The Australian Curriculum

Learning areas	Mathematics
Year levels	Foundation Year, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 10A
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The Australian Curriculum
Mathematics

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Rationale and Aims

Rationale

Learning mathematics creates opportunities for and enriches the lives of all Australians. The Australian Curriculum: Mathematics provides students with essential mathematical skills and knowledge in **Number and Algebra**, **Measurement and Geometry**, and **Statistics and Probability**. It develops the numeracy capabilities that all students need in their personal, work and civic life, and provides the fundamentals on which mathematical specialties and professional applications of mathematics are built.

Mathematics has its own value and beauty and the Australian Curriculum: Mathematics aims to instil in students an appreciation of the elegance and power of mathematical reasoning. Mathematical ideas have evolved across all cultures over thousands of years, and are constantly developing. Digital technologies are facilitating this expansion of ideas and providing access to new tools for continuing mathematical exploration and invention. The curriculum focuses on developing increasingly sophisticated and refined mathematical understanding, fluency, logical reasoning, analytical thought and problem-solving skills. These capabilities enable students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

The Australian Curriculum: Mathematics ensures that the links between the various components of mathematics, as well as the relationship between mathematics and other disciplines, are made clear. Mathematics is composed of multiple but interrelated and interdependent concepts and systems which students apply beyond the mathematics classroom. In science, for example, understanding sources of error and their impact on the confidence of conclusions is vital, as is the use of mathematical models in other disciplines. 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 and spatial information is an important aspect of making meaning of texts.

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

Aims

The Australian Curriculum: Mathematics aims to ensure that students:

- are confident, creative users and communicators of mathematics, able to investigate, represent and interpret situations in their personal and work lives and as active citizens
- develop an increasingly sophisticated understanding of mathematical concepts and fluency with processes, and are able to pose and solve problems and reason in **Number and Algebra, Measurement and Geometry, and Statistics and Probability**
- recognise connections between the areas of mathematics and other disciplines and appreciate mathematics as an accessible and enjoyable discipline to study.

Content structure

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

The content strands are *Number and Algebra*, *Measurement and Geometry*, and *Statistics and Probability*. They describe what is to be taught and learnt.

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

Content strands

Number and Algebra

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

Measurement and Geometry

Measurement and Geometry are presented together to emphasise their relationship to each other, enhancing their practical relevance. 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 investigate properties and apply their understanding of them to define, compare and construct figures and objects. They learn to develop geometric arguments. They make meaningful measurements of quantities, choosing appropriate metric units of measurement. They build an understanding of the connections between units and calculate derived measures such as area, speed and density.

Statistics and Probability

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

Proficiency strands

The proficiency strands describe the actions in which students can engage when learning and using the content. While not all proficiency strands apply to every content description, they indicate the breadth of mathematical actions that teachers can emphasise.

Understanding

Students build a robust knowledge of adaptable and transferable mathematical concepts. They make connections between related concepts and progressively apply the familiar to develop new ideas. They develop an understanding of the relationship between the 'why' and the 'how' of mathematics. Students build understanding when they connect related ideas, when they represent concepts in different ways, when they identify commonalities and differences between aspects of content, when they describe their thinking mathematically and when they interpret mathematical information.

Fluency

Students develop skills in choosing appropriate procedures, carrying out procedures flexibly, accurately, efficiently and appropriately, and recalling factual knowledge and concepts readily. Students are fluent when they calculate answers efficiently, when they recognise robust ways of answering questions, when they choose appropriate methods and approximations, when they recall definitions and regularly use facts, and when they can manipulate expressions and equations to find solutions.

Problem Solving

Students develop the ability to make choices, interpret, formulate, model and investigate problem situations, and communicate solutions effectively. Students formulate and solve problems when they use mathematics to represent unfamiliar or meaningful situations, when they design investigations and plan their approaches, when they apply their existing strategies to seek solutions, and when they verify that their answers are reasonable.

Reasoning

Students develop an increasingly sophisticated capacity for logical thought and actions, such as analysing, proving, evaluating, explaining, inferring, justifying and generalising. Students are reasoning mathematically when they explain their thinking, when they deduce and justify strategies used and conclusions reached, when they adapt the known to the unknown, when they transfer learning from one context to another, when they prove that something is true or false and when they compare and contrast related ideas and explain their choices.

Content descriptions

The mathematics curriculum includes content descriptions at each year level. These describe the knowledge, concepts, skills and processes that teachers are expected to teach and students are expected to learn. However, they do not prescribe approaches to teaching. The content descriptions are intended to ensure that learning is appropriately ordered and that unnecessary repetition is avoided. However, a concept or skill introduced at one year level may be revisited, strengthened and extended at later year levels as needed.

Sub-strands

Content descriptions are grouped into sub-strands to illustrate the clarity and sequence of development of concepts through and across the year levels. They support the ability to see the connections across strands and the sequential development of concepts from Foundation to Year 10.

Number and Algebra	**Measurement and Geometry**	**Statistics and Probability**
Number and place value (F-8)	*Using units of measurement (F-10)*	*Chance (1-10)*
Fractions and decimals (1-6)	*Shape (F-7)*	*Data representation and interpretation (F-10)*

Real numbers (7-10)	*Geometric reasoning (3-10)*	
Money and financial mathematics (1-10)	*Location and transformation* *(F-7)*	
Patterns and algebra (F-10)	*Pythagoras and trigonometry (9-10)*	
Linear and non-linear relationships (8-10)		

Year level descriptions

Year level descriptions emphasise the importance of working mathematically within the content. They provide an overview of the relationship between the proficiencies (*Understanding, Fluency, Problem Solving* and *Reasoning*) and the content for each year level.

Content elaborations

Content elaborations are provided for Foundation to Year 10 to illustrate and exemplify content and assist teachers to develop a common understanding of the content descriptions. They are not intended to be comprehensive content points that all students need to be taught.

Glossary

A glossary is provided to support the common understanding of key terms in the content descriptions.

This support document contains additional information to support the glossary.

Mathematics across Foundation to Year 12

Although the curriculum is described year by year, this document provides advice across four year groupings on the nature of learners and the relevant curriculum:

- Foundation – Year 2: typically students from 5 to 8 years of age
- Years 3–6: typically students from 8 to 12 years of age
- Years 7–10: typically students from 12 to 15 years of age
- Senior secondary years: typically students from 15 to 18 years of age.

Foundation – Year 2

The early years (5–8 years of age) lay the foundation for learning mathematics. Students at this level can access powerful mathematical ideas relevant to their current lives and learn the language of mathematics, which is vital to future progression.

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

Understanding and experiencing these concepts in the early years provides a foundation for algebraic, statistical and multiplicative thinking, that will develop in subsequent years. These foundations also enable children to pose basic mathematical questions about their world, to identify simple strategies to investigate solutions, and to strengthen their reasoning to solve personally meaningful problems.

Years 3–6

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

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

In these years of schooling, it is particularly important for students to develop a deep understanding of whole numbers to build reasoning in fractions and decimals and to develop a conceptual understanding of place value. These concepts allow students to develop proportional reasoning and flexibility with number through mental computation skills, and to extend their number sense and statistical fluency.

Years 7–10

These years of school mark a shift in mathematics learning to more abstract ideas. Through key activities such as the exploration, recognition and application of patterns, the capacity for abstract thought can be developed and the ways of thinking associated with abstract ideas can be illustrated.

The foundations built in previous years prepare students for this change. Previously established mathematical ideas can be drawn upon in unfamiliar sequences and combinations to solve non-routine problems and to consequently develop more complex mathematical ideas. However, students of this age also need an understanding of the connections between mathematical concepts and their application in their world as a motivation to learn. This means using contexts directly related to topics of relevance and interest to this age group.

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

The intent of the curriculum is to encourage the development of important ideas in more depth, and to promote the interconnectedness of mathematical concepts. An obvious concern is the preparation of students intending to continue studying mathematics in the senior secondary years. Teachers will, in implementing the curriculum, extend the more mathematically able students by using appropriate challenges and extensions within available topics. A deeper understanding of mathematics in the curriculum enhances a student's potential to use this knowledge to solve non-routine problems, both at this level of study and at later stages.

The 10A content is optional and is intended for students who require more content to enrich their mathematical study whilst completing the common Year 10 content. It is NOT anticipated that all students will attempt the 10A content, but doing so would be advantageous for students intending to pursue Mathematical Methods (Course C) or Specialist Mathematics (Course D) in the senior secondary years. A selection of topics from the 10A curriculum can be completed according to the needs of the students.

It is anticipated that all students will study the Australian Curriculum: Mathematics up to the end of Year 10. From Year 10, the curriculum should provide pathway options suitable for students of differing abilities and interests, and with a range of future career and study plans.

Senior secondary years

Four mathematics courses have been designed for the senior secondary years. They have been designed to allow flexibility for students, taking into account a range of future pathways and the reality that some students reassess their choice of mathematics program part way through the senior secondary years.

The elements of the content strands from Foundation to Year 10 are evident in the senior secondary curriculum, but are not used as the major organisers. The proficiency strands of Understanding, Fluency, Reasoning and Problem Solving are integrated into the content descriptions as in the Foundation to Year 10 curriculum.

Achievement Standards

Across Foundation to Year 10, achievement standards indicate the quality of learning that students should typically demonstrate by a particular point in their schooling. Achievement standards comprise a written description and student work samples.

An achievement standard describes the quality of learning (the extent of knowledge, the depth of understanding, and the sophistication of skills) that would indicate the student is well placed to commence the learning required at the next level of achievement.

The sequence of achievement standards across Foundation to Year 10 describes progress in the learning area. This sequence provides teachers with a framework of growth and development in the learning area.

Student work samples play a key role in communicating expectations described in the achievement standards. Each work sample includes the relevant assessment task, the student's response, and annotations identifying the quality of learning evident in the student's response in relation to relevant parts of the achievement standard.

Together, the description of the achievement standard and the accompanying set of annotated work samples help teachers to make judgments about whether students have achieved the standard.

Diversity of Learners

Australian students have multiple, diverse, and changing needs that are shaped by individual learning histories and abilities as well as personal, cultural and language backgrounds and socio-economic factors.

ACARA is committed to the development of a high-quality curriculum for all Australian students that promotes excellence and equity in education. Teachers will use the Australian Curriculum to develop teaching and learning programs that build on student's current learning and which are not limited by an individual student's gender, language, sexual orientation, pregnancy, culture, ethnicity, religion, health or disability, socio economic background or geographic location.

The Australian Curriculum is shaped by the propositions that each student can learn and that the needs of every student are important. The flexibility offered by the Australian Curriculum enables teachers to plan rigorous, relevant and engaging learning and assessment experiences for all students

The Australian Curriculum sets out the sequence of learning typically expected across the years of schooling Foundation to Year 10. The curriculum content, presented as content descriptions, specifies the knowledge, understanding and skills that young people are to be taught and are expected to learn across the years of schooling F – 10. Teachers make flexible use of instructional processes and assessment strategies to ensure that all students are able to access, and engage with the Australian Curriculum in ways that are rigorous, relevant and meaningful. The achievement standards describe a broad sequence of expected learning in terms of what students are typically able to understand and able to do. Teachers use the achievement standards to locate the students' current levels of achievement and then plan programs that build on, and account for the different abilities of students, their prior learning experiences, cultural and linguistic backgrounds, and the different rates at which they learn.

Students with disability

ACARA acknowledges the Disability Discrimination Act (1992) (DDA) and the Disability Standards for Education (2005), and its obligation as an education and training service provider to articulate the rights of students with disability to access, participate and achieve in the curriculum on the same basis as students without disability.

The objectives of the Australian Curriculum are the same for all students. The curriculum offers flexibility for teachers to tailor their teaching in ways that provide rigorous, relevant and engaging learning and assessment opportunities for students with disability.

Students with disability can engage with the curriculum provided the necessary adjustments are made to the complexity of the curriculum content and to the means through which students demonstrate their knowledge, skills and understanding.

For some learners, making adjustments to instructional processes and to assessment strategies enables students to achieve educational standards commensurate with their peers.

For other students, teachers will need to make appropriate adjustments to the complexity of the curriculum content and by necessity, how the student's progress is monitored, assessed and reported.

English as an additional language or dialect

Many students in Australian schools are learners of English as an additional language or dialect (EAL/D). EAL/D students are those whose first language is a language other than Standard Australian English and who require additional support to assist them to develop English language proficiency.

EAL/D students come from diverse backgrounds and may include:

- overseas- and Australian-born students whose first language is a language other than English
- students whose first language is an Aboriginal or Torres Strait Islander language, including creoles and related varieties, or Aboriginal English.

EAL/D students enter Australian schools at different ages and at different stages of English language learning and have various educational backgrounds in their first languages. For some, school is the only place they use English.

The aims of the Australian Curriculum: Mathematics are ultimately the same for all students. However, EAL/D students are simultaneously learning a new language and the knowledge, understanding and skills of the Australian Curriculum: Mathematics through that new language. They require additional time and support, along with informed teaching that explicitly addresses their language needs, and assessments that take into account their developing language proficiency.

The **English as an Additional Language or Dialect: Teacher Resource** has been produced to support teachers as they develop teaching and learning programs using the Australian Curriculum. It describes four phases of language proficiency that will enable teachers to identify the typical language skills and understandings of their EAL/D students. Advice for teachers about cultural and linguistic considerations related to the Australian Curriculum: Mathematics and teaching strategies supportive of EAL/D students will help make the content of the curriculum accessible to EAL/D students. The EAL/D resource is available here.

General capabilities

In the Australian Curriculum, the general capabilities encompass the knowledge, skills, behaviours and dispositions that, together with curriculum content in each learning area and the cross-curriculum priorities, will assist students to live and work successfully in the twenty-first century.

There are seven general capabilities:

- Literacy
- Numeracy
- Information and communication technology (ICT) capability
- Critical and creative thinking
- Personal and social capability
- Ethical behaviour
- Intercultural understanding.

In the Australian Curriculum: Mathematics, general capabilities are identified wherever they are developed or applied in content descriptions. They are also identified where they offer opportunities to add depth and richness to student learning through content elaborations. Icons indicate where general capabilities have been identified in Mathematics content. Teachers may find further opportunities to incorporate explicit teaching of the capabilities depending on their choice of activities.

Literacy

Students become literate as they develop the knowledge, skills and dispositions to interpret and use language confidently for learning and communicating in and out of school and for participating effectively in society. Literacy involves students in listening to, reading, viewing, speaking, writing and creating oral, print, visual and digital texts, and using and modifying language for different purposes in a range of contexts.

Literacy is an important aspect of mathematics. Students develop literacy in mathematics as they learn the vocabulary associated with number, space, measurement and mathematical concepts and processes. This vocabulary includes synonyms (minus, subtract), technical terminology (digits, lowest common denominator), passive voice (If 7 is taken from 10) and common words with specific meanings in a mathematical context (angle, area). They develop the ability to create and interpret a range of texts typical of Mathematics ranging from calendars and maps to complex data displays.

Students use literacy to understand and interpret word problems and instructions that contain the particular language features of mathematics. They use literacy to pose and answer questions, engage in mathematical problem solving, and to discuss, produce and explain solutions.

Numeracy

Students become numerate as they develop the knowledge and skills to use mathematics confidently across all learning areas at school and in their lives more broadly. Numeracy involves students in recognising and understanding the role of mathematics in the world and having the dispositions and capacities to use mathematical knowledge and skills purposefully.

Mathematics has a central role in the development of numeracy in a manner that is more explicit and foregrounded than is the case in other learning areas. It is important that the Mathematics curriculum provides the opportunity to apply mathematical understanding and skills in context, both in other learning areas and in real world contexts. A particularly important context for the application of **Number and Algebra** is financial mathematics. In **Measurement and Geometry**, there is an opportunity to apply understanding to design. The twenty-first century world is information driven, and through **Statistics and Probability** students can interpret data and make informed judgments about events involving chance.

Information and Communication Technology (ICT) capability

Students develop ICT capability as they learn to use ICT effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas at school, and in their lives beyond school. ICT capability involves students in learning to make the most of the technologies available to them, adapting to new ways of doing things as technologies evolve and limiting the risks to themselves and others in a digital environment.

Students develop ICT capability when they investigate, create and communicate mathematical ideas and concepts using fast, automated, interactive and multimodal technologies. They employ their ICT capability to perform calculations, draw graphs, collect, manage, analyse and interpret data; share and exchange information and ideas and investigate and model concepts and relationships.

Digital technologies, such as spreadsheets, dynamic geometry software and computer algebra software, can engage students and promote understanding of key concepts.

Critical and creative thinking

Students develop capability in critical and creative thinking as they learn to generate and evaluate knowledge, clarify concepts and ideas, seek possibilities, consider alternatives and solve problems. Critical and creative thinking are integral to activities that require students to think broadly and deeply using skills, behaviours and dispositions such as reason, logic, resourcefulness, imagination and innovation in all learning areas at school and in their lives beyond school.

Students develop critical and creative thinking as they learn to generate and evaluate knowledge, ideas and possibilities, and use them when seeking solutions. Engaging students in reasoning and thinking about solutions to problems and the strategies needed to find these solutions are core parts of the Mathematics curriculum.

Students are encouraged to be critical thinkers when justifying their choice of a calculation strategy or identifying relevant questions during a statistical investigation. They are encouraged to look for alternative ways to approach mathematical problems, for example, identifying when a problem is similar to a previous one, drawing diagrams or simplifying a problem to control some variables.

Personal and social capability

Students develop personal and social capability as they learn to understand themselves and others, and manage their relationships, lives, work and learning more effectively. The personal and social capability involves students in a range of practices including recognising and regulating emotions, developing empathy for and understanding of others, establishing positive relationships, making responsible decisions, working effectively in teams and handling challenging situations constructively.

Students develop and use personal and social capability as they apply mathematical skills in a range of personal and social contexts. This may be through activities that relate learning to their own lives and communities, such as time management, budgeting and financial management, and understanding statistics in everyday contexts.

The Mathematics curriculum enhances the development of students' personal and social capabilities by providing opportunities for initiative taking, decision making, communicating their processes and findings, and working independently and collaboratively in the Mathematics classroom.

Ethical behaviour

Students develop the capability to behave ethically as they identify and investigate the nature of ethical concepts, values, character traits and principles, and understand how reasoning can assist ethical judgment. Ethical behaviour involves students in building a strong personal and socially oriented ethical outlook that helps them to manage context, conflict and uncertainty, and to develop an awareness of the influence that their values and behaviour have on others.

There are opportunities in the Mathematics curriculum to explore, develop and apply ethical behaviour in a range of contexts, for example through analysing data and statistics; seeking intentional and accidental distortions; finding inappropriate comparisons and misleading scales when exploring the importance of fair comparison; and interrogating financial claims and sources.

Intercultural understanding

Students develop intercultural understanding as they learn to value their own cultures, languages and beliefs, and those of others. They come to understand how personal, group and national identities are shaped, and the variable and changing nature of culture. The capability involves students in learning about and engaging with diverse cultures in ways that recognise commonalities and differences, create connections with others and cultivate mutual respect.

Intercultural understanding can be enhanced in Mathematics when students are exposed to a range of cultural traditions. Students learn to understand that mathematical expressions use universal symbols, while mathematical knowledge has its origin in many cultures. Students realise that proficiencies such as understanding, fluency, reasoning and problem solving are not culture or language specific, but that mathematical reasoning and understanding can find different expression in different cultures and languages. New technologies and digital learning environments provide interactive contexts for exploring mathematical problems from a range of cultural perspectives and within diverse cultural contexts. Students can apply mathematical thinking to identify and resolve issues related to living with diversity.

Cross-curriculum priorities

There are three cross curriculum priorities in the Australian Curriculum:

- Aboriginal and Torres Strait Islander histories and cultures
- Asia and Australia's engagement with Asia
- Sustainability.

The cross curriculum priorities are embedded in the curriculum and will have a strong but varying presence depending on their relevance to each of the learning areas.

Aboriginal and Torres Strait Islander histories and cultures

Aboriginal and Torres Strait Islander communities are strong, rich and diverse. Aboriginal and Torres Strait Islander Identity is central to this priority and is intrinsically linked to living, learning Aboriginal and Torres Strait Islander communities, deep knowledge traditions and holistic world view.

A conceptual framework based on Aboriginal and Torres Strait Islander Peoples' unique sense of Identity has been developed as a structural tool for the embedding of Aboriginal and Torres Strait Islander histories and cultures within the Australian curriculum. This sense of Identity is approached through the interconnected aspects of Country/Place, People and Culture. Embracing these elements enhances all areas of the curriculum.

The Aboriginal and Torres Strait Islander priority provides opportunities for all learners to deepen their knowledge of Australia by engaging with the world's oldest continuous living cultures. This knowledge and understanding will enrich their ability to participate positively in the ongoing development of Australia.

The Australian Curriculum: mathematics values Aboriginal and Torres Strait Islander histories and cultures. It provides opportunities for students to appreciate that Aboriginal and Torres Strait Islander societies have sophisticated applications of mathematical concepts.

Students will explore connections between representations of number and pattern and how they relate to aspects of Aboriginal and Torres Strait Islander cultures. They will investigate time, place, relationships and measurement concepts in Aboriginal and Torres Strait Islander contexts. Students will deepen their understanding of the lives of Aboriginal and Torres Strait Islander Peoples through the application and evaluation of statistical data.

Asia and Australia's engagement with Asia

In the Australian Curriculum: Mathematics, the priority of Asia and Australia's engagement with Asia provides rich and engaging contexts for developing students' mathematical knowledge, skills and understanding.

The Australian Curriculum: Mathematics provides opportunities for students to learn about the understandings and applications of Mathematics in Asia. Mathematicians from Asia continue to contribute to the ongoing development of Mathematics.

In this learning area, students develop mathematical understanding in fields such as number, patterns, measurement, symmetry and statistics by drawing on knowledge of and examples from the Asia region. These could include calculation, money, art, architecture, design and travel. Investigations involving data collection, representation and analysis can be used to examine issues pertinent to the Asia region.

Sustainability

In the Australian Curriculum: Mathematics, the priority of sustainability provides rich, engaging and authentic contexts for developing students' abilities in number and algebra, measurement and geometry, and statistics and probability.

The Australian Curriculum: Mathematics provides opportunities for students to develop the proficiencies of problem solving and reasoning essential for the exploration of sustainability issues and their solutions. Mathematical understandings and skills are necessary to measure, monitor and quantify change in social, economic and ecological systems over time. Statistical analysis enables prediction of probable futures based on findings and helps inform decision making and actions that will lead to preferred futures.

In this learning area, students can observe, record and organise data collected from primary sources over time and analyse data relating to issues of sustainability from secondary sources. They can apply spatial reasoning, measurement, estimation, calculation and comparison to gauge local ecosystem health and can cost proposed actions for sustainability.

Learning in mathematics involves the use of knowledge and skills learnt in other areas, particularly in English, science and history.

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

English

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

Science

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

History

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

Implications for teaching, assessment and reporting

In mathematics, challenging problems can be posed using basic age-appropriate content. Accelerating students by using content beyond their year level may not be the best way to extend proficient mathematicians. Choosing engaging experiences as contexts for a variety of tasks assists in making mathematics inclusive, and these tasks can be effectively differentiated both for students experiencing difficulty and those who complete tasks easily. The proficiency strands apply expectations of the range and nature of how mathematical content is enacted, and can help focus teaching.

Teachers use the Australian Curriculum content and achievement standards first to identify current levels of learning and achievement and then to select the most appropriate content (possibly from across several year levels) to teach individual students and/or groups of students. This takes into account that in each class there may be students with a range of prior achievement (below, at, and above the year level expectations) and that teachers plan to build on current learning.

Teachers also use the achievement standards, at the end of a period of teaching, to make on-balance judgments about the quality of learning demonstrated by the students – that is whether they have achieved below, at, or above the standard. To make these judgments, teachers draw on assessment data that they have collected as evidence during the course of the teaching period. These judgments about the quality of learning are one source of feedback to students and their parents and inform formal reporting processes.

If a teacher judges that a student's achievement is below the expected standard, this suggests that the teaching programs and practice should be reviewed to better assist individual students in their learning in the future. It also suggests that additional support and targeted teaching will be needed to ensure that the student does not fall behind.

Assessment of the Australian Curriculum takes place in different levels and for different purposes, including:

- ongoing formative assessment within classrooms for the purposes of monitoring learning and providing feedback, to teachers to inform their teaching, and for students to inform their learning
- summative assessment for the purposes of twice-yearly reporting by schools to parents and carers on the progress and achievement of students
- annual testing of Years 3, 5, 7 and 9 students' levels of achievement in aspects of literacy and numeracy, conducted as part of the National Assessment Program – Literacy and Numeracy (NAPLAN)
- periodic sample testing of specific learning areas within the Australian Curriculum as part of the National Assessment Program (NAP).

Foundation Year

The proficiency strands **Understanding, Fluency, Problem Solving** and **Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra**, **Measurement and Geometry,** and **Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes connecting names, numerals and quantities

Fluency includes readily counting numbers in sequences, continuing patterns, and comparing the lengths of objects

Problem Solving includes using materials to model authentic problems, sorting objects, using familiar counting sequences to solve unfamiliar problems, and discussing the reasonableness of the answer

Reasoning includes explaining comparisons of quantities, creating patterns, and explaining processes for indirect comparison of length

Number and Algebra

Number and place value	Elaborations
Establish understanding of the language and processes of counting by naming numbers in sequences, initially to and from 20, moving from any starting point (ACMNA001)	• reading stories from other cultures featuring counting in sequence to assist students to recognise ways of counting in local languages and across cultures • identifying the number words in sequence, backwards and forwards, and reasoning with the number sequences, establishing the language on which subsequent counting experiences can be built • developing fluency with forwards and backwards counting in meaningful contexts, including stories and rhymes • understanding that numbers are said in a particular order and there are patterns in the way we say them
Connect number names, numerals and quantities, including zero, initially up to 10 and then beyond (ACMNA002)	• 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 'how many' question • using scenarios to help students recognise that other cultures count in a variety of ways, such as by placing one pebble in a bag to represent one object (for example to count the number of cattle).
Subitise small collections of objects (ACMNA003)	• using subitising as the basis for ordering and comparing collections of numbers

Compare, order and make correspondences between collections, initially to 20, and explain reasoning (ACMNA289) 	• comparing and ordering items of like and unlike characteristics using the words ‘more’, ‘less’, ‘same as’ and ‘not the same as’ and giving reasons for these answers • understanding and using terms such as ‘first’ and ‘second’ to indicate ordinal position in a sequence. • using objects which are personally and culturally relevant to students
Represent practical situations to model addition and sharing (ACMNA004) 	• using a range of practical strategies for adding small groups of numbers, such as visual displays or concrete materials • using Aboriginal and Torres Strait Islander methods of adding, including spatial patterns and reasoning
Patterns and algebra	**Elaborations**
Sort and classify familiar objects and explain the basis for these classifications. Copy, continue and create patterns with objects and drawings (ACMNA005) 	• observing natural patterns in the world around us • creating and describing patterns using materials, sounds, movements or drawings

Measurement and Geometry

Using units of measurement	**Elaborations**
Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language (ACMMG006) 	• comparing objects directly, by placing one object against another to determine which is longer or by pouring from one container into the other to see which one holds more • using suitable language associated with measurement attributes, such as ‘tall’ and ‘taller’, ‘heavy’ and ‘heavier’, ‘holds more’ and ‘holds less’
Compare and order the duration of events using the everyday language of time (ACMMG007) 	• knowing and identifying the days of the week and linking specific days to familiar events • sequencing familiar events in time order
Connect days of the week to familiar events and actions (ACMMG008) 	• choosing events and actions that make connections with students’ everyday family routines
Shape	**Elaborations**
Sort, describe and name familiar two-dimensional shapes and three-dimensional objects in the environment (ACMMG009) 	• sorting and describing squares, circles, triangles, rectangles, spheres and cubes
Location and transformation	**Elaborations**

Describe position and movement (ACMMG010) 	• interpreting the everyday language of location and direction, such as ‘between’, ‘near’, ‘next to’, ‘forwards’, ‘towards’ • following and giving simple directions to guide a friend around an obstacle path and vice versa

Statistics and Probability

Data representation and interpretation	Elaborations
Answer yes/no questions to collect information (ACMSP011) 	• posing questions about themselves and familiar objects and events • representing responses to questions using simple displays, including grouping students according to their answers • using data displays to answer simple questions such as ‘how many students answered “yes” to having brown hair?’

Foundation Year achievement standard

By the end of the Foundation year, students make connections between number names, numerals and quantities up to 10. They compare objects using mass, length and capacity. Students connect events and the days of the week. They explain the order and duration of events. They use appropriate language to describe location.

Students count to and from 20 and order small collections. They group objects based on common characteristics and sort shapes and objects. Students answer simple questions to collect information.

Year 1

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level: Understanding includes connecting names, numerals and quantities, and partitioning numbers in various ways

Fluency includes counting number in sequences readily forward and backwards, locating numbers on a line, and naming the days of the week

Problem Solving includes using materials to model authentic problems, giving and receiving directions to unfamiliar places, and using familiar counting sequences to solve unfamiliar problems and discusing the reasonableness of the answer

Reasoning includes explaining direct and indirect comparisons of length using uniform informal units, justifying representations of data, and explaining patterns that have been created

Number and Algebra

Number and place value	Elaborations
Develop confidence with number sequences to and from 100 by ones from any starting point. Skip count by twos, fives and tens starting from zero (ACMNA012)	• using the popular Korean counting game (sam-yuk-gu) for skip counting • developing fluency with forwards and backwards counting in meaningful contexts such as circle games
Recognise, model, read, write and order numbers to at least 100. Locate these numbers on a number line (ACMNA013)	• modelling numbers with a range of material and images • identifying numbers that are represented on a number line and placing numbers on a prepared number line
Count collections to 100 by partitioning numbers using place value (ACMNA014)	• understanding partitioning of numbers and the importance of grouping in tens • understanding two-digit numbers as comprised of tens and ones/units
Represent and solve simple addition and subtraction problems using a range of strategies including counting on, partitioning and rearranging parts (ACMNA015)	• developing a range of mental strategies for addition and subtraction problems

Fractions and decimals	Elaborations
Recognise and describe one-half as one of two equal parts of a whole. (ACMNA016)	• sharing a collection of readily available materials into two equal portions • splitting an object into two equal pieces and describing how the pieces are equal

Money and financial mathematics	Elaborations
Recognise, describe and order Australian coins according to their value (ACMNA017) 	• showing that coins are different in other countries by comparing Asian coins to Australian coins • understanding that the value of Australian coins is not related to size • describing the features of coins that make it possible to identify them

Patterns and algebra	Elaborations
Investigate and describe number patterns formed by skip counting and patterns with objects (ACMNA018) 	• using place-value patterns beyond the teens to generalise the number sequence and predict the next number • investigating patterns in the number system, such as the occurrence of a particular digit in the numbers to 100

Measurement and Geometry

Using units of measurement	Elaborations
Measure and compare the lengths and capacities of pairs of objects using uniform informal units (ACMMG019) 	• understanding that in order to compare objects, the unit of measurement must be the same size
Tell time to the half-hour (ACMMG020) 	• reading time on analogue and digital clocks and observing the characteristics of half-hour times
Describe duration using months, weeks, days and hours (ACMMG021) 	• describing the duration of familiar situations such as ‘how long is it until we next come to school?’

Shape	Elaborations
Recognise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features (ACMMG022) 	• focusing on geometric features and describing shapes and objects using everyday words such as 'corners', 'edges' and 'faces'

Location and transformation	Elaborations
Give and follow directions to familiar locations (ACMMG023) 	• understanding that people need to give and follow directions to and from a place, and that this involves turns, direction and distance • understanding the meaning and importance of words such as ‘clockwise’, ‘anticlockwise’, ‘forward’ and ‘under’ when giving and following directions • interpreting and following directions around familiar locations

Statistics and Probability	
Chance	**Elaborations**
Identify outcomes of familiar events involving chance and describe them using everyday language such as ‘will happen’, ‘won’t happen’ or ‘might happen’ (ACMSP024) 	• justifying that some events are certain or impossible
Data representation and interpretation	**Elaborations**
Choose simple questions and gather responses (ACMSP262) 	• determining which questions will gather appropriate responses for a simple investigation
Represent data with objects and drawings where one object or drawing represents one data value. Describe the displays (ACMSP263) 	• understanding one-to-one correspondence • describing displays by identifying categories with the greatest or least number of objects

Year 1 achievement standard

By the end of Year 1, students describe number sequences resulting from skip counting by 2s, 5s and 10s. They identify representations of one half. They recognise Australian coins according to their value. Students explain time durations. They describe two-dimensional shapes and three-dimensional objects. Students describe data displays.

Students count to and from 100 and locate numbers on a number line. They carry out simple additions and subtractions using counting strategies. They partition numbers using place value. They continue simple patterns involving numbers and objects. Students order objects based on lengths and capacities using informal units. They tell time to the half hour. They use the language of direction to move from place to place. Students classify outcomes of simple familiar events. They collect data by asking questions and draw simple data displays.

Year 2

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry,** and **Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes connecting number calculations with counting sequences, partitioning and combining numbers flexibly, identifying and describing the relationship between addition and subtraction and between multiplication and division

Fluency includes counting numbers in sequences readily, using informal units iteratively to compare measurements, using the language of chance to describe outcomes of familiar chance events and describing and comparing time durations

Problem Solving includes formulating problems from authentic situations, making models and using number sentences that represent problem situations, and matching transformations with their original shape

Reasoning includes using known facts to derive strategies for unfamiliar calculations, comparing and contrasting related models of operations, and creating and interpreting simple representations of data

Number and Algebra

Number and place value	Elaborations
Investigate number sequences, initially those increasing and decreasing by twos, threes, fives and ten from any starting point, then moving to other sequences. (ACMNA026)	• developing fluency and confidence with numbers and calculations by saying number sequences • recognising patterns in number sequences, such as adding 10 always results in the same final digit
Recognise, model, represent and order numbers to at least 1000 (ACMNA027)	• recognising there are different ways of representing numbers and identifying patterns going beyond 100 • developing fluency with writing numbers in meaningful contexts
Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting (ACMNA028)	• using an abacus to model and represent numbers • understanding three-digit numbers as comprised of hundreds, tens and ones/units • demonstrating and using models such as linking blocks, sticks in bundles, place-value blocks and Aboriginal bead strings and explaining reasoning
Explore the connection between addition and subtraction (ACMNA029)	• becoming fluent with partitioning numbers to understand the connection between addition and subtraction • using counting on to identify the missing element in an additive problem

Solve simple addition and subtraction problems using a range of efficient mental and written strategies (ACMNA030) 	• becoming fluent with a range of mental strategies for addition and subtraction problems, such as commutativity for addition, building to 10, doubles, 10 facts and adding 10 • modelling and representing simple additive situations using materials such as 10 frames, 20 frames and empty number lines
Recognise and represent multiplication as repeated addition, groups and arrays (ACMNA031) 	• representing array problems with available materials and explaining reasoning • visualising a group of objects as a unit and using this to calculate the number of objects in several identical groups
Recognise and represent division as grouping into equal sets and solve simple problems using these representations (ACMNA032) 	• dividing the class or a collection of objects into equal-sized groups • identifying the difference between dividing a set of objects into three equal groups and dividing the same set of objects into groups of three
Fractions and decimals	**Elaborations**
Recognise and interpret common uses of halves, quarters and eighths of shapes and collections (ACMNA033) 	• recognising that sets of objects can be partitioned in different ways to demonstrate fractions • relating the number of parts to the size of a fraction
Money and financial mathematics	**Elaborations**
Count and order small collections of Australian coins and notes according to their value (ACMNA034) 	• identifying equivalent values in collections of coins or notes, such as two five-cent coins having the same value as one 10-cent coin • counting collections of coins or notes to make up a particular value, such as that shown on a price tag
Patterns and algebra	**Elaborations**
Describe patterns with numbers and identify missing elements (ACMNA035) 	• describing a pattern created by skip counting and representing the pattern on a number line • investigating features of number patterns resulting from adding twos, fives or 10s
Solve problems by using number sentences for addition or subtraction (ACMNA036) 	• representing a word problem as a number sentence • writing a word problem to represent a number sentence
Measurement and Geometry	
Using units of measurement	**Elaborations**

Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units (ACMMG037)	• comparing lengths using finger length, hand span or a piece of string • comparing areas using the palm of the hand or a stone • comparing capacities using a range of containers
Compare masses of objects using balance scales (ACMMG038)	• using balance scales to determine whether the mass of different objects is more, less or about the same, or to find out how many marbles are needed to balance a tub of margarine or a carton of milk
Tell time to the quarter-hour, using the language of 'past' and 'to' (ACMMG039)	• describing the characteristics of quarter-past times on an analogue clock, and identifying that the small hand is pointing just past the number and the big hand is pointing to the three
Name and order months and seasons (ACMMG040)	• investigating the seasons used by Aboriginal people, comparing them to those used in Western society and recognising the connection to weather patterns.
Use a calendar to identify the date and determine the number of days in each month (ACMMG041)	• using calendars to locate specific information, such as finding a given date on a calendar and saying what day it is, and identifying personally or culturally specific days
Shape	**Elaborations**
Describe and draw two-dimensional shapes, with and without digital technologies (ACMMG042)	• identifying key features of squares, rectangles, triangles, kites, rhombuses and circles, such as straight lines or curved lines, and counting the edges and corners
Describe the features of three-dimensional objects (ACMMG043)	• identifying geometric features such as the number of faces, corners or edges
Location and transformation	**Elaborations**
Interpret simple maps of familiar locations and identify the relative positions of key features (ACMMG044)	• understanding that we use representations of objects and their positions, such as on maps, to allow us to receive and give directions and to describe place • constructing arrangements of objects from a set of directions
Investigate the effect of one-step slides and flips with and without digital technologies (ACMMG045)	• understanding that objects can be moved but changing position does not alter an object’s size or features
Identify and describe half and quarter turns (ACMMG046)	• predicting and reproducing a pattern based around half and quarter turns of a shape and sketching the next element in the pattern
Statistics and Probability	

Chance	Elaborations
Identify practical activities and everyday events that involve chance. Describe outcomes as ‘likely’ or ‘unlikely’ and identify some events as ‘certain’ or ‘impossible’ (ACMSP047) 	• classifying a list of everyday events according to how likely they are to happen, using the language of chance, and explaining reasoning
Data representation and interpretation	**Elaborations**
Identify a question of interest based on one categorical variable. Gather data relevant to the question (ACMSP048) 	• determining the variety of birdlife in the playground and using a prepared table to record observations
Collect, check and classify data (ACMSP049) 	• recognising the usefulness of tally marks • identifying categories of data and using them to sort data
Create displays of data using lists, table and picture graphs and interpret them (ACMSP050) 	• creating picture graphs to represent data using one-to-one correspondence • comparing the usefulness of different data displays

Year 2 achievement standard

By the end of Year 2, students recognise increasing and decreasing number sequences involving 2s, 3s and 5s. They represent multiplication and division by grouping into sets. They associate collections of Australian coins with their value. Students identify the missing element in a number sequence. Students recognise the features of three-dimensional objects. They interpret simple maps of familiar locations. They explain the effects of one-step transformations. Students make sense of collected information.

Students count to and from 1000. They perform simple addition and subtraction calculations using a range of strategies. They divide collections and shapes into halves, quarters and eighths. Students order shapes and objects using informal units. They tell time to the quarter hour and use a calendar to identify the date and the months included in seasons. They draw two- dimensional shapes. They describe outcomes for everyday events. Students collect data from relevant questions to create lists, tables and picture graphs.

Year 3

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes connecting number representations with number sequences, partitioning and combining numbers flexibly, representing unit fractions, using appropriate language to communicate times, and identifying environmental symmetry

Fluency includes recalling multiplication facts, using familiar metric units to order and compare objects, identifying and describing outcomes of chance experiments, interpreting maps and communicating positions

Problem Solving includes formulating and modelling authentic situations involving planning methods of data collection and representation, making models of three-dimensional objects and using number properties to continue number patterns

Reasoning includes using generalising from number properties and results of calculations, comparing angles, creating and interpreting variations in the results of data collections and data displays

Number and Algebra

Number and place value	Elaborations
Investigate the conditions required for a number to be odd or even and identify odd and even numbers (ACMNA051)	• identifying even numbers using skip counting by twos or by grouping even collections of objects in twos • 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
Recognise, model, represent and order numbers to at least 10 000 (ACMNA052)	• placing four-digit numbers on a number line using an appropriate scale • reproducing numbers in words using their numerical representations and vice versa
Apply place value to partition, rearrange and regroup numbers to at least 10 000 to assist calculations and solve problems (ACMNA053)	• recognising that 10 000 equals 10 thousands, 100 hundreds, 1000 tens and 10 000 ones • justifying choices about partitioning and regrouping numbers in terms of their usefulness for particular calculations
Recognise and explain the connection between addition and subtraction (ACMNA054)	• demonstrating the connection between addition and subtraction using partitioning or by writing equivalent number sentences

Recall addition facts for single-digit numbers and related subtraction facts to develop increasingly efficient mental strategies for computation (ACMNA055)	• recognising that certain single-digit number combinations always result in the same answer for addition and subtraction, and using this knowledge for addition and subtraction of larger numbers • combining knowledge of addition and subtraction facts and partitioning to aid computation (for example 57 + 19 = 57 + 20 – 1)
Recall multiplication facts of two, three, five and ten and related division facts (ACMNA056)	• establishing multiplication facts using number sequences
Represent and solve problems involving multiplication using efficient mental and written strategies and appropriate digital technologies (ACMNA057)	• writing simple word problems in numerical form and vice versa • using a calculator to check the solution and reasonableness of the answer
Fractions and decimals	**Elaborations**
Model and represent unit fractions including 1/2, 1/4, 1/3, 1/5 and their multiples to a complete whole (ACMNA058)	• partitioning areas, lengths and collections to create halves, thirds, quarters and fifths, such as folding the same sized sheets of paper to illustrate different unit fractions and comparing the number of parts with their sizes • locating unit fractions on a number line • recognising that in English the term ‘one third’ is used (order: numerator, denominator) but that in other languages this concept may be expressed as ‘three parts, one of them’ (order: denominator, numerator) for example Japanese
Money and financial mathematics	**Elaborations**
Represent money values in multiple ways and count the change required for simple transactions to the nearest five cents (ACMNA059)	• recognising the relationship between dollars and cents, and that not all countries use these denominations and divisions (for example Japanese Yen)
Patterns and algebra	**Elaborations**
Describe, continue, and create number patterns resulting from performing addition or subtraction (ACMNA060)	• identifying and writing the rules for number patterns • describing a rule for a number pattern, then creating the pattern
Measurement and Geometry	
Using units of measurement	**Elaborations**
Measure, order and compare objects using familiar metric units of length, mass and capacity (ACMMG061)	• recognising the importance of using common units of measurement • recognising and using centimetres and metres, grams and kilograms, and millilitres and litres

Tell time to the minute and investigate the relationship between units of time (ACMMG062) 	• recognising there are 60 minutes in an hour and 60 seconds in a minute
Shape	**Elaborations**
Make models of three-dimensional objects and describe key features (ACMMG063) 	• exploring the creation of three-dimensional objects using origami, including prisms and pyramids
Location and transformation	**Elaborations**
Create and interpret simple grid maps to show position and pathways (ACMMG065) 	• creating a map of the classroom or playground
Identify symmetry in the environment (ACMMG066) 	• identifying symmetry in Aboriginal rock carvings or art • identifying symmetry in the natural and built environment
Geometric reasoning	**Elaborations**
Identify angles as measures of turn and compare angle sizes in everyday situations (ACMMG064) 	• opening doors partially and fully and comparing the size of the angles created • recognising that analogue clocks use the turning of arms to indicate time, and comparing the size of angles between the arms for familiar times
Statistics and Probability	
Chance	**Elaborations**
Conduct chance experiments, identify and describe possible outcomes and recognise variation in results (ACMSP067)	• conducting repeated trials of chance experiments such as tossing a coin or drawing a ball from a bag and identifying the variations between trials
Data representation and interpretation	**Elaborations**
Identify questions or issues for categorical variables. Identify data sources and plan methods of data collection and recording (ACMSP068) 	• refining questions and planning investigations that involve collecting data, and carrying out the investigation (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?’)

Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies (ACMSP069) 	• exploring meaningful and increasingly efficient ways to record data, and representing and reporting the results of investigations • collecting data to investigate features in the natural environment
Interpret and compare data displays (ACMSP070) 	• comparing various student-generated data representations and describing their similarities and differences

Year 3 achievement standard

By the end of Year 3, students recognise the connection between addition and subtraction and solve problems using efficient strategies for multiplication. They model and represent unit fractions. They represent money values in various ways. Students identify symmetry in the environment. They match positions on maps with given information. Students recognise angles in real situations. They interpret and compare data displays.

Students count to and from 10 000. They classify numbers as either odd or even. They recall addition and multiplication facts for single digit numbers. Students correctly count out change from financial transactions. They continue number patterns involving addition and subtraction. Students use metric units for length, mass and capacity. They tell time to the nearest minute. Students make models of three-dimensional objects. Students conduct chance experiments and list possible outcomes. They carry out simple data investigations for categorical variables.

Year 4

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes making connections between representations of numbers, partitioning and combining numbers flexibly, extending place value to decimals, using appropriate language to communicate times, and describing properties of symmetrical shapes

Fluency includes recalling multiplication tables, communicating sequences of simple fractions, using instruments to measure accurately, creating patterns with shapes and their transformations, and collecting and recording data

Problem Solving includes formulating, modelling and recording authentic situations involving operations, comparing large numbers with each other, comparing time durations, and using properties of numbers to continue patterns

Reasoning includes using generalising from number properties and results of calculations, deriving strategies for unfamiliar multiplication and division tasks, comparing angles, communicating information using graphical displays and evaluating the appropriateness of different displays

Number and Algebra

Number and place value	Elaborations
Investigate and use the properties of odd and even numbers (ACMNA071)	• using the four operations with pairs of odd or even numbers or one odd and one even number, then using the relationships established to check the accuracy of calculations
Recognise, represent and order numbers to at least tens of thousands (ACMNA072)	• reproducing five-digit numbers in words using their numerical representations, and vice versa
Apply place value to partition, rearrange and regroup numbers to at least tens of thousands to assist calculations and solve problems (ACMNA073)	• recognising and demonstrating that the place-value pattern is built on the operations of multiplication or division of tens
Investigate number sequences involving multiples of 3, 4, 6, 7, 8, and 9 (ACMNA074)	• recognising that number sequences can be extended indefinitely, and determining any patterns in the sequences
Recall multiplication facts up to 10 × 10 and related division facts (ACMNA075)	• using known multiplication facts to calculate related division facts

Develop efficient mental and written strategies and use appropriate digital technologies for multiplication and for division where there is no remainder (ACMNA076) 	• using known facts and strategies, such as commutativity, doubling and halving for multiplication, and connecting division to multiplication when there is no remainder
Fractions and decimals	**Elaborations**
Investigate equivalent fractions used in contexts (ACMNA077) 	• exploring the relationship between families of fractions (halves, quarters and eighths or thirds and sixths) by folding a series of paper strips to construct a fraction wall
Count by quarters halves and thirds, including with mixed numerals. Locate and represent these fractions on a number line (ACMNA078) 	• converting mixed numbers to improper fractions and vice versa • investigating the use of fractions and sharing as a way of managing Country: for example taking no more than half the eggs from a nest to protect future bird populations
Recognise that the place value system can be extended to tenths and hundredths. Make connections between fractions and decimal notation (ACMNA079) 	• using division by 10 to extend the place-value system • using knowledge of fractions to establish equivalences between fractions and decimal notation
Money and financial mathematics	**Elaborations**
Solve problems involving purchases and the calculation of change to the nearest five cents with and without digital technologies (ACMNA080) 	• recognising that not all countries use dollars and cents, eg India uses rupees. • Carrying out calculations in another currency as well as in dollars and cents, and identifying both as decimal systems
Patterns and algebra	**Elaborations**
Explore and describe number patterns resulting from performing multiplication (ACMNA081) 	• identifying examples of number patterns in everyday life
Solve word problems by using number sentences involving multiplication or division where there is no remainder (ACMNA082) 	• representing a word problem as a number sentence • writing a word problem using a given number sentence
Use equivalent number sentences involving addition and subtraction to find unknown quantities (ACMNA083) 	• writing number sentences to represent and answer questions such as: ‘When a number is added to 23 the answer is the same as 57 minus 19. What is the number?’ • using partitioning to find unknown quantities in number sentences

Measurement and Geometry

Using units of measurement	Elaborations
Use scaled instruments to measure and compare lengths, masses, capacities and temperatures (ACMMG084) 	• reading and interpreting the graduated scales on a range of measuring instruments to the nearest graduation
Compare objects using familiar metric units of area and volume (ACMMG290) 	• comparing areas using grid paper • comparing volume using centicubes • recognising that metric units are not the only units used throughout the world, for example measuring the area of floor space using tatami mats (Japan), using squares for room and house area (Australia)
Convert between units of time (ACMMG085) 	• identifying and using the correct operation for converting units of time
Use am and pm notation and solve simple time problems (ACMMG086) 	• calculating the time spent at school during a normal school day • calculating the time required to travel between two locations • determining arrival time given departure time

Shape	Elaborations
Compare the areas of regular and irregular shapes by informal means (ACMMG087) 	• comparing areas using metric units, such as counting the number of square centimetres required to cover two areas by overlaying the areas with a grid of centimetre squares
Compare and describe two dimensional shapes that result from combining and splitting common shapes, with and without the use of digital technologies (ACMMG088) 	• identifying common two-dimensional shapes that are part of a composite shape by re-creating it from these shapes • creating a two-dimensional shapes from verbal or written instructions

Location and transformation	Elaborations
Use simple scales, legends and directions to interpret information contained in basic maps (ACMMG090) 	• identifying the scale used on maps of cities and rural areas in Australia and a city in Indonesia and describing the difference • using directions to find features on a map
Create symmetrical patterns, pictures and shapes with and without digital technologies (ACMMG091) 	• using stimulus materials such as the motifs in Central Asian textiles, Tibetan artefacts, Indian lotus designs and symmetry in Yolngu or Central and Western Desert art

Geometric reasoning	Elaborations

Compare angles and classify them as equal to, greater than or less than a right angle (ACMMG089) 	• creating angles and comparing them to a right angle using digital technologies

Statistics and Probability

Chance	Elaborations
Describe possible everyday events and order their chances of occurring (ACMSP092) 	• using lists of events familiar to students and ordering them from ‘least likely’ to ‘most likely’ to occur
Identify everyday events where one cannot happen if the other happens (ACMSP093) 	• using examples such as weather, which cannot be dry and wet at the same time
Identify events where the chance of one will not be affected by the occurrence of the other (ACMSP094) 	• explaining why the probability of a new baby being either a boy or a girl does not depend on the sex of the previous baby

Data representation and interpretation	Elaborations
Select and trial methods for data collection, including survey questions and recording sheets (ACMSP095) 	• comparing the effectiveness of different methods of collecting data • choosing the most effective way to collect data for a given investigation
Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data values (ACMSP096) 	• exploring ways of presenting data and showing the results of investigations • investigating data displays using many-to-one correspondence
Evaluate the effectiveness of different displays in illustrating data features including variability (ACMSP097) 	• interpreting data representations in the media and other forums in which symbols represent more than one data value • suggesting questions that can be answered by a given data display and using the display to answer questions

Year 4 achievement standard

By the end of Year 4, students choose appropriate strategies for calculations involving multiplication and division. They recognise common equivalent fractions in familiar contexts and make connections between fraction and decimal notations up to two decimal places. Students solve simple purchasing problems. They identify unknown quantities in number sentences. They describe number patterns resulting from multiplication. Students compare areas of regular and irregular shapes using informal units. They solve problems involving time duration. They interpret information contained in maps. Students identify dependent and independent events. They describe different methods for data collection and representation, and evaluate their effectiveness.

Students use the properties of odd and even numbers. They recall multiplication facts to 10 x 10 and related division facts. Students locate familiar fractions on a number line. They continue number sequences involving multiples of single digit numbers. Students use scaled instruments to measure temperatures, lengths, shapes and objects. They convert between units of time. Students create symmetrical shapes and patterns. They classify angles in relation to a right angle. Students list the probabilities of everyday events. They construct data displays from given or collected data.

Year 5

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes making connections between representations of numbers, using fractions to represent probabilities, comparing and ordering fractions and decimals and representing them in various ways, describing transformations and identifying line and rotational symmetry

Fluency includes choosing appropriate units of measurement for calculation of perimeter and area, using estimation to check the reasonableness of answers to calculations and using instruments to measure angles

Problem Solving includes formulating and solving authentic problems using whole numbers and measurements and creating financial plans

Reasoning includes investigating strategies to perform calculations efficiently, continuing patterns involving fractions and decimals, interpreting results of chance experiments, posing appropriate questions for data investigations and interpreting data sets

Number and Algebra

Number and place value	Elaborations
Identify and describe factors and multiples of whole numbers and use them to solve problems (ACMNA098)	• exploring factors and multiples using number sequences • using simple divisibility tests
Use estimation and rounding to check the reasonableness of answers to calculations (ACMNA099)	• recognising the usefulness of estimation to check calculations • applying mental strategies to estimate the result of calculations, such as estimating the cost of a supermarket trolley load
Solve problems involving multiplication of large numbers by one- or two-digit numbers using efficient mental, written strategies and appropriate digital technologies (ACMNA100)	• exploring techniques for multiplication such as the area model, the Italian lattice method or the partitioning of numbers • applying the distributive law and using arrays to model multiplication and explain calculation strategies
Solve problems involving division by a one digit number, including those that result in a remainder (ACMNA101)	• using the fact that equivalent division calculations result if both numbers are divided by the same factor • interpreting and representing the remainder in division calculations sensibly for the context

Use efficient mental and written strategies and apply appropriate digital technologies to solve problems (ACMNA291) 	• using calculators to check the reasonableness of answers
Fractions and decimals	**Elaborations**
Compare and order common unit fractions and locate and represent them on a number line (ACMNA102) 	• recognising the connection between the order of unit fractions and their denominators
Investigate strategies to solve problems involving addition and subtraction of fractions with the same denominator (ACMNA103) 	• modelling and solving addition and subtraction problems involving fractions by using jumps on a number line, or making diagrams of fractions as parts of shapes
Recognise that the place value system can be extended beyond hundredths (ACMNA104) 	• using knowledge of place value and division by 10 to extend the number system to thousandths and beyond • recognising the equivalence of one thousandths and 0.001
Compare, order and represent decimals (ACMNA105)	• locating decimals on a number line
Money and financial mathematics	**Elaborations**
Create simple financial plans (ACMNA106) 	• creating a simple budget for a class fundraising event • identifying the GST component of invoices and receipts
Patterns and algebra	**Elaborations**
Describe, continue and create patterns with fractions, decimals and whole numbers resulting from addition and subtraction (ACMNA107) 	• using the number line or diagrams to create patterns involving fractions or decimals
Use equivalent number sentences involving multiplication and division to find unknown quantities (ACMNA121) 	• using relevant problems to develop number sentences
Measurement and Geometry	
Using units of measurement	**Elaborations**

Choose appropriate units of measurement for length, area, volume, capacity and mass (ACMMG108) 	• investigating alternative measures of scale to demonstrate that these vary between countries and change over time, for example temperature measurement in Australia, Indonesia, Japan and USA • recognising that some units of measurement are better suited for some tasks than others, for example kilometres rather than metres to measure the distance between two towns
Calculate the perimeter and area of rectangles using familiar metric units (ACMMG109) 	• exploring efficient ways of calculating the perimeters of rectangles such as adding the length and width together and doubling the result • exploring efficient ways of finding the areas of rectangles
Compare 12- and 24-hour time systems and convert between them (ACMMG110) 	• investigating the ways time was and is measured in different Aboriginal Country, such as using tidal change • using units hours, minutes and seconds
Shape	**Elaborations**
Connect three-dimensional objects with their nets and other two-dimensional representations (ACMMG111) 	• identifying the shape and relative position of each face of a solid to determine the net of the solid, including that of prisms and pyramids • representing two-dimensional shapes such as photographs, sketches and images created by digital technologies
Location and transformation	**Elaborations**
Use a grid reference system to describe locations. Describe routes using landmarks and directional language (ACMMG113) 	• comparing aerial views of Country, desert paintings and maps with grid references • creating a grid reference system for the classroom and using it to locate objects and describe routes from one object to another
Describe translations, reflections and rotations of two-dimensional shapes. Identify line and rotational symmetries (ACMMG114) 	• identifying and describing the line and rotational symmetry of a range of two-dimensional shapes, by manually cutting, folding and turning shapes and by using digital technologies • identifying the effects of transformations by manually flipping, sliding and turning two-dimensional shapes and by using digital technologies
Apply the enlargement transformation to familiar two dimensional shapes and explore the properties of the resulting image compared with the original (ACMMG115) 	• using digital technologies to enlarge shapes • using a grid system to enlarge a favourite image or cartoon
Geometric reasoning	**Elaborations**

Estimate, measure and compare angles using degrees. Construct angles using a protractor (ACMMG112)	• measuring and constructing angles using both 180° and 360° protractors • recognising that angles have arms and a vertex, and that size is the amount of turn required for one arm to coincide with the other

Statistics and Probability

Chance	Elaborations
List outcomes of chance experiments involving equally likely outcomes and represent probabilities of those outcomes using fractions (ACMSP116)	• commenting on the likelihood of winning simple games of chance by considering the number of possible outcomes and the consequent chance of winning in simple games of chance such as jan-ken-pon (rock-paper-scissors)
Recognise that probabilities range from 0 to 1 (ACMSP117)	• investigating the probabilities of all outcomes for a simple chance experiment and verifying that their sum equals 1
Data representation and interpretation	**Elaborations**
Pose questions and collect categorical or numerical data by observation or survey (ACMSP118)	• posing questions about insect diversity in the playground, 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
Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies (ACMSP119)	• identifying the best methods of presenting data to illustrate the results of investigations and justifying the choice of representations
Describe and interpret different data sets in context (ACMSP120)	• using and comparing data representations for different data sets to help decision making

Year 5 achievement standard

By the end of Year 5, students solve simple problems involving the four operations using a range of strategies. They check the reasonableness of answers using estimation and rounding. Students identify and describe factors and multiples. They explain plans for simple budgets. Students connect three-dimensional objects with their two-dimensional representations. They describe transformations of two-dimensional shapes and identify line and rotational symmetry. Students compare and interpret different data sets.

Students order decimals and unit fractions and locate them on number lines. They add and subtract fractions with the same denominator. Students continue patterns by adding and subtracting fractions and decimals. They find unknown quantities in number sentences. They use appropriate units of measurement for length, area, volume, capacity and mass, and calculate perimeter and area of rectangles. They convert between 12 and 24 hour time. Students use a grid reference system to locate landmarks. They measure and construct different angles. Students list outcomes of chance experiments with equally likely outcomes and assign probabilities between 0 and 1. Students pose questions to gather data, and construct data displays appropriate for the data.

Year 6

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes describing properties of different sets of numbers, using fractions and decimals to describe probabilities, representing fractions and decimals in various ways and describing connections between them, and making reasonable estimations

Fluency includes representing integers on a number line, calculating simple percentages, using brackets appropriately, converting between fractions and decimals, using operations with fractions, decimals and percentages, measuring using metric units, and interpreting timetables

Problem Solving includes formulating and solving authentic problems using fractions, decimals, percentages and measurements, interpreting secondary data displays, and finding the size of unknown angles

Reasoning includes explaining mental strategies for performing calculations, describing results for continuing number sequences, explaining the transformation of one shape into another, explaining why the actual results of chanceexperiments may differ from expected results

Number and Algebra

Number and place value	Elaborations
Identify and describe properties of prime, composite, square and triangular numbers (ACMNA122)	• understanding that some numbers have special properties and that these properties can be used to solve problems • representing composite numbers as a product of their prime factors and using this form to simplify calculations by cancelling common primes • understanding that if a number is divisible by a composite number then it is also divisible by the prime factors of that number (for example 216 is divisible by 8 because the number represented by the last three digits is divisible by 8, and hence 216 is also divisible by 2 and 4)
Select and apply efficient mental and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers (ACMNA123)	• applying strategies already developed for solving problems involving small numbers to those involving large numbers • applying a range of strategies to solve realistic problems and commenting on the efficiency of different strategies

Investigate everyday situations that use integers. Locate and represent these numbers on a number line (ACMNA124) 	• understanding that integers are ...-3, -2, -1, 0, 1, 2, 3,..... • solving everyday additive problems using a number line • investigating everyday situations that use integers, such as temperatures • using number lines to position and order integers around zero
Fractions and decimals	**Elaborations**
Compare fractions with related denominators and locate and represent them on a number line (ACMNA125) 	• demonstrating equivalence between fractions using drawings and models
Solve problems involving addition and subtraction of fractions with the same or related denominators (ACMNA126) 	• understanding the processes for adding and subtracting fractions with related denominators and fractions as an operator, in preparation for calculating with all fractions • solving realistic additive (addition and subtraction) problems involving fractions to develop understanding of equivalent fractions and the use of fractions as operators • modelling and solving additive problems involving fractions by using methods such as jumps on a number line, or by making diagrams of fractions as parts of shapes
Find a simple fraction of a quantity where the result is a whole number, with and without digital technologies (ACMNA127) 	• recognising that finding one third of a quantity is the same as dividing by 3
Add and subtract decimals, with and without digital technologies, and use estimation and rounding to check the reasonableness of answers (ACMNA128) 	• extending whole-number strategies to explore and develop meaningful written strategies for addition and subtraction of decimal numbers to thousandths • exploring and practising efficient methods for solving problems requiring operations on decimals, to gain fluency with calculating with decimals and with recognising appropriate operations
Multiply decimals by whole numbers and perform divisions by non-zero whole numbers where the results are terminating decimals, with and without digital technologies (ACMNA129) 	• interpreting the results of calculations to provide an answer appropriate to the context
Multiply and divide decimals by powers of 10 (ACMNA130) 	• Multiplying and dividing decimals by multiples of powers of 10

Make connections between equivalent fractions, decimals and percentages (ACMNA131) 	• connecting fractions, decimals and percentages as different representations of the same number, moving fluently between representations and choosing the appropriate one for the problem being solved
Money and financial mathematics	**Elaborations**
Investigate and calculate percentage discounts of 10%, 25% and 50% on sale items, with and without digital technologies (ACMNA132) 	• using authentic information to calculate prices on sale goods
Patterns and algebra	**Elaborations**
Continue and create sequences involving whole numbers, fractions and decimals. Describe the rule used to create the sequence (ACMNA133) 	• identifying and generalising number patterns • investigating additive and multiplicative 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/decrease
Explore the use of brackets and order of operations to write number sentences (ACMNA134) 	• appreciating the need for rules to complete multiple operations within the same number sentence

Measurement and Geometry

Using units of measurement	**Elaborations**
Connect decimal representations to the metric system (ACMMG135) 	• recognising the equivalence of measurements such as 1.25 metres and 125 centimetres
Convert between common metric units of length, mass and capacity (ACMMG136) 	• identifying and using the correct operations when converting units including millimetres, centimetres, metres, kilometres, milligrams, grams, kilograms, tonnes, millilitres, litres, kilolitres and megalitres • recognising the significance of the prefixes in units of measurement
Solve problems involving the comparison of lengths and areas using appropriate units (ACMMG137) 	• recognising and investigating familiar objects using concrete materials and digital technologies
Connect volume and capacity and their units of measurement (ACMMG138) 	• recognising that 1ml is equivalent to 1cm3

Interpret and use timetables (ACMMG139) 	• planning a trip involving one or more modes of public transport • developing a timetable of daily activities

Shape	Elaborations
Construct simple prisms and pyramids (ACMMG140) 	• considering the history and significance of pyramids from a range of cultural perspectives including those structures found in China, Korea and Indonesia • constructing prisms and pyramids from nets, and skeletal models

Location and transformation	Elaborations
Investigate combinations of translations, reflections and rotations, with and without the use of digital technologies (ACMMG142) 	• designing a school or brand logo using transformation of one or more shapes • understanding that translations, rotations and reflections can change the position and orientation but not shape or size
Introduce the Cartesian coordinate system using all four quadrants (ACMMG143) 	• understanding that the Cartesian plane provides a graphical or visual way of describing location

Geometric reasoning	Elaborations
Investigate, with and without digital technologies, angles on a straight line, angles at a point and vertically opposite angles. Use results to find unknown angles (ACMMG141) 	• identifying the size of a right angle as 90° and defining acute, obtuse, straight and reflex angles • measuring, estimating and comparing angles in degrees and classifying angles according to their sizes • investigating the use of rotation and symmetry in the diagrammatic representations of kinship relationships of Central and Western Desert people • recognising and using the two alternate conventions for naming angles

Statistics and Probability

Chance	Elaborations
Describe probabilities using fractions, decimals and percentages (ACMSP144) 	• investigating games of chance popular in different cultures and evaluating the relative benefits to the organisers and participants (for example Pachinko)
Conduct chance experiments with both small and large numbers of trials using appropriate digital technologies (ACMSP145) 	• conducting repeated trials of chance experiments, identifying the variation between trials and realising that the results tend to the prediction with larger numbers of trials
Compare observed frequencies across experiments with expected frequencies (ACMSP146) 	• predicting likely outcomes from a run of chance events and distinguishing these from surprising results

Data representation and interpretation	Elaborations
Interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables (ACMSP147) 	• 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 • understanding that data can be represented in different ways, sometimes with one symbol representing more than one piece of data, and that it is important to read all information about a representation before making judgments
Interpret secondary data presented in digital media and elsewhere (ACMSP148) 	• investigating data representations in the media and discussing what they illustrate and the messages the people who created them might want to convey • identifying potentially misleading data representations in the media, such as 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

Year 6 achievement standard

By the end of Year 6, students recognise the properties of prime, composite, square and triangular numbers. They describe the use of integers in everyday contexts. They solve problems involving all four operations with whole numbers. Students connect fractions, decimals and percentages as different representations of the same number. They solve problems involving the addition and subtraction of related fractions. Students make connections between the powers of 10 and the multiplication and division of decimals. They describe rules used in sequences involving whole numbers, fractions and decimals. Students connect decimal representations to the metric system and choose appropriate units of measurement to perform a calculation. They make connections between capacity and volume. They solve problems involving length and area. They interpret timetables. Students describe combinations of transformations. They solve problems using the properties of angles. Students compare observed and expected frequencies. They interpret and compare a variety of data displays including those displays for two categorical variables. They evaluate secondary data displayed in the media.

Students locate fractions and integers on a number line. They calculate a simple fraction of a quantity. They add, subtract and multiply decimals and divide decimals where the result is rational. Students calculate common percentage discounts on sale items. They write correct number sentences using brackets and order of operations. Students locate an ordered pair in any one of the four quadrants on the Cartesian plane. They construct simple prisms and pyramids. Students list and communicate probabilities using simple fractions, decimals and percentages.

Year 7

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes describing patterns in uses of indices with whole numbers, recognising equivalences between fractions, decimals, percentages and ratios, plotting points on the Cartesian plane, identifying angles formed by a transversal crossing a pair of lines, and connecting the laws and properties of numbers to algebraic terms and expressions

Fluency includes calculating accurately with integers, representing fractions and decimals in various ways, investigating best buys, finding measures of central tendency and calculating areas of shapes and volumes of prisms

Problem Solving includes formulating and solving authentic problems using numbers and measurements,working with transformations and identifying symmetry, calculating angles and interpreting sets of data collected through chance experiments

Reasoning includes applying the number laws to calculations, applying known geometric facts to draw conclusions about shapes, applying an understanding of ratio and interpreting data displays

Number and Algebra

Number and place value	Elaborations
Investigate index notation and represent whole numbers as products of powers of prime numbers (ACMNA149)	• defining and comparing prime and composite numbers and explaining the difference between them • applying knowledge of factors to strategies for expressing whole numbers as products of powers of prime factors, such as repeated division by prime factors or creating factor trees • solving problems involving lowest common multiples and greatest common divisors (highest common factors) for pairs of whole numbers by comparing their prime factorisation
Investigate and use square roots of perfect square numbers (ACMNA150)	• investigating square numbers such as 25 and 36 and developing square-root notation • investigating between which two whole numbers a square root lies
Apply the associative, commutative and distributive laws to aid mental and written computation (ACMNA151)	• understanding that arithmetic laws are powerful ways of describing and simplifying calculations
Compare, order, add and subtract integers (ACMNA280)	
Real numbers	**Elaborations**

Compare fractions using equivalence. Locate and represent positive and negative fractions and mixed numbers on a number line (ACMNA152) 	• exploring equivalence among families of fractions by using a fraction wall or a number line (for example by using a fraction wall to show that 2/3 is the same as 4/6 and 6/9)
Solve problems involving addition and subtraction of fractions, including those with unrelated denominators (ACMNA153) 	• exploring and developing efficient strategies to solve additive problems involving fractions (for example by using fraction walls or rectangular arrays with dimensions equal to the denominators)
Multiply and divide fractions and decimals using efficient written strategies and digital technologies (ACMNA154) 	• investigating multiplication of fractions and decimals, using strategies including patterning and multiplication as repeated addition, with both concrete materials and digital technologies, and identifying the processes for division as the inverse of multiplication
Express one quantity as a fraction of another, with and without the use of digital technologies (ACMNA155) 	• using authentic examples for the quantities to be expressed and understanding the reasons for the calculations
Round decimals to a specified number of decimal places (ACMNA156) 	• using rounding to estimate the results of calculations with whole numbers and decimals, and understanding the conventions for rounding
Connect fractions, decimals and percentages and carry out simple conversions (ACMNA157) 	• justifying choices of written, mental or calculator strategies for solving specific problems including those involving large numbers • understanding that quantities can be represented by different number types and calculated using various operations, and that choices need to be made about each • calculating the percentage of the total local municipal area set aside for parkland, manufacturing, retail and residential dwellings to compare land use
Find percentages of quantities and express one quantity as a percentage of another, with and without digital technologies. (ACMNA158) 	• using authentic problems to express quantities as percentages of other amounts
Recognise and solve problems involving simple ratios (ACMNA173) 	• understanding that rate and ratio problems can be solved using fractions or percentages and choosing the most efficient form to solve a particular problem
Money and financial mathematics	**Elaborations**
Investigate and calculate 'best buys', with and without digital technologies (ACMNA174) 	• applying the unitary method to identify ‘best buys’ situations, such as comparing the cost per 100g

Patterns and algebra	Elaborations
Introduce the concept of variables as a way of representing numbers using letters (ACMNA175)	• understanding that arithmetic laws are powerful ways of describing and simplifying calculations and that using these laws leads to the generality of algebra
Create algebraic expressions and evaluate them by substituting a given value for each variable (ACMNA176)	• using authentic formulas to perform substitutions
Extend and apply the laws and properties of arithmetic to algebraic terms and expressions (ACMNA177)	• identifying order of operations in contextualised problems, preserving the order by inserting brackets in numerical expressions, then recognising how order is preserved by convention • moving fluently between algebraic and word representations as descriptions of the same situation

Linear and non-linear relationships	Elaborations
Given coordinates, plot points on the Cartesian plane, and find coordinates for a given point (ACMNA178)	• plotting points from a table of integer values and recognising simple patterns, such as points that lie on a straight line
Solve simple linear equations (ACMNA179)	• solving equations using concrete materials, such as the balance model, and explain the need to do the same thing to each side of the equation using substitution to check solutions • investigating a range of strategies to solve equations
Investigate, interpret and analyse graphs from authentic data (ACMNA180)	• using travel graphs to investigate and compare the distance travelled to and from school • interpreting features of travel graphs such as the slope of lines and the meaning of horizontal lines • using graphs of evaporation rates to explore water storage

Measurement and Geometry

Using units of measurement	Elaborations
Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving (ACMMG159)	• building on the understanding of the area of rectangles to develop formulas for the area of triangles • establishing that the area of a triangle is half the area of an appropriate rectangle • using area formulas for rectangles and triangles to solve problems involving areas of surfaces

Calculate volumes of rectangular prisms (ACMMG160)	• investigating volumes of cubes and rectangular prisms and establishing and using the formula V = l × b × h • understanding and using cubic units when interpreting and finding volumes of cubes and rectangular prisms

Shape	Elaborations
Draw different views of prisms and solids formed from combinations of prisms (ACMMG161)	• using aerial views of buildings and other 3-D structures to visualise the structure of the building or prism

Location and transformation	Elaborations
Describe translations, reflections in an axis, and rotations of multiples of 90° on the Cartesian plane using coordinates. Identify line and rotational symmetries (ACMMG181)	• describing patterns and investigating different ways to produce the same transformation such as using two successive reflections to provide the same result as a translation • experimenting with, creating and re-creating patterns using combinations of reflections and rotations using digital technologies

Geometric reasoning	Elaborations
Identify corresponding, alternate and co-interior angles when two straight lines are crossed by a transversal (ACMMG163)	• defining and classifying pairs of angles as complementary, supplementary, adjacent and vertically opposite
Investigate conditions for two lines to be parallel and solve simple numerical problems using reasoning (ACMMG164)	• constructing parallel and perpendicular lines using their properties, a pair of compasses and a ruler, and dynamic geometry software • defining and identifying the relationships between altenate, corresponding and co-interior angles for a pair of parallel lines cut by a transversal
Demonstrate that the angle sum of a triangle is 180° and use this to find the angle sum of a quadrilateral (ACMMG166)	• using concrete materials and digital technologies to investigate the angle sum of a triangle and quadrilateral
Classify triangles according to their side and angle properties and describe quadrilaterals (ACMMG165)	• identifying side and angle properties of scalene, isosceles, right-angled and obtuse-angled triangles • describing squares, rectangles, rhombuses, parallelograms, kites and trapeziums

Statistics and Probability

Chance	Elaborations

Construct sample spaces for single-step experiments with equally likely outcomes (ACMSP167) 	• discussing the meaning of probability terminology (for example probability, sample space, favourable outcomes, trial, events and experiments) • distinguishing between equally likely outcomes and outcomes that are not equally likely
Assign probabilities to the outcomes of events and determine probabilities for events (ACMSP168) 	• expressing probabilities as decimals, fractionals and percentages
Data representation and interpretation	**Elaborations**
Identify and investigate issues involving numerical data collected from primary and secondary sources (ACMSP169) 	• obtaining secondary data from newspapers, the Internet and the Australian Bureau of Statistics • investigating secondary data relating to the distribution and use of non-renewable resources around the world
Construct and compare a range of data displays including stem-and-leaf plots and dot plots (ACMSP170) 	• understanding that some data representations are more appropriate than others for particular data sets, and answering questions about those data sets • 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
Calculate mean, median, mode and range for sets of data. Interpret these statistics in the context of data (ACMSP171) 	• understanding that summarising data by calculating measures of centre and spread can help make sense of the data
Describe and interpret data displays using median, mean and range (ACMSP172) 	• using mean and median to compare data sets and explaining how outliers may affect the comparison • locating mean, median and range on graphs and connecting them to real life

Year 7 achievement standard

By the end of Year 7, students solve problems involving the comparison, addition and subtraction of integers. They make the connections between whole numbers and index notation and the relationship between perfect squares and square roots. They solve problems involving percentages and all four operations with fractions and decimals. They compare the cost of items to make financial decisions. Students represent numbers using variables. They connect the laws and properties for numbers to algebra. They interpret simple linear representations and model authentic information. Students describe different views of three-dimensional objects. They represent transformations in the Cartesian plane. They solve simple numerical problems involving angles formed by a transversal crossing two parallel lines. Students identify issues involving the collection of continuous data. They describe the relationship between the median and mean in data displays.

Students use fractions, decimals and percentages, and their equivalences. They express one quantity as a fraction or percentage of another. Students solve simple linear equations and evaluate algebraic expressions after numerical substitution. They assign ordered pairs to given points on the Cartesian plane. Students use formulas for the area and perimeter of rectangles and calculate volumes of rectangular prisms. Students classify triangles and quadrilaterals. They name the types of angles formed by a transversal crossing parallel line. Students determine the sample space for simple experiments with equally likely outcomes and assign probabilities to those outcomes. They calculate mean, mode, median and range for data sets. They construct stem-and-leaf plots and dot-plots.

Year 8

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes describing patterns involving indices and recurring decimals, identifying commonalities between operations with algebra and arithmetic, connecting rules for linear relations their graphs, explaining the purpose of statistical measures, and explaining measurements of perimeter and area

Fluency includes calculating accurately with simple decimals, indices and integers, recognising equivalence of common decimals and fractions including recurring decimals, factorising and simplifying basic algebraic expressions, and evaluating perimeters, areas of common shapes and their volumes and three dimensional objects

Problem Solving includes formulating, and modelling practical situations involving ratios, profit and loss, areas and perimeters of common shapes, and using two-way tables and Venn diagrams to calculate probabilities

Reasoning includes justifying the result of a calculation or estimation as reasonable, deriving probability from its complement, using congruence to deduce properties of triangles, finding estimates of means and proportions of populations

Number and Algebra

Number and place value	Elaborations
Use index notation with numbers to establish the index laws with positive integral indices and the zero index (ACMNA182)	• evaluating numbers expressed as powers of positive integers
Carry out the four operations with rational numbers and integers, using efficient mental and written strategies and appropriate digital technologies (ACMNA183)	• using patterns to assist in finding rules for the multiplication and division of integers • using the number line to develop strategies for adding and subtracting rational numbers

Real numbers	Elaborations
Investigate terminating and recurring decimals (ACMNA184)	• recognising terminating, recurring and non-terminating decimals and choosing their appropriate representations
Investigate the concept of irrational numbers, including π (ACMNA186)	• understanding that the real number system includes irrational numbers

Solve problems involving the use of percentages, including percentage increases and decreases, with and without digital technologies (ACMNA187) 	• using percentages to solve problems, including those involving mark-ups, discounts,and GST • using percentages to calculate population increases and decreases
Solve a range of problems involving rates and ratios, with and without digital technologies (ACMNA188) 	• understanding that rate and ratio problems can be solved using fractions or percentages and choosing the most efficient form to solve a particular problem • calculating population growth rates in Australia and Asia and explaining their difference
Money and financial mathematics	**Elaborations**
Solve problems involving profit and loss, with and without digital technologies (ACMNA189) 	• expressing profit and loss as a percentage of cost or selling price, comparing the difference • investigating the methods used in retail stores to express discounts
Patterns and algebra	**Elaborations**
Extend and apply the distributive law to the expansion of algebraic expressions (ACMNA190) 	• applying the distributive law to the expansion of algebraic expressions using strategies such as the area model
Factorise algebraic expressions by identifying numerical factors (ACMNA191) 	• recognising the relationship between factorising and expanding • identifying the greatest common divisor (highest common factor) of numeric and algebraic expressions and using a range of strategies to factorise algebraic expressions
Simplify algebraic expressions involving the four operations (ACMNA192) 	• understanding that the laws used with numbers can also be used with algebra
Linear and non-linear relationships	**Elaborations**
Plot linear relationships on the Cartesian plane with and without the use of digital technologies (ACMNA193) 	• completing a table of values, plotting the resulting points and determining whether the relationship is linear • finding the rule for a linear relationship
Solve linear equations using algebraic and graphical techniques. Verify solutions by substitution (ACMNA194) 	• solving real life problems by using variables to represent unknowns
Measurement and Geometry	
Using units of measurement	**Elaborations**

Choose appropriate units of measurement for area and volume and convert from one unit to another (ACMMG195) 	• choosing units for area including mm^2, cm^2, m^2, hectares, km^2, and units for volume including mm^3, cm^3, m^3 • recognising that the conversion factors for area units are the squares of those for the corresponding linear units • recognising that the conversion factors for volume units are the cubes of those for the corresponding linear units
Find perimeters and areas of parallelograms, trapeziums, rhombuses and kites (ACMMG196) 	• establishing and using formulas for areas such as trapeziums, rhombuses and kites
Investigate the relationship between features of circles such as circumference, area, radius and diameter. Use formulas to solve problems involving circumference and area (ACMMG197) 	• investigating the circumference and area of circles with materials or by measuring, to establish an understanding of formulas • investigating the area of circles using a square grid or by rearranging a circle divided into sectors
Develop the formulas for volumes of rectangular and triangular prisms and prisms in general. Use formulas to solve problems involving volume (ACMMG198) 	• investigating the relationship between volumes of rectangular and triangular prisms
Solve problems involving duration, including using 12- and 24-hour time within a single time zone (ACMMG199) 	• identifying regions in Australia and countries in Asia that are in the same time zone

Geometric reasoning	Elaborations
Define congruence of plane shapes using transformations (ACMMG200) 	• understanding the properties that determine congruence of triangles and recognising which transformations create congruent figures • establishing that two figures are congruent if one shape lies exactly on top of the other after one or more transformations (translation, reflection, rotation), and recognising that the matching sides and the matching angles are equal
Develop the conditions for congruence of triangles (ACMMG201) 	• investigating the minimal conditions needed for the unique construction of triangles, leading to the establishment of the conditions for congruence (SSS, SAS, ASA and RHS) • solving problems using the properties of congruent figures • constructing triangles using the conditions for congruence

Establish properties of quadrilaterals using congruent triangles and angle properties, and solve related numerical problems using reasoning (ACMMG202)	• establishing the properties of squares, rectangles, parallelograms, rhombuses, trapeziums and kites • identifying properties related to side lengths, parallel sides, angles, diagonals and symmetry

Statistics and Probability

Chance	Elaborations
Identify complementary events and use the sum of probabilities to solve problems (ACMSP204)	• identifying the complement of familiar events • understanding that probabilities range between 0 to 1 and that calculating the probability of an event allows the probability of its complement to be found
Describe events using language of 'at least', exclusive 'or' (A or B but not both), inclusive 'or' (A or B or both) and 'and'. (ACMSP205)	• posing 'and', 'or' and 'not' probability questions about objects or people
Represent events in two-way tables and Venn diagrams and solve related problems (ACMSP292)	• using Venn diagrams and two-way tables to calculate probabilities for events, satisfying 'and', 'or' and 'not' conditions • understanding that representing data in Venn diagrams or two-way tables facilitates the calculation of probabilities • collecting data to answer the questions using Venn diagrams or two-way tables

Data representation and interpretation	Elaborations
Investigate techniques for collecting data, including census, sampling and observation (ACMSP284)	• identifying situations where data can be collected by census and those where a sample is appropriate
Explore the practicalities and implications of obtaining data through sampling using a variety of investigative processes (ACMSP206)	• investigating the uses of random sampling to collect data
Explore the variation of means and proportions of random samples drawn from the same population (ACMSP293)	• using sample properties to predict characteristics of the population
Investigate the effect of individual data values , including outliers, on the mean and median (ACMSP207)	• using displays of data to explore and investigate effects

Year 8 achievement standard

By the end of Year 8, students solve everyday problems involving rates, ratios and percentages. They recognise index laws and apply them to whole numbers. They describe rational and irrational numbers. Students solve problems involving profit and loss. They make connections between expanding and factorising algebraic expressions. Students solve problems relating to the volume of prisms. They make sense of time duration in real applications. They identify conditions for the congruence of triangles and deduce the properties of quadrilaterals. Students model authentic situations with two-way tables and Venn diagrams. They choose appropriate language to describe events and experiments. They explain issues related to the collection of data and the effect of outliers on means and medians in that data.

Students use efficient mental and written strategies to carry out the four operations with integers. They simplify a variety of algebraic expressions. They solve linear equations and graph linear relationships on the Cartesian plane. Students convert between units of measurement for area and volume. They perform calculations to determine perimeter and area of parallelograms, rhombuses and kites. They name the features of circles and calculate the areas and circumferences of circles. Students determine complementary events and calculate the sum of probabilities.

Year 9

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability.** The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes describing the relationship between graphs and equations, simplifying a range of algebraic expressions, explaining the use of relative frequencies to estimate probabilities, and the use of the trigonometric ratios for right-angle triangles

Fluency includes applying the index laws to expressions with integer indices, expressing numbers in scientific notation, listing outcomes for experiments and developing familiarity with calculations involving the Cartesian plane and calculating areas of shapes and surface areas of prisms

Problem Solving includes formulating, and modelling practical situations involving surface areas and volumes of right prisms, applying ratio and scale factors to similar figures, solving problems involving right-angle trigonometry, and collecting data from secondary sources to investigate an issue

Reasoning includes following mathematical arguments, evaluating media reports and using statistical knowledge to clarify situations, developing strategies in investigating similarity and sketching linear graphs

Number and Algebra

Real numbers	Elaborations
Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems (ACMNA208)	• identifying direct proportion in real-life contexts
Apply index laws to numerical expressions with integer indices (ACMNA209)	• simplifying and evaluating numerical expressions, using involving both positive and negative integer indices
Express numbers in scientific notation (ACMNA210)	• representing extremely large and small numbers in scientific notation, and numbers expressed in scientific notation as whole numbers or decimals

Money and financial mathematics	Elaborations
Solve problems involving simple interest (ACMNA211)	• understanding that financial decisions can be assisted by mathematical calculations

Patterns and algebra	Elaborations

Extend and apply the index laws to variables, using positive integer indices and the zero index (ACMNA212) 	• understanding that index laws apply to variables as well as numbers
Apply the distributive law to the expansion of algebraic expressions, including binomials, and collect like terms where appropriate (ACMNA213) 	• understanding that the distributive law can be applied to algebraic expressions as well as numbers • understanding the relationship between expansion and factorisation and identifying algebraic factors in algebraic expressions

Linear and non-linear relationships	Elaborations
Find the distance between two points located on a Cartesian plane using a range of strategies, including graphing software (ACMNA214) 	• investigating graphical and algebraic techniques for finding distance between two points • using Pythagoras' theorem to calculate distance between two points
Find the midpoint and gradient of a line segment (interval) on the Cartesian plane using a range of strategies, including graphing software (ACMNA294) 	• investigating graphical and algebraic techniques for finding midpoint and gradient • recognising that the gradient of a line is the same as the gradient of any line segment on that line
Sketch linear graphs using the coordinates of two points and solve linear equations (ACMNA215) 	• determining linear rules from suitable diagrams, tables of values and graphs and describing them using both words and algebra
Graph simple non-linear relations with and without the use of digital technologies and solve simple related equations (ACMNA296) 	• graphing parabolas, and circles connecting x-intercepts of a graph to a related equation

Measurement and Geometry

Using units of measurement	Elaborations
Calculate the areas of composite shapes (ACMMG216) 	• understanding that partitioning composite shapes into rectangles and triangles is a strategy for solving problems involving area
Calculate the surface area and volume of cylinders and solve related problems (ACMMG217) 	• analysing nets of cylinders to establish formulas for surface area • connecting the volume and capacity of a cylinder to solve authentic problems
Solve problems involving the surface area and volume of right prisms (ACMMG218) 	• solving practical problems involving surface area and volume of right prisms

Investigate very small and very large time scales and intervals (ACMMG219)	• investigating the usefulness of scientific notation in representing very large and very small numbers
Geometric reasoning	**Elaborations**
Use the enlargement transformation to explain similarity and develop the conditions for triangles to be similar (ACMMG220)	• establishing the conditions for similarity of two triangles and comparing this to the conditions for congruence • using the properties of similarity and ratio, and correct mathematical notation and language, to solve problems involving enlargement (for example, scale diagrams) • using the enlargement transformation to establish similarity understanding that similarity and congruence help describe relationships between geometrical shapes and are important elements of reasoning and proof
Solve problems using ratio and scale factors in similar figures (ACMMG221)	• establishing the relationship between areas of similar figures and the ratio of corresponding sides (scale factor)
Pythagoras and trigonometry	**Elaborations**
Investigate Pythagoras' Theorem and its application to solving simple problems involving right angled triangles (ACMMG222)	• understanding that Pythagoras' Theorem is a useful tool in determining unknown lengths in right-angled triangles and has widespread applications • recognising that right-angled triangle calculations may generate results that can be integers, fractions or irrational numbers
Use similarity to investigate the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles (ACMMG223)	• developing understanding of the relationship between the corresponding sides of similar right-angled triangles
Apply trigonometry to solve right-angled triangle problems (ACMMG224)	• understanding the terms 'adjacent' and 'opposite' sides in a right-angled triangle • selecting and accurately using the correct trigonometric ratio to find unknown sides (adjacent, opposite and hypotenuse) and angles in right-angled triangles
Statistics and Probability	
Chance	**Elaborations**
List all outcomes for two-step chance experiments, both with and without replacement using tree diagrams or arrays. Assign probabilities to outcomes and determine probabilities for events (ACMSP225)	• conducting two-step chance experiments • using systematic methods to list outcomes of experiments and to list outcomes favourable to an event • comparing experiments which differ only by being undertaken with replacement or without replacement

Calculate relative frequencies from given or collected data to estimate probabilities of events involving 'and' or 'or' (ACMSP226) 	• using Venn diagrams or two-way tables to calculate relative frequencies of events involving ‘and’, ‘or’ questions • using relative frequencies to find an estimate of probabilities of ‘and’, ‘or’ events
Investigate reports of surveys in digital media and elsewhere for information on how data were obtained to estimate population means and medians (ACMSP227) 	• investigating a range of data and its sources, for example the age of residents in Australia, Cambodia and Tonga; the number of subjects studied at school in a year by 14-year-old students in Australia, Japan and Timor-Leste
Data representation and interpretation	**Elaborations**
Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly from secondary sources (ACMSP228) 	• comparing the annual rainfall in various parts of Australia, Pakistan, New Guinea and Malaysia
Construct back-to-back stem-and-leaf plots and histograms and describe data, using terms including ‘skewed’, ‘symmetric’ and ‘bi modal’ (ACMSP282) 	• using stem-and-leaf plots to compare two like sets of data such as the heights of girls and the heights of boys in a class • describing the shape of the distribution of data using terms such as ‘positive skew’, ‘negative skew’ and 'symmetric' and 'bi-modal'
Compare data displays using mean, median and range to describe and interpret numerical data sets in terms of location (centre) and spread (ACMSP283) 	• comparing means, medians and ranges of two sets of numerical data which have been displayed using histograms, dot plots, or stem and leaf plots

Year 9 achievement standard

By the end of Year 9, students solve problems involving simple interest. They interpret ratio and scale factors in similar figures. Students explain similarity of triangles. They recognise the connections between similarity and the trigonometric ratios. Students compare techniques for collecting data in primary and secondary sources. They make sense of the position of the mean and median in skewed, symmetric and bi-modal displays to describe and interpret data.

Students apply the index laws to numbers and express numbers in scientific notation. They expand binomial expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment. They sketch linear and non-linear relations. Students calculate areas of shapes and the volume and surface area of right prisms and cylinders. They use Pythagoras’ Theorem and trigonometry to find unknown sides of right-angled triangles. Students calculate relative frequencies to estimate probabilities, list outcomes for two-step experiments and assign probabilities for those outcomes. They construct histograms and back-to-back stem-and-leaf plots.

Year 10

The proficiency strands **Understanding, Fluency, Problem Solving and Reasoning** are an integral part of mathematics content across the three content strands: **Number and Algebra, Measurement and Geometry, and Statistics and Probability**. The proficiencies reinforce the significance of working mathematically within the content and describe how the content is explored or developed. They provide the language to build in the developmental aspects of the learning of mathematics.

At this year level:

Understanding includes applying the four operations to algebraic fractions, finding unknowns in formulas after substitution, making the connection between equations of relations and their graphs, comparing simple and compound interest in financial contexts and determining probabilities of two and three step experiments

Fluency includes factorising and expanding algebraic expressions, using a range of strategies to solve equations and using calculations to investigate ing the shape of data sets

Problem Solving includes calculating the surface area and volume of a diverse range of prisms to solve practical problems, finding unknown lengths and angles using applications of trigonometry, using algebraic and graphical techniques to find solutions to simultaneous equations and inequalities, and investigating independence of events

Reasoning includes formulating geometric proofs involving congruence and similarity, interpreting and evaluating media statements and interpreting and comparing data sets

Number and Algebra

Money and financial mathematics	Elaborations
Connect the compound interest formula to repeated applications of simple interest using appropriate digital technologies (ACMNA229)	• working with authentic information, data and interest rates to calculate compound interest and solve related problems

Patterns and algebra	Elaborations
Factorise algebraic expressions by taking out a common algebraic factor (ACMNA230)	• using the distributive law and the index laws to factorise algebraic expressions • understanding the relationship between factorisation and expansion
Simplify algebraic products and quotients using index laws (ACMNA231)	• applying knowledge of index laws to algebraic terms, and simplifying algebraic expressions using both positive and negative integral indices
Apply the four operations to simple algebraic fractions with numerical denominators (ACMNA232)	• expressing the sum and difference of algebraic fractions with a common denominator • using the index laws to simplify products and quotients of algebraic fractions

Expand binomial products and factorise monic quadratic expressions using a variety of strategies (ACMNA233)	• exploring the method of completing the square to factorise quadratic expressions and solve quadratic equations • identifying and using common factors, including binomial expressions, to factorise algebraic expressions using the technique of grouping in pairs • using the identities for perfect squares and the difference of squares to factorise quadratic expressions
Substitute values into formulas to determine an unknown (ACMNA234)	• solving simple equations arising from formulas
Linear and non-linear relationships	**Elaborations**
Solve problems involving linear equations, including those derived from formulas (ACMNA235)	• representing word problems with simple linear equations and solving them to answer questions
Solve linear inequalities and graph their solutions on a number line (ACMNA236)	• representing word problems with simple linear inequalities and solving them to answer questions
Solve linear simultaneous equations, using algebraic and graphical techniques including using digital technology (ACMNA237)	• associating the solution of simultaneous equations with the coordinates of the intersection of their corresponding graphs
Solve problems involving parallel and perpendicular lines (ACMNA238)	• solving problems using the fact that parallel lines have the same gradient and conversely that if two lines have the same gradient then they are parallel • solving problems using the fact that the product of the gradients of perpendicular lines is –1 and conversely that if the product of the gradients of two lines is –1 then they are perpendicular
Explore the connection between algebraic and graphical representations of relations such as simple quadratics, circles and exponentials using digital technology as appropriate (ACMNA239)	• sketching graphs of parabolas, and circles • applying translations, reflections and stretches to parabolas and circles • sketching the graphs of exponential functions using transformations
Solve linear equations involving simple algebraic fractions (ACMNA240)	• solving a wide range of linear equations, including those involving one or two simple algebraic fractions, and checking solutions by substitution • representing word problems, including those involving fractions, as equations and solving them to answer the question

Solve simple quadratic equations using a range of strategies (ACMNA241) 	• using a variety of techniques to solve quadratic equations, including grouping, completing the square, the quadratic formula and choosing two integers with the required product and sum

Measurement and Geometry

Using units of measurement	Elaborations
Solve problems involving surface area and volume for a range of prisms, cylinders and composite solids (ACMMG242) 	• Investigating and determining the volumes and surface areas of composite solids by considering the individual solids from which they are constructed

Geometric reasoning	Elaborations
Formulate proofs involving congruent triangles and angle properties (ACMMG243) 	• applying an understanding of relationships to deduce properties of geometric figures (for example the base angles of an isosceles triangle are equal)
Apply logical reasoning, including the use of congruence and similarity, to proofs and numerical exercises involving plane shapes (ACMMG244) 	• distinguishing between a practical demonstration and a proof (for example demonstrating triangles are congruent by placing them on top of each other, as compared to using congruence tests to establish that triangles are congruent) • performing a sequence of steps to determine an unknown angle giving a justification in moving from one step to the next. • communicating a proof using a sequence of logically connected statements

Pythagoras and trigonometry	Elaborations
Solve right-angled triangle problems including those involving direction and angles of elevation and depression (ACMMG245) 	• applying Pythagoras's Theorem and trigonometry to problems in surveying and design

Statistics and Probability

Chance	Elaborations
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 (ACMSP246) 	• recognising that an event can be dependent on another event and that this will affect the way its probability is calculated

Use the language of 'if ....then, 'given', 'of', 'knowing that' to investigate conditional statements and identify common mistakes in interpreting such language (ACMSP247) 	• using two-way tables and Venn diagrams to understand conditional statements • using arrays and tree diagrams to determine probabilities
Data representation and interpretation	**Elaborations**
Determine quartiles and interquartile range (ACMSP248) 	• finding the five-number summary (minimum and maximum values, median and upper and lower quartiles) and using its graphical representation, the box plot, as tools for both numerically and visually comparing the centre and spread of data sets
Construct and interpret box plots and use them to compare data sets (ACMSP249) 	• understanding that box plots are an efficient and common way of representing and summarising data and can facilitate comparisons between data sets • using parallel box plots to compare data about the age distribution of Aboriginal and Torres Strait Islander people with that of the Australian population as a whole
Compare shapes of box plots to corresponding histograms and dot plots (ACMSP250) 	• Investigating data in different ways to make comparisons and draw conclusions
Use scatter plots to investigate and comment on relationships between two numerical variables (ACMSP251) 	• using authentic data to construct scatter plots, make comparisons and draw conclusions
Investigate and describe bivariate numerical data where the independent variable is time (ACMSP252) 	• investigating biodiversity changes in Australia since European occupation • constructing and interpreting data displays representing bivariate data over time
Evaluate statistical reports in the media and other places by linking claims to displays, statistics and representative data (ACMSP253) 	• investigating the use of statistics in reports regarding the growth of Australia's trade with other countries of the Asia region • evaluating statistical reports comparing the life expectancy of Aboriginal and Torres Strait Islander people with that of the Australian population as a whole

Year 10 achievement standard

By the end of Year 10, students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities. They make the connections between algebraic and graphical representations of relations. Students solve surface area and volume problems relating to composite solids. They recognise the relationships between parallel and perpendicular lines. Students apply deductive reasoning to proofs and numerical exercises involving plane shapes. They compare data sets by referring to the shapes of the various data displays. They describe bivariate data where the independent variable is time. Students describe statistical relationships between two continuous variables. They evaluate statistical reports.

Students expand binomial expressions and factorise monic quadratic expressions. They find unknown values after substitution into formulas. They perform the four operations with simple algebraic fractions. Students solve simple quadratic equations and pairs of simultaneous equations. They use triangle and angle properties to prove congruence and similarity. Students use trigonometry to calculate unknown angles in right-angled triangles. Students list outcomes for multi-step chance experiments and assign probabilities for these experiments. They calculate quartiles and inter-quartile ranges.

Year 10A

Number and Algebra

Real numbers	Elaborations
Define rational and irrational numbers and perform operations with surds and fractional indices (ACMNA264)	• understanding that the real number system includes irrational numbers • extending the index laws to rational number indices • performing the four operations with surds
Use the definition of a logarithm to establish and apply the laws of logarithms (ACMNA265)	• investigating the relationship between exponential and logarithmic expressions • simplifying expressions using the logarithm laws

Patterns and algebra	Elaborations
Investigate the concept of a polynomial and apply the factor and remainder theorems to solve problems (ACMNA266)	• investigating the relationship between algebraic long division and the factor and remainder theorems

Linear and non-linear relationships	Elaborations
Solve simple exponential equations (ACMNA270)	• investigating exponential equations derived from authentic mathematical models based on population growth
Describe, interpret and sketch parabolas, hyperbolas, circles and exponential functions and their transformations (ACMNA267)	• applying transformations, including translations, reflections in the axes and stretches to help graph parabolas, rectangular hyperbolas, circles and exponential functions
Apply understanding of polynomials to sketch a range of curves and describe the features of these curves from their equation (ACMNA268)	• investigating the features of graphs of polynomials including axes intercepts and the effect of repeated factors
Factorise monic and non-monic quadratic expressions and solve a wide range of quadratic equations derived from a variety of contexts (ACMNA269)	• writing quadratic equations that represent practical problems

Measurement and Geometry

Using units of measurement	Elaborations
Solve problems involving surface area and volume of right pyramids, right cones, spheres and related composite solids (ACMMG271)	• using formulas to solve problems • using authentic situations to apply knowledge and understanding of surface area and volume

Geometric reasoning	Elaborations
Prove and apply angle and chord properties of circles (ACMMG272)	• performing a sequence of steps to determine an unknown angle or length in a diagram involving a circle, or circles, giving a justification in moving from one step to the next • communicating a proof using a logical sequence of statements • proving results involving chords of circles

Pythagoras and trigonometry	Elaborations
Establish the sine, cosine and area rules for any triangle and solve related problems (ACMMG273)	• applying knowledge of sine, cosine and area rules to authentic problems such as those involving surveying and design
Use the unit circle to define trigonometric functions, and graph them with and without the use of digital technologies (ACMMG274)	• establishing the symmetrical properties of trigonometric functions • investigating angles of any magnitude • understanding that trigonometric functions are periodic and that this can be used to describe motion
Solve simple trigonometric equations (ACMMG275)	• using periodicity and symmetry to solve equations
Apply Pythagoras' theorem and trigonometry to solving three-dimensional problems in right-angled triangles (ACMMG276)	• investigating the applications of Pythagoras's theorem in authentic problems

Statistics and Probability

Chance	Elaborations
Investigate reports of studies in digital media and elsewhere for information on their planning and implementation (ACMSP277)	• evaluating the appropriateness of sampling methods in reports where statements about a population are based on a sample • evaluating whether graphs in a report could mislead, and whether graphs and numerical information support the claims

Data representation and interpretation	Elaborations
Calculate and interpret the mean and standard deviation of data and use these to compare data sets (ACMSP278)	• using the standard deviation to describe the spread of a set of data • using the mean and standard deviation to compare numerical data sets

Use information technologies to investigate bivariate numerical data sets. Where appropriate use a straight line to describe the relationship allowing for variation (ACMSP279) 	• investigating different techniques for finding a ‘line of best fit’

Algebraic expression

An **algebraic expression** is formed by combining numbers and algebraic symbols using arithmetic operations. The expression must be constructed unambiguously according to the rules of algebra.

For example, $a^2 + 3ab - 2b^2$, and $(x + 1)e^x$ are algebraic expressions, but $2x + \div 3y$ is not because it is incomplete.

Algebraic fraction

An **algebraic fraction** is a fraction in which both the numerator and denominator are algebraic expressions.

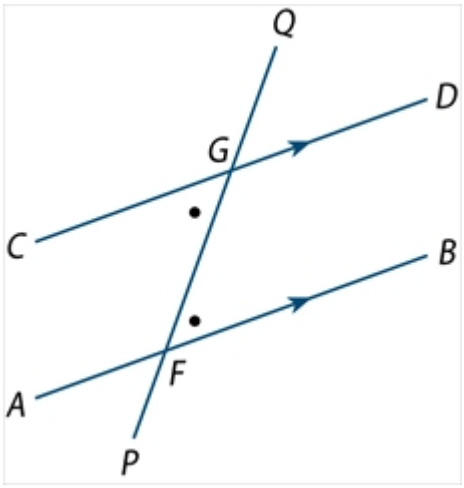
Algebraic term

An **algebraic term** is an algebraic expression that forms a 'separable' part of some other algebraic expression. For example, x^2 and $5x^{-1}$ are terms in the inequality $x^2 \leq 5x^{-1}$, and $2, 3x, 5x^2$ are terms of the polynomial $2 + 3x + 5x^2$.

Alternate

In each diagram below, the two marked angles are called **alternate angles** (since they are on alternate sides of the transversal).

If the lines *AB* and *CD* are parallel, then each pair of alternate angles are equal.

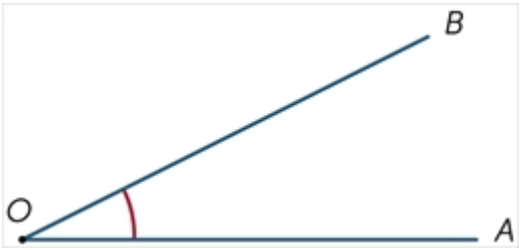


Angle

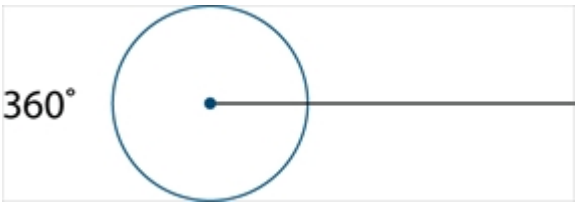
An **angle** is the figure formed by two rays sharing a common endpoint, called the vertex of the angle.

The size of an angle

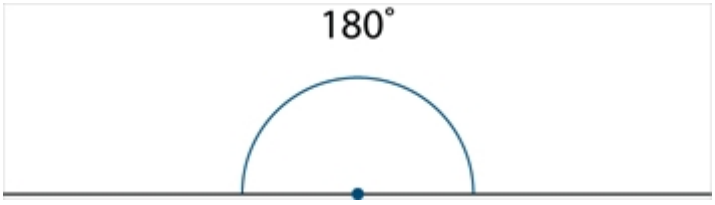
Imagine that the ray *OB* is rotated about the point *O* until it lies along *OA*. The amount of turning is called the size of the angle *AOB*.



A **revolution** is the amount of turning required to rotate a ray about its endpoint until it falls back onto itself. The size of 1 revolution is 360o.



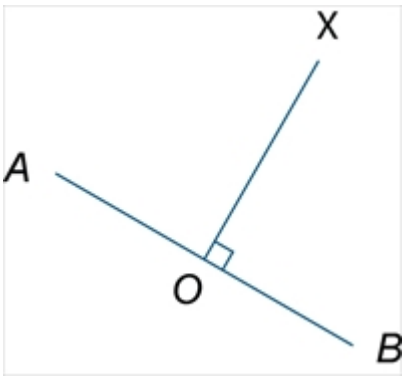
A **straight angle** is the angle formed by taking a ray and its opposite ray. A straight angle is half of a revolution, and so has size equal to
180o.



Right angle

Let *AOB* be a line, and let *OX* be a ray making equal angles with the ray *OA* and the ray *OB*. Then the equal angles *AOX* and *BOX* are called right angles.

A right angle is half of a straight angle, and so is equal to 90o.



Classification of angles

Angles are classified according to their size.

We say that

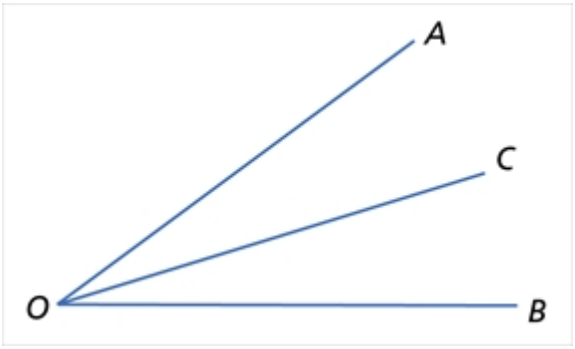
- An angle with size α is **acute** if $0^o < \alpha < 90^o$,
- An angle with size α is **obtuse** if $90^0 < \alpha < 180^o$,
- An angle with size α is **reflex** if $180^0 < \alpha < 360^o$

Adjacent angles

Two angles at a point are called **adjacent** if they share a common ray and a common vertex.

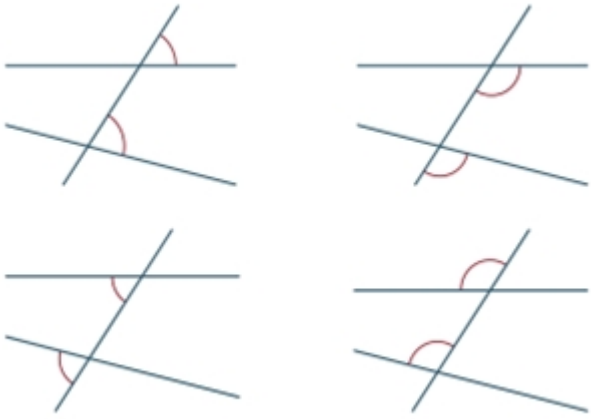
Hence, in the diagram,

- *AOC* and *BOC* are adjacent, and
- *AOB* and *AOC* are adjacent.

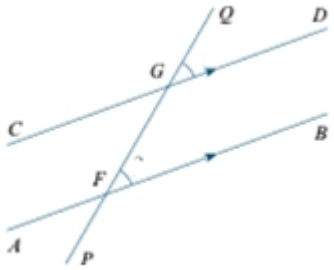


Two angles that add to 90^o are called **complementary**. For example, 23^o and 67^o are complementary angles.

In each diagram the two marked angles are called **corresponding angles**.



If the lines are parallel, then each pair of corresponding angles are equal.

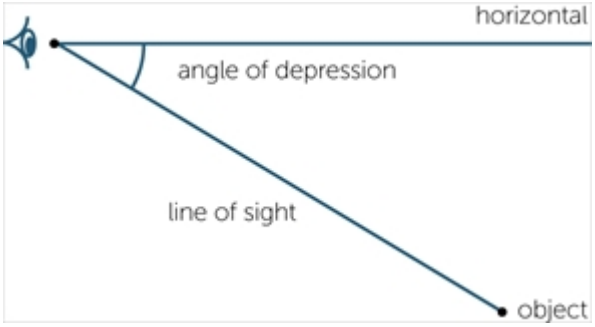


Conversely, if a pair of corresponding angles are equal, then the lines are parallel.

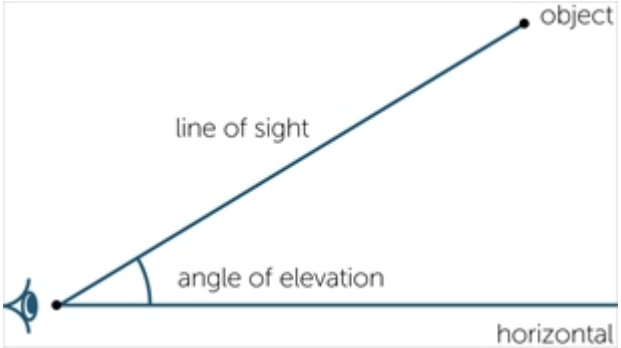
Two angles that add to 180o are called **supplementary angles**. For example, 45o and 135o are supplementary angles.

Angles of elevation and depression

When an observer looks at an object that is lower than ‘the eye of’ the observer’, the angle between the line of sight and the horizontal is called the **angle of depression**.



When an observer looks at an object that is higher than ‘the eye of’ the observer’, the angle between the line of sight and the horizontal is called the **angle of elevation**.



Array

An array is an ordered collection of objects or numbers. Rectangular arrays are commonly used in primary mathematics.

Associative

A method of combining two numbers or algebraic expressions is **associative** if the result of the combination of three objects does not depend on the way in which the objects are grouped.

For example, addition of numbers is associative and the corresponding **associative law** is:

$(a + b) + c = a + (b + c)$ for all numbers a, b and c.

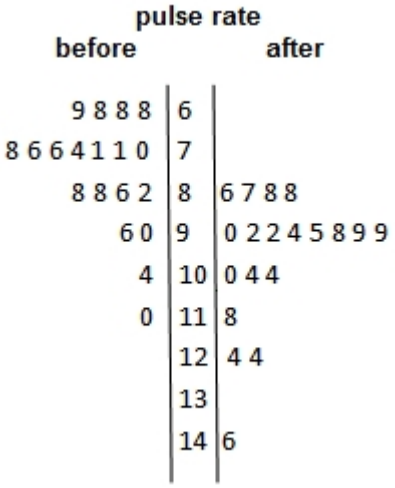
Multiplication is also associative: $(ab)c = a(bc)$ for all numbers a, and c, but subtraction and division are not, because, for example,

$(7 - 4) - 3 \neq 7 - (4 - 3)$ and $(12 \div 6) \div 2 \neq 12 \div (6 \div 2)$.

Back-to-back stem-and-leaf plot

A **back-to-back stem-and-leaf plot** is a method for comparing two data distributions by attaching two sets of 'leaves' to the same 'stem' in a stem-and-leaf plot.

For example, the stem-and-leaf plot below displays the distribution of pulse rates of 19 students before and after gentle exercise.



Bi modal

Bi modal data is data whose distribution has two modes.

Bivariate data

Bivariate data is data relating to two variables, for example, the arm spans and heights of 16 year olds, the sex of primary school students and their attitude to playing sport.

Bivariate numerical data

Bivariate numerical data is data relating to two numerical variables, for example height and weight.

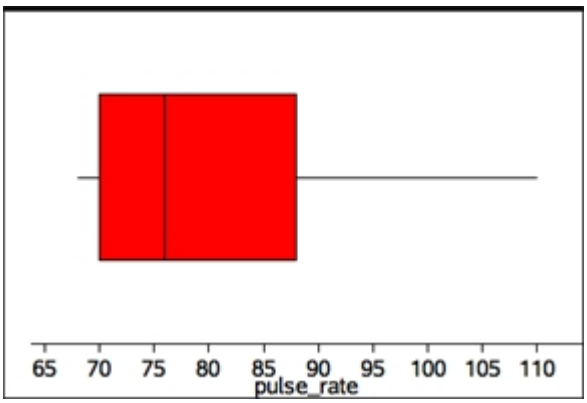
Box plot

The term **box plot** is a synonym for a box-and-whisker plot

A **box-and-whisker plot** is a graphical display of a five-number summary.

In a box-and-whisker plot, the 'box' covers the interquartile range (IQR), with 'whiskers' reaching out from each end of the box to indicate maximum and minimum values in the data set. A vertical line in the box is used to indicate the location of the median.

The box-and-whisker plot below has been constructed from the five -number summary of the resting pulse rates of 17 students.



The term ‘box-and-whisker plot’ is commonly abbreviated to ‘box plot’.

A **five-number-summary** is a method for summarising a data set using five statistics, the minimum value, the lower quartile, the median, the upper quartile and the maximum value.

Capacity

Capacity is a term used to describe how much a container will hold. It is often used in relation to the volume of fluids. Units of capacity (volume of fluids or gases) include litres and millilitres.

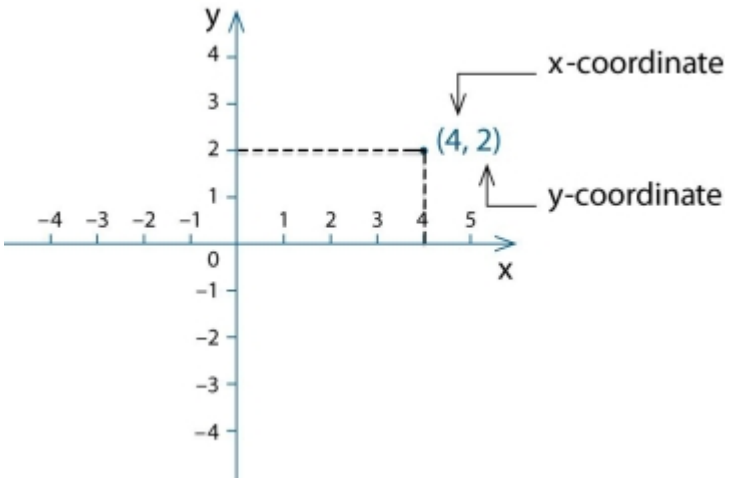
Cartesian coordinate system

Two intersecting number lines are taken intersecting at right angles at their origins to form the axes of the coordinate system.

The plane is divided into four quadrants by these perpendicular axes called the ***x*-axis** (horizontal line) and the ***y*-axis** (vertical line).

The position of any point in the plane can be represented by an **ordered pair** of numbers (*x*, *y*). These ordered are called the coordinates of the point. This is called the **Cartesian coordinate system.** The plane is called the **Cartesian plane.**

The point with coordinates (4, 2) has been plotted on the Cartesian plane shown. The coordinates of the origin are (0, 0).



Categorical variable

A **categorical variable** is a variable whose values are categories.

Examples: *blood group* is a categorical variable; its values are: A, B, AB or O. So too is *construction type* of a house; its values might be brick, concrete, timber, or steel.

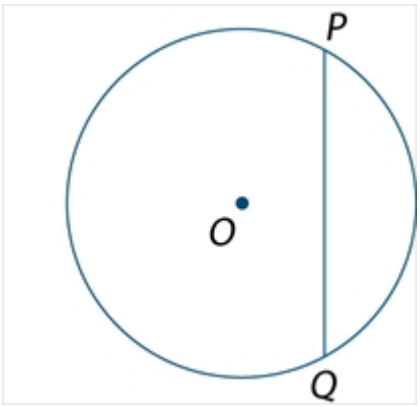
Categories may have numerical labels, for example, for the variable *postcode* the category labels would be numbers like 3787, 5623, 2016, etc, but these labels have no numerical significance. For example, it makes no sense to use these numerical labels to calculate the average postcode in Australia.

Census

A **census** is an attempt to collect information about the whole population.

A **population** is the complete set of individuals, objects, places, etc, that we want information about.

Chord



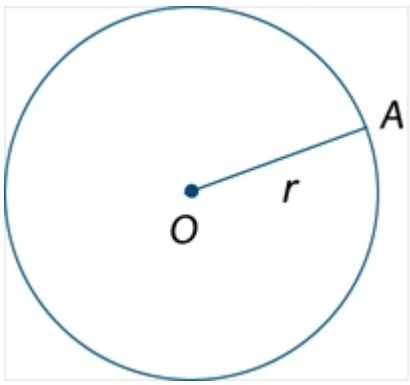
A **chord is a** line segment (interval) joining two points on a circle

A **diameter** is a chord passing through the centre.

The word diameter is also used for the length of the diameter.

Circle

The **circle** with **centre** *O* and **radius** *r* is the set of all points in the plane whose distance from *O* is *r*.



The line segment *OA* (interval *OA*) is also called a radius of the circle.

Putting the point of a pair of compasses at the centre and opening the arms to the radius can draw a circle.

Pi is the name of the Greek letter π, that is used to denote the ratio of the circumference of any circle to its diameter. The number π is irrational, but $22/7$ is a rational approximation accurate to 2 decimal places. The decimal expansion of π begins

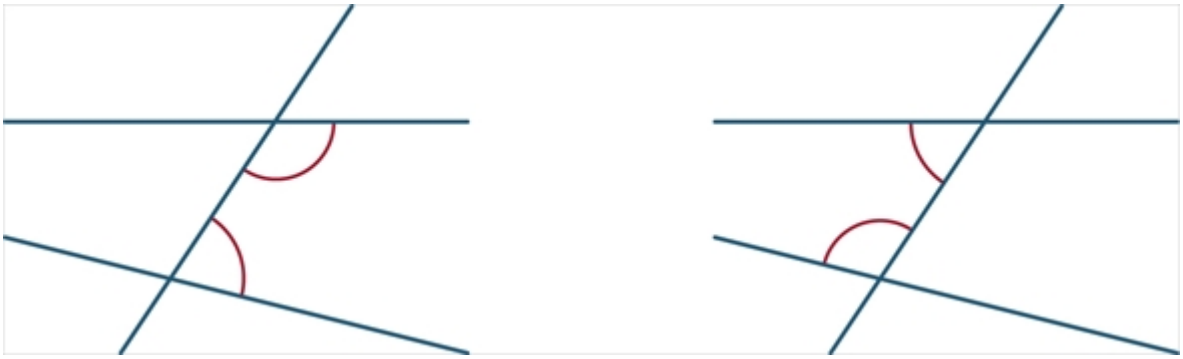
$$\pi = 3.141\,592\,653\,589\,79\cdots$$

There is a very long history of attempts to estimate π accurately. One of the early successes was due to Archimedes (287–212 BC) who showed that $3\frac{10}{71} < \pi < 3\frac{1}{7}$.

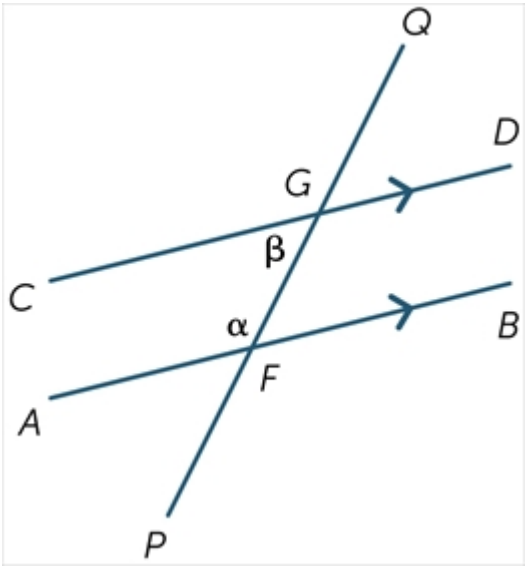
The decimal expansion of π has now been calculated to at least the first 10^{12} places.

Cointerior angles

In each diagram the two marked angles are called co-interior angles and lie on the same side of the transversal.



If the lines *AB* and *CD* are parallel then a + *b* = 180o



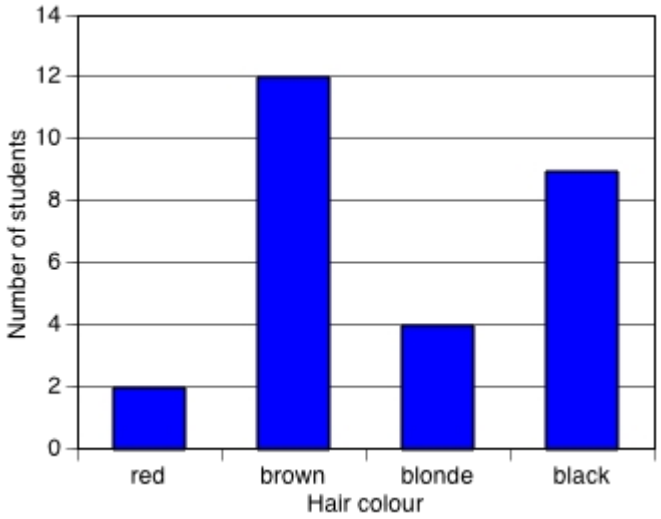
Cointerior angles formed by parallel lines are supplementary.

Conversely, if a pair of cointerior angles is supplementary then the lines are parallel.

Column graph

A **column graph** is a graph used in statistics for organising and displaying categorical data.

To construct a column graph, equal width rectangular bars are constructed for each category with height equal to the observed frequency of the category as shown in the example below which displays the hair colours of 27 students.

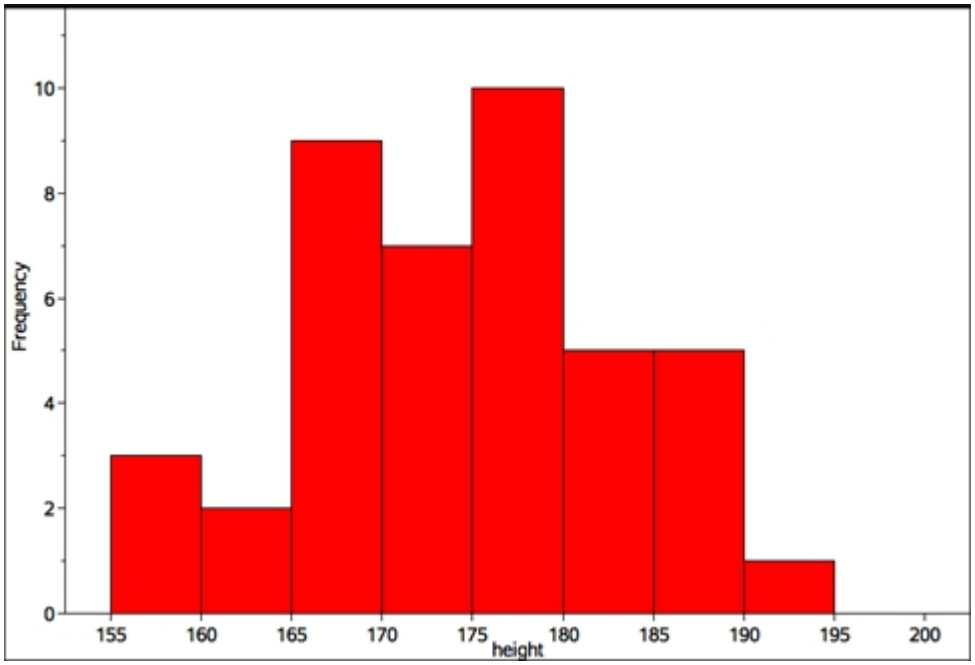


Column graphs are frequently called **bar graphs** or **bar charts**. In a bar graph or chart, the bars can be either vertical or horizontal.

A **histogram** is a statistical graph for displaying the frequency distribution of continuous data.

A histogram is a graphical representation of the information contained in a frequency table. In a histogram, class frequencies are represented by the areas of rectangles centred on each class interval. The class frequency is proportional to the rectangle's height when the class intervals are all of equal width.

The histogram below displays the frequency distribution of the heights (in cm) of a sample of 42 people with class intervals of width 5 cm.



Common factor

A **common factor** (or **common divisor**) of a set of numbers or algebraic expression is a factor of each element of that set.

For example, 6 is a common factor of $24, 54$ and 66, and $x + 1$ is a common factor of $x^2 - 1$ and $x^2 + 5x + 4$.

Commutative

A method of combining two numbers or algebraic expressions is **commutative** if the result of the combination does not depend on the order in which the objects are given.

For example, addition of numbers is commutative, and the corresponding **commutative law** is:

$a + b = b + a$ for all numbers a and b.

Multiplication is also commutative: $ab = ba$ for all numbers a and b, but subtraction and division are not, because, for example, $5 - 3 \neq 3 - 5$ and $12 \div 4 \neq 4 \div 12$.

Complementary events

Events *A* and *B* are **complementary** events, if A and B are mutually exclusive and Pr(*A*) + Pr(*B*) = 1.

Composite number

A natural number that has a factor other than 1 and itself is a **composite number**.

Compound interest

The interest earned by investing a sum of money (the principal) is **compound interest** if each successive interest payment is added to the principal for the purpose of calculating the next interest payment.

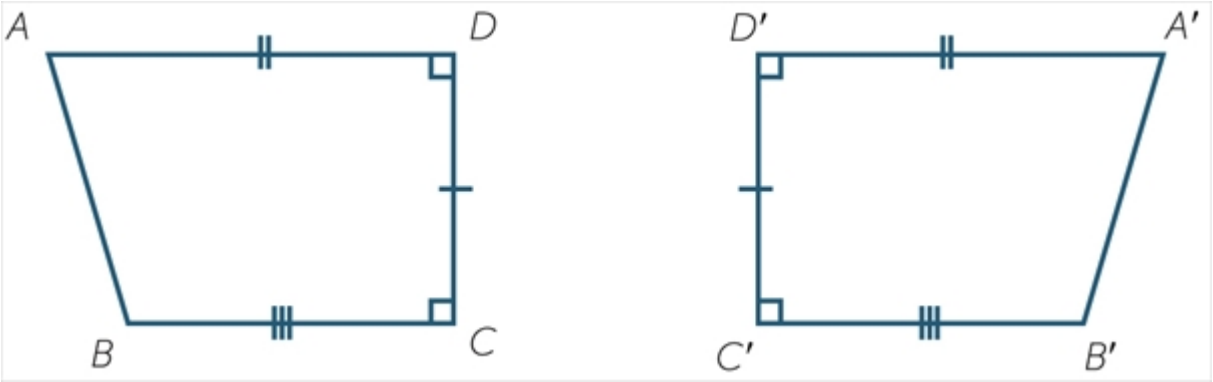
For example, if the principal $\$P$ earns compound interest at the rate of r per period, then after n periods the principal plus interest is $\$P(1 + r)^n$

Congruence

Two plane figures are called **congruent** if one can be moved by a sequence of translations, rotations and reflections so that it fits exactly on top of the other figure.

Two figures are congruent when we can match every part of one figure with the corresponding part of the other figure. For example, the two figures below are congruent.

Matching intervals have the same length, and matching angles have the same size.



Congruent triangles

The four standard congruence tests for triangles.

Two triangles are congruent if:

SSS: the three sides of one triangle are respectively equal to the three sides of the other triangle, or

SAS: two sides and the included angle of one triangle are respectively equal to two sides and the included angle of the other triangle, or

AAS: two angles and one side of one triangle are respectively equal to two angles and the matching side of the other triangle, or

RHS: the hypotenuse and one side of one right-angled triangle are respectively equal to the hypotenuse and one side of the other right-angled triangle.

Continuous variable

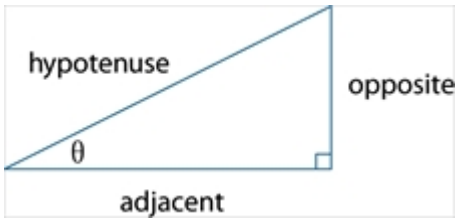
A **continuous variable** is a numerical variable that can take any value that lies within an interval. In practice, the values taken are subject to the accuracy of the measurement instrument used to obtain these values.

Examples include height, reaction time to a stimulus and systolic blood pressure.

Cosine

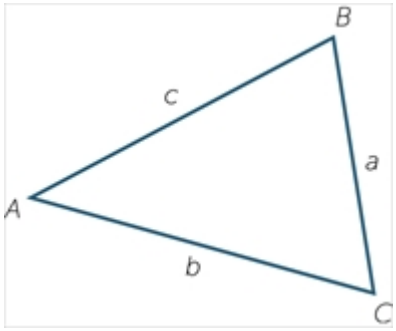
In any right-angled triangle,

$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$ where $0^o < \theta < 90^o$



In any triangle *ABC*,

$c^2 = a^2 + b^2 - 2ab\cos C$



Counting number

The **counting numbers** are the non-negative integers, that is, one of the numbers $0,1,2,3,\cdots$

Sometimes it is taken to mean only a positive integer.

A **natural number** is a positive integer or counting number. The natural numbers are $1,2,3,\cdots$. The set of natural numbers is usually denoted by $\mathbb{N}$.

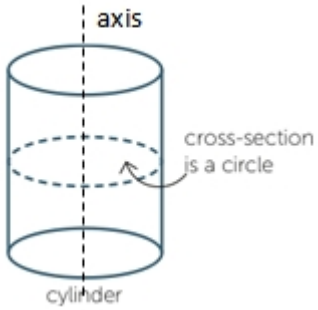
Counting on

Counting a collection, or reciting a sequence of number words, from a point beyond the beginning of the sequence.

For example, when a child has counted to established that there are 6 objects in a collection and is then asked “How Many?” after several more are added might *count on* from 6 saying “7, 8, 9, ...” to reach the total. This is considered a more sophisticated strategy than counting the whole collection from 1.

Cylinder

A **cylinder** is a solid that has parallel circular discs of equal radius at the ends. Each cross-section parallel to the ends is a circle with the same radius, and the centres of these circular cross-sections lie on a straight line, called the **axis of the cylinder**.



Data

Data is a general term for a set of observations and measurements collected during any type of systematic investigation.

Primary data is data collected by the user. **Secondary data** is data collected by others. Sources of secondary data include, web-based data sets, the media, books, scientific papers, etc.

Univariate data is data relating to a single variable, for example, hair colour or the number of errors in a test.

Data display

A **data display** is a visual format for organising and summarising data.

Examples include, box plots, column graphs, frequency tables and stem plots.

Decimal

A **decimal** is a numeral in the decimal number system.

For example, the decimal expansion of $6\frac{3}{4}$ is 6.75. The integer part is 6 and the fractional part is 0.75

A decimal is terminating if the fractional part has only finitely many decimal digits. It is non-terminating if it has infinitely digits.

For example, 6.75 is a terminating decimal, whereas $0.3161616\cdots$, where the pattern 16 repeats indefinitely, is non-terminating.

Non-terminating decimals may be recurring, that is, contain a pattern of digits that repeats indefinitely after a certain number of places.

For example, $0.3161616\cdots$ is a recurring decimal, whereas $0.101001000100001\cdots$, where the number of 0's between the 1's increases indefinitely, is not recurring.

It is common practice to indicate the repeating part of a recurring decimal by using dots or lines as superscripts.

For example, $0.3161616\cdots$ could be written as $0.3\dot{1}\dot{6}$ or $0.3\overline{16}$

The **decimal number system** is the base 10, place-value system most commonly used for representing real numbers. In this system positive numbers are expressed as sequences of Arabic numerals 0 to 9, in which each successive digit to the left or right of the decimal point indicates a multiple of successive powers (respectively positive or negative) of 10.

For example, the number represented by the decimal 12.345 is the sum
$1\times 10^1+2\times 10^0+3\times 10^{-1}+4\times 10^{-2}+5\times 10^{-3}$.

Denominator

In the fraction $\frac{a}{b}$, b is the **denominator**. It is the number of equal parts into which the whole is divided in order to obtain fractional parts. For example, if a line segment is divided into 5 equal parts, each of those parts is one fifth of the whole and corresponds to the unit fraction $\frac{1}{5}$.

Dependent variable

Two events are **independent** if knowing the outcome of one event tells us nothing about the outcome of the other event.

Difference

A difference is the result of subtraction one number or algebraic quantity from another.

Distributive

Multiplication of numbers is **distributive** over addition because the product of one number with the sum of two others equals the sum of the products of the first number with each of the others. This means that we can multiply two numbers by expressing one (or both) as a sum and then multiplying each part of the sum by the other number (or each part of its sum.)

For example,

$$8\times 17=8\times(10+7)=8\times 10+8\times 7=80+56=136$$

This **distributive law** is expressed algebraically as follows:

$$a(b+c)=ab+ac,\ \text{for all numbers } a,b \text{ and } c$$

Divisible

In general, a number or algebraic expression x is **divisible** by another y if there exists a number or algebraic expression q of a specified type for which $x=yq$.

A natural number m is divisible by a natural number n if there is a natural number q such that $m=nq$.

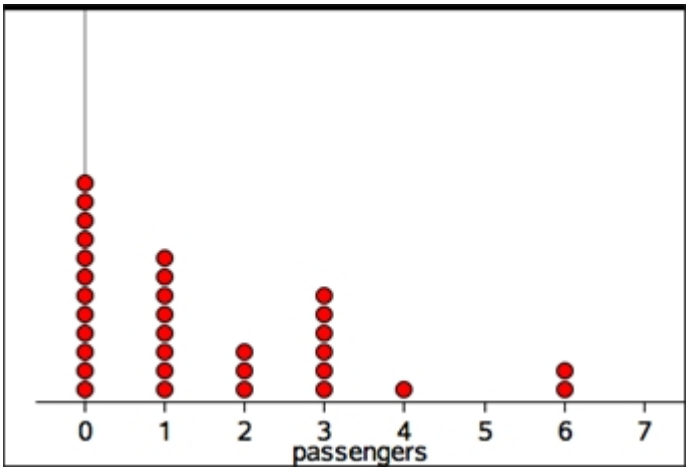
For example, 12 is divisible by 4 because $12=3\times 4$.

Dot plot

A **dot plot** is a graph used in statistics for organising and displaying numerical data.

Using a number line, a dot plot displays a dot for each observation. Where there is more that one observation, or observations are close in value, the dots are stacked vertically. If there are a large number of observations, dots can represent more than one observation. Dot plots are ideally suited for organising and displaying discrete numerical data.

The dot plot below displays the number of passengers observed in 32 cars stopped at a traffic light.



Dot plots can also be used to display categorical data, with the numbers on the number line replaced by category labels.

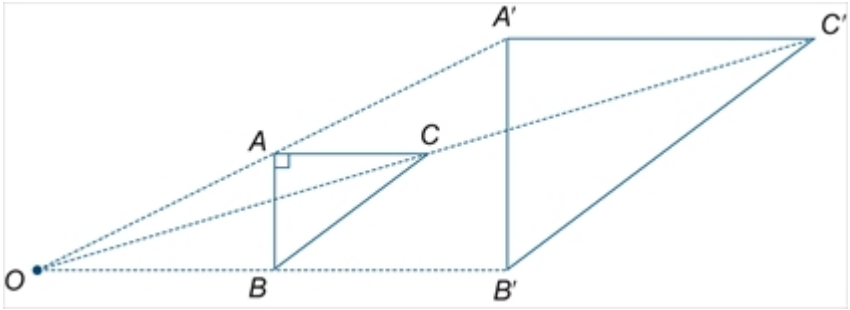
Element

An **element** of a set is a member of that set. For example, the elements of the set $\{2,3,4,6,8\}$ are the numbers $2,3,4,6$ and 8. We write $x \in S$ to indicate that x is a member of the set S.

Enlargement (Dilation)

An enlargement is a scaled up (or down) version of a figure in which the transformed figure is in proportion to the original figure. The relative positions of points are unchanged and the two figures are similar.

In the diagram below triangle *A′B′C′* is the image of triangle *ABC* under the enlargement with enlargement factor 2 and centre of enlargement *O*.



Equally Likely outcomes

Equally likely outcomes occur with the same probability.

For example, in tossing a fair coin, the outcome ‘head’ and the outcome ‘tail’ are equally likely.

In this situation, Pr(head) = Pr(tail) = 0.5

Equation

An **equation** is a statement that asserts that two numbers or algebraic expressions are equal in value. An equation must include an equal sign. For example, $3 + 14 = 11 + 6.$

An **identity** is an equation involving algebraic expressions that is true for all values of the variables involved.

For example $x^2 - 4 = (x - 2)(x + 2).$

An identity is an equation that is true for all values of the variables involved.

Example: $x^2 - y^2 = (x - y)(x + y)$

An **inequality** is a statement that one number or algebraic expression is less than (or greater than) another. There are four types of inequalities:

- The relation a is less than b is written $a < b,$
- a is greater than b is written $a > b$,
- a is less than or equal to b is written $a \leq b$, and
- a is greater than or equal to b is written $a \geq b$.

Equivalent fractions

Two fractions $\frac{a}{b}$ and $\frac{c}{d}$ are **equivalent** if they are equal, that is, $ad = bc.$

Equivalent fractions are alternative ways of writing the same fraction.

For example, $\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \cdots$

Estimate

In statistical terms, an **estimate** is information about a population extrapolated from a sample of the population.

For example, the mean number of decayed teeth in a randomly selected group of eight-year old children is an estimate of the mean number of decayed teeth in eight-year old children in Australia.

Even number

A whole number is **even** if it is divisible by 2. The even whole numbers are $0,2,4,6,\cdots.$

Event

An **event** is a subset of the sample space for a random experiment.

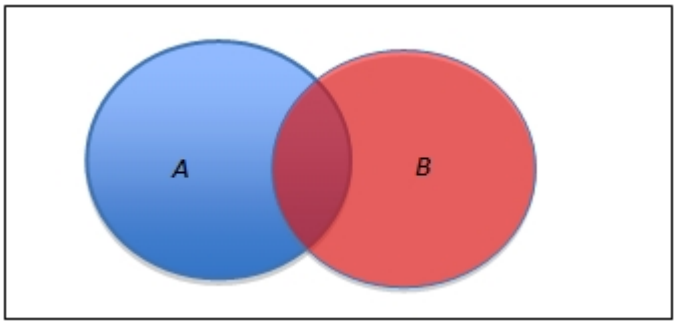
For example, the set of outcomes from tossing two coins is { HH,HT,TH,TT }, where H represents a ‘head’ and T a ‘tail’.

For example, if *A* is the event ‘at least one head is obtained’, then *A* = { HT,TH, HH }.

Two events *A* and *B* are **mutually exclusive** if one is incompatible with the other; that is, if they cannot be simultaneous outcomes in the same chance experiment.

For example, when a fair coin is tossed twice, the events ‘HH’ and ‘TT’ cannot occur at the same time and are, therefore, mutually exclusive.

In a Venn diagram, as shown below, mutually exclusive events do not overlap.



Expression

Two or more numbers or variables connected by operations. For example, 17 – 9, 8 x (2 + 3), 2*a* + 3*b* are all expressions. Expressions do not include an equal sign.

Factor

In general, a number or algebraic expression x is a **factor** (or **divisor**) of another y if there exists a number or algebraic expression q of a specified type for which $y = xq$.

A natural number m is a factor of a natural number n if there is a natural number q such that $n = mq$.

For example, 4 is a factor of 12 because $12 = 3 \times 4$.

A polynomial $a(x)$ is divisible by a polynomial $b(x)$ if there is a polynomial $q(x)$ for which $a(x) = b(x)q(x)$.

For example, $x - 2$ is a factor $x^2 - 6x + 8$ because $x^2 - 6x + 8 = (x - 4)(x - 2)$.

A **prime factor** of a natural number n is a factor of n that is a prime number.

For example, the prime factors of 330 are $2,3,5$ and 11.

Factor and remainder theorem

According to the **factor theorem**, if $p(x)$ is a polynomial and $p(a) = 0$ for some number a, then $p(x)$ is divisible by $x - a$.

This follows easily from the remainder theorem, because for $p(x) \div (x - a)$ the remainder is $p(a)$. So if $p(a) = 0$, the remainder is 0 and $p(x)$ is divisible by $x - a$.

The factor theorem can be used to obtain factors of a polynomial.

For example, if $p(x) = x^3 - 3x^2 + 5x - 6$, then it is easy to check that $p(2) = 2^3 - 3 \times 2^2 + 5 \times 2 - 6 = 0$. So by the factor theorem $x - 2$ is a factor of $x^3 - 3x^2 + 5x - 6$.

According to the **remainder theorem**, if a polynomial $p(x)$ is divided by $x - a$, where a is any real number, the remainder is $p(a)$. That is, $p(x) = q(x)(x - a) + p(a)$, for some polynomial $q(x)$

Factorise

To **factorise** a number or algebraic expression is to express it as a product.

For example, 15 is factorised when expressed as a product: $15 = 3 \times 5$, and $x^2 - 3x + 2$ is factorised when written as a product:

$$x^2 - 3x + 2 = (x - 1)(x - 2).$$

Fraction

The **fraction** $\frac{a}{b}$ (written alternatively as a/b), where a is a non negative integer and b is a positive integer, was historically obtained by dividing a unit length into b equal parts and taking a of these parts.

For example, $\frac{3}{5}$ refers to 3 of 5 equal parts of the whole, taken together.

In the fraction $\frac{a}{b}$ the number a is the numerator and the number b is the denominator.

It is a **proper fraction** if $a < b$ and an **improper fraction** otherwise.

Frequencies

Frequency, or **observed frequency**, is the number of times that a particular value occurs in a data set.

For grouped data, it is the number of observations that lie in that group or class interval.

An **expected frequency** is the number of times that a particular event is expected to occur when a chance experiment is repeated a number of times. For example, If the experiment is repeated *n* times, and on each of those times the probability that the event occurs is *p*, then the expected frequency of the event is *np*.

For example, suppose that a fair coin is tossed 5 times and the number of heads showing recorded. Then the expected frequency of ‘heads’ is 5/2.

This example shows that the expected frequency is not necessarily an observed frequency, which in this case is one of the numbers 0,1,2,3,4 or 5.

A **frequency table** lists the frequency (number of occurrences) of observations in different ranges, called class intervals.

The frequency distribution of the heights (in cm) of a sample of 42 people is displayed in the **frequency table** below

Height (cm)

Class interval	Frequency
155-<160	3
160-<165	2
165-<170	9
170-<175	7
175-<180	10

180-<185	5
185-<190	5
185-<190	5

A **frequency distribution** is the division of a set of observations into a number of classes, together with a listing of the number of observations (the frequency) in that class.

Frequency distributions can be displayed in tabular or graphical form.

Frequency, or **observed frequency**, is the number of times that a particular value occurs in a data set.

For grouped data, it is the number of observations that lie in that group or class interval.

Relative frequency is given by the ratio $\frac{f}{n}$, where *f* is the frequency of occurrence of a particular data value or group of data values in a data set and *n* is the number of data values in the data set.

Frequency table

A **two-way frequency table** is commonly used to for displaying the two-way frequency distribution that arises when a group of individuals or things are categorised according to two criteria.

For example, the two-way table below displays the two-way frequency distribution that arises when 27 children are categorised according to *hair type* (straight or curly) and *hair colour* (red, brown, blonde, black).

Hair colour	**Hair type**		**Total**
red	1	1	2
brown	8	4	12
blonde	1	3	4
black	7	2	9
Total	17	10	27

The information in a two-way frequency table can also be displayed graphically using a side-by-side column graph.

Function

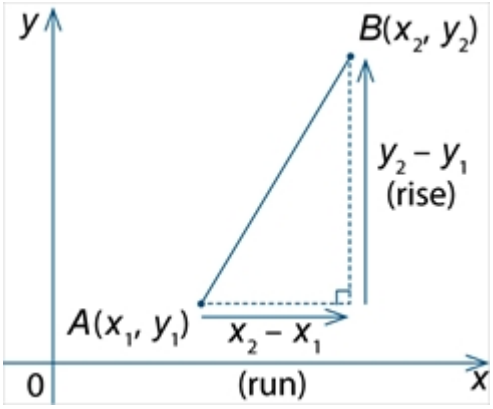
A **function** f assigns to each element of one set S precisely one element of a second set T.

The functions most commonly encountered in elementary mathematics are real functions of real variables. For such functions, the domain and codomain are sets of real numbers.

Functions are usually defined by a formula for $f(x)$ in terms of x. For example, the formula $f(x) = x^2$ defines the 'squaring function' that maps each real number x to its square x^2.

Gradient

If $A(x_1,y_1)$ and points $B(x_2, y_2)$ are points in the plane, $x_2 - x_1 \neq 0$, the **gradient** of the line segment (interval) $AB = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$.



The **gradient of a line** is the gradient of any line segment (interval) within the line.

Greatest common divisor

The **greatest common divisor (**gcd), **greatest common factor** (gcf) or **highest common factor** (hcf), of a given set of natural numbers is the common divisor of the set that is greater than each of the other common divisors.

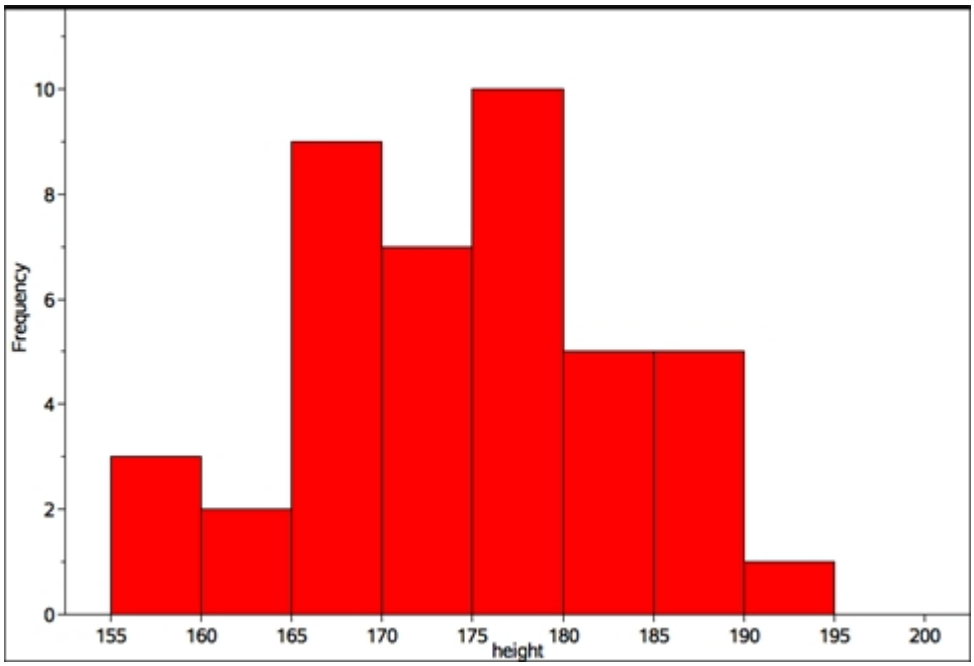
For example, 1,2,3, and 6 are the common factors of 24,54 and 66 and 6 is the greatest common divisor.

Histogram

A **histogram** is a statistical graph for displaying the frequency distribution of continuous data.

A histogram is a graphical representation of the information contained in a frequency table. In a histogram, class frequencies are represented by the areas of rectangles centred on each class interval. The class frequency is proportional to the rectangle's height when the class intervals are all of equal width.

The histogram below displays the frequency distribution of the heights (in cm) of a sample of 42 people with class intervals of width 5 cm.



Independent event

Two events are **independent** if knowing the outcome of one event tells us nothing about the outcome of the other event.

Independent variable

When investigating relationships in bivariate data, the **explanatory variable** is the variable that may explain or cause a difference in the r**esponse variable**.

For example, when investigating the relationship between the temperature of a loaf of bread and the time it has spent in a hot oven, *temperature* is the response variable and *time* is the explanatory variable.

With numerical bivariate data it is common to attempt to model such relationships with a mathematic equation and to call the response variable the **dependent variable** and the explanatory variable the **independent variable**.

When graphing numerical data, the convention is to display the response (dependent) variable on the vertical axis and the explanatory (independent) variable on the horizontal axis.

When there is no clear causal link between the events, the classification of the variables as either the dependent or independent variable is quite arbitrary.

Index

Index is synonymous with exponent.

The **exponent** or index of a number or algebraic expression is the power to which the latter is be raised. The exponent is written as a superscript. Positive integral exponents indicate the number of times a term is to be multiplied by itself. For example,$a^3 = a \times a \times a.$

Index law

Index laws are rules for manipulating indices (**exponents**). They include

$$x^a x^b = x^{a+b}; \quad (x^a)^b = x^{ab}; \quad \text{and} \quad x^a y^a = (xy)^a$$

and

$$x^0 = 1; \quad x^{-a} = \frac{1}{x^a}; \quad \text{and} \quad x^{1/a} = \sqrt[a]{x}$$

Informal unit

Informal units are not part of a standardised system of units for measurement. For example, an informal unit for length could paperclips of uniform length. An informal unit for area could be uniform paper squares of any size. Informal units are sometimes referred to as non-standard units.

Integer

The **integers** are the 'whole numbers' $\cdots, -3, -2, -1, 0, 1, 2, 3, \cdots$. The set of integers is usually denoted by $\mathbb{Z}$. Integers are basic building blocks in mathematics.

Interquartile range

The **interquartile range** (IQR) is a measure of the spread within a numerical data set. It is equal to the upper quartile (Q_3) minus the lower quartiles (Q_1); that is, $IQR = Q_3 - Q_1$

The IQR is the width of an interval that contains the middle 50% (approximately) of the data values. To be exactly 50%, the sample size must be a multiple of four.

Interval

An interval is a certain type of subset of the number line.

A **finite interval** is the set of all real numbers between two given real numbers called the **end points** of the interval. The end points may or may not be included in the interval.

Irrational number

An irrational number is a real number that is not rational. Some commonly used irrational numbers are π, *e* and $\sqrt{2}$.

The Euler number is an irrational real number whose decimal expansion begins

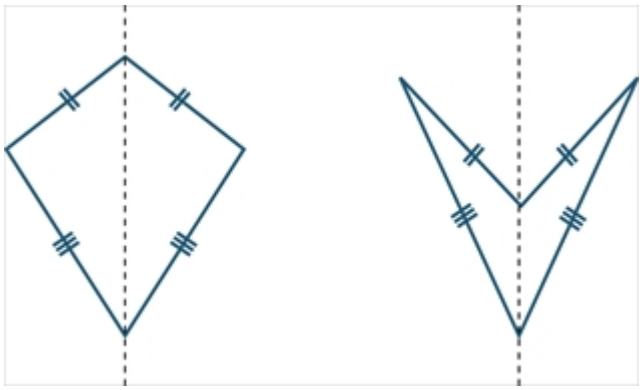
$$e = 2.718281828\cdots$$

Irregular shape

An irregular shape can be a polygon. A polygon that is not regular is irregular.

Kite

A **kite** is a quadrilateral with two pairs of adjacent sides equal.

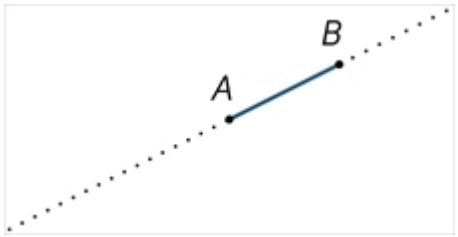


A kite may be convex as shown in the diagram above to the left or non-convex as shown above to the right. The **axis** of the kite is shown.

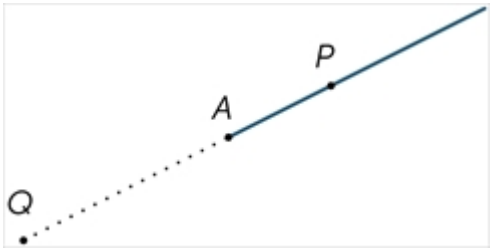
Line segment (Interval)

If *A* and *B* are two points on a line, the part of the line between and including *A* and *B* is called a **line segment** or **interval**.

The **distance** *AB* is a measure of the size or length of *AB*.



Any point *A* on a line divides the line into two pieces called rays. The **ray** *AP* is that ray which contains the point P (and the point A). The point *A* is called the **vertex** of the ray and it lies on the ray.



Linear equation

A **linear equation** is an equation involving just linear terms, that is, polynomials of degree 1. The general form of a linear equation in one variable is $ax + b = 0$

Location (statistics)

A measure of **location** is a single number that can be used to indicate a central or 'typical value' within a set of data.

The most commonly used measures of location are the mean and the median although the mode is also sometimes used for this purpose.

Logarithm

The **logarithm** of a positive number x is the power to which a given number b , called the **base**, must be raised in order to produce the number $x.$. The logarithm of x , to the base b is denoted by $\log_b x$. Algebraically: $\log_b x = y \leftrightarrow b^y = x$

For example, $\log_{10} 100 = 2$ because $10^2 = 100,$ and $\log_2 \left(\frac{1}{32}\right) = -5$ because $2^{-5} = \frac{1}{32}.$

Many-to-one correspondence

A **many-to-one correspondence** is a function or mapping that takes the same value for at least two different elements of its domain. For example, the squaring function $x \mapsto x^2$ is many-to-one because $x^2 = (-x)^2$ for all real numbers. x

Mean

The arithmetic **mean** of a list of numbers is the sum of the data values divided by the number of numbers in the list.

In everyday language, the arithmetic mean is commonly called the **average**.

For example, for the following list of five numbers { 2, 3, 3, 6, 8 } the mean equals

$$\frac{2+3+3+6+8}{5} = \frac{22}{5} = 4.4$$

Median

The **median** is the value in a set of ordered data that divides the data into two parts. It is frequently called the ‘middle value’.

Where the number of observations is odd, the median is the middle value.

For example, for the following ordered data set with an **odd** number of observations, the median value is five.

1 3 3 4 5 6 8 9 9

Where the number of observations is **even**, the median is calculated as the mean of the two central values.

For example, in the following ordered data set, the two central values are 5 and 6, and median value is the mean of these two values, 5.5

1 3 3 4 5 6 8 9 9 10

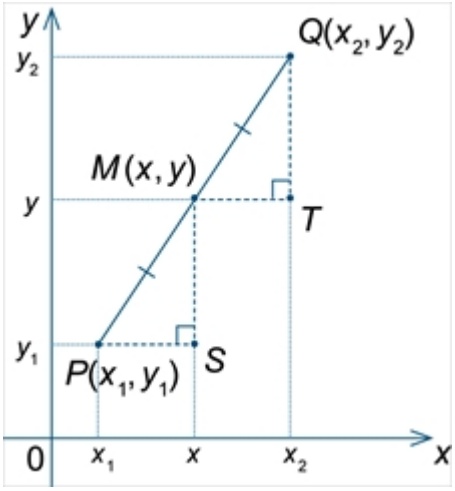
The median provides a measure of location of a data set that is suitable for both symmetric and skewed distributions and is also relatively insensitive to outliers.

Midpoint

The **midpoint** *M* of a line segment (interval) *AB* is the point that divides the segment into two equal parts.

Let $A(x_1, y_1)$ be points in the Cartesian plane. Then the **midpoint** *M* of line segment *AB* has coordinates ($\frac{x_1 + x_2}{2}$, $\frac{x_1 + x_2}{2}$).

This can be seen from the congruent triangles below.



Mode

The **mode** is the most frequently occurring value in a set of data. There can be more than one mode. When there are two modes, the data set is said to be **bimodal**.

The mode is sometimes used as a measure of location.

Monic

A **monic** polynomial is one in which the coefficient of the leading term is 1. For example, $x^3 + 2x^2 - 7$ is monic, but $4x^2 - x + 1$ is not.

Multiple

A multiple of a number is the product of that number and an integer.

A multiple of a real number x is any number that is a product of x and an integer. For example, 4.5 and -13.5 are multiples of 1.5 because $4.5 = 3 \times 1.5$ and $13.5 = -7 \times 1.5$.

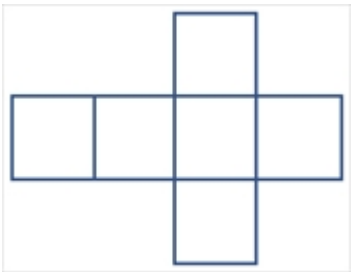
Multiplication

Multiplicative situations are problems or contexts that involve multiplication (or division). Calculating the number of seats in a theatre that has 30 rows of 24 seats, finding equivalent fractions, and working with ratios and percentages are all multiplicative situations.

Net

A **net** is a plane figure that can be folded to form a polyhedron.

One possible net for a cube is shown below.



Number

A real number is **rational** if it can be expressed as a quotient of integers. It is **irrational** otherwise.

Number line

A **number line** gives a pictorial representation of real numbers.

Numeral

A figure or symbol used to represent a number. For example, -3, 0, 45, IX

Numerator

In the fraction $\frac{a}{b}$, a is the **numerator**. If an object is divided into b equal parts, then the fraction $\frac{a}{b}$ represents a of these parts taken together. For example, if a line segment is divided into 5 equal parts, each of those parts is one fifth of the whole and 3 of these parts taken together corresponds to the fraction $\frac{3}{5}$.

Numerical data

Numerical data is data associated with a numerical variable.

Numerical variables are variables whose values are numbers, and for which arithmetic processes such as adding and subtracting, or calculating an average, make sense.

Odd and even number

A whole number is **even** if it is divisible by 2. The even whole numbers are $0,2,4,6,\cdots$.

An **odd number** is an integer that is not divisible by 2. The odd numbers are $\cdots -5,-3,-1,1,3,5,\cdots$.

One-to-one correspondence

In early counting development one-to-one correspondence refers to the matching of one and only one number word to each element of a collection.

More generally it refers to a relationship between two sets such that every element of the first set corresponds to one and only one element of the second set.

Operation

The process of combining numbers or expressions. In the primary years operations include addition, subtraction, multiplication and division. In later years operations include substitution and differentiation.

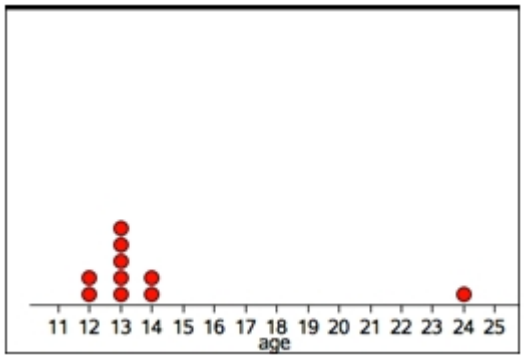
Order of operations

A convention for simplifying expressions that stipulates that multiplication and division are performed before addition and subtraction and in order from left to right. For example, in 5 – 6 ÷ 2 +7, the division is performed first and the expression becomes 5 – 3 + 7 = 9. If the convention is ignored and the operations are performed in order, the incorrect result, 6.5 is obtained.

Outlier

An **outlier** is a data value that appears to stand out from the other members of the data set by being unusually high or low. The most effective way of identifying outliers in a data set is to graph the data.

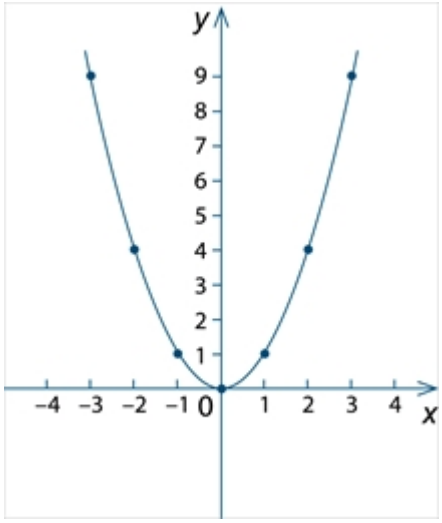
For example, in following list of ages of a group of 10 people, { 12, 12, 13, 13, 13, 13, 13, 14, 14, 14, 24 }, the 24 would be considered to be a possible outlier.



Parabola

Definition 1

The graph of $y = x^2$ is called a **parabola**. The point (0, 0) is called the **vertex** of the parabola and the y axis is the axis of symmetry of the parabola called simply the **axis**.



Some other parabolas are the graphs of $y = ax^2 + bx + c$ where $a \neq 0$.

More generally, every **parabola** is similar to the graph of $y = x^2$.

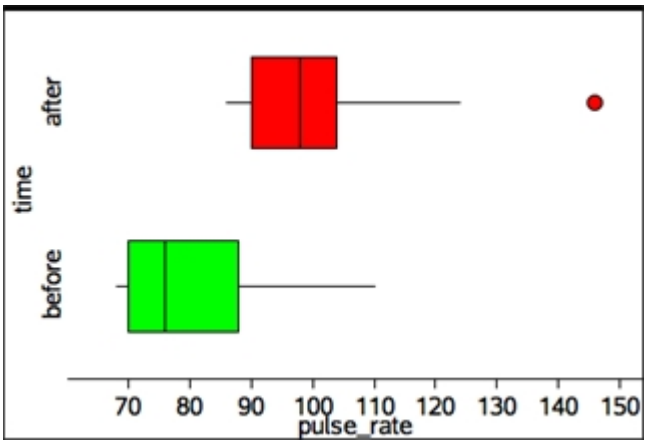
Definition 2

A parabola is the locus of all points P such that the distance from P to a fixed point F is equal to the distance from P to a fixed line l.

Parallel box plots

Parallel box-and-whisker-plots are used to visually compare the five-number summaries of two or more data sets.

For example, box-and-whisker-plots below can be used to compare the five-number summaries for the pulse rates of 19 students before and after gentle exercise.



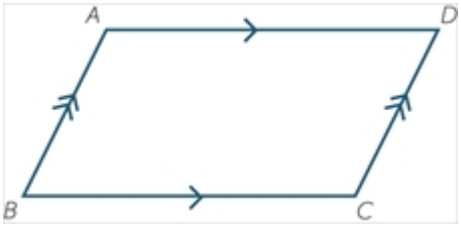
Note that the box plot for pulse rates after exercise shows the pulse rate of 146 as a possible outlier (**.**). This is because the distance of this data point above the upper quartile 42 (146-104) is more than 21 (1.5 ´ IQRs = 1.5 ´ (104 – 90) = 1.5 ´ 14 = 21).

The term ‘parallel box-and-whisker plots’ is commonly abbreviated to ‘parallel boxplots’.

Parallelogram

A **parallelogram** is a quadrilateral whose opposite sides are parallel.

Thus the quadrilateral *ABCD* shown below is a parallelogram because *AB* || *DC* and *DA* || *CB*.



Properties of a parallelogram

- The opposite angles of a parallelogram are equal.
- The opposite sides of a parallelogram are equal.
- The diagonals of a parallelogram bisect each other.

Partitioning

Dividing a quantity into parts. In the early years it commonly refers to the ability to think about numbers as made up of two parts, for example, 10 is 8 and 2. In later years it refers to dividing both continuous and discrete quantities into equal parts.

Percentage

A **percentage** is a fraction whose denominator is 100.

For example, 6 percent (written as 6%) is the percentage whose value is $\frac{6}{100}$

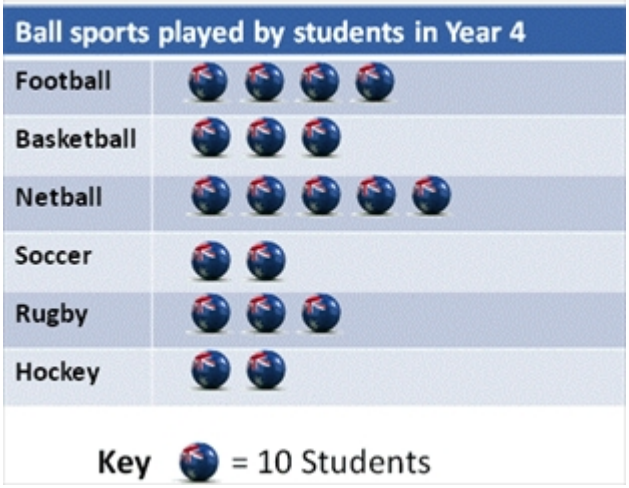
Similarly, 40 as a percentage of 250 is $\frac{40}{250} \times 100 = 16\%$

Perimeter

The **perimeter** of a plane figure is the length of its boundary.

Picture graphs

A **picture graph** is a statistical graph for organising and displaying categorical data.



Place value

The value of digit as determined by its position in a number relative to the ones (or units) place. For integers the ones place is occupied by the rightmost digit in the number.

For example in the number 2 594.6 the 4 denotes 4 ones, the 9 denotes 90 ones or 9 tens, the 5 denotes 500 ones or 5 hundreds, the 2 denotes 2000 ones or 2 thousands, and the 6 denotes $\frac{6}{10}$ of a one or 6 tenths.

Point

A **point** marks a position, but has no size.

Polynomial

A polynomial in one variable x (simply called a **polynomial**) is a finite sum of terms of the form ax^k, where a is a number and k is a non-negative integer.

A non-zero polynomial can be written in the form $a_0 + a_1x + a_2x^2 + \cdots + a_nx^n$, where n is a non-negative integer and $a_n \neq 0$.

Population

A **population** is the complete set of individuals, objects, places, etc, that we want information about.

A **census** is an attempt to collect information about the whole population.

Prime number

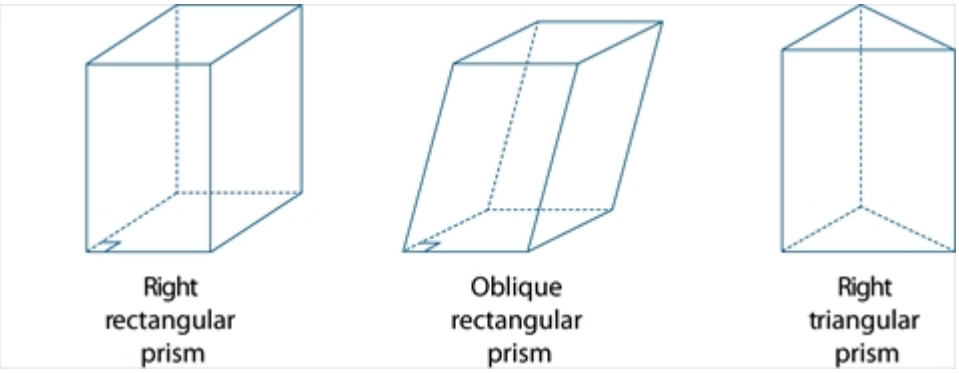
A prime number is a natural number greater than 1 that has no factor other 1 and itself.

Prism

A **prism** is a convex polyhedron that has two congruent and parallel faces and all its remaining faces are parallelograms.

A right **prism** is a convex polyhedron that has two congruent and parallel faces and all its remaining faces are rectangles. A prism that is not a right prism is often called an **oblique prism**.

Some examples of prisms are shown below.



Probability

The probability of an event is a number between 0 and 1 that indicates the chance of something happening.

For example the probability that the sun will come up tomorrow is 1, the probability that a fair coin will come up 'heads' when tossed is 0.5, while the probability of someone being physically present in Adelaide and Brisbane at exactly the same time is zero.

Product

A **product** is the result of multiplying together two or more numbers or algebraic expressions.

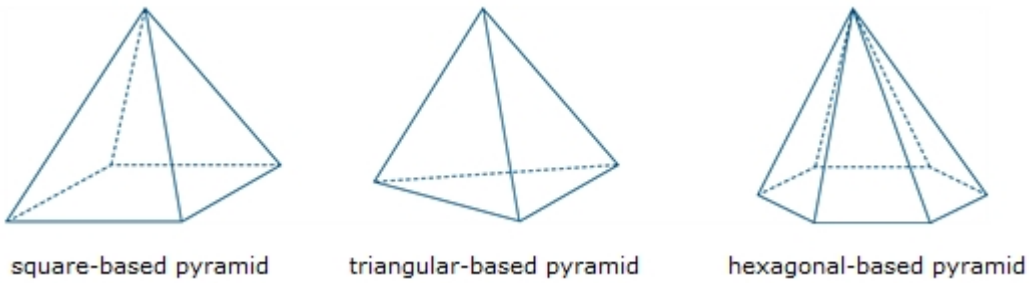
For example, 36 is the product of 9 and 4, and $x^2 - y^2$ is product of $x - y$ and $x + y$.

Proportion

Corresponding elements of two sets are in proportion if there is a constant ratio. For example, the circumference and diameter of a circle are in proportion because for any circle the ratio of their lengths is the constant π.

Pyramid

A **pyramid** is a convex polyhedron with a polygonal base and triangular sides that meet at a point called the vertex. The pyramid is named according to the shape of its base.

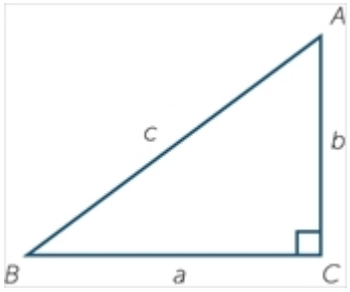


Pythagoras' theorem

Pythagoras' theorem

For a right-angled triangle

- The square of the hypotenuse of a right-angled triangle equals the sum of the squares of the lengths of the other two sides.
- In symbols, $c^2 = a^2 + b^2$.



The converse

If $c^2 = a^2 + b^2$ in a triangle *ABC*, then C is a right angle.

Quadratic equation

The general quadratic equation in one variable is $ax^2 + bx + c = 0$, where $a \neq 0$.

The roots are given by the quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Quadratic expression

A **quadratic expression** or function contains one or more of the terms in which the variable is raised to the second power, but no variable is raised to a higher power. Examples of quadratic expressions include $3x^2 + 7$ and $x^2 + 2xy + y^2 - 2x + y + 5$.

Quartile

Quartiles are the values that divide an ordered data set into four (approximately) equal parts. It is only possible to divide a data set into exactly four equal parts when the number of data of values is a multiple of four.

There are three quartiles. The first, the **lower quartile** (Q_1) divides off (approximately) the lower 25% of data values. The second quartile (Q_2) is the median. The third quartile, the **upper quartile** (Q_3), divides off (approximately) the upper 25% of data values.

Percentiles are the values that divide an ordered data set into 100 (approximately) equal parts. It is only possible to divide a data set into exactly 100 equal parts when the number of data values is a multiple of one hundred.

There are 99 percentiles. Within the above limitations, the first percentile divides off the lower 1% of data values. The second, the lower 2% and so on. In particular, the **lower quartile** (Q_1) is the 25th percentile, the **median** is the 50th percentile and the **upper quartile** is the 75th percentile.

Quotient

A **quotient** is the result of dividing one number or algebraic expression by another. See also remainder.

Random number

A random number is one whose value is governed by chance; for example, the number of dots showing when a fair die is tossed. The value of a random number cannot be predicted in advance.

Range (statistics)

The **range** is the difference between the largest and smallest observations in a data set.

The range can be used as a measure of spread in a data set, but it is extremely sensitive to the presence of outliers and should only be used with care.

Rate

A rate is particular kind of ratio in which the two quantities are measured in different units. For example, the ratio of distance to time, known as speed is a rate because distance and time are measured in different units (such as kilometres and hours). The value of the rate depends on the units in which of the quantities are expressed.

Ratio

A **ratio** is a quotient or proportion of two numbers, magnitudes or algebraic expressions. It is often used as a measure of the relative size of two objects. For example the ratio of the length of a side of a square to the length of a diagonal is $1:\sqrt{2}$ that is, $\frac{1}{\sqrt{2}}$.

Real numbers

The numbers generally used in mathematics, in scientific work and in everyday life are the **real numbers**. They can be pictured as points on a number line, with the integers evenly spaced along the line, and a real number b to the right of a real number a if $a < b$.

A real number is either rational or irrational.

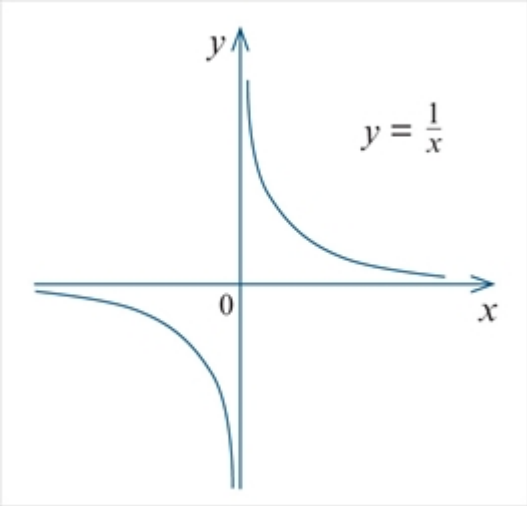
Every real number has a decimal expansion. Rational numbers are the ones whose decimal expansions are either terminating or recurring.

Rectangle

A **rectangle** is a quadrilateral in which all angles are right angles

Rectangular Hyperbola

The graph of *y* = 1/x is called a **rectangular hyperbola**. The *x* and *y* axes are asymptotes as the curve gets as close as we like to them.



Recurring decimal

A **recurring decimal** is a decimal that contains a pattern of digits that repeats indefinitely after a certain number of places.

For example,

$$0.1\dot{0}\dot{7} = 0.1070707\cdots,$$

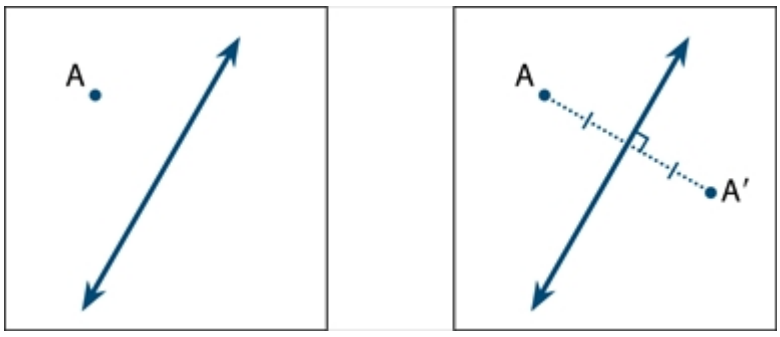
and this is the decimal expansion of the rational number

$$\frac{1}{10} + \frac{7}{1000} + \frac{7}{100000} + \frac{7}{10000000} + \cdots = \frac{1}{10} + \left(\frac{7/1000}{1 - 1/100}\right) = \frac{1}{10} + \frac{7}{990} = \frac{106}{990}$$

Every recurring decimal is the decimal expansion of a rational number

Reflection

To **reflect** the point A in an **axis of reflection,** a line has been drawn at right angles to the axis of reflection and the point A′ is marked at the same distance from the axis of reflection as A, but on the other side.



The point A′ is called the reflection image of A.

A **reflection** is a transformation that moves each point to its reflection image.

Related denominators

Denominators are related when one is a multiple of the other. For example, the fractions $\frac{1}{3}$ and $\frac{5}{9}$ have related denominators because 9 is a multiple of 3.

Fractions with related denominators are more easily added and subtracted than fractions with unrelated denominators because only one needs to be renamed. For example to add $\frac{1}{3}$ and $\frac{5}{9}$ we can rename $\frac{1}{3}$ as $\frac{3}{9}$ and then compute $\frac{3}{9}+\frac{5}{9}=\frac{8}{9}$.

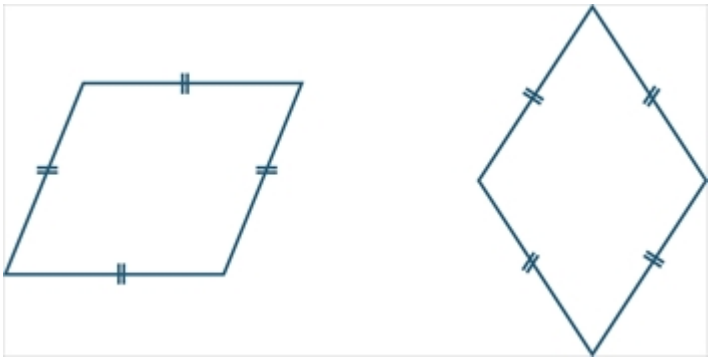
Remainder

A **remainder** is the amount left over when one number or algebraic quantity a is divided by another b. If a is divisible by b then the remainder is 0.

For example, when 68 is divided by 11, the remainder is 2, because 68 can be expressed as $68 = 6 \times 11 + 2$.

Rhombus

A rhombus is a quadrilateral with all sides equal.



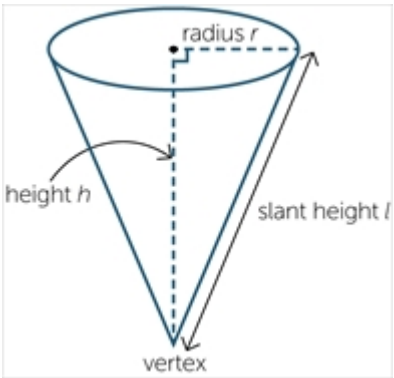
Right Cone

A **cone** is a solid that is formed by taking a circle called the base and a point not in the plane of the circle, called the vertex, which lies above or below the circle and joining the vertex to each point on the circle.

If the vertex is directly above or below the centre of the circular base, we call the cone a **right cone**.

The **height of the cone** is the distance from the vertex to the centre of the circular base.

The **slant height** of a cone is the distance from any point on the circle to the vertex to the circle.



Rotation

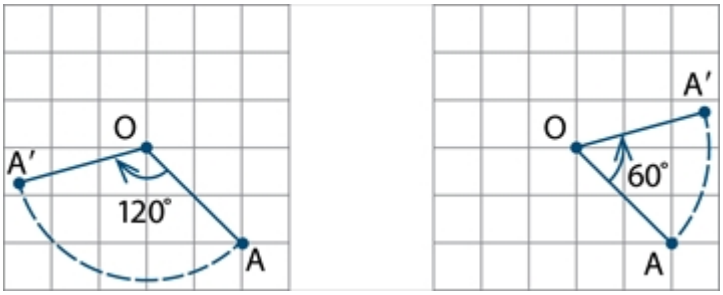
A **rotation** turns a figure about a fixed point, called the **centre of rotation**.

A rotation is specified by:

- the centre of rotation *O*

- the angle of rotation
- the direction of rotation (clockwise or anticlockwise).

In the first diagram below, the point A is rotated through 120o clockwise about O. In the second diagram, it is rotated through 60o anticlockwise about O.



A **rotation** is a transformation that moves each point to its rotation image.

Rounding

The decimal expansion of a real number is **rounded** when it is approximated by a terminating decimal that has a given number of decimal digits to the right of the decimal point.

Rounding to n decimal places is achieved by removing all decimal digits beyond (to the right of) the n^{th} digit to the right of the decimal place, and adjusting the remaining digits where necessary.

If the first digit removed (the $(n+1)^{th}$ digit) is less than 5 the preceding digit is not changed.

For example, 4.02749 becomes 4.027 when rounded to 3 decimal places.

If the first digit removed is greater than 5, or 5 and some succeeding digit is non-zero, the preceding digit is increased by 1. For example, 6.1234586 becomes 6.12346 when rounded to 5 decimal places.

Sample

A **sample** is part of a population. It is a subset of the population, often randomly selected for the purpose of estimating the value of a characteristic of the population as a whole.

For instance, a randomly selected group of eight-year old children (the sample) might be selected to estimate the incidence of tooth decay in eight-year old children in Australia (the population).

Sample space

A **sample space** is the set of all possible outcomes of a chance experiment. For example, the set of outcomes (also called **sample points**) from tossing two heads is { HH, HT, TH, TT }, where H represents a ‘head’ and T a ‘tail’.

Scientific notation

A positive real number is expressed in **scientific notation** when it is written as the product of a power of 10 and a decimal that has just one digit to the left of the decimal point.

For example, the scientific notation for 3459 is 3.459×10^3, and the scientific notation for 0.000004567 is 4.567×10^{-6}.

Many electronic calculators will show these as $3.459E3$ and $4.567E-6$

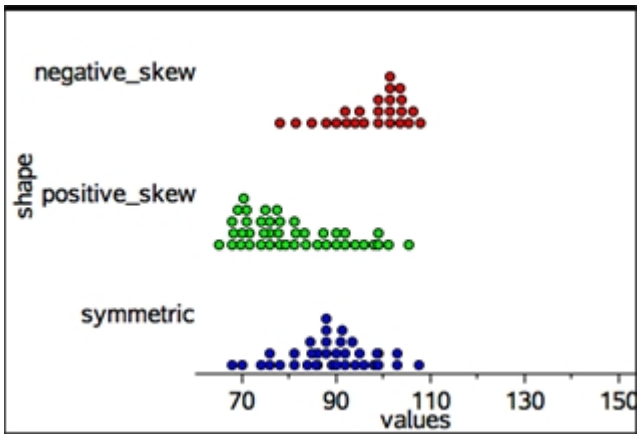
Secondary data set

Primary data is data collected by the user. **Secondary data** is data collected by others. Sources of secondary data include, web-based data sets, the media, books, scientific papers, etc.

Shape (statistics)

The **shape** of a numerical data distribution is mostly simply described as **symmetric** if it is roughly evenly spread around some central point or **skewed**, if it is not. If a distribution is skewed, it can be further described as **positively skewed** ('tailing-off' to the upper end of the distribution) or **negatively skewed** ('tailing-off' to the lower end of the distribution).

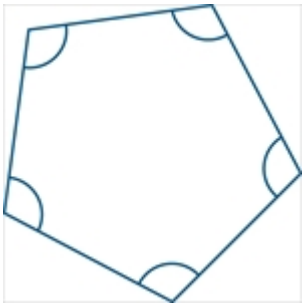
These three distribution shapes are illustrated in the parallel dot plot display below.



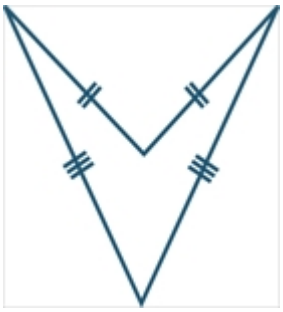
Dot plots, histograms and stem plots can all be used to investigate the shape of a data distribution.

Shapes (geometry)

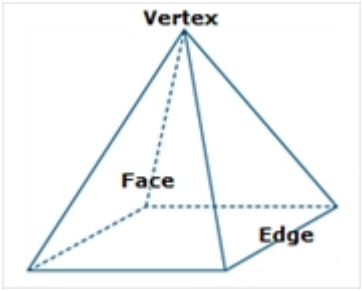
A **polygon** is plane figure bounded by line segments.



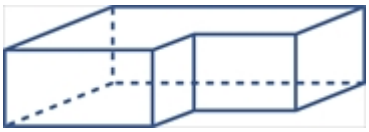
The figure shown above is a **regular pentagon.** It is a convex five-sided polygon. It is called a **pentagon** because it has five sides. It is called **regular** because all sides have equal length and all interior angles are equal.



A **polyhedron** is a solid figure bounded by plane polygonal faces. Two adjacent faces intersect at an edge and each edge joins two vertices.



The polyhedron shown above is a pyramid with a square base. It has 5 vertices, 8 edges and 5 faces. It is a convex polyhedron.



The figure above is a non-convex polyhedron.

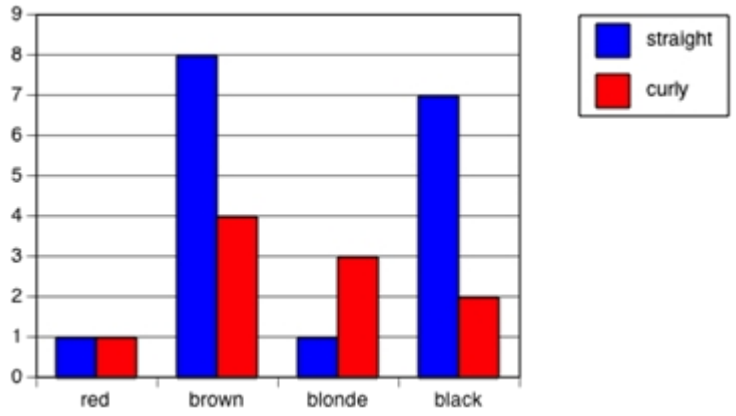
A **convex polyhedron** is a finite region bounded by planes, in the sense that the region lies entirely on one side of the plane.

A regular shape can be a polygon. A polygon is regular if all of its sides are the same length and all of its angles have the same measure.

Side-by-side column graph

A side-by-side **column graph** can be used to organise and display the data that arises when a group of individuals or things are categorised according to two or more criteria.

For example, the side-by-side column graph below displays the data obtained when 27 children are categorised according to *hair type* (straight or curly) and *hair colour* (red, brown, blonde, black). The legend indicates that blue columns represent children with straight hair and red columns children with curly hair.



Side-by-side column graphs are frequently called **side-by-side bar graphs** or **bar charts**. In a bar graph or chart, the bars can be either vertical or horizontal.

Similar

The four standard tests for two triangles to be similar.

AAA: If two angles of one triangle are respectively equal to two angles of another triangle, then the two triangles are similar.

SAS: If the ratio of the lengths of two sides of one triangle is equal to the ratio of the lengths of two sides of another triangle, and the included angles are equal, then the two triangles are similar.

SSS: If we can match up the sides of one triangle with the sides of another so that the ratios of matching sides are equal, then the two triangles are similar.

RHS: If the ratio of the hypotenuse and one side of a right-angled triangle is equal to the ratio of the hypotenuse and one side of another right-angled triangle, then the two triangles are similar.

Similarity

Two plane figures are called **similar** if an enlargement of one figure is congruent to the other.

That is, if one can be mapped to the other by a sequence of translations, rotations, reflections and enlargements.

Similar figures thus have the same shape, but not necessarily the same size.

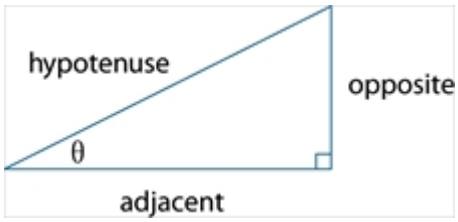
Simple interest

Simple interest is the interest accumulated when the interest payment in each period is a fixed fraction of the principal. For example, if the principle $\$P$ earns simple interest at the rate of $i\%$ per period, then after n periods the accumulated simple interest is $\$Pni/100.$

Sine

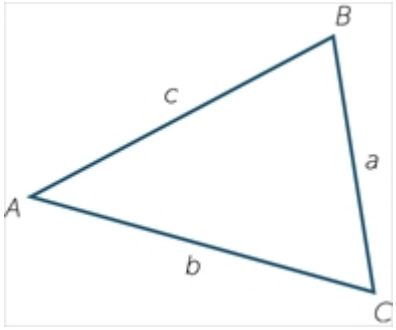
In any right-angled triangle,

$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$, where $0^o < \theta < 90^o$



In any triangle *ABC,*

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

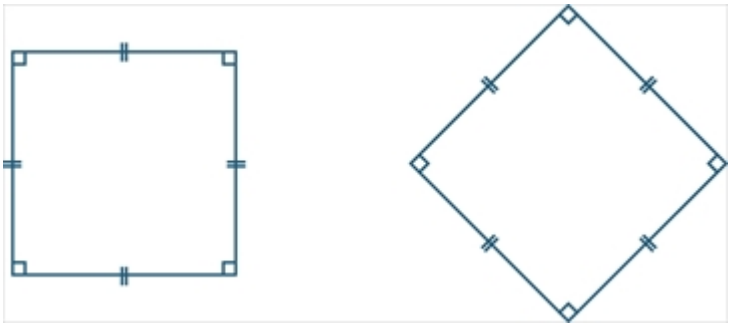


In words it says:

Any side of a triangle over the sine of the opposite angle equals any other side of the triangle over the sine of its opposite angle.

Square

A **square** is a quadrilateral that is both a rectangle and a rhombus.



A square thus has all the properties of a rectangle, and all the properties of a rhombus.

Standard deviation

Standard deviation is a measure of the variablity or spread of a data set. It gives an indication of the degree to which the individual data values are spread around their mean.

Stem and leaf plot

A **stem-and-leaf plot** is a method of organising and displaying numerical data in which each data value is split in to two parts, a ‘stem’ and a ‘leaf’.

For example, the stem-and-leaf plot below displays the resting pulse rates of 19 students.

pulse rate

6	8 8 8 9
7	0 1 1 4 6 6 8
8	2 6 8 8
9	0 6
10	4
11	0

In this plot, the stem unit is '10' and the leaf unit is '1'. Thus the top row in the plot 6½8 8 8 9 displays pulse rates of 68, 68, 68 and 69.

Stemplot is a synonym for stem-and-leaf plot.

Subitising

Recognising the number of objects in a collection without consciously counting

Sum

A **sum** is the result of adding together two of more numbers or algebraic expressions.

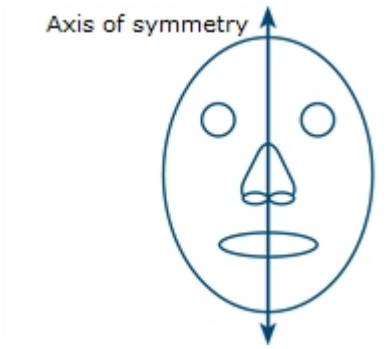
Surd

A **surd** is a numerical expression involving one or more irrational roots of numbers. Examples of surds include $\sqrt{2}$, $\sqrt[3]{5}$, and $4\sqrt{3}+7\sqrt[3]{6}$

Symmetrical

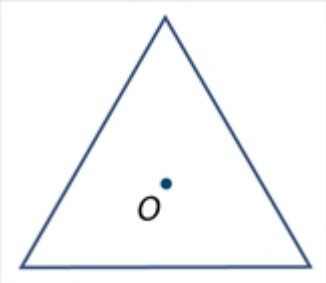
Line symmetry

A plane figure F has line symmetry in a line m if the image of F under the reflection in m is F itself. The line m is called the axis of symmetry.



Rotational symmetry

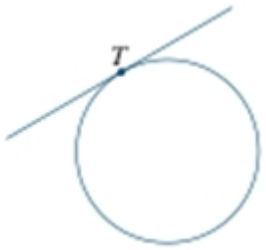
A plane figure *F* has **rotational symmetry** about a point *O* if there is a non-trivial rotation such that the image of *F* under the rotation is *F* itself.



A rotation of 120o around O moves the equilateral triangle onto itself.

Tangent

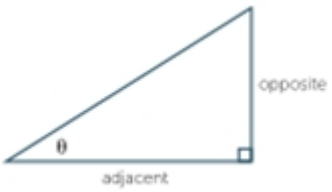
A **tangent** to a circle is a line that intersects a circle at just one point. It touches the circle at that point of contact, but does not pass inside it.



Tangent

In any right-angled triangle,

$$\tan\theta = \text{opposite} / \text{adjacent}, \text{ where } 0° < \theta < 90°.$$



Terminating decimal

A **terminating decimal** is a decimal that contains only finitely many decimal digits.

Every terminating decimal represents a rational number $10.$ where the denominator is a power of For example, 54.321 is the decimal expansion of the sum

$$5 \times 10^{1} + 4 \times 10^{0} + 3 \times 10^{-1} + 2 \times 10^{-2} + 3 \times 10^{-3} = \frac{54321}{1000}$$

Transformation

The transformations included in this glossary are enlargements, reflections, rotations and translations.

Translation

Shifting a figure in the plane without turning it is called **translation**. To describe a translation, it is enough to say how far left or right and how far up or down the figure is moved.

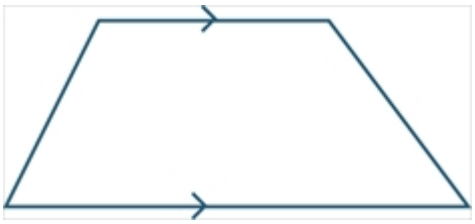
A translation is a transformation that moves each point to its translation image.

Transversal

A **transversal** is a line that meets two or more other lines in a plane.

Trapezium

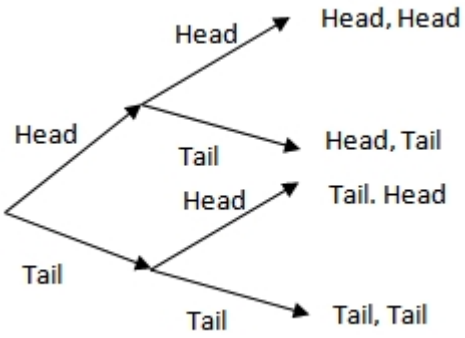
A **trapezium** is a quadrilateral with one pair of opposite sides parallel.



Tree diagram

A **tree diagram** is a diagram that can used to enumerate the outcomes of a multi-step random experiment.

The diagram below shows a tree diagram that has been used to enumerate all of the possible outcomes when a coin is tossed twice This is an example of a **two-step random experiment**.



Triangular number

A triangular number is the number of dots required to make a triangular array of dots in which the top row consists of just one dot, and each of the other rows contains one more dot than the row above it. So the first triangular number is 1, the second is $3 (= 1 + 2)$, the third is $6 (= 1 + 2 + 3)$ and so on.

Trigonometric ratios

Sine, Cosine, Tangent

Unit fraction

A unit fraction is a simple fraction whose numerator is 1, that is, a fraction of the form $1/n$, where n is a natural number.

Variable

Numerical variables are variables whose values are numbers, and for which arithmetic processes such as adding and subtracting, or calculating an average, make sense.

A **discrete numerical variable** is a numerical variable, each of whose possible values is separated from the next by a definite 'gap'. The most common numerical variables have the counting numbers 0,1,2,3,… as possible values. Others are prices, measured in dollars and cents.

Examples include the number of children in a family or the number of days in a month.

Variable (algebra)

A **variable** is a symbol, such as x, y or z, used to represent an unspecified member of some set. For example, the variable x could represent an unspecified real number.

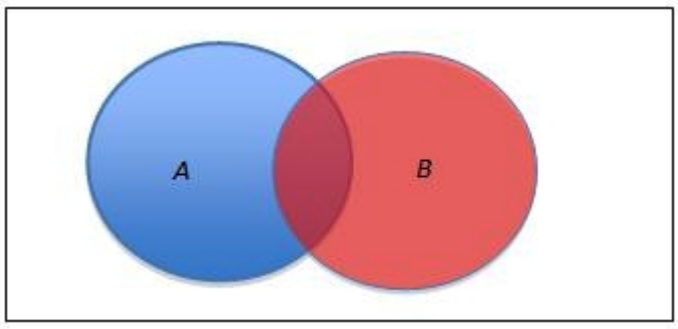
Variable (statistics)

A **variable** is something measurable or observable that is expected to either change over time or between individual observations.

Examples of variables in statistics include the age of students, their hair colour or a playing field's length or its shape.

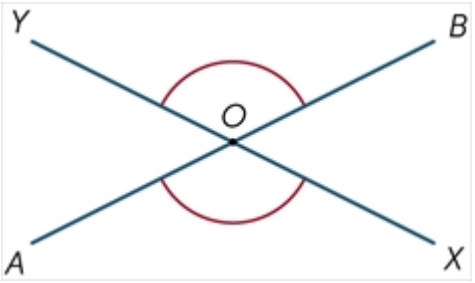
Venn diagram

A **Venn diagram** is a graphical representation of the extent to which two or more events, for example *A* and *B*, are mutually inclusive (overlap) or mutually exclusive (do not overlap).



Vertically opposite angle

When two lines intersect, four angles are formed at the point of intersection. In the diagram, the angles marked *AOX* and *BOY* are called **vertically opposite**.



Vertically opposite angles are equal.

Volume

The **volume** of a solid region is a measure of the size of a region.

For a rectangular prism, *Volume* = *Length* × *Width* × *Height*

Whole number

A **whole number** is a non–negative integer, that is, one of the numbers $0,1,2,3,\cdots$,

Sometimes it is taken to mean only a positive integer, or any integer.

Mathematics Scope and Sequence: Foundation to Year 6

		Foundation Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Number and Algebra	Number and place value	Establish understanding of the language and processes of counting by naming numbers in sequences, initially to and from 20, moving from any starting point Connect number names, numerals and quantities, including zero, initially up to 10 and then beyond Subitise small collections of objects Represent practical situations to model addition and sharing Compare, order and make correspondences between collections, initially to 20, and explain reasoning	Develop confidence with number sequences to and from 100 by ones from any starting point. Skip count by twos, fives and tens starting from zero Recognise, model, read, write and order numbers to at least 100. Locate these numbers on a number line Count collections to 100 by partitioning numbers using place value Represent and solve simple addition and subtraction problems using a range of strategies including counting on, partitioning and rearranging parts	Investigate number sequences, initially those increasing and decreasing by twos, threes, fives and ten from any starting point, then moving to other sequences. Recognise, model, represent and order numbers to at least 1000 Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting Explore the connection between addition and subtraction Solve simple addition and subtraction problems using a range of efficient mental and written strategies Recognise and represent multiplication as repeated addition, groups and arrays Recognise and represent division as grouping into equal sets and solve simple problems using these representations	Investigate the conditions required for a number to be odd or even and identify odd and even numbers Recognise, model, represent and order numbers to at least 10 000 Apply place value to partition, rearrange and regroup numbers to at least 10 000 to assist calculations and solve problems Recognise and explain the connection between addition and subtraction Recall addition facts for single-digit numbers and related subtraction facts to develop increasingly efficient mental strategies for computation Recall multiplication facts of two, three, five and ten and related division facts Represent and solve problems involving multiplication using efficient mental and written strategies and appropriate digital technologies	Recall multiplication facts up to 10 _ 10 and related division facts Investigate and use the properties of odd and even numbers Recognise, represent and order numbers to at least tens of thousands Apply place value to partition, rearrange and regroup numbers to at least tens of thousands to assist calculations and solve problems Investigate number sequences involving multiples of 3, 4, 6, 7, 8, and 9 Develop efficient mental and written strategies and use appropriate digital technologies for multiplication and for division where there is no remainder	Identify and describe factors and multiples of whole numbers and use them to solve problems Use estimation and rounding to check the reasonableness of answers to calculations Solve problems involving multiplication of large numbers by one- or two-digit numbers using efficient mental, written strategies and appropriate digital technologies Solve problems involving division by a one digit number, including those that result in a remainder Use efficient mental and written strategies and apply appropriate digital technologies to solve problems	Identify and describe properties of prime, composite, square and triangular numbers Select and apply efficient mental and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers Investigate everyday situations that use integers. Locate and represent these numbers on a number line
	Fractions and decimals		Recognise and describe one-half as one of two equal parts of a whole.	Recognise and interpret common uses of halves, quarters and eighths of shapes and collections	Model and represent unit fractions including 1/2, 1/4, 1/3, 1/5 and their multiples to a complete whole	Investigate equivalent fractions used in contexts Count by quarters halves and thirds, including with mixed numerals. Locate and represent these fractions on a number line Recognise that the place value system can be extended to tenths and hundredths. Make connections between fractions and decimal notation	Compare and order common unit fractions and locate and represent them on a number line Investigate strategies to solve problems involving addition and subtraction of fractions with the same denominator Recognise that the place value system can be extended beyond hundredths Compare, order and represent decimals	Compare fractions with related denominators and locate and represent them on a number line Solve problems involving addition and subtraction of fractions with the same or related denominators Find a simple fraction of a quantity where the result is a whole number, with and without digital technologies Add and subtract decimals, with and without digital technologies, and use estimation and rounding to check the reasonableness of answers Multiply decimals by whole numbers and perform divisions by non-zero whole numbers where the results are terminating decimals, with and without digital technologies Multiply and divide decimals by powers of 10 Make connections between equivalent fractions, decimals and percentages
	Real numbers							This sequence ends at Year 7

Mathematics Scope and Sequence: Year 6 to Year 10

		Year 6	Year 7	Year 8	Year 9	Year 10	Year 10 A
Number and Algebra	Number and place value	Identify and describe properties of prime, composite, square and triangular numbers Select and apply efficient mental and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers Investigate everyday situations that use positive and negative whole numbers and zero. Locate and represent these numbers on a number line	Investigate index notation and represent whole numbers as products of powers of prime numbers Investigate and use square roots of perfect square numbers Apply the associative, commutative and distributive laws to aid mental and written computation Compare, order, add and subtract integers	Use index notation with numbers to establish the index laws with positive integral indices and the zero index Carry out the four operations with rational numbers and integers, using efficient mental and written strategies and appropriate digital technologies	This sequence ends at this year level		
	Fractions and decimals	Compare fractions with related denominators and locate and represent them on a number line Solve problems involving addition and subtraction of fractions with the same or related denominators Find a simple fraction of a quantity where the result is a whole number, with and without digital technologies Add and subtract decimals, with and without digital technologies, and use estimation and rounding to check the reasonableness of answers Multiply decimals by whole numbers and perform divisions that result in terminating decimals, with and without digital technologies Multiply and divide decimals by powers of 10 Make connections between equivalent fractions, decimals and percentages	This sequence ends at Year 6				
	Real numbers	This sequence starts at Year 7	Compare fractions using equivalence. Locate and represent positive and negative fractions and mixed numbers on a number line Solve problems involving addition and subtraction of fractions, including those with unrelated denominators Multiply and divide fractions and decimals using efficient written strategies and digital technologies Express one quantity as a fraction of another, with and without the use of digital technologies Round decimals to a specified number of decimal places Connect fractions, decimals and percentages and carry out simple conversions Find percentages of quantities and express one quantity as a percentage of another, with and without digital technologies. Recognise and solve problems involving simple ratios	Investigate terminating and recurring decimals Investigate the concept of irrational numbers, including π Solve problems involving the use of percentages, including percentage increases and decreases, with and without digital technologies Solve a range of problems involving rates and ratios, with and without digital technologies	Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems Apply index laws to numerical expressions with integer indices Express numbers in scientific notation		Define rational and irrational numbers and perform operations with surds and fractional indices Use the definition of a logarithm to establish and apply the laws of logarithms

Mathematics Scope and Sequence: Foundation to Year 6

		Foundation Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Number and Algebra	Money and financial mathematics		Recognise, describe and order Australian coins according to their value	Count and order small collections of Australian coins and notes according to their value	Represent money values in multiple ways and count the change required for simple transactions to the nearest five cents	Solve problems involving purchases and the calculation of change to the nearest five cents with and without digital technologies	Create simple financial plans	Investigate and calculate percentage discounts of 10%, 25% and 50% on sale items, with and without digital technologies
	Patterns and algebra	Sort and classify familiar objects and explain the basis for these classifications. Copy, continue and create patterns with objects and drawings	Investigate and describe number patterns formed by skip counting and patterns with objects	Describe patterns with numbers and identify missing elements Solve problems by using number sentences for addition or subtraction	Describe, continue, and create number patterns resulting from performing addition or subtraction	Explore and describe number patterns resulting from performing multiplication Solve word problems by using number sentences involving multiplication or division where there is no remainder Use equivalent number sentences involving addition and subtraction to find unknown quantities	Describe, continue and create patterns with fractions, decimals and whole numbers resulting from addition and subtraction Use equivalent number sentences involving multiplication and division to find unknown quantities	Continue and create sequences involving whole numbers, fractions and decimals. Describe the rule used to create the sequence Explore the use of brackets and order of operations to write number sentences
	Linear and non-linear relationships							This sequence starts at Year 7

Mathematics Scope and Sequence: Year 6 to Year 10

		Year 6	Year 7	Year 8	Year 9	Year 10	Year 10 A
Number and Algebra	Money and financial mathematics	Investigate and calculate percentage discounts of 10%, 25% and 50% on sale items, with and without digital technologies	Investigate and calculate 'best buys', with and without digital technologies	Solve problems involving profit and loss, with and without digital technologies	Solve problems involving simple interest	Connect the compound interest formula to repeated applications of simple interest using appropriate digital technologies	
	Patterns and algebra	Continue and create sequences involving whole numbers, fractions and decimals. Describe the rule used to create the sequence Explore the use of brackets and order of operations to write number sentences	Introduce the concept of variables as a way of representing numbers using letters Create algebraic expressions and evaluate them by substituting a given value for each variable Extend and apply the laws and properties of arithmetic to algebraic terms and expressions	Extend and apply the distributive law to the expansion of algebraic expressions Factorise algebraic expressions by identifying numerical factors Simplify algebraic expressions involving the four operations	Extend and apply the index laws to variables, using positive integer indices and the zero index Apply the distributive law to the expansion of algebraic expressions, including binomials, and collect like terms where appropriate	Factorise algebraic expressions by taking out a common algebraic factor Simplify algebraic products and quotients using index laws Apply the four operations to simple algebraic fractions with numerical denominators Expand binomial products and factorise monic quadratic expressions using a variety of strategies Substitute values into formulas to determine an unknown	Investigate the concept of a polynomial and apply the factor and remainder theorems to solve problems
	Linear and non-linear relationships	This sequence starts at Year 7	Given coordinates, plot points on the Cartesian plane, and find coordinates for a given point Solve simple linear equations Investigate, interpret and analyse graphs from authentic data	Plot linear relationships on the Cartesian plane with and without the use of digital technologies Solve linear equations using algebraic and graphical techniques. Verify solutions by substitution	Find the distance between two points located on a Cartesian plane using a range of strategies, including graphing software Sketch linear graphs using the coordinates of two points and solve linear equations Find the midpoint and gradient of a line segment (interval) on the Cartesian plane using a range of strategies, including graphing software Graph simple non-linear relations with and without the use of digital technologies and solve simple related equations	Solve problems involving linear equations, including those derived from formulas Solve linear inequalities and graph their solutions on a number line Solve linear simultaneous equations, using algebraic and graphical techniques including using digital technology Solve problems involving parallel and perpendicular lines Explore the connection between algebraic and graphical representations of relations such as simple quadratics, circles and exponentials using digital technology as appropriate Solve linear equations involving simple algebraic fractions Solve simple quadratic equations using a range of strategies	Describe, interpret and sketch parabolas, hyperbolas, circles and exponential functions and their transformations Solve simple exponential equations Apply understanding of polynomials to sketch a range of curves and describe the features of these curves from their equation Factorise monic and non-monic quadratic expressions and solve a wide range of quadratic equations derived from a variety of contexts

Mathematics Scope and Sequence: Foundation to Year 6

		Foundation Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Measurement and Geometry	Using units of measurement	Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language Compare and order the duration of events using the everyday language of time Connect days of the week to familiar events and actions	Measure and compare the lengths and capacities of pairs of objects using uniform informal units Tell time to the half-hour Describe duration using months, weeks, days and hours	Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units Compare masses of objects using balance scales Tell time to the quarter-hour, using the language of 'past' and 'to' Name and order months and seasons Use a calendar to identify the date and determine the number of days in each month	Measure, order and compare objects using familiar metric units of length, mass and capacity Tell time to the minute and investigate the relationship between units of time	Use scaled instruments to measure and compare lengths, masses, capacities and temperatures Convert between units of time Use am and pm notation and solve simple time problems Compare objects using familiar metric units of area and volume	Choose appropriate units of measurement for length, area, volume, capacity and mass Calculate the perimeter and area of rectangles using familiar metric units Compare 12- and 24-hour time systems and convert between them	Connect decimal representations to the metric system Convert between common metric units of length, mass and capacity Solve problems involving the comparison of lengths and areas using appropriate units Connect volume and capacity and their units of measurement Interpret and use timetables
	Shape	Sort, describe and name familiar two-dimensional shapes and three-dimensional objects in the environment	Recognise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features	Describe and draw two-dimensional shapes, with and without digital technologies Describe the features of three-dimensional objects	Make models of three-dimensional objects and describe key features	Compare the areas of regular and irregular shapes by informal means Compare and describe two dimensional shapes that result from combining and splitting common shapes, with and without the use of digital technologies	Connect three-dimensional objects with their nets and other two-dimensional representations	Construct simple prisms and pyramids
	Location and transformation	Describe position and movement	Give and follow directions to familiar locations	Interpret simple maps of familiar locations and identify the relative positions of key features Investigate the effect of one-step slides and flips with and without digital technologies Identify and describe half and quarter turns	Create and interpret simple grid maps to show position and pathways Identify symmetry in the environment	Use simple scales, legends and directions to interpret information contained in basic maps Create symmetrical patterns, pictures and shapes with and without digital technologies	Use a grid reference system to describe locations. Describe routes using landmarks and directional language Describe translations, reflections and rotations of two-dimensional shapes. Identify line and rotational symmetries Apply the enlargement transformation to familiar two dimensional shapes and explore the properties of the resulting image compared with the original	Investigate combinations of translations, reflections and rotations, with and without the use of digital technologies Introduce the Cartesian coordinate system using all four quadrants
	Geometric reasoning	This sequence starts at Year 3			Identify angles as measures of turn and compare angle sizes in everyday situations	Compare angles and classify them as equal to, greater than or less than a right angle	Estimate, measure and compare angles using degrees. Construct angles using a protractor	Investigate, with and without digital technologies, angles on a straight line, angles at a point and vertically opposite angles. Use results to find unknown angles
	Pythagoras and trigonometry	This sequence starts at Year 9						

Mathematics Scope and Sequence: Year 6 to Year 10

		Year 6	Year 7	Year 8	Year 9	Year 10	Year 10 A
Measurement and Geometry	Using units of measurement	Connect decimal representations to the metric system Convert between common metric units of length, mass and capacity Solve problems involving the comparison of lengths and areas using appropriate units Connect volume and capacity and their units of measurement Interpret and use timetables	Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving Calculate volumes of rectangular prisms	Choose appropriate units of measurement for area and volume and convert from one unit to another Find perimeters and areas of parallelograms, rhombuses and kites Investigate the relationship between features of circles such as circumference, area, radius and diameter. Use formulas to solve problems involving circumference and area Develop the formulas for volumes of rectangular and triangular prisms and prisms in general. Use formulas to solve problems involving volume Solve problems involving duration, including using 12- and 24-hour time within a single time zone	Calculate the areas of composite shapes Find perimeters and areas of parallelograms, trapeziums, rhombuses and kites Solve problems involving the surface area and volume of right prisms Investigate very small and very large time scales and intervals	Solve problems involving surface area and volume for a range of prisms, cylinders and composite solids	Solve problems involving surface area and volume of right pyramids, right cones, spheres and related composite solids
	Shape	Construct simple prisms and pyramids	Draw different views of prisms and solids formed from combinations of prisms	This sequence ends at Year 7			
	Location and transformation	Investigate combinations of translations, reflections and rotations, with and without the use of digital technologies Introduce the Cartesian coordinate system using all four quadrants	Describe translations, reflections in an axis, and rotations of multiples of 90° on the Cartesian plane using coordinates. Identify line and rotational symmetries	This sequence ends at Year 7			
	Geometric reasoning	Investigate, with and without digital technologies, angles on a straight line, angles at a point and vertically opposite angles. Use results to find unknown angles	Identify corresponding, alternate and co-interior angles when two straight lines are crossed by a transversal Investigate conditions for two lines to be parallel and solve simple numerical problems using reasoning Classify triangles according to their side and angle properties and describe quadrilaterals Demonstrate that the angle sum of a triangle is 180° and use this to find the angle sum of a quadrilateral	Define congruence of plane shapes using transformations Develop the conditions for congruence of triangles Establish properties of quadrilaterals using congruent triangles and angle properties, and solve related numerical problems using reasoning	Use the enlargement transformation to explain similarity and develop the conditions for triangles to be similar Solve problems using ratio and scale factors in similar figures	Formulate proofs involving congruent triangles and angle properties Apply logical reasoning, including the use of congruence and similarity, to proofs and numerical exercises involving plane shapes	Prove and apply angle and chord properties of circles
	Pythagoras and trigonometry			This sequence starts at Year 9	Investigate Pythagoras' Theorem and its application to solving simple problems involving right angled triangles Use similarity to investigate the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles Apply trigonometry to solve right-angled triangle problems	Solve right-angled triangle problems including those involving direction and angles of elevation and depression	Establish the sine, cosine and area rules for any triangle and solve related problems Use the unit circle to define trigonometric functions, and graph them with and without the use of digital technologies Solve simple trigonometric equations Apply Pythagoras' theorem and trigonometry to solving three-dimensional problems in right-angled triangles

Mathematics Scope and Sequence: Foundation to Year 6

		Foundation Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Statistics and Probability	Chance		Identify outcomes of familiar events involving chance and describe them using everyday language such as 'will happen', 'won't happen' or 'might happen'	Identify practical activities and everyday events that involve chance. Describe outcomes as 'likely' or 'unlikely' and identify some events as 'certain' or 'impossible'	Conduct chance experiments, identify and describe possible outcomes and recognise variation in results	Describe possible everyday events and order their chances of occurring Identify everyday events where one cannot happen if the other happens Identify events where the chance of one will not be affected by the occurrence of the other	List outcomes of chance experiments involving equally likely outcomes and represent probabilities of those outcomes using fractions Recognise that probabilities range from 0 to 1	Describe probabilities using fractions, decimals and percentages Conduct chance experiments with both small and large numbers of trials using appropriate digital technologies Compare observed frequencies across experiments with expected frequencies
	Data representation and interpretation	Answer yes/no questions to collect information	Choose simple questions and gather responses Represent data with objects and drawings where one object or drawing represents one data value. Describe the displays	Identify a question of interest based on one categorical variable. Gather data relevant to the question Collect, check and classify data Create displays of data using lists, table and picture graphs and interpret them	Identify questions or issues for categorical variables. Identify data sources and plan methods of data collection and recording Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies Interpret and compare data displays	Select and trial methods for data collection, including survey questions and recording sheets Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data values Evaluate the effectiveness of different displays in illustrating data features including variability	Pose questions and collect categorical or numerical data by observation or survey Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies Describe and interpret different data sets in context	Interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables Interpret secondary data presented in digital media and elsewhere

Mathematics Scope and Sequence: Year 6 to Year 10

		Year 6	Year 7	Year 8	Year 9	Year 10	Year 10 A
Statistics and Probability	Chance	Describe probabilities using fractions, decimals and percentages Conduct chance experiments with both small and large numbers of trials using appropriate digital technologies Compare observed frequencies across experiments with expected frequencies	Construct sample spaces for single-step experiments with equally likely outcomes Assign probabilities to the outcomes of events and determine probabilities for events	Identify complementary events and use the sum of probabilities to solve problems Describe events using language of 'at least', exclusive 'or' (A or B but not both), inclusive 'or' (A or B or both) and 'and'. Represent events in two-way tables and Venn diagrams and solve related problems	List all outcomes for two-step chance experiments, both with and without replacement using tree diagrams or arrays. Assign probabilities to outcomes and determine probabilities for events Calculate relative frequencies from given or collected data to estimate probabilities of events involving 'and' or 'or' Investigate reports of surveys in digital media and elsewhere for information on how data were obtained to estimate population means and medians	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 Use the language of 'if ....then, 'given', 'of', 'knowing that' to investigate conditional statements and identify common mistakes in interpreting such language	Investigate reports of studies in digital media and elsewhere for information on their planning and implementation
	Data representation and interpretation	Interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables Interpret secondary data presented in digital media and elsewhere	Identify and investigate issues involving numerical data collected from primary and secondary sources Construct and compare a range of data displays including stem-and-leaf plots and dot plots Calculate mean, median, mode and range for sets of data. Interpret these statistics in the context of data Describe and interpret data displays using median, mean and range	Explore the practicalities and implications of obtaining data through sampling using a variety of investigative processes Investigate the effect of individual data values , including outliers, on the mean and median Explore the variation of means and proportions in of random samples drawn from the same population Investigate techniques for collecting data, including census ,sampling and observation.	Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly from secondary sources Construct back-to-back stem-and-leaf plots and histograms and describe data, using terms including 'skewed', 'symmetric' and 'bi modal' Compare data displays using mean, median and range to describe and interpret numerical data sets in terms of location (centre) and spread Investigate techniques for collecting data, including census, sampling and observation	Determine quartiles and interquartile range Construct and interpret box plots and use them to compare data sets Compare shapes of box plots to corresponding histograms and dot plots Use scatter plots to investigate and comment on relationships between two numerical variables Investigate and describe bivariate numerical data where the independent variable is time Evaluate statistical reports in the media and other places by linking claims to displays, statistics and representative data	Calculate and interpret the mean and standard deviation of data and use these to compare data sets Use information technologies to investigate bivariate numerical data sets. Where appropriate use a straight line to describe the relationship allowing for variation

AUSTRALIAN CURRICULUM, ASSESSMENT AND REPORTING AUTHORITY

General Capabilities in the Australian Curriculum

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Overview

General capabilities in the Australian Curriculum

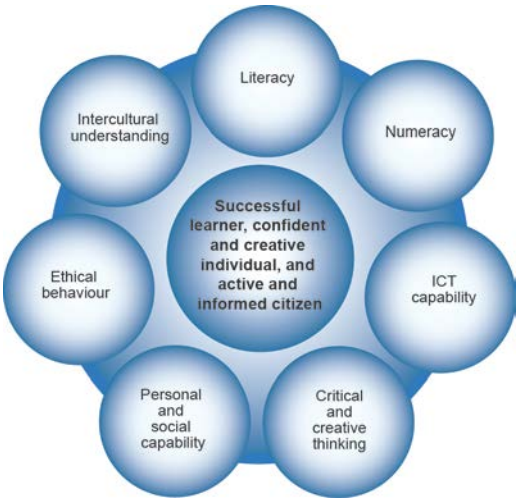
General capabilities, a key dimension of the Australian Curriculum, are addressed explicitly in the content of the learning areas. They play a significant role in realising the goals set out in the *Melbourne Declaration on Educational Goals for Young Australians* (MCEETYA 2008) that all young people in Australia should be supported to become successful learners, confident and creative individuals, and active and informed citizens.

The Melbourne Declaration identifies essential skills for twenty-first century learners – in literacy, numeracy, information and communication technology (ICT), thinking, creativity, teamwork and communication. It describes individuals who can manage their own wellbeing, relate well to others, make informed decisions about their lives, become citizens who behave with ethical integrity, relate to and communicate across cultures, work for the common good and act with responsibility at local, regional and global levels.

The general capabilities encompass the knowledge, skills, behaviours and dispositions that, together with curriculum content in each learning area and the cross-curriculum priorities, will assist students to live and work successfully in the twenty-first century. They complement the key learning outcomes of the *Early Years Learning Framework* (COAG 2009) – that children have a strong sense of identity and wellbeing, are connected with and contribute to their world, are confident and involved learners and effective communicators.

The Australian Curriculum includes seven general capabilities:

- Literacy
- Numeracy
- Information and communication technology (ICT) capability
- Critical and creative thinking
- Personal and social capability
- Ethical behaviour
- Intercultural understanding.



General capabilities in the Australian Curriculum

General capabilities materials for schools and teachers

These materials are presented as a resource to help teachers:

- develop a shared understanding of the nature, scope and sequence of the general capabilities in the Australian Curriculum
- confirm their understanding of intended learning wherever general capabilities are identified in learning area content descriptions and elaborations
- plan for and guide students' development of the general capabilities in school and classroom learning programs.

Development of the general capabilities materials

Initially, the general capabilities materials were developed to inform the writing of learning area curriculum (Foundation to Year 10) and to ensure the strong and coherent inclusion of the general capabilities in the Australian Curriculum.

They were developed by writing teams with expertise in the particular capabilities, together with advice from academics, focus groups of teachers and curriculum experts from state and territory education authorities, and from a national consultation process. The materials build on significant state and territory initiatives and practice, and are informed by national and international research.

Work associated with general capabilities is ongoing. Future work includes:

- the further development of general capability learning continua to include descriptions at the end of the Foundation Year, Year 4 and Year 8
- additional exemplification of the general capabilities in the learning areas
- monitoring and review of the materials as additional learning areas are developed and approved by Ministers for implementation in schools
- revision of the ICT capability in conjunction with the development of the Australian Curriculum: Technologies
- following completion of all learning area curriculum, a review of the extent to which general capabilities have been addressed in the curriculum.

Teaching and assessment of general capabilities

Teachers are expected to teach and assess general capabilities to the extent that they are incorporated within each learning area.

State and territory school authorities will determine whether and how student learning of the general capabilities will be further assessed and reported.

For some students, it may be necessary to adjust the levels of complexity and the processes they use to develop capabilities. However, the role and place of general capabilities in the Australian Curriculum remain the same for all students.

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Nature of general capabilities

General capabilities comprise an integrated and interconnected set of knowledge, skills, behaviours and dispositions that students develop and use in their learning across the curriculum, in co-curricular programs and in their lives outside school.

In the Australian Curriculum 'capability' encompasses knowledge, skills, behaviours and dispositions. Students develop capability when they apply knowledge and skills confidently, effectively and appropriately in complex and changing circumstances, both in their learning at school and in their lives outside school. The encouragement of positive behaviours and dispositions underpins all general capabilities. Within individual capabilities, specific behaviours and dispositions have been identified and incorporated into each learning continuum as appropriate.

When combined in learning area contexts, general capabilities enhance and complement each other. For example, students require literacy skills and ICT capability to communicate effectively across all learning areas. They apply intercultural understanding and personal and social capability when they challenge stereotypes and prejudice in texts and interactions with others.

It is important to recognise that the capabilities are intended to be 'general' and operate across the whole curriculum. More 'specialised' knowledge and skills will be detailed in learning areas, particularly in relation to literacy, numeracy and information and communication technology.

Students in Australian schools bring different world views, histories and abilities to their learning. This means that some aspects of the capabilities may be interpreted and enacted in different ways. For example, the world views of Aboriginal and Torres Strait Islander Peoples inform Personal and social capability by drawing on responsibilities and relationships within cultural knowledge systems that connect the personal, through kin and community, to land, sky and waterways.

General capabilities in the learning areas

In the Australian Curriculum, general capabilities are addressed through the learning areas and are identified wherever they are developed or applied in content descriptions. They are also identified where they offer opportunities to add depth and richness to student learning in content elaborations.

Icons (as shown below) indicate where general capabilities have been identified in learning area content descriptions and elaborations. A filter function on the Australian Curriculum website assists users to identify F–10 curriculum content where a capability has been identified. Teachers may find further opportunities to incorporate explicit teaching of general capabilities depending on their choice of activities. Students can also be encouraged to develop capabilities through personally relevant initiatives of their own design.

Literacy 

Numeracy 

ICT capability 

Critical and creative thinking 

Personal and social capability 

Ethical behaviour 

Intercultural understanding 

Each learning area includes a brief description of the general capabilities that have been explicitly included in the content or advice about those that could be developed through particular teaching contexts.

- General capabilities in English (http://www.australiancurriculum.edu.au/English/General-capabilities)
- General capabilities in Mathematics (http://www.australiancurriculum.edu.au/Mathematics/General-capabilities)
- General capabilities in Science (http://www.australiancurriculum.edu.au/Science/General-capabilities)
- General capabilities in History (http://www.australiancurriculum.edu.au/History/General-capabilities)

Many capabilities find ‘natural homes’ in specific learning areas (for example, Literacy in English, Numeracy in Mathematics, ICT capability in Technologies, Personal and social capability in Health and Physical Education and English, and Intercultural understanding in Languages. Many of the foundational capability knowledge and skills are likely to be taught most explicitly in these learning areas, and applied, adapted, strengthened and extended in other learning areas.

General capabilities are represented to different degrees in each of the learning areas. Literacy, Numeracy, ICT capability, and Critical and creative thinking are fundamental in students becoming successful learners. While the primary development of Literacy, Numeracy and ICT capability is based in English, Mathematics and Technologies respectively, the development and application of these capabilities across the curriculum is essential to effective teaching and learning. Further information about the relationships between English/ Literacy, Mathematics/ Numeracy and Technologies/ ICT capability in the Australian Curriculum is provided in the introductions to relevant capabilities.

Personal and social capability, Ethical behaviour and Intercultural understanding focus on ways of being, behaving and learning to live with others, and are more strongly represented in some learning areas than in others. Though all learning involves some personal and social dimensions, these capabilities are most evident wherever personal, social and cultural learning is highlighted. For example, the social and cultural nature of these content descriptions provides opportunities for the inclusion of Personal and social capability and Intercultural understanding.

> **Year 6 Historical knowledge and understanding [H5]**
>
> *The contribution of individuals and groups, including Aboriginal people and/or Torres Strait Islanders and migrants, to the development of Australian society, for example in areas such as the economy, education, science, the arts, sport (ACHHK116)*

> **Year 10 English Literature [H5]**
>
> *Compare and evaluate a range of representations of individuals and groups in different historical, social and cultural contexts (ACELT1639)*

Student learning is enhanced when the capabilities work in combination with other capabilities, learning areas and cross-curriculum priorities. For example:

> **Year 2 Science as a Human Endeavour [H5]**
>
> *People use science in their daily lives, including when caring for their environment and living things (ACSHE035)*

combines Critical and creative thinking, Ethical behaviour and Sustainability.

> **Year 8 Mathematics – Statistics and probability [H5]**
>
> *Investigate reports of surveys in digital media and elsewhere for information on how data were obtained to estimate population means and medians (ACMSP227)*

combines Numeracy, ICT capability, Critical and creative thinking, and Ethical behaviour.

Structure of the materials

The materials for each general capability are in three parts:

- an introduction that describes the nature and scope of the capability, its place in the learning areas and its evidence base
- organising elements that underpin a learning continuum
- a learning continuum that describes the knowledge, skills, behaviours and dispositions that students can reasonably be expected to have developed at particular stages of schooling.

Learning continua

The general capabilities are presented as learning continua or sequences that describe the knowledge, skills, behaviours and dispositions that students can reasonably be expected to have developed by the end of particular years of schooling.

The continua are based on the belief that students need opportunities to develop capabilities over time and across learning areas. What is learned in the early years supports all subsequent learning. The continua assume it is possible to map common paths for general capability development while recognising that each student's pace of development may be influenced by factors such as their prior experience, sense of self in the world and cognitive capacity.

The Literacy and Numeracy continua are organised into five stages, describing student learning at the end of Years 2, 4, 6, 8 and 10, recognising that national literacy and numeracy assessment occurs in early Years 3, 5, 7 and 9. Each stage incorporates learning for the intervening years. Descriptions include F–10 English, Mathematics, Science and History examples where relevant that illustrate ways that literacy and numeracy can be made explicit in the learning areas.

Continua for the other five capabilities are currently organised into three stages, describing student learning at the end of Years 2, 6 and 10 to approximate the end of early childhood, primary and junior secondary years in most states and territories. Descriptions include examples that illustrate ways each capability can be made explicit in the learning areas.

Continua are available online in two views:

- the first shows expected learning across the three stages of schooling
- the second shows expected learning for each stage of schooling.

Literacy

Introduction

In the Australian Curriculum, students become literate as they develop the knowledge, skills and dispositions to interpret and use language confidently for learning and communicating in and out of school and for participating effectively in society. Literacy involves students in listening to, reading, viewing, speaking, writing and creating oral, print, visual and digital texts, and using and modifying language for different purposes in a range of contexts.

The *Melbourne Declaration on Educational Goals for Young Australians* (MCEETYA 2008) recognises literacy as an essential skill for students in becoming successful learners and as a foundation for success in all learning areas. Success in any learning area depends on being able to use the significant, identifiable and distinctive literacy that is important for learning and representative of the content of that learning area.

Scope of the Literacy capability

Literacy encompasses the knowledge and skills students need to access, understand, analyse and evaluate information, make meaning, express thoughts and emotions, present ideas and opinions, interact with others and participate in activities at school and in their lives beyond school.

Becoming literate is not simply about knowledge and skills. Certain behaviours and dispositions assist students to become effective learners who are confident and motivated to use their literacy skills broadly. Many of these behaviours and dispositions are also identified and supported in other general capabilities. They include students managing their own learning to be self-sufficient; working harmoniously with others; being open to ideas, opinions and texts from and about diverse cultures; returning to tasks to improve and enhance their work; and being prepared to question the meanings and assumptions in texts.

For a description of the organising elements for the Literacy learning continuum go to Organising elements.

Literacy across the curriculum

The Literacy capability presents those aspects of the Language and Literacy strands of the English curriculum that should also be applied in all other learning areas. It is not a separate component of the Australian Curriculum and does not contain new content. In some instances in the Literacy learning continuum, examples or more explanation have been included to show how aspects of the Language and Literacy strands of the English curriculum function in other learning areas.

While much of the explicit teaching of literacy occurs in the English learning area, it is strengthened, made specific and extended in other learning areas as students engage in a range of learning activities with significant literacy demands. These literacy-rich situations are a part of learning in all curriculum areas. Paying attention to the literacy demands of each learning area ensures that students' literacy development is strengthened so that it supports subject-based learning.

This means that:

- all teachers are responsible for teaching the subject-specific literacy of their learning area
- all teachers need a clear understanding of the literacy demands and opportunities of their learning area
- literacy appropriate to each learning area can be embedded in the teaching of the content and processes of that learning area.

The Literacy continuum will enable learning area teachers to:

- identify the general level of expected language and literacy skills for each year level that they are teaching
- plan how to teach specific language and literacy knowledge and skills essential to students' understanding of learning area content.

For students who speak a language or dialect other than Standard Australian English at home, access to language and literacy development is especially important. EAL/D students learn English at the same time as they are learning the content of each learning area through English. For many Aboriginal and Torres Strait Islander students, their home language is a dialect of English such as Aboriginal English. This means that they learn the English of the school context and of the curriculum as a second dialect. It is important to acknowledge the home language, prior knowledge and experiences of these students, and to build on these in developing students' literacy capabilities in the curriculum. The *English as an Additional Language or Dialect: Teacher Resource* can be used in conjunction with the Literacy general capability to assist teachers in meeting the language-learning needs of these students.

The Literacy capability is addressed through the learning areas and is identified wherever it is developed or applied in content descriptions. It is also identified where it offers opportunities to add depth and richness to student learning in content elaborations. An icon indicates where literacy has been identified in learning area content descriptions and elaborations. A filter function on the Australian Curriculum website assists users to identify F–10 curriculum content where literacy has been identified. Teachers may find further opportunities to incorporate explicit teaching of literacy depending on their choice of activities. Students can also be encouraged to develop capability through personally relevant initiatives of their own design.

- Literacy in English (http://www.australiancurriculum.edu.au/English/General-capabilities)
- Literacy in Mathematics (http://www.australiancurriculum.edu.au/Mathematics/General-capabilities)
- Literacy in Science (http://www.australiancurriculum.edu.au/Science/General-capabilities)
- Literacy in History (http://www.australiancurriculum.edu.au/History/General-capabilities)

Background

This background summarises the evidence base from which the Literacy capability's introduction, organising elements and learning continuum have been developed. It draws on the Australian Curriculum: English and on recent international and national research, as well as initiatives and programs that focus on literacy across the curriculum.

The Australian Curriculum: English provides a rich resource for learning in all areas of the curriculum. The skills and knowledge taught in the Language and Literacy strands of the Australian Curriculum: English support and contribute to the literacy requirements needed for all learning areas. These skills and knowledge have been used as the basis for constructing the Literacy continuum as it relates to all learning areas of the curriculum.

The definition of literacy in the Australian Curriculum is informed by a social view of language that considers how language works to construct meaning in different social and cultural contexts. This view builds on the work of Vygotsky (1976), Brice Heath (1983), Halliday and Hasan (1985), Freebody and Luke (1990), Gee (1991, 2008), and Christie and Derewianka (2008), who have articulated the intrinsic and interdependent relationship between social context, meaning and language.

This view is concerned with how language use varies according to the context and situation in which it is used. There are important considerations for curriculum area learning stemming from this view because, as students engage with subject-based content, they must learn to access and use language and visual elements in the particular and specific ways that are the distinctive and valued modes of communication in each learning area. They need to learn how diverse texts build knowledge in different curriculum areas, and how language and visual information work together in distinctive ways to present this knowledge.

The social view of language enables insights into differences between 'spoken-like' and 'written-like' language, and the increasing complexity of language as students progress through school. This is an important concept for subject-based learning. When young children begin school, they generally have developed facility with the spoken language of their home and community to interact informally in face-to-face situations in their immediate environment. This is the meaning-making system they use to engage with the learning experiences of the school; and their first interactions with written text generally employ print versions of 'spoken-like' language.

As subject-based learning proceeds, particularly in the middle and later school years, the texts that students need to understand and produce take on increasingly formal and academic features employing technical, abstract and specialised 'written-like' language forms, in order to communicate complexities of meaning. These texts include precise, densely packed information and place increasing cognitive demands on the student.

There are significant differences in the way different learning areas structure texts and in the language features and vocabulary that students are required to know and use. Therefore, a student's repertoire of literacy knowledge and skills needs to be diverse, flexible, dynamic and versatile, developing throughout their schooling to deal with the increasing challenges and demands of the curriculum.

Like the Australian Curriculum: English, the Literacy capability also takes account of visual literacy and the rapid changes that have occurred as a result of new technologies in the ways that communication takes place. It is informed by the work of Kress and Van Leeuwen (2006), who have identified a comprehensive grammar of visual design.

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Organising elements

The Literacy continuum incorporates two overarching processes:

- Comprehending texts through listening, reading and viewing
- Composing texts through speaking, writing and creating

with the following areas of knowledge applying to both processes:

- Text knowledge
- Grammar knowledge
- Word knowledge
- Visual knowledge.

These processes and areas of knowledge are used as the organising elements of the Literacy continuum. The elements are drawn from the Language and Literacy strands of the Australian Curriculum: English as shown in the table below:

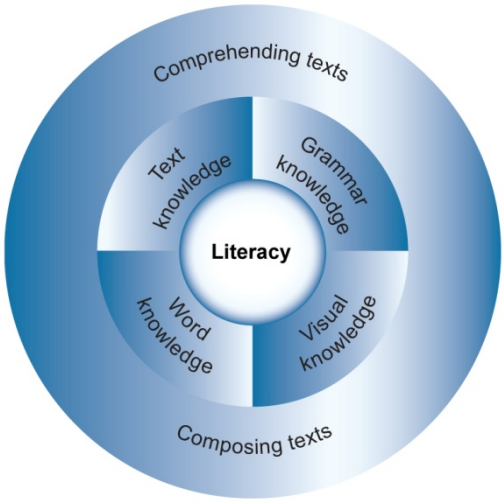
Literacy Continuum	Australian Curriculum: English	
	Language	Literacy
Comprehending texts through listening, reading and viewing	Expressing and developing ideas	Interpreting, analysing, evaluating
Composing texts through speaking, writing and creating	Language for interaction	Interacting with others Creating texts
Text knowledge	Text structure and organisation Concepts of print and screen	Interpreting, analysing, evaluating Creating texts
Grammar knowledge	Expressing and developing ideas Language for interaction	
Word knowledge	Expressing and developing ideas	
Visual knowledge	Expressing and developing ideas	Interpreting, analysing, evaluating Creating texts

Texts in the Literacy continuum

A text is the means for communication. Texts can be written, spoken, visual or multimodal, and in print or digital/online forms. Multimodal texts combine language with other systems for communicating such as visual images, soundtracks and spoken word, as in film or computer presentation media. The forms and conventions of texts have developed to help us communicate effectively with a variety of audiences for a range of purposes, and so texts in different learning areas can and do use language and other features in different ways.

Where the term ‘texts’ is used in the Literacy continuum, this should be read as the type of texts particular to or characteristic of a learning area – for example, reports, data displays and procedures in Mathematics; models, diagrams, explanations and reports in Science; and narratives, descriptions, discussions and explanations in History.

The diagram below sets out these elements.



Organising elements for Literacy

Comprehending texts through listening, reading and viewing

This element involves:

- using strategies for reading and viewing texts, including using applied topic knowledge, vocabulary and visual knowledge
- listening for information and to carry out tasks and participate in discussions
- using strategies for comprehending spoken, written, visual and multimodal texts, including retrieving literal information and making inferences.

Composing texts through speaking, writing and creating

This element involves:

- using language as a key learning tool to explore ideas, test possibilities and compare solutions
- composing different types of spoken, written, visual and multimodal texts for a range of purposes and audiences
- participating in group and class discussions using a range of oral interaction skills to share ideas, explore topics and express opinions
- making formal presentations incorporating oral, written, visual and audio elements.

Text knowledge

This element involves:

- understanding the structure and purpose of a range of imaginative, informative and persuasive texts, and how these are used in different learning areas
- understanding text cohesion
- identifying and using text features to access and navigate print and digital texts.

Grammar knowledge

This element involves:

- learning how different types of sentence structures – including simple, compound and complex sentences – are used to structure ideas and present information in different learning areas
- learning how different types of words and groups/phrases – including nouns, verbs, adverbs, adjective groups/phrases – are used to convey information and ideas in different learning areas
- learning how opinion and point of view are presented through specific word choices in different types of texts.

Word knowledge

This element involves:

- understanding and using new vocabulary, including learning area vocabulary, to compose and comprehend texts in different learning areas
- developing strategies to spell a range of subject-specific words.

Visual knowledge

This element involves:

- understanding how visual elements create meanings using features such as construction, placement of elements, framing and colour
- composing and comprehending a range of visual forms typical of each learning area, including illustrations, film, maps, graphs and digital graphics.

Literacy continuum across stages of schooling

Comprehending texts through listening, reading and viewing

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
Reading and viewing learning area texts				
use prior knowledge and vocabulary to read and view learning area texts, using developing strategies such as predicting, monitoring meaning and crosschecking	use topic knowledge and vocabulary to read and view learning area texts, using developing strategies such as predicting, monitoring meaning, crosschecking and reviewing	apply strategies for reading and viewing learning area texts, including selecting, navigating, monitoring meaning, crosschecking and reviewing	integrate topic and textual knowledge and developed strategies, including selecting, navigating, monitoring meaning and crosschecking to read and view learning area texts	integrate strategies and topic and textual knowledge to select, navigate, read and view complex learning area texts, analysing and evaluating information sources
Listening				
listen to one- and two-step instructions for undertaking learning tasks, listen for information about topics being learned and to participate in discussions	understand more detailed spoken instructions for undertaking learning tasks, listen to identify key information in spoken texts and to attend to others' ideas in discussions	understand detailed spoken instructions for undertaking learning tasks, listen to spoken texts, and interpret and evaluate information and opinions presented	engage with extended spoken and digital audio texts, interpret stated and implied meanings, and evaluate information and ideas presented	listen thoughtfully to a range of extended spoken texts, using knowledge of text purpose to interpret and evaluate ideas, information and opinions
Comprehending learning area texts				
understand and use different types of learning area texts to explore topics, gather information and make some obvious inferences	retrieve and understand literal information in learning area texts, and make inferences to expand and link ideas and to comprehend and interpret texts	understand, interpret and analyse information and ideas in learning area texts, comparing content from a range of sources and analysing similarities and differences in texts on similar topics or themes	understand, interpret and evaluate literal and inferential information in learning area texts, identify main ideas and supporting evidence, and analyse different perspectives and points of view	understand, interpret and evaluate information within and between learning area texts, combining, connecting, comparing and synthesising ideas and concepts, and identifying perspectives and evaluating supporting evidence

Composing texts through speaking, writing and creating

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
Exploratory language				
use speaking, writing, visual and multimodal elements as learning tools to explore learning area topics, to represent ideas and relationships, and to prepare for creating texts	use speaking, writing, visual and multimodal elements as learning tools to explore and represent ideas and relationships, test possibilities and to prepare for creating texts	use speaking, writing, visual and multimodal elements as learning tools to explore ideas and relationships, test possibilities, compare solutions and in preparation for creating texts	use speaking, writing, visual and multimodal elements as learning tools to explore ideas, test possibilities, compare solutions, rehearse ideas and arguments in preparation for creating texts	use speaking, writing, visual and multimodal elements as learning tools to explore ideas, test possibilities, compare solutions, evaluate information and ideas, and refine opinions and arguments
Composing spoken, written, visual and multimodal learning area texts				
compose a limited range of learning area texts for familiar and some new audiences incorporating: • known topic information • familiar, mostly spoken-like language structures	compose a range of learning area texts containing: • known and some researched information and supporting details • some more extended language features	compose learning area texts for different purposes combining: • information from several sources • more formal and extended language features to report ideas and information and express opinions	compose sustained learning area texts for a wide range of purposes incorporating: • researched information • some complex language features to explore topics and issues, and to express and support their own opinions	compose sustained learning area texts for a wide range of purposes incorporating and evaluating: • researched information • a range of complex language features to explore, interpret and analyse challenging and complex issues
	edit texts for language and visual choices	edit texts for structure, content, language and visual choices	edit texts for structure, content, strength of argument and supporting evidence, and language and visual choices	edit texts for structure, content, strength of argument and supporting evidence, and language and visual choices
Oral interactions				
participate in group and class discussions about learning area topics using oral interaction skills such as speaking clearly, initiating topics, expressing opinions and listening to the opinions of others	participate in group and class discussions, adjusting language to share and extend ideas and information, and to communicate clearly and coherently	participate in discussions and informal debates, clarifying and interrogating ideas, and evaluating information using interaction skills according to the needs of the audience	participate in discussions and formal and informal debates, developing and building ideas and arguments using interaction skills and language conventions to suit different audiences	participate in discussions and formal and informal debates, extending or refuting diverse opinions using interaction skills and language conventions to suit different audiences
Presentations				
rehearse and deliver short presentations on learning area topics, incorporating some visual and multimodal elements	plan, rehearse and deliver presentations on learning area topics, incorporating some learned content and appropriate visual and multimodal elements	plan, research, rehearse and deliver presentations on learning area topics, selecting appropriate content and visual and multimodal elements	plan, research, rehearse and deliver presentations on learning area topics, sequencing selected content and multimodal elements for accuracy and their impact on the audience	plan, research, rehearse and deliver presentations on learning area topics, combining visual and multimodal elements creatively to present opinions and to engage and persuade an audience

Text knowledge

By the end of Year 2 students	By the end of Year 4 students	By the end of Year 6 students	By the end of Year 8 students	By the end of Year 10 students
Organisational structures of learning area texts				
use beginning knowledge of the structure and features of learning area texts to comprehend and compose a limited number of texts	use increasing knowledge of the structure and features of learning area texts to comprehend and compose a growing number of texts	use developing control of the structure and features of learning area texts to comprehend and compose a range of texts	comprehend and compose texts typical of each learning area that use creative adaptations of text structures and graphic features	comprehend and compose innovative texts that use structures and features of learning area texts in complex and resourceful ways, using conventions for citing others
Mathematics examples				
• calendars • simple maps • word problems • reports of steps in a process • data displays such as lists and graphs	• reports of a process • procedures on how to make mathematical shapes or complete a process • data displays to represent information • oral and written reports of group tasks • multiplication and division word problems	• survey questions and reports • procedures on how to make mathematical shapes or complete a process • data displays with and without digital technologies • explanations of mathematical processes • recounts and evaluations of group tasks • word problems involving addition and subtraction of fractions	• survey questions and reports • procedures on how to complete a mathematical task or process • data displays with and without digital technologies • explanations of mathematical processes • recounts and evaluations of group tasks • word problems involving profit and loss	• survey questions and reports • procedures on how to complete a mathematical task or process • data displays with and without digital technologies • explanations of mathematical processes • recounts and evaluations of group tasks • word problems involving algebraic equations
Science examples				
• reports of steps in a process • descriptions of observations • annotated diagrams of observed objects or living things • sequential explanations, for example explaining personal growth and	• reports of a process • informational reports of procedures on how to design objects or processes • annotated diagrams that illustrate relationships or processes • descriptions of observed objects, living things or phenomena	• reports and evaluations of investigations • information reports using multi-source research • procedures on how to carry out a particular process or investigation using active voice • causal explanations, for example explaining the	• reports and evaluations of individual and group investigations • factual reports using multi-source research • persuasive texts to argue for a particular course of action • discussion texts with supporting evidence to	• reports and evaluations of investigations • factual reports using multi-source research • evidence-based arguments using appropriate scientific language, conventions and representations to justify a position and persuade others • discussion texts, for example

By the end of Year 2 students	By the end of Year 4 students	By the end of Year 6 students	By the end of Year 8 students	By the end of Year 10 students
changes from birth, life stages in animals	• causal explanations, for example explaining how the properties and use of materials could lead to pollution	effect of a change state caused by heating and cooling familiar substances	present both sides of a contentious issue and a conclusion • procedures on how to carry out a particular process or investigation using passive voice • consequential explanations, for example explaining how the flammability or corrosiveness of a substance affects its use	that present a point of view on a contentious issue with supporting evidence • theoretical explanations, for example explaining the relationship between DNA, genes and chromosomes using models and diagrams
History examples				
• historical retellings of an event • narratives built around historical events • descriptions of historical people and places	• historical reports of an event • historical narratives told from a particular perspective • descriptions of an historical figure or place	• historical recounts of a series of events with some summative commentary • historical narratives that retell past events, for example from a particular personal or cultural perspective • detailed descriptions of particular places from the past demonstrating use of source material • persuasive texts, for example presenting a particular point of view in relation to an historical event or figure	• historical recounts of a series of events with some summative commentary • historical narratives that retell past events, for example from a particular personal or cultural perspective • detailed descriptions, for example of particular places from the past demonstrating use of evidence from sources • explanations, for example that present the causes of an event • discussion texts with supporting evidence	• historical recounts of a series of events or developments within a chronological framework with some summative or evaluative commentary • explanations, for example that consider past events from a particular personal or cultural perspective • detailed descriptions of particular places from the past demonstrating use of evidence from primary and secondary sources, using appropriate referencing • discussion texts, for example that present historical arguments with supporting evidence
Text cohesion				
understand how texts are made cohesive through word repetitions and associations, synonyms and antonyms	understand how texts are made cohesive through linking words and phrases for example ‘so’, ‘therefore’, ‘then’, ‘in addition’, and the correct use of pronouns	understand that cohesive links can be made in texts through omitting and replacing words	understand how the cohesion in texts is improved by strengthening the internal structure of paragraphs through examples, quotations and substantiation of claims	understand how cohesive devices in texts serve to signpost ideas and make connections between ideas, such as through sequencing and developing an argument and signalling a conclusion

By the end of Year 2 students	By the end of Year 4 students	By the end of Year 6 students	By the end of Year 8 students	By the end of Year 10 students
Navigating learning area texts				
identify and use text features in learning area texts, such as page layout, alphabetical order, menu bars, and simple diagrams to aid text navigation, reading and viewing	identify and use features of learning area texts to enhance navigation, including page and screen layout, simple indexes, tables of contents, different types of diagrams, and icons and buttons	identify and use features of learning area texts such as text boxes, full indexes, paragraphs, topic sentences, home pages and sub-pages to aid navigation and use	use a range of organisational features of complex learning area texts with speed and efficiency to research and present ideas and information	use organisational features of complex learning area texts with speed and efficiency by exploiting features to locate and evaluate primary and secondary source material

Grammar knowledge

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
Sentence structures				
use simple and compound sentences to record observations, and make connections between ideas	use simple and compound sentence structures to describe and make connections between ideas	use a full range of sentence types, including complex sentences that elaborate or explain ideas	control complex sentence structures that show connections between ideas, evidence and conclusions	control complex sentence structures that build and support arguments, and understand how emphasis can be changed
Words and word groups				
understand how noun groups/phrases and verb groups are used to identify elements in the learning area	understand how groups/phrases are used to provide detailed descriptions in the learning areas	understand and use expanded groups/phrases, using specific learning area vocabulary to create detailed and accurate descriptions	understand and use aspects of language to suggest possibility, probability, obligation and conditionality	understand how higher order concepts are developed in academic texts through language features that compact and generalise text (nominalisation), and use language to discuss, analyse and evaluate ideas and information
Expressing opinion and point of view				
identify and use language that expresses feelings and opinions, and compares and evaluates people and things	understand differences between the language of opinion and feeling and the language of factual reporting or recording	understand and use subjective, objective and evaluative language, and identify bias	understand and use language to evaluate an object, action or text, and language that is designed to persuade the reader/viewer	understand and use language that indirectly expresses opinions and constructs representations of people and events, and consider whether judgments are expressed or implied in texts

Word knowledge

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
Understanding learning area vocabulary				
understand and use mostly familiar vocabulary, with a steady introduction of new learning area vocabulary in context	understand and use vocabulary needed to read, discuss and write about learning area topics, including subject-specific vocabulary	understand and use new vocabulary, including subject-specific vocabulary from a range of learning areas and vocabulary that expresses shades of meaning	understand and use a wide range of new specialist and topic vocabulary to contribute the specificity, authority and abstraction of texts	understand and use subject-specific vocabulary to express abstract concepts, and refine vocabulary choices to discriminate between shades of meaning
Spelling				
learn spellings for topic words, use phonic knowledge to spell new words with regular spelling patterns, and recognise meaning relationships between similar words such as ‘’play’, ‘playing’, ‘playground’	learn spellings for new topic words, for frequently used irregular words, regular words and word families containing known letters and letter clusters	read and spell new topic words and use word origins, base words, prefixes and suffixes when reading and spelling new words	spell most words correctly, and apply their understanding of spelling to spell specialist topic words	use knowledge of the spelling system and word origins to spell correctly and to deduce the meanings of unfamiliar words and to spell unknown words

Visual knowledge

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
Understanding how visual elements create meaning				
understand how images add to, contradict or multiply the meanings of words in a text, and compare images with the accompanying print text	understand the effects of choices in the construction of images, including framing and placement of elements	understand how analytical images such as figures, diagrams, tables, maps and graphs contribute to understanding of texts	understand the effects of different visual elements upon the reader/viewer, and how visual texts draw on and allude to other texts or images to enhance meaning	evaluate the impact of different visual choices in the composition of images, including symbolic images, and experiment with visual texts to establish different nuances
Composing and comprehending learning area texts using visuals				
comprehend and compose visual and multimodal texts in print and digital environments to express ideas and extend written information as part of problem solving and presentations	comprehend and compose visual and multimodal texts in print and digital environments to explore learning area topics, using illustrations and diagrams	comprehend and compose visual and multimodal texts in print and digital environments that make use of visual elements to represent ideas and events in different ways	comprehend and compose visual and multimodal texts such as diagrams, maps and timelines, understanding their contribution to the interpretation of ideas and information	comprehend and compose visual and multimodal texts in print and digital environments using a range of design choices and visual tools for the intended purpose and targeted audience

Numeracy

Introduction

In the Australian Curriculum, students become numerate as they develop the knowledge and skills to use mathematics confidently across all learning areas at school and in their lives more broadly. Numeracy involves students in recognising and understanding the role of mathematics in the world and having the dispositions and capacities to use mathematical knowledge and skills purposefully.

The *Melbourne Declaration of Educational Goals for Young Australians* (MCEETYA 2008) recognises that numeracy is an essential skill for students in becoming successful learners at school and in life beyond school, and in preparing them for their future roles as family, community and workforce members. More broadly, a highly numerate population is critical in ensuring the nation's ongoing prosperity, productivity and workforce participation.

Scope of the Numeracy capability

Numeracy encompasses the knowledge, skills, behaviours and dispositions that students need to use mathematics in a wide range of situations. The Numeracy learning continuum identifies the related mathematical knowledge and skills, and contextualises these through learning area examples.

When teachers identify numeracy demands across the curriculum, students have opportunities to transfer their mathematical knowledge and skills to contexts outside the mathematics classroom. These opportunities assist students to recognise the interconnected nature of mathematical knowledge, learning areas and the wider world, and encourage them to use their mathematical skills broadly.

For a description of the organising elements for the Numeracy learning continuum, go to Organising elements.

Numeracy across the curriculum

In the Australian Curriculum, much of the explicit teaching of numeracy skills occurs in Mathematics. Being numerate involves more than the application of routine procedures within the mathematics classroom. Students need to recognise that mathematics is constantly used outside the mathematics classroom and that numerate people apply mathematical skills in a wide range of familiar and unfamiliar situations. In the context of schooling, this is most often encountered in other learning areas.

Using mathematical skills across the curriculum both enriches the study of other learning areas and contributes to the development of a broader and deeper understanding of numeracy. Therefore, a commitment to numeracy development is an essential component of learning areas across the curriculum and a responsibility for all teachers. This requires that teachers:

- identify the specific numeracy demands of their learning area
- provide learning experiences and opportunities that support the application of students' mathematical knowledge and skills

- use the language of numeracy in their teaching as appropriate.

Understanding mathematical terminology and the specific uses of language in mathematics is essential for numeracy. Therefore, teachers should be aware of the correct use of mathematical language in their own learning areas.

The Numeracy capability is addressed through the learning areas and is identified wherever it is developed or applied in content descriptions. It is also identified where it offers opportunities to add depth and richness to student learning in content elaborations. An icon indicates where numeracy has been identified in learning area content descriptions and elaborations. A filter function on the Australian Curriculum website assists users to identify F–10 curriculum content where numeracy has been identified. Teachers may find further opportunities to incorporate explicit teaching of numeracy depending on their choice of activities. Students can also be encouraged to develop capability through personally relevant initiatives of their own design.

- Numeracy in English (http://www.australiancurriculum.edu.au/English/General-capabilities)
- Numeracy in Mathematics (http://www.australiancurriculum.edu.au/Mathematics/General-capabilities)
- Numeracy in Science (http://www.australiancurriculum.edu.au/Science/General-capabilities)
- Numeracy in History (http://www.australiancurriculum.edu.au/History/General-capabilities)

Background

This background summarises the evidence base from which the Numeracy capability's introduction, organising elements and learning continuum have been developed. It draws on recent international and national research, as well as initiatives and programs that focus on numeracy across the curriculum.

The identification of numeracy as a general capability or competence to be addressed across the curriculum is supported by the literature. In Australia, the *National Numeracy Review Report* (Commonwealth of Australia 2008) argued for an emphasis both on mathematics as a distinct area of study and numeracy as an across-the-curriculum competency. In order to develop the ability to communicate numeric information effectively, students should engage in learning that involves using mathematics in the context of other disciplines. This requires a cross-curricular commitment and is not just the responsibility of the Mathematics Department (Miller 2010).

The Numeracy capability and learning continuum have been informed by a range of findings identified in the literature over a considerable period of time. Steen (2001) pointed out the ever-increasing gap between the quantitative needs of citizens and their quantitative capacity, while Miller (2010) continues to argue that quantitative literacy is a proficiency that is essential for people to be able to participate fully in a democratic society. Most recently, concerns about low levels of financial literacy shown by young people in Australia prompted the development of a *National Consumer and Financial Literacy Framework* to support the development of financial literacy skills in young people (MCEECDYA 2011).

Aspects of numeracy in the literature that have informed the approach to the numeracy capability and that need to inform the approach taken in schools include that:

- there is a difference between the mathematics that people use in context and the mathematics they learn in school (Carraher, Carraher & Schliemann 1985; Zevenbergen & Zevenbergen 2009)
- knowledge is not automatically transferable from mathematics to other contexts (Lave 1988)
- numeracy requires contextual and strategic knowledge as well as mathematical skills (AAMT 1998)
- in numeracy there may be more than one suitable answer or method (Cohen 2001)
- numeracy moments often arise in unexpected situations (Thornton & Hogan 2005).

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Organising elements

The Numeracy learning continuum is organised into six interrelated elements:

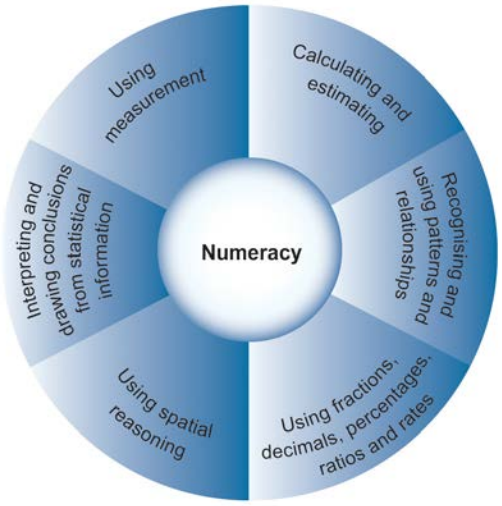
- Calculating and estimating
- Recognising and using patterns and relationships
- Using fractions, decimals, percentages, ratios and rates
- Using spatial reasoning
- Interpreting and drawing conclusions from statistical information
- Using measurement.

These elements are drawn from the strands of the Australian Curriculum: Mathematics as shown in the table below:

Numeracy Continuum	Australian Curriculum: Mathematics
Calculating and estimating	Number and Algebra
Recognising and using patterns and relationships	Number and Algebra (and other strands to a lesser extent)
Using fractions, decimals, percentages, ratios and rates	Number and Algebra
Using spatial reasoning	Measurement and Geometry
Interpreting and drawing conclusions from statistical information	Statistics and Probability
Using measurement	Measurement and Geometry

Financial literacy is a key aspect of numeracy. Relevant knowledge and skills relating to numeracy such as number and place value, money and financial mathematics have been incorporated into the Numeracy continuum, notably in the *Calculating and estimating*, *Using fractions, decimals, percentages, ratios and rates* and *Interpreting and drawing conclusions from statistical information* elements.

The diagram below sets out these elements.



Organising elements for Numeracy

Calculating and estimating

This element involves the application of skills in calculating with whole numbers, all types of fractions, decimals and percentages, squared and cubed numbers, and numbers raised to larger powers.

Students develop numeracy capability as they apply the four operations of addition, subtraction, multiplication and division in a wide range of authentic situations requiring estimation and calculation, such as halving or doubling quantities for recipes, circumstances involving cost, calculation of change, budgeting, saving and spending money, using spreadsheets for financial calculations, and using scientific notation in science when working with very large or very small numbers. They can estimate values to check the validity of their own answers and the answers of others, and so avoid potential error.

Recognising and using patterns and relationships

This element involves identifying and describing a wide range of patterns and relationships, including those requiring algebra and equations that can be visually represented on a graph.

These skills help students to make sense of and describe change as it occurs over time. Students demonstrate numeracy capability as they apply their understanding by making connections between apparently diverse facts and suggesting solutions to problems in a range of circumstances. For example: the relationship between weather patterns and the likelihood of landslides or droughts; the effect of political unrest and its effect on the number of homeless people; grammatical patterns and patterns in the structure of texts; patterns in the arts, architecture and design; the use of trends to predict specific outcomes; and identification of financial patterns as they occur with loans and/or savings.

Using fractions, decimals, percentages, ratios and rates

This element involves developing an understanding of the meaning of fractions and decimals, their representations as ratios, rates and percentages, and how they can be applied in real-life situations.

Students demonstrate numeracy capability as they apply these skills in areas such as working with scale in geography; constructing timelines in history; investigating the growth and decay of cultures in science; determining the relationship between everyday values such as fuel consumption and speed; investigating water usage and rates of consumption; comparing pay rates on an hourly basis, weekly basis and as a salary; and comparing housing loans and mobile phone packages.

Using spatial reasoning

This element involves students in making sense of the space immediately around them. Students demonstrate numeracy capability as they apply the skills of spatial reasoning by creating and interpreting maps through the use of coordinates, using graphic organisers such as mind maps, conceptualising either extremely small or extremely large spaces within the environment and the way these spaces affect the behaviour of living things, and using the properties of shapes and objects in design and architecture.

Interpreting and drawing conclusions from statistical information

This element requires students to gain familiarity with the way in which statistical information is represented through experience with a variety of graphs, lists and tables.

Students demonstrate numeracy capability in a range of learning areas and circumstances when they draw conclusions from and make predictions based on given or collected data, recognise the use and abuse of statistics in the media and advertising, identify bias in advertising and other texts that use probability, and understand randomness as it occurs in science and the environment. Numeracy can be used to analyse data relating to population density and its variations, comparative land use, fluctuations in share markets or the price of everyday commodities.

Using measurement

This element requires students to learn about measurement of length, area, volume, capacity, time and mass.

Students become numerate as they apply their skills and understanding of measurement by selecting appropriate units of measurement for a given situation and developing an ability to estimate units in measurement. As their skills increase, they use formal units for measurement and find areas and volumes when learning about environmental issues, such as comparing capacities for water storage, researching areas of land put aside for parkland or preservation or recognising how scales are used to report on environmental incidents such as earthquakes. Students identify commercial development and residential development within their local area, read timetables and timelines and plan itineraries, apply their understanding of mass when carrying out experiments in science or when preparing food, and use strategies that draw upon their knowledge of Pythagoras' theorem and trigonometry to calculate distance and direction.

Numeracy continuum across stages of schooling

Calculating and estimating

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
use numbers up to four digits in familiar contexts English – understanding and using numbers in texts Science – using numbers to describe and order observations	use numbers up to five digits in everyday contexts Science – using large numbers to describe time scales for changes in the Earth's surface History – using numbers to order events by date, recognising that dates such as 1770 describe time	use numbers larger than one million correctly in authentic situations English – using library classification systems to order and search for books Science – ordering planets in the Solar System according to size and distance from the Sun History - using data to develop graphs and tables from population figures	use positive and negative numbers in authentic situations involving change Science – using positive and negative numbers to demonstrate that substances have different boiling and freezing points History – categorising time into periods and interpreting timelines History – identifying the approximate beginning and end dates of ancient societies and the period in which they coexisted	use scientific notation to represent very large and very small numbers and calculations Science – using scientific notation to explore the scales involved in measurement of earthquake strength, sound levels or nanotechnology
recognise when a situation requires the use of addition or subtraction apply estimation and calculation strategies in familiar contexts Science – using addition, subtraction and estimation in the collection and recording of information History – calculating the age of objects brought from home	decide whether to use addition, subtraction, multiplication or division in everyday contexts experiment with and use number patterns to assist them in mental calculations and estimation History – calculating the difference between the number of convicts who left Britain on the First Fleet and the number who arrived in Australia	use mental and written strategies and digital technologies in calculations involving authentic situations use estimation and rounding to check the reasonableness of their calculations	choose and use a range of strategies (including mental and written strategies and digital technologies) in calculations to solve complex problems in authentic situations Science – comparing temperature variations in different parts of the world, including those with negative temperatures	choose and use a range of strategies (including mental and written strategies and digital technologies) in calculations involving complex data and contexts History – using historical sources to explain population movements, for example the transportation of slaves, the growth of cities

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
recognise familiar situations that involve the use of money	compare the costs of similar items	create financial plans and budgets to suit a range of contexts and recognise the benefits of saving for their future	create budgets that support specific financial goals justify 'best value for money' decisions	create financial plans that support specific financial goals and evaluate their effectiveness analyse the impact of debt on achieving financial goals and identify strategies for debt management

Recognising and using patterns and relationships

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
describe patterns in number Science - grouping living things based on the number of different body parts	describe, continue and create number patterns	describe, continue and create number patterns and predict a sequence Science - describing patterns in the natural environment, for example the Fibonacci sequence	describe, continue and create number patterns and look for patterns/rules that would help them to make predictions	recognise how the practical application of patterns can be used in authentic situations to make predictions History - developing interactive timelines to show relationships between events and developments and the places and times in which they occurred
describe patterns in the world around them English -recognising patterns in language, for example in rhymes and repetition Science - identifying patterns involving shapes in natural and constructed environments History - ordering important family and community events in a time sequence	identify and describe patterns in identified contexts English - identifying patterns in spelling of words, poetry Science - recognising patterns in the characteristics of living and non-living things History - developing timelines of significant people and events	recognise that patterns observed over time assist us to predict possible outcomes English - identifying and describing regular patterns in texts, for example in narrative structure Science - identifying patterns and trends in data and using these to make predictions Science - recording change in shadows' length and position throughout the day History - developing annotated timelines for key people and events	use their understanding of patterning to identify and extend linear patterns and make predictions English - explaining patterns and relationships in texts, for example cause and effect and rhetorical devices Science - using data (fuel consumptions vs distance) to determine patterns of vehicles' fuel consumption over time History - developing annotated timelines, showing broad patterns of continuity and change	use their understanding of patterning to identify and extend linear and non-linear patterns and make predictions Science - using linear modelling to predict air or water temperature, using non-linear modelling to predict changes in populations due to environmental changes

Using fractions, decimals, percentages, ratios and rates

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
recognise terms such as ‘a half’ and ‘a quarter’ as used in everyday language and use them in familiar contexts	recognise the equivalence of fractions and decimal representations and their use in everyday contexts, for example a quarter is equivalent to 0.25; 0.25 of $1 is 25 cents	make connections between equivalent fractions, decimals and percentages, and calculate these in authentic situations History - using data to calculate percentages, for example votes for and against Federation; the percentage of the Australian population born overseas	apply knowledge of percentages (including percentage increases and decreases), rates and ratios, and means and proportions in representative data, in a range of authentic contexts Science - calculating means and proportion in representative data, for example water storage, flow and usage	use graphs and equations to analyse and illustrate proportional relationships in a range of authentic contexts Science - analysing and illustrating the rate of chemical reactions History - using proportional reasoning to assess the impact of changes in society and significant events, for example population loss from 1919 influenza epidemic

Using spatial reasoning

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
recognise, visualise and classify familiar two-dimensional shapes and three-dimensional objects in the world around them describe position and movement in familiar contexts English - understanding and using the language of shape, position and movement Science - describing the shape of objects and the ways they move	identify and compare two-dimensional shapes and three-dimensional objects recognise symmetry in natural and built environments, and the importance of angles in symmetry English - using features such as shape and angle when creating visual texts Science: observing symmetry as a property of some living things History - building a 3-D structure of a past building	describe features of prisms and pyramids estimate, measure and compare angles using degrees English - identifying how camera angles impact on the viewer's experience Science: explaining why some angles are used more frequently in built environments than others	analyse the combination of different shapes and objects and their positions in the environment, in architecture, art and design English - understanding and using technical elements including shape, size, angle and framing to enhance meaning in visual and multimodal texts Science - describing the movements of objects using speed and direction	use their knowledge of right-angled triangles to solve problems involving direction and angles of elevation and depression English - understanding and evaluating the effect of technical elements in visual texts
give and follow directions to familiar locations	show and describe position and pathways on grid maps	describe routes using landmarks and directional language such as north, south, east, west, north-west History - using maps to explain routes followed by explorers or patterns of development in the Australian colonies		

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
interpret maps of familiar locations and identify the relative positions of key features Science- using maps to describe features of local environments	interpret information contained on maps to locate a position using simple scales, legends and directions English - using simple scales and legends to make connections between print and images in texts Science: using simple scales, legends and directions to interpret maps of given habitats History: creating and using grid maps, to show the location of historical features in communities	identify and describe locations using a grid reference system Science -using a grid system to locate geological events on the Earth's surface	create and interpret complex spatial information from maps and grids History - using stratigraphy (cross-sectional drawings of archaeological excavations) to identify layers and change over time History - using a map to depict the spread of the Black Death across Europe	

Interpreting and drawing conclusions from statistical information

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
collect data on an issue or question of interest based on one categorical variable, for example most popular car colours, favourite ice-cream flavours, cheapest toy display data using lists, tables and picture graphs interpret picture graphs, describing the data represented	collect and record data from issues and questions in given situations, using methods such as survey questions and recording sheets organise data into categories and create lists, tables, picture graphs and simple column graphs identify trends in data using class surveys and data displays	create and use data displays such as lists, tables, column graphs and sector graphs assess the relative effectiveness of different displays interpret secondary data presented in digital media and other information sources	interpret a variety of data displays, including tables, histograms, sector graphs, divided bar graphs, time series use the term 'mean' in connection with measures of central tendency and recognise that mean, median and mode can be different measures calculate mean, median, mode and range from a data set assess the practicalities and reasons for obtaining and reporting representative data	identify questions and issues involving several variables, and collect and interpret data from secondary sources use scatter plots to display and comment on relationships between two continuous variables, such as speed and distance describe trends in numerical data where the independent variable is time analyse techniques for collecting data, including census sampling and observation evaluate the use of statistics in media and other reports by linking claims to graphic displays, statistics and representative data
Science - using data displays to represent findings from investigations History - collecting and displaying data to compare their parents' childhoods with their own, for example class sizes, number of children in families then and now	Science - presenting evidence about the foods eaten by animals in a column graph History - organising and displaying data about different groups of people on the First Fleet	English - using data displays in texts to convey information or persuade Science - presenting results about resting pulse rates in a line graph History - interpreting statistical information such as Federation referenda figures or census data	English - using mathematical techniques such as graphs, tables and means to strengthen or support an argument Science - using secondary data collected over time to investigate changes in the mean and median rainfalls and water consumption History - selecting and using quantitative data as evidence to analyse historical events, for example the impact of warfare on the military forces of ancient societies	English - interrogating and using multiple sources of quantitative data as evidence in persuasive texts Science - using scatter plots to display the relationship between two continuous variables such as population growth and the use of fossil fuels History - using bar graphs to compare food rations from WWII with their own food consumption

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
identify practical activities and familiar events that involve chance such as games involving dice	describe possible outcomes from chance experiments and recognise variations in results	describe possible events using numerical representations, for example a 75% chance of rain, a 50/50 chance of snow, a 1 in 6 chance of rolling a 5 from a six-sided die compare observed frequencies with predicted frequencies of chance experiments	explain why the actual results of chance events are not always the same as expected results	
English - understanding and using language of chance in familiar contexts such as 'will', 'won't' and 'might'	English - understanding and using terms denoting the likelihood of events, including colloquial terms such as 'no way', 'for sure'	English - constructing a scale to depict the likelihood of event in a text from least to most probable		

Using measurement

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
make direct and indirect comparisons of familiar objects and terms, for example hours are longer than minutes, an elephant is heavier than a mouse use informal measures to collect and record information about length and height of shapes, and mass of objects English - understanding and using language of approximation and comparison and informal measurement terms in texts Science - using informal measures to record observations, comparing masses of objects using balance scale, such as measuring the heights of plants in standard measures, measuring hand spans	measure and compare lengths, mass, capacities and temperatures, using scaled instruments English - understanding and using measurement terms in texts Science - using a thermometer to measure heating and cooling, recording results to the nearest half unit	record measurements using the metric system, including decimals choose and use appropriate units of measurement for length, area, volume, capacity and mass convert between basic metric units of metres, grams and litres English - understanding the use of measurement terms to determine precision and recognising that precision varies according to context History - using measurements from maps, plans and other sources to describe historical buildings and the layout of settlements	choose appropriate formulas to find the areas of regular two-dimensional shapes and the volumes of prisms distinguish between and calculate the perimeter and area of regular shapes English - understanding that vocabulary choice related to measurement contributes to the specificity of texts	recognise that two- and three-dimensional shapes can be made up of composite shapes choose appropriate formulas for finding area and volume
name and order days of the week and months of the year use a calendar to identify the date and determine the number of days in each month describe duration using months, weeks, days and hours English - using the language of time to sequence events in a narrative History - using the language of time (for example now, then, before, after), months, weeks, days and hours to describe duration of events	use the terms ‘am’ and ‘pm’ accurately English - sequencing photographs in a time series (three time periods), identifying and communicating differences between present and past times English - using time-related vocabulary (second, minute, hour, day)	interpret and use timetables in authentic situations History - creating and using timetables of daily activities to describe how people lived in the past compared to today	use their knowledge of 12- and 24-hour time systems to solve problems involving time within a single time zone	use very small and very large timescales and intervals in appropriate contexts Science: using data from radiocarbon dating, DNA and stratigraphy to estimate dates and ages from the fossil record estimate

By the end of Year 2 students:	By the end of Year 4 students:	By the end of Year 6 students:	By the end of Year 8 students:	By the end of Year 10 students:
History - using calendars and pictorial representations to sequence events from the past	Science - using am and pm when describing night and day in relation to the Earth's rotation History - developing a calendar to calculate the duration of events, for example the journey of the First Fleet and comparing this with the time it would take to make the trip from Portsmouth to Sydney today			
tell time to the quarter hour	tell time to the minute	apply their knowledge of 12- and 24-hour time systems to convert between the two systems		

Information and communication technology (ICT) capability

Introduction

In the Australian Curriculum, students develop ICT capability as they learn to use ICT effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas at school, and in their lives beyond school. The capability involves students in learning to make the most of the digital technologies available to them, adapting to new ways of doing things as technologies evolve and limiting the risks to themselves and others in a digital environment.

The *Melbourne Declaration on the Educational Goals for Young Australians* (MCEETYA 2008) recognises that in a digital age, and with rapid and continuing changes in the ways that people share, use, develop and communicate with ICT, young people need to be highly skilled in its use. To participate in a knowledge-based economy and to be empowered within a technologically sophisticated society now and into the future, students need the knowledge, skills and confidence to make ICT work for them at school, at home, at work and in their communities.

Information and communication technologies are fast and automated, interactive and multimodal, and they support the rapid communication and representation of knowledge to many audiences and its adaptation in different contexts. They transform the ways that students think and learn and give them greater control over how, where and when they learn.

Scope of ICT capability

The nature and scope of ICT capability is not fixed, but is responsive to ongoing technological developments. This is evident in the emergence of advanced internet technology over the past few years and the resulting changes in the ways that students construct knowledge and interact with others.

Students develop capability in using ICT for tasks associated with information access and management, information creation and presentation, problem solving, decision making, communication, creative expression, and empirical reasoning. This includes conducting research, creating multimedia information products, analysing data, designing solutions to problems, controlling processes and devices, and supporting computation while working independently and in collaboration with others.

Students develop knowledge, skills and dispositions around ICT and its use, and the ability to transfer these across environments and applications. They learn to use ICT with confidence, care and consideration, understanding its possibilities, limitations and impact on individuals, groups and communities.

ICT capability across the curriculum

ICT capability supports and enhances student learning across all areas of the curriculum. Students develop and apply ICT knowledge, skills and appropriate social and ethical protocols and practices to investigate, create and communicate, as well as developing their ability to manage and operate ICT to meet their learning needs.

Learning areas provide the content and contexts within which students develop and apply the knowledge, skills, behaviours and dispositions that comprise ICT capability.

ICT capability and the Technologies learning area

Information and communication technology is represented in two ways in the Australian Curriculum: through the ICT capability that applies across all learning areas and within the Technologies curriculum through Digital technologies. The ICT capability will be reviewed (and revised if necessary) to ensure that there is consistency with the Technologies curriculum following its development.

The ICT capability is addressed through the learning areas and is identified wherever it is developed or applied in content descriptions. It is also identified where it offers opportunities to add depth and richness to student learning in content elaborations. An icon indicates where ICT capability has been identified in learning area content descriptions and elaborations. A filter function on the Australian Curriculum website assists users to identify F–10 curriculum content where ICT capability has been identified. Teachers may find further opportunities to incorporate explicit teaching of ICT capability depending on their choice of activities. Students can also be encouraged to develop capability through personally relevant initiatives of their own design.

- Information and communication technology in English (http://www.australiancurriculum.edu.au/English/General-capabilities)
- Information and communication technology in Mathematics (http://www.australiancurriculum.edu.au/Mathematics/General-capabilities)
- Information and communication technology in Science (http://www.australiancurriculum.edu.au/Science/General-capabilities)
- Information and communication technology in History (http://www.australiancurriculum.edu.au/History/General-capabilities)

Background

This background summarises the evidence base from which the ICT capability's introduction, organising elements and learning continuum have been developed. It draws on recent international and national research, as well as initiatives and programs that focus on ICT across the curriculum.

ICT capability is based on sets of relevant knowledge, skills, behaviours and dispositions. Internationally, such capability is typically represented developmentally across interrelated domains or elements to show increasingly sophisticated experiences with the technology. For example, the ICT curriculum for England presents 'lines of progression' in strands and sub-strands. The National Education Technology Standards (NETS) for students provided by the International Society for Technology in Education (ISTE) represent capability with six sets of standards.

In Australia, the *Statements of Learning for ICT* were presented as five broadly defined conceptual organisers, representing key aspects of ICT that apply across the curriculum. The Australian Council for Educational Research (ACER) has also identified a progression in research associated with the National Assessment Program – ICT Literacy.

Early researchers into ICT in education, such as Papert (1980) and Turkle (1984), considered that students constructed reality from experience and prior knowledge. The student interacts with the environment and, to cope with this environment, develops a conceptual framework to explain the interaction. More recent theorists, such as Dede (2009), echo these earlier propositions even as technologies evolve, giving rise to the set of constructs upon which the ICT capability is based. In particular, the overarching element *Applying social and ethical protocols and practices when using ICT* addresses the personal, social and cultural contexts introduced by theorists such as Papert and Turkle.

ICT capability is based on the assumption that technologies are digital tools that enable the student to solve problems and carry out tasks. That is, the ICT system needs to suit the student and the task, while the student needs to develop an understanding of what the machine can do and an appreciation of the limitations under which it operates. In this way, students come to perceive ICT systems as useful tools rather than feeling that they themselves are the tools of the machine (Maas 1983). The latter often occurs when users have little information about how ICT systems operate and simply follow set, standard procedures, determined for them by the system.

Therefore, ICT capability needs to consider the types of tasks that provide authentic contexts for learning. The range of tasks is categorised into three sets: *Investigating with ICT*, *Communicating with ICT* and *Creating with ICT*. Students also need the knowledge and skills to use ICT based on an understanding of the 'nature of the machine'. This is encompassed in the *Managing and operating ICT* element of the continuum.

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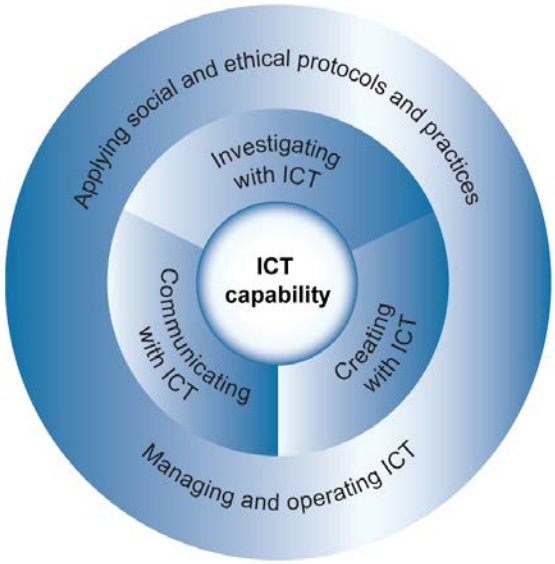
Organising elements

The ICT capability learning continuum is organised into five interrelated elements:

- Applying social and ethical protocols and practices when using ICT
- Investigating with ICT
- Creating with ICT
- Communicating with ICT
- Managing and operating ICT

The diagram below sets out these elements.



Organising elements for ICT capability

Applying social and ethical protocols and practices when using ICT

Students develop ICT capability within a context of social and ethical protocols and practice. This element involves students in developing an understanding of:

- intellectual property pertaining to digital information
- digital information security, including the responsibility to:
    - protect the rights, identity, privacy and emotional safety of online audiences
    - avoid and prevent cyberbullying
    - ensure security of self and/or others
    - respect audiences, being aware of the portrayal of self and others
- the benefits and consequences of ICT for individuals, groups and communities in society, such as:
    - becoming drivers of ICT, seeing themselves as creators as well as consumers of ICT
    - recognising its capacity to enhance participation and inclusion

- analysing how changes in technology impact on and relate to changes in society.

Investigating with ICT

This element involves students in using ICT to access data and information from a range of primary and secondary sources when investigating questions, topics or problems. To do this effectively and efficiently, students use processes of defining, planning, locating, accessing, selecting, organising and evaluating information and data. Students use ICT to:

- define and plan information searches
- locate and access data and information through:
  - search engines, search functions, and general and specialised directories
  - navigation tools between and within documents
  - opening files of different formats
  - organising data and information using a range of ICT tools
- select and evaluate data and information by applying criteria to verify the integrity of data and information and their sources.

Creating with ICT

This element involves students in using ICT to generate ideas, plans, processes and solutions to challenges and tasks. These may relate to learning a concept, completing an activity or responding to a need, and may be self- or teacher-generated. Students use ICT to generate ideas, plans and processes to:

- clarify a task, or the steps and processes required to develop responses to questions or solutions to problems
- generate products or solutions for challenges and learning area tasks to:
  - develop, refine and present new understandings in a digital form
  - create a digital input or a process to support a digital output to transform digital data and information.

Communicating with ICT

This element involves students in using ICT to communicate ideas and information with others and collaboratively construct knowledge, in adherence with social protocols appropriate to the communicative context (purpose, audience and technology). Students use ICT to:

- share, exchange and collaborate to enhance learning by:
  - sharing information in digital forms
  - exchanging information through digital communication
  - collaborating and collectively contributing to a digital product
- understand and apply social protocols to receive, send and publish digital data and information, taking into account characteristics of users

- apply techniques or strategies to ensure security of digital information, to control access, protect files and report abuse.

Managing and operating ICT

This element involves students in using ICT to investigate, create and communicate. This involves applying technical knowledge and skills to work with information as required and use information classification and organisation schemes. Students:

- use digital technologies efficiently including**:**
    - troubleshooting
    - adjusting parameters
    - monitoring occupational health and safety issues
- select appropriate combinations of digital hardware and software to match the needs of the user and the task
- understand the transferability of knowledge and skills between digital systems and applications
- use software to manage and maintain information in digital files.

ICT capability continuum across stages of schooling

Applying social and ethical protocols and practices

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Intellectual property		
recognise that people create information resources and that the information they create or provide can be used or misused by others (for example understanding that you cannot copy someone else's work)	apply practices that comply with legal obligations regarding the ownership and use of information resources (for example naming sources, avoiding plagiarism, knowing what may or may not be copied)	recognise ethical dilemmas and apply practices that protect intellectual property (for example understanding that pirating denies musicians payment for their work)
Information security		
follow class rules about using resources and apply basic guidelines to secure personal information (for example recognising that when logging onto the network, they are only able to access their own folders)	apply strategies for protecting the security of personal information (for example checking integrity of web links)	use a range of strategies for securing and protecting information and understand the need for codes and conduct (for example using filters to divert junk mail)
Personal security		
recognise the need to take care in sharing personal information (for example messaging only to people you know)	recognise the rights, identity, privacy and emotional safety of themselves and others when using ICT (for example understanding the dangers of providing personal information, recognising ways of using ICT that can result in cyberbullying)	apply appropriate strategies to protect rights, identity, privacy and emotional safety of others when using ICT (for example identifying possible consequences of posting personal information on social networking sites, taking responsibility for the effect of their communications on other people)
ICT and society		
identify how ICT is used in their homes and at school (for example identifying examples in the community such as borrowing a library book, online lunch ordering)	explain the use of ICT at school and in the local community, and understand its impact on their lives (for example recognising the potential impact on health of prolonged electronic game playing)	assess the impact of ICT in the workplace and in society, and speculate on its role in the future and how they can influence its use (for example recognising the potential of enhanced inclusivity for people with disability through ICT)

Investigating with ICT

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Defining and planning information searches		
use ICT to identify, record, group and classify textual and graphic information to show what is known and what needs to be investigated (for example using colour coding, drawing software to show steps in a sequence)	use appropriate ICT to identify and represent patterns in sets of information and to pose questions (for example using tables in word processing and charts in spreadsheets)	select and use appropriate ICT independently and collaboratively, analyse information to frame questions and plan search strategies (for example using wikis, searching databases)
Locating and accessing data and information		
locate and retrieve textual and graphic information from a range of digital sources (for example locating information following hyperlinks and typing in simple URL, printing pages, copying and pasting text and images)	plan, locate (using search engines and basic search functions), retrieve and organise information in meaningful ways (for example searching within document – find/search/buttons/tabs; locating files within school directory; searching across web or within site)	use advanced search tools and techniques to locate precise data and information that supports the development of new understandings (for example using logical statements such as true/false; searching within fields or for data type; using datalogger equipment, digital microscope)
Selecting and evaluating data and information		
explain the usefulness of located information (for example explaining how digital information answers a question)	assess the suitability of information using appropriate criteria (for example selecting the most useful/reliable/relevant digital resource from a set of three or four alternatives)	develop and use criteria systematically to evaluate the quality, suitability and credibility of located information and sources (for example comparing objective data from multiple digital sources to evaluate the likely credibility of the information provided)

Creating with ICT

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Generating ideas, plans and processes		
use ICT to prepare simple plans to find solutions or answers to questions (for example drawing simple mindmap using conceptual mapping software; drawing software to show steps in sequence	use ICT effectively to record ideas, represent their thinking and plan solutions (for example using timeline software to plan processes; concept mapping and brainstorming software to generate key ideas	select and use ICT to articulate ideas and concepts, and plan the development of complex solutions(for example using software to create hyperlinks, tables and charts)
Generating solutions to challenges and learning area tasks		
experiment with ICT as a creative tool to generate simple solutions or modifications for particular audiences or purposes (for example using the basic functionality of limited software to manipulate text, images, audio and numbers)	create digital solutions, independently or collaboratively, for particular audiences and purposes (for example manipulating images, text, video and sound for presentations; creating podcasts)	design and modify creative digital solutions, for particular audiences and for a range of purposes (for example modelling solutions in spreadsheets, creating movies, animations, websites and music; programming games; using databases; creating web pages for visually impaired users)

Communicating with ICT

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Collaborating, sharing and exchanging		
use identified ICT tools safely to share and exchange information with appropriate audiences (for example using email to read and post electronic messages)	select and use appropriate ICT tools safely to share and exchange information and to collaborate with others (for example contributing to the content of a wiki; blogging and posting to bulletin boards)	select and use a range of ICT tools efficiently and safely to share and exchange information and to construct knowledge collaboratively (for example using online applications and management tools for collaborative projects such as online portals, wikis)
Understanding and applying social protocols		
apply basic social protocols when communicating with known audiences (for example addressing recipients appropriately in emails)	apply generally accepted social protocols when sharing information in online environments, taking into account different social and cultural contexts (for example not posting a photo without the owner's permission; not revealing details of identity)	discriminate between protocols suitable for different communication tools when collaborating with local and global communities (for example using appropriate salutations; adjusting length and formality of message to suit form of communication)
Applying techniques or strategies to ensure security of information		
use limited techniques to ensure digital security (for example logging on to server and email)	independently establish secure accounts for approved online environments (for example using non-predictable user names and passwords)	assess the risks associated with online environments and establish appropriate security strategies as required (for example modifying default parameters at social networking site)

Managing and operating ICT

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Using ICT efficiently and ergonomically		
safely use a limited range of devices, functions and commands when operating an ICT system (for example mouse, USB flash drive, printer, digital camera, robot)	use a range of devices ergonomically and with increasing efficiency, and use basic troubleshooting procedures to solve routine malfunctions (for example using printer queues, file servers, scanners, probes, digital cameras)	use and optimise a selected range of devices and software functions to meet particular tasks (for example altering toolbars, sorting and layout functions; using duplex printing; setting proxies)
Selecting hardware and software		
identify appropriate software for a task (for example using page layout software for posters)	select from appropriate hardware and software to undertake specific tasks (for example selecting specific graphics software or graphic tools in word processors)	independently select and apply appropriate software and hardware to suit specific tasks, purposes and social contexts (for example selecting an appropriate option for creating a website such as an online tool or an HTML editor)
Understanding ICT systems		
identify the main components of an ICT system, their fundamental functions, and describe them using basic ICT terminology (for example identifying basic hardware and peripherals, such as mouse, keyboard, monitor, printer, and some software programs, such as word processing, drawing and paint software)	understand the uses of basic ICT system components (for example input – keyboard; process – central processing unit; output – display to monitor; storage – USB, hard drive)	apply an understanding of ICT system components to make changes to functions, processes, procedures and devices to fit the purpose of the solutions (for example saving files in different formats so that they are compatible across different software platforms)
Managing digital data		
manage and maintain digital files with guidance (for example saving and retrieving files; providing unique names for files; applying basic functions such as opening and dragging-and dropping files)	effectively manage and maintain files on different storage mediums – locally and on networks (for example saving/exporting data in files of different formats; routinely backing up and protecting data; moving a file from one location to another))	manage and maintain files securely in a variety of storage mediums and formats (for example designing and using logical and sustainable file/folder naming conventions; maintaining version control of documents; limiting access to files by location or password)

Critical and creative thinking

Introduction

In the Australian Curriculum, students develop capability in critical and creative thinking as they learn to generate and evaluate knowledge, clarify concepts and ideas, seek possibilities, consider alternatives and solve problems. Critical and creative thinking are integral to activities that require students to think broadly and deeply using skills, behaviours and dispositions such as reason, logic, resourcefulness, imagination and innovation in all learning areas at school and in the lives beyond school.

The *Melbourne Declaration on Educational Goals for Young Australians* (MCEETYA 2008) recognises that critical and creative thinking are fundamental to becoming successful learners. Thinking that is productive, purposeful and intentional is at the centre of effective learning. By applying a sequence of thinking skills, students develop an increasingly sophisticated understanding of the processes they can employ whenever they encounter problems, unfamiliar information and new ideas. In addition, the progressive development of knowledge about thinking and the practice of using thinking strategies can increase students' motivation for, and management of, their own learning. They become more confident and autonomous problem-solvers and thinkers.

Responding to the challenges of the twenty-first century – with its complex environmental, social and economic pressures – requires young people to be creative, innovative, enterprising and adaptable, with the motivation, confidence and skills to use critical and creative thinking purposefully.

Scope of Critical and creative thinking

This capability combines two types of thinking – critical thinking and creative thinking. Though the two are not interchangeable, they are strongly linked, bringing complementary dimensions to thinking and learning.

Critical thinking is at the core of most intellectual activity that involves students in learning to recognise or develop an argument, use evidence in support of that argument, draw reasoned conclusions, and use information to solve problems. Examples of thinking skills are interpreting, analysing, evaluating, explaining, sequencing, reasoning, comparing, questioning, inferring, hypothesising, appraising, testing and generalising.

Creative thinking involves students in learning to generate and apply new ideas in specific contexts, seeing existing situations in a new way, identifying alternative explanations, and seeing or making new links that generate a positive outcome. This includes combining parts to form something original, sifting and refining ideas to discover possibilities, constructing theories and objects, and acting on intuition. The products of creative endeavour can involve complex representations and images, investigations and performances, digital and computer-generated output, or occur as virtual reality.

Concept formation is the mental activity that helps us compare, contrast and classify ideas, objects, and events. Concept learning can be concrete or abstract and is closely allied with metacognition. What has been learned can be applied to future examples.

It underpins the elements outlined below. Dispositions such as inquisitiveness, reasonableness, intellectual flexibility, open- and fair-mindedness, a readiness to try new ways of doing things and consider alternatives, and persistence both promote and are enhanced by critical and creative thinking.

Critical and creative thinking can be encouraged simultaneously through activities that integrate reason, logic, imagination and innovation – for example, focusing on a topic in a logical, analytical way for some time, sorting out conflicting claims, weighing evidence, thinking through possible solutions, and then, following reflection and perhaps a burst of creative energy, coming up with innovative and considered responses. Critical and creative thinking are communicative processes that develop both flexibility and precision. Communication is integral to each of the thinking processes. By sharing thinking, visualisation and innovation, and by giving and receiving effective feedback, students learn to value the diversity of learning and communication styles.

For a description of the organising elements for Critical and creative thinking, go to Organising elements.

Critical and creative thinking across the curriculum

The imparting of knowledge (content) and the development of thinking skills are accepted today as primary purposes of education. The explicit teaching and embedding of critical and creative thinking throughout the learning areas encourages students to engage in higher order thinking. By using logic and imagination, and by reflecting on how they best tackle issues, tasks and challenges, students are increasingly able to select from a range of thinking strategies and employ them selectively and spontaneously in an increasing range of learning contexts.

Activities that foster critical and creative thinking should include both independent and collaborative tasks, and entail some sort of transition or tension between ways of thinking. They should be challenging and engaging, and contain approaches that are within the ability range of the learners, but also challenge them to think logically, reason, be open-minded, seek alternatives, tolerate ambiguity, inquire into possibilities, be innovative risk-takers and use their imagination.

Critical and creative thinking is addressed through the learning areas and is identified wherever it is developed or applied in content descriptions. It is also identified where it offers opportunities to add depth and richness to student learning in content elaborations. An icon indicates where critical and creative thinking has been identified in learning area content descriptions and elaborations. A filter function on the Australian Curriculum website assists users to identify F–10 curriculum content where critical and creative thinking has been identified. Teachers may find further opportunities to incorporate explicit teaching of critical and creative thinking depending on their choice of activities. Students can also be encouraged to develop capability through personally relevant initiatives of their own design.

- Critical and creative thinking in English (http://www.australiancurriculum.edu.au/English/General-capabilities)
- Critical and creative thinking in Mathematics (http://www.australiancurriculum.edu.au/Mathematics/General-capabilities)
- Critical and creative thinking in Science (http://www.australiancurriculum.edu.au/Science/General-capabilities)

- Critical and creative thinking in History
  (http://www.australiancurriculum.edu.au/History/ General-capabilities)

Background

This background summarises the evidence base from which the Critical and creative thinking capability's introduction, organising elements and learning continuum have been developed. It draws on foundational and recent international and national research, as well as initiatives and programs that focus on critical and creative thinking across the curriculum.

Critical and creative thinking are variously characterised by theorists as dispositions (Tishman, Perkins and Jay; Ritchhart, Church and Morrison), taxonomies of skills (Bloom; Anderson, Krathwohl et al.), habits and frames of mind (Costa and Kallick; Gardner; de Bono), thinking strategies (Marzano, Pickering and Pollock), and philosophical inquiry (Lipman, Sharp and Oscanyan). Each of these approaches has informed the development of the Critical and creative thinking capability.

The capability is concerned with the encouragement of skills and learning dispositions or tendencies towards particular patterns of intellectual behaviour. These include being broad, flexible and adventurous thinkers, making plans and being strategic, demonstrating metacognition, and displaying intellectual perseverance and integrity. Students learn to skilfully and mindfully use thinking dispositions or 'habits of mind' such as risk taking and managing impulsivity (Costa and Kallick 2000) when confronted with problems to which solutions are not immediately apparent.

Both Gardner (1994) and Robinson (2009) emphasise that we need to understand and capitalise on the natural aptitudes, talents and passions of students – they may be highly visual, or think best when they're moving, or listening, or reading. Critical and creative thinking are fostered through opportunities to use dispositions such as broad and adventurous thinking, reflecting on possibilities, and metacognition (Perkins 1995), and can result from intellectual flexibility, open-mindedness, adaptability and a readiness to experiment with and clarify new questions and phenomena (Gardner 2009). Recent discoveries in neuroscience have furthered theories about thinking, the brain, perception and the link between cognition and emotions. Theorists believe that learning is enhanced when rich environments contain multiple stimuli, stressing the importance of engaging the mind's natural curiosity through complex and meaningful challenges.

Educational taxonomies map sequences of skills and processes considered to be foundational and essential for learning. The most well known of these, developed by Bloom et al. (1956), divided educational objectives into domains where learning at the higher levels was dependent on having attained prerequisite knowledge and skills at lower levels. In 1967, Bruner and colleagues described the process of concept learning as an active process in which learners construct new concepts or ideas based on their knowledge.

The philosophical inquiry model, first applied to school education by Lipman, Sharp and Oscanyan (1980), has two major elements: critical and creative thinking, and forming a classroom environment called a 'community of inquiry', to support the development of thinking and discussion skills. This model places emphasis on possibilities and meanings, wondering, reasoning, rigour, logic, and using criteria for measuring the quality of thinking.

Lave and Wenger (1991) described 'learning communities' that value their collective competence and learn from each other. Through their notion of 'authentic' learning, the importance of engagement and linking student interests and preferred learning modes with classroom learning has emerged. Marzano, Pickering and Pollock (2001) identified the strategies most likely to improve student achievement across all content areas and grade levels. These include using non-linguistic representations and learning organisers, and generating and testing hypotheses.

In 2001, Anderson and Krathwohl changed Bloom's cognitive process of 'synthesis' to 'creativity' and made it the highest level of intellectual functioning. They believed the ability to create required the production of an original idea or a product from a unique synthesis of discrete elements.

Twenty-first century learning theories emphasise the importance of supporting authentic and ubiquitous (anywhere, anyhow) learning, and providing students with opportunities, resources and spaces to develop their creative and critical thinking skills (Newton and Fisher 2009; McGuinness 1999, 2010). Gardner's (2009) five 'minds' for the future – the disciplined, synthesising, creating, respectful and ethical minds – offers a helpful starting place. Learners need to develop the skills to analyse and respond to authentic situations through inquiry, imagination and innovation.

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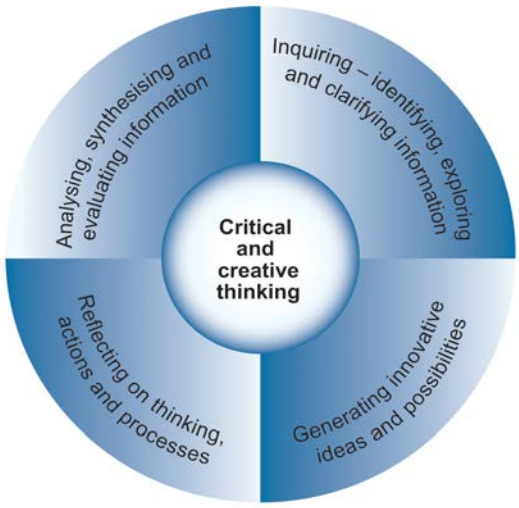
Organising elements

The Critical and creative thinking learning continuum is organised into four interrelated elements, each detailing differing aspects of thinking. The elements are not a taxonomy of thinking. Rather, each makes its own contribution to learning and needs to be explicitly and simultaneously developed.

- Inquiring – identifying, exploring and clarifying information
- Generating innovative ideas and possibilities
- Reflecting on thinking, actions and processes
- Analysing, synthesising and evaluating information.

The diagram below sets out these elements.



Organising elements for Critical and creative thinking

Inquiring – identifying, exploring and clarifying information

This element involves students in the identification and clarification of questions and issues, followed by gathering and processing information. When gathering, exploring and clarifying information and ideas creatively, students develop the capacity to be open-minded and ask different kinds of questions. Identifying and facing new challenges and opportunities leads them to more effectively process new information and more efficiently expand their knowledge. In summary, inquiring primarily consists of:

- identifying, exploring and clarifying questions and issues
- gathering, organising and processing information
- transferring knowledge into new contexts.

Generating innovative ideas and possibilities

This element involves students in the investigation, organisation and evaluation of ideas through considering alternatives and seeking innovative solutions. Students generate and develop ideas and possibilities through engagement in challenging activities.

Learning to plan and manage thinking aids the development of intellectual flexibility and leads to the consolidation of learning. In summary, generating primarily consists of:

- imagining possibilities and considering alternatives
- seeking and creating innovative pathways and solutions
- suspending judgment to visualise possibilities.

Reflecting on thinking, actions and processes

This element involves students in suspending judgment and reflecting on thinking processes (metacognition), procedures and products to create alternatives or open up possibilities. Through using these thinking skills, processes and dispositions, students gain an understanding of how to best achieve outcomes. They practise the categorisation and linking of ideas in innovative ways. In summary, reflecting primarily consists of:

- reflecting on thinking (metacognition)
- reflecting on procedures and products.

Analysing, synthesising and evaluating information

This element involves students in analysing, synthesising and applying logic, and reflecting on how to best tackle issues, tasks and challenges. Students assess and select from a range of thinking strategies to evaluate ideas and information and draw conclusions. Finding new contexts to employ these conclusions selectively, and synthesising their knowledge, assists in the design of a course of action. In summary, analysing primarily consists of:

- applying logical and inventive reasoning
- drawing conclusions and designing a course of action.

Critical and creative thinking continuum across stages of schooling

Inquiring – identifying, exploring and clarifying information

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Identifying, exploring and clarifying questions and issues		
pose questions to explore issues in their own world (for example asking why certain actions and events occurred)	pose questions that identify and describe issues beyond their immediate world (for example questioning conventional responses to local and world events, asking who, when and why)	pose questions that probe complex and abstract ideas about societal issues (for example developing and modifying questions to inform an inquiry, uncover complexity or provoke argument)
identify main ideas and clarify meaning in information (for example examining themes in texts or images)	prioritise ideas and select information to form a considered and/or creative response to an issue (for example giving reasons for preferring a photo or a memory to recall an occasion)	explore the coherence and logic of multiple perspectives on an issue (for example exploring contrasting positions such as in an environmental issue)
Gathering, organising and processing information		
organise information based on similar ideas from given sources (for example finding examples of kindness in several resources)	identify and categorise information from multiple sources (for example establishing issues of a similar nature in literature and film)	pose questions to test possibilities and examine independently sourced data for bias and reliability (for example critiquing a range of sources to establish ways of verifying reliability)
compare and contrast points identified within information	sequence, paraphrase, elaborate or condense information from a range of sources	process complementary and contradictory information from primary and secondary sources
Transferring knowledge into new contexts		
use relevant information from a previous experience to inform a new experience (for example recalling the reasons previously given and applying them in new situations)	apply knowledge gained from one context to another unrelated context and apply new meaning (for example considering the meaning of change as it is used in science compared with its meaning in history)	construct systematic plans to transfer ideas and trends between different scenarios (for example looking for patterns and integrating various topics into one problem)

Generating innovative ideas and possibilities

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Imagining possibilities and considering alternatives		
create new ideas by linking what they know in imaginative and original ways (for example considering whether it is possible for a person to be taller and shorter than you at the same time)	create analogies by matching two ideas in context (for example using unusual or unexpected combinations of ideas to create new possibilities)	draw parallels between known and new scenarios, and use ideas, patterns and trends to consider new possibilities (for example developing hypotheses based on known models and theories)
explain or demonstrate ideas in a variety of ways to help others' understanding	use a range of visualisation strategies to challenge and investigate possibilities (for example diagrams, mindmapping)	represent explanations and ideas by using imagery and symbolism to communicate creative ideas to others
Seeking and creating innovative pathways and solutions		
think imaginatively – asking 'What if ...?' to generate unusual responses to a problem (for example What if a person understood the language spoken by everyone?)	recognise there are multiple choices for solving a problem and imagine outcomes of these possibilities (for example generating and building on varied possible solutions to a problem that affects their lives)	predict possibilities and envisage consequences when seeking new meanings (for example pursuing an unexpected result or several solutions in an inquiry)
look for new patterns and connections within information in familiar situations (for example mapping connections between events in texts)	engage in challenging situations, and persist with generating new approaches when initial ideas do not work (for example persisting with an idea when conducting an investigation and seeing 'failures' as challenging)	speculate on possible options and outcomes, and modify responses to concrete and abstract ideas (for example developing ideas for further investigation based on past experiences)
Suspending judgment to visualise possibilities		
consider alternative actions to given situations (for example exploring problems identified in learning areas and ways of overcoming them)	set their judgments to one side to consider alternative ideas and actions (for example taking risks when exploring ideas, concepts and knowledge)	temporarily suspend rational thinking to allow new possibilities to emerge (for example expressing, in other forms, ideas or concepts that cannot be expressed in words)

Reflecting on thinking, actions and processes

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Reflecting on thinking		
with support, identify and describe thinking and learning strategies they have used(for example deciding the best strategy for solving a problem)	independently reflect on their thinking, consider reasonable criticism and adjust thinking if necessary(for example identifying where methods of investigation and inquiry could be improved)	give reasons to support their own thinking, show awareness of opposing viewpoints and possible weaknesses in their own positions (for example comparing justifications for approaching problems in certain ways)
describe their thinking in terms of personal feelings and concerns	form personal theories, paraphrase and construct analogies or similes to explain their thinking	set personal goals for further development of critical and creative thinking
Reflecting on procedures and products		
reflect on whether they have accomplished what they set out to do (for example Did they listen well to a peer's answer?)	explain and justify actions and solutions against identified criteria (for example examining their own and peer responses to an issue)	evaluate the effectiveness of possible solutions and implement improvement to achieve desired outcomes (for example evaluating the strength of a conclusion, identifying alternative solutions consistent with evidence)

Analysing, synthesising and evaluating information

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Applying logical and inventive reasoning		
consider and choose information that is relevant to understanding given situations or issues (for example distinguishing between what is 'real' and what is imagined in texts)	identify gaps in knowledge and missing elements in information, seek further information to make improvements and use evidence to test propositions (for example assessing whether there is enough evidence to make a particular claim)	analyse the means and resources available for finding solutions (for example testing propositions to identify reliability of data and faulty reasoning)
identify the details of a whole task and separate it into workable parts (for example sorting information in graphs and graphic organisers)	choose pertinent information from a range of sources and separate this information into smaller parts or ideas (for example examining sources of evidence to identify similarities and differences)	balance rational and irrational components of a complex or ambiguous problem to evaluate evidence (for example exploring attitudes to changing patterns of social groupings)
Drawing conclusions and designing a course of action		
recognise a problem and explore possible pathways for reaching a conclusion	draw on prior knowledge and evidence to formulate solutions to a problem	identify a problem, isolate its important aspects, and use logical and abstract thinking to formulate a response
consider alternative courses of action when presented with new information (for example asking how an outcome would change if a character acted differently)	use concrete, pictorial and digital models to check reasoning and modify actions accordingly (for example using graphs, charts, visuals to chart progress of an action/argument and propose alternatives)	analyse and synthesise complex information to draw conclusions and inform a course of action (for example using primary or secondary evidence to support or refute a conclusion)

Personal and social capability

Introduction

In the Australian Curriculum, students develop personal and social capability as they learn to understand themselves and others, and manage their relationships, lives, work and learning more effectively. The capability involves students in a range of practices including recognising and regulating emotions, developing empathy for and understanding of others, establishing positive relationships, making responsible decisions, working effectively in teams and handling challenging situations constructively.

The *Melbourne Declaration on the Educational Goals for Young Australians* (MCEETYA 2008) recognises that personal and social capability assists students to become successful learners, helping to improve their academic learning and enhancing their motivation to reach their full potential. Personal and social capability supports students in becoming creative and confident individuals with 'a sense of self-worth, self-awareness and personal identity that enables them to manage their emotional, mental, spiritual and physical wellbeing', with a sense of hope and 'optimism about their lives and the future'. On a social level, it helps students to 'form and maintain healthy relationships' and prepares them 'for their potential life roles as family, community and workforce members' (MCEETYA, p. 9).

Students with well-developed social and emotional skills find it easier to manage themselves, relate to others, develop resilience and a sense of self-worth, resolve conflict, engage in teamwork and feel positive about themselves and the world around them. The development of personal and social capability is a foundation for learning and for citizenship.

Scope of Personal and social capability

Personal and social capability encompasses students' personal/emotional and social/relational dispositions, intelligences, sensibilities and learning. It develops effective life skills for students, including understanding and handling themselves, their relationships, learning and work. Although it is named 'Personal and social capability', the words 'personal/emotional' and 'social/relational' are used interchangeably throughout the literature and within educational organisations. The term 'Social and Emotional Learning' is also often used, as is the SEL acronym.

When students develop their skills in any one of these elements, it leads to greater overall personal and social capability, and also enhances their skills in the other elements. In particular, the more students learn about their own emotions, values, strengths and capacities, the more they are able to manage their own emotions and behaviours, and to understand others and establish and maintain positive relationships.

For a description of the organising elements for Personal and social capability, go to Organising elements.

Personal and social capability across the curriculum

Personal and social capability skills are addressed in all learning areas and at every stage of a student's schooling. However, some of the skills and practices implicit in the development of the capability may be most explicitly addressed in specific learning areas, such as Health and Physical Education.

The Personal and social capability is addressed through the learning areas and is identified wherever it is developed or applied in content descriptions. It is also identified where it offers opportunities to add depth and richness to student learning in content elaborations. An icon indicates where Personal and social capability has been identified in learning area content descriptions and elaborations. A filter function on the Australian Curriculum website assists users to identify F–10 curriculum content where Personal and social capability has been identified. Teachers may find further opportunities to incorporate explicit teaching of Personal and social capability depending on their choice of activities. Students can also be encouraged to develop capability through personally relevant initiatives of their own design.

- Personal and social capability in English (http://www.australiancurriculum.edu.au/English/General-capabilities#Critical-and-creative-thinking)
- Personal and social capability in Mathematics (http://www.australiancurriculum.edu.au/Mathematics/General-capabilities#Critical-and-creative-thinking)
- Personal and social capability in Science (http://www.australiancurriculum.edu.au/Science/General-capabilities#Critical-and-creative-thinking)
- Personal and social capability in History (http://www.australiancurriculum.edu.au/History/General-capabilities#Critical-and-creative-thinking)

Background

This background summarises the evidence base from which the Personal and social capability's introduction, organising elements and learning continuum have been developed. It draws on recent international and national research, as well as initiatives and programs that focus on personal and social capability across the curriculum.

The domain of personal and social learning is not new, despite changes to nomenclature, definitions and understandings over the past century. In 1920, Thorndike identified 'social intelligence' as an important facet of intelligence. Since then, many researchers and educators, including Moss and Hunt (1927), Vernon (1933), Wechsler (1940), Gardner (1983), Salovey and Mayer (1990), Seligman (1998) and Goleman (1995, 1998, 2006), have explored this concept, each contributing to current understandings of this domain. Importantly, recent contributors have emphasised the ability to develop and improve personal and social capability both as adults and as children.

Two contributors have been particularly significant to recent developments in personal and social learning as a competence or capability in school education. Gardner's (1983) *Frames of Mind: the theory of multiple intelligences* broadened notions of intelligence, introducing and popularising the concepts of intrapersonal and interpersonal intelligence, which represented two of his eight intelligences. More recently, Goleman further popularised the concepts of emotional intelligence (1995) and social intelligence (2006) in educational discourse.

In 1994, Goleman and others founded the Collaborative for Academic, Social, and Emotional Learning (CASEL) at the University of Illinois Chicago (UIC). Since then, CASEL has been the world's leading organisation in advancing understandings, research, networks, curriculum, school practice and public policy in the area of personal and social learning.

CASEL's evidence-based approach and definitions of Social and Emotional Learning (SEL) are the best known and most highly respected in the world today, and provide an excellent framework for integrating the academic, emotional and social dimensions of learning.

Most educational programs around the world that integrate social and emotional learning are based on CASEL's SEL framework. This framework is also drawn upon and referenced by various personal, interpersonal and social curricula in Australian states and territories, and by programs such as *MindMatter*s, *KidsMatter* and *Response Ability*.

While some differences emerge within the literature about how personal and emotional learning should be named, constructed and taught, and different organisations also include some additional categories, it is widely accepted that a Personal and social capability will always include a minimum foundation of the four interrelated and non-sequential organising elements – *Self-awareness*, *Self-management*, *Social awareness* and *Social management* – used in the Personal and social capability learning continuum.

The capability has also been richly informed by understandings gained through the *National Framework for Values Education in Australian Schools* (DEEWR 2005), and the resultant Values education initiatives in all areas of Australian schooling. In addition, the *Melbourne Declaration on Goals for Young Australians* (MCEETYA, p. 5) states that 'a school's legacy to young people should include national values of democracy, equity and justice, and personal values and attributes such as honesty, resilience and respect for others'. While Values education is certainly found in the Personal and social capability, it is also located within other general capabilities, such as Ethical behaviour.

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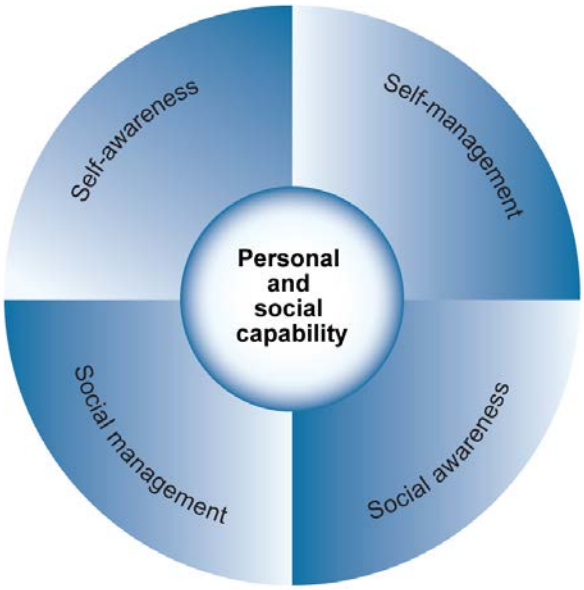
Organising elements

The Personal and social capability learning continuum is organised into four interrelated elements of:

- Self-awareness
- Self-management
- Social awareness
- Social management.

The diagram below sets out these elements.



Organising elements for Personal and social capability

Self-awareness

This element involves students in recognising, understanding and labelling their own emotions, values, strengths and capacities. It involves students in knowing what they are feeling in the moment, having a realistic assessment of their own abilities and a well-grounded sense of self-worth and self-confidence. Self-awareness also involves reflecting on and evaluating one's learning, identifying personal characteristics that contribute to or limit effectiveness, learning from successes or failures, and being able to interpret one's own emotional states, needs and perspectives. In summary, Self-awareness primarily consists of:

- recognition of emotions
- self-knowledge
- self-perception
- self-worth
- reflective practice.

Self-management

This element involves students in effectively managing and regulating their own emotions and behaviour, and persisting in completing tasks and overcoming personal obstacles. It includes learning self-discipline and self-control, and setting personal and academic goals. This is achieved through learning to be conscientious, delaying gratification and persevering in the face of setbacks and frustrations. Self-management also involves managing and monitoring one's own learning, taking responsibility for one's behaviour and performance, increasing personal motivation and planning, and undertaking work independently. It also involves the metacognitive skill of learning when and how to use particular strategies. In summary, Self-management primarily consists of:

- appropriate expression of emotions
- self-discipline
- goal setting and tracking
- working independently and showing initiative
- confidence, resilience and adaptability.

Social awareness

This element involves students in perceiving and understanding other people's emotions and viewpoints, and showing understanding and empathy for others. It includes appreciating and understanding what others are feeling, being able to consider their perspective and interacting positively with diverse groups of people. Social awareness involves being able to interpret and understand others' perspectives, emotional states and needs, which results in inclusive interactions and respect for individual and group differences. It also involves identifying the strengths of team members and defining and accepting individual and group roles and responsibilities. Ideally, this will result in a desire to advocate for and be of service to others, and to respect the principles of inclusivity, equality and social justice. Students will also gain an understanding of the diversity and rich cultural dimensions of contemporary Australia and the capacity to critique societal constructs and forms of discrimination, such as racism and sexism. In summary, Social awareness primarily consists of:

- empathy
- appreciating diverse perspectives
- contributing to civil society, advocacy for and service to others
- understanding relationships.

Social management

This element involves students in forming strong and healthy relationships, and managing and positively influencing the emotions and moods of others. It includes learning how to cooperate, negotiate and communicate effectively with others, work in teams, make decisions, resolve conflict and resist inappropriate social pressure. It also involves the ability to initiate and manage successful personal relationships, and participate in a range of social and communal activities. Social management involves building skills associated with leadership, such as working in harmony with others and with shared purposes. In summary, Social management primarily consists of:

- communication
- working collaboratively
- decision making
- conflict resolution and negotiation
- building and maintaining relationships
- leadership.

Personal and social capability continuum across stages of schooling

Self-awareness

Recognising emotions		
By the end of Year 2 students:	**By the end of Year 6 students:**	**By the end of Year 10 students:**
identify and name their emotions, and the impact emotions have on their lives (for example identifying specific emotions in responding to particular stories)	describe and understand their emotional responses in various situations, including how emotions are linked to behaviour and learning (for example making connections between texts and their own experiences)	demonstrate deepening understandings of their emotional responses in a range of learning and social situations (for example identifying and articulating their challenges and strengths in individual and collaborative learning situations)
Self-knowledge		
discover personal strengths and challenges, and describe their abilities, likes and dislikes (for example understanding that language can be used to explore ways of expressing needs, likes and dislikes)	describe and assess personal strengths and challenges, learning from success and failure (for example keeping a journal of their learning, describing both positive and negative experiences)	apply knowledge of their strengths and abilities as learners to other aspects of their lives (for example applying learning from scientific inquiry, such as forming and testing a hypothesis to other contexts)
Self-perception		
discover who they are and where they fit into their family, class and peer groups (for example using their senses to make observations and explore the world around them)	recognise a range of external influences that may impact on their sense of identity (for example using historical inquiry to examine factors that lead to a sense of identity for people in other cultures, and for themselves)	demonstrate deepening understandings of their personal identity, including its effects on their self-esteem, self-confidence, health, wellbeing, learning and relationships (for example creating literacy texts that reflect an emerging sense of personal style)
Self-worth		
recognise and celebrate what they have done well, and acknowledge and learn from their mistakes (for example sharing a personal experience, interest or discovery with peers, and verbalising what they have learnt from this experience)	demonstrate awareness of personal habits and behaviour, and factors influencing their successes and mistakes (for example setting learning and study goals that take into account their challenges and build on their strengths)	describe, clarify, value and reflect on the range of their own opinions, beliefs, values, questions, choices and emotional responses (for example reflecting on personal understanding of the world drawn from texts they have read, and creating texts that represent personal belief systems)
Reflective practice		
reflect on and discover more about themselves – their strengths, challenges and interests (for example reporting to class through 'show and tell' opportunities to identify and describe their interests)	reflect on and apply learning to their everyday lives to consolidate strengths and address challenges (for example when working in small groups, build on their strengths in various roles, and setting goals to develop specific skills)	reflect on and make realistic assessments of their abilities, identifying characteristics that contribute to or limit their effectiveness as learners, friends and community members (for example developing personal learning plans that take account of their strengths and challenges)

Self-management

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Appropriate expression of emotions		
understand and begin to demonstrate appropriate expression and management of their emotions (for example using voice level and facial expressions appropriate to different situations)	draw and understand complex connections between their emotions and their behaviour, as they relate to learning and relationships (for example understanding uses of subjective and objective language, including when it is appropriate to share feelings)	express and manage their opinions, beliefs, values, questions, choices and emotional responses (for example choosing appropriate language and voice to convey personal responses and opinions to a range of audiences)
Self-discipline		
show self-discipline in their learning, recognising the need to complete tasks within a given time (for example organising their time using calendars and clocks)	show self-discipline in organising their learning (for example identifying and using strategies to manage time and resources effectively)	manage and check their behaviours and performance in learning activities, applying learning from school to their personal lives (for example using spreadsheets and other organisers to plan and arrange activities at school and study outside school)
Goal setting and tracking		
set goals to assist their learning and personal organisation, demonstrating care for personal property and shared materials	set and keep track of personal and academic goals	set, keep track of and are accountable for goals related to self-management, self-regulation and stress management
Working independently and showing initiative		
begin to work independently, showing initiative and recognising when to ask for help and support	recognise the value of working independently, taking initiative to do so where appropriate	are accountable for their own learning, working independently, and setting and monitoring personal goals
Confidence, resilience and adaptability		
build confidence and resilience, being willing to undertake and persist with short tasks, and acknowledging successes	demonstrate confidence in themselves, showing persistence and adaptability in completing challenging tasks	demonstrate motivation, confidence and commitment when faced with new or difficult situations, and acknowledging progress and accomplishments

Social awareness

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
Empathy		
interpret and anticipate the emotional states of others based on their words, facial expressions and body language (for example comparing their own and others' responses to stories, images and historical artefacts, and sharing this with peers)	use listening and observational skills to identify and empathise with the feelings and perspectives of others in a range of situations (for example using historical data to imagine the experiences of people, dislocated by war, on their arrival and settlement in Australia)	identify increasingly complex verbal, physical and situational cues to interpret and empathise with the emotional states, needs and perspectives of others (for example understanding that language can be used to include or exclude people)
Appreciating diverse perspectives		
describe commonalities and differences between themselves and people in their communities, recognising that people hold many viewpoints (for example comparing changes in daily lives over time and in different places, describing what they would like their grandchildren to know about their lives)	recognise that social cues and means of communication may differ within and between various communities, explaining a point of view that is different from their own (for example identifying the ways that language is used in a range of social settings, identifying points of view in the past and present)	understand that social and cultural groups are represented in a range of ways by their own members and by others, evaluating two differing points of view (for example recognising how language can be used to position listeners in particular ways, analysing different accounts of the same event)
Contributing to civil society, advocacy for and service to others		
identify and carry out ways of contributing to their homes, classrooms and communities, and recognise how others help them (for example identifying where and how people use science in their daily lives, describing contributions made by significant individuals to their communities in the past)	explain and act on personal roles and responsibilities in their homes, schools and communities (for example considering how personal and community choices influence the use of sustainable sources of energy)	plan, implement and evaluate ways of contributing to their communities (for example assessing personal and social roles and responsibilities and ways of contributing to a more just society)
Understanding relationships		
value relationships and friendships, recognising how words and actions can help or hurt others, and recognise the effects of modifying their behaviour (for example discussing the effects of characters' words and actions on others in texts)	identify the differences between positive and negative relationships and ways of managing these(for example using visual and linguistic cues to describe and interpret relationships between characters in texts)	explain how relationships differ between peers, parents, teachers and other adults, and identify the skills needed to manage different types of relationships (for example identifying the various communities to which they belong and how language reinforces membership of these communities)

Social management

By the end of Year 2 students	By the end of Year 6 students:	By the end of Year 10 students:
Communication		
use verbal and nonverbal communication skills, such as listening when others speak, waiting their turn and knowing when to respond (for example using spoken language and body language to share observations and ideas)	build verbal and nonverbal communication skills, such as attentive and reflective listening, participation in class discussions, presentation of group reports (for example contributing to discussions and building on the ideas of others)	formulate and apply guidelines for effective communication (verbal, nonverbal, digital) to complete tasks of varying complexity (for example using agreed protocols to interrupt in group discussions, asserting their own viewpoint appropriately, showing willingness to entertain divergent views)
Working collaboratively		
work with partners and in small groups, using strategies such as taking turns, staying on task, sharing resources (for example participating in guided investigations as part of a group)	work in teams, encouraging others and recognising their contributions, negotiating roles and managing time and tasks (for example working collaboratively to suggest improvements in methods used for group investigations and projects)	develop strategies for working in diverse teams, drawing on the skills and contribution of team members to complete complex tasks (for example developing a plan for achieving group goals and criteria for evaluating success, considering the ideas of others in reaching an independent or shared decision)
Decision making		
practise group decision making with peers in situations such as class meetings and when working in pairs and small groups (for example negotiating and engaging in group rules such as taking turns, decision making)	identify and explain how factors such as feelings, social and cultural norms, and conflicting points of view influence individual and group decision making (for example discussing the influence of scientific knowledge on personal and community decisions)	develop and apply criteria to evaluate the consequences of individual and group decisions (for example using scientific, ethical, economic and social arguments to make decisions regarding personal and community issues)
Conflict resolution and negotiation		
clarify and practise solving simple interpersonal problems, recognising that there are many ways to solve conflicts (for example showing courtesy to others when voicing disagreement or an alternative point of view)	identify causes and effects of conflict, and use effective strategies to manage, resolve and negotiate these conflict situations (for example identifying issues that cause conflict and exploring how conflict has been resolved in a range of contexts)	generate, apply and evaluate strategies such as active listening, mediation and negotiation to prevent and resolve interpersonal problems and conflicts (for example using mediation skills to support people holding different views on a given topic and to respect one another's views)
Building and maintaining relationships		
build relationships with peers as they participate in and contribute to classroom and group activities (for example acknowledging the contribution of others in group tasks)	understand the difference between safe and risky behaviours in relationships (for example identifying risks in potentially dangerous situations and strategies for avoiding unsafe behaviours)	consolidate and evaluate skills used for communication and effective relationships with peers, teachers and families (for example differentiating between passive, assertive and aggressive responses)
Leadership		
show a sense of responsibility and sensitivity to others and become skilled in treating others fairly	initiate or help to organise classroom and group activities, identifying and addressing a common need	propose, implement and monitor strategies to address needs prioritised in classrooms, schools and communities

Ethical behaviour

Introduction

In the Australian Curriculum, students develop capability in learning to behave ethically as they identify and investigate the nature of ethical concepts, values, character traits and principles, and understand how reasoning can assist ethical judgment. Ethical behaviour involves students in building a strong personal and socially oriented ethical outlook that helps them to manage context, conflict and uncertainty, and to develop an awareness of the influence that their values and behaviour have on others.

The *Melbourne Declaration on Education Goals for Young Australians* (MCEETYA 2008) recognises that ethical behaviour assists students to become 'confident and creative individuals and active and informed citizens'. It does this through fostering the development of 'personal values and attributes such as honesty, resilience, empathy and respect for others', and the capacity to act with ethical integrity (MCEETYA, pp. 8–9).

As cultural, social, environmental and technological changes transform the world, the demands placed on learners and education systems are changing. Technologies bring local and distant communities into classrooms, exposing students to knowledge and global concerns as never before. Complex issues require responses that take account of ethical considerations such as human rights and responsibilities, animal rights, environmental issues and global justice.

Building capability in learning to behave ethically throughout all stages of schooling will assist students to engage with the more complex issues that they are likely to encounter in the future and to navigate a world of competing values, rights, interests and norms.

Scope of Ethical behaviour

Students learn to behave ethically as they explore ethical issues and interactions with others, discuss ideas, and learn to be accountable as members of a democratic community.

In this context, students need regular opportunities to identify and make sense of the ethical dimensions in their learning. As ethics is largely concerned with what we ought to do and how we ought to live, students need to understand how people can inquire collaboratively and come to ethical decisions. They need the skills to explore areas of contention, select and justify an ethical position, and engage with and understand the experiences and positions of others. These skills promote students' confidence as decision-makers and foster their ability to act with regard for others. Skills are enhanced when students have opportunities to put them into practice in their learning – for example, understanding the importance of applying appropriate ethical practices in areas such as Australian Indigenous studies (AIATSIS 2011).

Students also need to be introduced to agreed values and ethical principles – such as human rights, values and principles – to assist them in justifying their ethical position and in engaging with the position of others.

The processes of reflecting on and interrogating core ethical issues and concepts underlie all areas of the curriculum. These concepts include justice, right and wrong, freedom, truth, identity, empathy, goodness and abuse.

Processes of inquiring into ethical issues include giving reasons, being consistent, finding meanings and causes, and providing proof and evidence. Interrogating such concepts through authentic cases such as global warming, sustainable living and socioeconomic disparity can involve group and independent inquiry, critical and creative thinking, and cooperative teamwork, and can contribute to personal and social learning.

As students engage with these elements in an integrated way, they learn to recognise the complexity of many ethical issues. They develop a capacity to make reasoned ethical judgments through the investigation of a range of questions drawn from varied contexts in the curriculum.

For a description of the organising elements for Ethical behaviour, go to Organising elements.

Ethical behaviour across the curriculum

Ethical issues arise across all areas of the curriculum, with each learning area containing a range of content that demands consideration from an ethical perspective. This includes analysing and evaluating the ethics of the actions and motivations of individuals and groups, understanding the ethical dimensions of research and information, debating ethical dilemmas and applying ethics in a range of situations.

The Ethical behaviour capability is addressed through the learning areas and is identified wherever it is developed or applied in content descriptions. It is also identified where it offers opportunities to add depth and richness to student learning in content elaborations. An icon indicates where the Ethical behaviour capability has been identified in learning area content descriptions and elaborations. A filter function on the Australian Curriculum website assists users to identify F–10 curriculum content where Ethical behaviour capability has been identified. Teachers may find further opportunities to incorporate explicit teaching of Ethical behaviour capability depending on their choice of activities. Students can also be encouraged to develop capability through personally relevant initiatives of their own design.

- Ethical behaviour in English (http://www.australiancurriculum.edu.au/English/General-capabilities)
- *Ethical b*ehaviour in Mathematics (http://www.australiancurriculum.edu.au/Mathematics/General-capabilities)
- Ethical behaviour in Science (http://www.australiancurriculum.edu.au/Science/General-capabilities)
- Ethical behaviour in History (http://www.australiancurriculum.edu.au/History/General-capabilities)

Background

This background summarises the evidence base from which the Ethical behaviour capability's introduction, organising elements and continuum have been developed. It draws on recent international and national research, as well as initiatives and programs that focus on ethical behaviour across the curriculum.

Ethical behaviour can be informed by reason, character, values and ethical principles. Each of these is addressed in the Ethical behaviour learning continuum.

People call on principles, concepts, experiences, senses, emotions and reasoning to guide them when making judgments. Therefore, it is important that students are exposed to situations that develop both their awareness of meanings and their practical reasoning abilities associated with their thoughts and actions.

Ethical theories can be divided broadly into those that focus on action and those that focus on agency or character; both are concerned with the 'good life' and how concepts such as fairness and justice can inform our thinking about the world. These considerations can lead to students' developing a broad understanding of values and ethical principles as they mature.

Although they have their supporters and critics, interrogation of frameworks such as Kohlberg's stages of moral development (1964, in Crain 1985), Ruggiero's encouragement to apply ethical issues (1997), and the Values for Australian Schooling (in National Framework for Values Education in Australian Schools 2005), guides thinking about the dimensions of learning about ethical behaviour and how it might be developed or encouraged throughout schooling.

The Australian educational philosophers Burgh, Field and Freakley (2006) describe ethics as pertaining to the character of persons and the wider society. Lipman, Sharp and Oscanyan (1980) state that ethical inquiry should be 'an open-ended, sustained consideration of the values, standards and practices by which we live … taking place in an atmosphere of mutual trust, confidence and impartiality' (p.189).

One area of study in ethics is human nature itself and how that may equip us to answer the question: 'How ought I to live?' The classical philosophers Plato, Aristotle and Aquinas, along with Kant during the Enlightenment, and more recently modern philosophers such as Peter Singer (1997), identified the importance of reason as a human attribute – although their justification varied. Developing a capacity to be reasonable is one of the three elements of the Ethical behaviour learning continuum. Other dimensions in the exploration of human nature are perceptions of activities, virtues and character: 'What kind of person should I be?' For some philosophers, this replaces the question of 'How ought I to live?'

Although the basis of justification of what is right or good for the individual and for others is contentious, it is misleading to confuse disagreements in ethics with there being no right or wrong answer. There may be different positions, each with their strengths and weaknesses, and often there is the need to make a judgment in the face of competing claims. At the same time there is need for an open-minded, ongoing endeavour to create an ethical life.

The Ethical behaviour capability has also been richly informed by understandings gained through the *National Framework for Values Education in Australian Schools* (2005), and the resultant Values education initiatives in all areas of Australian schooling. In addition, the *Melbourne Declaration on Goals for Young Australians* (MCEETYA, p. 5) states that 'a school's legacy to young people should include national values of democracy, equity and justice, and personal values and attributes such as honesty, resilience and respect for others'. While Values education is certainly found within the Ethical behaviour capability, it is also located within other general capabilities, such as Personal and social capability.

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Organising elements

The Ethical behaviour learning continuum is organised into three interrelated organising elements:

- Understanding ethical concepts and issues
- Reflecting on personal ethics in experiences and decision making
- Exploring values, rights and ethical principles.

The diagram below sets out these elements:

Organising elements for Ethical behaviour

Understanding ethical concepts and issues

This element involves students in identifying, clarifying and exploring ethical concepts such as fairness, honesty and respect for others, and the different emphases placed on these values historically and culturally. As ethics is largely concerned with what we ought to do and how we ought to live, students need to explore areas of contention in order to understand how they can inquire collaboratively in order to come to ethical decisions. This is especially important for democratic societies that have a plurality of values and different beliefs about living an ethical life. Ethical judgment requires the ability to understand ethical concepts and issues.

Reflecting on personal ethics in experiences and decision making

This element involves students in reflection on character traits such as honesty, integrity, compassion and empathy, and shared values. Students explore questions that involve engaging with the meaning of specific traits and characteristics, and investigating the role of feelings, conscience and self-interest to promote understanding of ethical concerns and dilemmas.

Interacting with others, considering the place of experiences and authority in decision making and engaging critically with ethical dilemmas are ways that students can investigate ideas and account for their views and actions. This enriches their ethical maturity and their understandings of the benefits of a democratic society and participation in civic life. They become aware of the strengths and weaknesses of their own emotional responses, arguments and viewpoints.

Exploring values, rights and ethical principles

This element involves students in the exploration of values, beliefs and principles often used as the basis for making ethical judgments and acting responsibly and with integrity. Students identify values and rights promoted by groups such as peers, communities, corporations, cultural groups and governments through an exploration of ethical issues, the notion of the common good, the place of national values and human rights and universally accepted principles and values.

They examine the ways that values and principles such as freedom, honesty and equality are commonly used in ethical discourse but may be inconsistently applied. Exploring values and principles through authentic situations enables students to make connections with their own surroundings and to understand their impact, especially when values conflict.

Ethical behaviour continuum across stages of schooling

Understanding ethical concepts and issues

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
use examples to explain concepts such as right and wrong, good and bad, true and false (for example the difference between making a mistake and telling a lie)	explain the ethical concepts associated with achieving a particular outcome (for example considering the importance of 'intention and effect' in different ethical frameworks such as equality of results)	use contexts from learning areas to critique generalised statements about ethical concepts such as justice and concerns such as freedom of speech(for example denial of freedom of speech and defamation of others in the context of denying historical events)
identify and express their view on ethical issues within a range of familiar contexts (for example in scenarios involving fairness, honesty, and care for other people, animals and the environment)	explain what constitutes an ethically better or worse outcome to an issue and how particular outcomes might be accomplished (for example exploring the consequences for individuals of others' actions, in a range of scenarios)	identify ethical obligations and justify the need for these to be enacted (for example the implications of being a bystander in the context of bullying and cyberbullying)
recognise ethical and unethical behaviours in everyday settings (for example sharing, and bullying in friendship groups)	make relative judgments about ethical and unethical behaviours in a range of settings and contexts (for example analysing the ways that images and words are used for deliberate effect in advertisements)	distinguish between ethical and unethical dimensions of situations in complex settings found in literary, scientific and historical contexts (for example considering ethical or unethical behaviours of companies, governments and local farmers when patenting produce)

Reflecting on personal ethics in experiences and decision making

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
identify the role of conscience and self-interest when interacting with others (for example recognising when acting with self-interest clashes with the interests of others)	apply and test their understanding of ethical concepts such as honesty, fairness and respect in different social contexts (for example the role of human rights and values when considering equal treatment of others)	engage in reasoned debate to probe ethical concepts in issues of personal, social and global importance (for example ethical considerations associated with the treatment of refugees in the context of global socioeconomic disparity)
describe how personal feelings and values influence how people behave (for example keeping promises, being honest)	test their feelings about and perceptions of ethical and non-ethical behaviours in familiar and hypothetical scenarios (for example What if the rules of a game exclude a student with a disability or a language barrier?)	analyse the objectivity or subjectivity of ethical principles, particularly where there is more than one issue under consideration (for example exploring the complexities associated with issues such as land or water management)
recognise that there are many factors influencing individuals' decisions (for example wants, needs, feelings and experiences)	demonstrate awareness of a range of thinking strategies in ethical decision making (for example considering alternative perceptions and points of view, distinguishing relative merits of several options)	evaluate diverse perceptions, reasoning and ethical basis for decisions in complex settings (for example considering the circumstances in which it might be justifiable to restrict or limit the right to liberty or allow freedom from arbitrary arrest)

Exploring values, rights and ethical principles

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
identify some values and ethical principles agreed in family and school contexts (for example everyone's right to participate and express their opinion)	describe values and ethical principles agreed in local communities (for example instances where equality, respect, fairness, dignity and non-discrimination occur)	explain the role of values and ethical principles in national and international forums and debates (for example debates around medical research in the context of socioeconomic disparity between developed and developing countries)
appreciate the role of rules in classroom, school and family contexts (for example rules against bullying in school that help establish principles of respect and equality)	explain the roles that rules play in different communities (for example identifying examples of rules in their own and other communities, suggesting reasons for their creation)	critically analyse the role of law in democratic and pluralist societies (for example positive role of law in enforcing ethical behaviour such as respectful relationships in the public and private domain)
identify and demonstrate respect for the rights of their classmates (for example identifying times they felt hurt by another's behaviour and reflecting on the values of mutual respect, equality and inclusion)	ensure consistency between their words and actions associated with rights when interacting in face-to-face and virtual situations (for example role and responsibility of bystanders in bullying and cyberbullying)	apply their understanding of rights and associated duties and obligations to a range of personal and social situations – including the use of digital technologies(for example problematising freedom of speech in the context of internet censorship, such as websites inciting racial hatred)
recognise that there may be many points of view about ethical issues (for example recognising that individuals may have different views on caring for animals)	identify and explain different possibilities and points of view when thinking about ethical issues (for example diversity and socioeconomic disparity between groups of people in Australia)	use reasoning skills to consider the relative merits of different perspectives on ethical issues (for example the importance of 'intention and effect' in the context of equality of opportunity and of results)
explore the relevance of a range of values and principles in solving ethical problems and dilemmas (for example the need for honesty, fairness, respect and equality when working with others)	recognise that using values and principles to resolve ethical problems and dilemmas is rarely simple (for example modifying games to be inclusive, applying ethical principles to reach fair and respectful solutions)	analyse the interplay between ethical and other considerations in making decisions/policies (for example the ethical complexity of mandatory detention of refugees and 'intervention' programs)

Intercultural understanding

Introduction

In the Australian Curriculum, students develop intercultural understanding as they learn to value their own cultures, languages and beliefs, and those of others. They come to understand how personal, group and national identities are shaped, and the variable and changing nature of culture. The capability involves students in learning about and engaging with diverse cultures in ways that recognise commonalities and differences, create connections with others and cultivate mutual respect.

Intercultural understanding is an essential part of living with others in the diverse world of the twenty-first century. It assists young people to become responsible local and global citizens, equipped through their education for living and working together in an interconnected world.

The *Melbourne Declaration on Educational Goals for Young Australians* (MCEETYA 2008) recognises the fundamental role that education plays in building a society that is 'cohesive and culturally diverse, and that values Australia's Indigenous cultures' (MCEETYA, p. 4). Intercultural understanding addresses this role, developing students who are active and informed citizens with an appreciation of Australia's social, cultural, linguistic and religious diversity, and the ability to relate to and communicate across cultures at local, regional and global levels.

Scope of Intercultural understanding

Intercultural understanding combines personal, interpersonal and social knowledge and skills. It involves students in learning to value and view critically their own cultural perspectives and practices and those of others through their interactions with people, texts and contexts across the curriculum.

Intercultural understanding encourages students to make connections between their own worlds and the worlds of others, to build on shared interests and commonalities, and to negotiate or mediate difference. It develops students' abilities to communicate and empathise with others and to analyse intercultural experiences critically. It offers opportunities for them to consider their own beliefs and attitudes in a new light, and so gain insight into themselves and others.

Intercultural understanding stimulates students' interest in the lives of others. It cultivates values and dispositions such as curiosity, care, empathy, reciprocity, respect and responsibility, open-mindedness and critical awareness, and supports new and positive intercultural behaviours. Though all are significant in learning to live together, three dispositions – empathy, respect and responsibility – have been identified as critical to the development of intercultural understanding in the Australian Curriculum.

For a description of the organising elements for Intercultural understanding, go to Organising elements.

Intercultural understanding across the curriculum

Although the Intercultural understanding capability focuses primarily on the development of skills, behaviours and dispositions, it also draws on students' growing knowledge, understanding and critical awareness of their own and others' cultural perspectives and practices derived from learning area content.

Intercultural understanding is more apparent in some learning areas than others, being most evident in those aspects of learning concerned with people, their societies, relationships and interactions, and in conjunction with the cross-curriculum priorities for Aboriginal and Torres Strait Islander histories and cultures, Asia and Australia's engagement with Asia, and Sustainability.

Intercultural understanding is addressed through the learning areas and is identified wherever it is developed or applied in content descriptions. It is also identified where it offers opportunities to add depth and richness to student learning in content elaborations. An icon indicates where intercultural understanding has been identified in learning area content descriptions and elaborations. A filter function on the Australian Curriculum website assists users to identify F–10 curriculum content where intercultural understanding has been identified. Teachers may find further opportunities to incorporate explicit teaching of intercultural understanding depending on their choice of activities. Students can also be encouraged to develop capability through personally relevant initiatives of their own design.

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- Intercultural understanding in Mathematics (http://www.australiancurriculum.edu.au/Mathematics/General-capabilities)
- Intercultural understanding in Science (http://www.australiancurriculum.edu.au/Science/General-capabilities)
- Intercultural understanding in History (http://www.australiancurriculum.edu.au/History/General-capabilities)

Background

This background summarises the evidence base from which the Intercultural understanding capability's introduction, organising elements and learning continuum have been developed. It draws on recent international and national research, as well as initiatives and programs that focus on intercultural understanding across the curriculum.

Intercultural understanding is a relatively recent addition to Australian school curriculums. It has its origins in several fields including cultural studies (Hall 1997), language education (Kramsch 1998; Liddicoat, Lo Bianco and Crozet 1999), multicultural education (Banks and Banks 2004; Noble and Poynting 2000) and more broadly in sociology, linguistics and anthropology. Given its diverse origins, it is not surprising that the nature and place of intercultural learning are by no means settled and the definition of the term 'culture' is itself not agreed upon.

The Intercultural understanding capability adopts the *Shape of the Australian Curriculum: Languages* (ACARA 2011) definition of culture as involving:

> … a complex system of concepts, values, norms, beliefs and practices that are shared, created and contested by people who make up a cultural group and are passed on from

> generation to generation. Cultural systems include variable ways of seeing, interpreting and understanding the world. They are constructed and transmitted by members of the group through the processes of socialisation and representation. (p.16)

Drawing on this definition, Intercultural understanding focuses on sharing, creating and contesting different cultural perceptions and practices, and supports the development of a critical awareness of the processes of socialisation and representation that shape and maintain cultural differences.

Furthermore, in acknowledging the founding status of Aboriginal and Torres Strait Islander Peoples in Australia, it is alert to the place of negotiation and boundaries in engagements at the cultural interface (Nakata 2007) and mindful of practices that both celebrate and protect Aboriginal and Torres Strait Islander cultural heritage (Janke 2008). In recognising the importance for Australia of maintaining positive relations and communications in its region, it promotes recognition, communication and engagement with the different countries and cultures within Asia. It also supports the development of a strong vision for a sustained and peaceful global future.

Intercultural understanding assumes an integral connection between language and culture, acknowledging language as the primary means through which people establish and exchange shared meaning and ways of seeing the world (Scarino, Dellitt and Vale 2007). It works on the assumption that, in learning to live together in a world of social, cultural, linguistic and religious diversity, students need to look beyond their immediate worlds and concerns (Arigatou Foundation 2008) and engage with the experience and ideas of others (Appiah 2006) in order to understand the politics of culture on the world stage (Sleeter and Grant 2003).

Intercultural understanding identifies knowledge, skills, behaviours and dispositions that assist students in developing and acting with intercultural understanding at school and in their lives beyond school. At a personal level, intercultural understanding encourages students to engage with their own and others' cultures, building both their sense of belonging and their capacity to move between their own worlds and the worlds of others (Kalantzis and Cope 2005), recognising the attitudes and structures that shape their personal identities and narratives.

At an interpersonal level, it considers commonalities and differences between people, focusing on processes of interaction, dialogue and negotiation. It seeks to develop students' abilities to empathise with others, to analyse their experiences critically and to reflect on their learning as a means of better understanding themselves and people they perceive to be different from themselves (Liddicoat, Papademetre, Scarino and Kohler 2003; Wiggins and McTighe 2005). It provides opportunities for students to question the attitudes and assumptions of cultural groups in light of the consequences and outcomes for others.

At a social level, Intercultural understanding builds students' sense of the complex nature of their own histories, traditions and values, and of the history, traditions and values that underpin Australian society (MCEETYA 2008).

Students learn to interpret and mediate cultural inequalities within their own and other societies. They learn to take responsibility for their interactions with others, to act on what they have learnt and to become intercultural citizens in the world (Byram 2008).

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Organising elements

The Intercultural understanding learning continuum incorporates six interrelated organising elements.

Students develop intercultural understanding through:

- Recognising
- Interacting
- Reflecting
- Empathy
- Respect
- Responsibility.

The diagram below sets out these elements:

Organising elements for Intercultural understanding

Recognising

This element involves students in identifying, observing, analysing and describing increasingly sophisticated characteristics of their own cultural identities and those of others. These range from easily observed characteristics such as group memberships, traditions, customs and ways of doing things, to less readily observed characteristics such as values, attitudes, obligations, roles, religious beliefs and ways of thinking.

Students move beyond their known worlds to explore new ideas and experiences related to specific cultural groups through opportunities provided in the learning areas. They compare their own knowledge and experiences with those of others, learning to recognise commonalities, acknowledging differences between their lives and recognising the need to engage in critical reflection about such differences, seeking to understand them. In developing and acting with intercultural understanding students:

- identify and explain their own cultural beliefs, practices, values and traditions
- recognise that culture is dynamic and complex and that there is variability within all cultural, linguistic and religious groups

- compare the experiences of others with their own, looking for commonalities and differences between their lives and seeking to understand these
- recognise that people have many ways of knowing and being in the world

Interacting

This element gives an experiential dimension to intercultural learning in contexts that may be face-to-face, virtual or vicarious. It involves students in developing the skills to relate to and move between cultures through engagement with different cultural groups. Interacting includes developing critical insight into different viewpoints (perspective taking) and making sense of a culture for someone with limited experience of that culture (interpreting or mediating).

Through perspective taking, students think about familiar concepts in new ways, encouraging flexibility, adaptability and a willingness to try new cultural experiences. In developing and acting with intercultural understanding students:

- view aspects of their own language and culture from another cultural perspective
- view aspects of another language and culture from the perspectives of members of that cultural group
- recognise multiple views within a range of cultural contexts
- act positively in unfamiliar contexts.

Mediating and interpreting involves students learning to 'stand between' cultures – to explain their own cultural perspectives and practices and to understand the perspectives and practices of others. It enables students to engage critically with issues that may be controversial or require solutions. The ability to move between cultures empowers students to contribute to civic life. In developing and acting with intercultural understanding students:

- identify areas of misunderstanding and the cultural knowledge required to facilitate shared understanding
- mediate meaning with and between people who may not share the same world view, considering the importance of language in shaping how we see the world.

Reflecting

The capacity to process or reflect on the meaning of experience is an essential element in intercultural learning. Students use reflection to better understand the actions of individuals and groups in specific situations and how these are shaped by culture. They are encouraged to reflect on their own responses to intercultural encounters and to identify cultural influences that may have contributed to these. In developing and acting with intercultural understanding students:

- think critically to see their point of view as one of many
- consider how intercultural encounters have affected their thoughts, feelings and actions
- recognise how their actions, mediated by their own culture, have affected others
- recognise the influence of increased intercultural interaction on their personal identity and the nature of their communities.

Empathy

Empathy assists students to develop a sense of solidarity with others through imagining the perspectives and experiences of others as if they were their own. Empathy involves feeling for others, caring and imagining. Students are asked to consider what it might be like to 'walk in another's shoes'. In developing and acting with intercultural understanding students:

- imagine what their own feelings and responses might be in the situations of others
- seek to understand how others might feel
- consider the impact of their own behaviours on others.

Respect

Strong intercultural relationships are built on mutual respect between people, communities and countries. Respect is based on the recognition that every person is important and must be treated with dignity. It includes recognising and appreciating differences between people and respecting another person's point of view and their human rights. In developing and acting with intercultural understanding students:

- demonstrate respect for themselves and others whatever their cultural, linguistic or religious backgrounds
- understand and acknowledge the value of distinctive cultures within nations, including those of Aboriginal and Torres Strait Islander cultures in Australia
- understand that ways of demonstrating respect and its significance vary between cultural groups.

Responsibility

To cultivate respect, students need to reflect on and to take responsibility for their own behaviours and their interactions with others within and across cultures. They understand that behaviour can have unintended effects on individuals and communities, and they identify situations requiring intercultural understanding. In developing responsibility, students learn to respect the human rights of others and the values of democracy, equity and justice (MCEETYA 2008). In developing and acting with intercultural understanding, students:

- demonstrate a commitment to reconciliation between Aboriginal and Torres Strait Islander peoples and other Australians
- take responsibility for their understanding of and behaviour towards different cultural groups in Australia, the Asia-Pacific region and the world
- understand their reciprocal roles and shared responsibilities as local and global citizens.

Intercultural understanding across stages of schooling

Recognising

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
describe aspects of their personal identity and identify various groups to which they belong (for example describing place/role in family and their membership of different social and cultural groups)	explore and express aspects of their identities as they interact with others (for example explaining differences in their behaviour, such as language use and values, at home, at school and within different groups)	recognise how their membership in cultural groups shapes their identities (for example exploring the concept of multiple identities and what it means personally)
recognise that cultures influence how people live, work, dress, eat, speak and celebrate within their families and local communities, (for example identifying values and beliefs important to them and their families)	describe and compare cultural assumptions, beliefs and practices, with particular reference to traditions and customs (for example comparing traditions and customs surrounding a particular cultural practice)	understand the complex and dynamic nature of cultural experiences (for example comparing the biographies of people from different cultures who have relocated, considering their motivations, experiences, reflections)
understand that the way they live may not be the same as the ways other people live (for example showing interest in stories from other cultures, making comparisons and accepting differences)	recognise and respond to cultural diversity, its contributions and effects in national and regional contexts (for example describing the contribution of particular groups to the history and development of Australia and its region)	recognise and respond to the challenges of cultural diversity and the politics of culture (for example analysing media reports on particular groups within Australia and internationally with reference to stereotypes, prejudice, racism, privilege, voice)

Interacting

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
respond positively to stories and encounters that represent a range of cultural experiences and contexts (for example engaging with people, texts and artefacts from different cultures)	identify differences within and across cultures in relation to specific situations and events (for example explaining different perspectives on familiar and specific events)	analyse the visible and less visible features of their own and others' cultures (for example analysing their own cultural assumptions and those of others in relation to particular issues or events)
describe aspects of their own lives to others and make comparisons between their lives and those of other children (for example describing ways they relate to their immediate and extended families, listening to others and make comparisons)	value intercultural exchanges and work towards mutual understanding (for example adapting their communication to check for understanding)	understand the complex relations between language, culture, thought and context (for example engaging with the texts and experiences of others to gain insight into the way cultures shape peoples' perspectives)
engage in communication with others they perceive to be different from them (for example adapting their communication to ensure everyone is included in group activities)	look for similarities with people they think of as being unlike themselves and differences with people they consider to be similar (for example engaging with views they know to be different from their own to challenge their own thinking)	interpret cultural differences for others by identifying values and beliefs they take for granted and consider how these might look to someone with different values, beliefs and behaviours (for example suggesting cultural assumptions and perspectives that might underpin unfamiliar behaviours)
		identify areas of potential misunderstanding on the basis of language or culture and seek clarification or further explanation (for example analysing and reflecting on aspects of language and culture that need further explanation)

Reflecting

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
reflect on similarities and differences with children in their classes, in their local communities or whom they have met in other situations (for example describing and comparing their own experiences with those of other children)	reflect on how intercultural encounters have affected their thoughts, feelings and actions (for example describing their responses to the diversity of values and experiences represented in texts, films, the arts and other media)	reflect critically on their responses and attitudes to intercultural experiences (for example describing how exposure to a diversity of views, ideas or experiences has the potential to change the way they think about a particular issue or event)
demonstrate an initial understanding of the concept of cultural diversity and its presence and influence in Australian society (for example describing the effect of sharing different stories and experiences on their learning)	accept that their point of view is one of many and begin to see themselves as others may see them (for example describing an experience or event from another's viewpoint)	demonstrate open-mindedness to the positions of others (for example representing both sides of an argument, giving value to a variety of perspectives)
	identify and reflect on the impact of stereotypes and prejudices (for example identifying positive and negative effects of attributing features to particular social or cultural groups)	reflect on cultural diversity and its effects and influences in Australia and internationally (for example articulating an informed position on issues such as immigration, refugees, dispossession, globalisation, and analysing their impact on Australia)

Empathy

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
demonstrate care and consideration for others, recognising situations where others are in need or feeling excluded (for example acting to include children who are new or visiting the class)	demonstrate sensitivity to the feelings and needs of others(for example through a variety of role plays imagining how people can feel when included or excluded)	demonstrate empathy for others, understanding the role stereotyping, prejudice and racism may have played and may continue to play in their experiences (for example through imagined or authentic scenarios demonstrating an understanding of what it is like to be systematically excluded as a member of a cultural minority)
imagine and ask: 'How would I feel if this were me?' (for example in scenarios concerning difference imagining how it would feel to be excluded)	justify their decisions, choices and behaviours in relating to others (for example giving reasons for their own ideas and actions and relating these to the ideas and actions of others)	look for cultural explanations in analysing their societies or groups' decisions and actions and those of other societies and groups (for example describing the role of intercultural suspicion and misunderstanding in world conflicts)
	imagine and ask: 'How do I imagine others might feel?' (for example in scenarios concerning difference imagining how others might feel, putting themselves in the other person's shoes)	look beyond their immediate situations by considering questions such as: 'How might my actions affect another person?', 'Are there other people who might also be affected by what I say or do?' (for example recognising that their own actions and perspectives are subject to interpretation by others who might want them to think and act differently)

Respect

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
demonstrate respect for themselves and everyone they encounter at home, at school and in the local community (for example practising different ways of greeting others, considering language, culture and social context)	respect the right of others to be different and be accepting of others (for example listening, sharing and responding thoughtfully to the views and ideas of others)	respect the right of all to be heard (for example understanding the need to defend the right of all to be heard as a basic human right)
identify the Aboriginal Country or Torres Strait Islander place in which their school is located (for example learning and using the names for local peoples and places)	acknowledge the continuous and enduring contribution of Aboriginal and Torres Strait Islander peoples in Australia (for example showing respect for Aboriginal and Torres Strait Islanders peoples' knowledge and values relating to connection to family and the land)	challenge stereotypical representations of various social and cultural groups (for example comparing and analysing texts prepared by Aboriginal and Torres Strait Islander people about their lives with those developed historically by others)
express an awareness and appreciation of cultural diversity in familiar contexts (for example learning familiar expressions in another language)	acknowledge the importance of mutual respect for promoting harmony and peace in an interconnected world (for example cooperating and negotiating in culturally diverse networks of learning)	demonstrate respect for cultural and linguistic diversity in a range of local, regional and global settings (for example demonstrating skills of intercultural communication, including negotiation and conflict resolution in networks)
		understand and act in ways that observe local Aboriginal and Torres Strait Islander protocols (for example working with local groups to inform school-based learning)
		understand the importance of maintaining cultural traditions to the development of personal, group and national identities (for example recognising and valuing the significant relationship between language, culture and identity)

Responsibility

By the end of Year 2 students:	By the end of Year 6 students:	By the end of Year 10 students:
join in events that recognise and celebrate cultural diversity (for example joining with Chinese students and families in celebrating Chinese New Year)	contribute to the development of positive relationships between people from different cultural groups to achieve common goals (for example exploring possibilities for cooperation between diverse groups in working on a shared project)	take responsibility for listening and seeking to understand others' perspectives (for example developing strategies to achieve mutual understanding)
act to include children from diverse cultural groups in their games and activities (for example showing willingness to explain and demonstrate the rules of games to others)	identify ways people can work together and resist prejudice (for example developing and applying strategies for overcoming differences and for countering prejudice)	recognise the challenges of living harmoniously in a culturally diverse society and of negotiating, interpreting and mediating difference (for example representing the ideas and perspectives of others in a range of contexts)
cooperate in diverse groups to share information, narratives and interests (for example contributing to group tasks, valuing the contributions of others)	share responsibility for negotiating difference and resolving issues or tensions created by different cultural assumptions and practices (for example examining cultural perspectives and assumptions underlying issues of local or national concern)	act to secure positive outcomes for members of cultural groups faced with prejudice and misunderstanding (for example challenging and countering instances of prejudice and negotiating positive outcomes)