Mathematics

Rationale

Learning mathematics creates opportunities for and enriches the lives of all Australians. The Western 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 Western 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 Western 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 Western 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 Western 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 (7-10)		

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.

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 Western 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 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.

Student diversity

ACARA is committed to the development of a high-quality curriculum for all Australian students that promotes excellence and equity in education.

All students are entitled to rigorous, relevant and engaging learning programs drawn from the Western Australian Curriculum: Mathematics. Teachers take account of the range of their students' current levels of learning, strengths, goals and interests and make adjustments where necessary. The three-dimensional design of the Western Australian Curriculum, comprising learning areas, general capabilities and cross-curriculum priorities, provides teachers with flexibility to cater for the diverse needs of students across Australia and to personalise their learning.

More detailed advice has been developed for schools and teachers on using the Western Australian Curriculum to meet diverse learning needs and is available under Student Diversity on the Australian Curriculum website.

Students with disability

The Disability Discrimintion Act 1992 and the Disability Standards for Education 2005 require education and training service providers to support the rights of students with disability to access the curriculum on the same basis as students without disability.

Many students with disability are able to achieve educational standards commensurate with their peers, as long as the necessary adjustments are made to the way in which they are taught and to the means through which they demonstrate their learning.

In some cases curriculum adjustments are necessary to provide equitable opportunities for students to access age-equivalent content in the Western Australian Curriculum: Mathematics. Teachers can draw from content at different levels along the Foundation to Year 10 sequence. Teachers can also use the extended general capabilities learning continua in Literacy, Numeracy and Personal and social capability to adjust the focus of learning according to individual student need.

Gifted and talented students

Teachers can use the Western Australian Curriculum: Mathematics flexibly to meet the individual learning needs of gifted and talented students.

Teachers can enrich student learning by providing students with opportunities to work with learning area content in more depth or breadth; emphasising specific aspects of the general capabilities learning continua (for example, the higher order cognitive skills of the Critical and creative thinking capability); and/or focusing on cross-curriculum priorities. Teachers can also accelerate student learning by drawing on content from later levels in the Australian Curriculum: Mathematics and/or from local state and territory teaching and learning materials.

English as an additional language or dialect

Students for whom English is an additional language or dialect (EAL/D) enter Australian schools at different ages and at different stages of English language learning and have various educational backgrounds in their first languages. Whilst many EAL/D students bring already highly developed literacy (and numeracy) skills in their own language to their learning of Standard Australian English, there is a significant number of students who are not literate in their first language, and have had little or no formal schooling.

While the aims of the Western Australian Curriculum: Mathematics are the same for all students, EAL/D students must achieve these aims while simultaneously learning a new language and learning content and skills through that new language. These students may require additional time and support, along with teaching that explicitly addresses their language needs. Students who have had no formal schooling will need additional time and support in order to acquire skills for effective learning in formal settings.

General capabilities

In the Western 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 understanding
- Intercultural understanding.

In the Western 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 understanding

Students develop ethical understanding as they identify and investigate the nature of ethical concepts, values, character traits and principles, and understand how reasoning can assist ethical judgment. Ethical understanding 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 understanding 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

The Western Australian Curriculum is designed to meet the needs of students by delivering a relevant, contemporary and engaging curriculum that builds on the educational goals of the Melbourne Declaration. The Melbourne Declaration identified three key areas that need to be addressed for the benefit of both individuals and

Australia as a whole. In the Western Australian Curriculum these have become priorities that provide students with the tools and language to engage with and better understand their world at a range of levels. The priorities provide dimensions which will enrich the curriculum through development of considered and focused content that fits naturally within learning areas. They enable the delivery of learning area content at the same time as developing knowledge, understanding and skills relating to:

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

Cross-curriculum priorities are addressed through 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. They will have a strong but varying presence depending on their relevance to the learning area.

Aboriginal and Torres Strait Islander histories and culture

Across the Western Australian Curriculum, the Aboriginal and Torres Strait Islander histories and cultures priority provides opportunities for all learners to deepen their knowledge of Australia by engaging with the world's oldest continuous living cultures. Students will understand that contemporary Aboriginal and Torres Strait Islander Communities are strong, resilient, rich and diverse. The knowledge and understanding gained through this priority will enhance the ability of all young people to participate positively in the ongoing development of Australia.

The Western 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

Across the Western Australian curriculum, this priority will ensure that students learn about and recognise the diversity within and between the countries of the Asia region. They will develop knowledge and understanding of Asian societies, cultures, beliefs and environments, and the connections between the peoples of Asia, Australia, and the rest of the world. Asia literacy provides students with the skills to communicate and engage with the peoples of Asia so they can effectively live, work and learn in the region.

In the Western 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 Western 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

Across the Western Australian Curriculum, sustainability will allow all young Australians to develop the knowledge, skills, values and world views necessary for them to act in ways that contribute to more sustainable patterns of living. It will enable individuals and communities to reflect on ways of interpreting and engaging with the world. The Sustainability priority is futures-oriented, focusing on protecting environments and creating a more ecologically and socially just world through informed action. Actions that support more sustainable patterns of living require consideration of environmental, social, cultural and economic systems and their interdependence.

In the Western 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 Western 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.

Links to the other learning areas

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 Western 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 Western 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 Western Australian Curriculum as part of the National Assessment Program (NAP).

Glossary

Mathematics v8.1

Year 9 Syllabus

Year Level Description

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. The achievement standards reflect the content and encompass the proficiencies.

At this year level:

- **understanding** includes describing the relationship between graphs and equations, simplifying a range of algebraic expressions and explaining the use of relative frequencies to estimate probabilities and 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, 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

Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems (ACMNA208)

Literacy

Numeracy

Critical and creative thinking

Apply index laws to numerical expressions with integer indices (ACMNA209)

Numeracy

Measurement and Geometry

USING UNITS OF MEASUREMENT

Calculate areas of composite shapes (ACMMG216)

Numeracy

Calculate the surface area and volume of cylinders and solve related problems (ACMMG217)

Literacy

Numeracy

Critical and creative thinking

Solve problems involving the

Statistics and Probability

CHANCE

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)

Numeracy

Calculate relative frequencies from given or collected data to estimate probabilities of events involving 'and' or 'or' (ACMSP226)

Express numbers in scientific notation (ACMNA210)

Numeracy

MONEY AND FINANCIAL MATHEMATICS

Solve problems involving simple interest (ACMNA211)

Literacy

Numeracy

Critical and creative thinking

PATTERNS AND ALGEBRA

Extend and apply the index laws to variables, using positive integer indices and the zero index (ACMNA212)

Numeracy

Apply the distributive law to the expansion of algebraic expressions, including binomials, and collect like terms where appropriate (ACMNA213)

Numeracy

LINEAR AND NON-LINEAR RELATIONSHIPS

Find the distance between two points located on the Cartesian plane using a range of strategies, including graphing software (ACMNA214)

Numeracy

Information and Communication

surface area and volume of right prisms (ACMMG218)

Literacy

Numeracy

Critical and creative thinking

Investigate very small and very large time scales and intervals (ACMMG219)

Numeracy

GEOMETRIC REASONING

Use the enlargement transformation to explain similarity and develop the conditions for triangles to be similar (ACMMG220)

Literacy

Numeracy

Solve problems using ratio and scale factors in similar figures (ACMMG221)

Literacy

Numeracy

Critical and creative thinking

PYTHAGORAS AND TRIGONOMETRY

Investigate Pythagoras' Theorem and its application to solving simple problems involving right-angled triangles (ACMMG222)

Literacy

Numeracy

Literacy

Numeracy

Investigate reports of surveys in digital media and elsewhere for information on how data were obtained to estimate population means and medians (ACMSP227)

Literacy

Numeracy

Information and Communication Technology (ICT) capability

Critical and creative thinking

Ethical understanding

DATA REPRESENTATION AND INTERPRETATION

Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly and from secondary sources (ACMSP228)

Literacy

Numeracy

Critical and creative thinking

Ethical understanding

Construct back-to-back stem-and-leaf plots and histograms and describe data, using terms including 'skewed', 'symmetric' and 'bi modal' (ACMSP282)

Numeracy

Compare data displays using

Technology (ICT) capability

Find the midpoint and gradient of a line segment (interval) on the Cartesian plane using a range of strategies, including graphing software (ACMNA294)

Numeracy

Information and Communication Technology (ICT) capability

Sketch linear graphs using the coordinates of two points and solve linear equations (ACMNA215)

Numeracy

Critical and creative thinking

Graph simple non-linear relations with and without the use of digital technologies and solve simple related equations (ACMNA296)

Literacy

Numeracy

Information and Communication Technology (ICT) capability

Critical and creative thinking

Use similarity to investigate the constancy of the sine, cosine and tangent ratios for a given angle in right-angled triangles (ACMMG223)

Numeracy

Apply trigonometry to solve right-angled triangle problems (ACMMG224)

Literacy

Numeracy

mean, median and range to describe and interpret numerical data sets in terms of location (centre) and spread (ACMSP283)

Literacy

Numeracy

Critical and creative thinking

Year 9 Achievement Standard

Number and Algebra

At Standard, students solve problems involving simple interest. They apply the index laws to numbers and express numbers in scientific notation. Students expand binomial expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment. Students sketch linear and non-linear relations.

Measurement and Geometry

Students interpret ratio and scale factors in similar figures. They explain similarity of triangles. Students recognise the connections between similarity and the trigonometric ratios. They calculate areas of shapes and the volume and surface area of right prisms and cylinders. Students use Pythagoras' Theorem and trigonometry to find unknown sides of right-angled triangles.

Statistics and Probability

Students calculate relative frequencies to estimate probabilities, list outcomes for two-step experiments and assign probabilities for those outcomes. They compare techniques for collecting data from primary and secondary sources. Students construct histograms and back-to-back stem-and-leaf plots. They make sense of the position of the mean and median in skewed, symmetric and bi-modal displays to describe and interpret data.

Year 10 Syllabus

Year Level Description

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. The achievement standards reflect the content and encompass the proficiencies.

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 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

Connect the compound interest formula to repeated applications of simple interest using appropriate digital technologies (ACMNA229)

Numeracy

Information and Communication Technology (ICT) capability

PATTERNS AND ALGEBRA

Factorise algebraic expressions by taking out a common algebraic factor (ACMNA230)

Numeracy

Simplify algebraic products and quotients using index laws (ACMNA231)

Numeracy

Apply the four operations to simple algebraic fractions with numerical denominators (ACMNA232)

Numeracy

Critical and creative thinking

Expand binomial products and factorise monic quadratic expressions using a variety of strategies (ACMNA233)

Measurement and Geometry

USING UNITS OF MEASUREMENT

Solve problems involving surface area and volume for a range of prisms, cylinders and composite solids (ACMMG242)

Literacy

Numeracy

GEOMETRIC REASONING

Formulate proofs involving congruent triangles and angle properties (ACMMG243)

Numeracy

Apply logical reasoning, including the use of congruence and similarity, to proofs and numerical exercises involving plane shapes (ACMMG244)

Numeracy

PYTHAGORAS AND TRIGONOMETRY

Solve right-angled triangle problems including those involving direction and angles of elevation and depression (ACMMG245)

Literacy

Numeracy

Statistics and Probability

CHANCE

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)

Literacy

Numeracy

Critical and creative thinking

Use the language of ‘if ....then', ‘given’, ‘of’, ‘knowing that’ to investigate conditional statements and identify common mistakes in interpreting such language (ACMSP247)

Literacy

Numeracy

DATA REPRESENTATION AND INTERPRETATION

Determine quartiles and interquartile range (ACMSP248)

Construct and interpret box plots and use them to compare data sets (ACMSP249)

Literacy

Numeracy

Numeracy

Substitute values into formulas to determine an unknown (ACMNA234)

Numeracy

LINEAR AND NON-LINEAR RELATIONSHIPS

Solve problems involving linear equations, including those derived from formulas (ACMNA235)

Numeracy

Solve linear inequalities and graph their solutions on a number line (ACMNA236)

Numeracy

Solve linear simultaneous equations, using algebraic and graphical techniques, including using digital technology (ACMNA237)

Numeracy

Information and Communication Technology (ICT) capability

Solve problems involving parallel and perpendicular lines (ACMNA238)

Literacy

Numeracy

Explore the connection between algebraic and graphical

Compare shapes of box plots to corresponding histograms and dot plots (ACMSP250)

Literacy

Numeracy

Critical and creative thinking

Use scatter plots to investigate and comment on relationships between two numerical variables (ACMSP251)

Literacy

Numeracy

Critical and creative thinking

Investigate and describe bivariate numerical data where the independent variable is time (ACMSP252)

Literacy

Numeracy

Critical and creative thinking

Evaluate statistical reports in the media and other places by linking claims to displays, statistics and representative data (ACMSP253)

Literacy

Numeracy

Critical and creative thinking

Ethical understanding

representations of relations such as simple quadratics, circles and exponentials using digital technology as appropriate (ACMNA239)

- Literacy
- Numeracy
- Information and Communication Technology (ICT) capability

Solve linear equations involving simple algebraic fractions (ACMNA240)

- Numeracy

Solve simple quadratic equations using a range of strategies (ACMNA241)

- Numeracy
- Critical and creative thinking

Year 10 Achievement Standard

Number and Algebra

At Standard, students recognise the connection between simple and compound interest. They solve problems involving linear equations and inequalities. Students make the connections between algebraic and graphical representations of relations. They expand binomial expressions and factorise monic quadratic expressions. Students 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.

Measurement and Geometry

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 use triangle and angle properties to prove congruence and similarity. Students use

trigonometry to calculate unknown angles in right-angled triangles.

Statistics and Probability

Students 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 list outcomes for multi-step chance experiments and assign probabilities for these experiments. They calculate quartiles and inter-quartile ranges.

Year 10A Syllabus

Number and Algebra

REAL NUMBERS

Define rational and irrational numbers and perform operations with surds and fractional indices (ACMNA264)

- Numeracy
- Critical and creative thinking

Use the definition of a logarithm to establish and apply the laws of logarithms (ACMNA265)

- Numeracy
- Critical and creative thinking

PATTERNS AND ALGEBRA

Investigate the concept of a polynomial and apply the factor and remainder theorems to solve problems (ACMNA266)

- Numeracy
- Critical and creative thinking

Measurement and Geometry

USING UNITS OF MEASUREMENT

Solve problems involving surface area and volume of right pyramids, right cones, spheres and related composite solids (ACMMG271)

- Numeracy
- Critical and creative thinking

GEOMETRIC REASONING

Prove and apply angle and chord properties of circles (ACMMG272)

- Numeracy
- Critical and creative thinking

PYTHAGORAS AND TRIGONOMETRY

Establish the sine, cosine and area rules for any triangle and solve related problems (ACMMG273)

Statistics and Probability

CHANCE

Investigate reports of studies in digital media and elsewhere for information on their planning and implementation (ACMSP277)

- Literacy
- Numeracy
- Information and Communication Technology (ICT) capability
- Critical and creative thinking

DATA REPRESENTATION AND INTERPRETATION

Calculate and interpret the mean and standard deviation of data and use these to compare data sets (ACMSP278)

- Numeracy
- Critical and creative thinking

Use information technologies to

LINEAR AND NON-LINEAR RELATIONSHIPS

Describe, interpret and sketch parabolas, hyperbolas, circles and exponential functions and their transformations (ACMNA267)

- Numeracy
- Critical and creative thinking

Solve simple exponential equations (ACMNA270)

- Numeracy
- Critical and creative thinking

Apply understanding of polynomials to sketch a range of curves and describe the features of these curves from their equation (ACMNA268)

- Numeracy
- Critical and creative thinking

Factorise monic and non-monic quadratic expressions and solve a wide range of quadratic equations derived from a variety of contexts (ACMNA269)

- Numeracy
- Critical and creative thinking

- Numeracy
- Critical and creative thinking

Use the unit circle to define trigonometric functions, and graph them with and without the use of digital technologies (ACMMG274)

- Numeracy
- Information and Communication Technology (ICT) capability
- Critical and creative thinking

Solve simple trigonometric equations (ACMMG275)

- Numeracy
- Critical and creative thinking

Apply Pythagoras' Theorem and trigonometry to solving three-dimensional problems in right-angled triangles (ACMMG276)

- Numeracy

investigate bivariate numerical data sets. Where appropriate use a straight line to describe the relationship allowing for variation (ACMSP279)

- Numeracy
- Information and Communication Technology (ICT) capability
- Critical and creative thinking

Achievement standard

To be developed in 2015 using (assessment) work sample evidence to 'set' standards through paired comparisons.