematics
- become effective communicators of mathematics who can investigate, represent and interpret situations in their personal and work lives, think critically, and make choices as active, engaged, numerate citizens
- develop proficiency with mathematical concepts, skills, procedures and processes, and use them to demonstrate mastery in mathematics as they pose and solve problems, and reason with number, algebra, measurement, space, statistics and probability
- make connections between areas of mathematics and apply mathematics to model situations in various fields and disciplines
- develop a positive disposition towards mathematics, recognising it as an accessible and useful discipline to study
- appreciate mathematics as a discipline – its history, ideas, problems and applications, aesthetics and philosophy.

## Structure

Mathematics is presented in 15 levels, from Foundation Level A to Level 10.

Level 10 also includes Level 10A, which provides opportunities for students to extend their exploration of mathematical notions and further their mathematical studies.

## Strands

The curriculum is organised into 6 interrelated strands. The strands group the content descriptions, to provide both a focus and a clear sequence for the development of related concepts and skills across levels.

The 6 strands are:

- Number
- Algebra
- Measurement
- Space
- Statistics (commencing at Foundation Level C)
- Probability (commencing at Level 3).

An expectation of mathematical proficiency has been embedded into curriculum content across all strands to ensure that students develop mastery in mathematics through the development and application of increasingly sophisticated and refined mathematical understanding and fluency, reasoning and problem-solving skills. The concepts, skills, procedures and processes essential to the learning of mathematics are organised under the 6 interrelated strands, in a sequence of development that increases in depth and breadth across the years of schooling.

Natural connections exist between the content of these strands; for example, Number and Algebra build on an understanding of number systems and the properties of operations to describe relationships and formulate generalisations. Statistics and Probability have strong connections that rely on and build on the important links between them. Measurement relates not only to Space but is also foundational to all strands, enhancing their practical relevance. Combined with Number, it provides a means to quantify, compare, communicate and make sense of situations where metrics may provide insight. It is important that students develop the capability to identify and use the many connections that exist within and across the strands of Mathematics.

The 6 strands also specify content aimed at progressively developing students' knowledge and use of mathematical, statistical and computational thinking through the processes of mathematical modelling, computational thinking, statistical investigation, probability experiments and

simulations. When students are actively engaged in learning experiences involving the mathematical processes, they draw on and further develop their mathematical understanding, fluency, reasoning and problem-solving skills in an integrated way.

## Number

The Number strand develops ways of working with mental constructs that deal with correspondence, magnitude and order, for which operations and their properties can be defined. Numbers have wide-ranging application and specific uses in counting, measuring and other means of quantifying situations and objects. Number systems are constructed to deal with different contexts and problems involving finite and infinite, and discrete and continuous sets. Students apply number sense and strategies for counting and representing numbers as they explore the magnitude and properties of numbers, apply a range of strategies for computation and understand the connections between operations. Developing number sense and the ability to work effectively with numbers is critical to being an active and productive citizen who is successful at work and in future learning, who is financially literate, and who engages with the world and other individuals.

## Algebra

The Algebra strand develops ways of using symbols and symbolic representations to think and reason about relationships in both mathematical and real-world contexts. It provides a means for manipulating mathematical objects, recognising patterns and structures, making connections, understanding properties of operations and the concept of equivalence, abstracting information, working with variables, solving equations and generalising number and operation facts and relationships. Algebra connects symbolic, graphic and numeric representations. Students recognise patterns and understand the concepts of variable and function as they build on their understanding of the number system to describe relationships, formulate generalisations, recognise equivalence, and solve equations and inequalities. Algebra deals with situations of generality, communicating abstract ideas applied in areas such as science, health, finance, sport, engineering, and building and construction.

## Measurement

The Measurement strand develops ways of quantifying aspects of the human and physical world. Measures and units are defined and selected to be relevant and appropriate to the context. Measurement is used to answer questions, show results, demonstrate value, justify allocation of resources, evaluate performance, identify opportunities for improvement and manage results. Students develop an increasingly sophisticated understanding of size, shape, relative position and movement of two-dimensional figures in the plane and three-dimensional objects in space. They

make meaningful measurements of quantities, choosing appropriate metric units of measurement. They build an understanding of the connections between units and calculate derived measures such as area, speed and density. Measurement underpins understanding, comparison and decision-making in many personal, societal, environmental, agricultural, industrial, spatial, health and economic contexts.

## Space

The Space strand develops ways of visualising, representing and working with the location, direction, shape, placement, proximity and transformation of objects at macro, local and micro scales in natural and constructed worlds. It underpins students' capacity to make pictures, diagrams, maps, projections, networks, models and graphics that enable the manipulation and analysis of shapes and objects through actions and the senses. This includes notions such as surface, region, boundary, curve, object, dimension, connectedness, symmetry, direction, congruence and similarity. Students investigate properties and apply their understanding of them to define, compare and construct figures and objects as they learn to develop geometric arguments. These notions apply to art, design, architecture, planning, transportation, construction and manufacturing, physics, engineering, chemistry, biology and medicine.

## Statistics

The Statistics strand develops ways of collecting, understanding and describing data and its distribution. Statistics provides a story, or a means to support or question an argument, and enables exploratory data analysis that underpins decision-making and informed judgement. Statistical literacy requires an understanding of statistical information and processes, including an awareness of data and the ability to estimate, interpret, evaluate and communicate with respect to variation in the real world. Statistical literacy provides a basis for critical scrutiny of an argument, the accuracy of representations, and the validity and reliability of inferences and claims. The effective use of data requires acknowledging and expecting variation in the collection, analysis and interpretation of data arising for categorical and numerical variables. 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, as well as building skills to critically evaluate statistical information and develop intuitions about data. Statistics is used in business, government, research, sport, health care and media for critical and informed evaluation of issues, arguments and decision-making.

## Probability

The Probability strand develops ways of dealing with uncertainty and expectation, making predictions, and characterising the chance of events, or how likely events are to occur from both

empirical and theoretical bases. It provides a means of considering, analysing and utilising the chance of events, and recognising random phenomena for which it is impossible to exactly determine the next observed outcome before it occurs. In contexts where chance plays a role, probability provides experimental and theoretical ways to quantify how likely it is that a particular event will occur, or how likely it is that a proposition is the case. This enables students to understand contexts involving chance and to build mathematical models surrounding risk and decision-making in a range of areas of human endeavour. These include finance, science, business management, epidemiology, games of chance, computer science and artificial intelligence. Students recognise variation, assess likelihood and assign probabilities using experimental and theoretical approaches.

## Achievement standards

Achievement standards describe what students are typically able to understand and do, and they are the basis for reporting student achievement.

Students' mastery of concepts under the 6 strands is indicated by their ability to demonstrate proficiency against the achievement standards. Each achievement standard in Mathematics has been organised into paragraphs that reflect each of the strands.

In Mathematics, students progress along a curriculum continuum that provides an achievement standard at each level.

## Content descriptions

In Mathematics, content descriptions sequence and describe the mathematical knowledge and skills that teachers need to teach and students are expected to learn.

## Elaborations

Elaborations are examples that provide guidance on how the curriculum may be transformed into a classroom activity or learning opportunity. They are provided as advisory material only and are not mandated.

## Learning in Mathematics

Learning in Mathematics emphasises the importance of providing opportunities for students to develop proficiency in mathematics. This development of proficiency is achieved in how content is explored or developed, that is, how students experience the thinking and doing of mathematics.

## Proficiency in Mathematics

The proficiencies of Understanding, Fluency, Reasoning and Problem-solving are embedded in all 6 strands and further the development of increasingly sophisticated knowledge and understanding of mathematical concepts, fluency in representations and procedures, and sound mathematical reasoning and problem-solving skills. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical processes to solve problems efficiently and to make informed decisions. Proficiency in mathematics also enables students to reflect on and evaluate approaches, and verify that answers and results are reasonable in the context.

## Understanding

Mathematics provides opportunities for students to build and refine a robust knowledge of adaptable and transferable mathematical concepts, structures and procedures. Students make connections between related ideas, progressively draw on their reasoning skills to adapt and transfer understanding of familiar applications to unfamiliar contexts, and cultivate new ideas. They develop an understanding of the relationship between the 'why' and the 'how' of mathematics. Students build conceptual understanding and procedural fluency when they connect related ideas, represent concepts in different ways, identify commonalities and differences between aspects of content, describe their thinking mathematically and interpret mathematical information.

## Fluency

Mathematics provides opportunities for students to develop, practise and consolidate skills; choose appropriate procedures; carry out procedures flexibly, accurately, efficiently and appropriately; and apply their recall of factual knowledge and understanding of concepts readily. Students are fluent when they connect their conceptual understanding to learned strategies and procedures, make reasonable estimates and calculate answers efficiently, and choose and use computational strategies efficiently; when they recognise robust or multiple ways of answering questions; when they choose appropriate representations and approximations; when they understand and regularly apply definitions, facts and theorems; and when they can manipulate mathematical objects, expressions, relations and equations to find solutions to problems.

## Reasoning

Mathematics emphasises mathematical reasoning as central to thinking and working mathematically and as a critical component of proficiency in mathematics. Mathematical reasoning guides students in developing an increasingly sophisticated capacity for logical thought and actions, such as conjecturing, hypothesising, analysing, proving, experimenting, modelling, evaluating, explaining, inferring, justifying, refuting, abstracting and generalising. Students are

reasoning mathematically when they explain their thinking, deduce and justify strategies used and conclusions reached, adapt the known to the unknown, transfer learning from one context to another, make inferences about data or the likelihood of events, and prove that something is true or false. They are reasoning when they compare and contrast related ideas, and reflect on and explain their choices.

## Problem-solving

Mathematics recognises the importance of providing students with meaningful opportunities to use mathematics to solve problems from both abstract mathematical and real-world contexts. Students engage in mathematical problem-solving when they are presented with a problem situation for which they do not immediately know the answer, and they work through a process of planning, choosing and applying strategies and heuristics to find a solution to the problem, reviewing and analysing their solution. Problems can be simple, where there is only one possible solution, or complicated, where the problem may have many valid approaches to develop solutions. Problem-solving is the ability of students to make choices, interpret, formulate, model and investigate problem situations mathematically, select and use technological functions and communicate solutions effectively. Students pose and solve problems when they use mathematics to represent unfamiliar or meaningful situations, design investigations and plan their approaches, make mathematical decisions as they draw on previously learnt concepts, skills, procedures and processes to solve problems, verify that their answers are reasonable, communicate solutions clearly and justify the reasonableness of their approaches.

## Mathematical processes

Mathematical processes refer to the thinking, reasoning, communicating, problem-solving and investigation skills involved in working mathematically. Opportunities to learn process skills have been embedded across the strands, building in sophistication across the levels. Mathematical problem-solving and investigation draws on the processes of mathematical modelling, computational and algorithmic thinking, statistical investigation, probability experiments and simulations.

## Mathematical modelling

Mathematical models are used to gain insight into and make predictions about real-world phenomena, to inform judgements and make decisions in personal, civic and work life. In the modelling process students formulate a real-world problem mathematically by making assumptions; recognise, connect and apply mathematical structures; analyse and solve the mathematical model; and interpret, generalise and communicate their results in response to the real-world situation. Mathematical modelling is an essential dimension of the contemporary

discipline of mathematics and is key to informed and participatory citizenship.

## Computational thinking and simulations

Students develop computational thinking through the application of its various components: decomposition, abstraction, pattern recognition, use of models and simulations, algorithms and generalisation. Computational thinking approaches involve experimental and logical analysis, empirical reasoning and computer-based simulations. The simulations can then be used to generate and test hypotheses and conjectures, identify patterns and key features (or counterexamples), and dynamically explore variation in the behaviour of structures, systems and scenarios.

## Statistical investigation

Students develop the ability to conduct statistical investigations through informal exploration in the early levels. Later they use guided processes, which progressively lead them to conduct and review their own statistical investigations and to critique others' processes and conclusions.

Statistical investigation deals with uncertainty and variability in categorical (nominal or ordinal) or numerical (discrete or continuous) data arising from observations, surveys or experiments and can be initiated by a specific question, a situation or an issue.

## Probability experiments and simulations

Students develop an understanding of experimentation through exploration and play-based learning in the early levels. They progress to conducting chance experiments and probability simulations from Level 3 onwards. Experimentation and simulation in mathematics can involve the use of digital and other tools, often to generate large sets of data for consideration, drawing on the interconnections between Statistics and Probability. Experimenting in mathematics requires students to plan what to do and evaluate what they find out using mathematical reasoning.

## Computation, algorithms and the use of digital tools in mathematics

The capacity to purposefully select and effectively use the functionality of a digital device, platform, software or digital resource is a key aspect of engaging with computational thinking in the Mathematics curriculum. Digital tools can be used effectively to learn and apply mathematics in and across all of the strands. The use of digital tools addresses elements of the Digital Literacy capability. The functionalities may be accessed through hand-held devices such as calculators (arithmetic four operation, scientific, graphics, financial, CAS) and measurement tools (digital scales and other digital measuring devices), software on a computer or tablet (spreadsheet, dynamic geometry, statistical, financial, graphing, computer-algebra), an application on a personal device, virtual and augmented reality technologies or tools accessed from the internet or

cloud. Different digital tools or platforms can carry out computations and implement algorithms using numerical, textual, statistical, probabilistic, financial, measurement, geometrical, graphical, logical and symbolic functionalities.

The term ‘computation’ is used in mathematics to refer to arithmetic and non-arithmetic calculations, operations, transformations, procedures and processes that are applied to mathematical objects to produce an output or result. A computation may be an arithmetic calculation; running an algorithm; applying transformations to the graph of a relation, function, network or set of data; developing a set, list, sequence or table of values from a rule; developing a diagram or shape; or the evaluation of an algebraic equation.

The objects of computations may be sets of numbers, text, data, points, shapes and objects in space, images, diagrams, networks, or symbolic and logical expressions, including equations.

Some computations may be dynamic; that is, they enable parameters, conditions and constraints to be varied and the corresponding results to be progressively shown. Examples include the effect of varying an outlier on the mean of a data set, the behaviour of an algorithm under a different set of inputs, sorting or ordering the elements of a set, observing the relative frequency of an event as the number of experiments increases, manipulating a shape in 2 dimensions or an object in 3 dimensions and observing any symmetries, or transforming the graph of a function by varying defining parameters, such as changing the gradient of a linear function.

An algorithm is a precise description of efficient steps and decisions needed to carry out a computation, or a set of rules to follow in order to accomplish a task. Algorithms often involve iterative (repetitive) and recursive (repeatedly applied) processes and can be represented as text, in diagrams or symbolically as flow charts or pseudocode. As students develop a conceptual understanding of how an algorithm works and fluency with using algorithms appropriately, they can reason and solve problems using algorithms as part of a computational thinking process.

## Meeting the needs of diverse learners

The Victorian Curriculum F–10 is structured as a developmentally-sequenced continuum of learning across levels of learning achievement. The levels do not represent discrete years of schooling. The levelled continuum enables teachers to develop targeted learning programs that address the actual learning needs of students, rather than an assumed age-based level of learning.

For some students with diverse languages, cultures, abilities and talents, providing a range of curriculum adjustments will enable them to achieve educational standards commensurate with their peers. For other students, appropriate adjustments may include the delivery of content from

levels above or below the age-equivalent expectation. For a small cohort of students, this will include the delivery of the Foundation Levels A to D curriculum content.

The Victorian Curriculum F–10 values diversity by providing for multiple means of representation, action, expression and engagement, and it allows schools the flexibility to respond to the diversity of learners within their community. All schools have a responsibility when implementing the Victorian Curriculum to ensure that student learning is inclusive and relevant to their experiences, abilities and talents.

Mathematics responds to the diversity of students in the mathematics classroom by connecting familiar experiences and objects in students' lives. These add meaning to any mathematics exploration and help all students understand and use what they have learnt. Responding to student diversity also provides opportunities to deepen students' understanding of mathematics and its applications. Strategies that could support the diverse needs of students in mathematics include providing:

- access to manipulatives and concrete materials
- access to familiar objects to represent and solve mathematical problems; coins, blocks, counters, buttons or other small objects can be used to demonstrate concepts such as greater than, less than, equal to, counting, adding, subtracting, sharing, grouping and fractions
- access to visual supports
- multiple exposures and opportunities for practice
- experience with mathematical concepts using multisensory methods to stimulate thinking skills
- scaffolding procedures and processes using step-by-step instruction, demonstrating how to solve mathematical problems
- exposure to rich texts that stimulate mathematical thinking and exploration.

# Curriculum

## Foundation Level A

### Level description

In Foundation Level A, learning in Mathematics builds on each student's daily experiences. Students engage in a range of approaches to the learning and doing of mathematics that encourage their awareness of mathematical concepts, skills, procedures and processes and that support the establishment of cause and effect and intentional responses. Through multiple exposures and repetition within their daily lives and routines, students become aware of the environment around them and respond to changes within that environment.

Students develop awareness of and positive dispositions towards mathematics and its use as they:

- experience number in their environment and experience physical and virtual materials that build awareness of the number names and quantities
- respond and communicate with beginning intention, as they encounter situations and observe objects and situations
- engage, initiate and refine their responses towards mathematical experiences
- develop awareness and recognition of familiar people and routine activities
- respond to situations and events that occur regularly and routinely, developing a sense of sameness and routine patterns
- respond to personally relevant and familiar events that routinely involve activities and actions such as comparing, adding, removing, sharing, placing and moving.

### Achievement standard

By the end of Foundation Level A, students participate in and respond to structured learning experiences, including counting, sharing, and adding

and taking away from collections, in practical situations.

Students respond to cause-and-effect experiences.

Students participate in and respond to measurement activities through structured routine and non-routine activities and events during the school day.

Students observe and experience shapes and objects and respond to the sorting and naming of them. Students respond when the position of their body changes, and when they move to a different environment.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students:</i> respond to number names and representations of number VC2MFAN01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• responding to the use of number names and numerals in stories, songs and music; for example, showing interest when listening to counting in books or interacting with numbers and quantities of objects in sensory tubs</li> <li>• touching or feeling objects as they are being counted; for example, touching objects as they are lined up in order or touching tactile (sandpaper) numbers while they are being named</li> <li>• participating in movement activities such as counting when walking up steps, walking over sensory pads or moving fingers while they are being counted</li> </ul>
<p><i>Students:</i> respond to changing collections of objects VC2MFAN02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• tracking groups of objects; for example, following an object or group of objects with their eyes or through gesture</li> <li>• responding to significant disparity in collections of motivational objects; for example, vocalising excitement</li> </ul>

Content descriptions	Elaborations
	<p>when shown 20 cars compared to 1 car or when motivational items are covered to represent 'all gone'</p> <ul style="list-style-type: none"> <li>• vocalising or gesturing when objects appear; for example, making a noise when shown a preferred object, reaching towards a group of their favourite items when presented, or vocalising or gesturing when playing peekaboo and a face appears</li> <li>• vocalising or gesturing when familiar objects are taken away; for example, gesturing towards a sensory object when it is taken away or when a familiar person leaves a space</li> </ul>
<p><i>Students:</i> respond to counting, comparing and labelling of collections VC2MFAN03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• responding to the use of number names and number sequences in everyday routines and activities; for example, participating in counting the number of classmates at school, or vocalising or gesturing when objects are counted as they are being packed away</li> <li>• participating in modelled rote counting through songs, stories and activities; for example, participating in role-playing in the song 'Ten little monkeys jumping on the bed' or 'Five little ducks', or experiencing modelled counting when being pushed on the swing</li> <li>• participating in modelled counting, using one-to-one correspondence; for example, touching each cup of flour as it is added into a bowl or touching each pompom as it is counted in a line</li> </ul>
<p><i>Students:</i> respond to practical situations involving addition and subtraction of collections with physical and virtual materials VC2MFAN04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• responding to a familiar object being removed or added from a collection; for example, using gestures or vocalisations to indicate a change when the adult says 'all gone', 'no more left', 'another one', 'give me more' or 'finished'</li> <li>• participating in objects or groups of objects being subtracted from a collection to make none; for example, putting away all the pencils to leave none or posting letters in a letterbox until there are none left</li> <li>• participating in objects or groups of objects being added to a collection; for example, adding 3 flowers to a vase with 2 flowers</li> <li>• assisting in adding or taking away one object from a collection; for example, touching or gesturing at the</li> </ul>

Content descriptions	Elaborations
	<p>object that will be removed</p> <ul style="list-style-type: none"> <li>participating in situations that involve simple money transactions; for example, using a group of one-dollar coins or notes to 'pay' for physical items</li> </ul>
<p><i>Students:</i> respond to sharing objects or a collection equally, in practical situations VC2MFAN05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>participating in objects being equally distributed and shared; for example, assisting to distribute objects while an adult uses modelled phrases such as 'one each', 'two for everyone' or 'one for you and one for me'</li> <li>assisting in distributing objects to or sharing objects with others in everyday situations; for example, handing out a writing implement to each student from a collection of writing implements or sharing muffins with each class member after a cooking lesson</li> <li>participating in the modelled partitioning or combining of collections of objects; for example, vocalising or gesturing as the teacher partitions counters using a ten-frame while saying 'We have 6 counters altogether: there are 4 in this group and 2 in that group'</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<p><i>Students:</i> respond to actions that have an effect VC2MFAA01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>participating in using objects that generate an immediate effect upon an action; for example, using musical instruments, touch-sensitive lights, crinkly materials, pull-and-push toys, and adapted switch toys or appliances</li> <li>experiencing a repeating pattern on textured material; for example, rolling over a series of bumps or feeling a repeating pattern on objects with different textures</li> <li>using an instrument such as a drum or triangle to make a repeating sound</li> <li>participating in mark-making; for example, making lines or dots using paint, marker pens or a digital device</li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
<p><i>Students:</i> respond to routine and non-routine events during the school day VC2MFAM01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• responding to a routine or non-routine event by demonstrating a change in body language or facial expression or through vocalisation; for example, looking towards their lunchbox when brought out during mealtime, or responding to a change or disruption to a daily routine or event such as a wet-weather timetable or an incursion</li> <li>• participating in everyday events and their associated visual, equipment and sensory elements; for example, indicating a preference for a known activity through vocalisation or gesture, or looking towards a lunchbox when paired with a symbol, object and single word in response to the teacher saying 'lunchtime'</li> <li>• responding to routine school events; for example, gesturing or vocalising in response to teacher statements such as 'Today is Monday. We have swimming after lunch' or 'It is recess. Get your morning tea', or looking at the 'then' item on a 'first-then' board</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students:</i> respond to shapes and objects in their environment VC2MFASP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• participating in exploring shapes and objects; for example, feeling the curved edge of a circle compared to the straight edges of a rectangle, tracing the outline of the shapes</li> <li>• responding to the naming of different two-dimensional shapes; for example, looking at the corresponding object or picture symbol when it is named</li> <li>• assisting in sorting shapes and objects by a single attribute; for example, gazing or gesturing when objects are sorted by colour or shape</li> <li>• responding to objects that indicate routine activities; for example, vocalising when presented with a hat to be worn outside for playtime</li> </ul>
<p><i>Students:</i> respond to movement of objects,</p>	<p><i>This may involve students:</i></p>

Content descriptions	Elaborations
people or self within a familiar space VC2MFASP02	<ul style="list-style-type: none"><li>• participating in activities where there is a change of location or position; for example, exploring the concepts of 'inside' and 'outside' during structured activities</li><li>• responding when participating in activities where there is a change of movement or body position; for example, vocalising when they move towards or away from an object</li><li>• responding when participating in changes of location of objects or their body position; for example, responding to directions, statements or questions from familiar people ('Arms up', 'I am moving your bag', 'Where did it go?') or when they move from one place to another</li><li>• gesturing at, reaching for or looking for a desired object by moving their head or body for a better view; for example, tilting their head towards a preferred object</li></ul>

## Foundation Level B

### Level description

In Foundation Level B, learning in Mathematics builds on each student's prior learning and experiences. Students begin to explore their world with increasing independence. They begin to develop their understanding of mathematical concepts, skills, procedures and processes through practical experiences. They participate in structured learning activities for short periods of time. Students begin to attend to learning activities, and to compare, match and sort objects.

Students begin to develop proficiency and establish positive dispositions towards mathematics and its use as they:

- rely on multisensory experiences, concrete materials, verbal prompts and gestures to support and facilitate their learning
- look for and make connections to explore their world and engage in cause-and-effect activities
- participate in structured learning activities for short periods of time that explore and compare quantities and attributes of shapes and objects
- develop and use the concepts of 'more', 'different', 'lots', 'big' and 'little' to perceive, explore and compare:
  - numbers and counting
  - collections of objects and two-element repeating patterns
  - measurement and measurement attributes
  - two-dimensional shapes and three-dimensional objects and their attributes
  - familiar events, locations and environments
- recognise, anticipate and respond to familiar people and events
- engage, initiate and refine the communication of their mathematical understandings
- recognise regularity in some events and not others

- participate in learning activities that explore objects, events and recording of mathematical information.

## Achievement standard

By the end of Foundation Level B, students identify 'one' object and 'more' objects, and recognise one or more number names. Students demonstrate an awareness of quantity and use direct comparison to determine 'more' and 'different' in practical situations, including partitioning and combining collections, sharing collections, and adding to and taking away from collections.

Students initiate cause-and-effect experiences.

Students identify familiar objects as 'big' or 'little', using direct comparison in practical situations. They show anticipation in response to routine events when transitioning from one experience to another.

Students investigate the attributes of shapes and objects. They use direct comparison to determine if shapes and objects are 'big' or 'little'. Students locate objects or people in a familiar environment.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i> identify number names and representations of number VC2MFBN01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"><li>• participating in activities, stories, songs and music that involve number names, numerals and quantities; for example, nodding as objects are counted, tapping an object as it is counted, assisting to move objects from one container to another as each object is counted, or repeating some number names as objects are counted</li><li>• participating in activities that model one-to-one correspondence, such as putting pegs on a string number line one by one, when counting is being modelled</li></ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>responding to number names in everyday situations; for example, waiting for counting down or counting up before starting an action ('Three, two, one, go') or stepping, clapping, vocalising, making a sound or tapping a switch for each number being counted</li> <li>observing and indicating representations of numbers in a familiar environment; for example, identifying numerals in the classroom, even if they are not always correct in naming the numerals, such as saying 'two' when the numeral is 5</li> </ul>
<p><i>Students learn to:</i> identify, name and represent 'one' and 'more' using physical and virtual materials VC2MFBN02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>representing 'one' using a single object; for example, handing over one object when asked for 'one', pointing to the one object when shown a group of objects and one object, or looking at the single object when asked 'Where is one?' when offered 2 options</li> <li>identifying collections as either 'one' object or 'more' objects; for example, saying 'more' or a bigger number to indicate collections that are more than one, or indicating the group of objects when shown collections of 'one cow' and 'more cows'</li> <li>using an action, gesture or vocalisation to indicate when they want more or fewer objects</li> </ul>
<p><i>Students learn to:</i> compare the quantity of collections using direct comparison to identify which has more or if they are different VC2MFBN03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>participating in collections being directly compared; for example, matching quantities of 2 groups to identify which one has 'more'</li> <li>participating in the comparison of groups using modelled counting; for example, observing modelled counting using one-to-one correspondence and identifying whether 2 groups of objects are 'different' or which group has 'more'</li> <li>comparing collections of familiar objects by directly matching quantities of each group to determine if they are different; for example, lining up 2 collections and using matching to determine if the collections have a different number</li> <li>using direct comparison to respond to questions about group composition; for example, observing students</li> </ul>

Content descriptions	Elaborations
	lined up in 2 rows and responding to questions such as 'Are they different?' and 'Which one has more?'
<p><i>Students learn to:</i> partition and combine collections to make 'more' or 'different' VC2MFBN04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>partitioning a collection of objects into 2 groups and using matching and direct comparison to determine if the number of objects in each group is 'different'; for example, partitioning a group of 5 pencils by placing one pencil in a container and 4 pencils in another container and identifying which group has more</li> <li>joining 2 collections of objects together; for example, connecting 2 towers of blocks together to make one tower</li> <li>splitting an object into 2 parts and determining if they have different sizes; for example, breaking playdough into 2 unequal sections and comparing their sizes to determine which section has 'more'</li> <li>joining 2 parts together to make a whole; for example, squashing 2 balls of playdough together to make one big ball or pushing together 2 horseshoe magnets to make one circle</li> </ul>
<p><i>Students learn to:</i> add or take away objects, using physical and virtual materials and matching to determine whether the changed total is more or different VC2MFBN05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>starting with 2 collections with the same quantity, then adding or taking away objects from one collection to make the collections different; for example, matching elements in 2 equal collections of strawberries and taking one away from, or adding one to, one of the collections, and matching to determine if the totals are different or which collection has more</li> <li>responding to questions about group composition after 1 of 2 collections with the same starting quantity has changed, such as responding to 'Which has more?' and 'Are they different?'</li> <li>participating in modelled counting with demonstrated one-to-one correspondence; for example, assisting in counting the starting number of a collection of objects, and adding one or taking away one object from the collection and re-counting to find the changed total</li> <li>role-playing situations that involve simple money transactions using a group of one-dollar coins to 'pay' for physical items</li> </ul>
<i>Students learn to:</i>	<i>This may involve students:</i>

Content descriptions	Elaborations
share physical objects and collections equally in practical situations VC2MFBN06	<ul style="list-style-type: none"> <li>sharing objects equally among a group; for example, giving each group member a biscuit from a packet of biscuits or a book from the library shelf</li> <li>distributing objects to others in everyday situations by demonstrating one-to-one correspondence; for example, handing out one paintbrush to each student from a collection of paintbrushes</li> <li>participating in sharing a collection of objects; for example, giving each student a sticker until all the stickers are gone</li> <li>responding to yes/no questions about the equal and unequal sharing of objects or collections using direct comparison, such as 'Does anyone have a different amount?' and 'Who has more?'</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<i>Students learn to:</i> initiate and repeat actions that have an effect VC2MFBA01	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>creating patterns through songs and music; for example, moving a shaker to start a pattern</li> <li>repeating actions or sounds in familiar songs, stories or games, such as 'A sailor went to sea', <i>We're going on a bear hunt</i> and pat-a-cake</li> <li>identifying the first element of a repeating pattern comprising at least 2 elements; for example, touching a shape on a device to continue a pattern</li> <li>using repeated actions in play or to generate an effect; for example, sorting shape blocks in a shape sorter, placing puzzle pieces into a puzzle tray, stacking blocks, moving a bell or an egg shaker to generate a noise or tapping a drum</li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
<i>Students learn to:</i> identify whether 2 familiar objects	<i>This may involve students:</i>

Content descriptions	Elaborations
<p>are 'big' or 'little', using direct comparison VC2MFBM01</p>	<ul style="list-style-type: none"> <li>sorting everyday familiar objects by size, using direct comparison; for example, sorting square and circle shapes of the same colour into 2 collections based on size</li> <li>using direct comparison to compare the lengths of 2 objects; for example, lining up a stapler and a ruler next to each other and responding to the question 'Which one is big?' or 'Which one is little?'</li> <li>experiencing the modelled language of measurement when comparing objects in a pair that are big and little</li> <li>responding to yes/no questions about measurement attributes when directly comparing the sizes of objects, such as responding to the questions 'Is this circle the little circle?' and 'Is this circle the big circle?' when the teacher shows 2 different-sized circles</li> </ul>
<p><i>Students learn to:</i> recognise and participate in routine and non-routine daily events VC2MFBM02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>responding to familiar signals for transitions; for example, lining up when the school bell rings indicating the end of lunch or packing up an activity on the signal from a timer</li> <li>responding to regular routines and their representation on a visual schedule; for example, using a 'first-then' card to transition from one familiar activity to the next or placing items in a finished box</li> <li>responding to a change in daily schedule through the co-creation of a visual schedule, such as a 'first-then' card or an individual visual schedule, and then transitioning to the changed activity</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i> match and sort objects and shapes that are 'big' or 'little', using direct comparison VC2MFBSP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>matching shapes to the correct spaces in inset puzzles</li> <li>comparing physical and digital representations of two-dimensional shapes to identify attributes that are 'big' or 'little'; for example, 'posting' items into different containers or holes to sort different-sized familiar shapes, using object cutters to reproduce a shape with playdough or using other malleable materials to</li> </ul>

Content descriptions	Elaborations
	<p>make shapes that have different sizes</p> <ul style="list-style-type: none"> <li>sorting a large collection of objects into 'big' or 'little' groups; for example, sorting a collection of cars and animals into a 'big' group and a 'little' group based on size</li> </ul>
<p><i>Students learn to:</i></p> <p>indicate the location of known objects within a familiar environment VC2MFBSP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>responding to the language of location and direction through modelled daily routines; for example, looking upwards for 'up', using rhymes and chants that relate to movement, following a warm-up sequence for sport, unpacking their bag, washing their hands or getting their lunchbox before lunch</li> <li>participating in games and activities to reinforce the concept of object permanence; for example, answering yes/no questions when playing a game in which a familiar object is moved while they are not looking, or searching for a preferred object that has been hidden and indicating its location when found by gesturing, pointing or vocalising</li> <li>participating in activities that develop the concepts of 'in' and 'out'; for example, putting objects 'in' and 'out' of a container when asked, or following routines and instructions that involve moving between inside and outside locations</li> <li>responding to yes/no questions about location of self, people or objects, such as 'Is teddy on the floor?', 'Is Tuan next to Amy?' and 'Is the teddy in the same place as before?'</li> <li>responding to one-step directional language and communication used in the daily routine, such as 'sit down', 'stand up' and 'look here' during an activity or program</li> </ul>

## Foundation Level C

### Level description

In Foundation Level C, learning in Mathematics builds on each student's prior learning and experiences. Students demonstrate increased levels of independence, becoming more peer focused, intentionally participating in structured learning activities with others and communicating in a variety of ways.

Students build their independence as they engage in a range of approaches to the learning and doing of mathematics. They develop their understanding of and fluency with concepts, skills, procedures and processes in practical situations and contexts for learning by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students develop proficiency and positive dispositions towards mathematics and its use as they:

- start to use and link some familiar words, materials and symbols to communicate their ideas and understanding
- begin to develop, look for and demonstrate awareness of connecting objects and number names to groups
- compare quantities and objects by matching like objects and describing differences between objects for a given attribute
- manipulate concrete material to solve problems that involve comparing, combining and separating collections
- begin to respond to mathematical language, such as 'adding' and 'taking away'; measurement attributes, including 'big', 'small', 'tall' and 'short'; positional language, including 'first' and 'last'; and the names of familiar shapes and objects
- explore situations and events and develop familiarity with times of the day and events within a day using visual schedules
- participate in and contribute to the development of picture schedules, timetables and pictorial lists associated with familiar activities
- respond to prompts and simple clear directions from the teacher, including acting upon directions presented in 2 steps

- participate in structured learning activities with others and begin to use symbolic representations, pictures, photographs and objects to communicate personal ideas and understandings and to solve simple mathematical problems
- use practical situations to explore measurement attributes and build vocabulary to describe and compare the attributes of shapes and objects
- start to use and link some familiar words and images to construct meaningful communication around problem-solving and practice.

## Achievement standard

By the end of Foundation Level C, students recognise and name groups of at least 5. They use counting strategies to quantify collections to at least 5 and subitise to quantify collections to 3. They compare collections to identify ‘more’ and ‘less’. They communicate the number names from zero to at least 5 using stable number order. They partition and combine collections up to 5 in different ways. Students represent practical situations that involve quantifying and adding, taking away one from a collection up to 5 and equal sharing of a collection.

Students copy simple repeating patterns.

Students identify the attributes of mass, capacity and length, using direct comparison, in practical situations. They connect familiar events to times of the day.

Students name, match and sort familiar shapes and objects based on a single attribute. They describe the location of an object or person in a familiar environment. They follow simple movement instructions.

Students compare data collected in response to questions in familiar contexts.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
Students learn to:	<i>This may involve students:</i>

Content descriptions	Elaborations
<p>name and correctly sequence number names to at least 5 VC2MFCN01</p>	<ul style="list-style-type: none"> <li>• accurately counting forwards to at least 5; for example, counting to 5 and then naming some other numbers, such as saying ‘zero, one, two, three, four, six, seven, ten’</li> <li>• participating in modelled and shared counting experiences; for example, counting using a number line, counting using a number chart, counting using a ten-frame or counting objects in a collection by following along by pointing, nodding or touching a button</li> <li>• joining in shared counting songs and stories to establish the forwards counting sequence of numbers from 0 to 5</li> <li>• identifying when a modelled number count is incorrectly sequenced; for example, indicating ‘That’s wrong’ when presented with 0, 1, 3, 2, 4, 5</li> <li>• recognising that numerals look different from non-numeral shapes; for example, selecting the numbers from a tray that contains letters, numbers and other shapes or tracing numbers on different media</li> <li>• understanding and using terms to indicate ordinal position in a sequence; for example, identifying the ‘first’ and ‘last’ student going down a slide or lining up to enter or exit a room</li> </ul>
<p><i>Students learn to:</i> recognise and name the number of objects within a collection up to 3 using subitising VC2MFCN02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• naming collections of 1, 2 and 3 objects using subitising; for example, communicating ‘two’ for a pair of shoes when asked ‘How many?’, answering ‘three’ automatically after seeing 3 teddy counters revealed from under a container, or correctly subitising 1, 2 or 3 dots on a rolled dice</li> <li>• naming collections of 1, 2 and 3 dots using subitising; for example, when presented with a ten-frame with 3 dots, answering ‘three’ automatically</li> <li>• using subitising to compare and order collections and to say who has more when sharing items</li> <li>• recognising, with a quick look, how many objects are in a collection or in an image on a card, and indicating or saying the number without counting</li> </ul>
<p><i>Students learn to:</i> compare collections to at least 5 to</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• using subitising to compare 2 collections of up to 3 objects and indicating which collection has more and</li> </ul>

Content descriptions	Elaborations
<p>identify if the collections are the same or which has 'more' and which has 'less' VC2MFCN03</p>	<p>which has less; for example, viewing groups of up to 3 blocks hidden under 2 bowls, then responding to questions including 'Are they the same?', 'Which has more?' and 'Which has less?'</p> <ul style="list-style-type: none"> <li>using matching to copy a collection to show 'same', then adding or taking away from their collection to show more, or less, in response to prompts; for example, responding to 'Make a collection of bees that is more than mine' by using matching to create a collection that is the same as the first collection then adding to their collection to represent 'more' bees</li> <li>using counting strategies to compare 2 collections up to 5 to determine which has 'more' and which has 'less'</li> </ul>
<p><i>Students learn to:</i> partition and combine collections up to 5 to make 'more' and 'less' VC2MFCN04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>partitioning collections up to 5 objects in different ways and recognising that each part is 'less' than the total of the original collection; for example, creating a group of 3 counters and a group of 2 counters from a collection of 5 counters and answering 'Which group has more?' and 'Which group has less?'</li> <li>combining collections up to 5 objects in different ways and recognising that the total of the combined collections is 'more' (greater) than the parts</li> <li>using physical or virtual five-frames and counters to partition and combine collections, comparing the parts and the whole to determine 'more' and 'less'</li> </ul>
<p><i>Students learn to:</i> represent practical situations involving addition, subtraction and quantification up to at least 5 with physical and virtual materials, and use matching or counting strategies VC2MFCN05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>counting using one-to-one correspondence from zero to at least 5; for example, stopping their counter after they move it 4 spaces on a snakes and ladders board if they rolled the number 4</li> <li>role-playing using 5 one-dollar coins to pay for items that are priced at \$1 and communicating parts of the transaction; for example, requesting 3 bananas and paying with 3 one-dollar coins</li> <li>using word problems to solve two-number addition and subtraction problems; for example, having 5 one-dollar coins and saying 'I went to the shop and bought an ice cream for one dollar. How many coins do I take away?'</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>using games and stories to solve simple addition and subtraction problems; for example, using their fingers to show taking one away aligned with the song 'Five little ducks', or role-playing 'The wheels on the bus' and having a student 'get on'</li> <li>using manipulatives to solve two-number word problems containing addition and subtraction; for example, using teddy counters and a playhouse to model and solve the problem 'Two bears were playing in a house and another bear friend came over. How many bears are there now?' or, using a template, placing 3 pieces of playdough in one circle and 2 pieces of playdough in another circle to represent addition</li> </ul>
<p><i>Students learn to:</i></p> <p>represent practical sharing situations involving equal sharing between 2, using physical and virtual materials VC2MFCN06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>distributing materials equally in everyday situations; for example, sharing 4 toy ducks between 2 students and checking that each student has the same number by direct comparison, or counting the number of apple slices given to each student to see if these are the same</li> <li>using direct comparison to determine whether a collection has been shared equally into 2 groups; for example, lining up 2 groups of counters to see if the collection has been shared equally</li> <li>representing situations that involve sharing a collection equally; for example, starting with 8 beads or 6 coins and then sharing them equally between 2 students by distributing them to each student one by one, saying 'one for you, one for me', and then counting or subitising to determine the number each student received</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>copy repeating patterns represented in different ways VC2MFCA01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>replicating a repeating two-element (ABAB) rhythmic pattern; for example, copying touching their noses, then heads, then noses</li> <li>copying a simple repeating two-element pattern with given objects, movements or sounds, such as red,</li> </ul>

Content descriptions	Elaborations
	<p>blue, red, blue (when setting the table with drinking cups), paper and glue (when setting up equipment for an activity), or knife and fork (when setting a table using 2 types of cutlery)</p> <ul style="list-style-type: none"> <li>copying a repeating two-element pattern where one element has 2 parts (e.g. AAB), such as performing a clap, clap, stomp pattern or creating a necklace with beads in a blue, blue, green pattern</li> <li>recognising and indicating the ‘first’ and ‘last’ elements of a two-element pattern</li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i> identify and compare attributes of 2 familiar objects, including length, capacity and mass, using direct comparison VC2MFCM01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>comparing and labelling objects using the language of ‘long’ and ‘short’, ‘tall’ and ‘short’, and ‘heavy’ and ‘light’; for example, using a book to measure a hand, arm or foot and using the language ‘This book is shorter than my arm’, tracing around students and comparing heights and using the language ‘tall’ and ‘short’, or comparing fruits and vegetables during meal preparation and using the language ‘Which one is big?’ and ‘Which one is small?’</li> <li>directly comparing 2 objects (e.g. comparing the capacity of an egg cup and a bucket using sand, hefting a toy car and a full drink bottle to compare mass, or aligning a wooden block and a piece of rope to compare length), indicating if they are the same or different, and using appropriate comparative language such as ‘bigger’ and ‘smaller’, ‘empty’ and ‘full’, ‘heaver’ and ‘lighter’, or ‘shorter’ and ‘longer’</li> </ul>
<p><i>Students learn to:</i> identify morning, afternoon and night-time, and connect routine and familiar events to these times VC2MFCM02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising and labelling times of the day as ‘morning’, ‘afternoon’ and ‘night-time’; for example, using greetings such as ‘good morning’ and ‘good afternoon’ appropriately</li> <li>participating in shared songs, stories and games that reinforce the times of the day; for example, playing a modified version of ‘What’s the time, Mr Wolf?’ that uses morning, afternoon and night-time, with ‘lunchtime’ as the action word</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>recognising and responding to daily routines by selecting an image from a schedule to indicate an activity has finished or is about to begin</li> <li>matching visual representations of events by sorting images or symbols according to when they occur during the day; for example, connecting that they wake up in the morning and go to bed at night</li> <li>identifying the familiar events within the day; for example, using a visual schedule to match the events to the morning or afternoon at school</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i> sort and name familiar shapes and objects VC2MFCSP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using direct comparison to sort objects using a single given attribute, such as size, colour, texture or shape; for example, sorting a collection of cars or beads by colour or sorting a collection of pattern blocks by shape</li> <li>recognising and naming shapes that are similar to squares, triangles and circles in parts of the everyday environment, such as doors, windows, wheels and boxes</li> <li>sorting and naming familiar shapes, such as squares, rectangles, circles, stars and triangles, through hands-on games</li> </ul>
<p><i>Students learn to:</i> describe the location of objects or people within a familiar space, and follow simple instructions to move themselves or an object within a familiar environment VC2MFCSP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>locating known objects in the classroom and naming their locations using prepositional language, such as 'The book is on the desk' or 'Teddy is under the chair'</li> <li>copying the teacher demonstrating 'next to', 'behind' or 'in front of' in games and activities</li> <li>interpreting everyday language of location by following one- and two-step related directions, such as 'Stand up', 'Stand up and line up at the door', 'Sit on the floor', 'Put your lunchbox in your bag', 'Get your chair and take it to the table' or 'Line up behind ...', with explicit modelling from the teacher</li> <li>responding with location to a question from the teacher, such as 'Is the dog on or under the couch?'</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>describing where they have moved themselves or items in relation to familiar environmental locations and objects using 'in', 'out', 'off', 'on', 'up', 'down', 'next to', 'in front of' or 'under'; for example, communicating 'I am on the floor', or 'It is in the reading nook', '... on the bookcase' or '... behind the chair'</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i> compare data represented by objects in response to questions that have only 2 outcomes and relate to familiar situations VC2MFCST01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>participating in displaying collected information and data; for example, assisting in creating a visual display of 'yes' and 'no' responses to questions such as 'Do you have a dog?', 'Do you like ice cream?' and 'Do you like broccoli?' or choices between 2 options, such as 'Do you prefer noodles or rice?'</li> <li>using direct comparison to compare the responses to yes/no questions and questions with 2 outcomes to identify if the results are 'the same' or 'different', or 'more', 'the same' or 'less'; for example, comparing the number of images in a picture graph to determine which response was 'more' and which was 'less'</li> <li>assisting in organising responses to questions into a simple display, such as a picture graph or a collection of representative materials; for example, asking students to choose their favourite ice-cream flavour and displaying responses</li> <li>using counting strategies to determine the totals of collections that represent responses to questions; for example, counting the responses collated from students' favourite ice-cream flavours</li> </ul>

## Foundation Level D

### Level description

In Foundation Level D, learning in Mathematics extends to symbolic representation, building on each student's prior learning and experiences.

Students continue to build their independence as they engage in a range of approaches to the learning and doing of mathematics. They develop their understanding of and fluency with concepts, skills, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students develop proficiency and positive dispositions towards mathematics and its use as they:

- start to connect number words, concrete materials and numerals and use counting strategies to find the total when the quantity changes
- select objects based on one or more attributes and respond to directional instructions
- explore situations using physical and virtual materials to represent, sort, quantify, compare and solve everyday problems
- build their skills and understanding by learning to connect number names and numerals with sets of at least 10 elements and demonstrate one-to-one correspondence when counting objects to at least 10
- use concrete models to represent number in various situations
- use number names when comparing, counting, ordering, adding to or taking away from sets of 1 to 10 or more objects
- compare quantity, objects and shapes using mathematical reasoning and make simple qualitative measurement comparisons
- use mathematical reasoning to identify and understand similarities and differences between shapes, objects and collections
- identify and sequence regular daily events

- identify and copy repeating patterns of 2 or more elements and identify the first and last element of the repeating unit
- make simple qualitative measurement comparisons
- follow instructions to place and find themselves or objects in various locations.

## Achievement standard

By the end of Foundation Level D, students make connections between number names, numerals and position in the sequence of numbers from zero to at least 10. They use counting strategies to quantify collections to at least 10 and subitise to quantify collections to 4. Students compare the size of collections to at least 10. They partition and combine collections up to 10 in different ways. Students represent practical situations that involve quantifying, equal sharing between 2, and adding and taking away one from a collection up to 10.

Students copy and continue simple repeating patterns.

Students identify the attributes of mass, capacity, length and duration using direct comparison in practical situations. They order and connect familiar events to times of the day.

Students name, create and sort familiar shapes and objects into like groups and identify familiar shapes in their environment. They describe the position and the location of objects or people in relation to themselves in a familiar space.

Students sort and compare data collected in response to questions in familiar contexts.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<i>Students learn to:</i> name, represent and order	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>• recognising the order in the sequence of numbers to 10 and identifying the number that is 'one less' than a</li> </ul>

Content descriptions	Elaborations
<p>numbers including zero to at least 10, using physical and virtual materials and numerals VC2MF DN01</p>	<p>given number and the number that is ‘one more’; for example, playing instructive card games that involve reading and ordering number cards, or using counting songs, storybooks, number lines and rhymes to establish the forwards and backwards counting sequence of numbers in the context of active counting activities</p> <ul style="list-style-type: none"> <li>identifying when a given number sequence is incorrect; for example, recognising when a number is out of order in purposely designed incorrect number lines</li> <li>matching numerals to the correct number of items; for example, when shown a collection of beanbags, counting them and choosing the correct numeral or collecting a quantity of objects by reading a numeral; for example, collecting 7 pencils after reading the numeral 7</li> <li>counting forwards and backwards by ones to at least 10 in varied ways, such as using a number line, counting chart and ten-frames</li> <li>participating in activities that use modelled language to indicate ordinal position in a sequence; for example, identifying who was ‘first’, ‘second’ and ‘third’ when lining up or when following steps in a recipe</li> <li>recognising and reading numerals written on familiar objects; for example, recognising and reading numerals in images, text or illustrations in storybooks or room numbers at school</li> </ul>
<p><i>Students learn to:</i> recognise and name the number of objects within a collection up to 4 using subitising VC2MF DN02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>subitising regular and irregular arrangements; for example, recognising 4 objects when presented in different ways, such as on dot cards, and as objects, arrays and counters</li> <li>playing instructive card games that rely on the recognition of numbers represented in different ways; for example, playing memory games and matching pairs of quantities on dot cards or similar where the arrangement on each is different, or playing concentration with dot cards of different arrangements</li> <li>tossing 4 two-coloured counters and instantly recognising the total number of one of the colours without counting</li> <li>using subitising strategies up to 4 to partition and combine collections in different counting activities</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i> quantify and compare collections to at least 10 using counting, and explain or demonstrate reasoning VC2MF DN03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using one-to-one correspondence to determine that groups of objects are the same; for example, counting a group of 8 pineapples and a line of 8 pineapples and indicating they are the same quantity</li> <li>showing understanding that each object in a group is counted only once and the last number counted answers the question of 'How many?'; for example, counting 9 books and answering 9 when asked 'How many books are there?'</li> <li>sharing numbers and counting expressed in Aboriginal and Torres Strait Islander stories, such as <i>Ten scared fish</i> or <i>Joey counts to ten</i></li> <li>using counting to compare the size of 2 or more collections of like items to justify which collection contains more or fewer items; for example, playing 'go fish' and counting the pairs to determine who won the game ('Who has more?', 'Who has less?')</li> </ul>
<p><i>Students learn to:</i> partition and combine collections up to 10 and find the changed value using counting strategies VC2MF DN04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>counting all objects in a collection to find the value, then adding one to or taking one away from the collection and re-counting the collection to find the new total</li> <li>experiencing and participating in modelled and shared counting strategies, including counting on from the larger number and counting back; for example, using concrete materials, number lines, ten-frames and counting charts to determine 'one more' and 'one less'</li> <li>using part-part-whole relationships in numbers up to at least 10, using physical or virtual materials; for example, identifying numbers represented by dots in standard number configurations such as on dominoes and dice by recognising parts that form the whole</li> <li>partitioning collections of up to 10 objects in different ways and identifying the part-part-whole relationship; for example, partitioning a collection of 6 counters into 2 counters and 4 counters, and communicating 'Six is 4 and 2 more' or 'It's 2 and 4', and then partitioning the same collection into 3 and 3</li> </ul>
<i>Students learn to:</i>	<i>This may involve students:</i>

Content descriptions	Elaborations
<p>represent practical situations, including simple financial situations, involving addition, subtraction and quantification up to at least 10 with physical and virtual materials and use matching or counting strategies VC2MFDN05</p>	<ul style="list-style-type: none"> <li>• counting all to find the total of a combined collection up to at least 10; for example, counting collections of strawberries and pears separately and then combining them in a bowl and counting the whole collection</li> <li>• using role-play and materials to represent mathematical relationships in stories; for example, role-playing ‘Five kangaroos were drinking at the river and 3 hopped away’, drawing a picture and using materials to represent the situation, and recording the result of the action with a numeral</li> <li>• using counting strategies, including counting all, counting on from the larger number and counting back, using concrete materials, number lines, ten-frames and counting charts</li> <li>• actively engaging in situations that involve quantifying or comparing collections; for example, engaging with the question ‘Do we have enough glue sticks for our group so that each person has one?’</li> <li>• role-playing using 10 one-dollar coins to pay for items that are priced at \$1 and communicating parts of the transaction; for example, saying ‘I spent 7 one-dollar coins’ or ‘I spent \$7’; ‘I had \$10, I spent \$7 and now I have \$3’</li> <li>• modelling practical situations involving ‘adding to’ or ‘taking away’ with collections of at least 10 objects in digital or physical format</li> </ul>
<p><i>Students learn to:</i> represent practical situations that involve equal sharing of a collection of up to 10 physical or virtual objects and use counting strategies VC2MFDN06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• sharing materials equally and using one-to-one correspondence to count the amount that each student receives; for example, sharing pieces of fruit between 2 students and counting the amount to show that they were shared equally, or sharing playing cards between players and each player counting the number of cards after the deal to ensure all players have the same amount</li> <li>• representing situations that involve counting several items; for example, starting with 8 beads or 6 one-dollar coins and then sharing them equally between 2 students by subitising or counting each group by ones to decide how many beads or coins each student will receive</li> </ul>

## Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i> recognise, copy and continue repeating patterns represented in different ways VC2MFDA01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>copying and continuing a repeating pattern comprising 2 or more elements; for example, performing clap-clap-tap, clap-clap-tap, making a bead necklace using red, blue, red, blue, red, blue, or copying repeating patterns of drumbeats or dance moves during music activities</li> <li>examining and continuing a simple repeating two-element pattern with given objects, movements or sounds; for example, copying and continuing a yellow, blue, blue, yellow, blue, blue pattern when setting the table with drinking cups, repeating and continuing a step, step, clap pattern using their body, or copying and continuing a square, circle, circle pattern using pattern blocks</li> <li>identifying the first and last element in a pattern sequence; for example, stating or indicating the colour in response to questions such as 'What is the first colour in the pattern?' and 'What is the last colour in the pattern?'</li> </ul>

## Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i> identify and compare attributes of objects and events, including length, capacity, mass and duration, using direct comparison VC2MFDM01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using language to compare attributes of length, mass and capacity and to communicate differences between objects, such as 'longer' or 'shorter', 'smaller' or 'bigger', or 'heavier' or 'lighter'</li> <li>using direct comparison to compare objects based on their length, mass or capacity; for example, pouring water from one container into another to identify which holds more and which holds less, or hefting objects such as a tin of spaghetti and a bag of marshmallows to determine 'heavier' and 'lighter'</li> <li>identifying and comparing regular events that occur during the school day and commenting on their duration ('short', 'long', 'quick'); for example, starting 2 events at the same time to determine which takes longer, such as putting on a pair of shoes with buckles and putting on a pair of shoes with Velcro, and describing the duration using familiar terms, such as 'I took longer to do up my buckles'</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>sequence familiar routines and events using simple ordinal language and connect familiar events to times of the day, including morning, afternoon and night-time</p> <p>VC2MFDM02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>re-counting and sequencing 2 or more events from a shared story in the order in which they occurred, using language like ‘this happened first’, ‘this happened next’ and ‘this happened last’</li> <li>following a visual schedule based on the school day’s events</li> <li>sequencing images of daily events; for example, placing images on a string line across the classroom and justifying their placement by referring to morning, afternoon and night-time</li> <li>categorising familiar activities according to when they occur (in the morning, afternoon or night-time); for example, sorting pictographs of common activities such as eating breakfast, brushing teeth, going to school, going home from school and going to bed</li> <li>participating in shared songs and stories to build recognition of the names of the days of the week</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>sort and name familiar shapes and objects, and recognise and describe familiar shapes within objects in familiar environments</p> <p>VC2MFDSP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>sorting a collection of shapes or objects based on one feature (such as the number of sides, colour or size) and describing how they have been sorted</li> <li>sorting a collection of pattern blocks based on shape, and correctly naming the collections as circles, rectangles, squares and triangles</li> <li>sorting and grouping objects and communicating attributes such as texture, colour, size and category; for example, sorting pieces of paper into 2 colours or sorting cutlery into 2 groups</li> <li>identifying familiar shapes within a picture or illustration in a story</li> <li>recognising and naming shapes that are rectangles, squares, triangles and circles in parts of the everyday environment such as on bicycles, toy vehicles or kitchen pantry items</li> </ul>
<p><i>Students learn to:</i></p> <p>describe the position and location</p>	<p><i>This may involve students:</i></p>

Content descriptions	Elaborations
of objects or people in relation to themselves or known objects within a familiar space VC2MFDS02	<ul style="list-style-type: none"> <li>following directions with multiple steps or directions; for example, participating in chants, songs or rhymes with repeated actions, completing an art or drawing activity, locating a tool or completing a job</li> <li>communicating where items are located in relation to other items within a space, using familiar terms; for example, playing a hiding game and when asked ‘Where is Aseema hiding?’, responding with ‘Behind the bookshelf’</li> <li>describing the position of an item in relation to other items in a space using language such as ‘inside’, ‘underneath’ and ‘on top of’; for example, when asked ‘Where are the scissors kept?’, responding with ‘In the box on the bottom shelf’</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<i>Students learn to:</i> sort and compare data represented by objects and images in response to questions that have only 2 outcomes and relate to familiar situations VC2MF DST01	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>participating in the sorting and display of information and data; for example, helping to create a visual display of ‘yes’ and ‘no’ responses to questions such as ‘Do you have a horse?’, ‘Do you like the Magpies?’ or ‘Do you like cheese?’, or choices between 2 outcomes such as ‘Do you prefer orange or blue?’</li> <li>sorting and comparing the responses to questions with 2 outcomes and counting with one-to-one correspondence to quantify the result</li> <li>sorting collected responses and creating simple displays such as a picture graph or collections of representative materials and quantifying the result</li> </ul>

## Foundation

### Level description

In Foundation, learning in Mathematics builds on each student's prior learning and experiences, including the learning opportunities acquired through the implementation of the Victorian Early Years Learning and Development Framework (VEYLDF). Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, skills, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- explore situations, sparked by curiosity, using physical and virtual materials to represent, sort, quantify, compare and solve everyday problems
- look for and make connections between number names, numerals and quantities
- compare quantities and shapes using elementary mathematical reasoning in active learning experiences
- bring mathematical meaning to their use of familiar terms and language when they pose and respond to questions, and explain their thinking and reasoning
- build confidence and autonomy in being able to make and justify mathematical decisions based on quantification and direct comparisons
- learn to recognise repetition in pattern sequences and apply this to creatively build repeating patterns in a range of contexts
- develop a sense of sameness, difference and change when they engage in play-based activities.

### Achievement standard

By the end of Foundation, students make connections between number names, numerals and position in the sequence of numbers from zero to at least 20. They use subitising and counting strategies to quantify collections. Students compare the size of collections to at least 20. They partition and

combine collections up to 10 in different ways, representing these with numbers. Students represent practical situations, including simple financial situations involving money, that involve quantifying, equal sharing, adding to and taking away from collections to at least 10.

Students represent, continue and create simple repeating patterns.

Students identify the attributes of mass, capacity, length and duration, and use direct comparison strategies to compare objects and events. They sequence and connect familiar events to the time of day.

Students name, create and sort familiar shapes and give their reasoning. They describe the position and the location of themselves and objects in relation to other objects and people within a familiar space.

Students collect, sort and compare data in response to questions in familiar contexts.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i> name, represent and order numbers, including zero to at least 20, using physical and virtual materials and numerals VC2MFN01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• responding to a request to collect a quantity of objects or reading a numeral and selecting the associated quantity of items from a collection to match the number required; for example, collecting 9 paintbrushes after hearing the word ‘nine’</li> <li>• recognising the order in the sequence of numbers to 20 and identifying the number that is ‘one less’ than a given number and the number that is ‘one more’; for example, playing instructive card games that involve reading and ordering number cards, or using counting songs, storybooks and rhymes to establish the forwards and backwards counting sequence of numbers in the context of active counting activities</li> <li>• understanding and using terms to indicate ordinal position in a sequence; for example, filling in the missing</li> </ul>

Content descriptions	Elaborations
	<p>term in ‘first’, ‘second’, ‘third’, ... ‘fifth’ ..., or creating a number track using cards with the numerals zero to 20 and describing positions using terms such as ‘first’, ‘last’, ‘before’, ‘after’ and ‘between’</p> <ul style="list-style-type: none"> <li>recognising, writing and reading numerals written on familiar objects; for example, recognising and reading numerals in images, text or illustrations in storybooks, or writing a numeral on a container as a label to show how many objects it contains</li> <li>connecting quantities to number names and numerals when reading and reciting stories and playing counting games or determining and reasoning about the size of sets of objects within Aboriginal and/or Torres Strait Islander Peoples’ instructive games, for example, Segur etug from Mer Island in the Torres Strait region</li> </ul>
<p><i>Students learn to:</i> recognise and name the number of objects within a collection up to 5 using subitising VC2MFN02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising how many objects are in a collection or in images on a card with a quick look and saying the associated number without counting</li> <li>playing instructive card games that rely on the recognition of numbers represented in different ways (for example, playing memory games, or matching pairs of quantities on dot cards or similar where the arrangement on each is different) or using subitising to compare and order collections and to say who has more when sharing items in a game</li> </ul>
<p><i>Students learn to:</i> quantify and compare collections to at least 20 using counting and explain or demonstrate reasoning VC2MFN03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>establishing the language and process of counting, and understanding that each object must be counted only once, that the arrangement of objects does not affect how many there are and that the last number counted answers the question of ‘How many?'; for example, saying numbers in sequence while playing and performing actions</li> <li>using counting to compare the size of 2 or more collections of like items to justify which collection contains more or fewer items</li> <li>using counting and one-to-one correspondence to quantify the number of items required for a purpose; for</li> </ul>

Content descriptions	Elaborations
	<p>example, when asked to collect enough scissors for each member of their group to have a pair, counting each member and using the total count to know how many to collect</p> <ul style="list-style-type: none"> <li>discussing how different cultures may have alternative ways of representing the count; for example, discussing how some people of the Asia region use an abacus or Chinese hand gestures</li> <li>using body-tallying that involves body parts and one-to-one correspondence from counting systems of Aboriginal and/or Torres Strait Islander Peoples to count to 20</li> </ul>
<p><i>Students learn to:</i></p> <p>partition and combine collections up to 10 using part-part-whole relationships and subitising to recognise and name the parts</p> <p>VC2MFN04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising numbers represented in physical or virtual ten-frames, and describing their reasoning: 'It's 7 because there is 5 there and 2 more'</li> <li>partitioning collections of up to 10 objects in different ways and saying the part-part-whole relationship; for example, partitioning a collection of 6 counters into 4 counters and 2 counters and saying, '6 is 4 and 2 more, it's 2 and 4'; then partitioning the same collection into 5 and 1 or 3 and 3</li> <li>representing part-part-whole relationships in numbers up to 10 using physical or virtual materials; for example, identifying numbers represented by dots in standard number configurations such as on dominoes and dice by recognising parts that form the whole</li> <li>exploring number groupings in Aboriginal and/or Torres Strait Islander Peoples' counting systems and the different ways of representing these groupings to form and partition numbers, applying this to quantify collections of objects in the environment on Country/Place up to 10</li> </ul>
<p><i>Students learn to:</i></p> <p>represent practical situations, including simple financial situations, involving addition, subtraction and quantification with physical and virtual materials and use counting or subitising</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using role-play and materials to represent mathematical relationships in stories; for example, role-playing 'Eight kangaroos were drinking at the river and 3 hopped away', drawing a picture and using materials to represent the situation, discussing, and recording the result of the action with a numeral</li> <li>role-playing or actively engaging in situations that involve quantifying or comparing collections of items or simple money transactions; for example, engaging with the question 'Do we have enough scissors for our</li> </ul>

Content descriptions	Elaborations
strategies VC2MFN05	<p>group so that each person has their own pair?; or role-playing using \$1 coins to pay for items in a shop where items are priced in whole dollars</p> <ul style="list-style-type: none"> <li>representing situations expressed in Aboriginal and/or Torres Strait Islander stories, such as 'Tiddalick, the greedy frog', that describe additive situations and their connections to Country/Place</li> <li>representing addition and subtraction situations found in leaf games involving sets of objects used to tell stories, such as games from the Warlpiri Peoples of Yuendumu in the Northern Territory</li> </ul>
<i>Students learn to:</i> represent practical situations that involve equal sharing and grouping with physical and virtual materials and use counting or subitising strategies  VC2MFN06	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>using materials to role-play equal sharing; for example, sharing pieces of fruit or a bunch of grapes between 4 people and discussing how you would know they have been shared equally; or, when playing card games where each player is dealt the same number of cards, counting the number of cards after the deal to ensure they have the same amount</li> <li>representing situations that involve counting several items; for example, starting with 9 beads or 6 \$1 coins and then sharing them equally between 3 people by subitising or counting each group by ones to decide how many beads or coins each person will receive</li> <li>exploring instructive games of Aboriginal and/or Torres Strait Islander Peoples that involve sharing; for example, playing Yangamini of the Tiwi Peoples of Bathurst Island to investigate and discuss equal sharing</li> </ul>

## Strand: Algebra

Content descriptions	Elaborations
<i>Students learn to:</i> follow a short sequence of instructions; recognise, copy, continue and create repeating patterns represented in different ways	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>carrying out a specified sequence of actions to move an object from one location to another</li> <li>playing a simple rule-based game, moving a specified number of places according to the result on a dice in a chance-based game</li> <li>recognising, copying and describing different repeating patterns using materials, shapes, sounds and</li> </ul>

Content descriptions	Elaborations
VC2MFA01	<p>movements during activities and play; for example, making a bead necklace and describing the pattern they have created, such as 'red, blue, green, red, blue, green, red, blue, green', or copying repeating patterns of drumbeats or dance moves during music activities</p> <ul style="list-style-type: none"> <li>• recognising repeating patterns used at home and in daily activities to help make tasks easier or to solve problems; for example, setting the table to eat</li> <li>• recognising and describing repeating patterns that can be observed on Country/Place and in Aboriginal and Torres Strait Islander artwork, cultural performances and material cultures, for example, shell and seed necklaces, dances and songs</li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>identify and compare attributes of objects and events, including length, capacity, mass and duration, use direct comparisons and communicate reasoning</p> <p>VC2MFM01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• using language to describe the measurement attributes of length, mass, capacity and duration, and connecting the words with the appropriate attribute; for example, using words like 'tall', 'short', 'wide', 'long' and 'high' to describe the attribute of length</li> <li>• directly comparing pairs of objects to say which is longer/shorter, and explaining or demonstrating how they know; for example, standing back-to-back to determine who is taller or choosing to line up the bases of a spoon and fork to decide which is longer and explaining why</li> <li>• starting 2 events at the same time to decide which takes longer; for example, putting on a pair of sandals with buckles or Velcro, describing the duration using familiar terms and reasoning, 'I took a longer time because I'm still learning to do up my buckles'</li> <li>• directly comparing pairs of everyday objects from the kitchen pantry to say which is heavier/lighter; for example, hefting a tin of baked beans and a packet of marshmallows or comparing the same pair of objects to say which is longer/shorter and discussing comparisons</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i> sequence days of the week and times of the day, including morning, lunchtime, afternoon and night-time, and connect them to familiar events and actions VC2MFM02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• ordering images of daily events on a string line across the room, and justifying the placement by referring to morning, lunchtime, afternoon and night-time</li> <li>• distinguishing between the days of the school week and weekends, and recognising that the days of the week form a sequence that repeats, with Monday always following on from Sunday</li> <li>• sequencing the events from a story in the order in which they occurred, using language like ‘this happened first’ then ‘this happened next’</li> <li>• creating, interpreting and discussing classroom rosters, for example, a roster for watering the classroom garden, and asking, ‘Who watered the garden yesterday?’ or ‘Whose turn is it today?’</li> <li>• creating a pictorial diary to show the important events that happen on the various days of the week</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i> sort, name and create familiar shapes; recognise and describe familiar shapes within objects in the environment, giving reasons VC2MFSP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• sorting a collection of shapes into groups based on different features, such as the number of sides, colour or size, and describing how they have been sorted</li> <li>• creating a picture using a variety of shapes and a range of materials, including objects to trace around, describing the shapes they have created or used and sharing why they chose each shape in their picture</li> <li>• creating familiar shapes using groups of people; for example, holding hands and creating a circle</li> <li>• recognising and naming shapes that are (close to) rectangles, squares, triangles and circles in component parts of everyday items, for example, on bicycles, toy vehicles or kitchen pantry items</li> <li>• describing and naming shapes within objects that can be observed on Country/Place, recreating and sorting into groups based on their shape</li> </ul>
<p><i>Students learn to:</i> describe the position and location</p>	<p><i>This may involve students:</i></p>

Content descriptions	Elaborations
of themselves and objects in relation to other people and objects within a familiar space VC2MFSP02	<ul style="list-style-type: none"> <li>describing the position of an item in relation to other items in the space using language like 'inside', 'underneath' and 'on top of'; for example, when asked 'Where are the scissors kept?', responding with 'They are in a box, on the bottom shelf at the back of the classroom'</li> <li>describing where they have moved themselves and items in relation to other items within a space, using familiar terms; for example, playing a hiding game and when asked 'Where did you hide the ball?', responding, 'I hid it behind the garbage bin over there near the bench'</li> <li>exploring Aboriginal and/or Torres Strait Islander instructive games, for example, Thapumpan from the Wik-Mungkan Peoples of Cape Bedford in northern Queensland, describing position and movement of self in relation to other participants, objects or locations</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<i>Students learn to:</i> collect, sort and compare data represented by objects and images in response to given investigative questions that have only 2 outcomes and relate to familiar situations VC2MFST01	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>using data displays to answer simple questions such as 'How many students answered "yes" to having pets?'</li> <li>collecting and deciding how to organise data to answer yes/no questions; for example, in relation to the question 'Do more people in our class today have shoes with laces than without?', explaining that lining up and matching shoes with and without laces one-to-one will answer the question</li> <li>collecting data through everyday activities or events and sorting the collected data; for example, sorting toys into categories such as 'toys that move' and 'toys that don't move'</li> <li>creating classroom charts and rosters using stickers to represent data; and comparing and interpreting the representations</li> <li>investigating statistical contexts after reading a story; for example, after reading <i>The Waterhole</i> by Graeme Base, asking and responding to questions like 'What different animals did you see?', 'How many different</li> </ul>

Content descriptions	Elaborations
	<p>types of animals were there?' or 'Were there more tigers or kangaroos?'</p> <ul style="list-style-type: none"><li>exploring what and how information from the environment is collected and used by Aboriginal and/or Torres Strait Islander Peoples to predict weather events</li></ul>

## Level 1

### Level description

In Level 1, learning in Mathematics builds on each student's prior learning and experiences, including the learning opportunities acquired through the implementation of the Victorian Early Years Learning and Development Framework (VEYLD). Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- use their curiosity and imagination to explore situations, recognise patterns in their environment and choose ways of representing their thinking when communicating with others
- demonstrate that numbers can be represented, partitioned and composed in various ways; recognise patterns in numbers; and extend their knowledge of numbers beyond 2 digits
- use physical or virtual materials and diagrams when modelling practical problems through active learning experiences, recognise existing patterns, employ different strategies and discuss the reasonableness of answers
- explain ways of making direct and indirect comparisons and begin to use uniform, informal units to measure some attributes
- reason spatially and use spatial features to classify shapes and objects; recognise these shapes and objects in their environment; and use simple transformations, directions and pathways to move the positions of shapes and objects within a space
- use simple surveys to collect and sort data, based on a question of interest; recognise that data can be represented in different ways; and explain patterns that they see in the results
- develop a sense of equivalence, fairness, repetition and variability when they engage in play-based and practical activities.

## Achievement standard

By the end of Level 1, students connect number names, numerals and quantities, and order numbers to at least 120. They demonstrate how one- and two-digit numbers can be partitioned in different ways and that two-digit numbers can be partitioned into tens and ones. Students partition collections into equal groups and skip count in twos, fives or tens to quantify collections to at least 120. They solve problems involving addition and subtraction of numbers to 20 and use mathematical modelling to solve practical problems involving addition, subtraction, equal sharing and grouping, using calculation strategies.

Students use numbers, symbols and objects, including Australian coins, to create skip counting and repeating patterns, identifying the repeating unit.

Students compare and order objects and events based on the attributes of length, mass, capacity and duration, communicating their reasoning. They measure the length of shapes and objects using uniform informal units.

Students make, compare and classify shapes and objects using identifiable features. They give and follow directions to move people and objects within a space.

Students collect and record categorical data, create one-to-one displays, and compare and discuss the data using frequencies.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i> recognise, represent and order numbers to at least 120 using physical and virtual materials, numerals, number lines and charts VC2M1N01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>reading, writing and naming numerals and ordering two-digit numbers from zero to at least 120, using patterns within the natural number system, including numbers that look and sound similar, for example, 16, 60, 61 and 66</li> <li>using number tracks or positioning a set of numbered cards in the correct order and relative location by</li> </ul>

Content descriptions	Elaborations
	<p>pegging them on an empty number line</p> <ul style="list-style-type: none"> <li>using hundreds charts to build understanding and fluency with numbers; for example, collaboratively building a hundreds chart using cards numbered from zero to 99, or colour-coding the count of tens in a hundreds chart using one colour to represent the number of tens and another to represent the number of ones</li> <li>recognising that numbers are used in all languages and cultures but may be represented differently in words and symbols (for example, through kanji numbers in Japanese and characters in Chinese) and that there are alternative numeration systems (for example, using special characters for 10 and 100 and other multiples of 10 in Japanese and Chinese numeration)</li> </ul>
<p><i>Students learn to:</i></p> <p>partition one- and two-digit numbers in different ways using physical and virtual materials, including partitioning two-digit numbers into tens and ones</p> <p>VC2M1N02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>building knowledge and understanding of the part-part-whole facts to 10, using physical and virtual materials; for example, using virtual ten-frames through a digital app or website to identify pairs of numbers that combine to make 10</li> <li>using physical and virtual materials to partition numbers into counts of tens and ones; for example, recognising 35 as 3 tens and 5 ones or as 2 tens and 15 ones</li> <li>using part-part-whole reasoning and physical or virtual materials to represent 24, then partitioning 24 in different ways and recording the partitions using numbers; for example, 10, 10 and 4 combine to make 24 or 10 and 14 combine to make 24</li> </ul>
<p><i>Students learn to:</i></p> <p>quantify sets of objects, to at least 120, by partitioning collections into equal groups using number knowledge and skip counting</p> <p>VC2M1N03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>counting a large collection of items using groups of fives or tens and skip counting to work out how many there are, and recording the amount and connecting the digits in the number to the grouped materials when using groups of 10</li> <li>counting collections of objects, such as pencils or images of birds in a tree, by grouping them in tens to enable efficient counting, and connecting the digits in the number to the groups of tens and ones</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>counting a large collection of Australian \$1 coins by stacking them in piles of 10, skip counting in tens and including any leftover coins to determine the total value</li> </ul>
<p><i>Students learn to:</i></p> <p>add and subtract numbers within 20, using physical and virtual materials, part-part-whole knowledge to 10 and a variety of calculation strategies</p> <p>VC2M1N04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using drawings, physical and virtual materials, and number combinations within 10 to add and subtract collections to 20</li> <li>adding and subtracting numbers within 20, using a variety of representations and strategies, such as counting on, counting back, partitioning and part-part-whole knowledge of numbers to 10; for example, using partitioning and combining <math>7 + 5 = 7 + 3 + 2 = 10 + 2 = 12</math></li> <li>developing and using strategies for one-digit addition and subtraction based on part-part-whole relationships for each of the numbers to 10 and subitising with physical and virtual materials; for example, 8 and 6 is the same as 8 and 2 and 4</li> <li>representing story problems involving addition and subtraction of numbers within 20 using a Think Board; recognising and using + and - symbols and the equal sign (=) to represent the operations of addition and subtraction; and showing and explaining the connections between any materials used using the language of plus and minus, and the numbers within the story problem</li> <li>creating and performing addition and subtraction stories told through Aboriginal and/or Torres Strait Islander dances</li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems involving additive situations, including simple money transactions; represent the situations with diagrams, physical and virtual materials; use calculation strategies to solve the problem</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling problems involving addition and subtraction presented in stories, using a Think Board to represent the problem, solving the problem using physical materials and explaining the connections between any materials used, the Think Board diagram and the numbers within the story</li> <li>modelling simple money problems involving addition and subtraction using whole dollar amounts; for example, setting up a shop and role-playing practical problems of buying and selling goods, using addition and subtraction with play money and prices in whole dollar amounts; or solving the problem 'I had \$14 and</li> </ul>

Content descriptions	Elaborations
VC2M1N05	<p>'was given \$15 for my birthday' using addition to answer the problem</p> <ul style="list-style-type: none"> <li>modelling a variety of different additive situations to solve practical problems; for example, keeping track of the number of people on a bus as it stops to pick up and drop off passengers or the number of people entering a lift</li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems involving equal sharing and grouping; represent the situations with diagrams, physical and virtual materials, and use calculation strategies to solve the problem</p> <p>VC2M1N06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling problems involving repeated equal group situations, such as 'How many wheels are needed for 3 cars?', using materials and drawing a picture to show what they did, and recording the results with a number</li> <li>modelling practical problems involving equal sharing situations; for example, sharing a set of dominoes between the 2 players in a game, and then counting or subitising to ensure they both have the same number of tiles</li> <li>modelling money problems involving equal sharing; for example, sorting coins from a moneybox according to their denominations, sharing the coins equally between 4 people, and using counting or subitising to ensure they have equal amounts of each denomination</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>recognise, continue and create pattern sequences, with numbers, symbols, shapes and objects including Australian coins, formed by skip counting, initially by twos, fives and tens</p> <p>VC2M1A01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using number charts, songs, rhymes and stories to establish skip counting sequences of twos, fives and tens</li> <li>using shapes and objects to represent a growing pattern formed by skip counting; for example, using blocks or beads to represent the growing patterns 2, 4, 6, 8, 10 ... and 5, 10, 15, 20 ...</li> <li>recognising the patterns in sequences formed by skip counting; for example, recognising that skip counting in fives starting from zero always results in either a 5 or zero as the final digit</li> <li>counting by twos, fives or tens to determine how much money is in a collection of coins or notes of the same</li> </ul>

Content descriptions	Elaborations
	<p>denomination, for example, 5-cent, 10-cent and \$2 coins or \$5 and \$10 notes</p> <ul style="list-style-type: none"> <li>using different variations of the popular Korean counting game Sam-yuk-gu for generating skip counting pattern sequences</li> </ul>
<p><i>Students learn to:</i></p> <p>recognise, continue and create repeating patterns with numbers, symbols, shapes and objects, identifying the repeating unit and recognising the importance of repetition in solving problems VC2M1A02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>interpreting a repeating pattern sequence created by someone else, noticing and describing the repeating part of the pattern and explaining how they know what comes next in the sequence</li> <li>generalising a repeating pattern by identifying the unit of repeat and representing the elements using numbers, letters or symbols; for example, representing the repeating pattern of stamp, stamp, clap, stamp, clap, pause, stamp, stamp, clap, stamp, clap as SSCSC SSCSC ..., recognising the elements that are repeating, describing the unit of repeat as SSCSC and continuing the pattern</li> <li>recognising within the sequencing of natural numbers that 0–9 digits are repeated both in and between the decades and using this pattern to continue the sequence and name two-digit numbers beyond 20</li> <li>identifying the repeating patterns in Aboriginal and/or Torres Strait Islander systems of counting, exploring different ways of representing numbers including oral and gestural language</li> <li>considering how the making of shell or seed necklaces by Aboriginal and/or Torres Strait Islander Peoples includes practices such as sorting shells and beads based on colour, size and shape, and creating a repeating pattern sequence</li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>compare directly and indirectly and order objects and events using attributes of length, mass, capacity and duration, communicating</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using a piece of string to indirectly compare the length of several objects, deciding which will fit within a space, and using comparative language to describe the order (shortest, short, longer, longest)</li> <li>ordering the mass of 3 or more objects, such as rocks, using hefting and balance scales, and using</li> </ul>

Content descriptions	Elaborations
<p>reasoning VC2M1M01</p>	<p>comparative language to explain the order (lightest, light, heavier, heaviest) and how they decided on the order</p> <ul style="list-style-type: none"> <li>pouring sand, rice or water from one container to another to compare and order the capacity of 3 or more containers, and describing the order of the results in terms of which holds the most/least and those in between</li> <li>creating sand timers from everyday items or recycled materials and comparing them to order the duration of time required for the sand to run through</li> <li>investigating situations where Aboriginal and/or Torres Strait Islander Peoples estimate, compare and communicate measurements, for example, situations involving the duration of seasons, understanding animal behaviour using the length of animal tracks, or investigating capacity through Aboriginal and/or Torres Strait Islander water management techniques, such as traditional water-carrying vessels and rock holes</li> </ul>
<p><i>Students learn to:</i> measure the length of shapes and objects using informal units, recognising that units need to be uniform and used end-to-end VC2M1M02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using 2 different units (for example, icy pole sticks and pencils) to measure the length of an object (for example, a desk), and explaining why the number of units used may be different</li> <li>comparing the length of 2 objects, such as a desk and a bookshelf, by laying multiple copies of a unit and counting to say which is longer and how much longer; and explaining why they should not have gaps or overlaps between the units, as this will change the length of the unit</li> <li>measuring the distance between 2 locations using footsteps, comparing the results and explaining why there may be different results, for example, referring to the different lengths of footsteps as using different units</li> <li>measuring and comparing the length of objects using blocks; for example, comparing the height of 2 toys by stacking blocks one on top of the other and counting how many it takes to reach the height of each object to decide which is taller</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i> describe the duration and sequence of events using years, months, weeks, days and hours VC2M1M03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• naming, listing and using familiar units of time, such as hours, days, weeks and years</li> <li>• comparing the number of days in the months of the year and explaining how the months cycle from one year to the next</li> <li>• sequencing familiar events, including representing time, on pictorial timelines</li> <li>• discussing events and activities and deciding whether they would take closer to an hour, a day, a week, a month or a year; for example, it takes a day for the sun to rise and fall and rise again, but it takes less than an hour for me to walk to school</li> <li>• investigating durations of time represented in Aboriginal and/or Torres Strait Islander seasonal calendars</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i> make, compare and classify familiar shapes; recognise familiar shapes and objects in the environment, identifying the similarities and differences between them VC2M1SP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• classifying a collection of shapes including different circles, ovals, regular and irregular shapes, triangles and quadrilaterals, saying what is the same about the shapes in a group and what is different between the shapes in a group</li> <li>• selecting a shape from a small collection of shapes inside a bag and describing the shape by feel, so that others can name the shape and give reasons for their choice</li> <li>• comparing the different objects that can be built out of the same number of blocks or centi-cubes and discussing the differences between them</li> <li>• exploring string games used in storytelling by Aboriginal and/or Torres Strait Islander Peoples (for example, in Karda from the Yandruwandha Peoples of north-eastern South Australia), recognising, comparing, describing and classifying the shapes made by the string and these shapes' relationship to shapes and objects on Country/Place</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i> give and follow directions to move people and objects to different locations within a space VC2M1SP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>interpreting and following directions around familiar locations, and understanding the meaning and importance of the words when giving directions; for example, using words like 'forwards' and 'backwards', 'straight ahead', 'left' or 'right' to describe movement and giving instructions like 'Keep going straight until you reach the end of this passage and then turn to your right'</li> <li>creating and following an algorithm consisting of a set of instructions to move an object to a different location; for example, role-playing being a robot and following step-by-step instructions given by another classmate to move from one place to another, only moving as instructed</li> <li>following directions to move people into different positions within a line using both ordinal and positional language to describe their position; for example, directly comparing heights and following directions using ordinal and positional language to line up in height order</li> <li>describing a familiar journey across Country/Place using directional language</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i> acquire and record data for categorical variables in various ways including using digital tools, objects, images, drawings, lists, tally marks and symbols VC2M1ST01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>discussing methods of collecting data to answer a question such as 'What types of rubbish are found in the playground?', sharing ideas and trying out some of the suggested methods, reviewing the data collected and explaining how they might change the way they collect data next time</li> <li>collecting and recording information on a topic of interest using lists (for example, 'How many people follow a particular football team' or 'What colour eyes each person has'), examining the data to generate some questions that it could answer, and then rearranging the data or collecting different data to answer the question</li> <li>creating a tally to record data while observing events such as the year level of students using the bike shed,</li> </ul>

Content descriptions	Elaborations
	<p>deciding on the possible categories before the observations are taken, and then reviewing the data afterwards to notice whether the tally was effective</p> <ul style="list-style-type: none"> <li>using star charts with stickers or emojis to represent class data; for example, using emojis on a personal feeling chart to represent how they are feeling each day or using emojis to represent activities on the class calendar</li> <li>exploring ways of representing, sharing and communicating data through stories and symbols used by Aboriginal and Torres Strait Islander Peoples</li> </ul>
<p><i>Students learn to:</i></p> <p>represent collected data for a categorical variable using one-to-one displays and digital tools where appropriate; compare the data using frequencies and discuss the findings VC2M1ST02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>creating a pictograph with objects or drawings; discussing the possible categories for the pictograph, arranging the objects or drawings into the categories; and then reflecting on the chosen categories and deciding whether they were helpful</li> <li>translating data from a list or pictorial display into a tally chart to make counting easier; describing what the tally chart is showing, by referring to the categories; using skip counting by fives to compare the numbers within each category; and explaining how the tally chart answers the question</li> <li>recognising that when there is no data for a particular category you may choose whether or not to include it in your data display, and you may use a zero or blank for that category depending on the purpose of the data collection or presentation; for example, creating a birthday calendar for the class and discussing that there are no students born in May and therefore there are no names listed</li> <li>representing data with objects and drawings where one object or drawing represents one data value, and describing the displays and explaining patterns that have been created using counting strategies to determine the frequency of responses</li> <li>exploring Aboriginal and/or Torres Strait Islander children's instructive games, for example, Kolap from Mer Island in the Torres Strait region, recording the outcomes, and representing and discussing the results</li> </ul>

## Level 2

### Level description

In Level 2, learning in Mathematics builds on each student's prior learning and experiences, including the learning opportunities acquired through the implementation of the Victorian Early Years Learning and Development Framework (VEYLDF). Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- recognise that mathematics can be used to investigate things they are curious about, to solve practical problems and to model everyday situations, describing their thinking and reasoning using familiar mathematical language
- partition and combine numbers flexibly, recognising and describing the relationship between addition and subtraction and employing part-part-whole reasoning and relational thinking to solve additive problems
- use number sentences to formulate additive situations and represent simple multiplicative situations using equal groups and arrays
- use mathematical modelling to solve practical problems involving authentic situations by representing problems with physical and virtual materials, and diagrams, and using different calculation strategies to find solutions
- compare and contrast related operations and use known addition and subtraction facts to develop strategies for unfamiliar calculations
- recognise types of patterns in different contexts
- partition collections, shapes and objects into equal parts and build a sense of fractions as a measure, connecting this to measures of turn and representations of time
- use uniform units to measure, compare and discuss the attributes of shapes and objects, and the duration of events

- describe spatial relationships such as the relative position of objects represented within a two-dimensional space
- build the foundations for statistical inquiry by choosing questions based on their interests as they collect, represent and interpret data, and recognise features of different representations
- develop a sense of equivalence, chance and variability when they engage in play-based and practical activities.

## Achievement standard

By the end of Level 2, students order and represent numbers to at least 1000; apply knowledge of place value to partition, rearrange and rename two- and three-digit numbers in terms of their parts; and regroup partitioned numbers to assist in calculations. They use mathematical modelling to solve practical additive and multiplicative problems, including money transactions, representing the situation and choosing calculation strategies.

Students identify and represent part-whole relationships of halves, quarters and eighths in measurement contexts.

Students describe and continue patterns that increase and decrease additively by a constant amount and identify missing elements in the pattern.

They recall and demonstrate proficiency with addition and subtraction facts within 20 and multiplication facts for twos.

Students use uniform informal units to measure and compare shapes and objects. They determine the number of days between events using a calendar and read time on an analog clock to the hour, half-hour and quarter hour. Students use quarter, half, three-quarter and full measures of turn in everyday situations.

Students compare and classify shapes, describing features using formal spatial terms. They locate and identify positions of features in two-dimensional representations and move position by following directions and pathways.

Students use a range of methods to collect, record, represent and interpret categorical data in response to questions.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i> recognise, represent and order numbers to at least 1000 using physical and virtual materials, numerals and number lines VC2M2N01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• recognising missing numbers on different number lines, for example, a number line with 1800 on one end and 2200 on the other, with every decade numbered</li> <li>• recognising and locating the position of pieces within hundreds chart puzzles using knowledge of the order of natural numbers</li> <li>• reading and writing numerals, and saying and ordering two-, three- and four-digit numbers using patterns in the number system, including numbers with zeros in different places and numbers that look and sound similar (such as 808, 880, 818 and 881)</li> <li>• collecting large quantities of materials for recycling (for example, ring pulls, bottle tops and bread tags) and grouping them into ones, tens and hundreds, and using the materials to show different representations of two- and three-digit numbers</li> </ul>
<p><i>Students learn to:</i> partition, rearrange, regroup and rename two- and three-digit numbers using standard and non-standard groupings; recognise the role of a zero digit in place value notation VC2M2N02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• comparing the digits of a number with materials grouped into hundreds, tens and ones, and explaining the meaning of each of the digits in the materials</li> <li>• renaming numbers in different ways using knowledge of place value; for example, renaming 245 as 24 tens and 5 ones or 2 hundreds and 45 ones</li> </ul>
<p><i>Students learn to:</i> recognise and describe one-half as one of 2 equal parts of a whole and connect halves, quarters and eighths through repeated halving VC2M2N03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• creating halves of a range of collections sets by sharing collections into 2 equal groups; for example, comparing half of a set of 12 washers with half of a set of 8 bolts to identify how they both represent one-half of their respective set</li> <li>• creating halves using measurement attributes – for example, explaining that ‘a half is one part out of 2 equal parts of a whole’; equally folding a strip of paper, dividing a lump of playdough or separating a cup of</li> </ul>

Content descriptions	Elaborations
	<p>water into 2 equal parts, and then selecting one of the parts and naming it 'one-half'; or comparing half of a collection of 10 counters with half of a shape or object and explaining how each shows one-half of the respective whole</p> <ul style="list-style-type: none"> <li>using repeated halving to subdivide shapes and objects in different ways to make corresponding halves, quarters and eighths; naming the parts and comparing the size of them to notice that they are all the same size; and demonstrating that a quarter is a half of a half and that an eighth is a half of a quarter</li> <li>dividing a shape into equal parts and relating the number of parts to the unit fraction; for example, if there are 4 equal parts then each part is one-quarter and if there are 8 equal parts then each is one-eighth</li> </ul>
<p><i>Students learn to:</i></p> <p>add and subtract one- and two-digit numbers, represent problems using number sentences and solve using part-part-whole reasoning and a variety of calculation strategies</p> <p>VC2M2N04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using the associative property of addition to assist with mental calculation by partitioning, rearranging and regrouping numbers using number knowledge, near doubles and bridging-to-10 strategies; for example, calculating <math>7 + 8</math> using <math>7 + (7 + 1) = (7 + 7) + 1</math>, the associative property and near doubles; or calculating <math>7 + 8</math> using the associative property and bridging to 10: <math>7 + (3 + 5) = (7 + 3) + 5</math></li> <li>using strategies such as doubles, near doubles, part-part-whole knowledge to 10, bridging tens and partitioning to mentally solve problems involving two-digit numbers; for example, calculating <math>56 + 37</math> by thinking 5 tens and 3 tens is 8 tens, <math>6 + 7 = 6 + 4 + 3</math> is one 10 and 3, and so the result is 9 tens and 3, or 93</li> <li>representing addition and subtraction problems using a bar model and writing a number sentence, explaining how each number in the sentence is connected to the situation</li> <li>using mental strategies and informal written jottings to help keep track of the numbers when solving addition and subtraction problems involving two-digit numbers and recognising that zero added to a number leaves the number unchanged; for example, in calculating <math>34 + 20 = 54</math>, 3 tens add 2 tens is 5 tens, which is 50, and 4 ones add zero ones is 4 ones, which is 4, so the result is <math>50 + 4 = 54</math></li> <li>using a physical or mental number line or hundreds chart to solve addition or subtraction problems by moving along or up and down in tens and ones; for example, solving the problem 'I was given a \$100 gift'</li> </ul>

Content descriptions	Elaborations
	<p>card for my birthday and spent \$38 on a pair of shoes and \$15 on a T-shirt. How much money do I have left on the card?</p> <ul style="list-style-type: none"> <li>using Aboriginal and Torres Strait Islander Peoples' stories and dances to understand the balance and connection between addition and subtraction, representing relationships as number sentences</li> </ul>
<p><i>Students learn to:</i></p> <p>multiply and divide by one-digit numbers using repeated addition, equal grouping, arrays and partitioning to support a variety of calculation strategies</p> <p>VC2M2N05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>making and naming arrays and using bar models to solve simple multiplication or sharing problems; for example, making different arrays to represent 12 and naming them as '3 fours', '2 sixes', '4 threes' and '6 twos', using physical or virtual materials to make arrays or using bar models to demonstrate that '3 fours' is equal to '4 threes'</li> <li>finding the total number represented in an array by partitioning the array using subitising and number facts; for example, describing how they determined the total number of dots arranged in a '3 fives' array by saying, 'I saw 2 fives, which is 10, and then 5 more, which makes 15'</li> <li>recognising problems that can be solved using division and identifying the difference between dividing a set of objects into 3 equal groups and dividing the same set of objects into groups of 3</li> <li>using a Think Board to solve partition and quotient division problems; for example, sharing a prize of \$36 between 4 people, using materials, a diagram and skip counting to find the answer, and explaining whether the answer '9' refers to people or dollars</li> <li>using materials or diagrams, and skip counting, to solve repeated equal-quantity multiplication problems; for example, writing a repeated addition number sentence and using skip counting to solve the problem 'Four trays of biscuits with 6 on each tray – how many biscuits are there?'</li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems involving additive and multiplicative situations, including money</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling practical problems by interpreting an everyday additive or multiplicative situation; for example, making a number of purchases at a store and deciding whether to use addition, subtraction, multiplication or division to solve the problem and justifying the choice of operation, such as 'I used subtraction to solve</li> </ul>

Content descriptions	Elaborations
<p>transactions; represent situations and choose calculation strategies; interpret and communicate solutions in terms of the context VC2M2N06</p>	<p>this problem as I knew the total and one of the parts, so I needed to subtract to find the missing part'</p> <ul style="list-style-type: none"> <li>modelling and solving simple money problems involving whole dollar amounts with addition, subtraction, multiplication or division, for example, 'If each member of our class contributes \$5, how much money will we have in total?'</li> <li>modelling and solving practical problems such as deciding how many people should be in each team for a game or sports event, how many teams for a given game can be filled from a class, or how to share out some food or distribute money in whole dollar amounts, including deciding what to do if there is a remainder</li> <li>modelling and solving the problem 'How many days are there left in this year?' by using a calendar</li> <li>modelling problems involving equal grouping and sharing in Aboriginal and/or Torres Strait Islander children's instructive games; for example, in Yangamini from the Tiwi Peoples of Bathurst Island, representing relationships with a number sentence and interpreting and communicating solutions in terms of the context</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i>      recognise, describe and create additive patterns that increase or decrease by a constant amount, using numbers, shapes and objects, and identify missing elements in the pattern VC2M2A01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>creating a pattern sequence with materials, writing the associated number sequence, and then describing the sequence so someone else can replicate it with different materials; for example, using matchsticks or toothpicks to create a growing pattern of triangles – using 3 for one triangle, 5 for 2 triangles, 7 for 3 triangles – and describing the pattern as 'Start with 3 and add 2 each time'</li> <li>recognising patterns in the built environment to locate additive pattern sequences (for example, responding to 'How many windows in one train carriage, 2 train carriages, 3 train carriages ...?' or 'How many wheels on one car, 2 cars, 3 cars ...?') and recording the results in a diagram or table</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>recognising the constant term being added or subtracted in an additive pattern and using it to identify missing elements in the sequence</li> <li>recognising additive patterns in the environment on Country/Place and in Aboriginal and/or Torres Strait Islander material culture; and representing these patterns using drawings, coloured counters and numbers</li> </ul>
<p><i>Students learn to:</i></p> <p>recall and demonstrate proficiency with addition facts to 20; extend and apply facts to develop related subtraction facts VC2M2A02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using ten-frames or materials such as connecting cubes to develop and record addition and subtraction strategies including doubles, near doubles, counting on, combinations to 10 and bridging to 10, explaining patterns and connections noticed within the facts</li> <li>partitioning and rearranging collections to practise and develop fluency with addition and subtraction facts to 20, leading to the recall of these facts; for example, partitioning using materials and part-part-whole diagrams to develop subtraction facts related to addition facts, such as <math>8 + 7 = 15</math> therefore <math>15 - 7 = 8</math> and <math>15 - 8 = 7</math></li> <li>using partitioning to develop and record facts systematically (for example, 'How many ways can 10 birds be spread among 2 trees?', <math>10 = 10 + 0</math>, <math>10 = 9 + 1</math>, <math>10 = 8 + 2</math>, <math>10 = 7 + 3</math>, ...), explaining how they know they have found all possible partitions</li> </ul>
<p><i>Students learn to:</i></p> <p>recall and demonstrate proficiency with multiplication facts for twos; extend and apply facts to develop the related division facts using doubling and halving VC2M2A03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising and relating terms such as 'double', 'twice' and 'multiply by 2', and 'halve' and 'divide by 2' using physical and virtual materials; for example, colouring numbers on a hundreds chart to represent doubles and using it to recognise halves or recognising the doubling pattern and applying the pattern to find related facts such as 'For 8 twos, think 2 eights'</li> <li>doubling and halving collections to practise and develop fluency with multiplication and division facts for twos, leading to recall of these facts</li> <li>establishing an understanding of doubles and near doubles using physical or virtual manipulatives; for example, using manipulatives to establish that doubling 5 gives you 10, then extending this doubling fact to</li> </ul>

Content descriptions	Elaborations
	<p>respond to the question 'How can you use this fact to double 6 or double 4?'</p> <ul style="list-style-type: none"> <li>developing fluency with doubling and halving numbers within 20 using physical or virtual materials and playing doubling and halving games; for example, using a physical or virtual dice and choosing whether to double or halve to reach a target number</li> </ul>
<p><i>Students learn to:</i> apply repetition in arithmetic operations, including multiplication as repeated addition and division as repeated subtraction VC2M2A04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using technology to construct a sequence of numbers based on constant addition or subtraction from a given starting value</li> <li>sharing a set of objects equally between a small number of groups</li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i> measure and compare objects based on length, capacity and mass using appropriate uniform informal units and smaller units for accuracy when necessary VC2M2M01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>choosing suitable informal units to measure the length of a range of objects, and justifying their choice of a longer unit to measure things that are long (such as the width of a room) and a shorter unit to measure shorter things or when more accuracy is needed</li> <li>comparing the capacity of several containers using sand and units such as a spoon or cup, to say which container will hold the most and how much more it will hold; recording the results; writing an explanation of their measurement process, including using smaller units to be more accurate; and justifying the result</li> <li>using balance scales to compare the mass of several objects, selecting an appropriate informal unit; counting the number of informal units to determine which object is heavier and how much heavier; and explaining why the informal units chosen need to be the same mass</li> <li>recognising that the same informal unit needs to be used when measuring (for example, demonstrating and discussing why using different shoe lengths to measure the same distance could result in the measures</li> </ul>

Content descriptions	Elaborations
	<p>being different) and discussing why a smaller-sized informal unit may result in a larger number of units compared to a larger-sized informal unit</p> <ul style="list-style-type: none"> <li>investigating Aboriginal and/or Torres Strait Islander Peoples' use of body parts, such as hands, as uniform informal units of measurement used to measure and compare objects, for example, in the manufacturing of nets for a particular purpose</li> <li>investigating and comparing measurable attributes that are interpreted by Aboriginal and/or Torres Strait Islander Peoples to understand animal behaviour, such as the length, width and depth of animal tracks</li> </ul>
<p><i>Students learn to:</i></p> <p>identify common uses and represent halves, quarters and eighths in relation to shapes, objects and events</p> <p>VC2M2M02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>demonstrating how food items can be cut in halves, quarters or eighths; for example, cutting pizzas, slices, cakes or sandwiches into equal parts by halving, then halving again to form quarters and eighths, ensuring that the parts are equal</li> <li>investigating cup and spoon measures used in cooking and discussing what half or quarter of a cup or tablespoon measure means, and using sand or water to compare these to the full cup and tablespoon measures</li> <li>demonstrating and using halves and quarters in folding activities; for example, folding paper in half and quarters and ensuring that the pieces are the same size</li> <li>recognising that halves and quarters can be used to describe lengths, positions and distances; for example, describing the halfway point in a race or instructing someone to stand halfway between 2 chairs</li> <li>discussing that halves and quarters are used to describe durations of time, including durations of time in sporting events, and what this means; for example, discussing how the sirens used during an Australian Rules football game represent quarter time, half-time and three-quarter time during the game, or recognising and using half an hour or quarter of an hour to describe a duration of time</li> </ul>
<p><i>Students learn to:</i></p> <p>identify the date and determine</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using calendars to locate specific dates and identify what day it is, to determine the date 2 weeks prior to or</li> </ul>

Content descriptions	Elaborations
<p>the number of days between events using calendars VC2M2M03</p>	<p>after a given date</p> <ul style="list-style-type: none"> <li>creating a class calendar to enter specific dates relevant to the class, for example, students' birthdays, school assemblies, sports carnivals or class excursions</li> <li>using addition and a calendar to model and solve the problem 'How many days are left in this year?' by identifying the number of days left in this month and in each of the remaining months, and using addition to model and solve the problem</li> <li>identifying and locating specific days or dates on a calendar, for example, school holidays, sports days, Anzac Day, Easter, Diwali or Ramadan</li> </ul>
<p><i>Students learn to:</i> recognise and read the time represented on an analog clock to the hour, half-hour and quarter hour VC2M2M04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>creating an analog clock from a paper plate, showing the placement of the numbers and the 2 hands, and explaining how long it takes for the 2 hands to move around the clock face and what time unit each is showing</li> <li>recognising and describing the relationship between the movement of the hands on an analog clock and the duration of time it represents; for example, connecting the language of 'half past' to mean when the 'big hand' will be at half past the hour and recognising this position as being halfway around its full cycle</li> <li>dividing a clock face into halves and quarters, and connecting the subdivisions with telling the time to the half-hour and quarter hour; and explaining the meaning of 'quarter past' and 'quarter to' referring to the hour</li> </ul>
<p><i>Students learn to:</i> identify, describe and demonstrate quarter, half, three-quarter and full measures of turn in everyday situations VC2M2M05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying things that turn in the school environment, for example, the handle on a tap or a door, or the dial or switch on a piece of equipment; and identifying a half turn and a full turn, drawing a diagram and labelling it with arrows to show the direction and amount of turn</li> <li>giving and following instructions to move during an activity; for example, demonstrating and describing half, quarter and full turns in a choreographed dance</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>investigating hands turning on a clock and relating quarter, half and full hours to angles and the language of clockwise or anticlockwise</li> <li>giving or following directions to locate an object in the room or to provide a pathway through a grid, such as programming a robot, referring to quarter, half, three-quarter and full turns</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i> recognise, compare and classify shapes, referencing the number of sides and using spatial terms such as 'opposite', 'parallel', 'curved' and 'straight'</p> <p>VC2M2SP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>sorting a collection of shapes in different ways based on their features, such as number of sides, whether all sides are equal and whether pairs of opposite sides are parallel; for example, sorting collections of triangles and other polygons</li> <li>manipulating shapes and recognising that different orientations do not change the shape; for example, cutting out pictures of various shapes and recognising that they are still classified as the same shape even if they are upside down or on their side</li> <li>investigating the shapes of different sporting fields, describing and labelling their features, including sidelines, centre circles and goal squares; for example, labelling the lines on a basketball court and using spatial terms to describe them</li> <li>creating regular shapes using digital tools, describing and observing what happens when you manipulate them; for example, dragging or pushing vertices to produce irregular shapes, or moving or rotating a shape</li> </ul>
<p><i>Students learn to:</i> locate positions in two-dimensional representations of a familiar space; move positions by following directions and pathways</p> <p>VC2M2SP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>interpreting maps of familiar places and identifying the position of key features</li> <li>understanding that we use maps to receive and give directions and to describe place and spatial relationships between places</li> <li>using a classroom seating plan to locate a new seating position and giving directions to other classmates to</li> </ul>

Content descriptions	Elaborations
	<p>find their seats</p> <ul style="list-style-type: none"> <li>following and creating movement instructions that need to be carried out to move through a <math>4 \times 4</math> grid mat on the classroom floor or on a computer screen, for example, one forward, 2 to the right and one backwards and so on to reach a target square; or using a robotic toy to follow a path on a street scene on a floor mat, adjusting their instructions to the robot toy as they consider the order of their instructions, the direction and how far they want the toy to travel</li> <li>moving around a two-dimensional maze using directional language to describe turns and changes in direction, including saying, for example, 'clockwise', 'anticlockwise', 'quarter turn to the left' and 'take the path to the right'</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i>          acquire data for categorical variables through surveys, observation, experiment and using digital tools; sort data into relevant categories and display data using lists and tables  <b>VC2M2ST01</b></p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>posing a question of interest about favourite things (for example, asking classmates 'What are your favourite types of fruit/football teams/days of the week?'), recording responses using a table, and using counting strategies to determine the number of different responses and the most popular and least popular responses</li> <li>investigating questions such as 'How much rubbish is really rubbish?' by gathering data about objects in categories (for example, 'throw away', 'recycle' and 're-use'), deciding whether the data answers the question</li> <li>using familiar software to construct a survey to collect class data; sorting and interpreting responses; and considering the questions asked and whether they need to be modified to re-use the survey</li> <li>observing events and using the observations to design a table or list to record data; for example, observing students arriving at school prior to deciding the appropriate data categories for investigating the different</li> </ul>

Content descriptions	Elaborations
	<p>ways students get to school</p> <ul style="list-style-type: none"> <li>exploring the ways Aboriginal and Torres Strait Islander Peoples observe, collect, sort and record data</li> </ul>
<p><i>Students learn to:</i></p> <p>create different graphical representations of data using software where appropriate; compare the different representations, and identify and describe common and distinctive features in response to questions</p> <p>VC2M2ST02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>collecting data from a limited list of choices, creating 2 different graphical representations of the data, and discussing and comparing the different representations; for example, asking the class to choose their favourite colour from a given set, then co-creating a picture graph with colours on the horizontal axis and comparing it to a column graph with colours on the horizontal axis and numbers on the vertical axis</li> <li>creating different data displays (for example, lists, tally charts, jointly created column graphs and picture graphs) to represent a data set, describing the information that each display represents and discussing how easy or hard they are to interpret and why</li> <li>using digital tools to create picture graphs to represent data using one-to-one correspondence, deciding on an appropriate title for the graph and considering whether the categories of data are appropriate for the context</li> <li>comparing picture graphs with one-to-one column graphs of the same data, interpreting the data in each and saying how they are the same and how they are different; for example, collecting data on the country of birth of each student and creating different pictographs to represent classroom data</li> <li>using dot plots, sticker charts, picture graphs, bar charts and column graphs to represent data</li> </ul>

## Level 3

### Level description

In Level 3, learning in Mathematics builds on each student's prior learning and experiences. Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- become increasingly aware of the usefulness of mathematics to model situations and solve practical problems
- recognise that mathematics has conventions and language enabling the unambiguous communication of ideas and results
- experience the power of being able to manipulate numbers using a range of strategies that are based on proficiency with single-digit addition facts and their understanding of place value in the base-10 number system, partitioning and regrouping
- begin to apply their understanding of algorithms and technology to experiment with numbers and recognise patterns
- develop, extend and apply their addition and multiplication facts and related facts for subtraction and division through recognising connections between operations, and develop automaticity for 3, 4, 5 and 10 multiplication facts through games and meaningful practice
- learn to formulate, choose and use calculation strategies, communicating their solutions within a modelling context
- use metric units to measure and compare objects and events
- recognise the relationship between dollars and cents and learn to represent money values in different ways, including virtual money
- determine key features of objects and spaces, and use these when they build models and spatial representations
- undertake, with guidance, statistical investigations that are meaningful to them, making decisions about their use and representation of

categorical and discrete numerical data, and reporting findings

- develop a qualitative understanding of chance and use the language of chance to describe and compare the outcomes of familiar chance events
- become increasingly able to understand that different outcomes can be the results of random processes.

## Achievement standard

By the end of Level 3, students order and represent natural numbers beyond 10 000, classify numbers as either odd or even, and use the properties of odd and even numbers. They partition, rearrange and regroup two- and three-digit numbers in different ways to assist in calculations. Students extend and use single-digit addition and related subtraction facts and apply additive strategies to model and solve problems involving two- and three-digit numbers. They use a range of strategies to apply mathematical modelling to solve practical problems involving single-digit multiplication and division, recalling multiplication facts for twos, threes, fours, fives and tens. Students represent unit fractions and their multiples in different ways. They represent money values in different ways. They make estimates and determine the reasonableness of financial and other calculations.

Students find unknown values in number sentences involving addition and subtraction. They create algorithms to investigate numbers and explore simple patterns.

Students use familiar metric units when estimating, comparing and measuring the attributes of objects and events. They identify angles as measures of turn and compare them to right angles. Students estimate and compare measures of duration using formal units of time.

Students make, compare and classify objects using key features. They interpret and create two-dimensional representations of familiar environments.

Students conduct guided statistical investigations involving categorical and discrete numerical data and interpret their results in terms of the context. They record, represent and compare data they have collected.

Students use practical activities, observation or experiment to identify and describe outcomes and the likelihood of everyday events explaining reasoning. Students conduct repeated chance experiments and discuss variation in results.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i> identify, explain and use the properties of odd and even numbers VC2M3N01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying even numbers using skip counting by twos or by grouping even collections of objects in twos</li> <li>explaining why all numbers that end in the digits 0, 2, 4, 6 and 8 are even and that numbers ending in 1, 3, 5, 7 and 9 are odd</li> <li>explaining why some materials can be shared evenly between 2 people without leaving a remainder and some cannot</li> <li>explaining the patterns involved in adding, subtracting and multiplying odd and even numbers (for example, even + even = even, odd + even = odd, odd + odd = even) and using this to decide whether answers to addition, subtraction and multiplication calculations are correct or not</li> <li>following an algorithm consisting of a flow chart with a series of instructions and decisions to determine whether a number is even or odd; and using the algorithm to identify which elements of a set of numbers are divisible by 2</li> </ul>
<p><i>Students learn to:</i> recognise, represent and order natural numbers using naming and writing conventions for numerals beyond 10 000 VC2M3N02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>moving materials from one place to another on a place value model to show renaming of numbers (for example, 1574 can be shown as one thousand, 5 hundreds, 7 tens and 4 ones, or as 15 hundreds, 7 tens and 4 ones)</li> <li>using the repeating pattern of place value names and spaces within sets of 3 digits to name and write larger numbers: ones, tens, hundreds, ones of thousands, tens of thousands, hundreds of thousands, ones of millions, tens of millions; for example, writing four hundred and twenty-five thousand as 425 000</li> <li>predicting and naming the number that is one more than 99, 109, 199, 1009, 1099, 1999, 10 009 ... 99 999 and discussing what will change when one, one ten and one hundred is added to each</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>comparing the Hindu-Arabic numeral system to other numeral systems; for example, investigating the Japanese numeral system, 一、十、百、千、万</li> <li>comparing, reading and writing the numbers involved in more than 60 000 years of Aboriginal and Torres Strait Islander Peoples' presence on the Australian continent through timescales relating to pre-colonisation and post-colonisation</li> </ul>
<p><i>Students learn to:</i></p> <p><b>recognise and represent unit fractions including <math>\frac{1}{2}</math>, <math>\frac{1}{3}</math>, <math>\frac{1}{4}</math>, <math>\frac{1}{5}</math> and <math>\frac{1}{10}</math> and their multiples in different ways; combine fractions with the same denominator to complete the whole</b></p> <p>VC2M3N03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising that unit fractions represent equal parts of a whole; for example, one-third is one of 3 equal parts of a whole</li> <li>representing unit fractions and their multiples in different ways; for example, using a Think Board to represent three-quarters using a diagram, concrete materials, a situation and fraction notation</li> <li>cutting objects such as oranges, sandwiches or playdough into halves, quarters or fifths and reassembling them to demonstrate (for example, two-halves make a whole, four-quarters make a whole), counting the fractions as they go</li> <li>sharing collections of objects, such as icy pole sticks or counters, between 3, 4 and 5 people and connecting division with fractions; for example, sharing equally between 3 people gives <math>\frac{1}{3}</math> of the collection to each and sharing equally between 5 people gives <math>\frac{1}{5}</math> of the collection to each</li> </ul>
<p><i>Students learn to:</i></p> <p><b>add and subtract two- and three-digit numbers using place value to partition, rearrange and regroup numbers to assist in calculations without a calculator</b></p> <p>VC2M3N04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using partitioning and part-part-whole models and the inverse relationship between addition and subtraction to solve addition or subtraction problems, making informal written 'jottings' to keep track of the numbers if necessary</li> <li>using physical or virtual grouped materials or diagrams to make proportional models of numbers to assist in calculations, for example, to calculate 214 + 325, representing 214 as 2 groups of 100, one group of 10 and 4 ones and 325 as 3 groups of 100, 2 groups of 10 and 5 ones, resulting in 5 groups of 100, 3 groups of 10 and 9 ones, which is 539</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>choosing between standard and non-standard place value partitions to assist with calculations, for example, to solve <math>485 + 365</math>, thinking of <math>365</math> as <math>350 + 15</math>, then adding the parts, <math>485 + 15 = 500</math>, <math>500 + 350 = 850</math></li> <li>solving subtraction problems efficiently by adding or subtracting a constant amount to both numbers to create an easier calculation; for example, <math>534 - 395</math>, adding 5 to both numbers to make <math>539 - 400 = 139</math></li> <li>justifying choices about partitioning and regrouping numbers in terms of their usefulness for particular calculations when solving problems</li> <li>applying knowledge of place value to assist in calculations when solving problems involving larger numbers; for example, calculating the total crowd numbers for an agricultural show that lasts a week</li> </ul>
<p><i>Students learn to:</i></p> <p>multiply and divide one- and two-digit numbers, representing problems using number sentences, diagrams and arrays, and using a variety of calculation strategies</p> <p>VC2M3N05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>applying knowledge of numbers and the properties of operations using a variety of ways to represent multiplication or division number sentences; for example, using a Think Board to show different ways of visualising <math>8 \times 4</math>, such as an array, a diagram and a worded problem</li> <li>using part-part-whole and comparative models to visually represent multiplicative relationships and choosing whether to use multiplication or division to solve problems</li> <li>matching or creating a problem scenario or story that can be represented by a given number sentence involving multiplication and division; for example, using given number sentences to create worded problems for others to solve</li> <li>formulating connected multiplication and division expressions by representing situations from Aboriginal and/or Torres Strait Islander Peoples' cultural stories and dances about how they care for Country/Place, such as turtle egg gathering, using number sentences</li> </ul>
<p><i>Students learn to:</i></p> <p>estimate the quantity of objects in collections and make estimates</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>estimating how much space a grid paper representation of a large number such as <math>20\ 200</math> will take up on the wall and how much paper will be required</li> </ul>

Content descriptions	Elaborations
<p>when solving problems to determine the reasonableness of calculations VC2M3N06</p>	<ul style="list-style-type: none"> <li>estimating the number of people in a large gathering (for example, a school assembly) using known numbers (such as how many students per class)</li> <li>choosing which place value they would estimate to for different situations; for example, choosing to estimate to the nearest ten when estimating how many dots on a ladybird or choosing to estimate to the nearest thousand when estimating crowd sizes at a venue</li> <li>checking the reasonableness of an addition calculation by using two- and three-digit numbers to the nearest ten or hundred to estimate; for example, using <math>200 + 400 = 600</math> to estimate and check the solution to the calculation <math>219 + 385</math></li> </ul>
<p><i>Students learn to:</i> recognise the relationships between dollars and cents and represent money values in different ways VC2M3N07</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating the relationship between dollars and cents, using physical or virtual materials to make different combinations of the same amount of money</li> <li>representing money amounts in different ways using knowledge of part-part-whole relationships; for example, knowing that \$1 is equal to 100 cents, representing \$1.85 as \$1 + 50c + 20c + 10c + 5c or 50c + 50c + 10c + 10c + 10c + 5c; or when calculating change from buying an item for \$1.30 from \$2, starting from \$1.30 and adding 20c and 50c, which gives \$2</li> </ul>
<p><i>Students learn to:</i> use mathematical modelling to solve practical problems involving additive and multiplicative situations, including financial contexts; formulate problems using number sentences and choose calculation strategies, using digital tools where appropriate; interpret and communicate solutions in terms of the situation</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling practical additive situations, choosing whether to use an addition, subtraction or both when representing the problem as a number sentence, and explaining how each number in their number sentence is connected to the situation</li> <li>modelling additive problems using a bar model to represent the problem; for example, modelling the problem 'I had 75 tomatoes and then picked some more. Now I have 138. How many did I pick?'</li> <li>modelling practical multiplicative situations using materials or a diagram to represent the problem; for example, if 4 tomato plants each have 6 tomatoes, deciding whether to use an addition or multiplication number sentence, explaining how each number in their number sentence is connected to the situation</li> </ul>

Content descriptions	Elaborations
VC2M3N08	<ul style="list-style-type: none"> <li>modelling and solving practical division problems involving unknown numbers of groups or finding how much is in each group by representing the problem with both division and multiplication number sentences, and explaining how the 2 number sentences are connected to the problem</li> <li>modelling the problem of deciding how to share an amount equally (for example, 48 horses into 2, 4, 6 or 8 paddocks), representing the shares with a division and a multiplication number sentence, and counting the number in each share to check the solutions</li> </ul>
<p><i>Students learn to:</i></p> <p>follow and create algorithms involving a sequence of steps and decisions to investigate numbers; describe any emerging patterns</p> <p>VC2M3N09</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>following or creating an algorithm to generate number patterns formed by doubling and halving using technology to assist, where appropriate, and identifying and describing emerging patterns</li> <li>following or creating an algorithm that determines whether a given number is a multiple of 2, 5 or 10, identifying and discussing emerging patterns</li> <li>creating an algorithm as a set of instructions that a classmate can follow to generate multiples of 3 using the rule ‘To multiply by 3 you double the number and add on one more of the number’ (for example, for 3 threes, you double 3 and add on 3 to get 9; for 3 fours you double 4 and add one more 4 to get 12 ...)</li> <li>creating a sorting algorithm that will sort a collection of 5-cent and 10-cent coins and providing the total value of the collection by applying knowledge of multiples of 5 and 10</li> </ul>

## Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>recognise and explain the connection between addition and subtraction as inverse operations, apply to partition numbers and find unknown values in number</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>partitioning numbers using materials, part-part-whole diagrams or bar models, and recording addition and subtraction facts for each representation, explaining how each fact is connected to the materials, diagrams or models (for example, <math>16 + 8 = 24</math>, <math>24 - 8 = 16</math>, <math>8 = 24 - 16</math>)</li> <li>using the inverse relationship between addition and subtraction to find unknown values with a calculator or</li> </ul>

Content descriptions	Elaborations
sentences VC2M3A01	<p>by counting on; for example, representing the problem 'Peter had some money and then spent \$375. Now he has \$158 left. How much did Peter have to start with?' as <math>\square - \\$375 = \\$158</math> and solving the problem using <math>\\$375 + \\$158 = \\$533</math>; or solving <math>27 + \square = 63</math> using subtraction, <math>\square = 63 - 27</math>, or by counting on 27, 37, 47, 57, 60, 63, so add 3 tens and 6 ones, so <math>\square = 36</math></p> <ul style="list-style-type: none"> <li>exploring Aboriginal and/or Torres Strait Islander Peoples' stories and dances that show the connection between addition and subtraction, representing this as a number sentence and discussing how this conveys important information about balance in processes on Country/Place</li> </ul>
<i>Students learn to:</i> extend and apply knowledge of addition and subtraction facts to 20 to develop efficient mental strategies for computation with larger numbers without a calculator VC2M3A02	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>partitioning using materials and part-part-whole diagrams to develop subtraction facts related to addition facts, such as <math>8 + 7 = 15</math> therefore <math>15 - 7 = 8</math> and <math>15 - 8 = 7</math></li> <li>using partitioning to develop and record facts systematically (for example, 'How many ways can 12 monkeys be spread among 2 trees?', <math>12 = 12 + 0</math>, <math>12 = 11 + 1</math>, <math>12 = 10 + 2</math>, <math>12 = 9 + 3</math>, ...), explaining how they know they have found all possible partitions</li> <li>understanding basic addition and related subtraction facts and using extensions to these facts; for example, <math>6 + 6 = 12</math>, <math>16 + 6 = 22</math>, <math>6 + 7 = 13</math>, <math>16 + 7 = 23</math>, and <math>60 + 60 = 120</math>, <math>600 + 600 = 1200</math></li> </ul>
<i>Students learn to:</i> recall and demonstrate proficiency with multiplication facts for 3, 4, 5 and 10; extend and apply facts to develop the related division facts VC2M3A03	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>using concrete or virtual materials, groups and repeated addition to recognise patterns and establish the 3, 4, 5 and 10 multiplication facts; for example, using the language of '3 groups of 2 equals 6' to develop into '3 twos are 6' and extend to establish the <math>3 \times 10</math> multiplication facts and related division facts</li> <li>recognising that when they multiply a number by 5, the resulting number will either end in a 5 or a zero; and using a calculator or spreadsheet to generate a list of the multiples of 5 to develop the multiplication and related division facts for fives</li> <li>practising calculating and deriving multiplication facts for 3, 4, 5 and 10, explaining and recalling the</li> </ul>

Content descriptions	Elaborations
	<p>patterns in them and using them to derive related division facts</p> <ul style="list-style-type: none"> <li>systematically exploring algorithms used for repeated addition, comparing and describing what is happening, and using them to establish the multiplication facts for 3, 4, 5 and 10; for example, following the sequence of steps, the decisions being made and the resulting solution, recognising and generalising any emerging patterns</li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i> identify which metric units are used to measure everyday items; use measurements of familiar items and known units to make estimates VC2M3M01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>examining the packaging on supermarket items to determine the metric unit used to describe the mass or volume of the contents</li> <li>identifying items that have a mass of one kilogram or 500 grams, or a capacity of one litre or 500 millilitres, and using these benchmarks to estimate the mass or capacity of other things, explaining their reasoning</li> <li>estimating the height of a tree by comparing it to the height of their friend and quoting the result as 'The tree is about 3 times as tall'; and estimating the capacity of a fish tank by using a litre milk carton as a benchmark</li> <li>choosing and using metres to estimate the dimensions of the classroom</li> </ul>
<p><i>Students learn to:</i> measure and compare objects using familiar metric units of length, mass and capacity, and instruments with labelled markings VC2M3M02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>making a measuring tape using metric units of length and using it to measure and compare things, for example, the girth of a tree; and explaining that the lines on a ruler show the beginning and end of each unit</li> <li>using a strip of one-centimetre grid paper to measure and compare the length of objects, connecting this with centimetre units on a ruler and using fractions of a graduation to give a more accurate measure</li> <li>discussing how the capacity of a container or object usually refers to the amount of liquid it can hold, measured in millilitres and litres, and comparing the capacity of different sizes of familiar drinks (for</li> </ul>

Content descriptions	Elaborations
	<p>example, 600-millilitre, one-litre, 2-litre and 3-litre milk containers)</p> <ul style="list-style-type: none"> <li>measuring and comparing the mass of objects and capacity of containers, using measuring jugs and kitchen or other scales and standard metric units of millilitres, litres, grams and kilograms; and interpreting and explaining what the lines on the measuring jug or scales mean</li> <li>comparing the capacity of different beakers used in science lessons and using the numbered graduations to measure out different capacities of liquid</li> </ul>
<p><i>Students learn to:</i> recognise and use the relationship between formal units of time, including days, hours, minutes and seconds, to estimate and compare the duration of events VC2M3M03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>estimating how long it would take to read a set passage of text, and sharing this information to demonstrate understanding of formal units of duration of time</li> <li>planning a sequence of events based on estimates of the duration of each event; for example, planning a set of activities for a class party by estimating how long each game or activity will take</li> <li>reading or setting the time on digital devices to the minute or second; for example, setting an online timing device to count down from a set time, or setting the time on a digital clock</li> <li>using sand timers and digital timers to measure and check estimates of short durations of time, such as one minute, 3 minutes and 5 minutes</li> <li>exploring how cultural accounts of Aboriginal and Torres Strait Islander Peoples explain cycles of time that involve the sun, moon and stars</li> </ul>
<p><i>Students learn to:</i> describe the relationship between the hours and minutes on analog and digital clocks, and read the time to the nearest minute VC2M3M04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>representing and reading the time on an analog clock using the markings and the positions of the hands, to the nearest minute mark or 5-minute interval</li> <li>reading and connecting analog and digital time, interpreting times, and recognising and using the language of time, for example, 12:15 as a quarter past 12, or 15 minutes past 12; 12:45 as a quarter to one or 15 minutes before one o'clock; and 10:05 as 5 minutes past 10</li> <li>reading analog clocks throughout the day, and noticing and connecting the position of the hour hand and</li> </ul>

Content descriptions	Elaborations
	the distance the minute hand has travelled during the current hour
<p><i>Students learn to:</i> identify angles as measures of turn and use right angles as a reference to compare angles in everyday situations VC2M3M05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using quarter, half and three-quarter turns and comparing them to a right angle, for example, a quarter turn is the same as a right angle; a half a turn is greater than a right angle and is the same as 2 right angles; a three-quarter turn is greater than a right angle and is the same as 3 right angles</li> <li>recognising that right angles occur at the corners of many everyday objects, for example, books, windows, tabletops and whiteboards</li> <li>identifying angles that are bigger than, smaller than and the same as a right angle in the environment; for example, opening doors partially and fully and comparing the angles created to a right angle</li> <li>exploring Aboriginal and/or Torres Strait Islander children's instructive games to investigate angles as measures of turn, for example, in the game Waayin from the Datiwuy People in the northern part of the Northern Territory</li> </ul>

## Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i> make, compare and classify objects, identifying key features and explaining why these features make them suited to their uses VC2M3SP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>classifying a collection of geometric objects, including cylinders, spheres, prisms and pyramids, according to key features such as the shape and number of faces and/or surfaces, edges and vertices</li> <li>making and comparing objects built out of cubic blocks and discussing key features; for example, comparing the amount of space that objects occupy by counting how many blocks it takes to build different rectangular prisms that have the same height but different bases</li> <li>making geometric objects in solid form out of connecting cubes and in skeleton form with straws, and constructing objects using dynamic geometry software, recognising, comparing and discussing the features of the objects using the different representations</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>using familiar shapes and objects to build or construct models and compare the suitability of different shapes and objects for aspects of the model; for example, building rectangular towers out of connecting cubes and recognising that the taller the tower, the less stable it becomes unless the base is increased; or building bridges out of straws bent into different shapes and comparing the strength of different designs</li> <li>identifying, classifying and comparing common objects found on Country/Place as cubes, rectangular prisms, cylinders, cones and spheres</li> <li>investigating and explaining how Aboriginal and/or Torres Strait Islander Peoples' dwellings are oriented in the environment to accommodate climatic conditions</li> </ul>
<p><i>Students learn to:</i></p> <p>interpret and create two-dimensional representations of familiar environments, locating key landmarks and objects relative to each other</p> <p>VC2M3SP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>designing the layout of a space; for example, designing a proposed games room or a classroom using a blank sheet of paper as the boundary and cut-outs of shapes to represent furniture from a top-view perspective</li> <li>locating themselves within a space, such as a basketball court, oval, stage or assembly hall, guided by a simple hand-held plan indicating the different positions of the participants in the activity</li> <li>sketching a map indicating where they have hidden an object within the classroom, swapping maps with partners and then providing feedback about what was helpful and what was confusing on the map</li> <li>identifying differences in the representation of a place on a map, in an aerial photograph, in a street view and in a satellite image, and discussing the different information the representations can give</li> <li>exploring land maps or cultural maps used by Aboriginal and Torres Strait Islander Peoples to locate, identify and position important landmarks such as waterholes</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i></p>	<p><i>This may involve students:</i></p>

Content descriptions	Elaborations
<p>acquire data for categorical and discrete numerical variables to address a question of interest or purpose by observing, collecting and accessing data sets; record the data using appropriate methods, including frequency tables and spreadsheets VC2M3ST01</p>	<ul style="list-style-type: none"> <li>• using efficient ways to collect and record data (for example, written surveys, online surveys, polling the class using interactive digital mediums) and representing and reporting the results of investigations</li> <li>• developing questions of interest and using surveys, observations or experiments to collect categorical, discrete numerical or qualitative data sets and discussing what kind of data can be used to help inform or answer the question in a statistical investigation</li> <li>• using lists, tallies, symbols and digital data tables to record and display data collected during a chance experiment, for interpretation</li> <li>• using different online sources to access data; for example, using online query interfaces to select and retrieve data from an online database such as weather records, data frequency mapping software such as Google Trends, or the World Health Organization</li> <li>• using software to sort and calculate data when solving problems; for example, sorting discrete numerical and categorical data in ascending or descending order and automating simple arithmetic calculations using nearby cells and the summation ('sum') function in spreadsheets to calculate total frequencies of collected data</li> </ul>
<p><i>Students learn to:</i> create and compare different graphical representations of data sets, including using software where appropriate; interpret the data in terms of the context VC2M3ST02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• comparing various student-generated data representations and describing their similarities and differences</li> <li>• using digital tools and graphing software to construct graphs of data acquired through experiments or observation and interpreting the data and making inferences; for example, graphing data from a science experiment and interpreting the results</li> <li>• selecting appropriate formats or layout styles to present data as information, depending on the type of data and the audience; for example, lists, tables, graphs and infographics</li> <li>• using newspapers or magazines to find examples of different displays of data, interpreting and describing the information they present</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>conduct guided statistical investigations involving the collection, representation and interpretation of data for categorical and discrete numerical variables with respect to questions of interest</p> <p>VC2M3ST03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• creating a poster, flow chart or infographic that describes the process of statistical investigation, and the components, tools and types of data that can be collected, represented and interpreted for a purpose</li> <li>• collaboratively working through a whole-class investigation by choosing a question of interest, using an efficient collection method and recording collected data, and then interpreting the data in terms of the question</li> <li>• planning and carrying out investigations that involve collecting data; for example, narrowing the focus of a question such as 'Which is the most popular breakfast cereal?' to 'Which is the most popular breakfast cereal among Year 3 students in our class?'</li> <li>• conducting a whole-class statistical investigation into the best day to hold an open day for parents by creating a simple survey, collecting the data by asking the parents, representing and interpreting the results, and deciding as a class which day would be best</li> <li>• investigating seasonal calendars of Aboriginal and/or Torres Strait Islander Peoples by collecting data and creating frequency tables and spreadsheets based on environmental indicators, and creating one-to-one data displays about frequency of environmental indicators for the current season</li> </ul>

## Strand: Probability

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>identify practical activities and everyday events that involve chance, and describe possible outcomes and events as 'likely' or 'unlikely' and identify some events as 'certain' or 'impossible', explaining reasoning</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• predicting what could happen next in practical activities that involve an element of chance, considering possible outcomes and using terms such as 'likely' or 'unlikely' to explain their predictions</li> <li>• classifying a list of everyday events or sorting a set of event cards according to how likely they are to happen, using the language of chance and giving reasons for classifications; and discussing how impossible outcomes cannot ever happen, and uncertain outcomes are affected by chance as they may or may not</li> </ul>

Content descriptions	Elaborations
VC2M3P01	<p>happen, whereas certain events must always happen so they are not affected by chance</p> <ul style="list-style-type: none"> <li>making predictions and testing what would happen, for example, if 10 names were put in a box and names were then drawn out one at a time and replaced after each selection, discussing how likely it would be after 10 selections that all 10 names were drawn from the box or that one name was drawn multiple times</li> </ul>
<p><i>Students learn to:</i></p> <p>conduct repeated chance experiments; identify and describe possible outcomes, record the results, and recognise and discuss the variation</p> <p>VC2M3P02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying the possible outcomes of a chance experiment, creating a tally chart to record results, carrying out a few trials and tallying the results for each trial, and then responding to the questions 'How did your results vary for each trial?' and 'How do the results vary across the class?'</li> <li>conducting repeated trials of chance experiments such as tossing a coin, throwing a dice, drawing a coloured or numbered ball from a bag, or using a coloured spinner with equal partitions, and identifying the variation in the number of heads/fives/reds between trials</li> </ul>

## Level 4

### Level description

In Level 4, learning in Mathematics builds on each student's prior learning and experiences. Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- consolidate their knowledge and facility with arithmetic operations, and draw on their proficiency with number facts, fractions and decimals, to deepen their appreciation of how numbers work
- develop and use strategies for multiplication that are based on their understanding of multiplication as an operation and their knowledge of laws for arithmetic operations
- choose and use efficient mental and written strategies when modelling problems, communicating their solutions within the context of the situation
- use algorithms to generate sets of numbers, recognising and describing any patterns that emerge
- become aware of the importance of context and purpose when they make judgements and reflect on the reasonableness of measurements and the results of calculations, and how they choose to represent mathematics and mathematical information
- measure and estimate common attributes of objects using conventional instruments and appropriate metric units
- develop and use surveys to obtain data that is directly relevant to their statistical investigations
- draw on their reasoning skills to analyse, categorise and order chance events and identify independent and dependent events
- investigate variability by conducting repeated chance experiments and observing results.

## Achievement standard

By the end of Level 4, students use their understanding of place value to represent tenths and hundredths in decimal form and to multiply natural numbers by multiples of 10. Students use mathematical modelling to solve financial and other practical problems, formulating the problem using number sentences, solving the problem choosing efficient strategies and interpreting the results in terms of the situation. They use their proficiency with addition, subtraction, multiplication facts for tens ( $\times 10$ ) and related division facts to perform arithmetic operations to add and subtract, and multiply and divide numbers efficiently. They choose rounding and estimation strategies to determine whether results of calculations are reasonable. They recognise common equivalent fractions in familiar contexts and make connections between fraction and decimal notations. Students count and represent familiar fractions on a number line.

Students find unknown values in numerical equations involving addition and subtraction. They follow and create algorithms that generate sets of numbers and identify emerging patterns.

Students use appropriate scaled instruments and appropriate units to measure length, mass, capacity and temperature. They measure and approximate perimeters and areas for regular and irregular shapes. They convert between units of time when solving problems involving duration. Students compare angles relative to a right angle using angle names.

Students represent and approximate shapes and objects from their environment. Students create and interpret grid references. They identify line and rotational symmetry in plane shapes and create symmetrical patterns.

Students create many-to-one data displays, assess the suitability of displays for representing data and informally discuss the shape of distributions and variation in data. They use surveys and digital tools to generate categorical or discrete numerical data in statistical investigations and communicate their findings in context.

Students order events or the outcomes of chance experiments in terms of likelihood and identify whether events are independent or dependent. They conduct repeated chance experiments and describe the variation in results.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i>        recognise and extend the application of place value to tenths and hundredths and use the conventions of decimal notation to name and represent decimals        VC2M4N01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using a bar to represent the whole, dividing it into 10 equal pieces with each piece representing 0.1 or one-tenth of the whole length and understanding that 2 pieces are 0.2 or two-tenths of the whole</li> <li>using materials to show the multiplicative relationship between the whole, tenths and hundredths; for example, using a bundle of 10 straws to represent the whole, one straw as the tenth, and cutting the tenth into 10 parts to show the hundredths; or using deci-pipes to represent tenths</li> <li>recognising that one is the same as ten-tenths and one-tenth is the same as ten-hundredths and using this relationship to rename decimals; for example, renaming 0.25 as two-tenths and five-hundredths or twenty-five-hundredths</li> <li>making models of measurement attributes to show the relationship between the base unit and parts of the unit, for example, 1.5 metres is one metre and five-tenths of the next metre; 1.75 units is one unit and seventy-five-hundredths of the next unit</li> <li>counting large quantities of mixed notes and coins, writing the total using dollars and cents, and recognising the cents as parts of the next dollar</li> <li>comparing the way money and measures are read and said, and explaining how they are the same and different; for example, explaining that \$2.75 is said ‘two dollars seventy-five’ and 2.75 metres is said ‘two point seven five metres’, and recognising that the 7 means seven-tenths and the 5 means five-hundredths in both</li> </ul>
<p><i>Students learn to:</i>        investigate number sequences involving multiples of 3, 4, 6, 7, 8 and 9</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising that number sequences can be extended indefinitely, and determining any patterns in the sequences</li> </ul>

Content descriptions	Elaborations
VC2M4N02	
<p><i>Students learn to:</i>          find equivalent representations of fractions using related denominators and make connections between fractions and decimal notation          VC2M4N03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>extending fraction families within collections of materials, for example, by seeing <math>\frac{3}{4}</math> as 3 in each 4, showing this within related fractions like <math>\frac{6}{8}</math> or seeing that <math>\frac{2}{5}</math> means 2 in each 5 so it can be shown within <math>\frac{4}{10}</math></li> <li>creating models of equivalent fractions by subdividing capacity measures into smaller fractions; for example, half a cup of flour could be shown as two-quarters or four-eighths of a cup of flour</li> <li>folding paper to show equivalence between different fractions; for example, folding A4 paper in half and half again, repeating to form eighths and demonstrating that <math>\frac{4}{8} = \frac{2}{4} = \frac{1}{2}</math>; or folding paper strips into fifths and tenths, and recording as both fractions and decimals</li> <li>identifying and using the connection between fractions of metres and decimals; for example, finding <math>\frac{1}{4}</math> of a metre and connecting this to 0.25 metres or 25 centimetres, or finding <math>\frac{1}{10}</math> of a metre and connecting this with 0.10 metres or 10 centimetres</li> <li>using array diagrams to show the relationship between fractions and division and multiplication of natural numbers, for example, <math>3 \times 4 = 12</math>, <math>12 \div 4 = 3</math>, <math>\frac{1}{4}</math> of 12 is 3, <math>\frac{1}{3}</math> of 12 is 4</li> </ul>
<p><i>Students learn to:</i>          count by multiples of quarters, halves and thirds, including mixed numerals; locate and represent these fractions as numbers on number lines          VC2M4N04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>cutting objects such as oranges or sandwiches into quarters and counting by quarters to find the total number, and saying the counting sequence 'one-quarter, two-quarters, three-quarters, four-quarters or one-whole, five-quarters or one-and-one-quarter, six-quarters or one-and-two-quarters ... eight-quarters or two-wholes ...'</li> <li>subdividing the sections between whole numbers on parallel number lines so that one shows halves, another shows quarters and one other shows thirds; and counting the fractions by jumping along the number lines, and noticing when the count is at the same position on the parallel lines</li> <li>converting mixed numerals into improper fractions and vice versa, and representing mixed numerals on a number line</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>using a number line to represent and count in tenths, recognising that 10 tenths is equivalent to one</li> </ul>
<p><i>Students learn to:</i></p> <p>solve problems involving multiplying or dividing natural numbers by multiples and powers of 10 without a calculator, using the multiplicative relationship between the place value of digits</p> <p>VC2M4N05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using physical or virtual materials to demonstrate the multiplicative relationship between the places</li> <li>using materials such as place value charts, numeral expanders or sliders to recognise and explain why multiplying by 10 moves the digits one place to the left and dividing by 10 moves digits one place to the right</li> <li>using a calculator or other digital tools to recognise and develop an understanding of the effect of multiplying or dividing numbers by tens, hundreds and thousands, recording sequences in a place value chart, in a table or spreadsheet, generalising the patterns noticed and applying them to solve multiplicative problems without a calculator</li> </ul>
<p><i>Students learn to:</i></p> <p>develop efficient mental and written strategies and use appropriate digital tools for solving problems involving addition and subtraction, and multiplication and division where there is no remainder</p> <p>VC2M4N06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using and choosing efficient calculation strategies for addition and subtraction problems involving larger numbers, for example, place value partitioning, inverse relationship, compatible numbers, jump strategies, bridging tens, splitting one or more numbers, extensions to basic facts, algorithms and digital tools where appropriate</li> <li>using physical or virtual materials to demonstrate doubling and halving strategies for solving multiplication problems; for example, for <math>5 \times 18</math>, using the fact that double 5 is 10 and half of 18 is 9; or using <math>10 \times 18 = 180</math>, then halving 180 to get 90; or applying the associative property of multiplication, where <math>5 \times 18</math> becomes <math>5 \times 2 \times 9 = 10 \times 9 = 90</math> so that <math>5 \times 18 = 90</math></li> <li>using an array to represent a multiplication problem, connecting the idea of how many groups and how many in each group with the rows and columns of the array, and writing an associated number sentence</li> <li>using materials or a diagram to solve a multiplication or division problem, by writing a number sentence and explaining what each of the numbers within the number sentence refers to</li> <li>representing a multiplicative situation using materials, array diagrams and/or a bar model, and writing multiplication and/or division number sentences, based on whether the number of groups, the number per</li> </ul>

Content descriptions	Elaborations
	<p>group or the total is missing, and explaining how each number in their number sentence is connected to the situation</p> <ul style="list-style-type: none"> <li>using place value partitioning, basic facts and an area or region model to represent and solve multiplication problems; for example, for <math>16 \times 4</math>, thinking <math>10 \times 4</math> and <math>6 \times 4</math>, then <math>40 + 24 = 64</math>, or a double double strategy where double 16 is 32, double this is 64, so <math>16 \times 4</math> is 64</li> </ul>
<p><i>Students learn to:</i></p> <p>choose and use estimation and rounding to check and explain the reasonableness of calculations, including the results of financial transactions VC2M4N07</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using proficiency with basic facts to estimate the result of a calculation and say what amounts the answer will be between; for example, 5 packets of biscuits at \$2.60 each will cost between \$10 and \$15 as <math>5 \times \\$2 = \\$10</math> and <math>5 \times \\$3 = \\$15</math></li> <li>using rounded amounts to complete an estimated budget for a shopping trip or an excursion, explaining why overestimating the amounts is appropriate</li> <li>recognising the effect of rounding in addition and multiplication calculations; rounding both numbers up, both numbers down, and one number up and one number down, and explaining which is the best approximation and why</li> </ul>
<p><i>Students learn to:</i></p> <p>solve problems involving purchases and the calculation of change to the nearest 5 cents with and without digital tools VC2M4N08</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising that not all countries use dollars and cents; for example, India uses rupees</li> <li>carrying out calculations in another currency as well as in dollars and cents, and identifying both as decimal systems</li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems that involve additive and multiplicative situations, including financial contexts; formulate the problems</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling and solving a range of practical additive problems using materials, part-part-whole diagrams and/or a bar model, and writing addition and/or subtraction number sentences, based on whether a part or the whole is missing; and explaining how each number in their number sentence is connected to the situation</li> </ul>

Content descriptions	Elaborations
<p>using number sentences and choose efficient calculation strategies, using digital tools where appropriate; interpret and communicate solutions in terms of the situation VC2M4N09</p>	<ul style="list-style-type: none"> <li>modelling practical problems with division, interpreting and representing the situation using a diagram or array to represent what is unknown (the number of groups, or the number per group); and writing a division number sentence to represent the situation and choosing an efficient calculation strategy</li> <li>modelling practical problems involving money (such as a budget for a large event) that require either addition, subtraction, multiplication or division and justifying the choice of operation in relation to the situation</li> <li>modelling and solving multiplication problems involving money, such as buying 5 toy scooters for \$96 each, using efficient mental strategies and written jottings to keep track if needed; for example, rounding \$96 up to \$100 and subtracting <math>5 \times \\$4 = \\$20</math>, so <math>5 \times \\$96</math> is the same as <math>5 \times \\$100</math> less \$20, giving the answer <math>\\$500 - \\$20 = \\$480</math></li> <li>modelling situations by formulating comparison problems using number sentences, comparison models and arrays; for example, ‘Ariana read 16 books for the “readathon”; Maryam read 4 times as many books. How many books did Maryam read?’ using the expression <math>4 \times 16</math> and using place value partitioning, basic facts and an array, thinking <math>4 \times 10 = 40</math> and <math>4 \times 6 = 24</math>, so <math>4 \times 16</math> can be written as <math>40 + 24 = 64</math></li> </ul>
<p><i>Students learn to:</i> follow and create algorithms involving a sequence of steps and decisions that use addition or multiplication to generate sets of numbers; identify and describe any emerging patterns VC2M4N10</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>creating an algorithm that will generate number sequences involving multiples of one to 10 using digital tools to assist, identifying and explaining emerging patterns, and recognising that number sequences can be extended indefinitely</li> <li>creating a basic flow chart that represents an algorithm that will generate a sequence of numbers using multiplication by a constant term; using a calculator to model and follow the algorithm, and recording the sequence of numbers generated; and checking results and describing any emerging patterns</li> <li>using a multiplication formula in a spreadsheet and the ‘fill down’ function to generate a sequence of numbers (for example, entering the number ‘1’ in the cell A1, using ‘fill down’ to cell A100, entering the formula ‘=A1*4’ in the cell B1 and using the ‘fill down’ function to generate a sequence of 100 numbers) and</li> </ul>

Content descriptions	Elaborations
	<p>describing emerging patterns</p> <ul style="list-style-type: none"> <li>creating an algorithm that will generate number sequences involving multiples of one to 10, using digital tools to assist, identifying and explaining emerging patterns, and recognising that number sequences can be extended indefinitely</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i> find unknown values in numerical equations involving addition and subtraction, using the properties of numbers and operations VC2M4A01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>demonstrating the commutative properties of addition using materials, diagrams and number lines; for example, using number lines to demonstrate that <math>5 + 2 = 2 + 5</math>, and demonstrating that <math>2 + 2 + 3 = 7</math> and <math>2 + 3 + 2 = 7</math> and <math>3 + 2 + 2 = 7</math></li> <li>using balance scales and informal uniform units to create addition or subtraction number sentences showing equivalence, such as <math>7 + 8 = 6 + 9</math>, and to find unknowns in equivalent number sentences, such as <math>6 + 8 = \square + 10</math></li> <li>using relational thinking and knowledge of equivalent number sentences to explain whether equations involving addition or subtraction are true; for example, explaining that <math>27 - 14 = 17 - 4</math> is true and using a number line to show the common difference is 13</li> </ul>
<p><i>Students learn to:</i> recall and demonstrate proficiency with multiplication facts up to <math>10 \times 10</math> and related division facts, and explain the patterns in these; extend and apply facts to develop efficient mental and written strategies for computation with larger numbers without a</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using arrays on grid paper or created with blocks or counters to develop, represent and explain patterns in multiplication facts up to <math>10 \times 10</math>; and using the arrays to explain the related division facts</li> <li>using materials or diagrams to develop and record multiplication strategies such as doubling, halving, commutativity and adding one more or subtracting from a group to reach a known fact; for example, creating multiples of 3 on grid paper and doubling to find multiples of 6, and recording and explaining the connections to the <math>\times 3</math> and <math>\times 6</math> multiplication facts: 3, 6, 9, ... doubled is 6, 12, 18, ...</li> </ul>

Content descriptions	Elaborations
calculator VC2M4A02	<ul style="list-style-type: none"> <li>using known multiplication facts for 2, 3, 5 and 10 to establish multiplication facts for 4, 6, 7, 8 and 9 in different ways; for example, using multiples of 10 to establish the multiples of 9 as 'to multiply a number by 9 you multiply by 10 then take the number away': <math>9 \times 4 = 10 \times 4 - 4</math>, so <math>9 \times 4</math> is <math>40 - 4 = 36</math>; or using multiples of 3 as 'to multiply a number by 9 you multiply by 3, and then multiply the result by 3 again'</li> <li>using arrays and known multiplication facts for twos and fives to develop the multiplication facts for sevens, applying the distributive property of multiplication; for example, when finding <math>6 \times 7</math>, knowing that 7 is made up of 2 and 5, and using an array to show that <math>6 \times 7</math> is the same as <math>6 \times 2 + 6 \times 5 = 12 + 30</math>, which is 42</li> </ul>

## Strand: Measurement

Content descriptions	Elaborations
<i>Students learn to:</i> use scaled and digital instruments to interpret unmarked and partial units to measure and compare lengths, masses, capacities, durations and temperatures, using appropriate units VC2M4M01	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>reading the mass of objects measured with digital and analog kitchen scales and explaining what unit of mass the lines on the analog scales refer to</li> <li>deciding on which attribute, unit and measuring instrument to use to compare the length and mass of various things, such as the distance travelled by an object in a science investigation; and explaining the use of units such as grams or millimetres to give accurate measures when needed</li> <li>using scaled instruments such as tape measures, measuring jugs, kitchen scales and thermometers to record measures using whole units (for example, 560 millimetres) or whole and part units (for example, 5.25 metres, 1.75 litres, 2.5 kilograms, 28.5° Celsius)</li> <li>reading and interpreting the scale of an analog clock without marked minutes to estimate the time to the nearest minute and to determine the duration of time between events</li> <li>using the timer or alarm function of a clock to alert when a specified duration has elapsed from a given starting time, for example, for the different activities of an exercise routine</li> <li>making a scaled measuring instrument such as a tape measure, ruler, sand timer, sundial or measuring cup</li> </ul>

Content descriptions	Elaborations
	<p>using scaled instruments and direct comparisons</p> <ul style="list-style-type: none"> <li>exploring the different types of scaled instruments used by Aboriginal and/or Torres Strait Islander ranger groups and other groups to make decisions about caring for Country/Place, and modelling these in local contexts</li> </ul>
<p><i>Students learn to:</i></p> <p>recognise ways of measuring and approximating the perimeter and area of shapes and enclosed spaces, using appropriate formal and informal units</p> <p>VC2M4M02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising that perimeter is the sum of the lengths that form the boundary of a shape or enclosed space; choosing suitable units from a range of objects to measure around the boundary of a shape such as a garden bed; comparing the results to say which unit was an appropriate choice for the context; and using a piece of string or rope to measure the perimeter of irregular shapes and enclosed spaces, including those that have curved sections</li> <li>creating a range of rectangles representing ‘paddocks’ on grid paper and establishing different methods of working out the length of the boundary fences; and explaining that the more efficient methods involve adding the side lengths rather than counting squares</li> <li>recognising that area is the space enclosed by the boundary of a shape or the surface of an object; measuring and comparing the area of shapes using an array of paper tiles or mosaic squares, including part units to fill gaps at the edge of the shapes; and comparing the total areas by combining the fractional parts to make whole units</li> <li>demonstrating how to use one unit repeatedly to measure the area of a shape (for example, using one paper square to measure and compare the area of a rectangle and a triangle) and recording and explaining how they used part units to give a more accurate measure, and why they needed to ensure there were no gaps or overlaps</li> <li>investigating the ways Aboriginal and/or Torres Strait Islander ranger groups and other groups measure areas of land to make decisions about fire burns to care for Country/Place</li> </ul>
<i>Students learn to:</i>	<i>This may involve students:</i>

Content descriptions	Elaborations
<p>solve problems involving the duration of time including situations involving 'am' and 'pm' and conversions between units of time VC2M4M03</p>	<ul style="list-style-type: none"> <li>calculating the amount of time between 2 events, such as the start and finish of a movie, a bus journey or a flight, including cases where the starting and finishing times are written using 'am' and 'pm' notation</li> <li>converting units of time using relationships between units, such as 60 minutes in an hour and 60 seconds in a minute, to solve problems; for example, creating a daily timetable for an activity such as an athletics carnival or planning an exercise routine with activities and rests</li> <li>exploring Aboriginal and/or Torres Strait Islander Peoples' explanations of the passing of time through cultural accounts about cyclic phenomena involving the sun, moon and stars</li> </ul>
<p><i>Students learn to:</i> estimate and compare angles using angle names including acute, obtuse, straight angle, reflex and revolution, and recognise their relationship to a right angle VC2M4M04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>classifying the interior angles of a range of shapes, using examples of angles to identify acute, obtuse, right and reflex angles</li> <li>identifying angles within the environment and estimating whether they are acute, obtuse, right or reflex</li> <li>creating a right-angle template using cardboard or a double-folded piece of paper and using it to compare angles in the environment, commenting on whether they are smaller than or greater than a right angle</li> <li>using different measuring tools such as a spirit level or set squares to determine whether lines or objects are straight, square or perpendicular (at right angles)</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i> explain and compare the geometric properties of two-dimensional shapes and three-dimensional objects VC2M4SP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>describing the similarities and differences between two-dimensional shapes and three-dimensional objects</li> <li>recognising two-dimensional shapes that are the faces for three-dimensional objects such as prisms, pyramids and platonic solids (including tetrahedrons, cubes and dodecahedrons)</li> </ul>
<i>Students learn to:</i>	<i>This may involve students:</i>

Content descriptions	Elaborations
<p>represent and approximate composite shapes and objects in the environment, using combinations of familiar shapes and objects VC2M4SP02</p>	<ul style="list-style-type: none"> <li>identifying common shapes that form part of a composite shape by re-creating these shapes using physical or virtual materials</li> <li>physically or virtually using cubes to make three-dimensional models that approximate real objects; for example, building a virtual environment by using a computer software program to construct objects out of cubes</li> <li>approximating complex shapes and objects in the environment with familiar shapes and objects; for example, drawing cartoon animals by combining familiar shapes</li> <li>recognising how familiar shapes and objects are used in logos and other graphics to represent more complex shapes, and creating logos using graphic design software</li> </ul>
<p><i>Students learn to:</i> create and interpret grid reference systems using grid references and directions to locate and describe positions and pathways VC2M4SP03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>interpreting a grid reference map of a familiar location of interest, such as a map of the showgrounds, a food festival, botanical garden, a park in the local area or a train station, and writing instructions using grid references for a friend to find them at a specified location</li> <li>recognising that a spreadsheet uses a grid reference system, locating and entering data in cells, and using a spreadsheet to record data collected through observations or experiments</li> <li>comparing and contrasting, describing and locating landmarks, people or things in a bird's-eye picture of a busy scene, such as people in a park, initially without a transparent grid reference system overlaid on the picture and then with the grid overlaid; and noticing how the grid helps to pinpoint things quickly and easily</li> <li>using different-sized grids as a tool to enlarge an image or artwork</li> </ul>
<p><i>Students learn to:</i> recognise line and rotational symmetry of shapes and create symmetrical patterns and pictures, using dynamic geometry software where appropriate</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying rotational symmetry of shapes by tracing around various shapes and objects to create an image, and using the image to test and record which different rotations result in the same image</li> <li>using dynamic geometry software to manipulate shapes and create symmetrical patterns; for example, creating tessellation patterns that are symmetrical</li> </ul>

Content descriptions	Elaborations
VC2M4SP04	<ul style="list-style-type: none"> <li>• using stimulus materials such as the motifs in Central Asian textiles, Tibetan artefacts, Indian lotus designs and Islamic artwork to investigate and discuss line and rotational symmetry</li> <li>• exploring the natural environment on Country/Place to investigate and discuss patterns and symmetry of shapes and objects such as in flowers, plants and landscapes</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>acquire data for categorical and discrete numerical variables to address a question of interest or purpose using digital tools; represent data using many-to-one pictographs, column graphs and other displays or visualisations; interpret and discuss the information that has been created</p> <p>VC2M4ST01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• investigating many-to-one data displays using digital tools and graphical software, interpreting and discussing key features</li> <li>• understanding that data can be represented with one symbol representing more than one piece of data, and that it is important to read all information about a representation before making judgements</li> <li>• constructing graphs of data collected through observation during science experiments, recording, interpreting and discussing the results in terms of the scientific study</li> <li>• acquiring samples of data using practical activities, observations or repeated chance experiments; recording data using tally charts, digital tables or spreadsheets; and graphing, discussing and comparing the results using a column graph</li> <li>• using secondary data of fire burns to construct data displays that assist Aboriginal and/or Torres Strait Islander ranger groups and other groups to care for Country/Place</li> </ul>
<p><i>Students learn to:</i></p> <p>analyse the effectiveness of different displays or visualisations in illustrating and comparing data distributions, then discuss the shape of distributions and the</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• suggesting questions that can be answered by a given data display and using the display to answer these questions</li> <li>• interpreting data representations in the media and other forums where symbols represent one-to-many relationships and how this can be challenging when the representations use part-whole representations</li> </ul>

Content descriptions	Elaborations
variation in the data VC2M4ST02	<ul style="list-style-type: none"> <li>comparing different student-generated diagrams, tables and graphs, describing their similarities and differences and commenting on the usefulness of each representation for interpreting the data</li> </ul>
<p><i>Students learn to:</i></p> <p>conduct statistical investigations, collecting data through survey responses and other methods; record and display data using digital tools; interpret the data and communicate the results VC2M4ST03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>creating a survey to collect class responses to a preferred movie choice, and recording data responses using spreadsheets; graphing data using a column graph or other appropriate representations; and interpreting the results of the survey and reporting findings back to the class</li> <li>conducting a statistical investigation and acquiring data from different online sources; for example, using online query interfaces to select and retrieve data from an online database such as weather records, data frequency mapping software such as Google Trends, or the World Health Organization</li> <li>investigating different contexts in which statistical investigations can take place and the types of questions to ask to collect data relevant to the context; for example, investigating supermarket customer complaints that breakfast cereals with the most sugar are positioned at children's eye level, discussing what questions they would need to ask and answer</li> </ul>

### Strand: Probability

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>describe possible everyday events and the possible outcomes of chance experiments and order outcomes or events based on their likelihood of occurring; identify independent or dependent events VC2M4P01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using lists of events familiar to students and ordering them from 'least likely' to 'most likely' to occur; and considering and discussing why the order of some events might be different for different students</li> <li>predicting the outcome of a coin toss after 5 heads have been tossed in a row, discussing the assertion that because so many heads came up, it is more likely that a tail rather than a head will come up next; and discussing with reasons why this assertion is correct or incorrect</li> <li>predicting how likely it is – from least likely to most likely – that they would select a red ball from a bag containing 10 red balls and 5 white balls, from a bag containing 20 of each, or from a bag that has 25 red</li> </ul>

Content descriptions	Elaborations
	<p>balls and 20 white balls, justifying their decision</p> <ul style="list-style-type: none"> <li>identifying school activities where the chance of them taking place is affected by the chance of other events occurring; for example, given that there is a high chance of a storm on Friday, there is only a small chance that the coastal dune planting project will go ahead</li> <li>listing the outcomes of everyday chance situations and identifying where one cannot happen if the other happens; for example, discussing that it cannot be hot and cold at the same time, or selecting a card from a deck and discussing if it is red it cannot be a spade or a club</li> <li>identifying different dependent events where the chance of one outcome occurring will be affected by the occurrence of other outcomes and different independent events where the chance of one outcome occurring will not be affected by the occurrence of other outcome(s)</li> </ul>
<p><i>Students learn to:</i></p> <p>conduct repeated chance experiments to observe relationships between outcomes in games and other chance situations, and identify and describe the variation in results</p> <p>VC2M4P02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>playing games such as noughts-and-crosses or First to 20 and deciding if it makes a difference who goes first and whether you can use a particular strategy to increase your chances of winning</li> <li>recording and ordering the outcomes of experiments using different physical or virtual random generators such as coins, dice and a variety of spinners</li> <li>experimenting with tossing 2 coins at the same time, recording and commenting on the chance of outcomes after a number of tosses</li> <li>shuffling a set of cards, drawing a card at random, and recording whether it was a spade, club, diamond or heart, or a picture card or numbered card; and repeating the experiment a number of times and discussing the results</li> </ul>

## Level 5

### Level description

In Level 5, learning in Mathematics builds on each student's prior learning and experiences. Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- apply their understanding of relationships to convert between forms of numbers, units and spatial representations
- use mathematical modelling to solve practical problems with guidance, using natural numbers and operations, and report on insights and conclusions they reach about the context
- use common percentages to make proportional comparisons of quantities
- use appropriate instruments and digital tools to construct and measure angles in degrees
- use appropriate metric units to directly measure the area and perimeter of regular and irregular spaces
- locate and move positions within a grid coordinate system
- recognise what stays the same and what changes when shapes undergo transformations
- experiment with factors and multiples using algorithms and digital tools
- plan, conduct and report findings from statistical investigations that involve an increasing range of types of data and means for representing data
- develop their reasoning skills when they consider relationships between events and connect long-term frequency over many trials to the

likelihood of an event occurring.

## Achievement standard

By the end of Level 5, students use place value to write and order decimals including decimals greater than one. They express natural numbers as products of factors and identify multiples and divisors. Students order and represent, add and subtract fractions with the same or related denominators. They represent common percentages and connect them to their fraction and decimal equivalents. Students use their proficiency with multiplication facts and efficient mental and written calculation strategies to multiply large numbers by one- and two-digit numbers and divide by one-digit numbers. They check the reasonableness of their calculations using estimation. Students use mathematical modelling to solve financial and other practical problems, formulating and solving problems, choosing arithmetic operations and interpreting results in terms of the situation.

Students apply properties of numbers and operations to find unknown values in numerical equations involving multiplication and division. They design and use algorithms to identify and explain patterns in the factors and multiples of numbers.

Students choose and use appropriate metric units to measure the attributes of length, mass and capacity, and to solve problems involving perimeter and area. Students convert between 12- and 24-hour time. They estimate, construct and measure angles in degrees.

Students connect objects to their two-dimensional nets. Students use grid coordinates to locate and move positions. They perform and describe the results of transformations and identify any symmetries.

Students plan and conduct statistical investigations that collect nominal and ordinal categorical and discrete numerical data with and without digital tools. Students identify the mode and interpret the shape of distributions of data in context. They interpret and compare data represented in line graphs.

Students conduct repeated chance experiments, list the possible outcomes, estimate likelihoods and make comparisons between those with and without equally likely outcomes.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i>            interpret, compare and order numbers with more than 2 decimal places, including numbers greater than one, using place value understanding; represent these on a number line  <b>VC2M5N01</b></p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>making models of decimals including tenths, hundredths and thousandths by subdividing materials or grids, and explaining the multiplicative relationship between consecutive places; for example, explaining that thousandths are 10 times smaller than hundredths, or writing numbers into a place value chart to compare and order them</li> <li>renaming decimals to assist with mental computation; for example, when asked to solve <math>0.6 \div 10</math> they rename 6 tenths as 60 hundredths and say, 'If I divide 60 hundredths by 10, I get 6 hundredths' and write <math>0.6 \div 10 = 0.06</math></li> <li>using a number line or number track to represent and locate decimals with varying numbers of decimal places and numbers greater than one and justifying the placement; for example, 2.335 is halfway between 2.33 and 2.34, that is, <math>2.33 &lt; 2.335 &lt; 2.34</math>, and 5.283 is between 5.28 and 5.29 but closer to 5.28</li> <li>interpreting and comparing the digits in decimal measures, for example, the length or mass of animals or plants, such as a baby echidna weighing 1.78 kilograms and a platypus weighing 1.708 kilograms</li> <li>interpreting plans or diagrams showing length measures as decimals, placing the numbers into a decimal place value chart to connect the digits to their value</li> </ul>
<p><i>Students learn to:</i>            express natural numbers as products of their factors, recognise multiples and determine if one number is divisible by another  <b>VC2M5N02</b></p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using a certain number of blocks to form different rectangles and using these to list all possible factors for that number; for example, 12 blocks can form the following rectangles: <math>1 \times 12</math>, <math>2 \times 6</math> and <math>3 \times 4</math></li> <li>researching divisibility tests and explaining each rule using materials; for example, using base-10 blocks to test if numbers are divisible by 2, 5 and 10</li> <li>using divisibility tests to determine if larger numbers are multiples of one-digit numbers; for example,</li> </ul>

Content descriptions	Elaborations
	<p>testing if 89 472 is divisible by 3 using <math>8 + 9 + 4 + 7 + 2 = 30</math>, as 30 is divisible by 3 then 89 472 is a multiple of 3</p> <ul style="list-style-type: none"> <li>demonstrating and reasoning that all multiples can be formed by combining or regrouping; for example, multiples of 7 can be formed by combining a multiple of 2 with the corresponding multiple of 5: <math>3 \times 7 = 3 \times 2 + 3 \times 5</math>, and <math>4 \times 7 = 4 \times 2 + 4 \times 5</math></li> </ul>
<p><i>Students learn to:</i></p> <p>compare and order common unit fractions with the same and related denominators, including mixed numerals, applying knowledge of factors and multiples; represent these fractions on a number line</p> <p>VC2M5N03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using pattern blocks to represent equivalent fractions; selecting one block or a combination of blocks to represent one whole, and making a design with shapes; and recording the fractions to justify the total</li> <li>creating a fraction wall from paper tape to model and compare a range of different fractions with related denominators, and using the model to play fraction wall games</li> <li>connecting a fraction wall model and a number line model of fractions to say how they are the same and how they are different; for example, explaining <math>\frac{1}{4}</math> on a fraction wall represents the area of one-quarter of the whole, while on the number line <math>\frac{1}{4}</math> is identified as a point that is one-quarter of the distance between zero and one</li> <li>using an understanding of factors and multiples as well as equivalence to recognise efficient methods for the location of fractions with related denominators on parallel number lines; for example, explaining on parallel number lines that <math>\frac{2}{10}</math> is located at the same position on a parallel number line as <math>\frac{1}{5}</math> because <math>\frac{1}{5}</math> is equivalent to <math>\frac{2}{10}</math></li> <li>converting between mixed numerals and improper fractions to assist with locating them on a number line</li> </ul>
<p><i>Students learn to:</i></p> <p>recognise that 100% represents the complete whole and use percentages to describe, represent and compare relative size; connect familiar percentages to their decimal and fraction equivalents</p> <p>VC2M5N04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising applications of percentages used in everyday contexts, for example, the bar model used for charging devices indicating the percentage of power remaining, and advertising in retail contexts relating to discounts or sales</li> <li>creating a model by subdividing a whole (for example, using <math>10 \times 10</math> grids to represent various percentage amounts) and recognising complementary percentages (such as 30% and 70%) combine to make 100%</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>creating a model by subdividing a collection of materials, such as blocks or money, to connect decimals and percentage equivalents of tenths and the commonly used fractions <math>\frac{1}{2}</math>, <math>\frac{1}{4}</math> and <math>\frac{3}{4}</math>; for example, connecting that one-tenth or 0.1 represents 10% and one-half or 0.5 represents 50%, and recognising that 60% of a whole is 10% more of the whole than 50%</li> <li>using physical and virtual materials to represent the relationship between decimal notation and percentages, for example, 0.3 is 3 out of every 10, which is 30 out of every 100, which is 30%</li> </ul>
<p><i>Students learn to:</i> solve problems involving addition and subtraction of fractions with the same or related denominators, using different strategies VC2M5N05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using different ways to add and subtract fractional amounts by subdividing different models of measurement attributes; for example, adding half an hour and three-quarters of an hour using a clock face, adding a <math>\frac{3}{4}</math> cup of flour and a <math>\frac{1}{4}</math> cup of flour, subtracting <math>\frac{3}{4}</math> of a metre from <math>2\frac{1}{4}</math> metres</li> <li>representing and solving addition and subtraction problems involving fractions by using jumps on a number line, or bar models, or making diagrams of fractions as parts of shapes</li> <li>using materials, diagrams, number lines or arrays to show and explain that fraction number sentences can be rewritten in equivalent forms without changing the quantity, for example, <math>\frac{1}{2} + \frac{1}{4}</math> is the same as <math>\frac{2}{4} + \frac{1}{4}</math></li> </ul>
<p><i>Students learn to:</i> solve problems involving multiplication of larger numbers by one- or two-digit numbers, choosing efficient mental and written calculation strategies and using digital tools where appropriate; check the reasonableness of answers VC2M5N06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>solving multiplication problems such as <math>253 \times 4</math> using a doubling strategy, for example, <math>2 \times 253 = 506</math> and <math>2 \times 506 = 1012</math></li> <li>solving multiplication problems like <math>15 \times 16</math> by thinking of factors of both numbers, <math>15 = 3 \times 5</math>, <math>16 = 2 \times 8</math>, and rearranging the factors to make the calculation easier, <math>5 \times 2 = 10</math>, <math>3 \times 8 = 24</math> and <math>10 \times 24 = 240</math></li> <li>using an array to show place value partitioning to solve multiplication, such as <math>324 \times 8</math>, thinking <math>300 \times 8 = 2400</math>, <math>20 \times 8 = 160</math>, <math>4 \times 8 = 32</math> then adding the parts, <math>2400 + 160 + 32 = 2592</math>; and connecting the parts of the array to a standard written algorithm</li> <li>using different strategies used to multiply numbers, and explaining how they work and if they have any limitations; for example, discussing how the Japanese visual method for multiplication is not effective for</li> </ul>

Content descriptions	Elaborations
	multiplying larger numbers
<p><i>Students learn to:</i></p> <p>solve problems involving division, choosing efficient mental and written strategies and using digital tools where appropriate; interpret any remainder according to the context and express results as a whole number, decimal or fraction</p> <p>VC2M5N07</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>interpreting and solving everyday division problems such as 'How many buses are needed if there are 436 passengers and each bus carries 50 people?', deciding whether to round up or down in order to accommodate the remainder and justifying choices</li> <li>solving division problems mentally, such as 72 divided by 9, <math>72 \div 9</math>, by thinking, 'How many nines make 72?' <math>\square \times 9 = 72</math>, or 'Share 72 equally 9 ways'</li> <li>using the fact that equivalent division calculations result if both numbers are divided by the same factor</li> </ul>
<p><i>Students learn to:</i></p> <p>check and explain the reasonableness of solutions to problems, including financial contexts using estimation strategies appropriate to the context</p> <p>VC2M5N08</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>interpreting a series of contextual problems to decide whether an exact answer or an approximate calculation is appropriate, and explaining their reasoning in relation to the context and the numbers involved</li> <li>recognising the effect of rounding addition, subtraction, multiplication and division calculations, and rounding both numbers up, both numbers down, and one number up and one number down; and explaining which estimation is the best approximation and why</li> <li>considering the type of rounding that is appropriate when estimating the amount of money required; for example, rounding up or rounding down when buying one item from a store using cash, compared to rounding up the cost of every item when buying groceries to estimate the total cost and not rounding when the financial transactions are digital</li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems involving additive and multiplicative situations, including simple</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling an everyday situation and determining which operations can be used to solve it using materials, diagrams, arrays and/or bar models to represent the problem; formulating the situation as a number sentence; and justifying their choice of operations in relation to the situation</li> </ul>

Content descriptions	Elaborations
<p>financial planning contexts; formulate the problems, choosing operations and efficient mental and written calculation strategies, and using digital tools where appropriate; interpret and communicate solutions in terms of the situation VC2M5N09</p>	<ul style="list-style-type: none"> <li>modelling a series of contextual problems, deciding whether an exact answer or an approximate calculation is appropriate, and explaining their reasoning in relation to the context and the numbers involved</li> <li>modelling financial situations such as creating financial plans; for example, creating a budget for a class fundraising event, using a spreadsheet to tabulate data and perform calculations</li> <li>investigating how mathematical models involving combinations of operations can be used to represent songs, stories and/or dances of Aboriginal and Torres Strait Islander Peoples</li> </ul>
<p><i>Students learn to:</i> follow a mathematical algorithm involving branching and repetition (iteration); create and use algorithms involving a sequence of steps and decisions and digital tools to experiment with factors, multiples and divisibility; identify, interpret and describe emerging patterns VC2M5N10</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>simulating a simple random walk</li> <li>manipulating sets of numbers using a given rule, for example, if a number is even, halve it; or if a number is odd, subtract 1 then halve it</li> <li>creating algorithms that use multiplication and division facts to determine if a number is a multiple or factor of another number; for example, using a flow chart that determines whether numbers are factors or multiples of other numbers using branching, such as yes/no decisions</li> <li>identifying lowest common multiples and highest common factors of pairs or triples of natural numbers; for example, the lowest common multiple of {6, 9} is 18, and the highest common factor is 3, and the lowest common multiple of {3, 4, 5} is 60 and the highest common factor is 1</li> <li>using the ‘fill down’ function of a spreadsheet and a multiplication formula to generate a sequence of numbers that represent the multiples of any number you enter into the cell, and describing and explaining the emerging patterns</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i></p>	<p><i>This may involve students:</i></p>

Content descriptions	Elaborations
<p>recognise and explain the connection between multiplication and division as inverse operations and use this to develop families of number facts VC2M5A01</p>	<ul style="list-style-type: none"> <li>using materials or diagrams to develop and explain division strategies, such as halving, using the inverse relationship to turn division into a multiplication</li> <li>using arrays, multiplication tables, and physical and virtual materials to develop families of facts, for example, <math>3 \times 4 = 12</math>, <math>4 \times 3 = 12</math>, <math>12 \div 3 = 4</math> and <math>12 \div 4 = 3</math></li> <li>demonstrating multiplicative partitioning using materials, diagrams or arrays and recording 2 multiplication and 2 division facts for each grouping (for example, <math>4 \times 6 = 24</math>, <math>6 \times 4 = 24</math>, <math>24 \div 4 = 6</math> and <math>24 \div 6 = 4</math>), explaining how each grouping is different from and connected to other groupings in the materials, diagrams or arrays</li> <li>using materials, diagrams or arrays to recognise and explain the inverse relationship between multiplication and division (for example, solving <math>240 \div 20 = \square</math> by thinking <math>20 \times \square = 240</math>) and using the inverse to make calculations easier (for example, solving <math>17 \times \square = 221</math> using division, <math>\square = 221 \div 17</math>)</li> </ul>
<p><i>Students learn to:</i> find unknown values in numerical equations involving multiplication and division using the properties of numbers and operations VC2M5A02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using knowledge of equivalent number sentences to form and find unknown values in numerical equations; for example, given that <math>3 \times 5 = 15</math> and <math>30 \div 2 = 15</math>, then <math>3 \times 5 = 30 \div 2</math>, and therefore the solution to <math>3 \times 5 = 30 \div \square</math> is 2</li> <li>using relational thinking, and an understanding of equivalence and number properties to determine and reason about numerical equations; for example, explaining whether an equation involving equivalent multiplication number sentences is true, such as <math>15 \div 3 = 30 \div 6</math></li> <li>using materials, diagrams and arrays to demonstrate that multiplication is associative and commutative but division is not – for example, using arrays to demonstrate that <math>2 \times 3 = 3 \times 2</math> but <math>6 \div 3</math> does not equal <math>3 \div 6</math>; demonstrating that <math>2 \times 2 \times 3 = 12</math> and <math>2 \times 3 \times 2 = 12</math> and <math>3 \times 2 \times 2 = 12</math>; and understanding that <math>8 \div 2 \div 2 = (8 \div 2) \div 2 = 2</math> but <math>8 \div (2 \div 2) = 8 \div 1 = 8</math></li> <li>using materials, diagrams or arrays to recognise and explain the distributive property, for example, where <math>4 \times 13 = 4 \times 10 + 4 \times 3</math></li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>constructing equivalent number sentences involving multiplication to form a numerical equation, and applying knowledge of factors, multiples and the associative property to find unknown values in numerical equations; for example, considering <math>3 \times 4 = 12</math> and knowing <math>2 \times 2 = 4</math>, then <math>3 \times 4</math> can be written as <math>3 \times (2 \times 2)</math> and, using the associative property, <math>(3 \times 2) \times 2</math> so <math>3 \times 4 = 6 \times 2</math> and so 6 is the solution to <math>3 \times 4 = \square \times 2</math></li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>choose appropriate metric units when measuring the length, mass and capacity of objects; use smaller units or a combination of units to obtain a more accurate measure</p> <p>VC2M5M01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>ordering metric units from the largest unit to the smallest, for example, kilometre, metre, centimetre, millimetre</li> <li>recognising that some units of measurement are better suited to some tasks than others; for example, kilometres are more appropriate than metres to measure the distance between 2 towns</li> <li>deciding on the unit required to estimate the amount of paint or carpet for a room or a whole building, and justifying the choice of unit in relation to the context and the degree of accuracy required</li> <li>measuring and comparing distances (for example, measuring and comparing jumps or throws using a metre length of string and then measuring the part metre with centimetres and/or millimetres) and explaining which unit of measure is most accurate</li> <li>researching how the base units are derived for the International System of Units (SI), commonly known as the metric system of units, recognising that the metric unit names for the attributes of length and mass are international standards for measurement</li> </ul>
<p><i>Students learn to:</i></p> <p>solve practical problems involving the perimeter and area of regular and irregular shapes using appropriate metric units</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating problem situations involving perimeter, for example, 'How many metres of fencing are required around a paddock, or around a festival event?'</li> <li>using efficient ways to calculate the perimeters of rectangles, such as adding the length and width together</li> </ul>

Content descriptions	Elaborations
VC2M5M02	<p>and doubling the result</p> <ul style="list-style-type: none"> <li>solving measurement problems such as 'How much carpet would be needed to cover the entire floor of the classroom?', using square metre templates to directly measure the floor space</li> <li>creating a model of a permaculture garden, dividing the area up to provide the most efficient use of space for gardens and walkways, labelling the measure of each area, and calculating the amount of resources needed, for example, compost to cover the vegetable garden</li> <li>using a physical geoboard or a virtual geoboard app to recognise the relationship between area and perimeter and solve problems; for example, investigating what is the largest and what is the smallest area that has the same perimeter</li> <li>exploring the designs of fishing nets and dwellings of Aboriginal and Torres Strait Islander Peoples, investigating the perimeter, area and purpose of the shapes within the designs</li> </ul>
<p><i>Students learn to:</i></p> <p>compare 12- and 24-hour time systems and solve practical problems involving the conversion between them</p> <p>VC2M5M03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using timetables written in 24-hour time, such as flight schedules, to plan an overseas or interstate trip, converting between 24- and 12-hour time</li> <li>converting between the digital and analog representation of 24-hour time, matching the same times represented in both systems; for example, setting the time on an analog watch from a digital alarm clock</li> </ul>
<p><i>Students learn to:</i></p> <p>estimate, construct and measure angles in degrees, using appropriate tools, including a protractor, and relate these measures to angle names</p> <p>VC2M5M04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using a protractor to measure angles in degrees and classifying these angles using angle names; for example, an acute angle is less than <math>90^\circ</math>, an obtuse angle is more than <math>90^\circ</math> and less than <math>180^\circ</math>, a right angle is equal to <math>90^\circ</math> and a reflex angle is more than <math>180^\circ</math> and less than <math>360^\circ</math></li> <li>estimating the size of angles in the environment using a clinometer and describing the angles using angle names</li> <li>using a ruler and protractor to construct triangles, given the angle measures and side lengths</li> <li>using a protractor to measure angles when creating a pattern or string design within a circle</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>recognising the size of angles within shapes that do and do not tessellate, measuring the angles and using the sum of angles to explain why some shapes will tessellate and other shapes do not</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i> connect objects to their nets and build objects from their nets using spatial and geometric reasoning VC2M5SP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>designing and constructing exact nets for packaging particular-shaped items or collections of interest, taking into consideration how the faces will be joined and how the package will be opened</li> <li>visualising folding some possible nets for a range of prisms and pyramids, predicting which will work and which cannot work, and justifying their choices, based on the number, size and position of particular shapes in each diagram</li> <li>sketching nets for a range of prisms and pyramids considering the number, shape and placement of the faces, and testing by cutting and folding</li> <li>investigating objects designed and developed by Aboriginal and/or Torres Strait Islander Peoples, such as those used in fish traps and instructive toys, identifying the shape and relative position of each face to determine the net of the object</li> </ul>
<p><i>Students learn to:</i> construct a grid coordinate system that uses coordinates to locate positions within a space; use coordinates and directional language to describe position and movement VC2M5SP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>understanding how the numbers on the axes on a grid coordinate system are numbers on a number line and are used to pinpoint locations</li> <li>discussing the conventions of indicating a point in a grid coordinate system; for example, writing the horizontal axis number first and the vertical axis number second, and using brackets and commas</li> <li>comparing a grid reference system to a grid coordinate system (first quadrant only) by using both to play strategy games involving location; for example, in playing the game Quadrant Commander, deducing that in a grid coordinate system the lines are numbered (starting from zero), not the spaces</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>placing a coordinate grid over a contour line, drawing and listing the coordinates of each point in the picture, asking a peer to re-create the drawing using only the list of coordinates, and discussing the reasons for the potential similarities and differences between the 2 drawings</li> </ul>
<p><i>Students learn to:</i></p> <p>describe and perform translations, reflections and rotations of shapes, using dynamic geometry software where appropriate; recognise what changes and what remains the same, and identify any symmetries VC2M5SP03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>understanding and explaining that translations, rotations and reflections can change the position and orientation of a shape but not its shape or size</li> <li>using pattern blocks and paper, tracing around a shape and then conducting a series of one-step transformations and tracing each resulting image, and then finally copying the original position and end position on a new sheet of paper</li> <li>demonstrating how different combinations of transformations can produce the same resulting image</li> <li>challenging classmates to select a combination of transformations to move from an original image to the final image, noting the different combinations by using different colours to trace images</li> <li>investigating how animal tracks can be interpreted by Aboriginal and Torres Strait Islander Peoples using the transformation of their shapes, to help determine and understand animal behaviour</li> </ul>

## Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>acquire, validate and represent data for nominal and ordinal categorical and discrete numerical variables to address a question of interest or purpose using software including spreadsheets; discuss and report on data distributions in terms of highest frequency (mode)</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising that ordinal data is a form of categorical data even though the data being collected might be numbers, for example, a rating scale using numbers 1–5 to represent the categories people can choose from when asked, 'What rating would you give this film out of 5?'</li> <li>determining the mode for a set of data and discussing that there may be more than one mode</li> <li>identifying the best methods of presenting data to illustrate the results of investigations and justifying the choice of representations</li> </ul>

Content descriptions	Elaborations
<p>and shape, in the context of the data VC2M5ST01</p>	<ul style="list-style-type: none"> <li>acquiring data through chance experiments, discussing and reporting on the distribution of outcomes and how this relates to equal and unequal outcomes</li> <li>using digital systems to validate data; for example, recognising the difference between numerical, text and date formats in spreadsheets, and setting data types in a spreadsheet to make sure a date is input correctly</li> <li>investigating data relating to the reconciliation process between Aboriginal and Torres Strait Islander Peoples and non-Indigenous Australians, posing questions, discussing and reporting on findings</li> </ul>
<p><i>Students learn to:</i> interpret line graphs representing change over time; discuss the relationships that are represented and conclusions that can be made VC2M5ST02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>reading and interpreting different line graphs, discussing how the horizontal axis represents measures of time such as days of the week or times of the day, and the vertical axis represents numerical quantities or ordinal categorical variables such as percentages, money, measurements or ratings such as fire hazard ratings</li> <li>interpreting real-life data represented as a line graph showing how measurements change over a period of time, and make simple inferences</li> <li>matching unlabelled line graphs to the context they represent based on the stories of the different contexts</li> <li>interpreting the data represented in a line graph, making inferences; for example, reading line graphs that show the varying temperatures or ultraviolet (UV) rates over a period of a day and discussing when would be the best time to hold an outdoor assembly</li> </ul>
<p><i>Students learn to:</i> plan and conduct statistical investigations by posing questions or identifying a problem and collecting relevant data; choose appropriate displays and interpret the data; communicate findings</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>posing questions about insect diversity in the playground, and collecting data by taping a one-metre-square piece of paper to the playground and observing the type and number of insects on it over time</li> <li>posing a question or identifying a problem of interest; collecting, interpreting and analysing the data; and discussing if the data generated provides the information necessary to answer the question</li> <li>developing survey questions that are objective, without opinion, and have a balanced set of answer choices</li> </ul>

Content descriptions	Elaborations
<p>within the context of the investigation VC2M5ST03</p>	<p>without bias</p> <ul style="list-style-type: none"> <li>exploring Aboriginal and/or Torres Strait Islander ranger groups' and other groups' biodiversity detection techniques to care for Country/Place, posing investigative questions, and collecting and interpreting related data to represent and communicate findings</li> </ul>

### Strand: Probability

Content descriptions	Elaborations
<p><i>Students learn to:</i> list the possible outcomes of chance experiments involving equally likely outcomes and compare to those that are not equally likely VC2M5P01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>discussing what it means for outcomes to be equally likely and comparing the number of possible and equally likely outcomes of chance events; for example, when drawing a card from a standard deck of cards there are 4 possible outcomes if you are interested in the suit, 2 possible outcomes if you are interested in the colour or 52 outcomes if you are interested in the exact card</li> <li>discussing how chance experiments that have equally likely outcomes can be referred to as random chance events; for example, if all the names of students in a class are placed in a hat and one is drawn at random, each person has an equally likely chance of being drawn</li> <li>commenting on the chance of winning games by considering the number of possible outcomes and the consequent chance of winning</li> <li>investigating why some games are fair and others are not; for example, drawing a track game to resemble a running race and taking it in turns to roll 2 dice, where the first runner moves a square if the difference between the 2 dice is zero, one or 2 and the second runner moves a square if the difference is 3, 4 or 5, and responding to the questions 'Is this game fair?', 'Are some differences more likely to come up than others?' and 'How can you work that out?'</li> <li>comparing the chance of a head or a tail when a coin is tossed, whether some numbers on a dice are more likely to be facing up when the dice is rolled, or the chance of getting a 1, 2 or 3 on a spinner with uneven</li> </ul>

Content descriptions	Elaborations
	<p>regions for the numbers</p> <ul style="list-style-type: none"> <li>discussing supermarket promotions such as collecting stickers or objects and whether there is an equal chance of getting each of them</li> </ul>
<p><i>Students learn to:</i></p> <p>conduct repeated chance experiments, including those with and without equally likely outcomes, and observe and record the results; use frequency to compare outcomes and estimate their likelihoods</p> <p>VC2M5P02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>discussing and listing all the possible outcomes of an activity and conducting experiments to estimate the probabilities (for example, using coloured cards in a card game and experimenting with shuffling the deck and turning over one card at a time) and recording and discussing the results</li> <li>conducting experiments, recording the outcomes and the number of times the outcomes occur, and describing the relative frequency of each outcome; for example, using 'I threw the coin 10 times, and the results were 3 times for a head, so that is 3 out of 10, and 7 times for a tail, so that is 7 out of 10'</li> <li>experimenting with and comparing the outcomes of spinners with equal coloured regions compared to unequal coloured regions; and responding to questions such as 'How does this spinner differ to one where each of the colours has an equal chance of occurring?', giving reasons</li> <li>comparing the results of experiments using a fair dice and one that has numbers represented on faces more than once, explaining how this affects the likelihood of outcomes</li> <li>using spreadsheets to record the outcomes of an activity and calculate the total frequencies of different outcomes, representing these as a fraction; for example, using coloured balls in a bag, drawing one out at a time and recording the colour, and replacing them in the bag after each draw</li> <li>investigating Aboriginal and/or Torres Strait Islander children's instructive games (for example, Diyari koolchee from the Diyari Peoples near Lake Eyre in South Australia), to conduct repeated trials and explore predictable patterns, using digital tools where appropriate</li> </ul>

## Level 6

### Level description

In Level 6, learning in Mathematics builds on each student's prior learning and experiences. Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- expand the repertoire of numbers they work with to include rational numbers and the use of integers in practical contexts, such as locating points in the 4 quadrants of a Cartesian plane
- extend their knowledge of factors and multiples to understand the properties of prime, composite, triangular and square numbers
- solve arithmetic problems involving all 4 operations with natural numbers of any size
- use mathematical modelling to solve practical problems, choosing models, representations and calculation strategies, and justify solutions
- apply computational thinking approaches to develop algorithms that use rules to generate numbers
- develop a range of written and digital means for representing objects and three-dimensional spaces in 2 dimensions
- apply their understanding of area and use multiplicative thinking to establish the formula for the area of a rectangle
- begin to formally use deductive reasoning in spatial contexts involving lines and angles
- describe and compare probabilities numerically
- determine the mode and range and discuss the shape of distributions in their reports of findings from their statistical investigations
- observe and compare long-run frequencies in repeated chance experiments and simulations.

## Achievement standard

By the end of Level 6, students use integers to represent points on a number line and on the Cartesian plane. They solve problems using the properties of prime, composite, square and triangular numbers. Students order common fractions, giving reasons, and add and subtract fractions with related denominators. They use all 4 operations with decimals and connect decimal representations of measurements to the metric system. Students solve problems involving finding a fraction, decimal or percentage of a quantity and use estimation to find approximate solutions to problems involving rational numbers and percentages. They use mathematical modelling to solve financial and other practical problems involving percentages and rational numbers, formulating and solving the problem, and justifying choices.

Students find unknown values in numerical equations involving combinations of arithmetic operations. They identify and explain rules used to create growing patterns. They design and use algorithms to generate sets of numbers, using a rule.

Students interpret and use timetables, and measure, calculate and compare elapsed time. They convert between common units of length, mass and capacity. They use the formula for the area of a rectangle and angle properties to solve problems.

Students identify the parallel cross-section for right prisms. They create tessellating patterns using combinations of transformations. They locate an ordered pair in any one of the 4 quadrants on the Cartesian plane.

Students compare distributions of discrete and continuous numerical and ordinal categorical data sets as part of their statistical investigations, using digital tools. They critique arguments presented in the media based on statistics.

Students assign probabilities using common fractions, decimals and percentages. They conduct simulations using digital tools, to generate and record the outcomes from many trials of a chance experiment. They compare observed frequencies to the expected frequencies of the outcomes of chance experiments.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i> recognise situations, including financial contexts, that use integers; locate and represent integers on a number line and as coordinates on the Cartesian plane VC2M6N01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>extending the number line in the negative direction to locate and represent integers, recognising the difference in location between <math>(-2)</math> and <math>(+2)</math> and their relationship to zero as <math>-2 &lt; 0 &lt; 2</math></li> <li>using integers to represent quantities in financial contexts, including the concept of profit and loss for a planned event</li> <li>using horizontal and vertical number lines to represent and find solutions to everyday problems involving locating and ordering integers around zero (for example, elevators, above and below sea level) and distinguishing a location by referencing the 4 quadrants of the Cartesian plane</li> <li>recognising that the sign (positive or negative) indicates a direction in relation to zero – for example, 30 metres left of the admin block is <math>(-30)</math> and 20 metres right of the admin block is <math>(+20)</math> – and programming robots to move along a number line that is either horizontal or vertical but not both at the same time</li> <li>representing the temperatures of the different planets in the solar system, using a diagram of a thermometer that models a vertical number line</li> </ul>
<p><i>Students learn to:</i> identify and describe the properties of prime, composite, square and triangular numbers and use these properties to solve problems and simplify calculations VC2M6N02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using the definition of a prime number to explain why one is not a prime number</li> <li>testing numbers by using division to distinguish between prime and composite numbers, recording the results on a number chart to identify any patterns</li> <li>representing composite numbers as a product of their factors, including prime factors when necessary and using this form to simplify calculations involving multiplication, such as <math>15 \times 16</math> as <math>5 \times 3 \times 4 \times 4</math>, which can be rearranged to simplify calculation to <math>5 \times 4 \times 3 \times 4 = 20 \times 12</math></li> <li>identifying and describing the product of a number with itself as square; for example, <math>3 \times 3</math> is the same as <math>3^2</math></li> <li>using spreadsheets to list all the numbers that have up to 3 factors, using combinations of only the first 3 prime numbers, recognising any emerging patterns, making conjectures and experimenting with other</li> </ul>

Content descriptions	Elaborations
	combinations
<p><i>Students learn to:</i>  apply knowledge of equivalence to compare, order and represent common fractions, including halves, thirds and quarters, on the same number line and justify their order  VC2M6N03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>applying factors and multiples to fraction denominators (such as halves with quarters, eighths and twelfths, and thirds with sixths, ninths and twelfths) to determine equivalent representations of fractions in order to make comparisons</li> <li>representing fractions on the same number line, paying attention to relative position, and using this to explain relationships between denominators</li> <li>explaining equivalence and order between fractions using number lines, drawings and models</li> <li>comparing and ordering fractions by placing cards on a string line across the room and referring to benchmark fractions to justify their position; for example, <math>\frac{5}{8}</math> is greater than <math>\frac{1}{2}</math> can be written as <math>\frac{5}{8} &gt; \frac{1}{2}</math>, because half of 8 is 4; <math>\frac{1}{6}</math> is less than <math>\frac{1}{4}</math>, because <math>6 &gt; 4</math> and can be written as <math>\frac{1}{6} &lt; \frac{1}{4}</math></li> </ul>
<p><i>Students learn to:</i>  apply knowledge of place value to add and subtract decimals, using digital tools where appropriate; use estimation and rounding to check the reasonableness of answers  VC2M6N04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>applying estimation strategies to addition and subtraction of decimals to at least thousandths before calculating answers or when a situation requires just an estimation</li> <li>applying whole-number strategies; for example, using basic facts, place value, partitioning and the inverse relationship between addition and subtraction, and properties of operations to develop meaningful mental strategies for addition and subtraction of decimal numbers to at least hundredths</li> <li>working additively with linear measurements expressed as decimals up to 2 and 3 decimal places; for example, calculating how far off the world record the athletes were at the last Olympic Games in the women's long jump or shot-put and comparing school records to the Olympic records</li> <li>deciding to use a calculator as a calculation strategy for solving additive problems involving decimals that vary in their number of decimal places beyond hundredths; for example, <math>1.0 - 0.0035</math> or <math>2.345 + 1.4999</math></li> </ul>
<p><i>Students learn to:</i>  solve problems involving addition</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>representing addition and subtraction of fractions, using an understanding of equivalent fractions and</li> </ul>

Content descriptions	Elaborations
<p>and subtraction of fractions using knowledge of equivalent fractions VC2M6N05</p>	<p>methods such as jumps on a number line, or diagrams of fractions as parts of shapes</p> <ul style="list-style-type: none"> <li>• determining the lowest common denominator using an understanding of prime and composite numbers to find equivalent representation of fractions when solving addition and subtraction problems</li> <li>• calculating the addition or subtraction of fractions in the context of real-world problems (for example, using part cups or spoons in a recipe), using the understanding of equivalent fractions</li> <li>• understanding the processes for adding and subtracting fractions with related denominators and fractions as an operator, in preparation for calculating with all fractions; for example, using fraction overlays and number lines to give meaning to adding and subtracting fractions with related and unrelated denominators</li> </ul>
<p><i>Students learn to:</i> multiply and divide decimals by multiples of powers of 10 without a calculator, applying knowledge of place value and proficiency with multiplication facts, using estimation and rounding to check the reasonableness of answers VC2M6N06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• applying place value knowledge, including that the value of the digit is 10 times smaller each time a place is moved to the right, and known multiplication facts, to multiply and divide a decimal by powers of 10</li> <li>• applying and explaining estimation strategies in multiplicative situations involving a decimal greater than one that is multiplied by a two- or three-digit number, using a multiple of 10 or 100 when the situation requires just an estimation</li> <li>• explaining the effect of multiplying or dividing a decimal by 10, 100, 1000 ... in terms of place value and not the decimal point shifting</li> </ul>
<p><i>Students learn to:</i> solve problems that require finding a familiar fraction, decimal or percentage of a quantity, including percentage discounts, choosing efficient calculation strategies with and without digital tools VC2M6N07</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• explaining how <math>\frac{1}{3}</math> of a quantity can be achieved by dividing by 3, and how knowledge of <math>\frac{1}{3}</math> of a quantity can be used to find <math>\frac{2}{3}</math> or <math>\frac{4}{3}</math> of the same quantity, using situations involving money, length, duration, mass or capacity</li> <li>• investigating percentage discounts of 10%, 25% and 50% in an online toy sale, using their equivalent decimal representations of 0.10, 0.25 and 0.50 to calculate the amount of discount on sale items, with and without digital tools</li> <li>• linking percentages to their decimal equivalent of tenths and hundredths and using these to determine</li> </ul>

Content descriptions	Elaborations
	<p>percentage discounts; for example, finding a 30% discount by using its equivalence to 0.3, dividing by 10 and multiplying the result by 3 to give 30%</p> <ul style="list-style-type: none"> <li>explaining the equivalence between percentages and fractions, for example, <math>33\frac{1}{3}\%</math> and <math>\frac{1}{3}</math>, keeping to percentages that are equivalent to fractions with small denominators such as <math>66\frac{2}{3}\%</math> and 12.5%</li> <li>representing a situation with a mathematical expression, for example, numbers and symbols such as <math>\frac{1}{4} \times 24</math>, that involves finding a familiar fraction or percentage of a quantity; and using mental strategies or a calculator and explaining the result in terms of the situation in question</li> </ul>
<p><i>Students learn to:</i></p> <p>approximate numerical solutions to problems involving rational numbers and percentages, using appropriate estimation strategies</p> <p>VC2M6N08</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using familiar fractions, decimals and percentages to approximate calculations, such as 0.3 of 180 is about <math>\frac{1}{3}</math> of 180, or 52% is about <math>\frac{1}{2}</math></li> <li>choosing appropriate estimation strategies including rounding to the nearest whole number, knowledge of multiples of 2, 5 or 10 and partitioning numbers, in contexts such as measuring or cost per unit</li> <li>recognising the effect of rounding on calculations involving fractions or decimals and saying what numbers the answer will be between</li> <li>recognising the usefulness of estimation to check calculations for contexts such as dividing wood into a number of lengths, calculating cost per unit, reducing a recipe or dividing the cost of dinner for a group into individual amounts</li> <li>verifying solutions by estimating percentages in suitable contexts, such as discounts, using common percentages of 10%, 25%, 30%, 50% and 1%</li> <li>investigating estimation strategies to make decisions about steam cooking in ground ovens by Aboriginal and/or Torres Strait Islander Peoples, including catering for different numbers of people and resources needed for cooking</li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems involving</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling practical situations involving percentages using efficient calculation strategies to find solutions,</li> </ul>

Content descriptions	Elaborations
<p>rational numbers and percentages, including in financial contexts; formulate the problems, choosing operations and using efficient mental and written calculation strategies, and using digital tools where appropriate; interpret and communicate solutions in terms of the situation, justifying the choices made VC2M6N09</p>	<p>such as mental calculations, spreadsheets, calculators or a variety of informal jottings, and interpreting the results in terms of the situation, for example, purchasing items during a sale</p> <ul style="list-style-type: none"> <li>modelling situations involving earning money and budgeting, asking questions such as 'Can I afford it?', 'Do I need it?' and 'How much do I need to save for it?' and developing a savings plan or budget for an upcoming event or personal purchase</li> <li>modelling and solving the problem of creating a budget for a class excursion or family holiday, using the internet to research costs and expenses, and representing the budget in a spreadsheet, creating and using formulas to calculate totals</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i>      recognise and use rules that generate visually growing patterns and number patterns involving rational numbers VC2M6A01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating patterns such as the number of tiles in a geometric pattern, or the number of dots or other shapes in successive repeats of a strip or border pattern, looking for patterns in the way the numbers increase or decrease</li> <li>using a calculator or spreadsheet to experiment with number patterns that result from multiplying or dividing; for example, <math>1 \div 9, 2 \div 9, 3 \div 9 \dots, 210 \times 11, 211 \times 11, 212 \times 11 \dots, 111 \times 11, 222 \times 11, 333 \times 11 \dots</math>, or <math>100 \div 99, 101 \div 99, 102 \div 99 \dots</math></li> <li>creating an extended number sequence that represents an additive pattern using decimals; for example, representing the additive pattern formed as students pay their \$2.50 for an excursion as 2.50, 5.00, 7.50, 10.00, 12.50, 15.00, 17.50 ...</li> <li>investigating the number of regions created by successive folds of a sheet of paper (one fold, 2 regions; 2 folds, 4 regions; 3 folds, 8 regions) and describing the pattern using everyday language</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>creating a pattern sequence with materials, writing the associated number sequence and then describing the sequence with a rule so someone else can replicate it with different materials; for example, using matchsticks or toothpicks to create a growing pattern of triangles using 3 for one triangle, 5 for 2 triangles and 7 for 3 triangles and describing the pattern as 'Multiply the number of triangles by 2 and then add one for the extra toothpick in the first triangle'</li> </ul>
<p><i>Students learn to:</i></p> <p>find unknown values in numerical equations involving brackets and combinations of arithmetic operations, using the properties of numbers and operations</p> <p>VC2M6A02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using brackets and the order of operations to write number sentences and appreciating the need for an agreed set of rules to complete multiple operations within the same number sentence; for example, for <math>40 \div 2 \times (4 + 6) = \square</math>, you solve what is in the brackets first then complete the number sentence from left to right as there is no hierarchy between division and multiplication</li> <li>constructing equivalent number sentences involving brackets and combinations of the 4 operations, and explaining the need to have shared agreement on the order of operations when solving problems involving more than one operation to have unique solutions</li> <li>finding pairs of unknown values in numerical equations that make the equation hold true; for example, listing possible combinations of natural numbers that make this statement true: <math>6 + 4 \times 8 = 6 \times \Delta + \square</math></li> </ul>
<p><i>Students learn to:</i></p> <p>design and use algorithms involving a sequence of steps and decisions that use rules to generate sets of numbers; identify, interpret and explain emerging patterns</p> <p>VC2M6A03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using an algorithm to create extended number sequences involving rational numbers, using a rule and digital tools, and explaining any emerging patterns</li> <li>designing an algorithm to model operations, using the concept of input and output, describing and explaining relationships and any emerging patterns; for example, using function machines to model operations and recognising and comparing additive and multiplicative relationships</li> <li>designing an algorithm or writing a simple program to generate a sequence of numbers based on the user's input and a chosen operation, discussing any emerging patterns; for example, generating a sequence of numbers and comparing how quickly the sequences are growing in comparison to each other using the rule</li> </ul>

Content descriptions	Elaborations
	'add 2 to the input number' compared to multiplying the input number by 2

## Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i> convert between common metric units of length, mass and capacity; choose and use decimal representations of metric measurements relevant to the context of a problem VC2M6M01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising the significance of the prefixes in units of measurement</li> <li>identifying and using the correct operations when converting between units including millimetres, centimetres, metres, kilometres, milligrams, grams, kilograms, tonnes, millilitres, litres, kilolitres and megalitres</li> <li>recognising the equivalence of measurements, such as 1.25 metres is the same as 125 centimetres</li> </ul>
<p><i>Students learn to:</i> establish the formula for the area of a rectangle and use it to solve practical problems VC2M6M02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using the relationship between the length and area of square units and the array structure to derive a formula for calculating the area of a rectangle from the lengths of its sides</li> <li>using one-centimetre grid paper to construct a variety of rectangles, recording the side lengths and the related areas of the rectangles in a table to establish the formula for the area of a rectangle by recognising the relationship between the length of the sides and its calculated area</li> <li>solving problems involving the comparison of lengths and areas using appropriate units</li> <li>investigating the connection between the perimeters of different rectangles with the same area and between the areas of rectangles with the same perimeter</li> </ul>
<p><i>Students learn to:</i> measure, calculate and compare elapsed time; interpret and use timetables and itineraries to plan activities and determine the</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>planning a trip involving one or more modes of public transport</li> <li>developing a timetable of daily activities for a planned event, for example, a sports carnival</li> <li>investigating different ways duration is represented in timetables and using different timetables to plan a</li> </ul>

Content descriptions	Elaborations
duration of events and journeys VC2M6M03	journey
<i>Students learn to:</i> identify the relationships between angles on a straight line, angles at a point and vertically opposite angles; use these to determine unknown angles, communicating reasoning VC2M6M04	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>using protractors or dynamic geometry software to measure and generalise about the size of angles formed when lines are crossed, and combinations of angles that meet at a point, including combinations that form right or straight angles</li> <li>demonstrating the meaning of language associated with properties of angles, including right, complementary, complement, straight, supplement, vertically opposite, and angles at a point</li> <li>using the properties of supplementary and complementary angles to represent spatial situations with number sentences and solving to find the size of unknown angles</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<i>Students learn to:</i> compare the parallel cross-sections of objects and recognise their relationships to right prisms VC2M6SP01	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>using objects made of foam or polystyrene, slicing along different cross-sections, and recording the different shapes of faces that result; and comparing cross-sections of different objects</li> <li>using different pieces of fruit, slicing across different cross-sections, and drawing the cross-section; and reporting back to the class the results of the investigation</li> <li>observing and drawing the shapes resulting from different ways of slicing through familiar objects; for example, slicing carrots at different angles or cutting through playdough models of objects; or using playdough models, fruit or similar to establish which objects can be cut in such a way that the cross-section will always be the same shape</li> <li>understanding that right prisms are objects where parallel cross-sections perpendicular to the base of the prism are the same shape and size</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>connecting different right prisms to the shape of their parallel cross-sections, such as a triangular prism, which can be described as a stack of the same-sized triangles, and a cube or square prism, which can be described as a stack of the same-sized squares</li> <li>investigating the design of Aboriginal and/or Torres Strait Islander Peoples' dwellings, exploring the relationship between the cross-sections and the dwellings' construction</li> </ul>
<p><i>Students learn to:</i></p> <p>locate points in the 4 quadrants of the Cartesian plane; describe changes to the coordinates when a point is moved to a different position in the plane VC2M6SP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>understanding that the Cartesian plane provides a graphical or visual way of describing location with respect to a fixed origin</li> <li>understanding that the axes are number lines that can have different scales, including fractions and decimals, depending on purpose</li> <li>understanding that the horizontal coordinate is written first and is changed if there is a move to the left or right, whereas a move up or down will change the vertical coordinate</li> <li>using the Cartesian plane to draw lines and polygons, listing coordinates in the correct order to complete a polygon</li> <li>investigating and connecting land or star maps used by Aboriginal and Torres Strait Islander Peoples with the Cartesian plane through a graphical or visual way of describing location</li> </ul>
<p><i>Students learn to:</i></p> <p>recognise and use combinations of transformations to create tessellations and other geometric patterns, using dynamic geometry software where appropriate VC2M6SP03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using digital tools to create tessellations of shapes, including paver and tiling patterns, describing the transformations used and discussing why these shapes tessellate; and identifying shapes or combinations of shapes that will or will not tessellate, answering questions such as 'Do all triangles tessellate?'</li> <li>designing a school or brand logo using the transformation of one or more shapes and describing the transformations used</li> <li>using dynamic geometry software and digital tools to experiment with transformations, for example, to demonstrate when the order of transformations produces different results; and experimenting with</li> </ul>

Content descriptions	Elaborations
	<p>transformations and their application to fractals</p> <ul style="list-style-type: none"> <li>designing an algorithm as a set of instructions to transform a shape, including getting back to where you started from; for example, programming a robot to move around the plane using instructions for movements, such as 2 down, 3 to the right, and combinations of these to transform shapes</li> <li>investigating symmetry, transformation and tessellation in different shapes on Country/Place, including rock formations, insects, and land and sea animals, discussing the purpose or role symmetry plays in their physical structure</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>interpret and compare data sets for ordinal and nominal categorical, discrete and continuous numerical variables using comparative displays or visualisations and digital tools; compare distributions in terms of mode, range and shape VC2M6ST01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>determining the range for a numerical data set by finding the difference between the highest and the lowest value in the set and comparing the range for different data sets</li> <li>representing acquired numerical data sets using side-by-side column graphs, comparing the spread of each data set using the range, the highest frequency for each data set using the mode, and discussing the shape</li> <li>representing ordinal data collected through surveys, using visualisation tools including dot plots and bar charts, and discussing the distribution of data in terms of shape</li> <li>using technology to access data sets and graphing software to construct side-by-side column graphs or stacked line graphs; and comparing data sets that are grouped by gender, year level, age group or other variables, and discussing findings</li> </ul>
<p><i>Students learn to:</i></p> <p>identify statistically informed arguments presented in traditional and digital media; discuss and</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating data representations in the media and discussing what they illustrate and the messages the people who created them might want to convey</li> </ul>

Content descriptions	Elaborations
<p>critique methods, data representations and conclusions VC2M6ST02</p>	<ul style="list-style-type: none"> <li>evaluating reports and secondary data relating to the distribution and use of non-renewable resources around the world</li> <li>identifying potentially misleading data representations in the media; for example, graphs with broken axes or non-linear scales, graphics not drawn to scale, data not related to the population about which the claims are made and pie charts in which the whole pie does not represent the entire population about which the claims are made</li> <li>investigating both traditional and digital media relating to Aboriginal and Torres Strait Islander Peoples, identifying and critiquing statistically informed arguments</li> </ul>
<p><i>Students learn to:</i>  plan and conduct statistical investigations by posing and refining questions to collect categorical or numerical data by observation or survey, or identifying a problem and collecting relevant data; analyse and interpret the data and communicate findings within the context of the investigation VC2M6ST03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>selecting and using appropriate peripherals; for example, using a scientific probe to collect data about changing soil moisture for plants, interpreting the data and sharing the results as a digital chart</li> <li>using a spreadsheet to record and analyse data, recognising the difference between cell formats in spreadsheets; for example, changing the default general format to numerical, text or date as needed</li> <li>investigating the daily water usage by a student in the home compared to the World Health Organization claim that between 50 and 100 litres of clean water is needed per person per day</li> <li>collecting sample sets of 'discrete numerical data' (for example, the number of cars or pets in a household), where the class is surveyed, then other classes are surveyed, and data is analysed and compared, discussing findings</li> <li>collecting ordinal categorical data through the use of a survey; for example, surveying each member of the class, by asking them to indicate their preference on a five-point scale for a particular graphic and colour combination of a proposed school logo</li> <li>collecting ordinal data for ranking nominees for school captain with respect to several criteria, contrasting the use of a five-point scale compared with using a four-point scale</li> </ul>

## Strand: Probability

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>describe probabilities using fractions, decimals and percentages; recognise that probabilities lie on numerical scales of 0–1 or 0%–100%; use estimation to assign probabilities that events occur in a given context, using common fractions, percentages and decimals</p> <p>VC2M6P01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising that the probability of an event occurring can be represented numerically as either a number ranging from zero to one or a percentage from 0% to 100% where zero or 0% means it will not happen and one or 100% means it is certain to happen</li> <li>using a scale of zero to one or 0% to 100% to estimate chances of events</li> <li>listing the different possible outcomes for rolling a dice and using a scale to locate the relative probability by considering the chance of more than or less than for each possible event, for example, the probability of getting a number greater than 4</li> <li>recognising the language used to describe situations involving uncertainty, such as what it means to be 'lucky', a '75% chance' of rain or a '1-in-100 years' flood</li> <li>exploring Aboriginal and/or Torres Strait Islander children's instructive games, such as Weme from the Warlpiri Peoples of Central Australia, to investigate and assign probabilities that events will occur, indicating their estimated likelihood</li> </ul>
<p><i>Students learn to:</i></p> <p>conduct repeated chance experiments and run simulations with an increasing number of trials using digital tools; compare observations with expected results and discuss the effect on variation of increasing the number of trials</p> <p>VC2M6P02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using digital tools to simulate multiple tosses of a coin or dice and comparing the relative frequency of an outcome as the number of trials increases; and identifying the variation between trials and realising that the results tend to the prediction with larger numbers of trials</li> <li>using online simulations of repeated random events to recognise emerging patterns, discussing and comparing expected results to the actual results</li> <li>investigating the relative frequencies of all outcomes for a chance experiment and verifying that their sum equals one</li> <li>systematically recording the outcome of large numbers of spins on a spinner and analysing the relative frequencies of outcomes, representing these as percentages</li> </ul>

## Level 7

### Level description

In Level 7, learning in Mathematics builds on each student's prior learning and experiences. Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- extend their understanding of the integer and rational number systems; strengthen their fluency with mental calculation, written algorithms and digital tools; and routinely consider the reasonableness of results in context
- use exponents and exponent notation to consolidate and formalise their understanding of representations of natural numbers, and use these to make conjectures involving natural numbers by experiment, with the assistance of digital tools
- recognise, develop and use algebraic expressions and formulas using conventions, notations, symbols and pronumerals; and interpret algebraic expressions and formulas, use substitution to evaluate and determine unknown terms where other values are given, and solve simple equations using a variety of methods
- use mathematical modelling to solve practical problems involving rational numbers, ratios and percentages, formulating and making choices about representations, calculation strategies and communicating solutions within the context
- use variables, constants, relations and functions to express relationships in real-life data and interpret key features of their representation in rules, tables and graphs
- extend their knowledge of angles to establish further relationships and apply these when solving measurement and spatial problems
- create and use algorithms to classify shapes in the plane and use tools to construct shapes, including two-dimensional representations of prisms

and other objects

- use coordinates in the Cartesian plane to describe transformations
- apply the statistical investigation process to obtain numerical data relating to questions of interest, choose displays for the distributions of data and interpret summary statistics for determining the centre and spread of the data in context
- conduct probability simulations and experiments involving chance events, and construct corresponding sample spaces and observe related frequencies, comparing expected, simulated and experimental results.

## Achievement standard

By the end of Level 7, students represent natural numbers in expanded form and as products of prime factors, using exponent notation. They solve problems involving squares of numbers and square roots of perfect square numbers. Students solve problems involving addition and subtraction of integers. They use all 4 operations in calculations involving positive fractions and decimals, choosing efficient mental and written calculation strategies. Students choose between equivalent representations of rational numbers and percentages to assist in calculations and make simple estimates to judge the reasonableness of results. They use mathematical modelling to solve practical problems involving rational numbers, percentages and ratios in spatial, financial and other applied contexts, justifying choices of representation.

Students use algebraic expressions to represent situations, describe the relationships between variables from authentic data and substitute values into formulas to determine unknown values. They solve linear equations with natural number solutions and verify their solutions through substitution. Students create tables of values relating to algebraic expressions and formulas, and describe how the values change.

Students apply knowledge of angle relationships and the sum of angles in a triangle to solve problems, giving reasons. They establish and use formulas for the areas of triangles and parallelograms and the volumes of rectangular and triangular prisms to solve problems. They describe the relationships between the radius, diameter and circumference of a circle.

Students classify polygons according to their features and design an algorithm to sort and classify shapes. They represent objects two-dimensionally in different ways, describing the usefulness of these representations. They use coordinates to describe transformations of points in the plane.

Students plan and conduct statistical investigations involving discrete and continuous numerical data, using appropriate displays. They interpret data in terms of the shape of distribution and summary statistics, identifying possible outliers. They decide which measure of central tendency is most suitable and explain their reasoning.

Students list sample spaces for single-step experiments, assign probabilities to outcomes of events and predict relative frequencies for related events. They conduct repeated single-step chance experiments and run simulations using digital tools, giving reasons for differences between predicted and observed results.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i> describe the relationship between perfect square numbers and square roots, and use squares of numbers and square roots of perfect square numbers to solve problems VC2M7N01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating squares of natural numbers from one to 20, and connecting them to visual representations such as dots arranged in a square pattern</li> <li>using the square and square root notation, and the distributive property and area diagrams, to calculate the squares of two-digit numbers; for example,  <math display="block">43^2 = (40 + 3)^2 = 40^2 + 2 \times 40 \times 3 + 3^2 = 1600 + 240 + 9 = 1849</math> </li> <li>determining between which 2 consecutive natural numbers the square root of a given number lies; for example, 43 is between the square numbers 36 and 49 so <math>\sqrt{43}</math> is between <math>\sqrt{36}</math> and <math>\sqrt{49}</math> and therefore between 6 and 7</li> <li>generating a list of perfect square numbers and describing any emerging patterns, for example, the last digit of perfect square numbers, or the difference between consecutive square numbers, and recognising the constant second difference</li> <li>using the relationship between perfect square numbers and their square roots to determine the perimeter of a square tiled floor using square tiles; for example, an area of floor with 144 square tiles has a perimeter</li> </ul>

Content descriptions	Elaborations
	of 48 tile lengths
<p><i>Students learn to:</i></p> <p>represent natural numbers in expanded notation using powers of 10, and as products of powers of prime numbers using exponent notation</p> <p>VC2M7N02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>relating the sequences 10, 100, 1000, 10 000 ... and <math>10^1, 10^2, 10^3, 10^4 \dots</math></li> <li>applying and explaining the connections between place value and expanded notations, for example, <math>7000 = 7 \times 10^3</math> and <math>3750 = 3 \times 10^3 + 7 \times 10^2 + 5 \times 10^1</math></li> <li>applying knowledge of factors to strategies for expressing natural numbers as products of powers of prime factors, such as repeated division by prime factors or creating factor trees, for example, <math>48 = 6 \times 8 = 2 \times 3 \times 2 \times 2 \times 2 = 3^1 \times 2^4 = 3 \times 2^4</math></li> <li>developing familiarity with the sequence 1, 2, 4, 8, 16, 32, 64, 128, 256, 512 and powers of 2; the sequence 1, 3, 9, 27, 81, 243, 729 and powers of 3; and the sequence 1, 5, 25, 125, 625 and powers of 5</li> <li>solving problems involving lowest common multiples and greatest common divisors (highest common factors) for pairs of natural numbers by comparing their prime factorisation</li> </ul>
<p><i>Students learn to:</i></p> <p>find equivalent representations of rational numbers and represent positive and negative rational numbers and mixed numbers on a number line</p> <p>VC2M7N03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating equivalence of fractions using common multiples and a fraction wall, diagrams or a number line to show that a fraction such as <math>\frac{2}{3}</math> is equivalent to <math>\frac{4}{6}</math> and <math>\frac{6}{9}</math> and therefore <math>\frac{2}{3} &lt; \frac{5}{6}</math></li> <li>expressing a fraction in simplest form using common divisors</li> <li>applying and explaining the equivalence between fraction, decimal and percentage representations of rational numbers, for example, 16%, 0.16, <math>\frac{16}{100}</math> and <math>\frac{4}{25}</math>, using manipulatives, number lines or diagrams</li> <li>representing positive and negative fractions and mixed numerals on various intervals of the real number line, including intervals that are not symmetrical about zero</li> </ul>
<p><i>Students learn to:</i></p> <p>round decimals to a given accuracy appropriate to the context and use appropriate rounding and estimation to check</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying the interval between a pair of consecutive integers that includes a given rational number</li> <li>choosing and applying conventions for rounding correct to a specified number of decimal places based upon the context</li> </ul>

Content descriptions	Elaborations
the reasonableness of computations VC2M7N04	<ul style="list-style-type: none"> <li>• checking that the accuracy of rounding is suitable for context and purpose; for example, for the amount of paint required or the cost estimate for renovating a house, purchasing 2 litres of paint to paint the bedroom even though 1.89 litres is the exact answer or estimating a renovation budget to the nearest \$100</li> </ul>
<i>Students learn to:</i> multiply and divide fractions and decimals using efficient mental and written strategies, and digital tools VC2M7N05	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• investigating multiplication of fractions and decimals, using strategies including patterning and multiplication as repeated addition, with both concrete materials and digital tools, and identifying the processes for division as the inverse of multiplication</li> </ul>
<i>Students learn to:</i> use the 4 operations with positive rational numbers, including fractions and decimals, to solve problems using efficient mental and written calculation strategies VC2M7N06	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• solving addition and subtraction problems involving fractions and decimals; for example, using rectangular arrays with dimensions equal to the denominators, algebra tiles, digital tools or informal jottings</li> <li>• choosing an appropriate numerical representation for a problem so that efficient computations can be made, such as 12.5%, <math>\frac{1}{8}</math>, 0.125 or <math>\frac{125}{1000}</math></li> <li>• developing efficient strategies with appropriate use of the commutative and associative properties, place value, patterning, and multiplication facts to solve multiplication and division problems involving fractions and decimals; for example, using the commutative property to calculate <math>\frac{2}{3}</math> of <math>\frac{1}{2}</math>, giving <math>\frac{1}{2}</math> of <math>\frac{2}{3} = \frac{1}{3}</math></li> <li>• solving multiplicative problems involving fractions and decimals using fraction walls, rectangular arrays, algebra tiles, calculators or informal jottings</li> <li>• developing efficient strategies with appropriate use of the commutative and associative properties, regrouping or partitioning to solve additive problems involving fractions and decimals</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>carrying out calculations to solve problems using the representation that makes computations efficient, such as 12.5% of 96 is more efficiently calculated as <math>\frac{1}{8}</math> of 96, including contexts such as comparing land use by calculating the total local municipal area set aside for parkland or manufacturing and retail, the amount of protein in daily food intake across several days, or increases or decreases in energy accounts each account cycle</li> </ul>
<p><i>Students learn to:</i></p> <p>find percentages of quantities and express one quantity as a percentage of another, with and without digital tools</p> <p>VC2M7N07</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using authentic problems to express quantities as percentages of other amounts</li> </ul>
<p><i>Students learn to:</i></p> <p>compare, order and solve problems involving addition and subtraction of integers</p> <p>VC2M7N08</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using less-than and greater-than notation in expressions when comparing and ordering integers; for example, negative 5 is less than positive 2 and can be represented as <math>(-5) &lt; (+2)</math>; <math>(-3) &gt; (-6)</math></li> <li>discussing language such as 'addition', 'subtraction', 'magnitude', 'difference' and 'sign' and synonyms of these terms</li> <li>ordering, adding and subtracting integers using a number line</li> </ul>
<p><i>Students learn to:</i></p> <p>recognise, represent and solve problems involving ratios</p> <p>VC2M7N09</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using diagrams, physical or virtual materials to represent ratios, recognising that ratios express the quantitative relationship between 2 or more groups; for example, using counters or coloured beads to show the ratios 1:4 and 1:1:2</li> <li>using fractions to solve ratio problems involving comparison of quantities and considering part-part and part-whole relations; for example, dividing a set into the ratio 1:2 by determining the number of parts as 3</li> <li>sharing quantities in a given ratio; for example, sharing an amount of money in a given ratio, such as sharing \$20 in the ratio 2:3</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>applying ratios to realistic and meaningful contexts – for example, mixing 500 millilitres of a liquid with a concentration of 1:4 means <math>\frac{1}{5}</math> concentrate and <math>\frac{4}{5}</math> water so, 0.2 of 500 millilitres is concentrate and 0.8 of 500 millilitres is water – and interpreting results in context</li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems involving rational numbers and percentages, including financial contexts such as ‘best buys’; formulate problems, choosing representations and efficient calculation strategies, designing algorithms and using digital tools as appropriate; interpret and communicate solutions in terms of the situation, justifying choices made about the representation</p> <p>VC2M7N10</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling additive situations involving positive and negative quantities; for example, a lift travelling up and down floors in a high-rise apartment where the ground floor is interpreted as zero, or in geography when determining altitude above and below sea level</li> <li>modelling contexts involving proportion, such as the proportion of students attending the school disco, proportion of the bottle cost to the recycling refund, proportion of the school site that is green space, 55% of Year 7 students attended the end of term function or 23% of the school population voted ‘yes’ to a change of school uniform; and interpreting and communicating answers in terms of the context of the situation</li> <li>modelling financial problems involving profit and loss, credits and debits, gains and losses; for example, holding a fundraising sausage sizzle and determining whether the event made a percentage profit or loss</li> <li>finding the sum of a set of consecutive numbers using a loop structure</li> <li>constructing geometric patterns such as a honeycomb, using dynamic geometry functionality</li> <li>using mathematical modelling to investigate the proportion of land mass/area of Aboriginal Peoples’ traditional grain belt compared with Australia’s current grain belt</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>recognise and use variables to represent everyday formulas algebraically and substitute values into formulas to determine an</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>linking variables to attributes and measures being modelled when using formulas, such as the area of a rectangle is equal to the length <math>\times</math> width as <math>A = l \times w</math> or using <math>p = 6g + b</math> to describe a total of points expressed as goals (worth 6 points) and behinds (worth one point)</li> <li>interpreting and using formulas obtained from other sources, for example, maximum heart rates and target</li> </ul>

Content descriptions	Elaborations
unknown VC2M7A01	<p>heart rates for moderate exercise</p> <ul style="list-style-type: none"> <li>substituting numerical values for variables when using formulas and calculating the value of an unknown in practical situations; for example, calculating weekly wage <math>W</math> given base wage <math>b</math> and overtime hours <math>h</math> at 1.5 times rate <math>r</math>, <math>W = b + 1.5 \times h \times r</math>, using values for mass <math>m</math> and volume <math>v</math> to determine density <math>d</math> of a substance where <math>d = \frac{m}{v}</math></li> <li>using everyday formulas and their application to contexts on Country/Place, investigating the relationships between variables</li> </ul>
<i>Students learn to:</i> apply the associative, commutative and distributive laws to aid mental and written computation, and formulate algebraic expressions using constants, variables, operations and brackets VC2M7A02	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>simplifying calculations</li> <li>forming simple estimates for calculations involving multiple and/or combined operations</li> <li>generalising arithmetic expressions to algebraic expressions involving constants, variables, operations and brackets; for example, <math>7 + 7 + 7 = 3 \times 7</math>, <math>x + x + x = 3 \times x</math> noting that <math>3x</math> includes implied multiplication and recognising the difference between <math>3x + 4</math> and <math>3(x + 4)</math></li> <li>formulating algebraic expressions that represent mathematical relationships; for example, translating from words to symbols in ‘think of a number’ type activities</li> <li>recognising and applying the concept of variable as something that can change in value, investigating the relationships between variables, and the application to processes on Country/Place, including how cultural expressions of Aboriginal and Torres Strait Islander Peoples, such as storytelling, communicate mathematical relationships that can be represented as mathematical expressions</li> </ul>
<i>Students learn to:</i> solve one-variable linear equations of increasing complexity with natural number solutions; verify equation solutions by substitution VC2M7A03	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>recognising that solving an equation is a process of determining a value that makes the equation true; and using substitution to determine whether a given number is a solution to an equation or not</li> <li>solving equations using concrete materials, the balance model and backtracking, explaining the process</li> <li>solving linear equations such as <math>3x + 7 = 19</math> algebraically, and verifying the solution by substitution</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i> investigate, interpret and describe relationships between variables represented in graphs of functions developed from authentic data VC2M7A04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using graphs to analyse a building's electricity or gas usage over a period of time, the value of shares on a stock market, or the temperature during a day, interpreting and discussing the relationships they represent</li> <li>using travel graphs to compare the distance travelled to and from school, interpreting and discussing features of travel graphs such as the slope of lines and the meaning of horizontal line segments</li> <li>telling the story behind what is being represented in graphs of functions, for example, graphs representing pouring rates or distance versus time</li> <li>using graphs of evaporation rates to explore and discuss Aboriginal and Torres Strait Islander Peoples' methods of water resource management</li> </ul>
<p><i>Students learn to:</i> generate tables of values from visually changing patterns or the rule of a function; describe and plot these relationships on the Cartesian plane VC2M7A05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>plotting points from a table of values generated using simple linear functions and recognising patterns, such as the points lie on a straight line</li> <li>discussing and using variables to create a general rule and using the rule to determine the value of the dependent variable for any given value of the independent variable; for example, plotting the value of the circumference of a circle for varying values of radius</li> <li>using function machines to generate a table of ordered pairs using input and output values, plotting the relationships on a Cartesian plane and describing the graph in terms of shape</li> <li>using diagrams and manipulatives to form linear growth patterns, representing these patterns in tables and describing the relationship in terms of the way the pattern is growing and in the context of the situation</li> </ul>
<p><i>Students learn to:</i> manipulate formulas involving several variables using digital tools, and describe the effect of systematic variation in the values of the variables</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>experimenting with different sets of tables of values from formulas; for example, using volume of a rectangular prism = length × width × height, and specifying a fixed width and equal length and varying the height</li> <li>using spreadsheets and the formula function to recognise the effect of changing parameters on the entries</li> </ul>

Content descriptions	Elaborations
VC2M7A06	<p>in cells</p> <ul style="list-style-type: none"> <li>• analysing distance travelled for different combinations of average speed and time of travel using a table of values and the distance formula</li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem-solving</p> <p>VC2M7M01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• building on the understanding of the area of rectangles to develop formulas for the area of triangles</li> <li>• establishing that the area of a triangle is half the area of an appropriate rectangle</li> <li>• using area formulas for rectangles and triangles to solve problems involving areas of surfaces</li> </ul>
<p><i>Students learn to:</i></p> <p>solve problems involving the volume of right prisms including rectangular and triangular prisms, using established formulas and appropriate units</p> <p>VC2M7M02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• building a rectangular prism out of unit cubes and showing that the measure of volume is the same as would be found by multiplying the 3 edge lengths or by multiplying the area of the base by the height/length</li> <li>• developing the connection between the area of the parallel cross-section (base), the height and the volume of a rectangular or triangular prism to other prisms</li> <li>• connecting the area of the floor space and the number of floors of a high-rise building to calculate the volume of a building</li> <li>• using dynamic geometry software, spatial reasoning and prediction to derive the formula for the volume of prisms</li> </ul>
<p><i>Students learn to:</i></p> <p>describe the relationship between <math>\pi</math> and the circumference, radius and diameter of a circle</p>	<p><i>This may involve students:</i></p>

Content descriptions	Elaborations
VC2M7M03	<ul style="list-style-type: none"> <li>• recognising the features of circles and their relationships to one another; for example, labelling the parts of a circle including centre, radius, diameter and circumference and using one of radius, diameter or circumference to determine the measure of the other 2; and understanding that the diameter of a circle is twice the radius, or that the radius is the circumference divided by <math>2\pi</math></li> <li>• comparing the circumference of circles in relation to their radius and diameter with materials and measuring, to establish measurement formulas; for example, using a compass to draw several circles, then using string to approximate the circumference, comparing the length of string to the diameter of the circle</li> <li>• investigating <math>\pi</math> as the constant in the proportional relationship between the circumference of a circle and its diameter, and historical approximations from different civilisations, including Egypt, Babylon, Greece, India and China</li> <li>• investigating the applications and significance of circles in everyday life of Aboriginal and Torres Strait Islander Peoples, such as in basketry, symbols and architecture, recognising the relationships between the centre, radius, diameter and circumference</li> </ul>
<p><i>Students learn to:</i></p> <p>identify corresponding, alternate and co-interior relationships between angles formed when parallel lines are crossed by a transversal; use them to solve problems and explain reasons</p> <p>VC2M7M04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>• constructing a pair of parallel lines and a pair of perpendicular lines using their properties, a pair of compasses and a ruler and set squares, or using dynamic geometry software</li> <li>• using dynamic geometry software to identify relationships between alternate, corresponding and co-interior angles for a pair of parallel lines cut by a transversal</li> <li>• using dynamic geometry software to demonstrate how angles and their properties are involved in the design and construction of scissor lifts, folding umbrellas, toolboxes and cherry pickers</li> <li>• using geometric reasoning of angle properties to generalise the angle relationships of parallel lines and transversals, and related properties, such as the size of an exterior angle of a triangle is equal to the sum of the sizes of opposite and non-adjacent interior angles, and the sum of the sizes of interior angles in a triangle in the plane is equal to the size of 2 right angles or <math>180^\circ</math></li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>demonstrate that the interior angle sum of a triangle in the plane is <math>180^\circ</math> and apply this to determine the interior angle sum of other shapes and the size of unknown angles</p> <p>VC2M7M05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using concrete materials to demonstrate that the sum of the interior angles of a triangle is <math>180^\circ</math>; for example, using paper triangles and tearing to demonstrate that the interior angles when combined form <math>180^\circ</math></li> <li>using decomposition and the angle sum of a triangle to generalise the interior angle sum of an <math>n</math>-sided polygon, as <math>180(n - 2) = 180n - 360</math></li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems involving ratios of lengths, areas and volumes; formulate problems, interpret and communicate solutions in terms of the situation, justifying choices made about the representation</p> <p>VC2M7M06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using fractions to model and solve ratio problems involving comparison of quantities, and considering part-part and part-whole relations</li> <li>modelling and solving practical problems involving ratios of length, capacity or mass, such as in construction, design, or food or textile production; for example, mixing concrete, the golden ratio in design, mixing a salad dressing</li> <li>modelling the situation using manipulatives, diagrams and/or mathematical discussion; for example, mixing primary colours in a variety of ratios to investigate how new colours are created and the strength of those colours</li> <li>investigating commercialised substances founded on Aboriginal and/or Torres Strait Islander Peoples' knowledges of substances, including pharmaceuticals and toxins, understanding how ratios are used in their development</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>represent three-dimensional objects in 2 dimensions; discuss</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>deconstructing packaging to identify shapes and nets</li> <li>using different nets to construct prisms and determining which nets will make a cube, rectangular prism,</li> </ul>

Content descriptions	Elaborations
<p>and reason about the advantages and disadvantages of different representations VC2M7SP01</p>	<p>triangular prism or pyramid</p> <ul style="list-style-type: none"> <li>using aerial views of buildings and other three-dimensional structures to visualise the footprint made by the building or structure, identifying prisms that could approximate the structure</li> <li>building objects by interpreting isometric and perspective drawings</li> <li>using isometric and square grid paper to draw views of front, back, side, top and bottom of objects</li> <li>exploring different two-dimensional representations of objects in Aboriginal and/or Torres Strait Islander artworks or cultural maps of Country/Place</li> </ul>
<p><i>Students learn to:</i> classify triangles, quadrilaterals and other polygons according to their side and angle properties; identify and reason about relationships VC2M7SP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using strips of paper with parallel sides to make triangles and quadrilaterals, and contrasting the rigidity of triangles with the flexibility of quadrilaterals</li> <li>constructing triangles with 3 given side lengths and discussing the question 'Can any 3 lengths be used to form the sides of a triangle?'</li> <li>identifying and communicating about side and angle properties of scalene, isosceles, equilateral, right-angled, acute and obtuse triangles using geometric conventions</li> <li>describing, comparing and contrasting squares, rectangles, rhombuses, parallelograms, kites and trapeziums, explaining the relationships between these shapes</li> </ul>
<p><i>Students learn to:</i> describe the effect of transformations of a set of points using coordinates in the Cartesian plane, including translations, reflections in an axis, and rotations about the origin VC2M7SP03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using digital tools to transform shapes in the Cartesian plane, describing and recording the transformations</li> <li>describing patterns and investigating different ways to produce the same transformation, such as using 2 successive reflections to provide the same result as a translation</li> <li>experimenting with, creating and re-creating patterns using combinations of translations, reflections and rotations, using digital tools</li> </ul>
<i>Students learn to:</i>	<i>This may involve students:</i>

Content descriptions	Elaborations
<p>design algorithms involving a sequence of steps and decisions that will sort and classify sets of shapes according to their attributes, and describe how the algorithms work VC2M7SP04</p>	<ul style="list-style-type: none"> <li>creating a classification scheme for triangles based on sides and angles, using a flow chart that uses sequences and decisions</li> <li>creating a flow chart or hierarchy for quadrilaterals that shows the relationships between trapeziums, parallelograms, rhombuses, rectangles, squares and kites</li> <li>creating a classification scheme for regular, irregular, concave or convex polygons that are sorted according to the number of sides</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i> acquire data sets for discrete and continuous numerical variables and calculate the range, median, mean and mode; make and justify decisions about which measures of central tendency provide useful insights into the nature of the distribution of data VC2M7ST01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>understanding that summarising data by calculating measures of centre can help make sense of the data, commenting on skewness or symmetry of data and the use of mean and median as representative measures</li> <li>comparing the mean, median, mode and range of displays of data from a given context, and explaining how outliers may affect summary statistics</li> <li>recognising how different data sets can have the same measures of central tendency and experimenting with how varying data affects these measures</li> <li>acquiring continuous numerical data by taking measurement samples during a science experiment, observation or field study, comparing measures of central tendency and identifying any anomalies in the distribution of data</li> </ul>
<p><i>Students learn to:</i> create different types of displays of numerical data, including dot plots and stem-and-leaf plots, using software where appropriate;</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using ordered stem-and-leaf plots to record and display numerical data collected in a class investigation, such as constructing a class plot of height in centimetres on a shared stem-and-leaf plot for which the stems 12, 13, 14, 15, 16 and 17 have been produced</li> </ul>

Content descriptions	Elaborations
<p>describe and compare the distribution of data, commenting on the shape, centre and spread including outliers and determining the range, median, mean and mode VC2M7ST02</p>	<ul style="list-style-type: none"> <li>comparing variation in attributes by category using split stem-and-leaf plots or dot plots; interpreting the shape of the distribution using qualitative terms to describe 'symmetry', 'skewness' and 'average' in terms of the mean, median and mode, and the amount of variation based on qualitative descriptions of the spread of the data</li> <li>connecting features of the data display (for example, highest frequency, clusters, gaps, symmetry or skewness) to the mode, range and median, and the question in context; describing the shape of distributions using terms such as 'positive skew', 'negative skew', 'symmetric' and 'bi-modal' and discussing the location of the median and mean on these distributions</li> <li>using mean and median to compare data sets, identifying possible outliers and explaining how these may affect the comparison; recognising how different displays make specific information about data more evident, including proportions, and measures of mean, mode or median, spread and extreme values; understanding that the median and the mean will be the same or similar for symmetric distributions but different for distributions that are skewed</li> <li>comparing the mean and median of data with and without extremes; for example, estimation of standard measures for length or mass, informally considering for a given set of data what might constitute an unexpected, unusual or extreme data value</li> </ul>
<p><i>Students learn to:</i> plan and conduct statistical investigations for issues involving discrete and continuous numerical data, and data collected from primary and secondary sources; analyse and interpret distributions of data and report findings in terms of shape and summary statistics</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>obtaining secondary data from newspapers, the internet or the Australian Bureau of Statistics</li> <li>investigating secondary data relating to the distribution and use of non-renewable resources around the world</li> <li>conducting an investigation to draw conclusions about whether teenagers have faster reaction times than adults</li> <li>conducting an investigation to support claims that a modification of a science, technology, engineering and mathematics (STEM) related design has improved performance</li> </ul>

Content descriptions	Elaborations
VC2M7ST03	<ul style="list-style-type: none"> <li>using secondary data from the Australian Reconciliation Barometer to conduct and report on statistical investigations relating to Aboriginal and Torres Strait Islander Peoples</li> </ul>

## Strand: Probability

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>identify the sample space for single-stage experiments; assign probabilities to the possible outcomes and predict relative frequencies for related experiments</p> <p>VC2M7P01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>discussing the meaning of probability terminology, for example, 'probability', 'sample space', 'favourable outcome', 'trial', 'experiment' and 'event'</li> <li>listing sample spaces for games involving throwing a coin or a dice, spinners, or lucky dip</li> <li>assigning the probability for throwing a 6 on a dice and using this to predict the number of times a 6 will occur when a dice is thrown multiple times</li> </ul>
<p><i>Students learn to:</i></p> <p>conduct repeated chance experiments and run simulations with a large number of trials using digital tools; compare predicted with observed results, explaining the differences and the effect of sample size on the outcomes</p> <p>VC2M7P02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>developing an understanding of the law of large numbers through using experiments and simulations to conduct large numbers of trials for seemingly random events and discussing findings</li> <li>conducting simulations using online simulation tools and comparing the combined results of a large number of trials to predicted results</li> <li>exploring and observing Aboriginal and/or Torres Strait Islander children's instructive games – for example, Koara from the Jawi and Bardi Peoples of Sunday Island in Western Australia – to investigate probability, predicting outcomes for an event and comparing with increasingly larger numbers of trials, and comparing observed and expected results</li> </ul>

## Level 8

### Level description

In Level 8, learning in Mathematics builds on each student's prior learning and experiences. Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- extend computation with combinations of the 4 operations with integers and positive rational numbers; recognise the relationship between fractions and their terminating or recurring decimal representations; convert between fraction and decimal forms of rational numbers and locate them on the real number line
- extend the exponent laws to numerical calculations involving positive and zero exponents, and solve a broad range of practical problems, using mental methods, written algorithms and digital tools
- use mathematical modelling to solve problems in a broad range of contexts that involve ratios with 2 or more terms, percentage increase and decrease, proportions with decimal values, and rates in measurement contexts, and apply proportional reasoning
- manipulate linear and other algebraic expressions, recognise and model situations using linear relations and solve related equations using tables, graphs and algebra
- interpret and explain demonstrations and proofs of Pythagoras' theorem and investigate irrational numbers, their infinite non-recurring decimal representation and their approximate location on the real number line
- select metric measurement units fit for purpose and convert between units, recognising the effects of different levels of measurement accuracy on the results of computations, and relate these to interval estimates for measurements in various contexts

- apply knowledge of the relationships between  $\pi$  and the features of circles to solve problems involving circumference and area, establish sets of congruency and similarity conditions for common shapes in the plane and create algorithms to test for these conditions, and discuss examples and counterexamples
- construct and locate objects with reference to three-dimensional coordinates using digital tools
- consider a variety of situations involving complementary and mutually exclusive events, and combinations of 2 events; and represent these using tables and diagrams, conducting simulations and calculating corresponding probabilities
- examine experimental and observational data and identify populations and samples with respect to context; investigate variation in summary statistics across samples of varying size; and discuss their findings.

## Achievement standard

By the end of Level 8, students recognise irrational numbers as numbers that cannot develop from the division of integer values by natural numbers and terminating or recurring decimals. They apply the exponent laws to calculations with numbers involving positive integer exponents. Students solve problems involving the 4 operations with integers and positive rational numbers. They use mathematical modelling to solve practical problems involving ratios, percentages and rates in measurement and financial contexts.

Students apply algebraic properties to simplify, rearrange, expand and factorise linear expressions. They graph linear relations and solve linear equations with rational solutions and one-variable inequalities, graphically and algebraically. Students plot linear and non-linear relations on the Cartesian plane, with and without the use of digital tools. Students use mathematical modelling to solve problems using linear relations, interpreting and reviewing the model in context. They make and test conjectures involving linear relations by developing algorithms and using digital tools.

Students use appropriate metric units when solving measurement problems involving the perimeter and area of composite shapes, and volume of right prisms. They use Pythagoras' theorem to solve measurement problems involving unknown lengths of right-angled triangles. Students use formulas to solve problems involving the area and circumference of circles. They solve problems of duration involving 12- and 24-hour cycles across multiple time zones.

Students use 3 dimensions to locate and describe position. They identify conditions for congruency and similarity in triangles and other common shapes, and design and test algorithms to test for congruency and similarity. Students apply the properties of quadrilaterals to solve problems.

Students conduct statistical investigations and explain the implications of obtaining data through sampling. Students analyse and describe the distribution of data. They compare the variation in distributions of random samples of the same and different size from a given population with respect to shape, measures of central tendency and range.

Students represent the possible combinations of 2 events with tables and diagrams, and determine related probabilities to solve practical problems. They conduct experiments or simulations using digital tools to determine related probabilities of compound events.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i>        recognise irrational numbers in applied contexts, including <math>\pi</math> and numbers that develop from the square root of positive real numbers that are not perfect squares, and recognise that irrational numbers cannot develop from the division of integer values by natural numbers</p> <p>VC2M8N01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising that the real number system includes irrational numbers that can be approximately located on the real number line; for example, the value of <math>\pi</math> lies somewhere between 3.141 and 3.142, that is, <math>3.141 &lt; \pi &lt; 3.142</math></li> <li>using digital tools to systematically explore contexts or situations that use irrational numbers, such as finding the length of the hypotenuse in a right-angled triangle with the other 2 sides having lengths of one metre or 2 metres and one metre; or given the area of a square, finding the length of the side where the result is irrational; or finding ratios involved with the side lengths of the paper sizes A0, A1, A2, A3 and A4</li> <li>investigating the golden ratio in art and design, and historical approximations to <math>\pi</math> in different societies</li> <li>connecting the ratio between the circumference and diameter of any circle to the irrational value of <math>\pi</math> using circular objects and string or dynamic geometry software</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i> establish and apply the exponent laws with positive integer exponents and the zero exponent, using exponent notation with numbers VC2M8N02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising the connection between exponent form and expanded form with the exponent laws of product of powers rule, quotient of powers rule, and power of a power rule, for example, <math>2^3 \times 2^2</math> can be represented as <math>(2 \times 2 \times 2) \times (2 \times 2) = 2^5</math>, and connecting the result to the addition of exponents</li> <li>applying the exponent laws of the product of powers rule, quotient of powers rule, power of a power rule and zero exponent individually and in combination; for example, using exponents to determine the effect on the volume of a 2 centimetre cube when the cube is enlarged to a 6 centimetre cube, <math>\frac{6^3}{2^3} = \frac{2^3 \times 3^3}{2^3} = 3^3</math>, so the volume is increased by a factor of 27</li> <li>using digital tools to systematically explore the application of the exponent laws; observing that the bases need to be the same</li> <li>using examples such as <math>\frac{3^4}{3^4} = 1</math>, and <math>3^{4-4} = 3^0</math> to illustrate the necessity that for any non-zero natural number <math>n</math>, <math>n^0 = 1</math></li> </ul>
<p><i>Students learn to:</i> convert between fractions and terminating or recurring decimals, using digital tools as appropriate VC2M8N03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying when a fraction has a terminating decimal expansion from the prime factorisation of its denominator; for example, <math>\frac{7}{24} = 0.291\bar{6}</math> does not have a terminating decimal expansion, while <math>\frac{7}{25} = 0.28</math> does</li> <li>identifying terminating, recurring and non-terminating decimals and choosing their appropriate representations such as <math>\frac{1}{3}</math> is represented as <math>0.\bar{3}</math></li> </ul>
<p><i>Students learn to:</i> use the 4 operations with integers and with rational numbers, choosing and using efficient mental and written strategies, and digital tools where appropriate, and making estimates for these computations VC2M8N04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using patterns to assist in establishing the rules for the multiplication and division of integers</li> <li>applying and explaining efficient strategies such as using the commutative or associative property for regrouping, partitioning, place value, patterning, multiplication or division facts to solve problems involving positive and negative integers, fractions and decimals</li> <li>recognising the effect of sign in the multiplication of integers, for example, <math>(-1)^4 = 1</math> and <math>(-1)^5 = -1</math></li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>solve problems involving the use of percentages, including percentage increases and decreases and percentage error, with and without digital tools</p> <p>VC2M8N05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using percentages to solve problems, including those involving mark-ups, discounts and Goods and Services Tax (GST)</li> <li>using percentages to calculate population increases and decreases</li> <li>using percentage error to compare the relative size of error in calculations involving a given or actual value, and an estimated or measured value</li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems involving rational numbers and percentages, including financial contexts involving profit and loss; formulate problems, choosing efficient mental and written calculation strategies and using digital tools where appropriate; interpret and communicate solutions in terms of the context, reviewing the appropriateness of the model</p> <p>VC2M8N06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling situations involving weather and environmental contexts, including temperature or sea depths, by applying operations to positive and negative rational numbers, for example, contexts involving average temperature increases and decreases</li> <li>modelling situations that involve percentage increases or decreases and explaining why it is an increase or decrease, such as mark-ups, discounts, Goods and Services Tax (GST), changes in populations or recycling rates</li> <li>modelling situations involving personal income tax, and interpreting tax tables to determine income tax at various levels of income, including overall percentage of income allocated to tax</li> <li>modelling situations involving percentage increase or decrease such as market trends, effects on population, or effects on the environment over extended time periods</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>create, expand, factorise, rearrange and simplify linear expressions, applying the associative, commutative, identity,</p>	<p><i>This may involve students:</i></p>

Content descriptions	Elaborations
distributive and inverse properties VC2M8A01	<ul style="list-style-type: none"> <li>rearranging and simplifying linear expressions involving variables with integer coefficients and constants; and using manipulatives such as algebra tiles to support calculations, for example, using manipulatives to demonstrate that <math>2x + 4 = 2(x + 2)</math>, <math>3(a - b) = 3a - 3b</math>, or <math>5(m + 2n) + 3m - 4n = 5m + 10n + 3m - 4n = 8m + 6n</math></li> <li>demonstrating the relationship between factorising and expanding linear expressions using manipulatives, such as algebra tiles or area models, and describing with mathematical language</li> <li>using the distributive, associative, commutative, identity and inverse properties to expand and factorise algebraic expressions using strategies such as the area model</li> </ul>
<i>Students learn to:</i> graph linear relations on the Cartesian plane using digital tools where appropriate; solve linear equations and one-variable inequalities using graphical and algebraic techniques; verify solutions by substitution VC2M8A02	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>recognising that in a table of values, if the first difference between consecutive values of the dependent variable is constant, then it is a linear relation</li> <li>graphing linear functions and relations of the form <math>x = a</math>, <math>y = a</math>, <math>x \leq a</math>, <math>x &gt; a</math>, <math>y \leq a</math>, <math>y &gt; a</math> on the Cartesian plane for known values of <math>a</math></li> <li>completing a table of values, plotting the resulting points on the Cartesian plane and determining whether the relationship is linear</li> <li>graphing the linear relationship <math>ax + b = c</math> for given values of <math>a</math>, <math>b</math> and <math>c</math> and identifying from the graph where <math>ax + b &lt; c</math> or where <math>ax + b &gt; c</math></li> <li>solving linear equations of the form <math>ax + b = c</math> and one-variable inequalities of the form <math>ax + b &lt; c</math> or <math>ax + b &gt; c</math> where <math>a &gt; 0</math> using inverse operations and digital tools, and checking solutions by substitution</li> <li>solving linear equations such as <math>3x + 7 = 6x - 9</math>, representing these graphically, and verifying solutions by substitution</li> </ul>
<i>Students learn to:</i> use mathematical modelling to solve applied problems involving	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>modelling situations involving linear functions, including practical contexts such as taxi fares involving flag fall fees, motion in a straight line at a constant speed, trade quotes involving call-out fees, cooking that</li> </ul>

Content descriptions	Elaborations
<p>linear relations, including financial contexts involving profit and loss; formulate problems with linear functions, and choose a representation; interpret and communicate solutions in terms of the context, and review the appropriateness of the model VC2M8A03</p>	<p>includes resting or cooling times, or water leakage from water tanks, interpreting the constant rate of change and initial value in context, and identifying when values of a model lie within a given range</p> <ul style="list-style-type: none"> <li>modelling problems in practical situations and interpreting solutions within the context of the problem, including giving attention to all units of measure and whether results are suitable; for example, once a water tank is empty no more water can flow from it</li> <li>modelling financial problems involving pay rates, using a table of values to represent the pay amounts and hours worked using an hourly rate of pay, and graphing the relationship to make inferences</li> <li>modelling patterns on Country/Place and exploring their connections and meaning to linear equations, using the model as a predictive tool and critiquing results by connecting back to Country/Place</li> </ul>
<p><i>Students learn to:</i> use algorithms and related testing procedures to identify and correct errors VC2M8A04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>debugging search-and-sort programs</li> <li>testing a number for divisibility</li> </ul>
<p><i>Students learn to:</i> experiment with linear functions and relations using digital tools, making and testing conjectures and generalising emerging patterns VC2M8A05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using graphing software to investigate the effect of systematically varying parameters of linear functions on the corresponding graphs, making and testing conjectures; for example, making a conjecture that if the coefficient of <math>x</math> is negative, then the line will slope down from left to right</li> <li>using graphing software to systematically contrast the graphs of <math>y = 2x</math>, <math>-y = 2x</math>, <math>y = -2x</math> and <math>-y = -2x</math> with those of <math>y &lt; 2x</math>, <math>-y &lt; 2x</math>, <math>y &lt; -2x</math> and <math>-y &lt; -2x</math> and those of <math>y &gt; 2x</math>, <math>-y &gt; 2x</math>, <math>y &gt; -2x</math> and <math>-y &gt; -2x</math>, making and testing conjectures about sign and direction of the inequality</li> <li>using digital tools to investigate integer solutions to equations such as <math>2x + 3y = 48</math></li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
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Content descriptions	Elaborations
<p><i>Students learn to:</i> solve problems involving the area and perimeter of irregular and composite shapes using appropriate units VC2M8M01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>determining the area of composite shapes by composing or decomposing shapes</li> <li>using arrays and rectangles to approximate the area of irregular shapes in situations such as a council needing to work out how much mosquito spray to use for a swamp area or a farmer needing to work out how much seed, fertiliser and herbicide are required to cover a paddock</li> <li>determining the perimeter and area of irregular shapes by sums of increasingly accurate covering measurements, such as line segments and grids; for example, using millimetres or square millimetres as opposed to centimetres or square centimetres</li> </ul>
<p><i>Students learn to:</i> solve problems involving the volume and capacity of right prisms using appropriate units VC2M8M02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using models to demonstrate the number of cubic centimetres in a cubic metre and relating this to capacities of millilitres and litres, recognising that one millilitre is equivalent to one cm<sup>3</sup></li> <li>solving practical problems involving volume and capacity, for example, optimal packaging and production</li> <li>choosing which measurements are useful to consider when solving practical problems in context; for example, when purchasing a new washing machine, the dimensions are useful when determining whether it will fit in the available space in the laundry and its capacity is useful when considering the maximum washing load it can carry</li> <li>investigating, reasoning and finding solutions to measurement problems involving dimensions, rates, volume and capacity of objects; for example, given the dimensions of a pool and the rate of flow from a tap, determining how long it will take to fill the pool to its normal capacity</li> </ul>
<p><i>Students learn to:</i> solve problems involving the circumference and area of a circle using formulas and appropriate units VC2M8M03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>deducing that the area of a circle is between 2 radius squares and 4 radius squares, and using <math>3 \times \text{radius}^2</math> as a rough estimate for the area of a circle</li> <li>investigating the area of circles using a square grid or by rearranging a circle divided into smaller and smaller sectors or slices to resemble a close approximation of a rectangle</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>applying the formulas for the area and circumference of a circle to solve practical problems, and using one of the measures of radius, diameter, circumference or area to deduce the value of the other measures; for example, determining the length of material needed to edge a round table, given its dimensions as the area of the tabletop</li> <li>exploring traditional weaving designs by Aboriginal and Torres Strait Islander Peoples and investigating the significance and use of circles</li> </ul>
<p><i>Students learn to:</i></p> <p>solve problems involving time and duration, including using 12- and 24-hour time across multiple time zones</p> <p>VC2M8M04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using digital tools to investigate time zones around the world and convert from one zone to another, such as time in Perth, Western Australia, compared to Suva in Fiji or Toronto in Canada</li> <li>recognising the challenges of planning regular virtual meeting times for a company that has both international staff and staff within different states and territories, and the impact daylight savings has due to multiple time zones, explaining the mathematical language used to communicate current time such as Coordinated Universal Time (UTC)+8, Australian Eastern Standard Time (AEST), Australian Central Standard Time (ACST) and Australian Western Standard Time (AWST)</li> <li>planning an international travel itinerary that covers destinations in different time zones across Asia</li> </ul>
<p><i>Students learn to:</i></p> <p>recognise and use rates to solve problems involving the comparison of 2 related quantities of different units of measure</p> <p>VC2M8M05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying examples of rates in the real world, including constant rates, rate of pay, cost per kilogram, recipes, simple interest and average rates</li> <li>applying rates to solve problems involving the conversion between different units of measure; for example, using a conversion rate to convert distances from miles to kilometres, or using currency exchange rates to determine the price of items</li> <li>applying rates to calculate solutions to problems in different contexts, for example, required run rates in cricket, dilution of concentrated chemicals and comparing the petrol consumption rates of different vehicles</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>using taxation tables to calculate an individual's annual income tax</li> <li>investigating the application of rates in Aboriginal and Torres Strait Islander Peoples' land management practices, including the rate of fire spread under different environmental conditions such as fuel types, wind speed, temperature and relative humidity; the conservation of water by Aboriginal and Torres Strait Islander Peoples by estimating rates of water evaporation based on surface area and climatic conditions</li> </ul>
<p><i>Students learn to:</i></p> <p>use Pythagoras' theorem to solve problems involving the side lengths of right-angled triangles VC2M8M06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>discussing and comparing different applications, demonstrations and proofs of Pythagoras' theorem, from Egypt and Mesopotamia, Greece, India and China, with other historical and contemporary applications and proofs</li> <li>using Pythagoras' theorem to determine unknown lengths of sides in right-angled triangles and finding lengths of sides of right-angled triangles in practical applications</li> <li>recognising the relationship between the squares of lengths of sides for different types of triangles: right-angled, acute or obtuse</li> <li>identifying Pythagorean triples, such as (3, 4, 5), (5, 12, 13), (7, 24, 25) and (8, 15, 17)</li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems involving ratios and rates, including distance-time problems for travel at a constant speed and financial contexts; formulate problems; interpret and communicate solutions in terms of the situation, reviewing the appropriateness of the model VC2M8M07</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling simple motion problems, finding one of distance travelled, time taken or average speed, given the other 2 quantities</li> <li>modelling and solving problems related to situations such as scales on maps and plans, the mixing of chemicals or ingredients, or calculating magnification factors applying relevant ratios and proportions</li> <li>modelling problems involving converting money amounts using different exchange rates and applying them when planning and budgeting for overseas travel</li> <li>modelling situations involving financial contexts (for example, income tax, using taxation rates on annual income, comparing different taxation brackets and rates of pay) or comparing the benefits of different phone plans using different call rates and associated fees to determine the best plan</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>modelling situations involving the use of ratios in radiocarbon dating methods, including the ratio of carbon-14 to carbon-12 isotopes in organisms, to measure dates of Aboriginal and Torres Strait Islander Peoples' habitation on the Australian continent</li> <li>modelling situations involving ratio and its application in the making of string and cordage by Aboriginal and/or Torres Strait Islander Peoples, including the ratio of length to the mass of a rope, the strength of the ply in proportion to a rope's pulling force, and the proportion of fibre for the length of string required</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>identify the conditions for congruence and similarity of triangles and explain the conditions for other sets of common shapes to be congruent or similar, including those formed by transformations</p> <p>VC2M8SP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>developing an understanding of what it means for shapes to be congruent or similar</li> <li>using the enlargement transformation and digital tools to develop sets of similar shapes</li> <li>investigating sufficient conditions to establish that 2 triangles are congruent</li> <li>applying logical reasoning and tests for congruence and similarity, to problems and proofs involving plane shapes</li> <li>comparing angle and side measurements of shapes under transformation to answer questions such as 'What changes?' and 'What stays the same?'</li> <li>establishing that 2 shapes are congruent if one lies exactly on top of the other after one or more transformations, including translations, reflections and rotations, and recognising that the matching sides and the matching angles are equal</li> </ul>
<p><i>Students learn to:</i></p> <p>establish properties of quadrilaterals using congruent triangles and angle properties, and solve related problems explaining</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>establishing the properties of squares, rectangles, parallelograms, rhombuses, trapeziums and kites using geometric properties and proof, such as the sum of the exterior angles of a polygon is equal to a complete turn or <math>360^\circ</math></li> </ul>

Content descriptions	Elaborations
reasoning VC2M8SP02	<ul style="list-style-type: none"> <li>identifying properties of quadrilaterals related to side lengths, parallel sides, angles, diagonals and symmetry</li> <li>applying the properties of triangles and quadrilaterals to construction designs such as car jacks, scissor lifts, folding umbrellas, toolboxes and cherry pickers</li> </ul>
<p><i>Students learn to:</i></p> <p>describe in different ways the position and location of three-dimensional objects in 3 dimensions, including using a three-dimensional Cartesian coordinate system with the use of dynamic geometry software or other digital tools</p> <p>VC2M8SP03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>locating aircraft or drones using latitude, longitude and altitude as a three-dimensional coordinate system</li> <li>constructing three-dimensional objects using 3D printers or designing software that uses a three-dimensional coordinate system</li> <li>comparing and contrasting two-dimensional and three-dimensional coordinate systems by highlighting what is the same and what is different, including virtual maps versus street views</li> <li>using dynamic geometry software to construct shapes and objects within the first quadrant of a three-dimensional coordinate system</li> <li>interpreting three-dimensional coordinate locations for objects in multistorey car parks, or playing games based on three-dimensional coordinate systems such as three-dimensional noughts-and-crosses</li> <li>exploring position and transformation through geospatial technologies used by Aboriginal and/or Torres Strait Islander communities</li> </ul>
<p><i>Students learn to:</i></p> <p>design and test algorithms involving a sequence of steps and decisions that identify congruency or similarity of shapes, and describe how the algorithm works</p> <p>VC2M8SP04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>listing the properties or criteria necessary to determine if shapes are similar or congruent</li> <li>using the conditions for congruence of triangles and similarity of triangles to develop a sorting algorithm; for example, creating a flow chart</li> <li>evaluating algorithms for accuracy in classifying and distinguishing between similar and congruent triangles</li> </ul>

## Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>distinguish between a population and a sample, and investigate techniques for data collection including census, sampling, experiment and observation, and explain the practicalities and implications of obtaining data through these techniques</p> <p>VC2M8ST01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying situations where data can be collected by census and those where a sample is appropriate</li> <li>investigating the practicalities and implications of obtaining data through sampling, using a variety of investigative processes; for example, investigating situations when random sampling or non-random sampling is used to collect data and the implication of each sampling method</li> <li>discussing how observations, experiments and sampling methods can be impacted by bias; for example, recognising that a sampling bias occurs when certain members of a population are more likely to be selected in a sample than others, such as a survey conducted at a shopping centre, and recognising that environmental conditions may bias the results of scientific investigations if experiments are conducted at different times or under different conditions</li> <li>using digital tools such as simulations and digital measuring devices to observe, measure and record qualitative and quantitative data, discussing precision and the implications of error</li> </ul>
<p><i>Students learn to:</i></p> <p>analyse and report on the distribution of data from primary and secondary sources using random and non-random sampling techniques</p> <p>VC2M8ST02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating different methods of sampling used to collect data, considering the source and size of samples</li> <li>comparing the sampling methods of simple random, systematic, stratified, quota, clustered or convenience, or judgement, and discussing the reliability of conclusions about the context that could be drawn</li> <li>defining and distinguishing between probabilistic terms such as 'random', 'sample space', 'sample' and 'sample distribution'</li> <li>investigating primary and secondary data sources relating to reconciliation between Aboriginal and Torres Strait Islander Peoples and non-Indigenous Australians, analysing and reporting on findings</li> </ul>
<p><i>Students learn to:</i></p> <p>compare variations in distributions and proportions obtained from random samples of the same size</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>comparing the proportion of students in favour of a proposal for a change in school uniform between different random samples of 50 students from the school population</li> </ul>

Content descriptions	Elaborations
<p>drawn from a population and recognise the effect of sample size on this variation VC2M8ST03</p>	<ul style="list-style-type: none"> <li>using digital tools to simulate repeated sampling of the same population, such as heights or arm spans of students, recording and comparing means, median and range of data between samples</li> <li>using relative frequencies from historical data to predict proportions and the likely number of outcomes in situations such as weather forecasting or the countries of origin of visitors to tourist attractions</li> <li>investigating the effect that adding or removing data from a data set has on measures of central tendency and spread</li> <li>investigating Aboriginal and/or Torres Strait Islander ranger groups and other groups' use of sampling techniques to track biodiversity of species</li> </ul>
<p><i>Students learn to:</i> plan and conduct statistical investigations involving samples of a population; use ethical and fair methods to make inferences about the population and report findings, acknowledging uncertainty VC2M8ST04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using data such as electricity consumption to draw conclusions about the impacts of events, such as pandemics, on households or business</li> <li>identifying situations where the collection of data from a sample is necessary due to efficiency, cost or restricted time for collection of data, and is sufficiently reliable for making inferences about a population</li> <li>exploring progress in reconciliation between Aboriginal and Torres Strait Islander Peoples and non-Indigenous Australians, investigating and evaluating sampling techniques and methods to gather relevant data to measure progress</li> </ul>

## Strand: Probability

Content descriptions	Elaborations
<p><i>Students learn to:</i> recognise that complementary events have a combined probability of one; use this relationship to calculate probabilities in applied contexts</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>understanding that knowing the probability of an event allows the probability of its complement to be found, including for those events that are not equally likely, such as getting a specific novelty toy in a supermarket promotion</li> </ul>

Content descriptions	Elaborations
VC2M8P01	<ul style="list-style-type: none"> <li>using the relationship that for a single event <math>A</math>, <math>\Pr(A) + \Pr(\text{not } A) = 1</math>; for example, if the probability that it rains on a particular day is 80%, the probability that it does not rain on that day is 20%, or the probability of not getting a 6 on a single roll of a fair dice is <math>1 - \frac{1}{6} = \frac{5}{6}</math></li> <li>using the sum of probabilities to solve problems, such as the probability of starting a game by throwing a 5 or 6 on a dice is <math>\frac{1}{3}</math> and probability of not throwing a 5 or 6 is <math>\frac{2}{3}</math></li> </ul>
<p><i>Students learn to:</i></p> <p>determine all possible outcome combinations for 2 events, using two-way tables, tree diagrams and Venn diagrams, and use these to determine probabilities of specific events in practical situations</p> <p>VC2M8P02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>describing events using language of 'at least', exclusive 'or' (<math>A</math> or <math>B</math> but not both), inclusive 'or' (<math>A</math> or <math>B</math> or both) and 'and'</li> <li>using the relation <math>\Pr(A \text{ and } B) + \Pr(A \text{ and not } B) + \Pr(\text{not } A \text{ and } B) + \Pr(\text{not } A \text{ and not } B) = 1</math> to calculate probabilities, including the special case of mutually exclusive events where <math>\Pr(A \text{ and } B) = 0</math></li> <li>using Venn diagrams or two-way tables to demonstrate the difference between events that are mutually exclusive, such as whether a coin toss will land on a head or a tail, and those that are not mutually exclusive, such as people who have blonde hair and people who have blue eyes</li> <li>exploring Aboriginal and/or Torres Strait Islander children's instructive games, for example, Battendi from the Ngarrindjeri Peoples of Lake Murray and Lake Albert in southern Australia, applying possible combinations and relationships and calculating probabilities using two-way tables and Venn diagrams</li> </ul>
<p><i>Students learn to:</i></p> <p>conduct repeated chance experiments and simulations, using digital tools to determine probabilities for compound events, and describe results</p> <p>VC2M8P03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using digital tools to conduct probability simulations involving compound events</li> <li>using a random number generator and digital tools to simulate rolling 2 dice and calculating the difference between them, investigating what difference is likely to occur more often</li> <li>using online simulation software to conduct probability simulations to determine in the long run if events are complementary</li> </ul>

## Level 9

### Level description

In Level 9, learning in Mathematics builds on each student's prior learning and experiences. Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- apply scientific notation in measurement contexts, routinely consider accuracy in measurement and work with absolute, relative and percentage errors in a range of different measurement contexts
- work with the real number line as a geometric model for real numbers that provides a continuous measurement scale; locate different fractions exactly on the common scale of the real number line using scale; and develop some irrational square roots of natural numbers using Pythagoras' theorem
- use linear and quadratic functions to model a broad range of phenomena and contexts, make predictions, and represent these using tables, graphs and algebra, including with the use of digital tools
- manipulate algebraic expressions involving variables, exponents, and the expansion and factorisation of simple quadratic expressions using a variety of techniques including tables, diagrams, algorithms and digital tools
- formulate and solve related linear and non-linear equations exactly or approximately using numerical, graphical and algebraic approaches
- solve measurement problems about the surface area and volume of objects and apply formulas to solve problems, calculating these and related dimensions of objects as required
- use similarity, scale, trigonometry, enlargement transformations, the triangle inequality and Pythagoras' theorem to solve practical problems

- investigate probabilities of compound events from two-step experiments and solve related problems; use a variety of representations such as Venn diagrams, tree diagrams, two-way tables and grids to assist in determining the probabilities for these events; and design experiments to gather empirical data about relative frequencies and use these to check their reasoning
- compare multiple numerical data subsets in context and analyse their distributions with consideration of symmetry and skew; justify their choice of data representation with respect to data types and context; and critically review the statistical presentation of data and related arguments of others.

## Achievement standard

By the end of Level 9, students recognise and use rational and irrational numbers to solve problems.

Students extend and apply the exponent laws with positive integers and the zero exponent to variables. They expand binomial products and factorise monic quadratic expressions. They find the distance between 2 points on the Cartesian plane, sketch linear graphs and find the gradient and midpoint of a line segment. Students use mathematical modelling to solve problems involving change, including simple interest in financial contexts and change in other applied contexts, choosing to use linear and quadratic functions. They graph quadratic functions and use null factor law to solve monic quadratic equations with integer roots algebraically. Students investigate and describe the effects of variation of parameters on functions and relations, using digital tools where appropriate, and make connections between their graphical and algebraic representations.

Students apply formulas to solve problems involving the surface area and volume of right prisms, cylinders and composite shapes. They solve problems involving ratio, similarity and scale in two-dimensional situations. They determine percentage errors in measurements. Students apply Pythagoras' theorem and use trigonometric ratios to solve problems involving right-angled triangles. They use mathematical modelling to solve practical problems involving direct and indirect proportion, ratio and scale, evaluating the model and communicating their methods and findings. Students express small and large numbers in scientific notation.

Students apply the enlargement transformation to images of shapes and objects, and interpret results. They design, use and test algorithms based on geometric constructions or theorems.

Students compare and analyse the distributions of multiple numerical data sets, choose representations, describe features of these data sets using summary statistics and the shape of distributions, and consider the effect of outliers. They explain how sampling techniques and representation can be used to support or question conclusions or to promote a point of view.

Students determine sets of outcomes for two-step chance experiments and represent these in various ways. They assign probabilities to the outcomes of two-step chance experiments. They design and conduct experiments or simulations for combined events using digital tools.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i>        recognise that the real number system includes the rational numbers and the irrational numbers, and solve problems involving real numbers with and without using digital tools        VC2M9N01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating the real number system by representing the relationships between irrational numbers, rational numbers, integers and natural numbers and discussing the difference between exact representations and approximate decimal representations of irrational numbers</li> <li>using a real number line to indicate the solution interval for inequalities of the form <math>ax + b &lt; c</math>, for example, <math>2x + 7 &lt; 0</math>; or of the form <math>ax + b &gt; c</math>, for example, <math>1.2x - 5.4 &gt; 10.8</math></li> <li>using positive and negative rational numbers to solve problems, for example, for financial planning such as budgeting</li> <li>solving problems involving the substitution of real numbers into formulas, understanding that solutions can be represented in exact form or as a decimal approximation, such as calculating the area of a circle using the formula <math>A = \pi r^2</math> and specifying the answer in terms of <math>\pi</math> as an exact real number; for example, the circumference of a circle with diameter 5 units is <math>5\pi</math> units, and the exact area is <math>\pi(\frac{5}{2})^2 = \frac{25}{4}\pi</math> square units, which rounds to 19.63 square units, correct to 2 decimal places</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>investigating the position of rational and irrational numbers on the real number line, using geometric constructions to locate rational numbers and square roots on a number line; for example, <math>\sqrt{2}</math> is located at the intersection of an arc and the number line, where the radius of the arc is the length of the diagonal of a one-unit square</li> </ul>

## Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>apply the exponent laws to numerical expressions with integer exponents and the zero exponent, and extend to variables VC2M9A01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>representing decimals in exponential form; for example, 0.475 can be represented as <math>0.475 = \frac{4}{10} + \frac{7}{100} + \frac{5}{1000} = 4 \times 10^{-1} + 7 \times 10^{-2} + 5 \times 10^{-3}</math> and 0.00023 as <math>23 \times 10^{-5}</math></li> <li>simplifying and evaluating numerical expressions, involving both positive and negative integer exponents, explaining why; for example, <math>5^{-3} = \frac{1}{5^3} = (\frac{1}{5})^3 = \frac{1}{125}</math> and connecting terms of the sequence 125, 25, 5, 1, <math>\frac{1}{5}</math>, <math>\frac{1}{25}</math>, <math>\frac{1}{125}</math>... to terms of the sequence <math>5^3, 5^2, 5^1, 5^0, 5^{-1}, 5^{-2}, 5^{-3} \dots</math></li> <li>relating the computation of numerical expressions involving exponents to the exponent laws and the definition of an exponent; for example, <math>2^3 \div 2^5 = 2^{-2} = \frac{1}{2^2} = \frac{1}{4}</math> and <math>(3 \times 5)^2 = 3^2 \times 5^2 = 9 \times 25 = 225</math></li> <li>recognising exponents in algebraic expressions and applying the relevant exponent laws and conventions; for example, for any non-zero natural number <math>a</math>, <math>a^0 = 1</math>, <math>x^1 = x</math>, <math>r^2 = r \times r</math>, <math>h^3 = h \times h \times h</math>, <math>y^4 = y \times y \times y \times y</math>, and <math>\frac{1}{w} \times \frac{1}{w} = \frac{1}{w^2} = w^{-2}</math></li> <li>relating simplification of expressions from first principles and counting to the use of exponent laws; for example, <math>(a^2)^3 = (a \times a) \times (a \times a) \times (a \times a) = a \times a \times a \times a \times a \times a = a^6</math>; <math>b^2 \times b^3 = (b \times b) \times (b \times b \times b) = b \times b \times b \times b \times b = b^5</math>; <math>\frac{y^4}{y^2} = \frac{y \times y \times y \times y}{y \times y} = \frac{y^2}{1} = y^2</math> and <math>(5a)^2 = (5 \times a) \times (5 \times a) = 5 \times 5 \times a \times a = 25 \times a^2 = 25a^2</math></li> <li>applying the exponent laws to simplifying expressions involving products, quotients, and powers of constants and variables; for example, <math>\frac{(2xy)^3}{xy^4} = \frac{8x^3y^3}{xy^4} = 8x^2y^{-1}</math></li> <li>relating the prefixes for SI units from pico- (trillionth) to tera- (trillion) to the corresponding powers of 10; for example, one pico-gram = <math>10^{-12}</math> grams and one terabyte = <math>10^{12}</math> bytes</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>simplify algebraic expressions, apply the distributive law to expand algebraic expressions including binomial products, and factorise monic quadratic expressions</p> <p>VC2M9A02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>expanding combinations of binomials such as <math>(x + 7)(x + 8)</math>, <math>(x + 7)(x - 8)</math>, <math>(x - 7)(x + 8)</math>, <math>(x - 7)(x - 8)</math> to identify expansion and factorisation patterns related to <math>(x + a)(x + b) = x^2 + (a + b)x + ab</math>, where <math>a</math> and <math>b</math> are integers</li> <li>using manipulatives such as algebra tiles or area models to expand or factorise algebraic expressions with readily identifiable binomial factors; for example, <math>(x + 1)(x + 3) = x^2 + 4x + 3</math>, <math>(x - 5)^2 = x^2 - 10x + 25</math> or <math>(x - 3)^2 + 4 = x^2 - 6x + 9 + 4 = x^2 - 6x + 13</math></li> <li>recognising the relationship between expansion and factorisation, and using digital tools to systematically explore the factorisation of <math>x^2 + mx + n</math> where <math>m</math> and <math>n</math> are integers</li> </ul>
<p><i>Students learn to:</i></p> <p>sketch linear graphs of equations in various algebraic forms, using the coordinates of 2 points, and solve linear equations</p> <p>VC2M9A03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>determining linear rules from suitable diagrams, tables of values and graphs, and describing them using both words and algebra</li> </ul>
<p><i>Students learn to:</i></p> <p>find the gradient of a line segment, the midpoint of the line interval and the distance between 2 distinct points on the Cartesian plane</p> <p>VC2M9A04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising that the gradient of a line is calculated using the gradient of a line segment on that line and is independent of which 2 distinct points on the line are used for this calculation</li> <li>using digital tools and transformations to illustrate that parallel lines in the Cartesian plane have the same gradient and that the relationship between the gradients of pairs of perpendicular lines is that their product is <math>(-1)</math></li> <li>using Pythagoras' theorem to establish the distance between 2 points in the Cartesian plane and applying this using horizontal and vertical distances and coordinates</li> <li>investigating graphical and algebraic techniques for finding the midpoint and gradient of the line segment between 2 points</li> <li>using dynamic graphing software and superimposed images (for example, playground equipment, ramps</li> </ul>

Content descriptions	Elaborations
	<p>and escalators) to investigate gradients in context and their relationship to rule of a linear function, and interpret gradient as a constant rate of change in linear modelling contexts</p>
<p><i>Students learn to:</i></p> <p>identify and graph quadratic functions, solve quadratic equations graphically and numerically, and use null factor law to solve monic quadratic equations with integer roots algebraically, using graphing software and digital tools as appropriate</p> <p>VC2M9A05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>recognising that in a table of values, if the second difference between consecutive values of the dependent variable is constant, then it is a quadratic</li> <li>graphing quadratic functions using digital tools and comparing what is the same and what is different between these different functions and their respective graphs; interpreting features of the graphs such as symmetry, turning point, maximum and minimum values; and determining when values of the quadratic function lie within a given range</li> <li>solving quadratic equations algebraically and comparing these to graphical solutions</li> <li>using graphs to determine the solutions of quadratic equations; recognising that the roots of a quadratic function correspond to the <math>x</math>-intercepts of its graph and that if the graph has no <math>x</math>-intercepts, then the corresponding equation has no real solutions</li> <li>relating horizontal axis intercepts of the graph of a quadratic function to the factorised form of its rule using the null factor law; for example, the graph of the function <math>y = x^2 - 5x + 6</math> can be represented as <math>y = (x - 2)(x - 3)</math> with <math>x</math>-axis intercepts where either <math>(x - 2) = 0</math> or <math>(x - 3) = 0</math></li> <li>recognising that the equation <math>x^2 = a</math>, where <math>a &gt; 0</math>, has 2 solutions, <math>x = \sqrt{a}</math> and <math>x = -\sqrt{a}</math> (for example, if <math>x^2 = 39</math> then <math>x = \sqrt{39} = 6.245</math> correct to 3 decimal places, or <math>x = -\sqrt{39} = -6.245</math> correct to 3 decimal places) and representing these graphically</li> <li>graphing percentages of illumination of moon phases in relation to Aboriginal and Torres Strait Islander Peoples' understandings that describe the different phases of the moon</li> </ul>
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve applied problems involving change, including financial</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling practical contexts using linear functions such as cooking times that include resting or cooling times, or water leakage from water tanks, using tables and graphs or digital tools and algebraically</li> </ul>

Content descriptions	Elaborations
<p>contexts involving simple interest; formulate problems, choosing to use either linear or quadratic functions or other simple variations; interpret solutions in terms of the context; evaluate the model and report methods and findings VC2M9A06</p>	<ul style="list-style-type: none"> <li>modelling measurement situations and determining the perimeter and areas of rectangles where the length, <math>l</math>, of the rectangle is a linear function of its width, <math>w</math>; for example, <math>l = w</math>, <math>l = w + 5</math>, <math>l = 3w</math>, <math>l = 2w + 7</math></li> <li>modelling practical contexts (for example, area, paths of projectiles, parabolic mirrors, satellite dishes) using simple quadratic functions, tables and graphs (hand drawn or using digital tools) and, algebraically, interpreting features of the graphs such as the turning point and intercepts in context; for example, area, paths of projectiles, parabolic mirrors, satellite dishes</li> <li>modelling and solving problems involving financial contexts using linear functions, for example, combinations of purchases of different items when they have a set amount of money to spend, profit/loss situations and trade quotes involving call-out fees</li> <li>modelling situations involving change, for example, change in daily temperature during the ski season, fluctuation of speed above and below the speed limit, and acceleration and deceleration of a car coming to and moving off from a set of traffic lights</li> <li>modelling the hunting techniques of Aboriginal and Torres Strait Islander Peoples using quadratic functions and exploring the effect of increasing the number of hunters to catch more prey</li> </ul>
<p><i>Students learn to:</i> experiment with the effects of the variation of parameters on graphs of related functions, using digital tools, making connections between graphical and algebraic representations, and generalising emerging patterns VC2M9A07</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating transformations of the graph of <math>y = x</math> to the graph of <math>y = ax + b</math> by systematic variation of <math>a</math> and <math>b</math> and interpreting the effects of these transformations using digital tools; for example, <math>y = x \rightarrow y = 2x</math> (vertical enlargement as <math>a &gt; 1</math>) <math>\rightarrow y = 2x - 1</math> (vertical translation) and <math>y = x \rightarrow y = \frac{1}{2}x</math> (vertical compression as <math>0 &lt; a &lt; 1</math>) <math>\rightarrow y = -\frac{1}{2}x</math> (reflection in the horizontal axis) <math>\rightarrow y = -\frac{1}{2}x + 3</math> (vertical translation)</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>investigating transformations of the parabola <math>y = x^2</math> to the graph of <math>y = a(x - h)^2 + b</math> in the Cartesian plane using digital tools to determine the relationship between graphical and algebraic representations of quadratic functions, including the completed square form; for example, <math>y = x^2 \rightarrow y = \frac{1}{3}x^2</math> (vertical compression as <math>0 &lt; a &lt; 1</math>) <math>\rightarrow y = \frac{1}{3}(x - 5)^2</math> (horizontal translation) <math>\rightarrow y = \frac{1}{3}(x - 5)^2 + 7</math> (vertical translation) or <math>y = x^2 \rightarrow y = 2x^2</math> (vertical enlargement as <math>a &gt; 1</math>) <math>\rightarrow y = -2x^2</math> (reflection in the horizontal axis) <math>\rightarrow y = -2(x + 6)^2</math> (horizontal translation) <math>\rightarrow y = -2(x + 6)^2 + 10</math> (vertical translation)</li> <li>experimenting with digital tools by applying transformations to the graphs of functions, such as reciprocal <math>y = \frac{1}{x}</math>, square root <math>y = \sqrt{x}</math>, cubic <math>y = x^3</math> and exponential functions <math>y = 2^x</math>, <math>y = (\frac{1}{2})^x</math>, identifying patterns</li> </ul>

## Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>solve problems involving the volume and surface area of right prisms, cylinders and composite objects using appropriate units VC2M9M01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>analysing nets of objects to generate short cuts and establish formulas for surface area</li> <li>determining the amount of material needed to make can-coolers for a class fundraising project and working out the most cost-efficient way to cut out the pieces</li> <li>finding different prisms that have the same volume but different surface areas, making conjectures as to what type of prism would have the smallest or largest surface area</li> <li>investigating objects and technologies of Aboriginal and Torres Strait Islander Peoples, analysing and connecting surface area and volume, and exploring their relationship to their capacity</li> </ul>
<p><i>Students learn to:</i></p> <p>solve problems involving very small and very large measurements, timescales and intervals expressed in scientific notation</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>representing very large and very small real numbers in scientific notation, converting real numbers expressed in scientific notation into decimal form; for example, the approximate geological age of Earth is <math>4.6 \times 10^9</math> years, and the mass of a glucose molecule is <math>2.99 \times 10^{-22}</math> grams</li> <li>using knowledge of place value and applying exponent laws to operate with numbers expressed in scientific</li> </ul>

Content descriptions	Elaborations
VC2M9M02	<p>notation in applied contexts; for example, performing calculations involving extremely small numbers in scientific and other contexts</p> <ul style="list-style-type: none"> <li>examining the degree of accuracy that different measurement instruments provide in a science laboratory, such as a measuring cylinder compared with a pipette, and recording data values to the correct degree of accuracy using appropriate scientific notation</li> </ul>
<p><i>Students learn to:</i></p> <p>solve spatial problems, applying angle properties, scale, similarity, ratio, Pythagoras' theorem and trigonometry in right-angled triangles</p> <p>VC2M9M03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating the applications of Pythagoras' theorem in authentic problems, including applying Pythagoras' theorem and trigonometry to problems in surveying and design</li> <li>applying the formula for calculation of distances between points on the Cartesian plane from their coordinates, emphasising the connection to vertical and horizontal displacements between the points</li> <li>understanding the relationship between the corresponding sides of similar right-angled triangles and establishing the relationship between areas of similar figures and the ratio of corresponding sides, the scale factor</li> <li>using images of proportional relationships to estimate actual measurements (for example, taking a photograph of a person standing in front of a tree and using the image and scale to estimate the height of the tree), discussing the findings and ways to improve the estimates</li> <li>investigating theorems and conjectures involving triangles, for example, the triangle inequality and generalising links between the Pythagorean rule for right-angled triangles, and related inequalities for acute and obtuse triangles, determining the minimal sets of information for a triangle from which other measures can all be determined</li> <li>using knowledge of similar triangles, Pythagoras' theorem, rates and algebra to design and construct a Biltmore stick, used to measure the diameter and height of a tree, and calculating the density and dry mass to predict how much paper could be manufactured from the tree</li> </ul>
<i>Students learn to:</i>	<i>This may involve students:</i>

Content descriptions	Elaborations
<p>calculate and interpret absolute, relative and percentage errors in measurements VC2M9M04</p>	<ul style="list-style-type: none"> <li>investigating error as a percentage of the exact value; for example, comparing an estimation of the number of people expected to come to an event by subtracting the actual number that turned up to give an error, then converting this into a percentage error</li> <li>using absolute value in a percentage error formula; considering when they would use the absolute value and when they would not, depending upon the context</li> <li>calculating the percentage errors in expected budgets to actual expenditure</li> <li>estimating the accuracy of measurements in practical contexts and giving suitable lower and upper bounds for measurement values</li> </ul>
<p><i>Students learn to:</i> use mathematical modelling to solve practical problems involving direct proportion, rates, ratio and scale, including financial contexts; formulate the problems and interpret solutions in terms of the situation; evaluate the model and report methods and findings VC2M9M05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling situations that involve direct proportion (such as pro rata pay rates, exchange rates, multiple quotes for a job, conversion between scales or other appropriate science contexts); for example, situations that involve Hooke's law and other science contexts involving wavelengths and frequencies</li> <li>modelling situations that impact on image editing used in social media and how proportion may not be maintained and can result in distorted images</li> <li>modelling situations involving compliance with building and construction standards in design and construction, such as the rise and tread of staircases, and vertical and horizontal components of escalators</li> <li>modelling situations involving the application of rates in practical contexts, for example, density, birth, flow or heartbeats</li> <li>exploring fire techniques in land management practices used by Aboriginal and Torres Strait Islander Peoples that use proportion relationships, including the rate of fire spread in different fuel types to wind speed, temperature and relative humidity</li> </ul>

### Strand: Space

Content descriptions	Elaborations
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Content descriptions	Elaborations
<p><i>Students learn to:</i> recognise the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles using properties of similarity VC2M9SP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>understanding the terms 'base', 'altitude', 'hypotenuse', and 'adjacent' and 'opposite' sides to an angle, in a right-angled triangle, and identifying these for a given right-angled triangle</li> <li>investigating patterns to reason about nested similar triangles that are aligned on a coordinate plane, connecting ideas of parallel sides and identifying the constancy of ratios of corresponding sides for a given angle</li> <li>establishing an understanding that the sine of an angle can be considered as the length of the altitude of a right-angled triangle with a hypotenuse of length one unit and similarly the cosine as the length of the base of the same triangle, and relating this to enlargement and similar triangles</li> <li>relating the tangent of an angle to the altitude and base of nested similar right-angled triangles, and connecting the tangent of the angle at which the graph of a straight line meets the positive direction of the horizontal coordinate axis to the gradient of the straight line</li> </ul>
<p><i>Students learn to:</i> apply the enlargement transformation to shapes and objects using dynamic geometry software as appropriate; identify and explain, using language of similarity, ratio and scale, aspects that remain the same and those that change VC2M9SP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>comparing the ratio of lengths of corresponding sides of similar triangles and angles</li> <li>using the properties of similarity to solve problems involving enlargement</li> <li>investigating and generalising patterns in length, angle, area and volume when side lengths of shapes and objects are enlarged or dilated by whole and rational numbers; for example, comparing an enlargement of a square and a cube of side length 2 units by a factor of 3 increases the area of the square, <math>(3 \times 2)^2 = 9 \times 2^2 = 9</math> times the original area and the volume of the cube, <math>2^3</math>, to <math>(3 \times 2)^3 = 27 \times 2^3 = 27</math> times the volume</li> </ul>
<p><i>Students learn to:</i> design, test and refine algorithms involving a sequence of steps and decisions based on geometric constructions and theorems;</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>creating an algorithm using pseudocode or flow charts to apply the triangle inequality, or an algorithm to generate Pythagorean triples</li> <li>creating and testing algorithms designed to construct or bisect angles, using pseudocode or flow charts</li> </ul>

Content descriptions	Elaborations
discuss and evaluate refinements VC2M9SP03	<ul style="list-style-type: none"> <li>developing an algorithm for an animation of a geometric construction, or a visual proof, evaluating the algorithm using test cases</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i>            analyse reports of surveys in digital media and elsewhere for information on how data was obtained around everyday questions and issues involving at least one numerical and at least one categorical variable, to estimate population means and medians            VC2M9ST01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating and evaluating statistical reports in the media and other places by linking claims to displays, statistics and representative data</li> <li>investigating the use of statistics in reports regarding the growth of Australia's trade with other countries of the Asia region</li> <li>investigating a range of data and its sources, for example, the age of residents in Australia, Cambodia and Tonga, or the number of subjects studied at school in a year by 14-year-old students in Australia, Singapore, Japan, South Korea and Timor-Leste</li> <li>analysing reports of public opinion surveys on environmental issues, such as land clearing, wind farms or single-use plastics, discussing methods of data collection and the reasonableness of any inferences made</li> <li>comparing the annual rainfall in various parts of Australia, Pakistan, New Guinea and Malaysia</li> </ul>
<p><i>Students learn to:</i>            analyse how different sampling methods, and different samples using the same method, can affect the results of surveys and how choice of representation can be used to support a particular point of view            VC2M9ST02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating and analysing different visualisations of data such as infographics found in the media and commenting on the strengths, weaknesses and possible biases of particular examples</li> <li>discussing the impact of decreased landline usage or an increased aversion to answering calls from unknown numbers on survey data</li> <li>exploring potential cultural bias relating to Aboriginal and Torres Strait Islander Peoples by critically analysing sampling techniques in statistical reports</li> </ul>
<i>Students learn to:</i>	<i>This may involve students:</i>

Content descriptions	Elaborations
<p>represent the distribution of multiple data sets for numerical variables using comparative representations such as back-to-back stem-and-leaf plots and histograms; describe data, using terms including 'skewed', 'symmetric' and 'bi-modal'; compare data distributions using mean, median and range to describe and interpret numerical data sets with consideration of centre, spread and shape, and the effect of outliers on these measures</p> <p>VC2M9ST03</p>	<ul style="list-style-type: none"> <li>describing the shape of the distribution of data using terms such as 'positive skew', 'negative skew', 'symmetric' and 'bi-modal'</li> <li>using stem-and-leaf plots to compare 2 like sets of data such as the heights of girls and the heights of boys in a class</li> <li>constructing grouped histograms that show trends in health issues such as lung cancer, leukaemia, stroke and diabetes, and using the graph to justify, verify or invalidate claims</li> <li>exploring comparative data presented in reports by the National Indigenous Australians Agency in regard to 'Closing the Gap', discussing the comparative distributions within the context of the data, for example, comparative data presented in the 'Closing the Gap – Prime Minister's Report'</li> <li>comparing means, medians and ranges of 2 sets of numerical data that have been displayed using histograms, dot plots or stem-and-leaf plots</li> </ul>
<p><i>Students learn to:</i></p> <p>choose appropriate forms of display or visualisation for a given type of data; justify selections and interpret displays for a given context</p> <p>VC2M9ST04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>comparing data displays using mean, median and range to describe and interpret numerical data sets in terms of centre and spread using histograms, dot plots or stem-and-leaf plots</li> <li>choosing the type of representations based on the data type: categorical (nominal or ordinal) or numerical (discrete or continuous)</li> <li>using different visualisations of data, including non-standard representations such as infographics, and discussing their purpose and intended audience, and evaluating how well they communicate responses to statistical questions of interest</li> <li>comparing and interpreting stacked bar charts, area charts and line graphs, discussing how they represent larger categories that can be subdivided into smaller categories and how information that can be obtained from these displays can be used for comparison</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>plan and conduct statistical investigations involving the collection and analysis of different kinds of data; report findings and discuss the strength of evidence to support any conclusions</p> <p>VC2M9ST05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>planning and conducting an investigation using questions together with analysis of a secondary data set collected from online databases such as the Australian Bureau of Statistics</li> <li>planning and conducting an investigation relating to consumer spending habits; and modelling market research on what teenagers are prepared to spend on technology compared to clothing, with consideration of sample techniques and potential sources of bias</li> <li>investigating where would be the best location for a tropical fruit plantation, by conducting a statistical investigation comparing different variables such as the annual rainfall in various parts of Australia, Indonesia, New Guinea and Malaysia, land prices and associated farming costs</li> <li>posing statistical questions; collecting, representing and interpreting data from different sources in relation to reconciliation between Aboriginal and Torres Strait Islander Peoples and non-Indigenous Australians; and considering the relationships between variables</li> </ul>

## Strand: Probability

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>list all outcomes for two-step chance experiments both with and without replacement, using lists, tree diagrams, tables or arrays; assign probabilities to outcomes and events</p> <p>VC2M9P01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>discussing two-step chance experiments, such as the game of heads and tails, describing the different outcomes and their related probabilities</li> <li>using systematic methods such as lists or arrays to record outcomes and assign probabilities, such as drawing the names of students from a bag to appoint 2 team leaders</li> <li>using a tree diagram to represent a three-stage event and assigning probabilities to these events; for example, selecting 3 cards from a deck, assigning the probability of drawing an ace, then a king, then a queen of the same suit, with and without replacing the cards after every draw</li> <li>assigning probabilities to compound events involving the random selection of people from a given</li> </ul>

Content descriptions	Elaborations
	population; for example, selecting 2 names at random from all of the students at a high school and assigning the probability that they are both in Year 9
<p><i>Students learn to:</i></p> <p>calculate relative frequencies from given or collected data to estimate probabilities of events involving 'and', inclusive 'or' and exclusive 'or'</p> <p>VC2M9P02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>understanding that relative frequencies from large data sets or long-run experiments can provide reliable measures of probability and can be used to make predictions of decisions</li> <li>using Venn diagrams or two-way tables to estimate frequencies of events involving 'and' and 'or' questions</li> </ul>
<p><i>Students learn to:</i></p> <p>design and conduct repeated chance experiments and simulations using digital tools to estimate probabilities that cannot be determined exactly</p> <p>VC2M9P03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using digital tools to conduct probability simulations that demonstrate the relationship between the probability of compound events and the individual probabilities</li> <li>comparing experiments that differ only by being undertaken with replacement or without replacement</li> <li>conducting two-step chance experiments using systematic methods to list outcomes of experiments and to list outcomes favourable to an event</li> <li>using repeated trials of Aboriginal and/or Torres Strait Islander children's instructive games, for example, Gorri from all parts of Australia, to calculate the probabilities of winning and not winning</li> </ul>

## Level 10

### Level description

In Level 10, learning in Mathematics builds on each student's prior learning and experiences and provides the basis for a sound background in number, algebra, function, geometry and statistics. Students engage in a range of approaches to the learning and doing of mathematics that develop their understanding of and fluency with concepts, procedures and processes by making connections, reasoning, problem-solving and practice. Proficiency in mathematics enables students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

Students further develop proficiency and positive dispositions towards mathematics and its use as they:

- investigate the accuracy of decimal approximations to irrational real numbers; and consider the accuracy of computation with real numbers in context and the use of logarithmic scales to deal with phenomena involving small and large quantities and change
- apply numerical, graphical and algebraic approaches to analyse the behaviour of linear equations, pairs of linear equations and linear inequalities in 2 variables
- expand, factorise, simplify and substitute into a wide range of algebraic expressions, including linear, quadratic, and exponential terms and relations, as well as simple algebraic fractions with numerical denominators
- solve related equations, linear inequalities and simultaneous linear equations, with and without the use of digital tools
- explore the connection between tabular, graphical and algebraic representations of non-linear relations, including circles with centres at any location in the Cartesian plane
- use mathematical modelling to solve problems in applied situations exhibiting growth or decay using linear, quadratic and exponential functions; and solve related equations, numerically, graphically and algebraically, with the use of digital tools as applicable
- solve measurement problems involving the surface area and volume of common objects, composite objects and irregular objects; use

Pythagoras' theorem and trigonometry of right-angled triangles to solve spatial problems in two- and three-dimensions; and manipulate images of their representations using digital tools

- apply geometric theorems to deduce results and solve problems involving plane shapes, and interpret networks and network diagrams in authentic contexts
- investigate conditional probability and its relation to dependent and independent events, including sampling with and without replacement; and devise and use simulations to test intuitions involving chance events that may or may not be independent
- compare different ways of representing the distribution of continuous data and interpret key features of the distribution; explore association between pairs of variables, decide the form of representation, interpret the data with respect to the context and discuss possible conclusions; use scatterplots to informally discuss and consider association between 2 numerical variables; and informally consider lines of good fit by eye, interpolation, extrapolation and limitations.

## Achievement standard

By the end of Level 10, students recognise the effect of approximations of real numbers in repeated calculations.

Students use mathematical modelling to solve problems involving growth and decay in financial and other applied situations, applying linear, quadratic and exponential functions as appropriate, and solve related equations, numerically and graphically. They make and test conjectures involving functions and relations using digital tools. Students substitute into formulas, find unknown values, manipulate linear and quadratic algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital tools. They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, algebraically and graphically, with and without the use of digital tools, and justify solutions. They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems. Students can design and implement simple algorithms using pseudocode or other general purpose programming language.

Students solve measurement problems involving surface area and volume of composite objects. They interpret and use logarithmic scales representing small or large quantities or change in applied contexts. Students apply Pythagoras' theorem and trigonometry to solve practical

problems involving right-angled triangles. They identify the impact of measurement errors on the accuracy of results. Students use mathematical modelling to solve practical problems involving direct and inverse proportion and scaling, evaluating and modifying models, and reporting assumptions, methods and findings.

Students use deductive reasoning, theorems and algorithms to solve spatial problems. They interpret networks used to represent practical situations and describe connectedness.

Students compare univariate data sets by referring to summary statistics and the shape of their displays. They plan and conduct statistical investigations involving bivariate data, including where the independent variable is time. They represent the distribution of data involving 2 variables, using tables and scatterplots, and comment on possible association. They analyse inferences and conclusions in the media, noting potential sources of bias. Students compare the distribution of continuous numerical data, using various displays, and discuss distributions in terms of centre, spread, shape and outliers.

Students apply conditional probability to solve problems involving compound events. They design and conduct simulations involving conditional probability, using digital tools.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i> recognise the effect of using approximations of real numbers in repeated calculations and compare the results when using exact representations VC2M10N01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>comparing and contrasting the effect of truncation or rounding on the final result of calculations when using approximations of real numbers rather than exact representations</li> <li>investigating the impact of approximation on multiple calculations in contexts that involve the area of compound shapes involving circles, the surface area and volume of compound objects, and repeated calculations of simple interest where the solutions are not exact cents</li> </ul>

## Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i> factorise algebraic expressions by taking out a common algebraic factor VC2M10A01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using the distributive law and the exponent laws to factorise algebraic expressions</li> <li>understanding the relationship between factorisation and expansion</li> </ul>
<p><i>Students learn to:</i> simplify algebraic products and quotients using exponent laws VC2M10A02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>applying knowledge of exponent laws to algebraic terms, and simplifying algebraic expressions using both positive and negative integral indices</li> </ul>
<p><i>Students learn to:</i> apply the 4 operations to simple algebraic fractions with numerical or single variable denominators VC2M10A03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>expressing the sum and difference of algebraic fractions with a common denominator</li> <li>using the exponent laws to simplify products and quotients of algebraic fractions</li> </ul>
<p><i>Students learn to:</i> expand binomial products and factorise monic quadratic expressions using a variety of strategies VC2M10A04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>exploring the method of completing the square to factorise quadratic expressions and solve quadratic equations</li> <li>identifying and using common factors, including binomial expressions, to factorise algebraic expressions using the technique of grouping in pairs</li> <li>using the identities for perfect squares and the difference of squares to factorise quadratic expressions</li> </ul>
<p><i>Students learn to:</i> substitute values into formulas to determine an unknown and rearrange formulas to solve for a particular term VC2M10A05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>solving simple equations arising from formulas</li> <li>rearranging expressions to make a specified variable the subject, such as calculating the radius of a sphere to produce a given volume</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i> implement algorithms that use data structures using pseudocode or a general purpose programming language VC2M10A06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using two-dimensional arrays such as matrices to represent and implement sequences of transformations of sets of points in the plane</li> <li>using pointers in algorithms</li> </ul>
<p><i>Students learn to:</i> solve problems involving linear equations, including those derived from formulas VC2M10A07</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>representing word problems with simple linear equations and solving them to answer questions</li> </ul>
<p><i>Students learn to:</i> solve linear inequalities and graph their solutions on a number line VC2M10A08</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>representing word problems with simple linear inequalities and solving them to answer questions</li> <li><b>graphing regions corresponding to inequalities in the Cartesian plane (for example, graphing <math>2x + 3y &lt; 24</math>) and verifying using a test point such as (0, 0)</b></li> </ul>
<p><i>Students learn to:</i> solve simultaneous linear equations, using algebraic and graphical techniques including using digital tools VC2M10A09</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating situations involving simultaneous linear equations in context (such as multiple quotes for a job, or profit and loss) and solving the equations graphically, giving solutions in everyday language (such as 'break-even point' or 'point to change providers' for the job)</li> <li>describing the solution of simultaneous equations within the context of the situation</li> <li>using the algebraic methods of substitution and elimination, with and without the use of digital tools, and identifying which technique is the most efficient for a given pair of equations</li> <li>associating the solution of simultaneous equations with the coordinates of the intersection of their corresponding graphs</li> <li>investigating the strategies inherent in Aboriginal and/or Torres Strait Islander children's instructive games, for example, Weme from the Warlpiri Peoples of central Australia, and their connection to strategies to solve</li> </ul>

Content descriptions	Elaborations
	simultaneous linear equations in 2 variables
<p><i>Students learn to:</i> solve problems involving gradients of parallel and perpendicular lines VC2M10A10</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>solving problems using the fact that parallel lines have the same gradient and conversely that if 2 lines have the same gradient then they are parallel</li> <li>solving problems using the fact that the product of the gradients of perpendicular lines is <math>-1</math> and conversely that if the product of the gradients of 2 lines is <math>-1</math> then they are perpendicular</li> </ul>
<p><i>Students learn to:</i> explore the connection between algebraic and graphical representations of relations such as simple quadratic, reciprocal, circle and exponential, using digital tools as appropriate VC2M10A11</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>sketching graphs of parabolas, and circles</li> <li>applying translations, reflections and stretches to parabolas and circles</li> <li>sketching the graphs of exponential functions using transformations</li> <li>plotting graphs of families of relations where the product of 2 variables is equal to a fixed constant</li> </ul>
<p><i>Students learn to:</i> solve linear equations involving simple algebraic fractions VC2M10A12</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>solving a wide range of linear equations, including those involving one or 2 simple algebraic fractions, and checking solutions by substitution</li> <li>representing word problems, including those involving fractions, as equations and solving them to answer the question</li> </ul>
<p><i>Students learn to:</i> solve simple quadratic equations using a range of strategies, including null factor law VC2M10A13</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using techniques to solve quadratic equations, including grouping like terms, completing the square, the quadratic formula and null factor law, and choosing 2 integers with the required product and sum</li> <li>using digital tools to explore the conditions for solutions to exist</li> <li>using digital tools to explore both graphically and algebraically the link between the value of the discriminant and the number of real solutions to a quadratic equation</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i> solve simple exponential equations VC2M10A14</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating exponential equations derived from authentic mathematical models based on population growth</li> <li>recognising that in a table of values, if the ratio between consecutive values of the dependent variable is constant, then it is an exponential relation</li> <li>investigating the links between algebraic and graphical representations of exponential functions using graphing software</li> <li>using digital tools with symbolic manipulation functionality to systematically explore exponential relations</li> <li>investigating Aboriginal and/or Torres Strait Islander ranger groups' and other groups' programs that attempt to eradicate feral animals for survival of native animals on Country/Place, exploring the competition between feral and native animals and their impact on natural resources by formulating exponential equations for population growth for each animal species</li> </ul>
<p><i>Students learn to:</i> use mathematical modelling to solve applied problems involving inverse proportion, growth and decay, including in financial contexts to establish the compound interest formula as repeated applications of simple interest; formulate problems, choosing to apply linear, quadratic or exponential models; interpret solutions in terms of the situation; evaluate and modify models as necessary and report assumptions, methods and findings</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>modelling problems involving inverse proportion in real-life contexts such as travel time decreasing with increased travel speed, the brightness of luminous objects decreasing with distance, or household expenditure and savings, and solving related equations</li> <li>modelling situations and choosing between linear, quadratic and exponential models by representing relationships in a table of values and recognising that linear functions have constant first differences, quadratic functions have constant second differences and exponential functions have a constant ratio between consecutive values of the dependent variable</li> <li>modelling situations involving exponential growth and decay, and contrasting this with linear growth or decay, for example, situations involving constant percentage change and constant ratio, and determining doubling time and half-life and approximate intervals for which the values of the model lie within a given range</li> </ul>

Content descriptions	Elaborations
VC2M10A15	<ul style="list-style-type: none"> <li>modelling situations that involve working with authentic information, data and interest rates to calculate compound interest and solve related problems</li> <li>modelling and investigating how exponential equations are used in carbon dating to estimate the age of Aboriginal and Torres Strait Islander artefacts or material culture</li> <li>modelling situations involving the growth of native animal populations on Country/Place with varying reproductive behaviour, using exponential functions and critiquing their applicability to real-world situations</li> </ul>
<p><i>Students learn to:</i></p> <p>solve equations graphically or using systematic numerical guess-check-and-refine with digital tools, with consideration of whether all solutions have been found</p> <p>VC2M10A16</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>refining intervals on graphs and/or in tables of values to determine with increasing accuracy when the values of 2 functions are approximately equal</li> <li>applying the graphing zoom functionality of digital tools and systematically refining intervals to identify approximate location of points of intersection of the graphs of 2 functions, such as <math>x^2 = 2^x</math></li> </ul>

### Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>solve problems involving the surface area and volume of composite objects using appropriate units</p> <p>VC2M10M01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>determining the volumes and surface areas of composite solids, formed from a range of right prisms and cylinders, by considering the individual solids from which they are constructed</li> <li>estimating the surface area and volume of composite objects in practical contexts</li> <li>using mathematical modelling to provide solutions to problems involving surface area and volume; for example, ascertaining the rainfall that can be saved from a rooftop and the optimal shape and dimensions for rainwater storage based on where it will be located on a property, or determining whether to hire extra freezer space for the amount of ice cream required at a fundraising event for the school or community</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>interpret and use logarithmic scales in applied contexts involving small and large quantities and change VC2M10M02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>understanding that the logarithmic scale is calibrated in terms of order of magnitude, for example, doubling or powers of 10</li> <li>identifying and interpreting data representations (charts and graphs) that use logarithmic scales (for example, graphs representing percentage change, a wide range of values or exponential growth) and discussing when it is appropriate to use this type of scale and when it is not appropriate</li> <li>investigating and interpreting logarithmic scales used in real-world contexts (for example, Richter, decibel and sensitivity scales or growth in investments, timescales and the spread of microorganisms and disease) and describing reasons for choosing to use a logarithmic scale rather than a linear scale</li> <li>investigating dating methods of geological sites to provide evidence of Aboriginal and Torres Strait Islander Peoples' presence in Australia, including the Madjedbebe dig in the Northern Territory, that use logarithmic scales, scientific notation and measurement accuracy in the dating</li> </ul>
<p><i>Students learn to:</i></p> <p>solve practical problems by applying Pythagoras' theorem and trigonometry to right-angled triangles, including problems involving direction and angles of elevation and depression VC2M10M03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>applying right-angled trigonometry to solve navigation problems involving bearings; for example, determining the bearing and estimating the distance of the final leg of an orienteering course</li> <li>applying Pythagoras' theorem and trigonometry to problems in surveying and design, where three-dimensional problems are decomposed into two-dimensional problems; for example, investigating the dimensions of the smallest box needed to package an object of a particular length</li> <li>using a clinometer to measure angles of inclination, and applying trigonometry and proportional reasoning to determine the height of buildings in practical contexts</li> <li>applying Pythagoras' theorem and trigonometry and using dynamic geometry software to design three-dimensional models of practical situations involving angles of elevation and depression; for example, modelling a crime scene</li> <li>exploring navigation, design of technologies or surveying by Aboriginal and Torres Strait Islander Peoples,</li> </ul>

Content descriptions	Elaborations
	investigating geometric and spatial reasoning and how these connect to trigonometry
<p><i>Students learn to:</i></p> <p>use mathematical modelling to solve practical problems involving direct and inverse proportion and scaling of objects; formulate problems and interpret solutions in terms of the situation, including the impact of measurement errors on the accuracy of results; evaluate and modify models as necessary, and report assumptions, methods and findings</p> <p>VC2M10M04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>exploring contexts where measurement errors may impact research results and how measurement data impacted by error can result in biased findings</li> <li>using plans and elevation drawings to investigate making changes to building designs, employing appropriate scales and converting to actual measurements within the context to make decisions about changes</li> <li>analysing and applying scale and ratios in situations such as production prototypes and 3D printing; for example, using a 3D printer to produce scaled versions of actual objects</li> <li>estimating the scale of an object by measuring a linear dimension and using typical life-size dimensions to determine the scale factor; for example, measuring the dimensions of a toy car to determine a scale that can be used to estimate the dimensions of a life-size car</li> <li>investigating compliance with building codes and standards in design and construction, such as for escalators in shopping centres</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>apply deductive reasoning to formulate proofs involving shapes in the plane and use theorems to solve spatial problems</p> <p>VC2M10SP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>distinguishing between a practical demonstration and a proof; for example, demonstrating that triangles are congruent by placing them on top of each other, as compared to using congruence tests to establish that triangles are congruent</li> <li>developing proofs involving congruent triangles and angle properties, communicating the proof using a sequence of logically connected statements</li> <li>applying an understanding of relationships to deduce properties of geometric figures; for example, the base</li> </ul>

Content descriptions	Elaborations
	<p>angles of an isosceles triangle are equal</p> <ul style="list-style-type: none"> <li>investigating proofs of geometric theorems and using them to solve spatial problems, for example, applying logical reasoning and similarity to proofs and numerical exercises involving plane shapes, and using visual proofs to justify solutions</li> <li>using dynamic geometry software to find the quadrilateral that has a vertex on each side of a rectangle and has the shortest possible path, and proving that the path forms a parallelogram</li> </ul>
<p><i>Students learn to:</i></p> <p>interpret networks and network diagrams used to represent relationships in practical situations and describe connectedness VC2M10SP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating how networks and network diagrams can be used to model authentic situations, recognising what real-world quantity is represented by the nodes (vertices), and what real-world quantity is represented by the links between them (edges)</li> <li>investigating the use of graphs to represent a network, for example, investigating the Seven Bridges of Königsberg problem</li> <li>investigating how polyhedrons may be represented as a network using edges, vertices, and interior and exterior faces; and representing the number of edges, vertices and faces in a table, exploring and demonstrating how Euler's formula <math>F + V = E + 2</math> applies</li> <li>investigating how a social network, intranet, local area network (LAN), electrical wiring or wireless network of a home can be represented as a network diagram to specify relationships; for example, using network diagrams to investigate practical problems involving connections, power overload or the need for routers</li> <li>investigating the use of networks to represent authentic situations, for example, rail or air travel between or within London, Paris and Hong Kong; a food web representing a simple ecosystem; metabolic networks and other chemical or biological structures</li> <li>representing Aboriginal and Torres Strait Islander Peoples' kinship systems using network diagrams and exploring the significance of relationships to Country/Place</li> </ul>

## Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i>            compare data distributions for continuous numerical variables using quartiles and interquartile range and appropriate data displays including boxplots, histograms and dot plots; discuss the shapes of these distributions in terms of centre, spread, shape and outliers in the context of the data            VC2M10ST01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>finding the five-number summary (minimum and maximum values, median and upper and lower quartiles) and using its graphical representation, the boxplot, as tools for both numerically and visually comparing the centre and spread of data sets</li> <li>exploring the effect of varying data values, including outliers, on the interquartile range for different sets of data</li> <li>constructing and interpreting boxplots and using them to compare data sets, understanding that boxplots are an efficient and common way of representing and summarising data and can facilitate comparisons between data sets</li> <li>comparing shapes of distributions using boxplots, histograms, cumulative frequency graphs and dot plots, discussing symmetry, skew and modality</li> <li>using digital tools to compare boxplots and histograms as displays of the same data in the light of the statistical questions being addressed and the effectiveness of the display in helping to answer the question</li> <li>comparing the information that can be extracted and the stories that can be told about continuous and discrete numerical data sets that have been displayed in different ways, including histograms, dot plots, boxplots and cumulative frequency graphs</li> </ul>
<p><i>Students learn to:</i>            construct scatterplots and consider a line of good fit; comment on the association between the 2 numerical variables in terms of strength, direction and linearity            VC2M10ST02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>discussing the difference between association and cause and effect, and relating this to situations such as health, diversity of species and climate</li> <li>using statistical evidence to make, justify and critique claims about association between variables, such as in contexts of climate change, migration, online shopping and social media</li> <li>informally using a line of good fit by eye and using digital tools to compare and discuss the reliability of any predictions</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>investigating the relationship between 2 variables of spearthrowers used by Aboriginal and Torres Strait Islander Peoples by using data to construct scatterplots, make comparisons and draw conclusions</li> </ul>
<p><i>Students learn to:</i></p> <p>construct two-way tables and discuss possible relationship between categorical variables VC2M10ST03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using two-way tables to investigate and comparing the survey responses to questions involving five-point Likert scale against 2 different categories of respondents, for example, junior students' responses compared to senior students' responses to a survey question</li> <li>recording data in two-way tables and using percentages and proportions to identify patterns and associations in the data</li> <li>conducting a litter survey around the school, considering the relationship between different categorical variables such as the day of the week (as canteen specials might lead to different types of litter) or the weather (due to hot days leading to more icy poles and cold drinks being sold)</li> </ul>
<p><i>Students learn to:</i></p> <p>analyse claims, inferences and conclusions of statistical reports in the media and other places, by linking claims to displays, statistics and representative data, including ethical considerations and identification of potential sources of bias VC2M10ST04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying potentially misleading data representations in the media such as graphs with broken axes and scales that do not start at zero or are nonlinear; and recognising when data is not relating to the claim, not representative of the population or is deliberately being used to mislead or support a claim or biased point of view</li> <li>investigating the source and size of the sample from which the data was collected and deciding whether the sample is appropriately representative of the population</li> <li>investigating population proportions and rates, and discussing potential ethical considerations, for example, when presenting statistical data involving infection rates and the number of cases per head of population</li> <li>discussing the ethical considerations associated with collecting data to predict the number of people likely to be infected with a strain of flu or experience side effects with a certain medication, considering validity claims and sample sizes</li> </ul>

Content descriptions	Elaborations
	<ul style="list-style-type: none"> <li>using the concept of Indigenous data sovereignty to critique and evaluate the Australian Government's 'Closing the Gap' report</li> </ul>
<p><i>Students learn to:</i></p> <p>plan and conduct statistical investigations of situations that involve bivariate data, including where the independent variable is time; evaluate and report findings with consideration of limitations of any inferences VC2M10ST05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>designing statistical investigations that collect bivariate data over time through observation, experiment or measurement; graphing, interpreting and analysing data; and reporting within the context of the statistical investigation question</li> <li>investigating and comparing anecdotal claims with data collected from well-constructed surveys, including those concerning climate, housing affordability and natural resources, with consideration of data validity and limitations of interpolation or extrapolation</li> <li>using a statistical investigation to address the question 'Is there a relationship between vaccines and immunity from a virus?'</li> <li>investigating biodiversity changes in Australia before and after colonisation by comparing related bivariate numerical data, discussing and reporting on associations</li> </ul>

### Strand: Probability

Content descriptions	Elaborations
<p><i>Students learn to:</i></p> <p>use the language of 'if ... then ...', 'given', 'of' and 'knowing that' to investigate conditional statements and identify common mistakes in interpreting such language, and describe and interpret situations involving conditional probability; design and conduct simulations using digital tools to model</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using two-way tables and Venn diagrams to understand conditional statements using the language of 'if ... then ...', 'given', 'of' and 'knowing that' and identifying common mistakes in interpreting such language</li> <li>using arrays and tree diagrams to represent, interpret and compare probabilities of dependent and independent events</li> <li>using samples of different sizes with and without replacement from a population to identify when the difference in methods becomes negligible</li> <li>using simulations to gather data on frequencies for situations involving chance that appear to be</li> </ul>

Content descriptions	Elaborations
conditional probability and interpret results VC2M10P01	counterintuitive, such as the three-door problem or the birthday problem <ul style="list-style-type: none"> <li>• identifying situations in real life where probability simulations are used for decision-making, such as supply and demand of product, insurance risk and queueing</li> <li>• using simulation to predict the number of people likely to be infected with a strain of flu or virus</li> </ul>
<i>Students learn to:</i> describe the results of two- and three-step chance experiments, both with and without replacements, assign probabilities to outcomes and determine probabilities of events; investigate the concept of independence VC2M10P02	<i>This may involve students:</i> <ul style="list-style-type: none"> <li>• recognising that a subsequent event can be dependent, and that this will affect the way its probability is calculated, for example, cards chosen from a standard deck without replacement, conditional selection problems from a fixed sample size, or the Bertrand's box paradox</li> </ul>

## Level 10A

### Level description

Level 10A provides optional, additional content to extend students in their mathematical studies in number, algebra, function, geometry, probability and statistics.

Level 10A does not include an achievement standard and does not require reporting.

Students may extend their studies in the Number and Algebra strands to investigate the structure and properties of number systems, with further algebraic and graphical analysis of higher-order polynomials, and relations such as circles, hyperbolas and other inequalities. They could extend the study of trigonometry to include an introduction to simple equations and graphs of circular functions, and extend the study of exponents and exponential functions to logarithm laws, including an introduction to logarithmic functions. Students could extend their study of graphing to explore the limiting value of rates of change.

Students could extend their studies in Measurement and Space to proving a broader range of geometric propositions solving trigonometric problems in non-right-angled triangles, or solving three-dimensional problems involving surface area and volume of cones, spheres and composite shapes.

Students could extend their studies in Statistics and Probability to explore the concepts of conditionality, dependence and independence in depth, or consider how various measures of location and spread can be used to describe the distribution of a data set, and investigate how robust these are with respect to variation in the data, in particular with respect to measurement error. They could explore factorials and how these may facilitate efficient counting in multiplicative and probabilistic contexts.

### Achievement standard

There is no achievement standard for Level 10A.

## Content descriptions and elaborations

### Strand: Number

Content descriptions	Elaborations
<p><i>Students learn to:</i> define rational and irrational numbers and perform operations with surds and fractional indices VC2M10AN01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>understanding that the real number system includes irrational numbers</li> <li>extending the exponent laws to rational number indices</li> <li>performing the 4 operations with surds</li> </ul>
<p><i>Students learn to:</i> perform operations on numbers involving fractional exponents and surds VC2M10AN02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>exploring the notion that <math>a^{\frac{m}{n}} = (a^{\frac{1}{n}})^m = (\sqrt[n]{a})^m = \sqrt[n]{a^m} = (a^m)^{\frac{1}{n}}</math>, where <math>m</math> is a non-zero integer and <math>n</math> is a natural number, and evaluating corresponding expressions; for example, <math>8^{\frac{2}{3}} = (\sqrt[3]{8})^2 = 2^2 = 4</math> and <math>8^{\frac{2}{3}} = \sqrt[3]{8^2} = \sqrt[3]{64} = 4</math></li> </ul>
<p><i>Students learn to:</i> use the definition of a logarithm to establish and apply the laws of logarithms and investigate logarithmic scales in measurement VC2M10AN03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating the relationship between exponential and logarithmic expressions</li> <li>simplifying expressions using the logarithm laws</li> <li>investigating the use of logarithmic scales to represent very small and very large quantities</li> </ul>

### Strand: Algebra

Content descriptions	Elaborations
<p><i>Students learn to:</i> investigate the concept of a polynomial and apply the factor and remainder theorems to solve problems VC2M10AA01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating the relationship between algebraic long division and the factor and remainder theorems</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i> devise and use algorithms and simulations to solve mathematical problems VC2M10AA02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>applying a systematic guess-check-and-refine algorithm to identify an approximate value for the root of an equation in an interval</li> <li>developing simulations for counterintuitive problems in probability such as the Monty Hall problem or derangements</li> </ul>
<p><i>Students learn to:</i> simplify combinations of linear expressions with rational coefficients and the solution of related equations VC2M10AA03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>simplifying sums and differences of linear expressions of the form <math>\frac{ax+b}{c}</math> where <math>a</math> and <math>b</math> are integers, and <math>c</math> is a non-zero integer, for example, <math>\frac{6x-11}{2} - \frac{7x}{4} + \frac{9-5x}{3} = \frac{-5x-30}{12}</math></li> <li>solving equations involving sums and differences of linear expressions with rational coefficients, for example, <math>\frac{-2x}{3} + \frac{4}{9} = \frac{11}{5}(7x - 1) \Rightarrow -30x + 20 = 693x - 99 \Rightarrow x = \frac{119}{723}</math>, and verifying the solution</li> </ul>
<p><i>Students learn to:</i> explore the inverse relationship between exponential functions and logarithmic functions and the solution of related equations VC2M10AA04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using the definition of a logarithm and the exponent laws to establish the logarithm laws</li> <li>evaluating <math>10^x</math> for decimal values of <math>x</math> and relating this to a logarithm base 10 scale; solving exponential equations algebraically using logarithms with base 10, for example, <math>5000 \times 1.01^x = 10000 \Rightarrow x = \frac{\log_{10}(2)}{\log_{10}(1.01)} \approx 69.66</math>; and connecting to the graph of the corresponding function</li> </ul>
<p><i>Students learn to:</i> describe, interpret, and sketch parabolas, hyperbolas, circles and exponential functions and their transformations VC2M10AA05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>applying transformations, including translations, reflections in the axes and stretches to help graph parabolas, rectangular hyperbolas, circles and exponential functions</li> </ul>
<p><i>Students learn to:</i> apply understanding of polynomials to sketch a range of curves and describe the features of these curves from their equation</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating the features of graphs of polynomials including axes intercepts and the effect of repeated factors</li> </ul>

Content descriptions	Elaborations
VC2M10AA06	
<p><i>Students learn to:</i> factorise monic and non-monic quadratic expressions and solve a wide range of quadratic equations derived from a variety of contexts</p> <p>VC2M10AA07</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>writing quadratic equations that represent practical problems</li> </ul>
<p><i>Students learn to:</i> use function notation to describe the relationship between dependent and independent variables in modelling contexts</p> <p>VC2M10AA08</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying independent and dependent variables in modelling contexts and represent the relation between them using tables, graphs and rules</li> <li>using technology to draw graphs of functions defined using function notation with consideration of domain and range</li> </ul>
<p><i>Students learn to:</i> solve linear and non-linear simultaneous equations using graphing or systematic guess-check-and-refine with digital tools</p> <p>VC2M10AA09</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using graphs to determine a convergent set of intervals that contain a point of intersection of the graphs of 2 functions</li> <li>using a cobweb diagram to solve simultaneous equations numerically</li> </ul>
<p><i>Students learn to:</i> experiment with functions and relations using digital tools, making and testing conjectures and generalising emerging patterns</p> <p>VC2M10AA10</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>applying a bisection algorithm to determine the approximate location of the horizontal axis intercepts of the graph of a quadratic function such as <math>f(x) = 2x^2 - 3x - 7</math></li> <li>applying transformations to the graph of <math>x^2 + y^2 = 1</math></li> <li>identifying the coordinates of any points of intersection of the graph of a linear function with the graph of a quadratic function or a circle</li> <li>identifying intervals on the real number line over which a given quadratic function is positive or negative</li> <li>using a table of values to determine when an exponential growth or decay function exceeds or falls below a</li> </ul>

Content descriptions	Elaborations
	given value, such as monitoring the trend in value of a share price in a context of exponential growth or decay

### Strand: Measurement

Content descriptions	Elaborations
<p><i>Students learn to:</i> solve problems involving surface area and volume of right pyramids, right cones, spheres and related composite solids VC2M10AM01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using formulas to solve problems</li> <li>using authentic situations to apply knowledge and understanding of surface area and volume</li> </ul>
<p><i>Students learn to:</i> explore the effect of increasingly small changes in the value of variables on the average rate of change and in relation to limiting values VC2M10AM02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using the gradient of the line segment between 2 distinct points as a measure of rate of change to obtain numerical approximations to instantaneous speed and interpreting ‘tell me a story’ piecewise linear position-time graphs</li> </ul>

### Strand: Space

Content descriptions	Elaborations
<p><i>Students learn to:</i> prove and apply relationships between angles and various lines associated with circles (radii, diameters, chords, tangents) VC2M10ASP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>identifying and proving relationships, for example, angles between tangents and chords, angles subtended by a chord with respect to the centre of a circle and angles subtended by a chord with respect to a point on the circumference of a circle, including using dynamic geometry software</li> <li>exploring how deductive reasoning and diagrams are used in proving geometric theorems related to circles</li> </ul>

Content descriptions	Elaborations
<p><i>Students learn to:</i> establish the sine, cosine and area rules for any triangle and solve related problems VC2M10ASP02</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>applying knowledge of sine, cosine and area rules to authentic problems such as those involving surveying and design</li> </ul>
<p><i>Students learn to:</i> use the unit circle to define the simple trigonometric functions of <math>y = \sin(x)</math>, <math>y = \cos(x)</math> and <math>y = \tan(x)</math> as functions of a real variable, and graph them with and without the use of digital tools VC2M10ASP03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>establishing the symmetrical properties of trigonometric functions</li> <li>investigating angles of any magnitude</li> <li>understanding that trigonometric functions are periodic and that this can be used to describe motion</li> <li>identifying points on the unit circle via arc lengths in radians, which correspond to specified values of the circular functions sine, cosine and tangent</li> </ul>
<p><i>Students learn to:</i> solve simple trigonometric equations VC2M10ASP04</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using periodicity and symmetry to solve equations</li> </ul>
<p><i>Students learn to:</i> apply Pythagoras' theorem and trigonometry to solving three-dimensional problems in right-angled triangles VC2M10ASP05</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating the applications of Pythagoras' theorem in authentic problems</li> </ul>
<p><i>Students learn to:</i> design, test and refine solutions to spatial problems using algorithms and digital tools; communicate and justify solutions VC2M10ASP06</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>designing and making scale models of three-dimensional objects using digital tools; for example, making components of a puzzle using a three-dimensional printer, and planning and designing the puzzle using principles of tessellations</li> <li>applying a computational thinking approach to solving problems involving networks, for example,</li> </ul>

Content descriptions	Elaborations
	<p>connectedness, coverage and weighted measures, such as taking different routes and choosing the most efficient route to take when travelling by car using virtual map software</p> <ul style="list-style-type: none"> <li>defining and decomposing spatial problems, creating and applying algorithms to generate solutions, and evaluating and communicating solutions in terms of the problem; for example, designing a floor plan for a department store that limits congestion at key areas such as check-outs, changing rooms and near popular sale items</li> <li>designing, creating and testing algorithms using pseudocode or flow charts for producing self-similar patterns; and validating algorithms using a range of test cases to compare their output</li> <li>exploring geospatial technologies used by Aboriginal and/or Torres Strait Islander communities, to consider spatial problems including position and transformation</li> </ul>

### Strand: Statistics

Content descriptions	Elaborations
<p><i>Students learn to:</i> calculate and interpret the mean and standard deviation of data and use these to compare data sets; investigate the effect of individual data values, including outliers, on the standard deviation VC2M10AST01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>using the standard deviation to describe the spread of a set of data</li> <li>using the mean and standard deviation to compare numerical data sets</li> <li>constructing distributions for the mean and standard deviation of simple random samples from a population</li> </ul>
<p><i>Students learn to:</i> identify measures of spread, and understand their interpretation and usefulness with respect to different data distributions</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>comparing the use of quantiles, percentiles, and cumulative frequency to analyse the distribution of data</li> <li>comparing measures of spread for different data distributions, such as mean or median absolute deviations with standard deviations, and exploring the effect of outliers</li> </ul>

Content descriptions	Elaborations
VC2M10AST02	
<p><i>Students learn to:</i> use digital tools to investigate bivariate numerical data sets; where appropriate use a straight line to describe the relationship allowing for variation, make predictions based on this straight line and discuss limitations VC2M10AST03</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>investigating different techniques for finding a 'line of best fit'</li> <li>using a fitted line to data to make predictions between and beyond existing data values and discussing limitations of these predictions</li> </ul>

## Strand: Probability

Content descriptions	Elaborations
<p><i>Students learn to:</i> explore counting principles, and factorial notation as a representation that provides efficient counting in multiplicative contexts, including calculations of probabilities VC2M10AP01</p>	<p><i>This may involve students:</i></p> <ul style="list-style-type: none"> <li>applying the multiplication principle to problems involving combinations including probabilities relating to sampling with and without replacement, and representing these using tree diagrams</li> <li>understanding that a set with <math>n</math> elements has <math>2^n</math> different subsets formed by considering each element for inclusion or not in combination, and that these can be systematically listed using a tree diagram or a table; for example, the set <math>\{a, b, c\}</math> has <math>2^3 = 8</math> subsets which are <math>\{\emptyset, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}\}</math>.</li> <li>using the definition of <math>n!</math> to represent and calculate in contexts that involve choices from a set; for example, how many different combinations of 3 playing cards from a pack? How many if the suits are ignored? How many with and without replacement?</li> <li>performing calculations on numbers expressed in factorial form, such as <math>\frac{n!}{r!}</math> to evaluate the number of possible arrangements of <math>n</math> objects in a row, <math>r</math> of which are identical; for example, 5 objects, 3 of which are identical, can be arranged in a row in <math>\frac{5!}{3!} = \frac{5 \times 4 \times 3 \times 2 \times 1}{3 \times 2 \times 1} = 20</math> different ways</li> </ul>
<i>Students learn to:</i>	<i>This may involve students:</i>

Content descriptions	Elaborations
investigate reports of studies in digital media and elsewhere for information on their planning and implementation VC2M10AP02	<ul style="list-style-type: none"><li>• evaluating the appropriateness of sampling methods in reports where statements about a population are based on a sample</li><li>• evaluating whether graphs in a report could mislead, and whether graphs and numerical information support the claims made</li></ul>